Integrating BRT with Rickshaws in Developing Cities: A Case Study on Dhaka City, Bangladesh

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The candidate confirms that the work submitted is his own and that appropriate credit has been given where reference has been made to the work of others.

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Abstract

Rickshaws (also known as cycle-rickshaw, becak, cyclos, samlors, pedicab in different countries) are available as a travel mode in many cities, particularly in Asia. There is evidence that in recent years, many cities (i.e. Jakarta, Surabaya, Karachi, Manila, Bangkok, Delhi, Dhaka) have tried to restrain or prohibit rickshaws either from the entire city or from certain roads or parts of the city and such bans have been highly controversial, opposed by environmentalists, rickshaw-pullers, and rickshaw users. An alternative approach to placing outright restrictions on rickshaws could be to integrate them into the formal public transport system by using them as feeder services.

The aim of this research is to understand whether generally rickshaws can serve as a feeder service of bus rapid transit (BRT) systems. Detailed objectives are to identify what type of design for BRT station would require for modal integration and to explore if there is any possibility of fare integration between rickshaws and BRT, and to study the understanding of passengers' and rickshaw-pullers' views and policymakers' opinions about the above mentioned aspects.

The case studies for this research were conducted in two study locations in Dhaka city, Bangladesh. A system was designed whereby the rickshaws serve as feeder services to BRT. These designs were discussed with passengers and rickshaw-pullers as well as with transport professionals in Dhaka city. A three-dimensional (3-D) physical model of BRT station in study locations were prepared and presented in the focus group discussions (FGDs) so that a layperson could understand the proposed development and its spatial contexts.

Results show that rickshaws could provide effective feeder services to BRT if the following points are addressed. The physical design of BRT stations should accommodate spaces for rickshaws for dropping off and picking up passengers, ensure not more than 200 m or 3 minutes of walk for modal interchanges between rickshaws and BRT, with better walking facilities and environment. Rickshaws should be well organised in terms of queuing at BRT stations. A pre-determined fare structure for rickshaws should be implemented. Above all, design of the new system should involve active involvement of the rickshaw-pullers and the public in the planning and decision-making process. Moreover, a 3-D physical model of the proposed BRT station helped effective participation during public consultation.

This research provides a potential solution for a common problem of urban transport (arguments between fast and slow transport) that exists in many countries. The design of BRT station and policy measures derived from case study in Dhaka would be transferable in other 'rickshaw city', but should be based on assessment of the barriers and facilities of that city.

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List of Abbreviations

ADB	Asian Development Bank
BDT	Bangladeshi Taka (currency)
BRT	Bus Rapid Transit
BRTA	Bangladesh Road Transport Authority
CBD	Central Business District
DCC	Dhaka City Corporation
DHUTS	Dhaka Urban Transport Network Development Study
DITS	Dhaka Integrated Transport Study
DMA	Dhaka Metropolitan Area
DMDP	Dhaka Metropolitan Development Plan
DMP	Dhaka Metropolitan Police
DNCC	Dhaka North City Corporation
DTCB	Dhaka Transport Coordination Board
DSCC	Dhaka South City Corporation
FGD	Focus Group Discussion
GDSUTCP	Greater Dhaka Sustainable Urban Transport Corridor Project
GNI	Gross National Income
IM	Informal Mode
IVT	In-Vehicle Time
JICA	Japan International Cooperation Agency
m	Metre
km	Kilometre
kmph	Kilometre per hour
LGED	Local Government Engineering Department
LOS	Level of Service

MRT	Mass Rapid Transit
MV	Motorised Vehicle
NGO	Non- Governmental Organisation
NMT	Non-Motorised Transport
NMV	Mon-Motorised Vehicle
NLTP	National Land Transport Policy
PAR	Participatory Action Research
PCU	Passenger Car Unit
PUA	Participatory Urban Appraisal
pphpd	Passengers Per Hour Per Direction
Paurashava	Urban local municipality
PRA	Participatory Rural Appraisal
PTI	Public Transport Interchange
RAJUK	Rajdhani Unnayan Kartipakkha (Capital Development Authority)
ROW	Right of Way
STP	Strategic Transport Plan
sq. km	Square kilometres
2-D	Two- Dimensional
3-D	Three-Dimensional

Chapter 1
Introduction

1.1 Overview of the Thesis and this Chapter

This research explores whether integration of rickshaws[1] would be possible with bus rapid transit (BRT) systems so that generally rickshaws could serve as a feeder service of BRT in 'rickshaw cities' (defined later in Section 1.3). The aim is to understand the design requirements of BRT station for modal integration (to provide convenient transfers between modes for passengers), possibility of fare integration for trips involving both rickshaws and BRT and requirements for this, and the views and opinions of passengers, rickshaw pullers and the policymakers about integration of rickshaws with BRT systems.

This chapter discusses on the following topics:

- Background of this study;
- Definition of the 'rickshaw city';
- Overview of this research (research questions, objectives, research approach and the process);
- Scope and limitions of this research; and
- Structure of this thesis.

1.2 Background of the Study

Transportation in developing[2] country cities (or developing cities) is significantly different from developed countries (Santoso and Tsunokawa, 2005; Replogle, 1991; Tiwari, 2003). There are various types of traffic, ranging from walking and non-motorised transport (NMT)[3] to motorised vehicles, are operating in developing cities. Different types of informal[4] modes (IMs) and para-transits[5] have been

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[1] Human powered, usually three-wheeler, public transport; two people can travel with a speed around 10 km per hour. It is widely known as cycle-rickshaw in India, becak in Indonesia, beckak in Malyasia, pedicab in the Philippines, samlors in Thailand, cyclos in Vietnam and Cambodia. Rickshaws in this research considered only the cycle-rickshaws for passenger transport.

[2] Newly emerging economy of Global South; low income and lower-middle income countries (as classified by World Bank) having gross national income (GNI) per capita $1,035 or less and $1,036-$4,084 respectively.

[3] Fuel-free vehicles and environment friendly. Examples of NMT are walking, bicycle and rickshaws. NMT could be private (i.e. walking and cycling) as well as public transport (i.e. rickshaws). NMT in this report refers excluding walking trips which is termed as pedestrians.

[4] No regulation from government, not formalised and organised, often do not have any specified route.

[5] Like public transport anybody can travel by paying the fare. Provide services both as a rented private taxi (door to door service) and as a public transport in a specified route.

evolved in many developing cities to serve the local demand. For instance, rickshaws and auto-rickshaws in Bangladesh and India, bicycle in China, pedicab and habalhabal in the Philippines, cyclos and motorcycle in Vietnam and Cambodia, becak and ojeg in Indonesia, tuktuk and samlors in Thailand. Even, many cities in developing countries are facing growing numbers of NMT and IMs (ITDP, 2009). It is worth mentioning that despite the growth of motorisation, rickshaws are increasing in a few Asian Cities. Even the number of rickshaws for freight transport is increasing in Latin America (i.e. Columbia, Chile, Dominican Republic, Mexico, Brazil), as Gallagher (1992) reported, about 0.3 million rickshaws were being used for carrying goods in 1988. Though the information is bit out-dated, the latest figure of rickshaw population in Latin America is not known. Nevertheless, this should be noted that the freight rickshaw is specially designed to carry goods and not similar as the design of passenger carrying rickshaws. Moreover, scope of this research does not include the freight rickshaws or goods carrying rickshaws.

A significant numbers people live in developing cities are poor (Sohail and Maunder, 2007; UNESCAP, 2011). So, the public[6] transport is expected to meet the transport needs of the vast majority of urban travellers who are unable to purchase cars (Zacharias, 2003; Hossain, 2006). Even in the car dominant US cities still many people (who have no regular access to car) depend on public transit as their main mode of transportation (Garrett and Taylor, 1999).

Rapid urbanisation is happening in many developing countries. According to United Nations sources, the urban population in the Asia and the Pacific region in 2010 was 43% of the total population which would represent 46% of its total projected population in 2020 (United Nations, 1999; UNESCAP, 2011). The vast majority of this urban growth is concentrated in mega-cities[7] and major urban areas (Dimitriou, 2006). As a result, cities are growing and expanding outwards and urban sprawl is on-going. Urban sprawl or expansion of the city is leading to longer trips; for example, average trip length in Delhi is 10 km (Sahai and Bishop, 2010) and a typical work trip of middle-class in Bangkok is about 16 km (Charoentrakulpeeti *et al*, 2006). Due to longer trips as well as its complicated nature, joint[8] (or linked or connected) trips on public transport are increasing. This is happening because either the formal[9] public transport network is not available within walking distance

[6] Anybody can travel by paying the correct amount of fare. It can be either formal or informal.
[7] The city having more than 10 million people.
[8] Linked trips where multiple (combination of at least two or more) modes are used to fulfil a trip.
[9] Organised public transport (regulated by government) operate in particular route and time with a fixed fare rate.

hence people have to take para-transit/NMT modes to reach a public transport station[10] (Rastogi and Rao, 2003), or NMT cannot alone serve the longer distance. NMT is often suitable only for shorter distance; for instance, up to 3 km for rickshaws (ITDP, 2009). Therefore, transfer of modes are inevitable for longer distance on public transport. This transfer of mode could involve a variety of modes such as: walking and NMT, walking and motorised public transport, NMT and motorised public transport, various public transport modes, private vehicle and motorised public transport.

Most of the major cities in developing countries are facing various transportation problems, most notably congestion and thus increasing travel time, air pollution, accidents, and so on (Gakenheimer, 1999; Dimitriou, 2006). This is mostly because of growing gap between demand and supply of transportation facilities of the city (Zacharias, 2003; Pucher *et al*, 2005; Santoso and Tsunokawa, 2005). High demand of transport facilities and infrastructure is the result of the growing mobility needs and private car ownership levels (Gakenheimer, 1999; Santoso and Tsunokawa, 2005; Srinivasan *et al*, 2007). The main agent of high increase in vehicle ownership is the modern lifestyle and consumption pattern of the emerging middle-class group of the city (Charoentrakulpeeti *et al*, 2006). However, due to resource constraints often the city authority poses limited ability (or is unable) to meet the increased demand (Pucher *et al*, 2005). This further leads to the increasing mismatch between demand and supply.

Improved public transport services, along with restricting personal car use and promoting walking and NMT, could be the possible solution for relieving congestion and reducing the associated environmental problems and costs of transferring passengers in developing cities (Vasconcellos, 2001; Sahai and Bishop, 2010; Britton; 2010). However, NMT and IMs are often viewed unsympathetically and considered as the culprit of creating congestion or transport problems in many cities (Gallagher, 1992; Bari and Efroymson, 2005; Samanta, 2012). Ironically, NMT and IMs play a crucial role for providing transport access of many people in the developing cities (Silcock, 1981; Cervero and Golub, 2007). Only the NMT or IMs can provide transport access to otherwise inaccessible areas (particularly where narrow streets deny access to formal public transport), and for certain groups of people (i.e. female or older people) who have difficulties of access to certain overcrowded public transport. Moreover, NMT is pollution free and environment friendly as they do not use fuel energy to run. In contrast, the car costs society more in terms of congestion and negative externalities. Traffic congestion is directly

[10] Where bus or other public transport stops for boarding and dropping passengers; such as a bus stop, train station, BRT station.

related with the speed and flow of traffic; Table 1.1 shows rickshaws are more efficient than private cars but less efficient than buses in terms of the passenger car unit (PCU)[11], passenger car space equivalent (PCSE)[12] and average occupancy.

Table 1.1: PCU, PSCE, average occupancy, road space per trip and flow of passengers of different mode

Mode	**PCU**[1]	**PCSE**[3]	**Average Occupancy**	**Road space per person trip (sq. m)**[7]	**Passengers flow (per lane)**[6]
Bus	2.5	1.80	52[4]	0.2	6,600
Car	1.0	1.0	1.5[5]	2.2	470
Bicycle	0.2	0.10	1.0[5]	NA	1,500
Rickshaw	0.5[2]	0.18	1.6[6]	1.3	1,000

Source: [1]DITS, 1998; [2]ITDP, 2009; [3]Bari, 2000; [3]Bari and Efroymson, 2005; [4]Mannan and Karim, 2001; [5]Efroymson and Bari, 2005; [6]Gallagher, 1992; [7]DTCB, 2005.

Despite the important role in transport, it has been common to ban or restrict certain mode (e.g. rickshaws and auto-rickshaws) in many developing cities either from the entire city or from certain roads and parts of the city (ITDP, 2009). For example, in the past, many cities (i.e. Jakarta, Surabaya, Karachi, Manila, Bangkok, Delhi, Dhaka) have tried to restrain or prohibit rickshaws from the entire city or from certain roads or parts of the city on the grounds of either reducing congestion for smooth flow of motorised vehicles or enhancing the city image by eliminating traditional modes. However, there are arguments that decisions to ban rickshaws have not been based on scientific or technical grounds (see ITDP, 2009; Gallagher, 1992; Bari and Efroymson, 2005), but rather upon ad-hoc ‘political decision’ taken from the top (bureaucrats and richer car-owners). Such bans have been highly controversial in each of the cities mentioned above; opposed by environmentalists, rickshaw-pullers and users.

An alternative approach to placing outright restrictions on IMs or rickshaws could be to integrate them into the formal public transport system by using them as feeder services. A multi-modal[13] integrated transport system where the formal mass public transport should get priority in the major arterials, with the rickshaws (or IMs) operating in other (narrow) streets to provide feeder services or access/egress legs to public transport. Integration is about getting from one place to another via rider

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[11] A vehicle unit for expressing the traffic flow rate or capacity of a road; one car is considered as a single unit. PCU is also sometimes used interchangeably with passenger car equivalent (PCE).

[12] The relative space that any vehicle category occupies in relation to a standard car.

[13] Journeys involve a combination of more than one mode; also termed as intermodal.

friendly inter-modal facilities and inter-connections to reduce the costs and inconveniences of travel (Ibrahim, 2003). May and Roberts (1995) mentioned ‘integrated’ or ‘balanced’; or ‘package’ are synonymous which indicates combination of measures or balanced in the treatment for achieving higher performance. As a variety of transport modes are available in developing cities it is important to ensure that each transport mode is used in its most efficient way. Because, a coordinated integration of different transport modes in multi-modal transport brings about reduced congestion on the road, convenience to customers, efficiency, and cost effectiveness (Ibrahim, 2003; May *et al*, 2006).

The public transport interchanges (PTIs) are an important element and precondition for sustainable and efficient transport system (Verster, 2005). Hence, the role of the public transport station is very important and critical for integrated multi-modal transport. To have efficient and comfortable journey of public transport users, the interchanges between modes should be convenient, fast, and safe for the passengers. The interchange node is a complex infrastructure where the passenger can choose among different modal options available for their trip (Zito and Salvo, 2009). However, often the PTIs in developing cities are often dull and unsafe for the passengers (Verster, 2005); and the passengers have to walk a longer distance between the modes in an unsafe, uncomfortable, and unpleasant environment for modal changes. “The interconnection of different modes seems to have easy solutions, but its implementation involves complex details” of accessibility, urban space management, and information or time-table integration (Burckhart and Blair, 2009: p.63). Interconnection with NMT is more difficult than with motorised transport as it requires different design requirements due to its different nature of operation, difference in structure (e.g. size and strength) and speed.

Many cities both in developed and developing countries have implemented bus rapid transit (BRT) systems as a form of mass transit, thus improving public transport and tackling increasing transport problems, whilst other cities are planning to do so. There are various BRT systems available globally that is directly connected with metro systems or include NMT (e.g. include bicycle parking in BRT station design). Several modern BRT systems have modal integration with bicycles; such as Guangzho BRT in China (Fjellstrom, 2010; UNESCAP, nd) and Bogota’s TransMilenio BRT in Colombia (Wright and Fulton, 2005; Duarte and Rojas, 2012). However, there is no BRT system in the world which demonstrates integration with rickshaws. When considering such integration, the design and planning of BRT stations is crucial for two main reasons. Firstly, the design of BRT stations is anyway very important for ensuring high levels of ridership. Secondly, the integration with rickshaws will involve different (special) planning and design requirements.

It is certain that the solutions developed elsewhere or in the Global North may be inadequate in addressing the transport problems in developing cities (Gakenhaimer and Zegras, 2004). This is because of the complex land use and transport interactions, the specific characteristics and mobility needs, and the rapid nature of changes in developing countries. This research is an endeavour to develop plans for the integration of NMTs or traditional IMs, particularly the rickshaws, with the high-quality mass public transport such as BRT systems in the developing cities. It will try to provide general guidelines for accommodating rickshaws at BRT station (in terms of convenient transfers for passengers) to ensure modal integration and the possibility of fare integration between rickshaws and BRT systems where rickshaws would serve as a feeder service of BRT. This research will also explore the opinions of passengers as well as rickshaw-pullers and policymakers regarding those aspects. The research outcome will be: a design for BRT station area, guidelines on organising rickshaws at BRT station to follow a tidy queue while waiting, determining a pre-determined fare structure for rickshaws, improved public participation during consultation process. Outcome of this research would help to improve public transport services by ensuring modal integration as well as fare integration and thus increase ridership and erase certain problems of the city transport. Furthermore, providing a solution that reconciles the two sides of the controversy – ‘for’ and ‘against’ the rickshaw bans where the solution involves providing a multi-modal integrated transport system where the formal mass public transport should get priority in the major arterials with the rickshaws operating in the narrow streets as feeder services or access/egress legs.

1.3 The ‘Rickshaw City’

There are many cities where the rickshaw is available not as a regular mode but only for the tourists, for instance, Berlin in Germany, Malacca and Penang in Malaysia, Beijing and Jinan in China, Colombo in Sri Lanka. On the other hand, there are some other Asian cities (i.e. Manila, Ho Chi Minh City, Phnom Penh, Battambang, Chiang Mai, Cebu) where a small amount of rickshaws are available and operating as a general travel mode. Even there are many small and medium-size cities in Asia which have no rickshaw. This type of city, where a very few rickshaws are available and operating only for tourists but not as a regular traffic for the city dwellers or rickshaws are absent or small level of rickshaws are operating as a general travel mode, will not be considered for the study because they would not fulfil the purpose of this research. The main interest of this research is in concentrating up on those cities have large levels of rickshaws (to be defined below).

On the other hand, there are many small cities in Asia, particularly in Bangladesh and India, where a large level of rickshaws are available but it is the only mode of public transport available for that city. Moreover, due to small size of the city, trip distances are shorter and people could easily travel from one corner to other end of the city either on foot or by rickshaw. For instance, there is no public transport apart from rickshaw in most of the small towns of Bangladesh and India. As a result, joint trips are almost absent or transfer to other public transit is not required in those small cities. This type of small cities will not be considered for this study. It is assumed that in the larger (in terms of land area) city, if trip distance is longer, usually rickshaw will not be able to serve for the entire trip length and transfer to motorised public transport will be needed. This is because the distance of rickshaw trips are usually short (Gallagher, 1992; ITDP, 2009). So, the focus of the study is upon large cities in terms of land area; due to their size they will have more than one public transport available. It is likely that a city with larger land area will also have larger population; so population size of the city could also be used.

The above mentioned points indicate that there is a need for defining the 'rickshaw city' to be considered for this research. For operational definition of a 'rickshaw city' some criteria have been chosen (as seen in Table 1.2); firstly, the city should have rickshaw as a regular travel mode (either at least 3 rickshaws per 1,000 people or 1 percent of the modal share of trips are on rickshaw), and secondly, the city size should be large (at least either 30 sq km land area or 0.3 million people).

Table 1.2: Criteria for defining the 'rickshaw city'

Criteria	**Scale of measuring the criteria**	**Defining the measuring criteria for a 'rickshaw city'**
Availability of rickshaw as a travel mode	Alternative availability criteria are: • Rickshaws per 1,000 person Or • Modal share of rickshaws	A 'rickshaw city' is defined as: • The city has more than 3 rickshaws per 1,000 people Or • At least 1% trips of the city are on rickshaw
City size	Alternative city size criteria are: • Total population of the city Or • Area of the city	A 'rickshaw city' is defined as: • More than 0.3 million people Or • More than 30 sq km land area

As already mentioned, the focus of this research is upon large cities located in developing countries; using the gross national income (GNI) per capita could be another criterion to ensure that the 'rickshaw city' is from a developing country.

However, to date there is no city in any developed country or Global North where a large amount of rickshaws are available and operating as a regular travel mode. All the cities having large amount of rickshaws are in the developing countries. Developing country in this thesis refers to low income and lower-middle income countries; as World Bank defines GNI per capita in 2012 is $1,035 or less and $1,036-$4,085 respectively for low income and lower-middle income (World Bank, 2012). As the attention of this research is restricted to these countries, therefore, GNI per capita is not necessary to keep as a criterion for defining 'rickshaw city'.

Considering the criteria (as outlined in Table 1.2), Table 1.3 reveals a list of the 'rickshaw city' of which anyone could be a case study city for this research.

Table 1.3: List of the 'rickshaw city'

Criteria		**Candidate 'rickshaw city' for case study**					
		Dhaka[1]	**Chittagong**[5]	**Delhi**[2]	**Kolkata**[3]	**Bandung**[4]	**Yogyakarta**[6]
Rickshaw	Rickshaw/1000 people	41	47	9	6	3	17
City size	Area of city (km^2)	1529	155	1484	196	167	32

Note: Rickshaws per 1,000 people and land area of the city have been used as criteria for availability of rickshaws and for size of city respectively.

Source: [1]STP, 2005; [2]Tiwari, 2003; [3]Kolkata, 2011; [4]Joewono and Kubota, 2005; [5]Al-quadery and Muhibullah, 2008; [6]Tambunan, 2006.

However, this should be noted that the list of 'rickshaw city', as mentioned in Table 1.3, is not inclusive. There are many other cities in Bangladesh (i.e. Khulna, Rajshahi, Sylhet, Barisal, and so on), in Indonesia (i.e. Surakarta) and in India (i.e. Agra, Lucknow, Kanpur, Patna, Jaipur, and so on) which would fulfil the conditions of the criteria set in Table 1.2 for a 'rickshaw city'. The cities included in the list of 'rickshaw city' (as in Table 1.3) was due to availability of information. Next paragraph will provide a brief description of the typology of the 'rickshaw city'.

Typology of the 'Rickshaw City'

It would be useful to have a typology of the 'rickshaw city'. Table 1.4 shows the descriptive indicators or dimensions of the cities for providing some more insights to explain the traffic and transport situation in 'rickshaw city'.

Table 1.4: Descriptive indicators for summary of the 'rickshaw city'

Dimensions	Dhaka[1]	Chittagong[13]	Delhi[2,3]	Kolkata[6]	Bandung[14,15]	Yogyakarta[9]
Population (million)	12.3	3.2	13	4.8	6.5[7]	0.45[10]
Per Capita Income (US$)	550	608	784	561	835	690
Average trip length (km)	14.5	NA	10[4]	7.8	16.3[7]	9.8[11]
Existing public transport mode (fixed route network)	Bus, Tempo	Bus, Tempo	Metro, BRT, Bus	Metro, Tram, Bus	Bus, Tempo	BRT, Bus
Para-transit or informal modes availability	Auto, Rickshaw	Auto, Rickshaw	Auto, Rickshaw	Auto, Rickshaw	Rickshaw, Ojeg	Auto, Rickshaw, Ojeg
Car per 1000 people	32	NA	70		85	47[8]
Modal share (%) of trips						
Public transport	40	NA	42	78[12]	9*[7]	18[8]
Rickshaws	37	NA	6.4[5]	7.8	12**	4[8]
Bicycle	-	NA	4.5	NA	6	17[8]
Walking (pedestrian)	18	NA	32	12[12]	NA	12[8]
Average vehicle speed (kmph)	7.5 - 17.5	NA	10 -15	15 -19	10[7]	24[11]

* motorised transport only. ** only work trips.

Note: NA means information is not available. Bus includes minibuses. Tempo is also called leguna or RTV in Bangladesh, jeepney in the Philippines. Auto is three-wheeler auto-rickshaw, widely known as auto in India, tuktuk in Thailand, tricycle in the Philippines and Indonesia, baby-taxi or CNG or scooter in Bangladesh. Ojeg is motorcycle operating as a taxi service, known as habalhabal in the Philippines.

Source: [1]STP, 2005; [2]Tiwari, 2003; [3]Tiwari, 2001; [4]Sahai and Bishop, 2010; [5]Sood, 2012; [6]Kundu, 2003; [7]Tamin, 2005; [8]Kidokoro and Kubota, 1997; [9]Tambunan, 2006; [10]GlobalWorks, 2011; [11]Haglund, 2011; [12]Pucher *et al,* 2004; [13]Al-quadery and Muhibullah, 2008; [14]Tarigan *et al*, 2010; [15]Joewono and Kubota, 2005.

Of the six candidate cities of 'rickshaw city' in the list mentioned above (in Table 1.4), Dhaka city has the highest percentage of modal share of trips on rickshaws. Dhaka is also globally known as 'the city of rickshaws'. Dhaka city was chosen as a case study city for this research mainly because availability or possibility of information gathering for Dhaka. Chapter 4 will briefly discuss about socio-economic condition as well as traffic and trabsportation situation in Dhaka city.

1.4 Overview of the Research

As already mentioned earlier that there are several modern BRT systems that have modal integration with bicycles. However, there is no BRT systems in the world which yet demonstrates well integration with rickshaws. Furthermore, there is no such example which demonstrates fare integration of NMT or informal para-transits with BRT systems. Therefore, it is worthwhile to investigate how to incorporate rickshaws with high quality public transport such as BRT systems so that rickshaws could provide feeder services.

1.4.1 Research Questions

This section provides the research questions of the study. These research questions will help for deriving the statement of objectives of the research. Following are the major research questions of this study grouped in three categories: designing good BRT-rickshaw interchange, fare integration of trips involving rickshaws and BRT systems, and how to carry out effective public participation in transport planning for deriving public opinions.

Designing BRT-Rickshaw Interchange

- **How rickshaws could provide feeder services to BRT systems?**

It is yet not clear what design requirements of BRT station is needed and how rickshaws could be organised to serve as a feeder service. So, this could be appropriate for this research to answer following questions:

  - Do rickshaws need to restrict or plan to provide as feeder services at neighbourhood level or to allow operating for city-wide longer trips?
  - How rickshaws could be organised to provide a feeder services of BRT system?

- **What type of design for BRT station could ensure modal integration of rickshaws with BRT systems?**

Public transport station should be in such that all type of modes are accommodated there and it provides easy, comfortable, safe, and fast transfer between modes. Therefore, BRT stations would be of critical for its well integration with other modes, particularly with rickshaws. Thus the issues for BRT station design are: comfortable walking distance and time required for inter-modal change, pedestrian road crossing (at-grade or grade separate) to access BRT station, passenger facilities required at modal interchange area.

Different literature may provide information on the parameters for safe, convenient and comfortable pedestrian crossing or inter-modal change. However, there is till knowledge gap how to ensure modal integration of rickshaws with BRT systems. Thus, a new design or plan of BRT station is needed for accommodating rickshaws considering their characteristics to trigger the following issues:

- How modal changes between rickshaws and BRT could be convenient and faster for passengers?
- How the modal-interchange areas could be safer for passengers?
- Which traffic signs and signals related to BRT systems could improve the overall road traffic flow into BRT station.
  - What is the level of understanding/knowledge of road users about traffic signs, signals and road marking?
  - Do literate people know better than illiterate people about traffic signs, symbols and road marking?
  - How would it be possible to improve the understanding of road users and rickshaw pullers about traffic signs and symbols related to BRT system?
- How to accommodate large volume of traffic (rickshaws and pedestrians) at BRT station? How much space needed for rickshaws at BRT station?
- How to ensure that the rickshaws waiting at BRT station maintain and follow a tidy queue?

Fare Integration

- **Is it possible for fare integration between rickshaws and BRT systems? If possible, how and what are the major challenges or issues for that?**

As the rickshaw fare is not pre-determined and passengers have to settle the cost of desired trip before the trip is initiated through a bargaining process with the puller; following questions are relevant to integrated fare:

- Is it necessary to have a pre-determined fare structure for rickshaws?
- Is it possible having an established pre-determined fare structure for rickshaws? If not why and if possible how?

Deriving Public Opinions

- **How to carry out effective public participation in transport planning and designing infrastructure?**
  - Would it help for better understanding of public and improved public participation during the consultation process if a three-dimensional (3-D) physical model of the proposed development is used during discussion?

1.4.2 Objectives of the Research

Following are the objectives of the research:

i) To understand whether in a 'rickshaw city' generally rickshaws can serve as a feeder service of the BRT systems.

   a) To identify what type of design for BRT station could assist for accommodating rickshaws at BRT station to provide easy transfer between rickshaws and BRT systems.
   b) To explore if there is any possibility of fare integration between the rickshaws and BRT systems.

ii) Try to get detailed understanding about objective (i) in the particular case of Dhaka city as a case study.

iii) To study the understanding of passengers' views, pullers' opinions and policymakers' opinions about the design of BRT station and its surrounding 200 metre to accommodate rickshaws for easy transfers to/from BRT systems as well as their opinions about fare integration of trips involving both rickshaws and BRT systems.

iv) To determine whether the design of BRT station (for accommodating rickshaws) as well as integrated fare structure (for trips involving both BRT and rickshaws) would be transferable in other rickshaw cities and what would be the issues and concerns for that.

1.4.3 Overview of the Research Approach

This section provides the broader overview of the research approach.

A Case Study Approach

As already mentioned that one of the objectives is to study the understanding of passengers' views as well as pullers' and policymakers' opinions regarding BRT integration with rickshaws, therefore, a case study approach was considered for this research. The case study research method investigates a contemporary phenomenon within its real-life contexts; briefly described in Section 3.1.

Epistemological Position: Qualitative Research

Two approaches of research methods are qualitative research and quantitative research (discussed briefly in Section 3.1). Data gathered in case studies is normally largely qualitative, but it may also be quantitative. A qualitative case study methodology provides tools for researchers to study complex phenomena within their contexts (Arksey and Knight, 1999; Baxter and Jack, 2008; Bryman, 2005;

Maykut and Morehouse, 2001). Good case studies use a number of different research tools to increase validity. For example, both qualitative and quantitative approaches and different data collection instruments (i.e. surveys, interviews) could be used to 'triangulate' the research instruments or techniques to provide different views of the case and thus avoid the problem of observer bias.

This research followed the qualitative approach or 'phenomenological position' to understand the 'soft data' or behaviour of social life (of the sample), based on empirical analysis of data, in specific settings of micro level in the case study area to investigate the phenomenon with its real-life contexts.

Participatory methods of primary data collection was considered to explore collective responses of road users, namely passengers and rickshaw pullers. This method helps for getting appropriate social dynamics in real life behaviour of participants. Behaviour or opinions of an individual may differ when (s)he is alone and in groups. Moreover, participatory methods help to raise or incorporating views of weaker groups in society such as pullers and people in poor income brackets. Focus group discussion (FGD) was considered for deriving collective responses of passengers and pullers and interviewing was considered for exploring opinions of policymakers.

Before collecting primary data from the case study locations, the researcher started with his personal opinions or different perspectives (view points) on various aspects of this research. The researcher's own view points were framed upon reading (reviewing of literature) and having personal experience (been inhabitant of Dhaka city and travelling on both rickshaws and public transport modes). The FGDs were very useful; provided information similar to resercher's views as well as gave the new ideas and angles of the view points and also challenged to a few of the pre-concived ideas and perspectives of the researcher.

Analytical Framework

Relevant hypotheses for this research were drawn based on the research questions and the review of literature. To test the hypotheses and fulfil the research questions, relevant primary data were collected from FGDs and interviews. Collected data - video records from the FGDs and audio records from the interviews - were transcribed, transcripted, and then translated in English. Transcribed and translated data were organised and analysed both in manually and using NVivo, a computer based technique. Descriptive summaries and categorisation of collected data were done under the topics or themes of discussion. Explanation-building (explanatory) analytical technique of research strategy was followed.

Coding or indexing of collected data were done for analysis. Following two types of techniques were considered for coding:

- Descriptive coding and notes; and
- Descriptive and analytical coding with notes.

Coding of data was done based on the themes and topics of the research (derived from research questions and objectives) and then marking the similar pages of texts with a code lebel. This was done by identifying the key words, phrase, word repetitions, pawing (i.e. handling); by underlining, coloring, highlighting, and circling the words. During the coding process, written notes were kept that are meaningful. At first a flat or non-hierarchical coding (a list) was prepared and then a tree or hierarchical coding (themes or topics and sub-topics) was prepared to organise the information in coherent categories. Then the patterns and connections within and between categories were identified. Finally, interpretation was made for bringing it all together and explaining the meaning.

In addition to the above mentioned analytical framework, video tapes of the FGDs were viewed to observe the specific aspects (e.g. facial expressions and physical reactions) of participants. Following issues of the participants were noted down:

- If looking away the 3-D physical model and why;
- Pointing or showing particularly where in 3-D physical model and why;
- What was facial expression when showing the road signs/symbols and what was telling about that symbol; and
- Whether doing something else during discussion and why.

1.4.4 The Research Process

This section provides the flow or process of the research (as seen in Figure 1.1). After finalising the research objectives, the methods appropriate to fulfil the objectives have been identified.

Selection of the Research Methods

A suitable research methodology was followed and the relevant tools were applied to fulfil the research objectives. Each of the objectives (as stated in Section 1.4.2) had its own research methods associated with it. A combination of tools were used for collecting the required information from both the primary and secondary sources. The tools applied in this research are described in Chapter 5.

Preparing the Generic Design

A generic design of BRT station was prepared for modal integration with rickshaws so that transfers between rickshaws and BRT systems become easier and convenient for passengers. Related journal papers and research documents were studied and reviewed for secondary information. This review of literature as well as current good practices of BRT systems operating in other countries provided basic guidelines for designing and planning of the BRT station area.

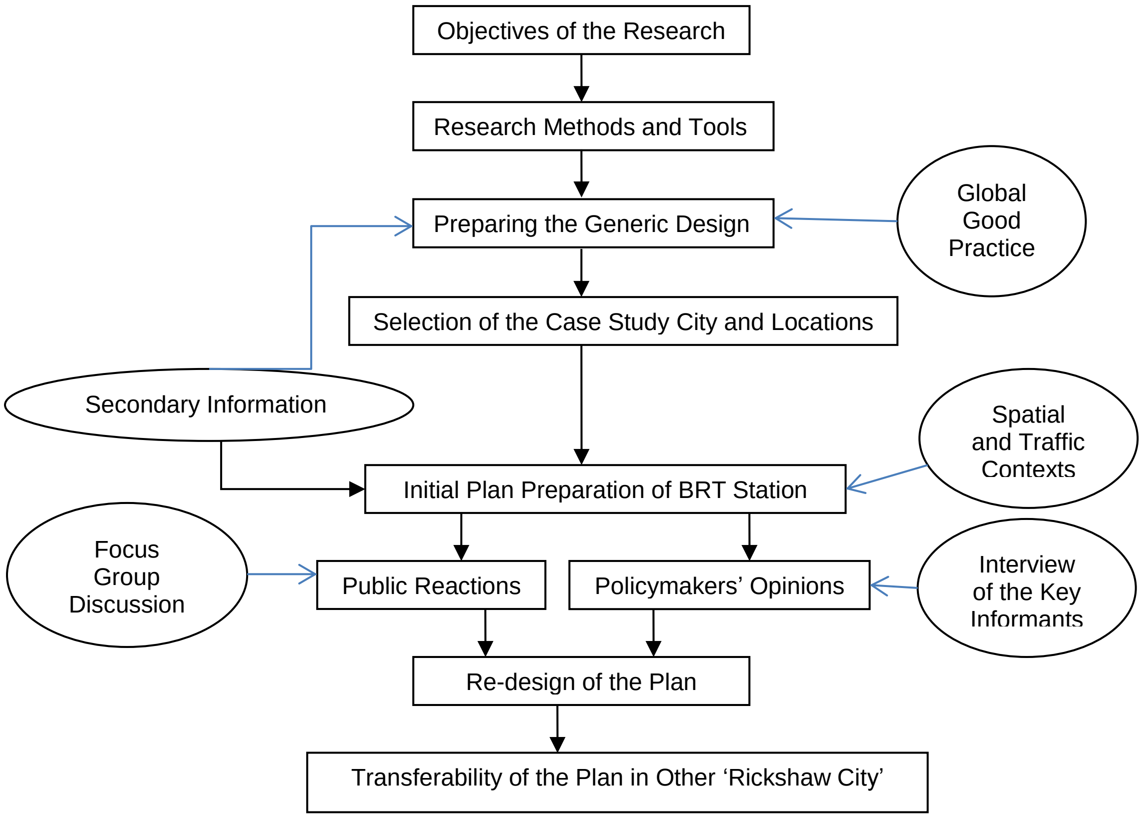

Figure 1.1: Flowchart of the research process

Selection of the Case Study City and the Study Locations

A 'rickshaw city' was selected for conducting the case study. As already discussed in Section 1.3, among the lists of 'rickshaw city' (seen in Table 1.3) Dhaka has been chosen as a case study city.

After the selection of a 'rickshaw city' for case study is being made, several major road intersections or public transport stoppage of that city have been identified as the potential case study locations (or areas) for detailed and in-depth studies. While selecting the areas for in-depth study, it was kept in mind that they do represent the whole city in terms of socio-economic condition, demography, urban structure, traffic situation, trip generator, etc. Resources were available for looking at two locations in detail. The selection of locations made for in-depth case study is described in Section 5.2.

Initial Design of the BRT Station

A plan of BRT station and its vicinity was prepared for each case study area to ensure physical (or modal) integration of rickshaws with BRT systems. The initial plan of BRT station was based on review of current literature and good practices in other cities or countries as well as considering the aspects (such as traffic and transport situation, road width, road side activities, and major issues specific to on-site location. The initial design of BRT station is described in Section 5.3.

Public Participation in the Planning Process

Effective public participation was ensured during the planning and design process. As the local people will be using the BRT station, it is crucial to know their behaviour pattern and opinions about the proposed plan. After preparing the initial design of the BRT station for case study area, rigorous consultation was made with the public (passengers and rickshaw-pullers) to explore their opinions, reactions, needs and issues about the initial design and about the possibility of fare integration. Public participation process is described in Section 5.4.

Policymakers' Opinions

Policymakers' opinions about the initial design prepared for BRT station and about the possibility of fare integration for trips involving both BRT and rickshaws were explored. The process of policymakers' opinions are described in Section 5.5.

Re-design of the Plan

After having the public opinions (users and pullers) and policymakers' opinions, the initial design of BRT station has been modified to incorporate their opinions and suggestions so that the plan is fit best with the local conditions and acceptable by all road users. The plan was re-designed on the basis of opinions derived from users, rickshaw-pullers and key informants as well as spatial local contexts and road traffic conditions.

Transferability of the Findings

After having the final plan (modified design of BRT station area and plan for fare integration) for the case study areas it was further analysed how the results could be helpful for other 'rickshaw city'. Transferability of the findings is described in Chapter 9.

1.5 Scope and Limitations of this Research

The scope of the study is confined only for modal integration and fare integration of rickshaws with BRT systems. Other forms or types of integration as well as other modes of travel except rickshaws and BRT systems are beyond the scope of this research. As mentioned earlier, while designing the BRT station for integration with rickshaws, the participatory approach has been followed. So, modelling and simulation of the BRT station (road intersection) as well as capacity of station, financial analysis are beyond the scope of study. Furthermore, the e-rickshaws[14] are beyond the scope of this research.

Street vendors and other non-traffic occupancy as well as beggars are very common on the streets of mega-cities in developing country. These non-traffic activities often create conflicts or cause problems for movement of pedestrians and particularly for passengers while changing modes at public transport station (or modal interchange area). Discussions with street vendors and beggars may give more insights and better results for managing road-side activities; however, having resource constraints participation of those groups were not considered in this research. BRT operators or bus service providers (operators) were outside the scope of this research.

1.6 Structure of the Thesis

This thesis has been organised and structured in the following different chapters:

Chapter 1 - Introduction

Chapter 2 – Transportation in developing cities and BRT integration with rickshaws

Chapter 3 – Review of the research methods and methods for this research

Chapter 4 – Description of the case study city: Dhaka

Chapter 5 – Research design for the case study in Dhaka city

Chapter 6 – Public opinions: Results from the FGDs

Chapter 7 – Policymakers, opinions: Results from the interviews

Chapter 8 – Comparison of the findings from FGDs and interviews with literature

Chapter 9 – Transferability of the findings to other cities

Chapter 10 – Conclusions and recommendations

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[14] Electric rickshaws or battery-driven rickshaws.

Chapter 2
Transportation in Developing Cities and BRT Integration with Rickshaws

This chapter first provides a brief summary of the selected literature on traffic and transport situation in different cities across the world, different decision options and system designs of bus rapid transit (BRT) systems, and integrated multi-modal urban transport. Then based on the review of literature a system design for BRT integration with rickshaws is presented. Finally, it outlines the relevant hypotheses related to integration and BRT station design which were drawn for this research.

2.1 Mobility and Accessibility in Developing Cities

This section discusses about public transport services and heterogeneous traffic, road user's behaviour, existing transport problems, recent rickshaw bans, and role of non-motorised transport (NMT) towards sustainable transpot.

2.1.1 Poor Public Transport Service

Despite increasing car ownership, the majority of trips in developing cities are served by public transport and the contribution of private vehicles (e.g. personal car and motorcycle) is very low. For example, road-based public transport serves 42% of trips in Delhi (Tiwari, 2003) and 44% of trips in Dhaka (STP, 2005), with private vehicles serving only 17% and 8% of trips in the two cities respectively (Tiwari, 2003; STP, 2005). An important factor affecting the modal shares is the high proportion of the population which cannot afford a personal vehicle, and are thus heavily dependent on public transport (Hossain, 2006). However, public transport system and services are often very poor in developing cities. Public transport is poorly functioning and often not adaptive to the increasing changes of big city needs (Gakenheimer, 1999), inadequate infrastructure (Soheil and Maunder, 2007), very poor institutional management (Dimitriou, 2006), and poor traffic management.

Formal public transport service is not accessible for many people in the developing cities. This is happening because either the overcrowded public transport is not accessible (especially for children, women, disabled and older people) or the network of public transport do not cover the whole city. Therefore, a variety of informal para-transits or NMT modes have been evolved to fulfil the transport gap. These NMT or informal modes provide taxi-type service for the entire trip length or as a feeder service (access leg) to the transit service. As the public transport network is not available within walking distance, many people have to take para-transit/NMT modes to reach a public transport station (Rastogi and Rao, 2003). NMTs or para-transits provide flexible and demand responsive services (Silcock, 1981) and able to enter the narrow alley-ways (Cervero and Golub, 2007). However, they alone cannot serve the longer distance.

2.1.2 Heterogeneous Traffic

Various types of vehicles, ranging from walking and NMT to motor vehicles, are operating in developing cities. For example, there are 48 modes of transport, of which 32 are motorised and 16 are non-motorised (DIMTS, nd). This heterogeneous traffic of varied static and dynamic characteristics often shares the same carriageway.

Effective channelization or lane discipline in heterogeneous traffic is rarely observed because they move by sharing the lateral as well as the linear gaps. Often, the narrow vehicles fill-in the lateral and longitudinal gaps between the wide vehicles. Tiwari (2001) showed that for heterogeneous traffic the queues grow length wise as well as laterally; and the term ‘car following’ is incorrect as the width of entities greatly vary and it is difficult to figure out which leading entity it is following. She also argued that “lane discipline is deficient in heterogeneous traffic not because driver behaviour is significantly different, but because heterogeneous traffic consists of entities of various width and varying dynamic characteristics” (p.81).

There are arguments that both NMT and motorised transport (MT) using the same road space often create problems of safety, efficiency, traffic management, congestion, and many others. Therefore, “conventional thinking suggests that modal separation raises efficiency while lowering risks” (Zacharias, 2003: p. 297). On this principle, separate lanes for bicycle or bus have been provided in many cities. In line with same direction, Replogle (1991) argued that rickshaws should be separated from motorised traffic when it is possible, except in areas where traffic speeds or motor vehicle volume will remain low. Segregation between NMT and MT may provide smooth flow with less conflict of speed difference as well as better safety. For instance, Tiwari (2001) claimed that segregation of modes, particularly motorised two-wheelers, is desirable in Delhi because of the high number of vulnerable road users’ fatalities. Similarly, segregation of NMT and MT at intersection approaches with fences is becoming common in China as a traffic safety measures (Replogle, 1991).

However, Gakenheimer (1999: p.674) mentioned, “… it is unquestionably inefficient for the street lanes to be divided into motor and non-motor lanes, especially because of difficulties of movements at intersections”. This claim was focused on complicated traffic movements and manoeuvres, particularly bicycles, and the difficulties of traffic management at the intersections; however, no quantitative evidence has been given for that. Nevertheless, segregation will require wider roads to accommodate various lanes or one lane may become congested while others are under-utilised in a given time of day. However, rationale allocation of road width for respective modes may solve this problem to some extent. Several years ago, lane for rickshaws was segregated (by providing physical barriers) in a few roads of Dhaka and soon the barriers have been removed to allow mixed vehicle operation. Separation of the rickshaw lane created more congestion on road because the kerb-side rickshaw lane was occupied with other non-traffic activities and thus the rickshaws were forced to move on motor lanes which created more pressure on roads as the carriage way has been reduced than before. This indicates road management is very crucial in developing cities. Nevertheless, separation of NMT and MT may provide some benefits of safety, operational performance, management, and discipline.

2.1.3 Road Users' Behaviour and Discipline

Ad-hoc evidence shows that grossly the road users' behaviour and discipline in developing cities are often very poor. For example, often the painted pedestrian crossings are completely disregarded by vehicles, motorcyclists move on walkways, pedestrians walk in the middle of road and wait for a gap in the traffic to cross the road or to get in a bus. Sahai and Bishop (2010), Gallagher (1992), Mfinanga (2014) reported lack of respect for traffic rules, signs and markings by drivers. Due to poor driving behaviour, Gallagher (1992, p.293) mentioned "driving in Dhaka is a nightmare, and the problem is steadily growing worse". Even, driver's knowledge about traffic signs in Dhaka is very poor (Razzak and Hasan, 2010). Moreover, pedestrians and NMT often think that they are excluded from the traffic rules and regulations. Poor driving behaviour and poor discipline among road users create many problems; namely implementation of traffic management (Gakenheimer, 1999), congestion and safety hazards.

Often it is blamed that in developing cities the behaviour and discipline of NMT is very poor. To some extend this might be true for rickshaws; as the majority of rickshaw-pullers are illiterate who migrated from rural areas for seeking job (Begum and Sen, 2005), and begin pulling a rickshaw without having any training or prior knowledge of road signs/signals and rules of urban roads. However, there is no scientific evidence for such claim that the rickshaws are the most undisciplined mode. Nevertheless, enforcement of road rules is very weak or almost absent in developing cities. For example, ad-hoc evidence shows that in Bangladesh the motorists are having driving license without attending in a rigorous test and even all the drivers of motor vehicles do not hold a valid license. Legally the rickshaws should be registered or licensed with the local government and its owner should have license for ownership. However, in many cities of Bangladesh only a minor portion of the rickshaws are actually licensed. Unlike the drivers of motorised vehicles, the rickshaw pullers do not need to hold a valid driving license. However, this is the understanding of the public of society or enforcement agency. Under the laws that date back to the 1920s, the rickshaw pullers must hold the driver's license (Gallagher, 1992). However, now-a-days nobody knows about this law and the rickshaw pullers do not bother to have the driving license. Ad-hoc evidence shows that all the rickshaw pullers in Bangladesh are pulling without a driving license.

2.1.4 Transport Problems

Most major cities in developing countries are facing various transportation problems, most notably congestion and thus increasing travel time, air pollution, and accidents. Mobility and accessibility are declining due to traffic congestions. Much of the problem is due to the rapid growth in vehicle ownership. For instance, annual growth of motor vehicles is 10% in India, 15% in China, 12% in Dhaka city of Bangladesh, and 23.7% in South Korea (Gakenheimer, 1999; Bhatia and Jain, 2009; Singh, 2006). The future of non-motorised vehicles (NMV) in many Asian cities is threatened by rapid motorisation and thus loss of street space for safe NMV use, as well as changes in urban form provoked by motorisation and policy to suppress the use of NMV (Replogle, 1991).

Dimitriou (2006: p.1094) argued that "urban transport founded on an unabated motorised vision are at the root of the more serious urban transport problems" in developing cities. Politicians (and also policymakers in some cases) in many countries widely view NMT as creating congestion or making problems for easy movement of motorised modes. Not only the NMTs, motorised two and three wheeler para-transits also often viewed as creating problems. However, ITDP (2009) claimed that there is generally no engineering or scientific basis for such view. Despite this fact, some cities have banned various types (two and three wheelers) of NMT and MT on specified roads and under specific conditions. Rickshaws face the most restrictions and are the subject of intense protest and debate in many countries, particularly in Asia.

2.1.5 Rickshaw Bans

In the past, many cities have tried to restrain or prohibit rickshaws either from the entire city or from certain roads or parts of the city. The restriction effort has usually been the restriction on registration numbers, removal from major roads, combination of both restricting registration numbers and removal from major roads, and removal from entire city or zones. Rickshaws have been banned in Bangkok, Karachi, Jakarta, Bogota, Beijing, and Manila, while Delhi put restriction on the number of registration and licensing of rickshaws as well as operating except within the old city. Dhaka put restrictions on operating rickshaws in several major roads. Purposes of the rickshaw bans for most of the cities were either for reducing congestion for smooth flow of motorised vehicles or enhancing the city image by eliminating traditional modes. However, there are arguments that decisions to ban rickshaws have not been based on scientific or technical grounds (see ITDP, 2009; Gallagher, 1992; Bari and Efroymson, 2005), but rather upon ad-hoc 'political decisions' taken from the top (bureaucrats and richer car-owners). Furthermore, there were many protests and demonstrations by the rickshaw-pullers (and in a few cases by civil organisations) against the 'political decision' of rickshaw bans in each of the cities mentioned above. With the onset of global warming there are arguments that transport modes resilient to climate change, including NMTs, should be promoted for sustainability. These comments clearly suggest that such bans have been highly controversial; opposed by environmentalists, rickshaw-pullers and users.

There are argument that even after many years of 'elimination', thousands of rickshaws still operate in the suburbs and local roads of Jakarta and Manila. Therefore, Gallagher (1992: p.67) mentioned, "abolition did not get rid of them, ….. what they have done, however, is make the existing rickshaws illegal". This indicates that existing motorised transport system is unable to serve the travel demand of the city, particularly in the suburbs or local narrow streets, and hence still there is a demand for rickshaws. However, this should be noted that after elimination of rickshaws they are operating only in the local narrow (secondary or tertiary) roads in the suburbs. A before and after study on Mirpur Road of Dhaka revealed that 'rickshaw ban' did not reduce travel time of bus passengers. Growth of private vehicles created new levels of congestion. After the rickshaw ban, average travel time on Mirpur Road for primary work trips reduced about 9 minutes (Barakat *et al*, 2004) while for non-work trips increased about 8 minutes (PATH Canada, 2005). Thus, the 'rickshaw ban' gives benefit to the motor vehicles but costs high both the rickshaw pullers and passengers in terms of employment and mobility respectively. In line with the above discussion, many researchers and policy analysts argue that the rickshaw bans are 'controversial'.

Nevertheless, different order or hierarchy of roads have different level of functions. Thus, a particular road type may have priority for a different vehicle class to have the greater social benefits. For instance, if a large share of traffic is of long trip length, rickshaws or bicycles are not likely to be the efficient or practical mode.

Arguments for banning rickshaws in the major arterials or central areas could be to provide priorities to high speed vehicles and mass transits respectively. However, ITDP (2009) claims that banning rickshaws is unlikely to be successful and recommends for limiting the number in major arterials. Above discussion indicates this policy measure, if adopted to restrict in a major road, should be backed up with better public transport services with available many alternatives of transport, good feeder services to the mass transit, private car restrictions, as well as many others. Otherwise, the purpose of having smooth transport system or traffic efficiency in major roads or certain areas may fade up.

2.1.6 Arguments for and Against the Rickshaw Bans

This section reports on the review of literature arguing for and against of rickshaw bans.

Are Rickshaws an Efficient Mode Or do they Create Congestion?

Reducing traffic congestion for better traffic flow or speed is one of the major reasons put forward for rickshaw bans in many cities (Samanta, 2012; Gallagher, 1992; Bari and Efroymson, 2005). For example, rickshaws were banned in the central areas and high-class residential suburbs of Jakarta (Gallagher, 1992) and in a few major arterials of Dhaka (Ahmed and Rahman, nd; Rahman *et al*, 2008) for this purpose. However, traffic congestion is directly related with the speed and flow of traffic. Efficiency in road space use of various modes could be an option to judge or compare with rickshaws. An ITDP study (2009) shows that the passenger car unit (PCU) or passenger car equivalent (PCE) value of a rickshaw in Bangladesh and Indonesia is 0.5, as in Table 1.1 in Chapter 1; which suggests that a rickshaw needs only half the road space of an average car. Gallagher (1992) showed that on crowded urban roads in Dhaka the rickshaws have a much greater passenger capacity than cars: road space used by the average car passenger is about 45% more than the average rickshaw passenger, and 5 to 10 times of bus passenger. Moreover, road space required per passenger trip on a particular vehicle would be appropriate to judge the efficiency on road space use and rickshaws are more efficient than private cars (refer Table 1.1), but less efficient than buses.

Nevertheless, a broader economic analysis of each trip on different modes for different lengths at different speeds and traffic levels are needed to justify the efficiency (Replogle, 1991). This is because different functional hierarchy of roads may have different level of utility from different modes at different speeds. The existence of such road hierarchies potentially leads to greater social and economic benefits as well as better traffic safety, as compared with having no road hierarchy. For instance, Kurosaki *et al* (2012, p.48) stated “reasonable restrictions, such as, restriction of slow-moving traffic from busy arterial roads or highways should not be rejected" to prioritise high speed and mass transits. However, for doing this, having a basic functional road classification system or hierarchy of urban roads is the most important; which often is not in place in many cities of developing countries, such as in Dhaka. Thus, ITDP (2009) claims that banning rickshaws is unlikely to be successful and instead of banning recommends limiting the number (applying a cap) in major arterials.

After the rickshaw ban on Mirpur Road of Dhaka, a certain number of (former) rickshaw passengers shifted to walking, buses, and other motorised modes for about 25%, 33%, and 42% respectively (Barakat *et al*, 2004). Given the poor pedestrian facilities it is unlikely that people would enjoy walking. For trips up to a certain length, say 1 km, improving pedestrian facilities could be a sufficient alternative for some rickshaw users; however for longer trips such measures would be insufficient and people need to use bus or other motorised modes. Modal shift from rickshaw to bus (which is already overcrowded) would create extra problem for passengers to secure a seat or get a room to board in bus unless an adequate number of fleets are provided whilst a shift to motorised modes such as private cars would aggravate travel problems by increasing congestion and emissions as Table 1.1 shows these are less efficient than rickshaws.

The discussion above reveals that a growth in cars leads to higher levels of traffic congestion than a growth in other modes. Car ownership rates are increasing very rapidly in developing cities (Morichi, 2005); and it has mainly been responsible for creating congestion (Gakenheimer, 1999; Gallagher, 1992; Dimitriou, 2006; ITDP, 2009). Furthermore, there is evidence that cities have not been able to get rid of congestion by restricting rickshaws (Bari and Efroymson, 2005; Gallagher, 1992).

Do Rickshaws Undermine the Image of a City?

Some critics consider rickshaws to be an "anachronism in the modern world" (Kurosaki *et al*, 2012: p.2): politicians and policy-makers often view it as a traditional outdated mode of travel. So, with a notion to improve the city image many cities have in the past banned rickshaws claiming that they represent backwardness (Samanta, 2012; Gallagher, 1992; Bari and Efroymson, 2005). For example, rickshaws have been prohibited from operating in a few major (VIP) roads in Dhaka for the first time in December 1986 and then again in December 2004 and the (then) minister for home affairs of Bangladesh declared in 2011 that operating in all other major roads of Dhaka will be prohibited step by step.

However, Gallagher (1992: p.63) argued that the real reason for rickshaw ban in developing cities was that "wealthy people didn't like them. They detracted from the modern city image that they were trying to create, and they got in the way of the motor cars". Instead of viewing them negatively or harshly, rickshaws could be considered as a part of heritage, history, and culture. They could be modernised and showcased to other nations; as the City Authority of Yogyakarta (Indonesia) took initiatives to modernise and preserve rickshaws as well as providing infrastructure for them. Yogyakarta city perceives rickshaws as a part of social and cultural pride rather than backwardness (Zudianto and Parikesit, nd; Utz and Peterson, nd). In the inaugural session of the Cricket World Cup 2011 held in Dhaka (Bangladesh), millions of viewers watched on TV whilst the captains took a rickshaw ride when entering the stadium to give a lap-of-honour (Busfield, 2011; Sportsmail Report, 2011). As has been reported by Wipperman and Sowula (2007), rickshaws are a symbol of Bangladesh and foreign visitors know them. Presumably, the organisers of the Cricket World Cup thought that rickshaws represented an aspect of the socio-cultural pride of the city/country and hence showcased them to the world. These examples indicate that it is not inevitable that rickshaw conveys a negative image of a city and that in some cases the image might be highly positive.

Is Rickshaw Pulling Inhuman Or a Sector of Employment & Economy?

Rickshaw sector absorbs unskilled labour forces, which have mostly migrated from rural areas. There are about 600,000 rickshaws in Dhaka (Rahman, 2007; STP, 2005), about 7,800 in Bandung (Joewono and Kubota, 2005), about 106,000 in Kolkata (Gupta and Agarwal, 2008), and about 456,000 in Delhi (Kurosaki *et al*, 2012). Assuming average household size 5, it is clear that in each of these cities a large number of people are directly (pulling) dependent on rickshaws for their livelihood. Moreover, there are many more people who are indirectly dependent as repairmen, shop keepers selling parts or providing pumping facilities, owners, etc. Thus, rickshaw is an important sector of the economy in many cities/countries. For instance, rickshaws are one of the largest sources of employment in Indian urban centres and its contribution to the economy is enormous (Samanta, 2012). It has been estimated that about 6% of national GDP in Bangladesh could be accounted for by rickshaw pulling (Ali and Islam, 2005); and its contribution is more than the combined contribution of Biman Airlines (national flag-carrier airline) and Railway of Bangladesh (Gallagher, 1992). Rickshaw pullers in Delhi or Dhaka transfer a portion of their income to the villages where their families are living (Samanta, 2012; Kurosaki *et al*, 2012; Begum and Sen, 2005); and this may help in reducing rural poverty or rural-urban gap.

Above discussion reveals rickshaw pulling can be viewed in a positive way that it is a trade or employment which provides income earning opportunities for poor individuals. Authors such as Bari and Efroymson (2005), Kurosaki *et al* (2012), Sangathan (nd), Samanta (2012) also mentioned this view. However, on the other hand, some critics consider rickshaw pulling as inhuman or an insult to human dignity and exploitation of human labour (Kurosaki *et al*, 2012). This is mainly because pulling a rickshaw involves hard physical labour under difficult conditions. Nevertheless, the issue of whether ‘pulling a rickshaw is inhuman or not’ could be important while discussing the arguments for and against of rickshaw bans; however, it is not the main part of this research and hence further analysis on this topic falls outside the scope.

Role of Rickshaws as a Travel Mode

Rickshaws provide flexible and demand-responsive taxi-type services as a feeder to public transport or for the entire trip. Travel data reveals that rickshaws contribute 38.7% of trips in Dhaka (DHUTS, 2010), 13.2% of trips in Kanpur (Gupta and Agarwal, 2008), and 12% of work trips in Bandung (Joewono and Kubota, 2005). Furthermore, it can be a popular mode to certain groups of people who have difficulties gaining access to the overcrowded public transport. For instance, considering only the female passengers or school trips in Dhaka, the contribution of rickshaw trips is 47.4% and 41% respectively (DHUTS, 2010). However, rickshaw trips are usually short; as in Dhaka or Delhi the average distance of rickshaw trips is below 3 km (ITDP, 2009; STP, 2005).

Rickshaws are usually complementary rather than competitive to public transport (Rahman *et al*, 2008; Gallagher, 1992). Given that rickshaw trips are usually for short distances, this might be true. However, if public transport services are very poor, say buses are overcrowded or not frequent, then rickshaws may eventually compete with buses. Thus, public transport services need to be improved in order to rickshaws to be used as feeder services. Nevertheless, motorised formal public transport would not replace the rickshaws; or as Replogle (1991) claims rickshaws would not replace the motorised vehicles. In the case of Delhi, this argument has been supported by evidence that the metro has increased the demand for rickshaws (see Kurosaki, 2012; Sahai and Bishop, 2010). The reason for increase is not known; however, it is hypothesised that a high volume of metro passengers need a feeder mode to/from stations. In summary, the above discussion indicates existing motorised transport alone is unable to meet the diverse travel demand and as a flexible mode there is a demand for rickshaws.

Rickshaws as an Environment Friendly Sustainable Public Transport

In recent years, ‘sustainable’ development has been amongst the top agenda items of governments as well as researchers across the globe (Ibrahim, 2003). Thus, NMTs have received much attention as a form of transportation since the adverse impacts of climate change have been realised. Being an emission free mode ('green vehicle'), rickshaws could play a crucial role in environmental aspects for sustainable transport. Furthermore, given the nature of rickshaw trips as well as rickshaw's contribution to the economy, as discussed in previous paragraphs, rickshaws may have potential positive role in socio-economic and financial aspects of sustainability.

2.1.7 What Could be Done to Improve the Transport Situation?

Instead of the controversial bans, if planned properly and provided the required facilities, rickshaws could play a significant role in city transport. Feeder services are crucial for many people in developing cities to have access the public transport services. This is because only the NMT and para-transits are able to enter in narrow alley-ways (Cervero and Golub, 2007). There are many areas or narrow streets in Dhaka which deny access to formal public transport but are accessible by rickshaws (Rahman *et al*, 2012). Therefore, rickshaws potentially have a useful role in the city transport.

Given the socio-economic context and traffic situation in rickshaw cities (refer Table 1.4 and Section 2.1.1 and 2.1.4), they need improved mass public transport services as well as promoting NMT to improve access to transport (see Sing, 2005; Newman and Kenworthy, 1997; Sahai and Bishop, 2010; Banister, 2006; Dimitriou, 2006). Future measures for traffic should be designed for the benefit of NMT - plans must be designed in such way that the street layout and traffic facilities give priority to the ease and safety of pedestrians and NMT, particularly rickshaw users. As Daniere (1999) mentioned, "the megacities of the future should aspire to invest in systems of bike lanes and walkways and only accommodate motorised transportation in the remaining areas, with priority given to buses and other high-capacity modes that can complement non-motorised modes for medium- and longer-distance trips". NMT should given priority because every motorised public transport trip involves access trips by NMT at each end (Tiwari, 2001). Feeder service (access leg) is crucial for many people to have access the public transport services. Therefore, bus services at a reasonable distance to/from low-income residential areas with feeder services by para-transit (or NMT) modes between such localities and bus routes may improve access to major roads from low-income residential areas in developing cities (Soheil and Maunder, 2007; Agarwal, 2006). Rickshaws could play its role as a feeder service to the mass public transit.

It has been argued that both the motorised and non-motorised vehicles, including public transport, should be treated together for a balanced transport system (Kubota and Kidokoro, 1996). Moreover, the urban transport systems should consider all the available modes (Tiwari, 2003). The ‘multi-modal’ solutions are argued to maximise synergies with existing transport and built infrastructure (Schipper, 2004). This discussion reinforce the importance of rickshaws as travel mode and not to restrain its use. Furthermore, a modal shift towards low emissions vehicles and NMTs have been recommended for reducing climate change effects and achieving environmental sustainability (Allen *et al*, 2014; Huizenga, 2013; IPCC, 2014; Sahai and Bishop, 2010; WBGEF, 2003), where rickshaws could play a crucial role as they are emission and noise free green vehicle.

However, this should be noted that rickshaws would not be an alternative of the public transport; because they are used mainly for short-distance trips. Moreover, rickshaws cannot always be readily replaced by motorised vehicles (Replogle, 1991). Nevertheless, the use of rickshaws could be promoted for short trips and in narrow streets or as a feeder service to the public transport. Because, a combination of modes needs to be accommodated in a complementary fashion to meet the needs of diverse travel, recognising limitations on road space, affordability, and the required speed and distance of trips in the corridor (Replogle, 1991). Thus, rickshaws might be the best option to fill the future need of feeder services to the mass transit systems in Dhaka city (Rahman *et al*, 2008), as well as in other rickshaw cities.

2.1.8 Role of NMT towards Sustainable Urban Transport

Sustainable urban transport (SUT) focuses on easy access and mobility for people (all groups in society) to reach work, services, resources, and each other in a manner that is within the environmental carrying capacity of a region and is affordable to both the providers and users of transport systems (EMBARQ, 2006; Richardson, 1999; World Bank, 1996). The major aspects of sustainable transport are the economic, environmental, and social (or equity) dimensions of sustainability; and these could be influenced by a wide range of factors such as fuel, technology, access, congestion, emission, safety, etc (Iwata, 1995; PUSTA, 2006; Richardson, 1999). Governance is also required for sustainable urban transport to have a broad appeal to stakeholders or their engagement for public acceptability.

Banister (2008) gave the sustainable mobility paradigm – a shift from the conventional approach of planning and engineering to an alternative approach. He mentioned “the sustainable mobility approach requires actions to reduce the need to travel, to encourage modal shift, to reduce trip lengths and to encourage greater efficiency in the transport system” (p.75). He also emphasised the need for designing the cities at the ‘personal scale’ to allow both high-quality accessibility and a high-quality environment. Moreover, “genuine efforts to strengthen the sustainability of transport systems require the involvement of all stakeholders in a structured manner and full access to information on all topics by all groups" (PUSTA, 2006: p.16). Hence, Banister (2008) outlined the key elements of sustainable mobility to promote public acceptability more effectively.

However, many developing cities do not have a vision for sustainable transport. Surprisingly, despite the severe resource constraints, no effective sustainable alternative to a motorised-development vision has been realistically introduced for future urban transport policy (Dimitriou, 2006). Promotion of walking and NMT along with public transport is the key for sustainability in urban transport. Many researchers pointed that NMT could play a crucial role and indeed bring sustainability in urban transport. As Dimitriou (1991) argued, there is a need to recognise the role of NMT and plan for them within the broader spectrum of urban transport networks given the emphasis towards environmentally more conscious planning and the needs of the urban poor. Nevertheless, there is a need for safe and convenient paths for the pedestrians throughout the city, preferably with easy access to public transport (Wright, 1992; Pendakur and Guarnaschelli, 1991; McClintock, 1987).

A mix of various travel modes are needed to cater the diversity of urban travel demand in developing cities. Particularly, there are always risks of fuel crisis or other unexpected events (i.e. flood or strike among the operators) that motor transport might be halted. So, Gallagher (1992: p.12) argued that "a diverse transport system is therefore essential for public security, and the rickshaws should be kept for strategic reasons". He specifically mentioned about rickshaws for strategic reason because only the rickshaws are able to go on in narrow streets or on certain roads during floods in Dhaka city.

2.2 Bus Rapid Transit (BRT) Systems

The BRT is a bus based transit system operates on exclusice bus-ways and usually include additional design and operational features to allow higher speed, improved capacity, better bus safety, and to provide unique impage of public transport. Different researchers provided definition of BRT systems and its major features (see Vincent, 2004; Wright and Hook, 2007; PADECO, 2008; Hook, 2004; Wright, 1010; Levinson *et al*, 2003; Polzin and Baltes, 2002; Hidalgo, 2010); been discussed the major features of BRT in Appendix C1. With the success of Bogota BRT, many transport professionals consider BRT as a form to shape the urban transport towards sustainability (Vincent, 2004; Sutomo *et al*, 2007; Munoz-Raskin, 2010; Matsumoto, 2007) – a cost-effective transit alternative to help reducing congestion, improve air quality, mobility and safety.

2.2.1 BRT System Decision Options

Decision about the options of BRT systems could be of various types and forms; each option have different pros and cons on particular aspects (be discussed in following paragraphs). The choice of options for BRT largely depends on aspects such as right of way (ROW), passenger demand, traffic pattern, government policy, and institutional aspects. For instance, Tiwari and Jain (2010, 2013) mentioned several different design and operational strategies have emerged in Asia, particularly in India, to address varying local needs and contexts.

Median Vs. Kerbside Configuration of BRT Lane and Station

The median option to locate the busway in the centre of the roadway or corridor is the most common practice globally. Most of the successful BRT systems, such as Bogota BRT, Jakarta BRT, and Ahmedabad BRT are operating in the centre of the roadway. On the contrary, BRT systems generally do not utilise kerbside configuration as it is not able serving a high capacity due to conflicts with turning vehicles. (Refer to Appendix C2.1 for the detail pros and cons of each configuration). However, there is no specific solution to roadway configuration which is best for locating the segregated bus lanes. Much of it depends on local circumstances like passenger demand, traffic pattern of the corridor and road users' behaviour.

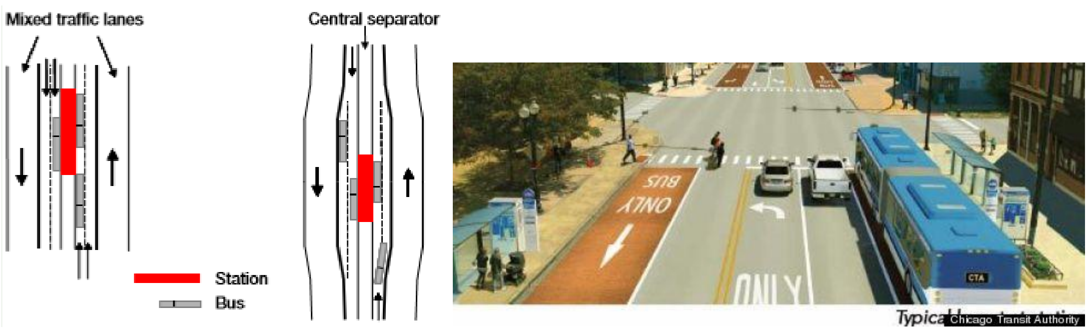

Figure 2.1: Configuration of a BRT station and lanes – median (left), kerbside (right)
Source: Wright and Hook (2007) and Chicago Transit Authority.

Similar to the busway configuration BRT stations also could be placed either in the median or along the curbsides. The kerbside configuration requires two separate stations and usually create problems for passengers to change directions into other BRT routes with paying a single fare. On the other hand, the configuration of a median station gives advantages of reduced infrastructure costs, ease of transfers for passengers by allowing to select routing options from a single platform.

However, comparative evaluation of BRT systems in Indian cities by Gandhi *et al* (2013) found midblock stations require higher access time for passengers than junction stations; and stated “in general, near side staggered stations provide better performance than island station, for both operational and passenger indicators in both open and closed bus operations”. Neverthelss, all other contemporary researchers suggest for a medin station for better performance. The existing models and standards appear universally in favour of a median station as it reduces costs (both capital, operational, and maintenance), minimise ROW requirements, and allow easy interchange for passengers (ITDP, 2011).

Open Vs. Closed Systems

In general, the closed system BRT does provide better speed as well as service than the open system. (Definitation of open system and closed system is available in Appendix C2.2). For instance, a closed system can produce average commercial speed of 25 km per hour (kmph) or higher whilst an open system is likely to produce considerably a lower speed, about 10 kmph only (Wright and Hook, 2007).

However, in a comparative evaluation of BRT system design, Gandhi *et al* (2013) found “For shorter trip lengths, time gain due to higher commercial speed in closed systems does not sufficiently offset interchanging lose time”. Closed systems have higher access time than open systems because all the feeder based passengers are in a closed system whilst 30% of such passengers in an open system encounter interchanging delays. Therefore, Gandhi *et al* (2013) stated “Though closed systems generally achieve higher operational speeds than open systems, they result in a higher passenger speeds only for long trip lengths. High operational speeds do not help offset passenger transfer delays if the operation of time spent in the vehicle is considerably shorter than accessing it. Open systems provide higher passenger speeds than closed bus operations for trip lengths less than 10 km when used with stations without overtaking lanes and less than approximately 16 km when stations with overtaking lanes are used”.

Nevertheless, the advantage of open systems is that they do not require any fundamental changes in the regulatory structure of the existing bus services; therefore, these are particularly common in cities where the political will does not exist to reorganise the bus system (Wright and Hook, 2007). The BRT Planning Guide (Wright and Hook, 2007) suggests if a given BRT corridor is not congested and future congestion can be controlled, or if the political will to restrict the mixed traffic is simply not present, then a temporary mixing of BRT vehicles with other traffic could be allowed. However, the degree to which access is limited to the operators and vehicles can have a significant impact on vehicle speeds, environmental impacts, and the system’s aesthetic quality. If there are no restrictions on access of operators or the types of vehicles, the busway may perform inefficiently; more vehicles will enter the busway and the resulting congestion at stations/intersections will greatly reduce the average speed of BRT. Mixed traffic operation for longer periods can make the BRT system indistinguishable from a standard bus system; which may also have an impact on the psychological image of the system (Wright and Hook, 2007). However, emergency vehicles (i.e. ambulance, fire fighter) are generally permitted access on most BRT systems whether it is open or closed system. Some cities also permit 'official' vehicles such as vehicles of ministers, MPs, government officials and agencies; however, justification for such usage can be somewhat questionable.

Trunk-feeder Services Vs. Direct Services

In a direct service passenger can travel from their origin to destination without having any change or transfer of vehicle. However, lower operational efficiency and speeds are the major disadvantages of direct services. On the other hand, in trunk-feeder services the smaller vehicles (access/egress legs) feed passengers to the larger vehicles operating along high-density trunk corridors (Figure C2 in Appendix C2.3). This is because: beyond a certain point, feeder services may become more viable than the transit services; in some communities may not have any other transport services, and the existence of feeder services may be essential for their access to transport services (Wright and Hook, 2007). Trunk-feeder services are typically coupled with 'closed system' business structure (Wright and Hook, 2007); the trunk vehicles operate on exclusive busways but the feeder service vehicles operate on mixed-traffic lanes. Therefore, many passengers using a trunk-feeder system will require making a transfer or changes between modes at BRT station.

2.2.2 BRT Corridor Capacity and System Design

Once the basic service options of the BRT system have been decided, then the design priority is how to optimise the local conditions to handle the expected passenger demand in a rapid manner. In general, the design of a given BRT system, as Wright and Hook (2007) mentioned, should be:

- To meet the passenger demand (both current and forecasted);
- To achieve the vehicle speed in an average of 25 kmph or more; and
- To minimise the passengers' door-to-door travel time.

BRT System Capacity

A high quality BRT system can carry about 45,000 passengers per hour per direction (pphpd) with a commercial speed of 22–24 kmph (Hidalgo *et al*, 2013; ADB, 2010). The capacity of BRT corridor depends on many design and operation as well as management aspects. BRT Planning Guide (Wright and Hook, 2007) gives the basic formula for calculating corridor capacity, which shows the main factors that affect the capacity of a BRT system are (see Appendix C3 for details):

- Vehicle capacity;
- Load factor;
- Service frequency; and
- The number of stopping bays at station.

Vehicle capacity heavily influences the capacity of a BRT corridor. A variety of standard vehicle sizes are available for BRT systems (see Table C.2 in Appendix C); however, the articulated bus of 18.5 m is becoming the standard for BRT systems (Wright and Hook, 2007). Peak frequencies of 60 seconds to 90 seconds are now common on BRT systems; however frequency per stopping bay tends to be around 60 seconds (Wright and Hook, 2007). BRT Planning Guide (Wright and Hook, 2007) calculated that irrespective to other factors the capacity of a BRT system can be increased either by using higher capacity vehicles or by increasing the number of stopping bays at station (refer to Table 2.1). For instance, the capacity of a given BRT corridor is 3,570 pphpd (serving with vehicles of 70 persons capacity) increases to 8,160 pphpd and 13,770 pphd when using vehicle capacity of 160 passengers and 270 passengers respectively. Similarly, capacity becomes 2-fold if two stopping bays are used instead of one at BRT station.

However, the capacity of a BRT system and its service level is heavily influenced by other design factors, as shown in Table 2.2, are:

- Dwell time;
- Renovation rate;
- Percentage of vehicles that are express or limited-stop vehicles;
- Average boarding and alighting time per passenger; and
- Saturation level.

Detail of these factors are available in Appendix C3.1. The important interfaces between vehicle and station at any BRT system, that sufficiently reduces the average boarding and alighting time, are (Wright and Hook, 2007):

- Off-board fare collection and fare verification;
- Platform level boarding;
- Efficient vehicle alignment to station and vehicle acceleration and deceleration;
- Wide and multiple doorways of the vehicle; and
- Sufficient customer space on station platform.

Table 2.1: Capacity scenario of a BRT corridor

Vehicle capacity (passengers)	Load Factor	Vehicle frequency per hour per stopping bay	Number of stopping bay per station	Corridor capacity flow (pphpd)
70	0.85	60	1	3,570
70	0.85	60	2	7,140
70	0.85	60	4	28,560
160	0.85	60	1	8,160
160	0.85	60	2	16,320
160	0.85	60	4	32,640
270	0.85	60	1	13,770
270	0.85	60	2	27,540
270	0.85	60	4	55,080

Source: Wright and Hook, 2007.

Table 2.2: Impacts of vehicle platform interface and vehicle size on capacity

Vehicle type	Operation type	Max. vehicle capacity	Average dwell time (sec)	Average boarding & alighting time (sec)	Corridor capacity (pphpd)	Vehicle capacity (vehicle/ hr)
Standard bus	Normal operation	70	12	3.0	1,867	27
Articulated vehicle	On-board Ticketing	160	13	1.5	3,777	24
	Level platform, on-board ticketing	160	13	1.0	5,120	32
	Level platform, off-board ticketing	160	13	0.3	9,779	61
Bi-articulated vehicle	On-board Ticketing	240	14	1.5	4,019	17
	Level platform, on-board ticketing	240	14	1.0	5,574	23
	Level platform, off-board ticketing	240	14	0.3	12,169	51

Source: Wright and Hook, 2007.

Table 2.2 shows the maximum capacity of a given BRT system (utilising off-board fare collection, level platform for boarding and alighting passengers, and bi-articulated bus) operating on a single lane and using a single stopping bay is 12,000 pphpd. For the case of articulated vehicles, with similar operating characteristics, the maximum capacity of a BRT corridor becomes 9,700 pphpd. It is clear that the measures such as vehicle size, vehicle-station interface, and doorway widths all make a contribution to high capacity and higher speed. This capacity can be achieved at an acceptable level of service, say without compromising average vehicle speeds of around 25 kmph. If a capacity of more than 12,000 pphd this is needed to achieve at an acceptable level of service, the BRT system will require other measures (to be discussed in next paragraph).

The discussion above shows that the specific factors that will most likely affect passenger and vehicle flows of any BRT system are:

- Size of the vehicle or vehicle capacity;
- Load factor per vehicle;
- Service frequency
- Frequency of stations;
- Number of stopping bays at each station;
- Vehicle-station interface (i.e. fare collection and validation, platform boarding, etc);
- Dwell time;
- Number of express and local bus services;
- Renovation rate;
- Intersection design;
- Boarding and alighting time per passenger;
- Station design (size, characteristics of pedestrian access, number of turnstiles, etc).

Improving the System Capacity

As noted earlier, by increasing the number of stopping bays at BRT station it is possible to increase the capacity of the system. Multiple stopping bays at station allow reducing the station saturation level. If 18.5 m articulated vehicles are used, then 60 vehicles per hour corresponds to an approximate capacity of 9,700 pphpd (Table 2.2), and this figure is the general limit for one lane simple operations. Since a lane will begin to congest once more than 60 vehicles per hour per direction is reached, say 65 or 75 vehicles, a second stopping bay is required whenever volume exceeds this level. Other possible techniques to increase the system capacity of BRT are:

- Allowing different type of services;
- Providing passing (overtaking) lanes; and
- Convoying the buses.

BRT Planning Gide (Wright and Hook, 2007) calculated and showed that the overall capacity of the corridor increases for about 25% if 50% of the vehicles serve as the limited-stop or express services. Similarly, a passing (overtaking) lane increases the system capacity as it allows the express services to overtake without stopping at station and to allow vehicles to pass one another in accessing and exiting the correct bay. A convoy system permits multiple stopping bays without a passing lane; can increase 50% capacity of the system - from 9,700 pphpd to a maximum of 13,000 pphpd of a single lane corridor operating with a single stopping bay.

BRT System Design

The width of a lane and the number of lanes need to be provided for busway as well as for mixed traffic in a given corridor will primarily depend on the ROW of road space. The volume of mixed traffic and the capacity requirements of BRT system (peak passenger volume) are also important determinants for deciding on about the number of lanes for BRT or mixed traffic.

Lane width

A standard vehicle lane for mixed traffic is typically 3.5 m wide; this can be as narrow as 3.0 m or even less if the ROW is very limited (Wright and Hook, 2007). However, a narrow lane tends to reduce speed and increase the risks of accidents.

Since a BRT vehicle is typically 2.6 m wide, it is expected that under normal operating conditions a driver will require a road width of approximately 3.5 m to safely maintain position within the BRT lane and 3 m at the station (as the driver must pull adjacent to the boarding platform). However, BRT Planning Guide (Wright and Hook, 2007) suggests a BRT lane just slightly wider than the vehicle width, such as 2.7 m, would do if the BRT system is ‘guided’. In ‘guided’ system, the vehicle is physically restrained by a guidance mechanism (a side-mounted guidance wheel) to maintain the vehicles position within the lane; such as BRT in Leeds, Bradford, and Adelaide. Despite the added infrastructure cost associated with the side-wheel and the guidance track, the ‘guided’ system provides advantages of safer vehicle operation and higher operating speeds.

Number of lanes

The number of lanes needed to provide for busway and mixed traffic in a corridor depends on the ROW as well as volume of traffic. However, there are no hard rules regarding the necessary ROW to implement BRT systems. BRT Planning Guide (Wright and Hook, 2007) illustrated various examples of BRT systems that have been designed in areas where the entire road width is very narrow. For example, a corridor having ROW of 14 m would allow operating a median busway with one lane for mixed traffic in each direction. Even the road segments of only 7 m wide could be appropriate to operate BRT in one lane as ‘transit mall’ (a commercial corridor segment in which only public transit and NMT are permitted) and mixed traffic in another lane. However, a wider road would give more flexibility on deciding about the number of lanes for BRT and mixed traffic, their width, and the station width. Nevertheless, multiple lanes for mixed traffic as well as for busway provide advantages; such as, in mixed traffic if a car breaks down or if a taxi stops for a passenger, other vehicles can go around such obstacles by using the second lane.

BRT station platform

The length of BRT station platform is determined by the vehicle dimension and the number of stopping bays per direction. Moreover, the station design will have to permit sufficient longitudinal distance for the vehicles to properly align and dock at the station platform.

The width of a station will depend on the width of available ROW; in general, the station shall be accommodated within the available ROW as far as practicable. The BRT Planning Guide (Wright and Hook, 2007) mentioned that the width of station platform should be at least 2 m wide whilst it is 3 m mentioned in BRT Standard 2013 (Cerveror, 2013).

However, the size required for BRT station platform area is largely a function of the projected peak passenger volume - the number of boarding and alighting passengers will determine how much station floor space will comfortably accommodate all passengers. Fruin (1971) provided Fruin Index - six different Level of Service (LOS) as seen in Appendix C3.3 – which provides the general requirements of average area per passenger for different LOS level. Douglas Economics (2006) also provided LOS ratings and crowding factors for various passenger densities at BRT station platform and walkways.

Staggered stations and elongated stations

The station area of a BRT system is likely to be the most critical point in terms of width along the corridor because the BRT station area needs to accommodate both the width of the busway and the width of the station platform (Wright and Hook, 2007). Furthermore, the station area needs to provide parking areas for other modes to facilitate easy transfer of passengers to/from BRT as well as to manage a high volume of pedestrian movements during peak hours. Widening the ROW could address the criticality or spatial constraints of the station area but often it is very expensive and time consuming for acquiring the land. However, in many instances this may not be either possible or sufficient to overcome the spatial limitations (Wright and Hook, 2007). Therefore, innovation in the physical placement and manipulating the physical dimensions of BRT station could be another option for addressing spatial constraints.

As noted earlier, configuration of the BRT stations could be two types: kerbsite (stations split with a different station serving each direction of travel), and median (a single station serving both directions). BRT Planning Guide (Wright and Hook, 2007) showed that staggering of stations for each direction (a different station serving each direction) or elongated stations (median) to offset the placement of the station doors for each direction would provide a marginal road space saving in terms of road width. Staggered station helps reducing station width because the station will have to accommodate approximately half as many passengers for a single direction. However, the marginal savings in road space width gained from this option usually is not a significant benefit compared with the overall operational disadvantages (i.e. required complicated connecting infrastructure, costly fare system to identify customers leaving and re-entering BRT from nearby station, increased overall construction costs for two stations instead of a single median one) associated with this type of configuration.

An elongated station allows a fairly narrow BRT station at median location. In a standard median station, there is a possibility that buses of both directions will stop at the same time and thus intensify the station peak load. In such case, if the station doors for each direction are situated opposite one another then the width of station should be increased to meet the demand of both the boarding and alighting passengers. Alternatively, an elongated station can offset the placement of the station doors for each directions (the doorways are staggered) to meet the peak station load. An elongated median station should be longer than a median station with doorways directly opposite one another (Wright and Hook, 2007).

Optimisation of BRT station location

Selecting the optimum location for placing the BRT station in relation to the intersection, major road side activities, and pedestrian walking distance or time from other modes is a critical issue. Because, the location of BRT station will greatly affect the mixed traffic flow and speed, pedestrian movement and their travel time, the ROW needed for the BRT systems, and many others. BRT Planning Guide (Wright and Hook, 2007) outlined the possible locations of a BRT station in relation to the intersection (see detail in Appendix C3.2); each of the configurations have some particular advantages and drawbacks. For instance, placing the station at intersection reduces walking times for transferring passengers whilst placing before the intersection increases the chances that boarding and alighting time can overlap with the traffic signal red phase (thus obvious benefit of time savings since the station dwell time coincides with the red signal phase). To utilise this benefit, for the case of split stations, the station for one direction can be placed on one side of the intersection whilst the station for other direction on the other side of the intersection. However, the question of before or after the intersection is irrelevant for the case of a median station serving both directions; as the platforms of one direction will be before the intersection and the platform of the other direction will be after intersection. Nevertheless, generally it is suggested to separate the BRT station and the intersection if the volume of mixed traffic or bus is very high (Wright and Hook, 2007). BRT Planning Guide suggests at least 78 m gap between station and intersection to avoid conflicts between BRT vehicle movement at station area and mixed-traffic movements at intersection. Current BRT Standards prescribe minimum 40 m distance from the stop line for station location though it sets no upper limit (Hook *et al*, 2012).

However, in general, optimising BRT station location is always location specific. There are no such strict rules to follow but it depends on the surrounding area of the station. For instance, optimising BRT station location in terms of pedestrian walking times depends on the location of popular pedestrian destinations, the volume of boarding and alighting passengers, the passenger transfer volumes, the location of allowed pedestrian crossings, and the structure of the signal phasing. Nevertheless, there are some general guidelines to obtain a preferred station location (see detail in Appnedix C3.2).

BRT stations should be located in such a way that they best serve the general population and maximise BRT ridership. Furthermore, passenger safety and ease of pedestrian access to BRT station are additional important consideration that would help define the exact location of a station. In general, locating the station near to popular trip origins and destinations like popular intersections, shopping malls, office complexes, will minimise pedestrian walking time.

2.2.3 BRT in Developing Cities

Success of TransMillenio (BRT systems in Bogota) has encouraged many cities, both in the global North and South, to have BRT systems for solving the transport problems within their budget constraints. During the last decade there has been a wave of installing BRT systems. However, all the BRT systems do not have all the features mentioned in Appendix C1.1.

The spread of BRT in Asia has become more noticeable since 2004, with TransJakarta (Matsumoto, 2007), the first ‘closed system’ BRT in Asia. Policymakers in many large cities in Asia have recently started to consider “BRT as an option for their urban transport, 30 years after the initial introduction of a comprehensive BRT system in Curitiba” (Matsumoto, 2007: p.353). However, due to poor lane order and enforcement in Asian cities, design of BRT requires segregating traffic into various dedicated lanes. Many issues are involved in developing cities, particularly in Asia, for successful implementation and operation of BRT systems. For instance, political will and leadership was the key for successful BRT implementation in Jakarta, Seoul, Beijing, and Delhi (Sutomo *et al*, 2007; Matsumoto, 2007; Ponnaluri, 2011).

At present many developing cities, particularly in China and India, have BRT in operation or actively planning for implementing BRT systems. Though BRT has improved overall public transport system and service quality in many cities, in several occations it has been criticised for worsening traffic situation. For example, Delhi BRT system was highly criticised and opposed by many stakeholders.

2.2.4 Feeder Services of BRT Systems

A BRT system cannot bring success as a stand-alone policy. Effectiveness of BRT depends on presence of complementary transport options such as promotion of NMT and integrated feeder service, planning and design based on real-world conditions, and strict enforcement (Matsumoto, 2007).

Obviously, feeder service and design of station is very crucial for a BRT system. Schipper (2004) claims that part of the reason the BRT system works well is “the integration of the trunk lines with other rapid lines and feeder routes through well-designed stations”. Similarly, Matsumoto (2007) identified ineffective feeder services and poor station design (terminal station capacities below passenger demand level) were the major shortcomings for Jakarta BRT. The key reason for not to attract passengers or major hurdle for users were: absence of inter-modal transport facility at the station (along with the high fare structure) for Chennai (India) metro (Advani and Tiwari, 2005); inconvenient transfers from station for high-speed trains in Korea (ITF, 2012). These clearly indicate the importance of feeder modes for public transport (i.e. BRT systems) though the results were not from BRT but from metro or rail.

BRT in the ‘rickshaw cities’ may require an innovative design to accommodate various types of NMTs and IMs, particularly rickshaws, with the BRT system. Because, there are a variety of NMTs and IMs are playing a crucial role of transport or as a feeder service. For instance, as a feeder service of transit system mostly NMT or para-transit is used in Mumbai, India (Rastogi and Rao, 2003); para-transit or walking as access or egress modes for Surabaya, Indonesia (Weningtyas *et al,* 2013; Tangphaisankun *et al*, 2009). Since everybody is also a pedestrian, the transit system must address the needs of pedestrians also. Up until today, only the Guangzhou (China) BRT in Asia has integrated bicycle with the system and none is integrated with rickshaws. The proposed multi-modal public transport strategy for Visakhapatnam (India) includes the provision of park-and-ride at corridor terminal and space allocation for intermediate public transport (IPT) modes such as bicycle, NMT and autos for transfer to/from BRT systems (Ponnaluri, 2011). However, only bicycle but not the rickshaws has been considered in design for Visakhapatnam.

2.3 Integrated Multi-Modal Transport

This section provides a brief review on integrated multi-modal transport systems; covering the following topics: definition of integrated transpotrt; interchange and transfer penalty; types and froms of integration; benefits of integration; and integrating (modal and fare) NMT with public transport.

2.3.1 Definition of integrated transport

Definition of integrated multi-modal transport has been given by many authors. Generally, integrated multi-modal transport systems provides opportunity for 'seamless journey' and passenger convenience. Potter and Skinner (2000) gave an outline or typology for 'integrated transport' considering what exactly is integrated with what or with higher levels incorporating the lower level. In strategic terms 'integrated', 'balanced', and 'package' are largely synonymous; each of them implies the combination, or integration, of measures into a package which is balanced in its treatment of modes, areas or groups of users (May and Roberts, 1995; May *et al*, 2006). "The integrated approach is not just about being able to cycle to the railway station or park and ride. It is about solutions or series of solutions which try to solve the several issues at once" (Potter and Skinner, 2000: p.280). Whatever is meant by integration, there is obvious benefit from an integrated approach when compared with the piecemeal implementation of individual measures (will be discussed in Section 2.3.4).

Wardman and Hine (2000) stated integration is "concerned with interchange, and specifically that between modes, but it also encompasses other intermodal issues such as through ticketing, information provision and coordination of services". This clearly suggests that along with other aspects an interchange is the integral part of integrated transport. A key component of an integrated transport is easy and convenient interchange for the public transport user (Wardman *et al*, 2001). However, Stokes and Parkhurst (1996) made a distinction between 'interchange' and 'integration'. Therefore, next section will discuss about interchange and the various aspects of interchange.

2.3.2 Interchange

Existing body of evidence suggests that "The literature available on interchange appears to be relatively sparse and rather old" (Colin Buchanan and Partners, 1998) and has a heavy bias towards rail and particularly that which is inter-urban (Wardman *et al*, 2001).

Transit travel often requires transfers (within mode or between modes) at interchange. However, transfers are often discomfort for passengers because they involve interchange penalty (discussed in next paragraph) such as the amount of time spent interchanging, wait time, and transfer time (the time spent transferring between vehicles). Moreover, at interchange, passengers need additional physical effort, cognitive (mental) efforts, affective (emotional) efforts plus the relative discomfort, insecurity and uncertainty for transfers at typical transit stops and stations (Wardman *et al*, 2001; Litman, 2011). A study of Wardman *et al* (2001) showed that interchanging on a bus journey increases passenger's anxieties about journey completion, concerns about excessive walking and waiting, worries about personal safety, and pre-trip cognitive load on passengers. Therefore, the need to interchange or transfer is often perceived as an impediment or even a deterrent to public transport use (Dirgahayani, 2012; Wardman *et al*, 2001). Transfers impose dis-utility or a penalty on users. Nevertheless, Litman (2011) argue that transfer penalty of interchange could be minimised by the design and operation of the system in and around interchange as well as by providing better user information and more comfortable waiting condition.

Transfer Penalty

Transfers or interchanges tend to impose extra costs or 'transfer penalty' due to the additional physical and mental effort they require (Evans, 2004). The transfer penalty in general indicates how much extra travellers would willing to pay (in monetary term) or travel (in minutes) to save a transfer (Dirgahayani, 2012). Interchange within mode influences the demand for that mode through the effect it has on time spent waiting, time spent transferring between vehicles and the inconvenience and risks involved, whilst interchange between modes has additional implications in terms of information provision, through ticketing and coordination (Wardman and Hine, 2000).

Transfers are estimated to impose penalties equivalent to 5-15 minutes of in-vehicle time (IVT) (Litman, 2011; Evans, 2004). Various studies indicate that walking and waiting time unit costs are two to five time higher than in-vehicle transit travel time (Pratt, 1999; Litman, 2004). Howevre, waiting time is sometimes valued higher than walking time (Steer Davies Gleave, 1977). Moreover, time spent waiting has greater perceived cost than equivalent time spent on the move. For example, time to 'get to/from the station' is estimated twice as long as in reality (Mook and Webb, 2012); interchange penalties for bus have been estimated at 3 to 4 minutes of waiting time over and above the actual waiting time (NBPI, 1970; Daly *et al,* 1973).

Value of Time

Wardman *et al* (2001) estimated that an interchange penalty valued at 4.5 minutes (reduce to 3.6 minutes when a guaranted connection is available) by bus passengers in Central Edinburgh. They also calculated that wait time and walk time at interchange are respectively 1.2 minutes and 1.6 minutes of IVT. Daly and Zachary (1977) estimated the value of waiting and walking time in the UK to be 3.5 and 0.9 times of IVT of public transport respectively. For rail passengers in UK the IVT values of interchange connection time are 1.67 (Fowkes and Johnson, 1985). MVA (1998) found that an interchange involving a change of platform via a subway or bridge relative to a cross-platform transfer was valued at 9 minutes of connection time whilst a change of station was valued at 27 minutes. The UK Department for Transport (DfT) accepted a recommendation in 2004 to increase wait time values to 2.5 times than the IVT; values of working time per person for bus passenger is £16.72 (2002 prices and values) per hour (DfT, 2004).

However, the value of wait time will vary according to the comfort of the interchange location, the security of the interchange location and the opportunities for engaging in worthwhile activities (Wardman and Hine, 2000). Moreover, as Wardman *et al* (2001) found, there are clear variations in values according to personal and trip characteristics. For example, the interchange penalty was valued more highly by women, those bearing burdens, and those aged 50 and over. Nevertheless, several researchers (see Mackie *et al*, 2003; Lyons and Urry, 2005) recognised that the increasing use of telecommunications (i.e. mobile phones and laptops) while travelling may have significant influence on the value of time as these technologies support ‘life on the move’ - enable to use travel time productively.

Safety at Interchange

Interchanges are usually provided at road intersections. Review of safety of the different types of at-grade intersections revealed that a substantial proportion of accidents occur at intersections and there is a close a relationship between intersection design and safety (Grime, 1987; TRB, 1984; O’Cinneide and Troutbeck, 1995). Moreover, the number of accidents at intersection is proportional to the volume and distribution of traffic on the primary and secondary roads (Hedman, 1990). Public puts great importance on travel safety, road geometry and protection barriers (de Luca, 2014; Mfinanga, 2014). It is widely accepted that intersection channelization is beneficial for safety (O’Cinneide and Troutbec, 1995). Pedestrians in Tanzania suggested that there should have barriers to stop pedestrians from crossing at any location to reduce incidents (Mfinanga, 2014).

2.3.3 Types and Forms of Integration

Transport integration could be of various types. Different author classified integration in various ways; though all these classification or types are almost similar and conveying the same idea. For example, Potter and Skinner (2000) gave functional or modal integration, transport and planning integration, social integration, and holistic integration. On the other hand, according to May and Roberts (1995), four main types of integration are:

- Integration between authorities;
- Integration between measures involving different modes;
- Integration between measures involving infrastructure provision, management and policy; and
- Integration between transport measures and land use planning measures.

Functional or modal integration means making travel easier through a better combination of different modes during one journey which may involve combining different modes of transport. Functional integration deals with ticketing arrangements to enable multi-modal journeys while modal integration deals with easy transfer between different modes due to their close physical location and integrated time-table planning. Easy transfer between different modes requires careful planning and provision of infrastructure. On the other hand, transport and planning integration involve consideration of land use and transport as a single entity to employ land use as a tool for reducing travel demand. Social integration deals with social areas to include those who use and provide transport systems, and others such as organisations that are major trip generators and those affected from negative externalities (involved through suffering noise and vibration from transport). Institutional integration and network integration are among the important strategies for achieving a multi-modal transit system in Singapore (Lam and Toan, 2006). Holistic integration brings together all the types of integration in a coherent way with the aim of ensuring the environmental, fiscal and social measures work in harmony to reduce the need for travel, and reduce the impact of journey’s mode. As all of the elements in social, economic, environmental, transport and land use policies are integrated, this is called holistic or environmental, economic and transport policy integration. Hence, it seems that holistic integration is possible to provide sustainable urban transport.

From the above discussion, integration of transport could be categorised as following:

- Fare or functional integration;

- Modal integration - interchange or transfer facilities (physical locations and facilities for each mode as well as adjacent buildings and land use activities);
- Cross city modes or network integration;
- Time-table and information integration;
- Institutional integration; and
- Policy integration (i.e. pricing - fare levels and structures, parking charges).

2.3.4 Benefits of Integrated Transport

Integrated transport does provide various benefits, most notably ‘seamless’ access or journey and convenience of public transport users. May and Roberts (1995) argued that an integrated approach, in which infrastructure provision, management of existing infrastructure, and use of that infrastructure are coordinated, can significantly reduce the scale of urban transport problems. Integration can potentially achieve benefits either from measures which complement one another in their impact on users, or from measures which make other elements of the strategy financially feasible and public acceptability. For example, fare integration would provide convenience to travellers by allowing travel in different modes with a single ticket (which will save time and money waiting in queues for purchasing individual tickets for different modes) as well as convenience; provision of park and ride would increase rail or bus patronage; revenue generated from parking charges or road pricing or fare increase could be invested for new infrastructures.

The ‘multi-modal’ transport solutions maximise synergies with existing transport and built infrastructure (Schipper, 2004). Thus, significant improvements in overall transport performance can be achieved by careful integration of strategy measures. Physical integration of multi-modal transport could provide convenience and comfort of public transport users. Even an improvement in public transport capacity is possible if integration between different modes is in placed (May and Roberts, 1995). Improved transport capacity or road capacity may help reducing congestion and travel time which in turn may change travel pattern or trip frequency. Moreover, integrated policy helps achieving efficiency in resource utilisation by optimisation of use or cost effectiveness. Integrated transport strategies have also the potential to improve sustainability (Potter and Skinner, 2000). “The more effective integrated strategies show the transport systems to be sustainable, allowing cities to achieve the economic growth to which they aspire without the unwanted increases in congestion and pollution” (May and Roberts, 1995: p.102). A well integration of all transport modes may also provide better road safety and social justice.

However, despite having the potentials of many benefits transport integration is not criticism free. As Schipper (2004: p.13) mentioned, “the greatest risk to any ‘multi-modal’ strategy is to lavish too many resources on promising but expensive technologies while ignoring the simple approaches that clean up and improve existing ones”.

2.3.5 Integrating NMT and Public Transport

A multi-modal transit system requires the careful planning and implementation of various issues and regulating of transit services where the other modes provide an alternative means of travel and also supplement and complement the transit systems. Burckhart and Blair (2009) showed public transport in most of the European cities is lacking physical and information integration. However, their result was drawn from the analysis of medium-sized cities; the situation may differ in major cities. For example, London, Copenhagen, Amsterdam, Berlin, etc. city demonstrates a good example of multi-modal urban public transport systems integrated with NMTs such as cycling and walking. Intermodality has been put forward in several Europen documents (EC, 2004) and other documents such as Terzis and Last (2000), Harmer *et al* (2014), Hine and Scott (2000), CIHT (1998). A transit connectivity plan designed to improve service quality and ridership developed by Sun Francisco Regional Metropolitan Transportation Commission suggested to improve the following features (MTC, 2006):

- Transit stop amenities such as reduction of walking distance, enhanced comfort, weather protection, restrooms, improved security and cleanliness;
- Last-mile improvements (ease of access to transit stops);
- Information and wayfinding; and
- Fare integration.

In Asia, Singapore demonstrates the improved and world class public transport services. The key for success of providing better public transport and restricting car ownership or use in Singapore is a coordinated integration of different modes or integrated multi-modal transit system (Ibrahim, 2003; Lam and Toan, 2006). The public transport in Singapore is convenient mainly because the public transport network is designed in such a way that the placement of stops and routing of services provide the greatest accessibility to the public (Lam and Toan, 2006). Public transport stops are located within a walking distance (i.e. all the light rapid transit stations are within 400 m walking and integrated with feeder bus routes) from the residential or commercial or social infrastructure (Ibrahim, 2003; Lam and Toan, 2006). The covered walkways linking the public transport stops with the surrounding infrastructures provide smoother journeys or transfers and protections against weather conditions for public transport users or pedestrians (Ibrahim, 2003; Lam and Toan, 2006). Moreover, schemes like fare integration, information integration, physical integration, network integration, integrated planning, and integrated transport management system have been implemented over the years to enhance integration of transport (Ibrahim, 2003). Improvements to all intermediate and end-point facilities, such as linkways, service information and customer service are provided for promoting public transport trips (Ibrahim, 2003). As a part of integration among different modes, taxi shelters or passenger pick-up points and bicycle stands are provided outside mass rapid transit (MRT) stations and bus stoppages (Ibrahim, 2003; Lam and Toan, 2006). The bus shelters and MRT stations have been incorporated better seating facilities, telephones, fans, lights, arrival information panels, farecard validators, drinking fountains, 'stop-press' kiosks and vending machines (Ibrahim, 2003). In short, the 'enhanced access and connectivity' and 'greater integration at the operational and service level' encourage commuters in their use of public transport modes (Ibrahim, 2003). However, this requires good planning and coordination among the different agencies involved in transport and land use planning and operations.

Safe, comfortable and convenient transfers of passengers between different transport modes is very crucial for integrated multi-modal transport system. Public transport station "constitutes the conjunctive chain in the complimentarily and the combination of the means of transport" (Pitsiava-Latinopoulou *et al,* 2008: p.241). Therefore, the role of public transport station is very important for multi-modal transport. However, poor station design and multiple activities other than traffic in the station (which is very common in developing countries) often make it difficult and inconvenient for passengers while changing modes. Hence, minor engineering works (infrastructure provision) along with effective management and planning of service provision at station could change the situation. As reported by Soheil and Maunder (2007), provision of shelter for passengers and designated areas for vendors could help providing safe and secure bus stops.

Most of the researches or publications on multi-modal urban transport or integrated transport are with the case study of cities in the developed world and focused on macro scale. Majority of them showed what/how was done and what could be done for integration; but do not give any specific plan or design considering the local traffic or travel behaviour and socio-economic condition of passengers. Furthermore, a detailed study at micro-level, particularly in developing cities where a variety of NMTs and IMs are available and no lane discipline exist among the road users, is still missing. Having the chaotic transport situation, resource constraints and negligence to NMTs in developing cities, it is logical to foresee that

NMT's integration with urban public transport is poor than in European cities or in developed countries.

Usually, individuals make decisions about travel modes based on a particular spatial and temporal context (Zacharias, 2003). Therefore, understanding the users' experience of various options is the key to management strategy of NMTs where crucial management is at the scale of streets and street-corners. Moreover, "the vast majority of the population make decisions about non-motorised transport based on non-monetary considerations" (Zacharias, 2003: p.288). Thus, the management of NMT problems is not a purely technical matter. As Zacharias (2003, p.284) argued, "while planners need to address questions of capacity, route structure and space allocation where motorised modes are concerned, there are relatively minor issues in relation to non-motorised modes. Rather, the issues for the latter centre on conflicts between the modes, travel time and qualities of the travel experience". So, it is very important how the NMTs are planned and the supporting facilities are provided at public transport station for ensuring an integrated multi-modal transport system. Following sections will discuss on two major aspects of the research - modal integration and fare integration respectively.

2.3.6 Modal Integration

The modal interchange area at public transport station is crucial in a multi-modal integrated transport system. Because, transfers are the major constraint on the use of public transport (Richmond, 1998); which often involve unnecessary delay, cost, and inconvenience. The operators and passengers of public transport in Athens (Greece) emphasised (as top priority) on quality of service and transfer quality; whilst the other key satisfaction indicators are: service frequency, transfer distance, ticketing system, and vehicle cleanliness (Tyrinopoulos and Antoniou, 2008). A major hurdle to the use of high-speed trains in Korea is poor access to stations and inconvenient transfers from trains to local transport modes; for this purpose, developing the environment and services for all transport modes at public transport stations has been recommended to enhance accessibility (ITF, 2012). On the contrary, Seoul BRT benefited from cheap and fast transfer between vehicles at station. Hence, it has been argued that along with reliability and comfort of the service, the operations of public must also reduce travel and transfer times (Rivasplata, 2008).

Transfer times between modes may greatly depend on distance need to walk between two modes as well as the spatial contexts and pedestrian facilities of that area. Therefore, public transport terminals need to be carefully designed so that interchanges become convenient, faster and safer for passengers.

Distance need to walk at interchange

Transport literature suggests acceptable distance of walk trips as access or egress to public transport is variable about 0.4 km to 1 km or a 10-minute walk (see Rastogi and Rao, 2003; Munoz-Raskin, 2010; Krygsman *et al*, 2004; Bus and Coach Council, 1992; Sahai and Bishop, 2010). A study among commuters in Stockholm revealed that a reasonable walking time between home and the bus stop 5 minutes was reported by the majority (Wardman and Hine, 2000).

However, certainly the distance need to walk at interchange for changes between modes should be less than a complete walk trip. Literature available on this subject matter is very scarce and they do not provide the absolute figure of distance. For instance, Wardman *et al* (2001) suggested for improving the proximity of stops at the interchange to reduce walking time; Harmer *et al* (2014) mentioned short distances between different modes; Oscar Faber (1996) found a strong preference for same or adjacent platform for modal changes where the elderly are less willing to accept changing platforms or stations (though compared with other passenger grouos students have less objection to changing platforms within a station).

Pedestrian road crossing

An at-grade crossing is the most convenient, easy and simple for pedestrians and provide universal[15] access. Interchange should be designed to provide access for all users (European Commission, 2010), and pedestrian ‘friendliness’ must be fully incorporated into all aspects of urban design (Goldsmith, 1992). Several researcher (see Mfinang, 2014; O’Cinneide and Troutbeck, 1995) showed that at-grade crossings are preferred because they require less effort to cross.

However, there are criticisms of at-grade crossings that they are not safer for pedestrians, reduces the speed of the BRT and obstructs the flow of mixed traffic lanes. For instance, due to safety reason pedestrians in Tanzania mostly rely on the traffic police to control oncoming vehicles for crossing the road (Mfinanga, 2014). A research (see Zagger *et al*, 2004 cited in NelsonNygaard, 2005) suggests that Zebra-crossings are only suitable for narrow roads or low-volume or low-speed but do not make safer crossings at higher volumes or speeds or high number of lanes. Nevertheless, there are many techniques (i.e. raised crosswalks, speed humps and other traffic calming measures, kerb extensions at intersections, increasing predictability and visibility, etc) for providing safer and effective pedestrian crossing

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15 Unrestricted access and use of a service by all potential customers, including the physically disabled, elderly person, children, persons with temporary physical conditions, parents with prams, customers with bicycles, and other load-carrying passengers.

(NelsonNygaard, 2005); which should be needed along with Zebra-crossings at higher volumes or speeds or number of lanes.

On the other hand, many traffic engineers recommend grade separation (overpass or underpass) for pedestrian crossing to reduce conflicts and incidents. However, an overpass or underpass requires more time and efforts for passengers (to climb the stairs) than at-grade to cross the road. Nevertheless, if a grade seperate pedestrian crossing is provided, there should have sloping ramps to provide universal access. For instance, Jakarta BRT provides pedestrian access to the station crossing the road by a bridge connected with sloping (1:8 gradient) ramps (Sutomo *et al*, 2007). However, MVs can use a longer route and over-bridges, but a pedestrian or NMV would often prefer not to use underpass or over-bridge even when it is safer to do so (Tiwari, 2001). For instance, pedestrian underpass and overpasses are not well used in Fushun, China (Tao *et al*, 2010). Transport for London (TfL) guidance (TfL, 2009) and the Norwegian NPRA guidance (2011) both suggest for universally designed facilities and services so that those with disabilities do not have to take circuitous routes to their destination. Step free access and locating lifts and escalators on natural desire lines are ways this can be implemented (Harmer *et al*, 2014). Therefore, modern public transport stations, if grade separated, are equipped with elevators or escalators; which obviously increase costs.

Regarding grade-separate pedestrian crossing, Mfinanga (2014) claimed that women and younger people in Tanzania prefer grade-separate crossing and they prefer overpass rather than underpass due to fear of underground and closed spaces as well as the low security associated with underpass. A study of Oscar Faber (1996) showed a strong preference for covered bridge or ramped subway, however, women are less willing to accept the covered bridge option than men; the willingness to accept anything other than a cross platform interchange declines with age. Nevertheless, aspects such as gender and age of pedestrian, purpose of trip, road class etc affect pedestrian preference for road crossing (Harmer *et al*, 2014; Mfinanga, 2014; PIRATE, 1999).

Passenger facilities

In a multi-modal transport system interchanges usually impose dis-utility or penalty to passengers (discussed in Section 2.3.2.), which can be minimised by design and operation of the system in and around interchanges (Wardman *et al*, 2001) and providing facilities or amenities at BRT station to aid passenger’s comfort while changing modes or waiting. When services are offered or shops are present at interchange, the quality of the time spent waiting may improve (Harmer *et al*, 2014). Comfort is a very important element of a trip, as is the perception of security and reliability (Litman, 2011). MVA (1998) showed the values of good facilities at the interchange station compared to poor and medium facilities were 18 and 9 minutes of interchange time respectively.

The facilities that can enhance the quality of interchange for users include the intermodal integration of modes, design aspects, and passenger services and facilities such as integrated ticketing and way-finding (Harmer *et al*, 2014). The important facilities to be provided at interchange location or bus station mentioned in several research documents (see Wardman *et al*, 2001; Litman, 2011; Oscar Faber, 1996; Ove Arup, 1995; Bus and Coach Council, 1992; SYPTE, 1996; GMPTE, 1997; Harmer *et al*, 2014; TfL, 2009) are almost common and these are: good shelter from the weather, sufficient seats, clean waiting areas, adequate lighting, toilets, information provision (in the form of timetables, real time information, route details and all stops to include a route map), and good signage. Beside these, SYPTE (1996) further mentioned provision of phones, how to find stops, having staff available and providing TV information screens whilst GMPTE (1997) mentioned ease of getting on and off the bus, safe and well defined crossing points, safety and security issues (i.e. video cameras, lighting, and security staff) and TfL (2009) mentioned clocks, bins and recycling facilities. The Bus and Coach Council (1992) further mentioned that bus stops should be transparent to improve the perception of safety.

The particular challenges faced during the design of multimodal interchanges, as Harmer *et al* (2014) reported from practitioner interview, are: access and way finding (need for good wayfinding, better pedestrian access), available space and legacy, communication, information systems, interchange planning and design, ownership and management structure, stakeholder cooperation and conflicting interests. Measures such as anti-slip flooring, uniform lighting, handrails, and high contrast finishes can all be used to reduce the frequency of accidents (TfL, 2009; Network Rail, 2011).

Information systems

A fundamental component of interchange design is information systems (Harmer *et al*, 2014). However, on the contrary de Luca (2014) argue that “public is accustomed to travelling on scheduled services and that information would not give any significant surplus to user protection”. Nevertheless, information has become increasingly important with infrequent users and also for regular travellers who are using real-time information to check their ongoing journeys with the capability of changing their plans if they wish (Grothenhuis *et al*, 2007).

Information should be clear, consistent and coherent in order to guide people through the interchange in a steady, convenient and safe manner to ensure users have a positive and stress free experience (Network Rail, 2011). GMPTE (1997) reported the most important factors relating to information are signage of boarding points, the display of bus times and the availability of accurate timetables. Ove Arup (1995) suggested to provide a route map (including the routes and all stops as well as other interchange information) at bus stop. Information should be inclusive (using audio loops for the hearing impaired, typeface large enough to be read by everyone, tactile signs and paths) and good positioning of information within the interchange as a lack of information in the correct place can generate conflicts between users (Harmer *et al,* 2014). Design aspects that should be considered for information systems to include are (Network Rail, 2011):

- Informing passengers of service and journey options, including interchange opportunities;
- Facilitating simple access to, from and around different interchange aspects and surrounding area;
- Identifying key external destinations.

Wayfinding is a crucial part of information systems, that travellers use to navigate, should be 'self-explaining' so that the amount of signage required is minimal (Harmer *et al*, 2014). MVA (1998) showed good information relative to poor information was equivalent to 7 minutes of interchange time. Thiagarajan *et al* (2010) found providing real-time tracking information in Chicago reduced mean wait time for passengers at bus stop from 9 minutes to 3 minutes. Recent researches (see Edwards *et al*, 2011; Harding *et al*, 2013; Mashhadi and Capra, nd; Zimmerman *et al*, 2011; Fries *et al*, 2011) show potentials of crowdsourcing data using smart-phones to provide real-time information.

Pedestrian path

It is crucial to consider the surrounding area of an interchange and to ensure that the space of interchange is appropriately sized based on current and future use (TfL, 2009). The CIHT Guidelines (CIHT, 2000) for 'Providing for Journeys of Foot' recommend an absolute minimum width of 1.8 m for footways, with 2 m being a desirable minimum and the preferred width being 2.6 m. However, the required width of the sidewalks, as Pitsiava-Latinopoulou *et al* (2008) and NelsonNygaard (2005) mentioned, depends on the flow of pedestrians and the desired LOS level. Refer to Appendix 3.3 where Fruin Index (Fruin, 1971) shows the minimum width required for certain LOS. However, should be noted that the width of walkways needs to be adjusted according to the available width of ROW of road.

In many developing cities most of the roads do not have pedestrian refuges or footways and even if they exist they are often narrow or unusable due to encroachments or obstructions of non-traffic activities (i.e. trading), potholes, and high kerb heights (see Sahai and Bishop, 2010; Lorenz, 2002; Rahman, 2014). Hence, Sohail and Maunder (2007) argue for ensuring safe and secure bus stops with provision of shelter for passengers and designated areas for vendors. Passengers prefer waiting for a trip in conditions of comfort, safety, and protection from the weather (Paulley *et al*, 2006).

Various building elements will be required at interchange, although these vary depending on the type of interchange and its location (Harmer *et al*, 2014). Permeability and legibility is important for users to be able to navigate and move around the interchange easily and results in quicker and easier transfers between modes (TfL, 2009; Network Rail, 2011). In order to provide good legibility for travellers, TfL (2009) suggested that layout, lighting, consistency of materials, finishes and use of colours should all be considered. Materials should be consistent throughout the interchange, high quality and fit for purpose as well as being appropriate to the local context (TfL, 2009; Network Rail, 2011). Appropriate information such as signs, maps and announcements can also enhance legibility (Harmer *et al*, 2014) whilst landscaping and public art can create added value to the interchange and encourage a sense of ownership to its users (TfL, 2009).

2.3.7 Fare Integration

Stokes and Parkhurst (1996) advocates ticketing policies that allow through travel on more than one mode such as the London travel card. They argue that the most important element to ensuring integration is to view all transport nodes as ‘travel points’ which could be used to encourage people to become aware of the travel possibilities which exists.

Rickshaw fare is usually determined through a bargaining process between the user and puller before the trip is initiated. This is why, even if the interchange area is designed to ensure convenient transfers to/from rickshaws; “without fare integration of rickshaws with the formal public transport there would not be the ultimate benefits or convenience for public transport users” (Rahman *et al*, 2012: p.11). Because, a passenger may have to approach many pullers (one after another) until he finds one willing to carry him with his desired rate; which will create crowding and congestion in front of station, delay in transfer trip, and inconvenience of passengers. There is no publication available on integrating rickshaw fares with public transport systems. However, it is certain that unless a pre-determined fare structure is established for rickshaws, it would be impossible to implement an integrated fare system for journeys involving both rickshaws and public transport.

As the rickshaw journey has no specific fixed route, and also because means are not readily available to measure the distance for each trip, it is a challenging task to have pre-determined and fixed fares for rickshaws. Furthermore, rickshaw fares for a certain distance may vary depending on different aspects such as weather and time of the day, availability of rickshaws, willingness of the puller for a trip, destination (location) of the trip, number of passengers travelling, quality of the road surface (of intended trip), traffic congestion, and the bargaining capacity of the two parties. Rahman *et al* (2012) reported that if the rickshaws operate only within a locality or neighbourhood for short distances, then a ‘pre-determined fixed fare structure’ for rickshaws would be possible based on an agreed predetermined (tentative) distance between two locations. Fazilka Ecocabs, a charity NGO for rickshaws based in India, operating with a pre-determined fare structure based on distance (km) of trip within/between locality (Asija, 2012).

On the other hand, Wipperman and Sowula (2007) suggested to determine rickshaw fares based on the travel time of a journey takes: a chart of pre-determined fare rate (previously set by the managing authority) would be available in each and every rickshaw, all the rickshaws would be nationalised and the passengers would pre-pay by purchasing ‘tokens’ for using rickshaws. However, there are potential risks of this system where the speed of a rickshaw varies due to quality of rickshaw and age (or physical strength) of puller: passengers may prefer to travel with young and strong pullers only; pullers may drive much slower than the average speed; pullers may ask for cash instead of tokens; and the passengers may forget to buy tokens before the trip so offer cash money.

2.4 System Design for BRT Integration with Rickshaws

Based on the review of literature discussed in previous sections, this section provides a system design (the generic plan) for integration of rickshaws with BRT systems, unfold the questions and issues relevant to the system design for modal integration and fare integration, and finally draws some hypotheses for this research will be presented in Section 2.5.

As already discussed in Section 2.1.7 and 2.1.8, several researchers argue for considering and treating all the available travel modes (including NMT) together in a multi-modal transport system to maximise synergies with existing transport and built infrastructure. Rickshaws fill a niche in transport and they could play a significant role in sustainable transport, particularly as a feeder to complement the public transport, if they are planned properly and the required facilities are provided. Therefore, instead of placing outright restrictions on rickshaws they could be integrated into the public transport system by using them as feeder services.

This section provides the issues which need to be considered for integrating rickshaws to serve as feeder services to BRT systems. This research deals only modal integration and fare integration of rickshaws with BRT to enable easy transfers through their close physical location and multi-modal journeys with a single payment respectively.

2.4.1 Modal Interchange Area: BRT Station

Design of BRT station and its surrounding area is very crucial for modal integrating with rickshaws. Because, usually passengers do not like interchanges between modes due to the intrinsic costs of transfer, waiting times, inconvenience, and uncertainty. Therefore, BRT stations need to be carefully designed so that interchanges become convenient, faster and safer for passengers.

BRT Systems Decision Options

The physical design of a BRT station will vary depending on different decision options of the system. The key aspects of decision choice on BRT systems that may have significant influence on design of BRT station were discussed in Section 2.2.1. Considering the comparative advantages and drawbacks, a closed system BRT with a median configuration of station (single station serving both directions) and BRT lane was considered for 'rickshaw city'. This configuration of BRT would provide better speed and service quality.

Convenient Distance of Walk at BRT Station for Modal Changes

There is no published reference which provides information on passenger's acceptable distance for walk at modal interchange area or BRT station for changes between rickshaws and BRT systems. However, it is obvious that this distance for changes between modes should be less than the distance of a complete walk trip. Moreover, as the rickshaw trips are usually for short distance, the distance for modal changes between rickshaws and BRT should be shorter than the minimum distance of a rickshaw trip. Therefore, probably a distance up to 200 m or a walk of three minutes would be comfortable for modal changes between rickshaws and BRT systems. Nevertheless, it is important to know the passenger's acceptable distance of walk between rickshaws and BRT at interchange area (or BRT station) for modal integration of rickshaws with BRT systems.

Pedestrian Road Crossing and Access to BRT Station

Passengers may need to cross the road at the interchange area to access in BRT station. In general, at-grade crossing (i.e. Zebra-crossings or signalised) would be the most convenient for pedestrians because grade-separation (overpass or underpass) requires more time and efforts of pedestrians. However, the at-grade crossings are suitable only for narrow roads or low-volume or low-speed but they do not make safer crossings at higher volumes or speeds or high number of lanes. Safety for passengers (pedestrians) at modal change area should be given high priority. Therefore, many traffic engineers recommend grade separation for pedestrian road crossing. Nevertheless, often pedestrians would prefer not using an underpass or overpass even when it is safer because it requires more time and efforts. Thus, it is a very crucial aspect of designing the BRT station area for physical integration with rickshaws - whether at-grade or grade separate pedestrian road crossings be provided to access BRT station to/from rickshaws.

Walkways

A modal interchange area should have good environment for walking to ensure convenient changes between modes for passengers. However, in many developing cities most of the roads do not have pedestrian refuges or footways and even if they exist they are often either very narrow or unusable due to encroachments and obstructions of non-traffic activities (i.e. trading, garbage disposal), potholes, and high kerb heights. Pedestrian paths should be clear (free from shops or vendors and other non-traffic activities) and wide enough for pedestrians' comfort while walking. The required width of a sidewalk would depend on the flow of pedestrians and the LOS level as well as the width of available ROW of the road.

Passenger Facilities at BRT Station

As the bus headway of BRT systems would be very low (i.e. around one minute), it may not require to provide seating arrangements or any other passenger facilities at BRT station platform. However, passengers may expect a safe and secured modal interchange area with provision of shelter (protection from weather) for waiting.

2.4.2 Organising (Queuing) Rickshaws at BRT Station

Rickshaws usually wait on carriage way in a disorganised and chaotic fashion, particularly in and around public transport stations or shopping malls, for picking-up and dropping-off passengers. Provision of designated rickshaw stands needs to be provided at BRT station. It is also important to have a discipline among the rickshaw-pullers as well as the passengers: rickshaw waiting areas should be properly maintained with rickshaws forming a tidy queue at BRT station.

Providing a physical barrier or fencing may help effective enforcement of organising rickshaws such as pullers must follow a tidy queue while waiting. Advocacy program to raise the awareness of rickshaw-pullers about the benefits of forming queues at station may encourage them forming a queue voluntarily. Along with infrastructure provision or awareness generation, effective enforcement is also needed for queuing rickshaws at public transport stations. Nevertheless, organising rickshaws at BRT station would involve potential difficulties such as: creating space for rickshaw stands at connecting narrow roads, rickshaws may wait at unauthorised place, waiting more than allowable number of rickshaws at a stand, space for rickshaw stand is occupied by others.

2.4.3 Fare Integration of Rickshaws

Unless a pre-determined fare structure is established for rickshaws, it would be impossible to implement an integrated fare system for journeys involving both rickshaws and BRT systems. As the rickshaw journey has no specific fixed route, and also because means are not readily available to measure the distance for each trip, it is a challenging task to have pre-determined and fixed fares for rickshaws.

If the rickshaws operate only within a locality or neighbourhood for short distances, then a ‘pre-determined fixed fare structure’ for rickshaws might be possible based on an agreed predetermined (tentative) distance between two locations. It may also possible to determine a fixed fare rate for rickshaw trips based on the trip time. However, it may not be possible to consider any variation of rickshaw fare rates (e.g. different rates for peak and off-peak time, any discount on advance/pre-paid or weekly/monthly purchase of tickets) because these would be more complicated (almost impossible) to implement and enforce.

After determining the fare structure for rickshaw trips, the next issue concerns integrating this with the tickets of public transport: what would be the mechanism for integrated fares and how to collect the fares as well as what would be the mechanism for distributing the revenue among different modes (particularly to the rickshaw pullers). Nevertheless, fare integration with rickshaws should be backed with effective planning, regular monitoring and enforcement, awareness generation of rickshaw-pullers, and wide publicity campaigns.

2.4.4 Enforcement Issues

Various aspects of enforcement such as whether rickshaws wait in designated rickshaw stands at BRT station, not exceeding the permitted limit of rickshaws allowable to wait in a given time at a particular stand, rickshaws follow a tidy queue while waiting, pullers are following the specified fare rate etc would be crucial for integrating rickshaws with BRT systems. The role of pullers and their acceptability is vital for effective enforcement of the above mentioned aspects. Forming an association of pullers at neighbourhood/local level may help them to become aware and to take some responsibility for implementing and enforcing themselves. The local government authority could take the responsibility of enforcement and practicing their administrative power within their jurisdiction. Cooperation between local authority and the pullers association or the rickshaw owners' association may provide excellent results in effective enforcement.

2.5 Hypotheses of the Research

Hypotheses drawn for this research are grouped in two categories: hypotheses relevant to BRT station design and rickshaw's integration with BRT; and hypotheses relevant to methods and techniques. This section presents the hypothese that are relevant to BRT station design and rickshaw's integration with BRT systems. These are following:

- Hypothesis 1: A distance of more than 200 m or a walk for more than three minutes for modal changes to and from rickshaws at BRT station would not be acceptable by the passengers.
- Hypothesis 2: At-grade pedestrian road crossing (either with Zebra-crossing or signalised crossing) to access into a median BRT station is preferable for public than an overpass or underpass when the road users follow (or respect) the traffic signs and signals and the speed of traffic is low.
- Hypothesis 3: Passengers would not require the seating arrangements and other facilities such as kiosk at BRT station if the bus headway in BRT system would be very low, i.e. around one minute.
- Hypothesis 4: Without an effective enforcement rickshaw-pullers do not form or maintain a tidy queue at modal interchange areas and they do not follow traffic signs and rules.
- Hypothesis 5: Both the pullers and passengers would prefer a fixed fare structure for rickshaws and an integrated fare system for journeys involving both rickshaws and BRT systems.

Hypotheses relevant to methods and techniques of this research will be discussed in Section 3.9.

2.6 Summary of the Chapter

This chapter first provided a review of literature on traffic and transport in developing cities focusing on policy towards rickshaw bans, BRT systems, and integrated multi-modal transport. A variety of heterogeneous modes are available in developing cities and current public transport services are poor. Traffic rules and signals are often disregarded by the drivers. Though rickshaws are providing a crucial role of transport services, many cities recently tried to impose a restriction or ban on rickshaw's operation. This controversial political decision was opposed by users, pullers, and environmentalists. There is a strong argument that rickshaws are green mode and could play a crucial role towards sustainable urban transport. Therefore, instead of controvsrcial ban, rickshaws could be planned as feeder modes of BRT systems. If rickshaws are planned as a feeder of BRT, and required services and facilities are provided at BRT station then this could solve transport problems of the city. However, rickshaws to be served as a feeder of BRT would require special plan of BRT station so that rickshaws are accommodated at BRT station to provide modal integration as well as pre-determined fare structure for rickshaw trips so that fare integration between rickshaws and BRT are possible.

Based on the review of literature, a system design for BRT integration with rickshaws was presented and then relevant hypotheses related to BRT integration with rickshaws and BRT station design were drawn for this research.

Next chapter will provide first a brief review on different research methods and techniques and then the methods for this research as well as relevant hypotheses related to methods and techniques of this research.

Chapter 3
Review of the Research Methods and Methods for this Research

Sound research requires a systematic and rigorous approach to design and for implementation of the study, the collection and analysis of information, and the interpretation and reporting of findings (Fossey *et al*, 2002). So, a viable research methodology is a must for good quality of the research output.

An overview of the research approach was provided in Section 1.4.3. This chapter, first, gives a review of literature on research methods and techniques. The review of methods and techniques considered for this research are organised on the following aspects/topics:

- High-level approaches of research methods;
- Methods for preparing transport plan;
- Participatory methods for deriving public opinions;
- Focus group discussions (FGDs) and visualisation techniques;
- Methods for deriving policymakers' opinions; and
- Methods for transferability of transport plan or policy.

Based on the review of literature, then, this chapter outlines the methods chosen for this research. Discussions about the methods chosen for this research covers and presented on following topics:

- Methods for preparing transport plan;
- Methods for deriving public opinions;
- Methods for deriving policymakers' opinions; and
- Methods for transfering the findings.

Finally, the chapter presents the hypotheses relevant to the methods and techniques for this research that were drawn based on the review of literature.

3.1 High-Level Approaches of Research Methods

Different high-level approaches of research methods are discussed in following paragraphs of this section.

Case Study Research

The case study research method is an empirical inquiry that investigates a contemporary phenomenon within its real-life contexts (Yin, 2003; Baxter and Jack, 2008). This approach offers insights that might not be achieved with other approaches (Rowley, 2002). Researchers (for example, see Yin, 2003; Baxter and Jack, 2008; Rowley, 2002) argue that the case studies can be used for exploratory, descriptive or explanatory research and particularly useful in providing answers of “why?” and “how?” questions.

The case study approach provides opportunity for collecting detailed and in-depth information specific to the study location with minimal resources in a reasonable short time. However, critics mentioned its drawbacks are: a small number of samples or cases which do not offer grounds for establishing reliability or generality of findings, small data sets may not be enough to meet the requirements for statistical significance, biases the findings due to intense exposure to study, only useful as an exploratory tool. Nevertheless, reports on case studies from many disciplines are widely available in the literature. A key strength of the case study method involves using multiple sources and techniques in the data gathering process.

Quantitative vs. Qualitative Research

Two approaches of research methods are the quantitative research and the qualitative research. Quantitative approach is based on ‘positivist position’ where the researcher “eliminate(s) all of the unique aspects of the environment in order to apply the results to the largest possible number of subjects and experiments” (Maykut and Morehouse, 2001: p.13). In this method, researchers stress objectivity and more ‘mechanical’ techniques to quantify the results, so ‘hard data’ (in the form of numbers) is gathered (Neuman, 1991). Hence, quantitative approach of research is deeply rooted on experiments and statistical analysis.

On the other hand, qualitative research is based on a ‘phenomenological position’ - understanding the context sensitivity or meaning of the events (Maykut and Morehouse, 2001). Data gathered from this approach is ‘soft data’ (Neuman, 1991); hence, this method “places emphasis on understanding through looking closely at people’s words, actions and records” (Maykut and Morehouse, 2001: p.13). Thus, qualitative data give rich information about the social process or understanding the behaviour in specific settings (Arksey and Knight, 1999; Neuman, 2003). Valuing participants and creating an environment in which everyone feels able and willing to participate and speak freely is always important in qualitative research (Marsden and King, 2009). This is narrative or descriptive approach. Hence, qualitative sampling may involve small numbers of participants, while the amount of data gathered could be large (Fossey *et al*, 2002). Qualitative method is best for investigation of the micro level of social life (Bryman, 2005), or when the project is implemented incrementally through a process of adapting to local conditions and needs (Patton, 1990). Some of the example of transport researches where qualitative methods have been applied are: Sorensen and Longva (2011), Marsden and King (2009), Zacharias (2003), Morris *et al* (1998), Parry-Jones *et al* (2005), Sohail *et al* (2006), Sohail and Maunder (2007), Hull (2008), Bickerstaff *et al* (2002).

Participatory Approach in Transport Planning

Participation is a two-way dialogue between participant and the professionals; which is interactive and involves re-distribution of power to the participants with direct influence in the decision-making process (Batheram *et al*, 2005). Public participation and bottom-up approach gained a lot of focus and importance in transport planning over the past decades. This happened because only the technical or engineering aspects often fail to engage effectively with the knowledge, value and interests of stakeholders and wider society (Burgess *et al*, 2007). It has been argued (see McAndrews *et al*, 2006; Cohen, 2005; Atvon, 2007; Bickerstaff *et al*, 2002) that the transport planners need to involve community people from an early stage in the planning and implementation process of designing the urban transportation system for its users and for those who experience its positive and negative externalities. Involvement of the community does provide better results in solving transport problems. Because, the residents have intimate knowledge about how the road functions or malfunctions and can offer useful suggestions for re-design, operational improvements, land use changes, and related social programs of the road (Bickerstaff *et al*, 2002; McAndrews *et al*, 2006). Moreover, residents' involvement in planning process may help to generate their 'sense of ownership' towards the project. Thus, incorporating the opinions of the stakeholders and transport officials with the analysis of researcher in the plan preparation process may produce better results because the context-sensitive design needs to respond the physical environment as well as social and economic conditions, including neighbourhood concerns and aspirations. Schipper (2004) also argued that the development of bus rapid transit (BRT) procedure should be done in a very open and communicative manner. Participation of citizen groups played important roles in BRT planning and implementation in Jakarta and Seoul (Matsumoto, 2007).

Different mechanisms of participation (i.e. interviewing, focus groups, participant observation, etc.) have been developed to improve the quality of contemporary democracies (Navarro, 2008). Cohen (2005) gave a simple relationship between the number of people involved and the depth of participation (the degree to which individuals participate) for a planning exercise in various methods of participation whilst Batheram *et al* (2005) gave three different levels of public involvement - awareness or information, consultation, and participation. Cohen (2005: p.5) argued for "…. a move from consultation to participation: where, before people were the objects of the activity - professionals consulted them - now the message is that people should participate in planning, that they will take an active role". Each of the different tools and techniques has comparative advantages or disadvantages over others on particular issues. For example, group work can facilitate collecting information from people who cannot read or write and may also encourage the participation of those who are anxious about talking or wary of an interviewer (Lederman, 1983). No one strategy is superior to the others (Peshkin, 2001); however, a combination of various tools may provide better results. Obviously, the participation should be effective and collaborative.

3.2 Methods for Preparing Transport Plan

The review of literature shows that there are various methods and techniques available for preparing transport plan. They are discussed in the following paragraphs.

Approaches to Making Literature Review

Literature review is based on the assumption that knowledge accumulates and that people learn from and build on what others have done (Neuman, 2003). Reviewing of literature gives many benefits (Flick, 2009); of which easy access to data or source for comparison of the collected data is worth mentioning. Literature review could be of various types (Neuman, 2003). For example, meta-analysis is a special technique of review where the researcher gathers the details about a large number of projects and then analyses the information statistically. Content analysis technique allows the researcher to discover the features in the content of large amount of written or textual or symbolic materials that might be otherwise unnoticed (Neuman, 2003; Flick, 2009). A strong benefit of literature review is that this method is same everywhere (in different geographical locations), no change or influence with the spatial or socio-economic variations.

Residents' Consultation

Parry-Jones *et al* (2005) gave a new approach of street design methodology through consultation of residents. They gave example of 'Dings Home Zone' project in Bristol, UK to illustrate the new design paradigm of highway designing at human-scale social streetscape. They also showed, with the example of 'Art & the Travelling Landscape', how to involve communities and artists as well as local authorities in the design process. 'Dings Home Zone' project involved collaborative multi-disciplinary approach where all the public organisations operating in the area were also involved in the process. For instance, fire service participated in the street layout trials with a fire truck to ensure that access to all parts of the neighbourhoods would be available. In 'Dings Home Zone' project, several resident representative of the community (one from each street) have been appointed as primary contact points and their informal chats with neighbours helped to spread the information and gather opinions; several street events and public meetings have been conducted over the years to engage the residents in the design process and developed a master plan of the area.

However, this method is very challenging; it requires more time, energy and flexibility. Moreover, involving the multi-disciplinary teams, especially the public organisations, are often difficult in the developing cities.

Modelling and Simulation

Computer-based modelling and simulation is a powerful tool for preparing a design or plan. For example, PAXPORT for flow-based pedestrian modelling; STEPS, LEGION, CAST and VISSIM for pedestrian microsimulation; TRANSIM for agent-based simulation of vehicles. Existing body of literature suggests many researchers (i.e. Acharya *et al*, 1999; Gandhi *et al*, 2013; Guevara and Donoso, 2014; Hoard *et al*, 2005; Holmgren *et al*, 2012; Tyworth, 1991) applied modelling and simulation tools. Hoard *et al* (2005) used computer based modelling to simulate a wide variety of scenarios to disaster planning whilst Tyworth (1991) applied to evaluate complex logistical trade-offs and Guevara and Donoso (2014) assessed tactical design of bus transfer areas.

However, computing models are data-intensive and require significant investment in time and resources. Moreover, it is difficult to bridge with public participation. For instance, analysis tools such as EMME2 are ill suited to iterative public planning processes because they require more engineering detail about an alternative than is possible from the schematic plans generated in public contexts.

Design Charrettes

Design charrette is a method of community-based planning and design or design-oriented participatory community planning events. These are collaborative session in which a group of designers and technical experts drafts a solution to design a problem with facilitated opportunities for engagement with both the general public and stakeholders (Brain, 2008; Girling *et al*, 2006). These methods are typically an intensive multi-day planning process, often take place in multiple sessions in which the group divides into sub-groups, and well supported by qualitative, design-based participatory methods that engage public (Girling *et al*, 2006). However, the charrette requires specialists to acquire sufficient general understanding of the project to be able to discuss issues with other specialists (Brain, 2008: p.252). Nevertheless, both right mix of disciplinary knowledge and effective community participation are required for interdisciplinary work (Sutton and Kemp, 2006). Most charrettes follow a similar sequence (information about goals and planning issues, cross-reference, alternative arrangements, potential plans) where the quality and integrity of the process largely depends on the level of understanding, communication and consensus among the people (Girling *et al*, 2006).

Girling *et al* (2006) developed computer-based decision-support tools for visualisation and modelling to design charrettes for participation in neighbourhood-scale planning. This tools have been applied in North Carvallis area planning in Oregon, USA in 2003 and in Squamish Municipal Council of British Columbia, Canada in 2005 (Girling *et al*, 2006). Sanoff (nd) applied charrette methods in Japan and used graphical symbols and video monitor to explore the community problems in older portion of two cities. Sutton and Kemp (2006) gave inter-disciplinary design charrette for integrating social sciences and design inquiry to solve community problems. However, yet, there is no example of application of design charrettes in developing cities.

Drawbacks of the design charrette are: evaluations of the alternatives are difficult to integrate into this process (Girling *et al*, 2006), achieving disciplinary balance is difficult, and some participants may feel out of place on designers' turf (Sutton and Kemp, 2006). Other possible drawbacks of this method are the lengthy time of process and thus associated costs.

3.3 Participatory Methods for Deriving Public Opinions

It is crucial to understand user's requirements, as well as their perception of the quality of service of intermodal trips, and the comfort and security of their transfers (Das and Pandit, 2013; Harmer *et al*, 2014). Various methods of participation are available in literature for feeding the views of the public into a decision-making process. These could vary from a simple transmission of information to a complex negotiation, such as, opinion pools and surveys, public meetings, citizens' panels and forums, citizens' jury, stakeholder workshop, participatory action research (Lenaghan and Coote, 1997). Each of these has comparative advantages or disadvantages over others on particular issues. Opinion polls and referendums are non-interactive and they do not provide opportunity for showing any design or plan to the public. Interviews and questionnaire survey or household survey do not give collective opinion. Public meetings, consensus conference and public exhibition are like consultation, as mentioned by Batheram *et al* (2005), and they do not provide deep participation.

Following paragraphs describe the various methods of participatory process for exploring stakeholders' views or public opinions.

Deliberative Methods

Deliberative methods are commonly described as a hybrid between consultation and research; involving ordinary citizens being willing to tackle difficult problems where participants are given an opportunity to reflect, discuss, question, think critically and have dialogue about a topic with other participants (Gregory *et al*, 2008; SGSRG, 2013). These methods are particularly useful for exploring public views and for topics about which the public are unlikely to have much knowledge or information (Kings *et al*, 2009). Deliberative methods and techniques can be of various ranges and types.

Deliberative methods enable the researchers to gain insight into existing public attitudes, views and opinions through initial discussions by focus group approach. "Deliberative methods when used as a research method combine research techniques with public consultation mechanisms to enable policy makers and others to understand the views of members of the public" (Marsden and King, 2009: p.115). To deal with technical topics, in this process, at first expert information is introduced to the group of citizens and then time is allowed for the citizens to debate and deliberate among themselves. Usually there is a short presentation by expert followed by question-and-answer sessions or split into smaller groups for in-depth discussion or brainstorming. Marsden and King (2009) mentioned that "deliberative methods can be participatory but do not need to be" (p.115).

Deliberative methods have been used by Marsden and King (2009) to understand travel choices in UK cities whilst by Bickerstaff and Walker (2005) to develop the local transport plans. This method of community engagement was also applied by Gregory *et al* (2008) for development of health policy and by Brouwer *et al* (1999) for environmental management. Marsden and King (2009) argued that "It is undoubtedly a powerful research tool with greater potential for application in the field of transport" (p.122). However, they have pointed that the deliberative research design must require sufficient resource for reordering and analysis of the data produced.

Citizens Forums or Panels

Citizens' forums are open to anyone living in a locality or belonging to a particular interest groups, however, panels usually have a fixed membership; where the participants meet over a period of time regularly (for 90 minutes or more) to discuss or debate the issues they are asked to address (Lenaghan and Coote, 1997). However, identified views of the stakeholders' are taken into account in decision making only if possible to accommodate those views.

Bickerstaff *et al* (2002) found that a third of (their sample) local transport authorities in UK had been employed citizens' panel formation to consult with citizens about transport policies and planning issues. They mentioned that citizens' panel formation is designed to establish and maintain a sample of opinions representative of the population as a whole.

Citizens' Jury

In citizens' jury, between 12 and 16 jurors are recruited (using random stratified sampling) to be broadly representative of their community and brought together for four days, with a team of two moderators, to address an important question about policy or planning. Jurors scrutinize the information, cross examine the witnesses and discuss different aspects of the question in small groups and plenary sessions. Citizens' juries are "usually commissioned by an organisation which has power to act on their recommendations" (Lenaghan and Coote, 1997); however, the jury is independent of the commissioning body. The commissioning authority is required to publicise the jury and its findings, to respond within a set time and either to follow its recommendations or to explain publicly why not. Lenaghan and Coote (1997) recommended to invite the representatives of the key stakeholders to observe and to encourage the media to attend. According to them, "the media can and do act as recorders and disseminators of the jury's deliberations, making the local community aware that a citizens' jury has taken place and with what effected" (p.86).

Cohen (2005) applied citizens' jury with a group of 12 people, recruited on-street, to explore what they likes and dislikes for developing a set of objectives for their local transport and environment and then, in second session, formulating the strategy options to achieve the objectives. He claims that the citizens' jury is able to combine representative and deep participation in a single activity. Nevertheless, citizens' jury is relatively time-consuming and expensive method.

Photovoice

Photovoice is an innovative participatory research method that incorporates the process of documentary photography which puts cameras in the hands of individuals often excluded from decision-making processes in order to capture their voices and visions about their lives (Wang and Burris, 1994). This method had been applied by Foster-Fishman *et al* (2005) to promote reflection and discourse among residents regarding neighbourhood and community life as well as to collect qualitative evaluation data from residents regarding their life. However, probably photovoice would not be appropriate for transport research exploring public views because they are suitable only for anthropological study or documenting life style.

Participatory Action Research (PAR)

Participatory action research (PAR) aims to engage key stakeholders as participants in the design and conduct of the research, diminishing the distinction between the researcher and the researched (Fossey *et al*, 2002). Thus, PAR involves collective action and intended to empower participants to take control of the political and economic forces that shape their lives (Healy, 2006; Fals-Borda, 1987). In this process, the researcher initiates the ground work through preliminary consultation and evaluation of the issues, promotes participant involvement, facilitates meetings, raises consciousness and promotes activist attitudes, and initiates the sharing of power itself (Healy, 2006). Thus, the voice of stakeholders is privileged in this method. Because, knowledge from experience and common-sense is represented in PAR (Hickes, 1997).

Atavon (2007) used PAR methods to induce change in street children's lives through their empowerment in a continuous learning process. He conducted a 3-year long project in collaboration with government officials, researchers, social workers, and 400 street children in 6 Turkish metropolitan cities; and claims that this PAR helped to create social change through joint actions. This method has been widely applied in social science. Liu *et al* (2006) used PAR method for community health programs in China. Elrahman (2006) showed PAR could be used in implementation of transport research development and technology transfer (RD&T).

Participatory Rural Appraisal (PRA)

Participatory Rural Appraisal (PRA) method enables "local people to share, enhance and analyse their knowledge of life and conditions, to plan and to act" (Chambers, 1994: p.1437). Chambers (1994) mentioned PRA has evolved from a synthesis of Rapid Rural Appraisal (RRA) and shares some of its principles with RRA. Since early 1994, PRA is being widely practiced in Bangladesh along with many other developing countries, mostly in non-governmental organisations (NGOs) and development works. Some of the methods of PRA are participatory mapping and modelling, transect walks, matrix scoring, well-being grouping and ranking, institutional diagramming, seasonal calendars, trend and change analysis, and analytical diagram, all are suitable for rural areas (Chambers, 1994). As PRA is undertaken by local people, few researchers (Mitlin and Thompson, 1994; Ahmed *at el*, 2006) tried to apply same procedure in urban areas, particularly for the poor, and termed as Participatory Urban Appraisal (PUA). There are many aspects common in PRA and PUA. However, yet there is no example of PUA applied in transport field.

3.4 FGD: A Tool for Participatory Research

The focus group discussion (FGD) is a rapid assessment of data gathering method in which a small group of purposively selected participants discuss (led by moderator) a specific topic of interest (Kumar, 1987; ODI, 2009; Frank, 2013). The FGD usually lasts for one or two hours and most moderators rely on an outline (discussion prompts) to ensure that all topics of interest are covered.

FGDs are frequently used in participatory research which uses the interaction among the group of individuals to discuss and give opinions on a particular topic or issue where the researcher or moderator facilitates the discussion. Participants are selected in random way (to assure representation of all segments of society) or non-random way (to obtain a particular position or point of view) or a combination of both techniques. Most focus group studies use a theoretical sampling model whereby participants are selected to reflect a range of the total study population or to test particular hypotheses (Kitzinger, 1995). As the participants are usually selected because of their shared social or cultural experiences, or shared concern related to the study focus; the information gathered from focus group method usually reflect the collective views of the group members (MacDougall and Fudge, 2001). Thus, a FGD provides qualitative responses and tailored to assess public reactions. Even the FGD can marshal expert opinion on a plan (FHA, 1996).

FGD has been used in various transport researches and projects. For example, to determine public opinions on high-occupancy vehicle (HOV) lane additions and rail transit alternatives in New York and Illinois; to find out why commuters were not taking advantage of free transit passes in Los Angeles; to identify user requests and needs for park-and-ride lots in Massachusetts Turnpike (FHA, 1996).

Travellers have different priorities depending on their age, purpose of travel and mode chosen (Harmer *et al*, 2014; Mfinanga, 2014). There are also differences in needs between users and potential users of interchange, and men and women (PIRATE, 1999). Therefore, following paragraphs discuss the various aspects of FGDs that need to be considered for effective results.

Category of the Groups

Identifying the key stakeholder is very crucial so that those who are recruited can best inform the study. Batheram *et al* (2005) gave the list, that Department for Transport (DfT) encourages to include, that must be consulted for local transport planning. Bickerstaff *et al* (2002) gave the broad categories of participants or stakeholders in transport planning, outlined by the Institute of Highways and Transportation (IHT), which should be included. However, these stakeholder groups are appropriate for UK where transport environment as well as context of the project is different.

Group Dynamics

Most researchers recommend for homogeneity within each group or people with similar characteristics to a single session (Krueger and Casey, 2000; Kitzinger, 1995). Because, group with highly diverse people does not work very well as the individuals may censor their ideas and thus decrease the quality of data (Grudens-Schuck *et al*, 2004). For instance, many Asian cultures endorse values, such as respect for authority or senior people and saving face (Tannen, 1998). It is important that all the members of focus group are able to represent fully their interests. Therefore, the discussion must be carried out in terms of good reasoning and arguments (Bickerstaff and Walker, 2005).

On the other hand, however, a diverse group may give advantage to maximize exploration of different perspectives within a group. In such case, it is important to be aware of how the hierarchy within the group may affect the data (Kitzinger, 1995).

Group Size

Focus groups need to be kept relatively small so that everyone has the opportunity to contribute and there is scope for discussions between participants. However, there is no particular number to be ideal size of the group. Different researcher argue for different size; for example, no more than 10 people (Communities Scotland, 2010), between four and eight people (Kitzinger, 1995), about 10 to 12 participants (Krueger and Casey, 2000), less than 20 members (FHA, 1996), 7 to 12 people (King, 2010). Nevertheless, the size of group depends on convenience of the researcher; for instance, Liu *et al* (2006) used 20 participants, Uddin *et al* (2000) used 8 to 10 members, List (2006) recruited 12 participants.

Gender of the Group Members

Transportation literature suggests that there is a significant difference in use and pattern of transport facilities and services among men and women both in developed and developing societies (see Turner and Grieco, 2006; Turner and Fouracre, 1995; Venter *et al*, 2007; Hamilton *et al*, 2005; Hamilton, 2001; Hamilton and Jenkins, 2000; Tran and Schlyter, 2010). This is because men and women often have different socio-economic roles as well as travel requirements. Even, there is likely to be greater differences in travel patterns between men and women of the same household in developing countries (Peters, 2001). This indicates the importance of gender inclusion in transport infrastructure and services provision. Turner and Grieco (2006) and Pulido (2014) outlined the benefits of gender inclusion and argued for a systematic gender inclusion procedure in the design and planning of transport systems. Turner and Grieco (2006) further mentioned that "one of the best ways of getting gender information on transport and of keeping that information update is to make use of user group planning technique" (p.56).

Great improvements of transport services for women could be achieved by ensuring that women are appropriately represented in user groups to give their feedback or place their issues (Turner and Grieco, 2006). Therefore, the group should be gender balanced. Because, equity and fairness should be assured in the provision of transport services so that gendered variation in transport needs are taken into consideration (Ubogu *et al*, 2010). The study of Brouwer *et al* (1999) used a number of selection criteria for the compilation of group format and each group had an equal number of women and men. However, they found it is difficult of getting an equal share of men and women in the group for each meeting. Consequently, there were some distortions of group meetings, as also reported by Krueger (1994), with married couples. Nevertheless, the user group planning techniques typically fail to ensure adequate gender representation, as Turner and Grieco (2006: p.62) reported, "the evidence is that when women speak within mixed groups, conversational dynamics work against them being listened to". That's why they argued for 'women only user groups' to have better representation of gender aspects. However, in mixed-users groups, it is important to have back-up procedures to extract women's opinions to ensure that their voices are heard.

Multiple Sessions and Duration of the Session

The professional researchers typically report the results of FGDs from a series of sessions rather than a single one. Because, composition of multiple groups on the same topic may help to get the perspectives of a different group of people (i.e. different age groups, employment patterns) who might have different views. As many as five focus groups may be needed to obtain a well-rounded picture of public opinion, reported by King (2010). Of course, the number of session needed may depend on the group dynamics, research objectives, and quality of data requirement. Project California used six focus groups of engineers and officials to evaluate guidelines for encouraging technological development (FHA, 1996). Brouwer *et al* (1999) organised seven group meetings to study public attitudes towards contingent valuation in UK whilst Uddin *et al* (2000) conducted 10 sessions to document the processes involved in the implementation of action plans for capacity building of health managers in Bangladesh.

Sessions of the group discussion may last one to two hours or extend into a whole afternoon or a series of small meetings (Kitzinger, 1995). Again, the duration of session depends on the researcher or extend of the research. For example, meetings in the study of Brouwer *et al* (1999) lasted between 2 and 3 hours, study of List (2006) was for the whole day, whilst the study of Liu *et al* (2006) was for a two-day session (each lasted about 8 hours).

Facilitation, Venue and Administration

FGDs are most informative when the group interaction is efficiently facilitated (MacDougall and Fudge, 2001); and this indicates the critical role of facilitator. However, Marsden and King (2009) mentioned “as with many group discussion activity, difficult people can dominate despite good facilitation, and the groupings had to be reorganised around personalities sometimes” (p.121).

Morris *et al* (1998) used visual displays to reinforce attendees’ attention to topics under discussion included a flip chart, and a large map highlighted the geographic boundaries. They also recorded all the group sessions on an audiotape and later transcribed. The study of Liu *et al* (2006) conducted focus group session in the dialects of participants.

The venue of FGDs unfamiliar to the participants would be better because it will help them not to falling back on familiar social patterns and more receptive to the questions (King, 2010). However, the familiar social pattern may give the real-life behaviour of the participants. The venue should be easy accessible for the participants. Sessions should be relaxed by providing a comfortable setting, refreshments, and sitting arrangements (round in a circle) to establish the right atmosphere (Kitzinger, 1995).

Role of the Moderator

The role of the researcher is to moderate, listen, observe and analyse the process of the interaction (Krueger, 1998). Hence, the key to success mostly depend on the ability of moderator to draw out responses that directly address the research questions of the study (King, 2010). The moderator should explain at the beginning that the aim of focus groups is to encourage people to talk to each other rather than addressing to the researcher (Morgan and O'Brien, 1993; Kitzinger, 1995). Moderators can use a variety of techniques for doing this. Brouwer *et al* (1999) used a standard discussion protocol to facilitate the group meeting. An outline of discussion is helpful for moderator to cover the major topics. Whatever, the central to the quality of this method is whether the participants’ perspectives have been represented authentically and the interpretations made from information gathered, and the findings are coherent in the sense that they fit the data and social context from which they were derived (Fossey *et al*, 2002).

3.5 Visualisation Techniques

Visualisation is the simulated representation of a proposed project and its associated impacts in such a way that is sufficient to convey the full extent of the development to the layperson (Hixon, 2006 cited in Cheu *et al*, 2011). It is a method that combines a variety of different tools or techniques and applications to generate and portray the existing and proposed project conditions in a realistic manner. Visualisation can be presented with two-dimensional (2-D) or 3-D techniques.

3.5.1 Two-Dimensional (2-D) Visualisation Techniques

Maps, photographs, artist's renderings, charts, architecture and engineering drawings are the examples of 2-D visual techniques where only the horizontal and vertical references of the project are portrayed. The 2-D plans are often prepared by the landscape architects or urban planners. In transport planning also 2-D maps are used to show the location, alignment of road, directions of traffic flow, etc.

3.5.2 Three-Dimensional (3-D) Visualisation Techniques

The 3-D visual techniques provide viewers an additional dimension – depth/height. This extra dimension in 3-D makes it easier for the viewers to understand the representation and spatial context of the proposed project more realistically. As argued by Knoll and Hechinger (2007: p.121), "the ability of a model to document a spatial concept and the essence of a design scheme in three-dimensional form represents a considerable advantage over drawings".

Use of 3-D visualisation techniques is increasing in the public involvement process as more planners and engineers become familiar with geographic information systems (GIS), AutoCAD, Google SketchUp, and similar tools (Cheu *et al*, 2011). Several successful applications of 3-D visualisation tools in the public involvement process are notable (i.e. Cheu *et al*, 2011; Gibson *et al*, 2002; Howard and Gaborit, 2007; Lai *et al*, 2011). The 3-D model for visualisation could be either a virtual model (prepared with computer aided software for viewing on a computer screen) or a physical model (prepared with paper or materials) discussed below:

Virtual (Computerised) 3-D Model

3-D virtual environment of visualisation has been used in many research projects (see Howard and Gaborit, 2007; Lai *et al*, 2011; Cheu *et al*, 2011; Wei and Jarboe, 2010). Most of the studies describe the development of the virtual visualisation models and report the successful use of the models at public events whilst a few describe changes in public opinion on projects and the positive attitude towards visualisation. In all the studies the 3-D virtual environment was applied for individual interviews but not for collective group responses.

No reference or literature was yet found which demonstrates the application of 3-D virtual models in a group environment like FGDs to gather a collective response. The main drawbacks of a 3-D virtual model are that it requires a huge cost and specialised skills to prepare and develop. Computer-based techniques require additional training or knowledge on computer and software as well as purchasing of the software and hiring the skilled professionals. Hiring of computer professionals also costs much. Therefore, in many developing countries, this may not be affordable by the researchers or city authorities. Moreover, using computer-based tools in developing cities is risky. This is because computers and internet are not readily available or accessible to everybody (general public) in many developing countries and those people who before have never seen or used a computer may find it difficult to use one for expressing their opinions. However, in future if the computer technologies are widely available in developing countries and become cheaper to use, computerised-visualisation techniques could be applied.

Physical 3-D Model

3-D physical models of visualisation are very common in the profession or field of architecture or urban landscape design. Gibson *et al* (2002) explained the potential applications and limits of rapid prototyping (RP) technology, which deals with constructing architectural physical models. However, there is no publication which describes the use of a 3-D physical model in the field of transport planning for public consultation. Nevertheless, "[3-D] models speak a different language than do [2-D] drawings, and consequently they articulate and describe architectural design concepts in a different way" (Knoll and Hechinger, 2007: p.121).

The scale and colours of a 3-D physical model is very important. A few researchers (Gibson *et al*, 2002; Knoll and Hechinger, 2007) mentioned proper consideration must be given about colouring and scale of a model. For instance, as Knoll and Hechinger (2007: p.107) mentioned, "Just as the materials and colours of a real architectural space influence human perception, the colouring of architectural models substantially determines the way they are perceived and understood". The scale of a map or a model could be of various sizes; its choice depends on how much detail is needed. A small scale model could be of 1:500, whilst the figures in profile could be 1:100 to 1:10 and the figures of paper and pins could be 1:200 to 1:100 scales (Knoll and Hechinger, 2007).

Compared to the computerised virtual model, a 3-D physical model is very cost effective and efficient to use in transport planning in developing countries (Rahman *et al*, 2012). The 3-D physical models could be prepared by locally produced materials and local manpower (i.e. architecture student or professionals) without requiring any sophisticated knowledge on computer or software skills.

3.6 Methods for Deriving Policymakers' Opinions

Review of literature showed that different methods are available to explore the policymakers' opinions. Following paragraphs of this section describe various methods for deriving the opinions of policymakers.

Interview of the Key Informants

Interviewing is conversation between people, particularly interviewer and interviewee, and usually aims to extract participants' views about their experiences, feelings and social worlds. However, the expert interview places less interest to the interviewees as a person than their capacities as experts for a certain field of activity (Flick, 2006). Thus, the experts or key informants represent not as a single case but as a group into the study. Key informants interview can be used for an expert validation of findings (Flick, 2006). However, often they complement to other methods or provide additional information of research. Interview of the key informants is very common in social research. This method is also used in transport research (see Morris *et al*, 1998; Zemp *et al*, 2007; Sohail and Maunder, 2007; Hull, 2008).

Interviews are expected to be unstructured for providing minimal guidance and allowing considerable freedom to the interviewee (Bryman, 2005). Patton (1990) advocates for using open-ended and discovery-oriented methods for the projects implemented incrementally through a process of adapting to local conditions and needs. However, expert interviews are normally based on an interview schedule because of time pressure (Flick, 2006). Nevertheless, the interview schedule or guide should ensure that interview does not get lost.

It is not too easy to identify the 'right' experts and also difficult to convince them to give an interview. However, experts are those persons who are particularly competent as authorities on a certain matter of facts. Flick (2006) argued for the selection of interviewees based on purposive sampling. Some possible drawbacks of this method are: the expert talks about internal matters (conflicts in the field) and his work instead of the topic of interview, or expert often change between the roles of expert and private person so that more information results about him as a person than about his expert knowledge.

Interview of key informants, particularly in qualitative approach, requires a small sample size. For example, Zemp *et al* (2007) conducted 13 face-to-face interviews whilst Hull (2008) did only six face-to-face loosely-structured interviews with the key informants. “A sample of eight is often sufficient, according to McCracken (1998), although survey methods should then be used to check out the findings” (Arksey and Knight, 1999: p.58).

Expert Survey

In expert survey, a predetermined questionnaire is sent by post or email to the key respondent and asked to return after filling up. This method is less expensive, easier, and convenient than the interviews. However, other additional information is not possible in this method.

Matsumoto (2007) conducted expert survey with the key informants (the individuals who were involved in the adoption process) of BRT in Jakarta, Seoul, and Beijing to analysis the policy process of BRT implementation in those cities.

Consensus Conference

Members of the community or professionals meet in conferences to share and exchange information. However, it is not a suitable method for exploring policymakers’ opinions on a particular issue of transport or plan of the particular city as this method considers participants only from specified target groups or class.

3.7 Methods for Transferability

Existing body of evidence suggests that different methods are available for transferability of findings from one specific location to other areas. Different methods for transferability of findings are discussed below.

Literature Review

Marsden and Stead (2010) used literature review to explore the concepts and evidence of policy transfer in the transport field. Their study was to outline a conceptual framework for policy transfer and learning. Even though the study dealt with policy only but not the design aspects, they found that infrastructure design and planning techniques also have been transferred in the transport policy arena. They cited the review of Matsumoto’s study on ‘BRT transfer in Asian Cities’, which suggests that along with the concepts certain design aspects also transferred from Latin America to Asia.

Macario and Marques (2008) gave a brief on transferability of sustainable urban mobility measures. Their study described an approach to identify common elements of city performance that have transferability potentials, proposed a transferability framework, and showed relationships between measures, drivers and barriers for transferability. According to them, evidence suggests that transferability of measures cannot actually be predicted from an objective analysis of certain key characteristics of origin and target cities.

Demonstration Projects

Demonstration projects of good practices could be one form for transferring the project outcomes. Matsumoto (2007) and Wright and Hook (2007) mentioned policymakers and city authority of many cities from Asia visited in Latin America, particularly in Bogota, to gain experience of TransMilinio BRT systems how they have designed a high-quality BRT and providing better transport services. Transport authorities from 37 different countries visited TransMilinio during its first five years of operation (Gilbert, 2008). In that case, TransMilinio was like a demonstration project of a successful BRT system.

3.8 Methods for this Research

Based on the review of literature presented in previous sections (Section 3.1 to 3.7), this section provides the methods suitable for this research and chosen to fulfil the research objectives.

3.8.1 Method for Preparing Transport Plan

Of the methods reviewed in Section 3.2, the approaches of making review of literature was chosen for preparing the transport plan. Literature review was chosen for preparing the initial plan of BRT station (designing station for integrating BRT with rickshaws) because it is a simple and easy method to conduct. Moreover, compared to other methods (e.g. resident's consultation, modelling and simulation, and design charrettes) it requires less time and resources to conduct.

3.8.2 Method for Deriving Public Opinions

Of the methods discussed in Section 3.3, deliberative methods using FGDs were chosen for deriving public opinions regarding the design of BRT station and rickshaw's integration with BRT systems. Deliberative methods were chosen because they are better than other methods (i..e citizens forum or panels, citizens' jury, photovice, PAR, PRA) for showing a design or plan to lay-persons; allow time to the participants for discussing about the design. Moreover, the FGD is an useful technique which provides collective and qualitative responses. Needs and expectations of people of weaker groups (e.g. pullers and poor-income bracket) need to be considered in policy making and palnning of transport, particularly for rickshaws, and FGDs would facilitate to raise their voice and concerns. Any example was not found in literature where FGD has been used to discuss technical aspects such as engineering design of BRT station area with spatial contexts.

Therefore, during the FGDs a 3-D physical model of the initial plan of BRT station and its surrounding area (prepared for the case study location) was always kept in front of the participants - in the middle of the group - so that everybody could visualise and understand the proposed development with spatial contexts and effectively take part in discussion.

3.8.3 Method for Deriving Policymakers' Opinions

Of the methods reviewed in Section 3.6, interviewing of the key informants was chosen for deriving policymakers' opinions about the initial design of BRT station prepared for case study locations as well as opinions on possibility of integrated fare structure for trips involving both BRT and rickshaws. Semi-structured face-to-face interviews of the key informants provide expert opinions on the subject matter. As the policy on rickshaw bans are often taken from the top (i.e. bureaucrates), key informants such as policymakers would able to provide insides behind adopting such policy and actions. However, it is very difficult to ensure that several high-official bureacrates would present in a specified place on a pre-determined date and time to take part in a group discussion for this research. Therefore, conducting interviews with each individuals in their preferred place and time would be feasible option. Anecdotal evidence suggests that the high-officials of government organisations in Dhaka are usually not willing to take part in interviews and do not provide information formally or allow recording of discussion. Thus, recruiting the bureaucrats and interviewing could be challenging and should be done with care.

3.8.4 Method for Transferability of the Findings

Of the methods discussed in Section 3.7, the review of literature was chosen as a method for analysing transferability of the findings (derived from case study locations) to other rickshaw cities. Compared with demonstration projects, literature review is cheaper and simple (quick) for transferring the findings.

3.9 Hypotheses of the Research

Section 2.5 presented five hypotheses (Hypothesis 1, Hypothesis 2, Hypothesis 3, Hypothesis 4, and Hypothesis 5) of this research that are relevant to BRT station design and rickshaw's integration with BRT systems. This section presents the hypotheses relavent to the methods and techniques. Based on the review of literature made in Sections 3.1 to 3.7; the hypotheses that are relavent to the methods and techniques (Hypothesis 6 and Hypothesis 7) were drawn for this research are following:

- Hypothesis 6: Using 3-D physical models help understanding for general public, particularly for the illiterate people, about the proposed development and facilitate their improved participation during the public consultation process.
- Hypothesis 7: Literate people know better than the illiterate people about the existing traffic signs and symbols.

3.10 Summary of the Chapter

This chapter at first provided a review of literature on various research methods and techniques. The review first provided a high-level approaches of different research methods and then discussed on the following topics or aspects: the methods for preparing transport plan, participatory methods for deriving public opinions, the FGDs and its different aspects, visualisation techniques, the methods for deriving policymakers' opinions, and the methods for transferability of the findings.

After the review of methods for each aspects (that are revelant and considered for this research) was done, the methods choosen for this research are discussed. To prepare a transport plan (designing BRT station for integrating with rickshaws) the approaches of making literature review were considered. Deliberative methods using FGDs were considered for deriving public opinions. A 3-D physical model was considered to use in the FGDs for visualisation and better understanding of the proposed development or design (e.g. BRT station) by public. To derive policymakers' opinions, interviewing of the key informants was considered. A review of literature was considered as a method for transferring the findings from the case study to other rickshaw cities.

Finally, the hypotheses relevant to the methods and techniques for this research (Hypothesis 6 and Hypothesis 7) were drawn mainly based on the review of literature presented earlier.

The next chapter will briefly discuss about Dhaka city, the case study city for this research, its general socio-economic condition and traffic and transport situation.

Chapter 4
Description of the Case Study City - Dhaka

This chapter gives a general description about Dhaka, the case study city, and its overall traffic and transport situation. Firstly explains the physical and socio-economic situation of the city and then discusses on traffic and transport situation: existing public transport systems and modes, travel pattern of people, current public transport services and major transport problems of the city, rickshaws and other informal para-transits of the city and their operation and services, and the future mass transit systems (both the proposed and on-going projects).

4.1 Physical and Socio-economic Condition

This section provides a brief on physical and socio-economic condition of Dhaka city to justify whethet bus rapid transit (BRT) systems would be feasible for the city and rickshaws could play as a feeder mode of BRT. The topics covered in this section are: land area and population in Dhaka city, income level of people, vehicle ownership rate, land use pattern, and road network of the city.

4.1.1 Background

Dhaka city is the administrative, commercial, financial, academic, and cultural hub of Bangladesh. Dhaka is one of the largest cities in the world; in respect of population of over 12 million in the main city and 16.7 million in the metropolitan area (United Nations, 2003). This city is ranked 11th largest mega city in the world. However, according to the rating of several international agencies the quality of living in Dhaka is very poor among the world cities, such as, according to the United Nations' City Development Index (CDI) Dhaka ranked 7th worst position (Ahmed *et al*, 2005).

Geographical centrality (Dewan and Yamaguchi, 2009) as well as good communication from all over the country influences the physical growth and primacy of Dhaka city. Over the years the city has grown towards the north along the corridor towards Mymensingh mainly due to topographic factors and physical growth (Alam and Rabbani, 2007; Chowdhury and Faruqui, 1989; Kabir and Parolin, 2012). Except a few residential areas (which have been planned and developed by the public sector), the city has grown and developed spontaneously in an unplanned manner (World Bank, 2006). The built-up areas are more compact on the higher grounds in the west than in the east, and in the south than in the north.

Figure 4.1: Location of Dhaka city in context of Bangladesh

Source: Banglapedia (2013), and modified by the author.

4.1.2 Land Area and Population of Dhaka City

Land area of Dhaka metropolitan area is 1,528 sq km whilst the main city is only 360 sq km (STP, 2005; GoB, 2000). Different organisations operating on Dhaka define the boundary with their own definition and utilise different city extents; thus there are four different definitions or names of Dhaka (Table 4.1). In the Strategic Transport Planning (STP) essentially the Rajdhani Unnayan Kartripakkha (RAJUK) (capital development authority) area is the Dhaka Metropolitan Area (DMA) whilst in other planning studies, such as the Dhaka Urban Transport Network Development Study (DHUTS) (JICA, 2010; JICA, 2011) and the Greater Dhaka Sustainable Urban Transport Corridor Project (GDSUTCP) (ALG, 2011), named the area of DCC as DMA and the RAJUK Area as Greater Dhaka.

Table 4.1: Defining Dhaka city by different organisations

Name	Administrative Body or Organisation	Description	Area (sq. km)	Population (million)	Density (per sq. km)
Dhaka City[1]	Dhaka City Corporation (DCC)	Jurisdiction of DCC area (DNCC and DSCC)	360	6.0	16,666
Statistical Metropolitan Area (SMA) [2]	Bangladesh Bureau of Statistics (BBS)	Dhaka City plus 27 Thanas/Upazilas in Dhaka, Narayanganj and Gazipur Districts	3,966	9.67	2,438
RAJUK Area or Dhaka Metropolitan Development & Planning Area (DMDP Area)[3]	RAJUK (Capital Development Authority)	Dhaka City plus GCC, NCC, and Savar Paurashava, and 80 Union Parishads (in Dhaka, Narayanganj and Gazipur Districts)	1,528	9.3	6,086
Greater Dhaka or STP Area or Metro Dhaka[4]	Dhaka Transport Coordination Board (DTCB)	Extension of DMDP Area covering the whole Dhaka district	7,440	19.2	2,580

Source: [1]DCC, 2011; [2]BBS, 2001; [3]DMDP, 1997; [4]STP (2005); Kabir and Parolin, 2012.

The population of DMDP area was about 10 million in 2004 which is projected to be 14.1 million by year 2014 and 19.8 million by year 2024 (STP, 2005; GoB, 2000). On the other hand, current population in DCC area is about 7.7 million (ALG, 2013). Estimated population of the Greater Dhaka in 2004 was 19.2 million, which is expected to become more than double by 2024 (STP, 2005).

Growth and Trends of Growth

Dhaka is growing very fast with a growth rate of 3.2% (World Bank, 2007). Over the last several decades Dhaka has expanded from a small city into a mega-city. The population has increased from a modest figure of just over one million in 1971 to more than 10 million in 2001 (STP, 2005). The DHUTS estimated that population of Dhaka grew at an annual rate of 2.44% between 2001 and 2008 (JICA, 2010). The demographic trends of the last decade are expected to continue in the coming decades (STP, 2005). Another study (ALG, 2011) suggests that population growth rate will be 3.3% between 2010 and 2020.

Density of Population

Dhaka city is having a very high density of population. The density per sq km of Greater Dhaka was around 5,000 persons in the year 1991 and 7,900 persons in 2001 whilst in DCC area it was much higher, approximately 16,300 and 19,500 persons (BBS, 2001). An estimated density was approximately 8,400 and 21,500 persons per sq km for Greater Dhaka and DCC respectively in the year 2004 (Niger, 2011). Nevertheless, population density in the central part of the city is much higher. For instance, 34,000 persons per sq km in DCC area (Ahmed *et al,* 2005) and more than 120,000 persons per sq km in southern part of the city namely Kotwali, Sutrapur and Motijheel (ALG, 2013).

Gender Equality

Male and female ratio in Dhaka City is 131:100 and in Greater Dhaka is 123:100 (BBS, 2011). This figure reflects that there are many male in Dhaka who are living alone whilst their family lives at home in other parts of the country (i.e. villages).

A strict *purdah* is not widely practiced in Dhaka. Even in the absence of the practice, cultural tradition and religious custom serve to keep women within certain bounds and the relationship between men and women is very formal (STP, 2005).

4.1.3 Income Level

The average per capita income in Dhaka is around US$ 550 (GoB, 2000). According to JICA (2010), about 20.4% of the household's monthly income is more than BDT[16] 50,000 (high income group) in Greater Dhaka. About 39.7% household's monthly income is between BDT 20,000 and BDT 50,000 whilst the remaining 39.8% household's income is less than BDT 20,000. A large portion of people living in Dhaka are poor. A study of Centre for Urban Studies (CUS) in 1990 estimated that about 30 percent of the population in Dhaka City were living below the extreme poverty level (hard core poor) whilst another CUS study in 2005 revealed that about 37% of the then population were living in slums and squatters (Islam, 2005). ALG (2011) also reported similar, 30% of the population in Dhaka are living in miserable conditions, with very poor access to transport services.

According to Dhaka Integrated Transportation Study- DITS (1994), average monthly transport expenditure of Dhaka's residents is around 12% of the total household income. However, the people whose monthly income is less than BDT 1,500 per month spend relatively more; around 16% of the household income.

4.1.4 Vehicle Ownership Rate

Dhaka is one of the least motorised cities in the world with approximately 30 motorised vehicles per 1,000 population (STP, 2005). This low rate of vehicle ownership is rationale given that the income level of the majority of households is low and there is a significant amount of poor people. However, the annual registration data of motorised vehicles for Dhaka over the past years (Figure 4.2)

[16] Bangladeshi currency; exchange rate in January 2012 was BDT79 for US$1, BDT122 for GB£1.

shows a continuous trend of rapid growth. Figure 4.3 shows the share of personal vehicles such as cars and motorcycles are of significant portion of overall motorised vehicle. A national daily newspaper (Prothom Alo, 2008) reported that everyday about 50 new cars are adding in the total number of vehicles of Dhaka city.

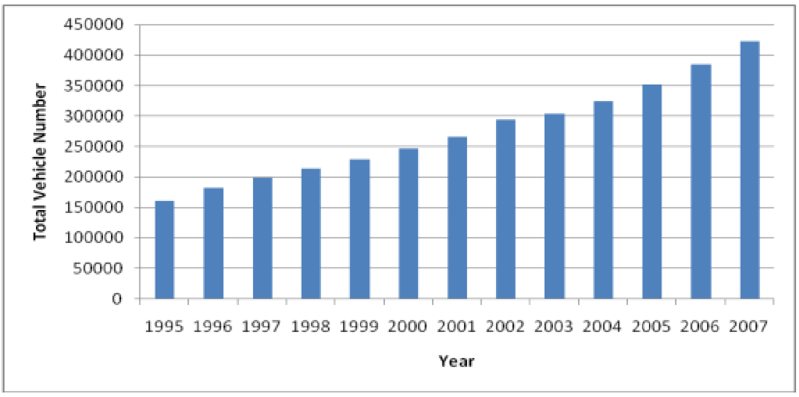

Table 4.2: Yearly registered number of motorised vehicles in Dhaka (1995-2007)
Source: BRTA, 2008.

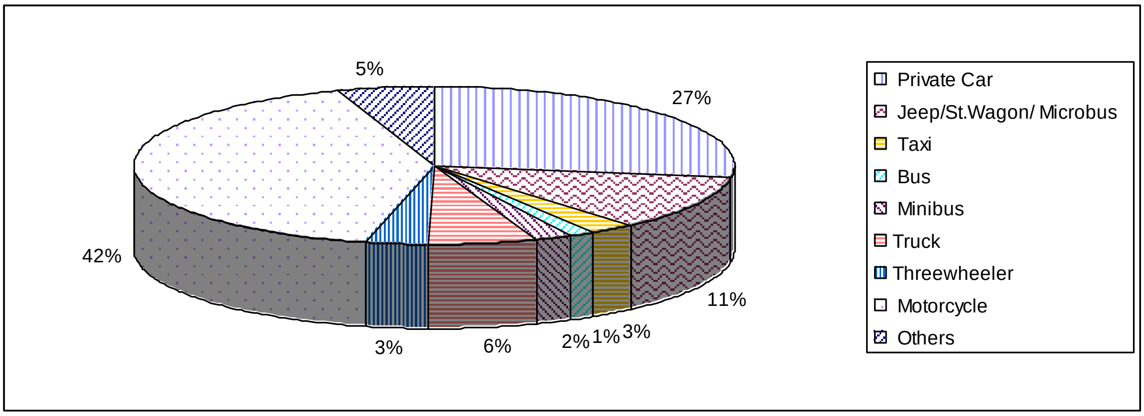

Table 4.3: The share of different vehicle types in 2007

Source: BRTA, 2008.

Given that the number of people in Greater Dhaka is expected to become more than double within the next 20 years and the economy is likely to expand significantly, the number of vehicles is also expected to increase. However, STP (2005a) accepted the hypothesis that the rate of vehicle ownership per capita is unlikely to change drastically.

4.1.5 Land Use Pattern

Land use of Dhaka city is mixed. The built-up areas of the city are very densely developed and the amount of open land within the built-up areas is very low (Nahrin, 2013). The major commercial activities are mostly located in the southern side of the city (Figure 4.4), namely Motijheel (the central business district area), Ramna, Tejgaon, Karwan Bazaar. Other commercial concentration is in Gulshan, Badda and Uttara located in the northern part of city and in Kotwali, Lalbag and Sutrapur in the older part of the city. Intense commercial activities are available at New Market, the DIT Road-Elephant Road intersection, Bashundhara City, along Mohakhali-Gulshan Road, along Gulshan Avenue, and along the Airport Road.

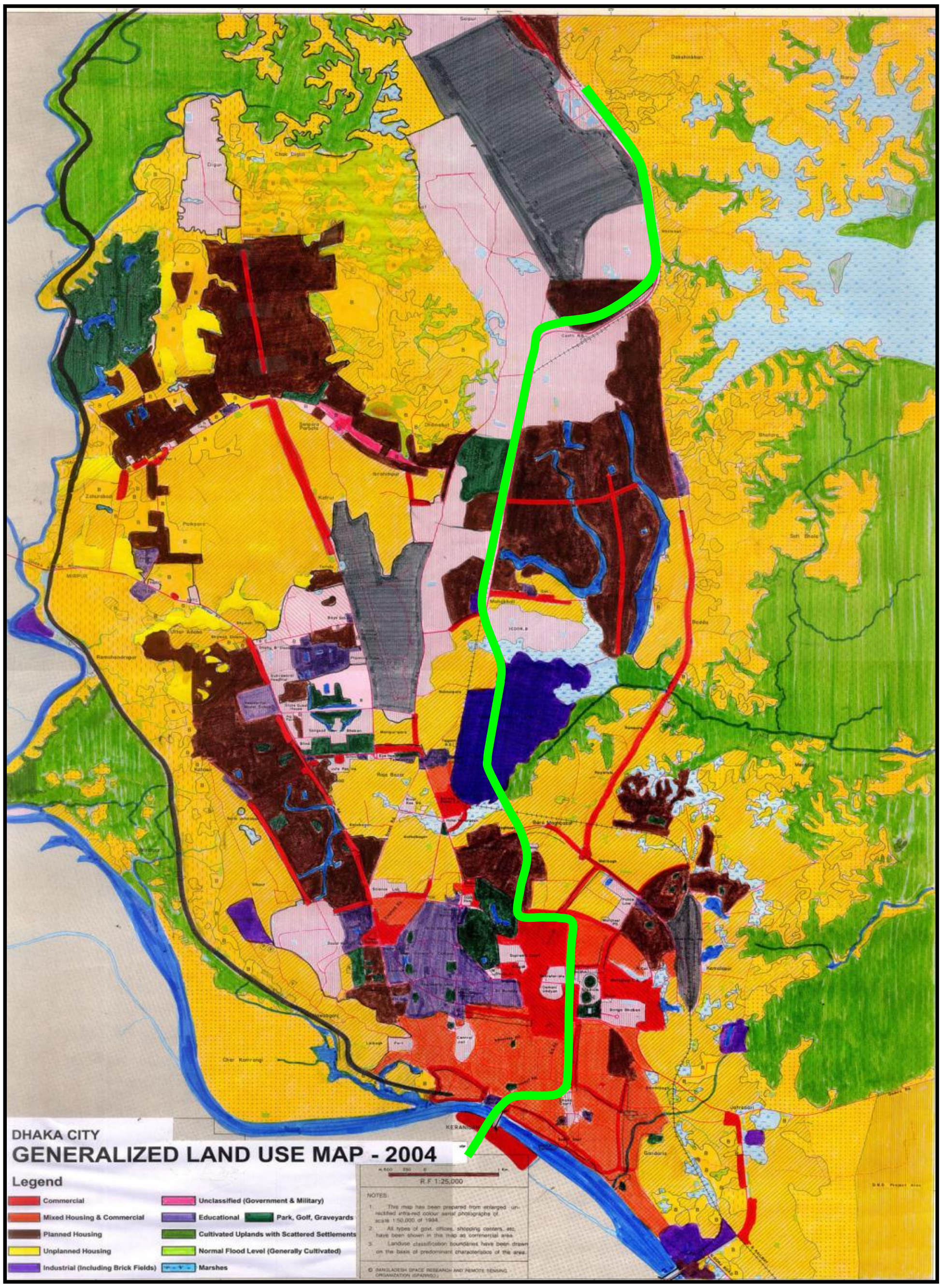

Figure 4.4: Land use pattern of Dhaka city

Source: STP, 2005.

Public facilities (i.e. education institutes, hospitals, government offices) are mainly concentrated in the central and southern part (Figure 4.4), namely Dhanmondi, Gulshan, Ramna, and Motijheel whilst the traditional mixed housing and commercial land use is most prominent in Old Dhaka. Some of the major planned residential areas are Gulshan, Banani, Uttara, Dhanmondi, Bashundhara, Nikunja, Mohammadi Housing, Mirpur Housing and Pallabi Housing; that are generally occupied by the middle and high-income brackets. Some of the spontaneous residential areas are located in Tejgaon, Badda and Kafrul (ALG, 2013).

4.1.6 Road Network

The road network of Dhaka city has been growing continuously with the expansion of the city; however, the network developed mostly in unplanned way, in an irregular and haphazard pattern (Ahsan, 1990). The road network of Dhaka, particularly most of the main roads and those have higher capacity, extended the north-south direction (Figure 4.5). This north-south roads materialised the expansion of city towards north; their width is sufficient for operating BRT. However, there are serious deficiencies of roads towards east-west direction. Hierarchy of road network in Dhaka is very poorly defined and maintained (Fjellstrom, 2004), and the roads transversal sections vary within links in the same category.

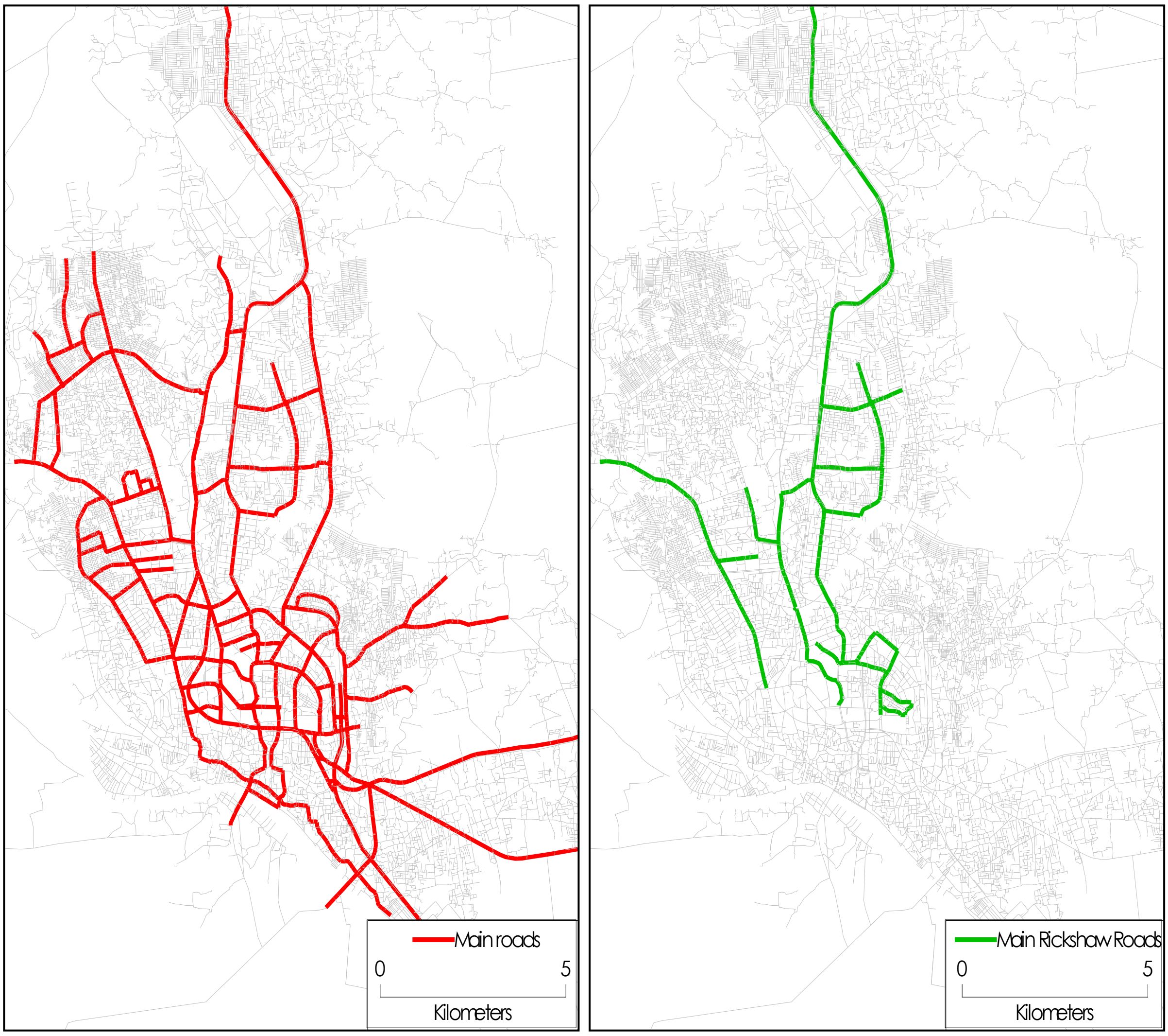

Figure 4.5: Road network of Dhaka; left- main roads, right- roads banned to rickshaws

Source: ALG, 2011a.

Total road network length in Dhaka is 2,374 km (refer to Table D2 in Appendix D) of which 82.9% are local streets, 11.5% are main streets, and only 5.64% are motorways (arterial roads). Arterial roads are more than 22 m wide in the DCC area that is nearly 388 km long. Some local streets in old parts of the city such as Old Dhaka and other early developments along the Buriganga River are too narrow for sustained circulation of cars or buses, but appropriate for rickshaws (ALG, 2013).

4.2 Traffic and Transportation in Dhaka City

This section provides a brief on existing traffic and transportation situation in Dhaka city; this section is organised in following sub-sections: transport modes and public transport, traffic volume, current public transport services, travel pattern, and rickshaw bans.

4.2.1 Transport Modes and Public Transport Systems

A numerous types of modes are available in Dhaka city which can be classified broadly into: motorised transport and non-motorised transport. The former includes bus, minibus, *human-hauler*[17], truck, car, utility vehicles, motorcycle, and auto-rickshaws whilst the latter includes rickshaws, rickshaw van, bicycle, and push carts.

Current public transport systems in Dhaka city is mainly road based; the role and contribution of railway or water transport is very minimal in terms of passenger transport. However, considering the physical growth and geographical shape of the city, the circular inland-water transport and 55 km long railway line towards north-south direction (between Narayanganj and Gazipur) may have some possibilities to utilise as public transport. Currently available travel means of passenger transport in Dhaka are:

- Buses and minibuses;
- Taxi;
- Auto-rickshaws; and
- Rickshaws.

The details on services and facilities of the current passenger transport in Dhaka will be discussed later in Section 4.2.3. There are no effective bicycle lanes in Dhaka city. Though bicycle is the cheapest mode after walking, bicycle is rarely observed in the streets of Dhaka (Rahman, 2009). There is a lack of safe walkways for pedestrians in Dhaka. Lack of discipline significantly diminishes the efficiency

[17] Microbus or locally called ‘tempo’.

and effectiveness of the existing transport system in Dhaka. Most of signals are manually controlled and police have to control traffic, without properly coordinated automated systems. STP (2005) reported that inadequate traffic management, inefficient road use, and poor operating conditions waste up to 50% capacity of the roads in Dhaka City. Traffic congestion is one of the major transport problems in Dhaka, which is becoming a serious impediment to mobility and the normal function of the city. Buses and minibuses in Dhaka are constrained by following poor service conditions: long waiting time, delay on plying, long boarding time, overloading or crowded condition, and long walking distance from the residence/work place to bus stoppages (Olsson and Thynell, 2004). Dhaka is one of the most polluted cities in the world; and the transport sector is one of the major causes of air pollution.

4.2.2 Traffic Volume

Volume of motorised traffic is very high in the major roads of Dhaka whilst volume of rickshaws is very high in local or narrow streets. Pedestrian volumes is very high in Dhaka city. For instance, a volume of 10,000 to 20,000 per day is common and reach as high as 30,000 to 50,000 per day in the Old City area (STP, 2005). Even, pedestrian counts of STP (2005) reveals that hourly volume of 1,000 to 3,000 pedestrians is very common in the Old Dhaka during the peak hours and it reaches as high as 5,000 pedestrians per hour.

4.2.3 Current Public Transport Services

Bus and Minibus Services

There are three types of buses at present operating in Dhaka city are: large buses; minibuses; and *human-haulers*. Table 4.2 summarises each bus type in terms of size and capacity and Table 4.3 summarises the number of bus routes and fleet size operating in Dhaka. *Human-haulers* usually provide feeder services in a fixed route of approximately 3 to 8 km stretch whilst some also operate on the corridors (ALG, 2011). According to the motor vehicle ordinance, *human-hauler* also needs to be registered with Bangladesh Road Transport Authority (BRTA) and should have route permit. It is apprehended that the *human-haulers* may be unauthorised as BRTA have not issued any route permits.

Table 4.2: Size and capacity of the buses operating in Dhaka city

Bus Type	Size or Length (m)	Seats
Large Bus	10-12	36-58
Minibus	7-8	15-30
Human-haulers	Various size	9-15

Source: ALG, 2011; JICA, 2010; Rahman, 2011.

Table 4.3: Number of bus routes and fleet size in Dhaka city

Bus Type	BRTA (Official Source)				Bhuiyan (2007)			
	Routes	Fleet			Routes	Fleet		
		Bus	Minibus	H. hauler		Large	Minibus	H. hauler
Large Bus & Minibus	123	1,647	3,160	-	103	1,617	2,973	-
Human haulers	47	-	-	1591	38	-	-	937
Total	170	1,647	3,160	1591	141	1,617	2,973	937

Source: BRTA, 2007; Bhuiyan, 2007.

Current bus routes system in Dhaka city consists of 152 routes operating mainly through the arterial roads and the bus service network covers approximately 250 km (ALG, 2013). Most of the bus routes in Dhaka are in north-south direction (Figure 4.6); as the majority of roads follow a north-south pattern. Although the bus route structure seems to cover most of the arterial roads on north-south corridor, the central (Old) Dhaka are generally less covered.

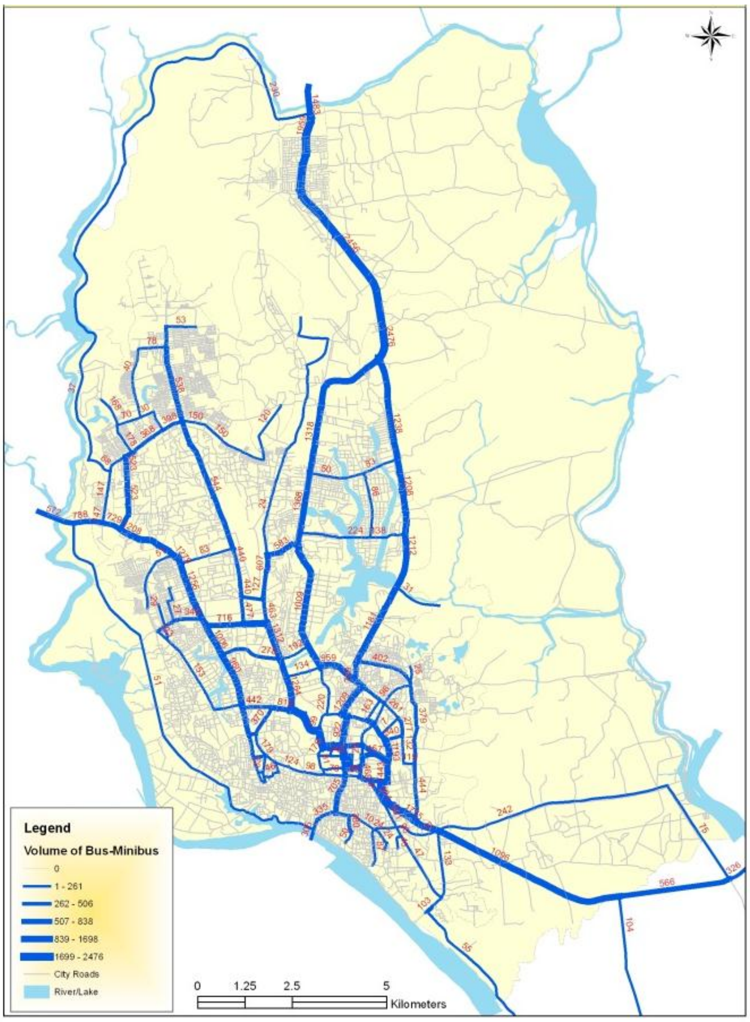

Figure 4.6: Existing bus routes of Dhaka city and the volume of buses in routes

Source: JICA, 2010.

Bus services available in Dhaka city could be categorised in two groups: *counter* bus service and *local* bus service (Rahman, 2011). The *counter* bus service has specified stops and tickets are sold at the counters of those stops; so, passengers have to purchase their tickets from the bus counters just before boarding. A very small number of *counter* buses are air-conditioned. In contrast, the *local* bus service has no specified stops (they stop anywhere on the way for boarding and alighting passengers) and passengers pay the fare to the bus conductor inside the bus after boarding on it. The buses of both types of services often remain overcrowded; mainly because of a gap between demand and supply. There are also few buses operating in a few routes termed as *seating* service which allow boarding passengers only if there is any empty seat available. These buses also board and alight passengers at specified stops (sometimes allowing alighting at any place where the passengers want to) and the passengers pay for their trip to the conductor inside the bus.

Most of the bus operators are privately owned small companies or individuals. With a few exceptions, the bus owners and operators in Dhaka do not pay adequate attention to passengers' comfort (Andaleeb *et al*, 2007). Internal facilities for passenger comfort inside the bus such as seat condition, leg room, windows and fans for air circulation, ceiling height for passengers' movement inside the bus, as well as behaviour of the staff and the facilities at bus station are very poor (Rahman, 2011). Furthermore, many people are making long queue standing on the roadside and waiting a long time for a bus indicates the service provision is not enough to meet the passenger demand (JICA, 2010; Rahman, 2011). This overcrowding makes it very difficult and uncomfortable for women, children, and senior people to travel by bus. Consequently, often these groups of vulnerable people do not have access to bus services during the rush hours (Karim and Mannan, 2008). Particularly for the women, existing bus services in Dhaka are insecure and unsafe (Rahman 2010; Rahman, 2011); because it is difficult for them to compete with men for getting in the bus and grabbing seats, and often they are physically harassed in overcrowded buses.

The average commercial speed of bus routes in Dhaka is 8.65 km per hour (kmph): 15.54 kmph in motorways, 11.97 kmph in main streets, and 7.73 kmph in local streets (ALG, 2013). The highest commercial speed of bus is 20 kmph only in some sections of motorways and main streets. However, the DHUTS (JICA, 2010) gave the average speed of bus approximately 17.7 kmph in the afternoon off-peak time and 14.4 kmph in the morning/evening peak time.

The fare of buses is the cheapest among the public transport means available in Dhaka. Fare rate per km is BDT 1.2 in large buses and BDT 1.1 in minibuses (JICA, 2010), whilst *human-haulers* normally charge BDT 2 per km (ALG, 2011). The fares are reviewed periodically by the government through negotiation with the operators.

Taxi Cabs

The taxi service in Dhaka city has been provided since 1998. The number of registered taxi vehicles of the city is relatively small; approximately 10,000 as of the end of 2008 (JICA, 2010). According to a record in 2004, the taxi driver pays BDT 950 for air-conditioned car and BDT 650 for non-air-conditioned car to taxi company or owner as the car rental fee per day.

The fare system for taxi is based on the distance and the type of vehicle. A committee in BRTA with the representatives from taxi owners recommends the fare structure for taxi which is then gazetted by the government. Taxi cabs have metre but the drivers usually do not operate as per metre fare; charge about 20-30 percent more than that of the metre. Taxi fare is relatively high compared to other public transport modes such as buses, auto-rickshaws, and rickshaws. JICA (2010) revealed that compared to auto-rickshaws the initial fare rate of a taxi is 2 to 3 times more and running fare rate is 1.3 to 2 times more.

Auto-rickshaws

Auto-rickshaw is a three-wheeler vehicle known as ‘baby-taxi’ or ‘CNG’ or ‘auto’. This is a widely used transport means throughout in Dhaka, particularly for people travelling further distances than normally covered by rickshaws and would prefer convenient door to door service at a lower cost than regular taxi. According to BRTA statistics, the number of registered auto-rickshaws in Dhaka is now about 40,000 and this number has been stable in the past several years (ALG, 2011).

Table 4.4: Fare rate of auto-rickshaws in Dhaka city

Fare rate (km/minutes basis)
• BDT 14.00 on boarding, up to 2 km • BDT 6.00 per km or part thereof, for onward travel • Waiting/stopping charge: BDT 1.00 per minute • Minimum fare: BDT 18.00

Source: JICA, 2010.

Autos are rent out by the owners to the drivers usually for half of a day in a rate BDT 600 to 800; though the government approved rate of hire is only BDT 450. Though autos do not have fixed routes they do require a permit (registration) from the BRTA to operate. There is a restriction on issuance of registration certificate in metropolitan Dhaka and Chittagong beyond the numbers mentioned in the ceiling. At present the approved ceiling of autos within metropolitan Dhaka is 13,000.

A committee of BRTA which also includes the representatives from the owners of auto-rickshaws recommends the fare structure which is then gazetted by the government. The fare system for auto-rickshaws is based on the distance and duration of trip (km/minutes) (see Table 4.4). The actual fares are established by metres installed in auto-rickshaw; however, drivers seldom use the metre and generally operate based on the negotiated fares (charge 20% to 30% more than that of metre charge). Fare of auto-rickshaws is very high compared with buses and slightly higer than rickshaws. However, auto-rickshaws usually do not serve for short distance trips such as 2-3 km though they are supposed to serve trips for any distance.

Easybikes

The easybike is similar to auto-rickshaw in terms of vehicle size and design (as seen in Appendix D 2.4); runs with electric chargeable battery. Easybikes operating between Mirpur 10 and Parish Road was observed and informal discussion with a driver was done. They are lighter than auto-rickshaw and passenger capacity is 5 to 8 persons excluding the driver. In a few fixed routes (i.e. Mirpur 10 to Parish Road, Mirpur 10 to Cantonment, Mirpur Purabi to Rupnagar) easybikes are operating as a public transport with a fixed fare; and the drivers themselves organised, determined the fare, and maintaining the tidy queuing while waiting for passengers at station.

Rickshaws

Rickshaws are widely being used as a public transport mode in Dhaka especially for the short distance trips. They are mostly operating in and around residential areas and market places; mainly providing door-to-door feeder service. However, sometimes a few rickshaws move in the corridor for a length up to 3 to 4 km. Municipal authority (e.g. City Corporation, Paurashava) generally issues license or permission for operating rickshaws in certain area or locality of their jurisdiction. At present there are almost 600,000 rickshaws are available in Dhaka for hire of which only about 90,000 are licensed.

Rickshaw owners generally rent out their rickshaw to the pullers for half of a day (6 am to 2 pm or 2 pm to 10 pm) or full day. Pullers pay approximately BDT 60-70 to the owner as a rent for hiring the rickshaw. Some owners have their own garage[18] but many owners park their rickshaws along the road at night.

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[18] The place where rickshaws are repaired, parked or stored at night, and also in few cases pullers sleep at night.

According to the Household Interview Survey of DHUTS (JICA, 2010), the number of daily rickshaw trips in Dhaka to be about 7.9 million. Traffic movement study on rickshaws revealed that the average speed of rickshaws in Dhaka is 6.8 km/h (JICA, 2010). Fare rate is generally determined by negotiation between passenger and puller depending on distance. Compared to bus fare, rickshaw fare is rather high; at present rickshaws charge approximately BDT 10 for a km or minimum trip length.

Rickshaws operating inside Dhaka Cantonment area

It was observed how rickshaws have been organised and following a tidy queue inside Dhaka Cantonment area and photographs were taken to understand or illustrate. Figure 4.7 shows rickshaws are following a queue in a major road due to presence of a traffic warden (a person or guard) for enforcement as well as physical infrastructure to make channelizing rickshaws in a particular lane. However, in this case rickshaws are following a queue only when dropping the passengers. They do not follow a queue while waiting for passengers.

 1	 2	 3
 4	 5	 6

In frame 1 passengers are dropped from rickshaws, rickshaws are taking U-turn (frame 2) and then waiting haphazardly (not in a tidy queue) for picking passengers (frame 3). Passengers are bargaining with pullers (frame 4) to settle a fare, after settling passengers are boarding (frame 5) and then rickshaws are leaving the waiting area through the channelized lane for rickshaws (frame 6).

Figure 4.7: Physical infrastructure and enforcement helping rickshaws following a tidy queue

		
1	2	3
		
4	5	6
		
7	8	9
		
10	11	12

Frame 1- queue of rickshaws for picking passengers; frame 2- yellow dress beard puller dropping passenger; frame 3- blue shirt puller dropping passenger, check shirt puller dropping passenger; frame 4- blue shirt puller dropping passenger, white shirt puller dropping kid; frame 5- blue shirt puller taking fare, white shirt puller dropped kid and taking U-turn; frame 6- black shirt puller dropping passenger, check shirt puller dropping passenger; frame 7- black shirt puller taking U-turn, check shirt puller taking U-turn; frame 8- yellow dress beard puller in the queue for picking passenger; frame 9- white shirt puller dropping passenger, blue shirt puller in the queue for picking; frame 10- white shirt puller taking fare, blue shirt puller in the queue; u-turned rickshaw joined at the end of the queue; frame 11- white shirt puller U-turned, blue shirt puller in the queue for picking passenger; frame 12- white shirt puller joined at the end of queue for picking passenger.

Figure 4.8: Time-lapse sequence of rickshaw movements for dropping and picking of passengers in Cantonment and maintaining a tidy queue

Figure 4.8 reveals how the rickshaw-pullers are maintaining a queue themselves and functioning well at a narrow alley street without having any guard or person for enforcement or physical infrastructure. In this case rickshaw-pullers are maintaining a queue while dropping and boarding passengers as well as waiting for picking passengers. Rickshaws are waiting for picking passengers and following first-in-first-out; other rickshaws arriving with passengers drop off the passenger and then take an U-turn to join at the back of the queue for picking passengers.

4.2.4 Travel Pattern in Dhaka City

A large portion of the trips in Dhaka is walking and rickshaw trips. According to the Household Survey data of STP, the modal share of buses is 44% and for rickshaws it is 34% as a primary travel mode of all person trips in Dhaka (STP, 2005). However, the DHUTS (JICA, 2010) shows that on an average day total 21,046,517 trips take place in metropolitan Dhaka (Table 4.5); of which rickshaws serve 38.8%, buses 30% (1.7% private bus and 28.3% public bus), walking 19.7%, car 4.9% and the rest other modes contribute a very insignificant share of trips.

Table 4.5: Modal share (daily trips) on an average working day in Dhaka

Transport Mode	Total Trips	Percentage (%)
Walking	4,138,515	19.7
Passenger car	1,036,606	4.9
Private bus	347,770	1.7
Public bus	5,966,659	28.3
Auto-rickshaw	1,359,719	6.5
Rickshaw	8,161,912	38.8
Truck	5,966	0.025
Railway	8,108	0.04
Waterway	21,316	0.1
Total	21,046,517	100

Source: JICA, 2010.

Table 4.5 shows soft modes (walking and rickshaw) account for 58% of the entire mobility in Dhaka. These modes are mostly used by people of low-income and meddle-income brackets whilst people of high-income bracket mainly use cars (although they use the rest of modes less frequently). ALG (2013) found modal share in Dhaka varies strongly depending on household income; the high-income group (more than BDT 50,000 per month) use private cars and its modal share accounts for 69% of the total quote of this mode, the middlie-income bracket dominates rickshaws and buses, and the low-income bracket use mainly non-motorised modes such as walking and rickshaws.

At present buses are the only available mode of mass public transport in Dhaka. The bus trips are generally longer than 0.5 km; average length is 5.8 km (ALG, 2013). Excluding walking and cycling, the buses is the cheapest public transport mode in Dhaka which also provides the highest passenger-km travel (STP, 2005). The formal public transport (e.g. bus services) in Dhaka is often inaccessible for many people. Therefore, the rickshaws has filled the unwanted demand and become a common mode among the middle and lower-middle income groups (Rahman, 2007). Due to absence of a dependable and adequate public transport system the major share of road space remains occupied by the small capacity vehicles (ALG, 2011). In a city of more than 12 million people, predominantly the middle and lower-middle class, a well-organised public transport system along with walking and cycling is yet to emerge for resolving the transport problems.

Pedestrian Mobility

Walking is a commonly used mode of transport in Dhaka. On an average week day about 4,138,515 trips on foot are taking place within metropolitan Dhaka of which 71.2% are within the locality (ALG, 2013). As walking trips are usually for short distance and they tend to be undertaken between nearby points it is inevitable that a large share would be within the neighbourhood. However, average length of walk trips to outside of neighbourhood is much longer, about 1.94 km (ALG, 2013).

For some people walking is a matter of choice and convenience, however, for many people of poor-income bracket it is the only travel mode they can afford. Despite a high dominance of pedestrians, suitable facilities have been neglected in Dhaka. There are only about 400 km of footpaths available within the DCC area (STP, 2005). Where footpaths have been provided, there are frequent obstructions that block or otherwise reduce their overall usefulness. Such obstructions include:

- Temporary vendors and hawkers who occupy portions of the footpaths;
- Parked cars;
- Solid waste skips;
- Building materials and debris stored or abandoned on the footpath; and
- Holes, surface irregularities and water accumulation.

According to certain estimates, nearly 40% of the footpaths in Dhaka are being occupied illegally (STP, 2005). In spite of a High Court ruling on 11 February 2001, ordering that the responsible agencies should make all footpaths free from illegal occupation for safer and convenient pedestrian movement, no significant change or improvement is evident. As a consequence, pedestrians are often forced to walk on carriageway instead of footpaths, even in areas where footpaths are available. Pedestrians' movement on carriageway increases the risk of traffic-related pedestrian injuries as well as have the adverse effect of reducing the capacity of road and thereby increase congestions. For instance, available information reveals that almost half of the road collisions in Dhaka are involved with pedestrians and two-thirds of all traffic related fatalities are pedestrians (STP, 2005).

Mobility by Rickshaws

Rickshaw is a common and widely available mode of travel in Dhaka; contribute 38.7% of trips (DHUTS, 2010). The STP (2005) data indicates that rickshaws are the primary travel mode for 34% of all person trips whilst the corresponding value in 1994, as reported in the Greater Dhaka Metropolitan Area Integrated Transport Study (DITS), was 19% (DITS, 1994). The average length of rickshaw trips is 2.34 km and 61% of the rickshaw trips are made by people in the middle income brackets (BDT 12,500 to 55,000 per month) (STP, 2005). ALG (2013) shows the average length (in straight line) of rickshaw trips in Dhaka is 2.84 km; about 75% of those trips are made within the neighbourhood or proximity neighbourhood (zones or neighbourhoods close to each other). Demand for rickshaw trips made inside the proximity area among the people of different income brackets are: 39% by low-income, 43% by middle-income, and 18% by high-income brackets.

Access Leg Modes of Public Transport

As the mass public transport services operating in the major arterial roads only, discussed in Section 4.2.3 and shown in Figure 4.6), access and egress modes are playing an important role for public transport trips in Dhaka. However, no study was found which analysed access or egress modes of public transport trips in Dhaka city and therefore secondary information on this topic is scarce. JICA study (JICA, 2010), the only research on this topic was conducted in Dhaka, showed the access legs of bus trips in Dhaka are: 24% on rickshaws, 48% on buses, 14% on auto-rickshaws, 7% walk and the remaining 7% on other modes such as taxi, *human-haulers*, private cars and motor-cycles. Though it was not mentioned in the report what was the sample size and whow the data were gathered; due to high figure of bus acces legs it is anticipated that the JICA study considered either the inter-city bus trips to explore their access legs or the data were gathered at major bus interchanges. Because, the anecdotal evidence suggests that not many passengers of [intra]city bus services in Dhaka use another bus trip to arrive into bus stop.

4.2.5 Rickshaw Bans in Dhaka City

Airport (VIP) Road is the first in Dhaka that was made rickshaw free in 1990s to enhance the image of city. Again in 2002, rickshaws have been banned in Mirpur Road (a major arterial of Dhaka) to reduce traffic congestion of that road. In both occasions many protests and demonstrations were made by the rickshaw-pullers and (and in few cases by civil organisations) against the decision of ‘rickshaw ban’. However, the protests and demonstrations were not able to help withdrawing the decision of bans. Moreover, another major arterial has been made ‘rickshaw free’ in April 2011. Furthermore, the then minister of home affairs declared that all the major arterials of Dhaka city will be made rickshaw free step by steps. Figure 4.5 shows the roads (marked in green lines) where at present rickshaws are banned.

Transport policies related to NMT and IMs for Dhaka covers rickshaws, auto-rickshaws and pedestrians. Government policies towards the rickshaws are defined in several policy documents (e.g. National land transport policy - NLTP, STP), and also in the practices of organisations (i.e. DMP, DNCC, DSCC). The main policy features towards rickshaws are to reduce or restrict/ban from major roads (see Appendix D2.3). These policies are being implemented in a number of ways. Firstly, no new rickshaw licenses have been issued by DCC since 1986. Secondly, rickshaw bans have been implemented progressively during the 2000’s in several major corridors. Thirdly, restrictions on movements of rickshaws are now being introduced at other busy junctions (i.e. Bangla Motor, Phoenix Road near DSCC).

The policies towards pedestrians are to provide/improve infrastructure for pedestrian facilities whilst policies related to multi-modal integrated transport are to encourage/develop physical integration of all modes (see Appendix D 2.3 for details). However, the policies related to multi-modal integration have had very less impacts in Dhaka. There are no designated parking spaces for rickshaws; therefore, they are normally parked in the junctions of the roads and becoming an obstacle to the traffic flow.

Implication of the Policies in Practice

The main aims of the government policies towards the rickshaws are apparently to reduce traffic congestion and to improve safety by reducing the interaction between motorised and non-motorised vehicles. However, implementation of the policies has had some negative results. Firstly, restricting rickshaw licenses has not reduced the number of rickshaws, but simply created a black market in rickshaw licenses. It is alleged that the current black market value of a license is around BDT 10,000 - BDT 12,000. For this reason, the STP for Dhaka (STP, 2005a) recommended that DCC should “Rely upon travel demand and market forces to determine the number of rickshaws in operation, rather than through the control of license numbers” (Recommendation 15). If the policy was changed and rickshaw licences were issued freely, as ALG (2013) estimated, DCC (North and South) could potentially raise over BDT 100 crore (assuming BDT 5,000 per license) - more than enough to fund well-staffed Traffic Planning and Engineering teams in each of the city’s 10 zones.

Secondly, the banning of rickshaws on some major roads has not been accompanied by bus priorities or bus-only lanes, despite the NLTP (NLTP, 2004) states: “A priority allocation of road space to buses will be introduced through bus lanes (in Dhaka)” (Policy 9.4.1). Nor have there been any restrictions on cars using or parking on these roads. The result is that motor vehicles, especially cars, have simply taken over the space vacated by rickshaws. Since cars on busy urban streets carry fewer passengers than rickshaws, per metre of road space, the result has been a decrease in road carrying capacity and a corresponding increase in congestion.

Thirdly, the restriction of rickshaws to a ‘feeder role’ has not been accompanied by any measures to facilitate this role. Again, this is despite the NLTP, which states that “Rickshaws will be allowed to cross such (major) roads from and to minor side roads at selected crossings” (Policy 9.2.1). The STP for Dhaka (STP, 2005a) also recommended that there should be a program to redefine the role for rickshaws as one of a neighbourhood circulation system and a feeder service to mass rapid transit stations “including suitable facilities to provide such services” (Recommendation 16).

4.3 Future Mass Transit Systems in Dhaka City

Increasing growth of population in Dhaka will make the transport situation more chaotic and critical if appropriate measures are not taken to tackle the increasing travel demand. Policy measures for transport in Dhaka should be directed towards sustainable transport for tackling the large amount of travel demand through affordable means (Rahman, 2008). Thus, an efficient mass transit system will be required which is affordable for the majority. To handle the increasing travel demand of the city, 6 mass rapid transit routes, as seen in Figure 4.9, of total length about 76 km have been proposed in the Strategic Transport Plan (STP) for Dhaka city (STP, 2005). Proposed 3 BRT routes are:

- *Uttara* to *Sayedabad* (BRT Line 1);
- *Gabtali* to *Sayedabad* (BRT Line 2); and
- *Airport* to *Old Dhaka* (BRT Line 3).

Proposed 3 Metro routes are:

- *Uttara* to *Sayedabad* (Metro Line 4);
- *Gulshan* to *Dhanmondi* (Metro Line 5); and
- *Pallabi* to *Sayedabad* (Metro Line 6).

However, due to the lead-in time for design, financing, appointment of a contractor and operating consortium and the construction period, it is unlikely that the Metro lines can be implemented in Dhaka city within the next 10 to 15 years.

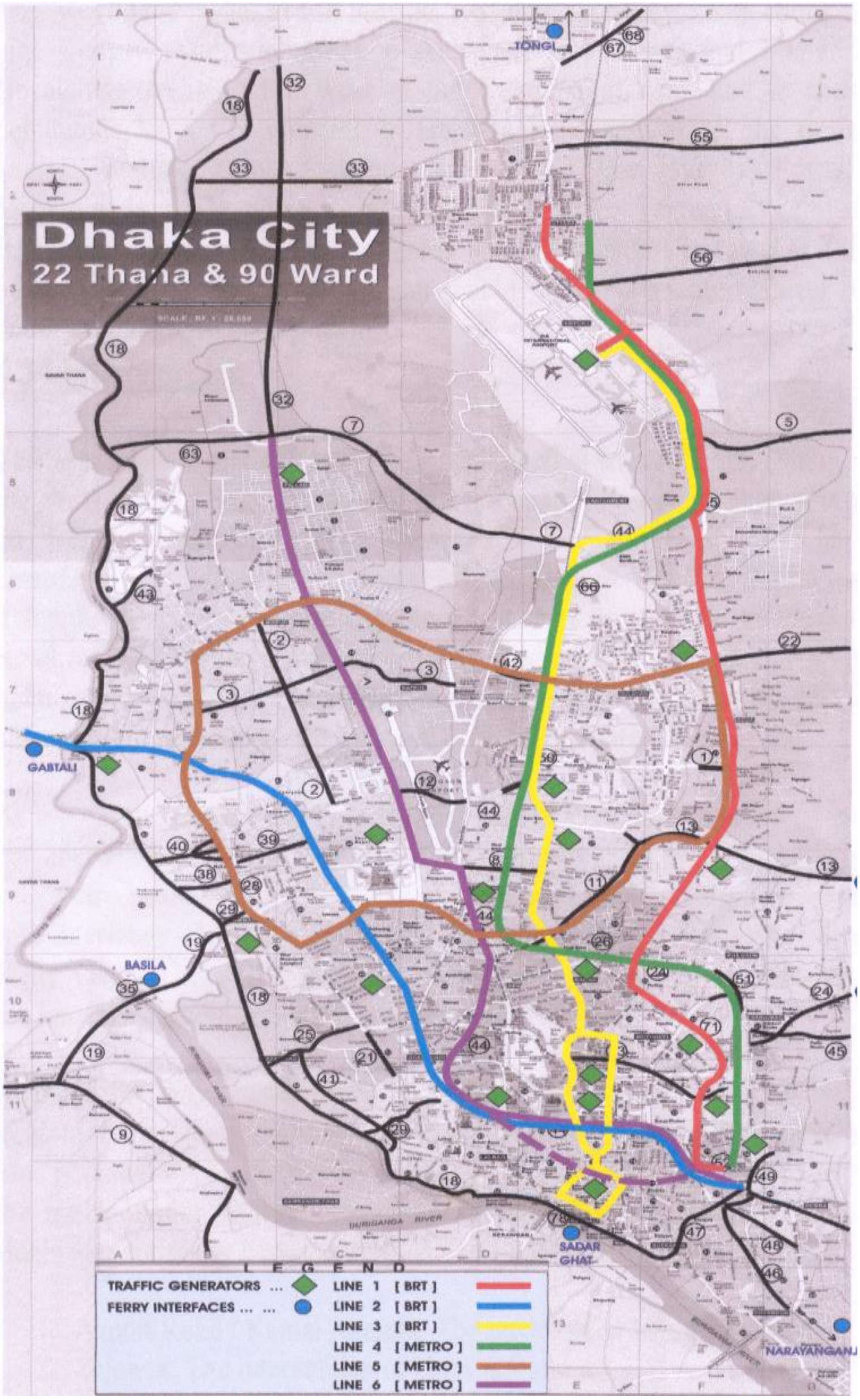

Figure 4.9: Proposed BRT and metro routes in STP for Dhaka City

Source: STP, 2005.

BRT Line 1 is proposed through *Uttara-Kuril-Badda-Rampura-Malibag-Kamalapur-Saidabad Bus Terminal* whilst *BRT Line 2* will passes through *Gabtali-Technical-Shyamoli-Dhanmondi-Fulbaria-Saidabad Bus Terminal* and the proposed *BRT Line 3* is through *Airport-Kuril-Mohakhali-Ramna-Fulbaria-Old Dhaka*.

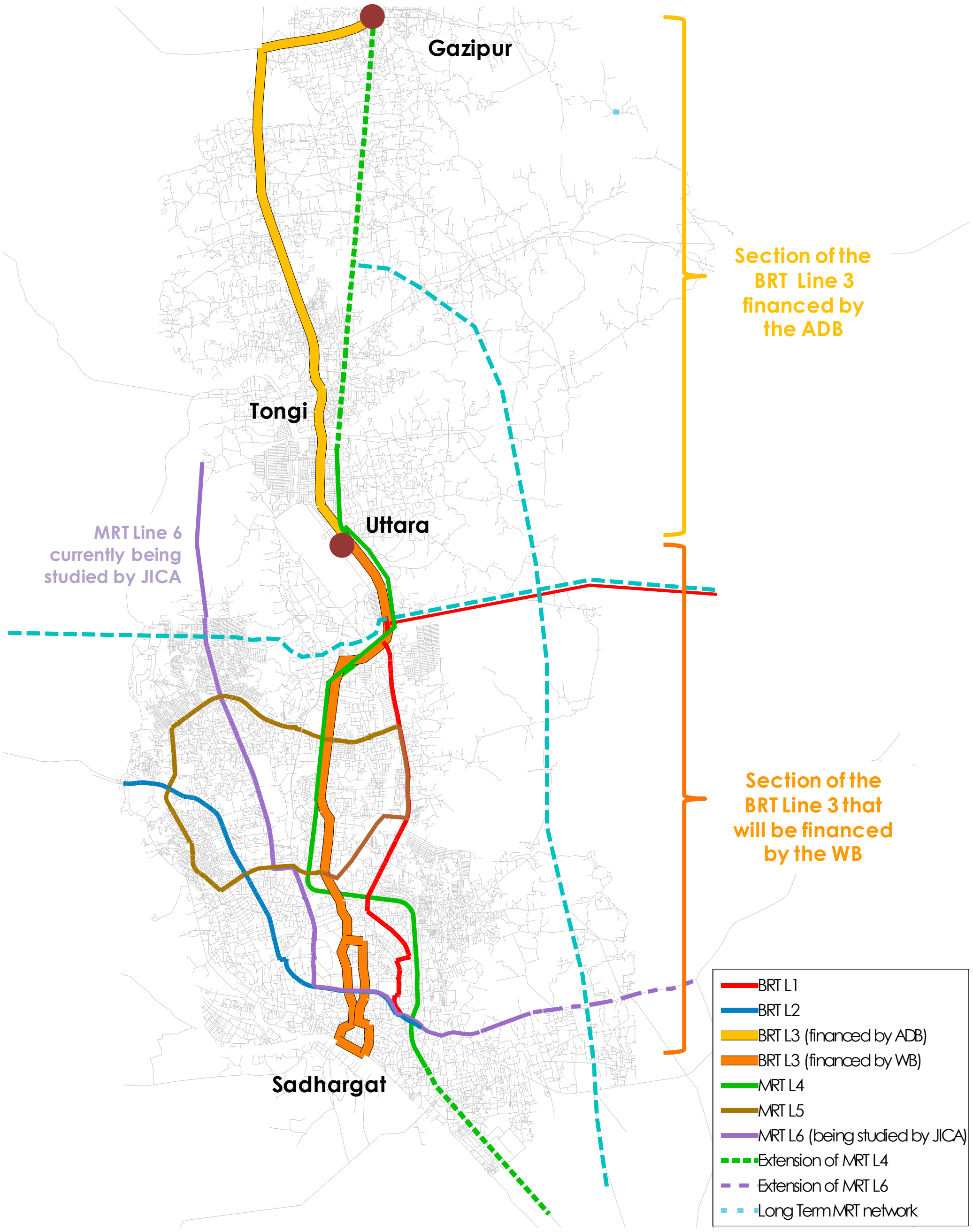

Figure 4.10: Routes of the ongoing BRT and metro to be implemented in Dhaka

Source: DTCB, 2009; ALG, 2011.

On the other hand, *Metro Line 4* is proposed through *Uttara-Airport-Mohakhali-Tejgaon-Mogh Bazar-Khilgaon-Kamalapur Station-Saidabad Bus Station*. This line is planned to serve the central corridor; at grade *Uttara* to *Mohakhali* and underground from *Mohakhali* to *Saidabad*. *Metro Line 5* is proposed through *Gulshan Progatisarani–Kamal Ataturk Avenue* across *Airport Road–Kafrul–Mirpur-*

Mohammadpur–Dhanmondi-Tejgaon (Farmgate)–Rampura–Badda-Gulshan to provide east-west connections. *Metro Line 6* is proposed through *Pallabi-Begum Rokey Sarani–Sonargaon Road–Zahir Raihan Sarani*.

Having the financial constraints, in 2009 government has initiated to implement only a BRT route proposed in STP (combination of the part of *BRT Line 1* and *BRT Line 3*) as a mass transit system of the city under Clean Air and Sustainable Environment (CASE) Project, funded by World Bank. The proposed BRT corridor runs from the north (*Uttara*) to the south (*Sadarghat*, near the river Buriganga) of Dhaka city. With loop operation in the CBD, the length of the proposed BRT route will be approximately 25 km. The proposed BRT route will start at *Abdullahpur* of *Uttara* and then will pass through *International Airport-Banani-Mohakhali-Ramna-CBD* and then terminating at *Sadarghat* (Figure 4.10). If this corridor is financially feasible and if possible to edge the massive congestion and mobility problems of the city dwellers by implementing BRT, it is expected that the government would take further initiatives for implementing other mass transit routes. However, the work is yet in the initial stage. In April 2009, Dhaka Transport Coordination Board (DTCB) announced the request for Expression of Interest (EOI) for this BRT route with the view of commencing the work from March 2010. However, the process of work has been delayed for some internal reasons. In April 2010, government had announced the short-listed firms and asked them for submitting the detailed technical plan and financial plan for conducting the detailed feasibility study by July 2010. Among the short-listed firms a consortium of ALG-TMB-ICT was awarded for the detailed feasibility study. In December 2011 they have submitted the Interim Report and later in 2013 submitted the detailed design and plan for implementation. It is hoped that the construction work for implementation will be initiated soon. However, progress of the initial paper work is very slow.

On the other hand, another BRT route between Uttara and Gazipur (satellite city in the north of Dhaka City) has been initiated by the Roads and Highways Department (RHD), under the ministry of communications (MoC), funded by Asian Development Bank (ADB). The consultant team formed by ALG-BETS-TMB was selected to develop the Greater Dhaka Sustainable Urban Transport Corridor Project (GDSUTCP), to be implemented by the RHD in close collaboration with the Dhaka Mass Transit Authority (DMTA) and the Local Government Engineering Department (LGED). The introduction of BRT services along the corridor between Uttara and Gazipur is the main task for GDSUTCP. Even though the project to study for this route was initiated after the Uttara-Gazipur project, the work for this was much faster. In August 2012, the consultancy firm (a consortium of ALG-BETS-TMB) has submitted the final design and plan of the BRT route. The government already secured money from ADB for the implementation of this project. In 2013 an agreement was signed with AECOM to implement this BRT route. It is hoped that the construction work for implementation will be initiated very soon.

Beside the above mentioned 2 BRT routes, the feasibility studies of a metro route was also done by Japan International Cooperation Agency (JICA). The Metro Line 6 for a length of 20.1 km between Uttara and Motijheel (through Mirpur and Framgate) has been suggested in 2011 by JICA in DHUTS Phase 2. At present the detailed plan and design of the metro route is on-going.

4.4 Summary of the Chapter

This chapter discussed the overall physical and socio-economic condion of Dhaka city, current traffic and transport situation of the city, and future mass transit systems.

Dhaka is one of the fasted growing and highly dense mega cities of the world. The impact of such rapid growth has major consequences on the ability of the transport sector to provide mobility for all people. Existing transport system of the city is almost unable to meet the increasing travel demand mostly because of growing concentration of population and economic activities but inadequate and disorganised public transport systems. A variety of travel modes are available in Dhaka; the majority of trips are made on rickshaws, buses, and on foot. The city is planning to have BRT systems in two routes and metro rail in one route to tackle the traffic and transport problems of the city. Beside this, existing bus services needs to be organised and improved as well as rickshaws and other para-transits need to be integrated with the public transport such as proposed BRT systems of the city. Despite the important role the rickshaws are playing as a travel mode in Dhaka city, they are banned in several major roads and also new restrictions are being imposed on rickshaw operation.

Next chapter will describe the research design for the case study conducted in Dhaka city for this research.

Chapter 5
Research Design for the Case Study in Dhaka City

This chapter describes the overall research design for the case study conducted in Dhaka city. The topics covered here are: the conceptual design, the procedure of selecting the case study locations in Dhaka city for detailed in-depth study, preparation of the initial plan of modal integration between rickshaws and bus rapid transit (BRT) systems, public reactions as well as policymakers' opinions about the initial plan prepared for modal integration and possibility of fare integration of the trips involving both rickshaws and BRT.

5.1 Conceptual Design

Figure 5.1 shows the conceptual design of this research; where the factors relevant to modal integration are in the top side and fare integration are in the bottom side; the design aspects are in the left side and the influencing factors of the design aspect are both in the middle and right side. Modal integration and fare integration are defined below.

Modal Integration

Convenient distance or maximum distance for modal changes between rickshaws and BRT systems would vary depending on age, gender, and disability or physical fitness of different passengers.

The preferences or choices among different options for pedestrian road crossing to access into median BRT station may also vary for different passenger depending on their age, gender, disability or physical fitness as well as behaviour of traffic (motorists) to follow traffic rules/laws and enforcement level of traffic rules. Furthermore, the number of traffic lanes, volume of traffic, and speed of traffic on the road (in BRT corridor) affect the choices of pedestrian road crossing.

Passengers' opinions about different facilities that are required at BRT station vary depending on their age, gender, physical fitness or disability, and income bracket. Bus headway or frequency of BRT services and other supporting infrastructure facilities available at surrounding areas of BRT station also influence the need for passenger facilities at BRT station. The need for relevant traffic signs and signals to improve overall traffic flow may differ between literate and illiterate people.

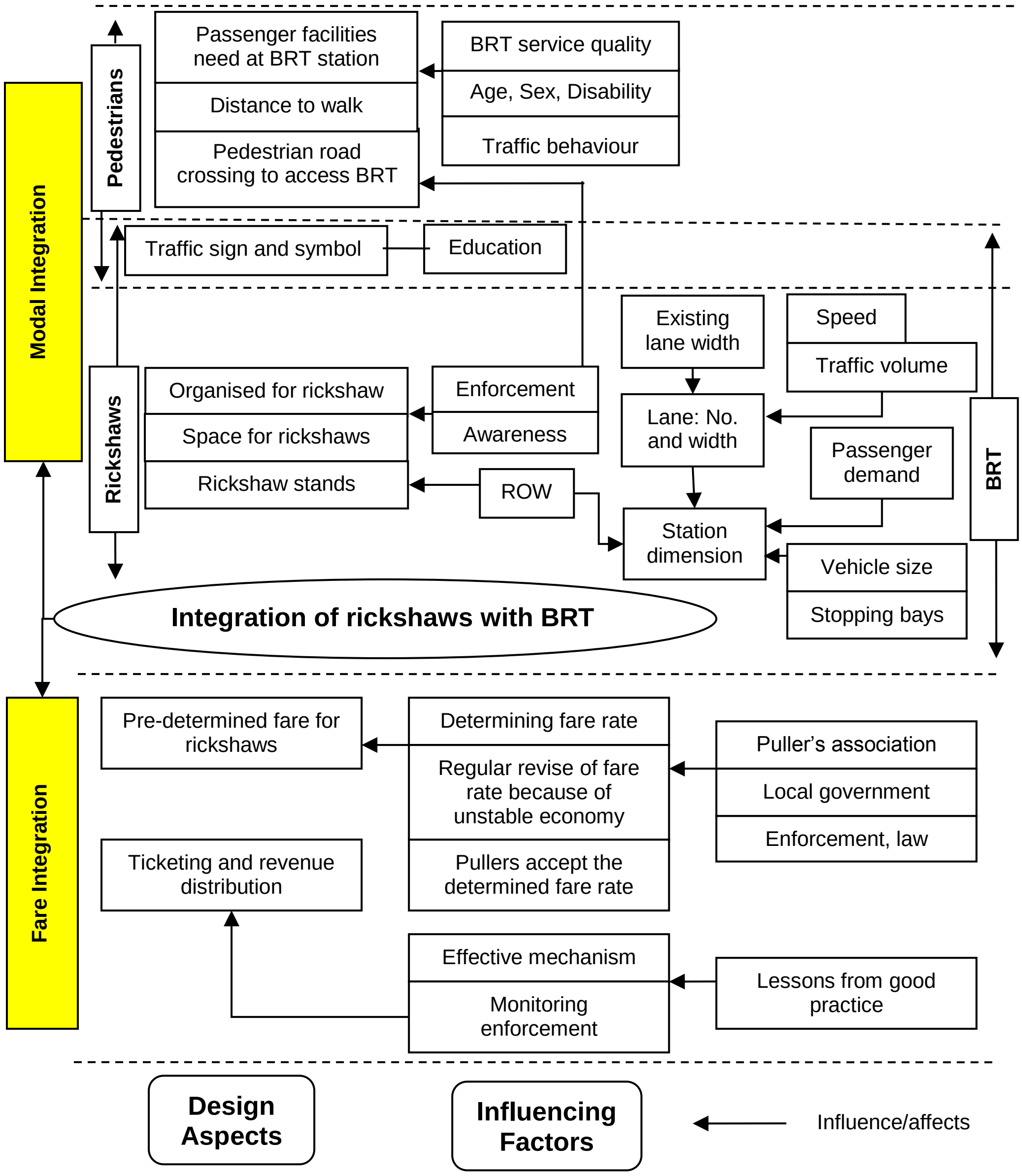

Figure 5.1: Conceptual design of the system for integration

Rickshaws may need to wait only at designated places for rickshaw waiting in and around BRT station and while waiting, they need to form and maintain tidy queue. Provision of rickshaw stand or designated space for rickshaw waiting at BRT station depends on availability of space or right of way (ROW), which is affected by width of BRT station platform, width of buses providing BRT service, number and width of mixed traffic lane, number and width of BRT lane. The number of rickshaw spaces required at rickshaw stand depends on either passenger demand or number of rickshaws. Organised queue for rickshaws at BRT station may be depended on enforcement, awareness generation among the rickshaw-pullers about benefits from queuing and following a queue while waiting, and available infrastructure to channelize rickshaws at BRT station to form a tidy queue.

Fare Integration

Determining a fare rate, regular updating of the fare rate, and its acceptance by the rickshaw-pullers are the major influencing factors for a pre-determined fare structure for rickshaws trips. Rickshaw-puller's association, role of local government, relevant rules and its effective enforcement would help in determining fare rate, regular updating, and acceptance of pullers to follow the fare rate. Ticketing system and revenue distribution are also important factors and design aspects for fare integration between rickshaws and BRT systems.

5.2 Selection of the Case Study Areas for Detailed Study

Two existing bus stoppages that must be possible BRT stations were identified and selected for detailed case study. Table 5.1 shows the different criteria used for identifying 'possible candidate locations' in Dhaka city and any of these locations could be selected for detailed study. These 'possible candidate locations' would represent the city in terms of its socio-economic condition, demography, urban structure, and traffic situation.

Table 5.1: Possible candidate locations for detailed case study

Types of Area (Criteria)	**Major Locations or Bus Stoppage**	**Possible Candidate Locations**	**Proposed BRT Line in the Selected Area (Refer Figure 4.9)**
Central business district (CBD)	Motijheel, Gulistan	Motijheel	Proposed BRT Line 1
Well-planned high-income residential area close to commercial area	Uttara, Dhanmondi, Kakoli-Banani, Gulshan	Kakoli-Banani	Proposed BRT Line 1
Unplanned (spontaneous growth) and low-income residential area	Sayedabad, Badda, Jurine, Khilgaon, Gabtoli	Sayedabad	Proposed BRT Line 1 and BRT Line 2
New commercial and business area on the major corridors	Mohakhali, Kawran Bazar, Gulshan	Mohakhali	Proposed BRT Line 3
Older part of city with narrow roads but very high density and mix of shopping-residential area	Sadarghat, Wari, Postogola, Zigatola	Sadarghat	Proposed BRT Line 3
Institutional area where various academic institutions are located	Ramna, Shahbag, Dhanmondi, Agargaon	Dhanmondi	Proposed BRT Line 2

Given the resource constraints, both in time and money, it was only feasible to cover two locations for the detailed study in this research. Therefore, among the six candidate locations outlined in Table 5.1, two were considered: one location is in well-planned and high-income residential area with higher car ownership where rickshaws are restricted in the main (BRT) corridor (e.g. Kakoli-Banani) whilst another location is in unplanned (spontaneous growth) and low-income or lower-middle-income groups residential area where rickshaws operating in the major (BRT) corridor (e.g. Sayedabad). Figure 5.2 shows the possible candidate locations for case study and the selected two case study locations in Dhaka city. Brief description of the selected case study locations are given in following sections.

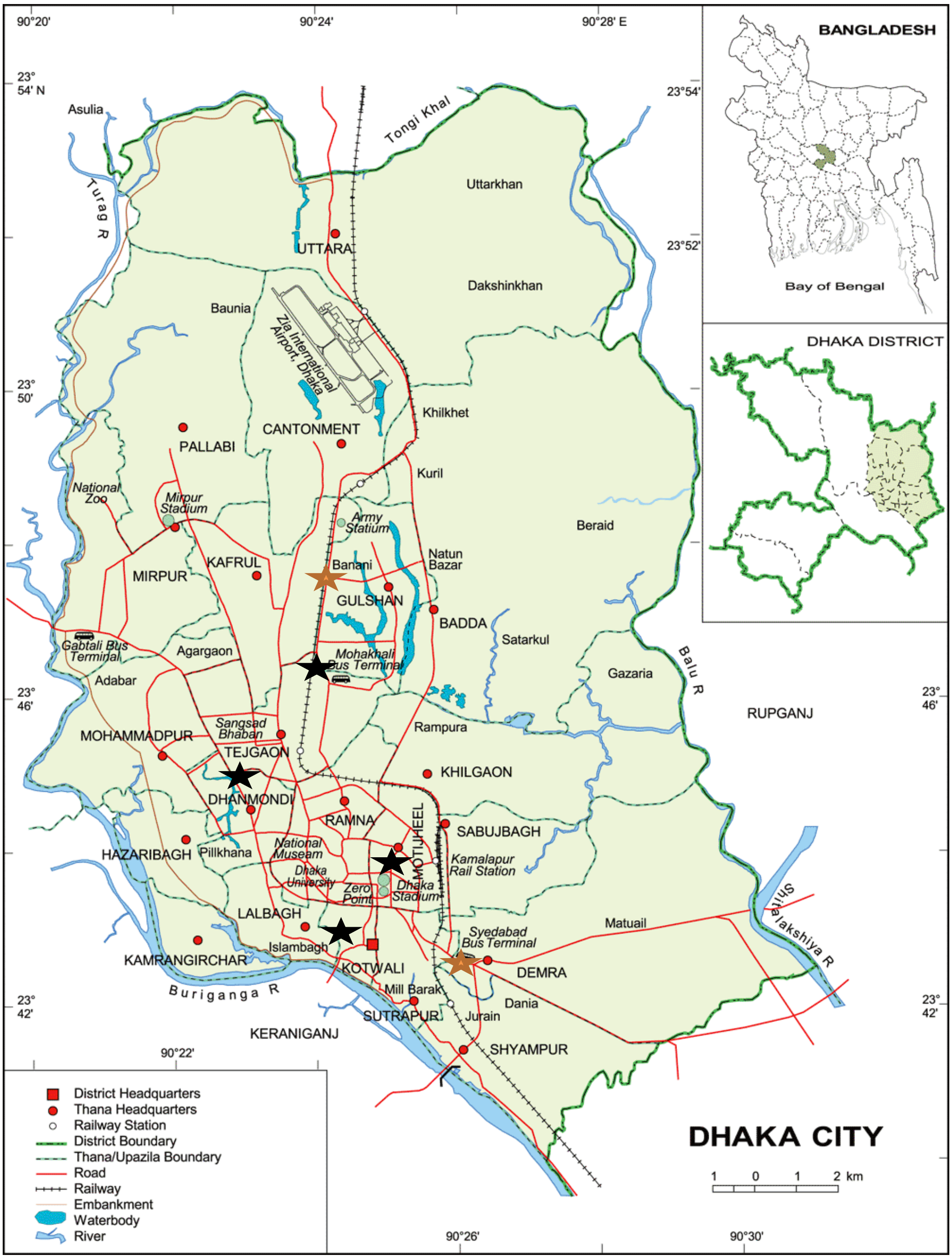

Figure 5.2: Possible candidate locations (stars) and the selected case study locations (pink stars) in Dhaka city

Source: Banglapedia (2013) and modified by the author.

5.2.1 Description of Location A: Kakoli-Banani Area

Kakoli-Banani intersection or bus stop is located on the Mohakhali-Airport corridor (seen in Figure 5.2 and Figure 5.3); Mohakhali in the south and Airport in the north. This north-south corridor connects the capital with the airport and the northern part of the country. Another major road, the Kamal Ataturk Avenue, in east-west direction connects Kakoli with Gulshan that has made this Kakoli-Banani intersection very busy. The proposed BRT Line 3 in the strategic transport plan (STP) of Dhaka passes through this location. The preliminary feasibility study of this BRT route, that was done by Dhaka transport coordination board (DTCB), also suggested locating a station at Kakoli-Banani location (ALG, 2011a).

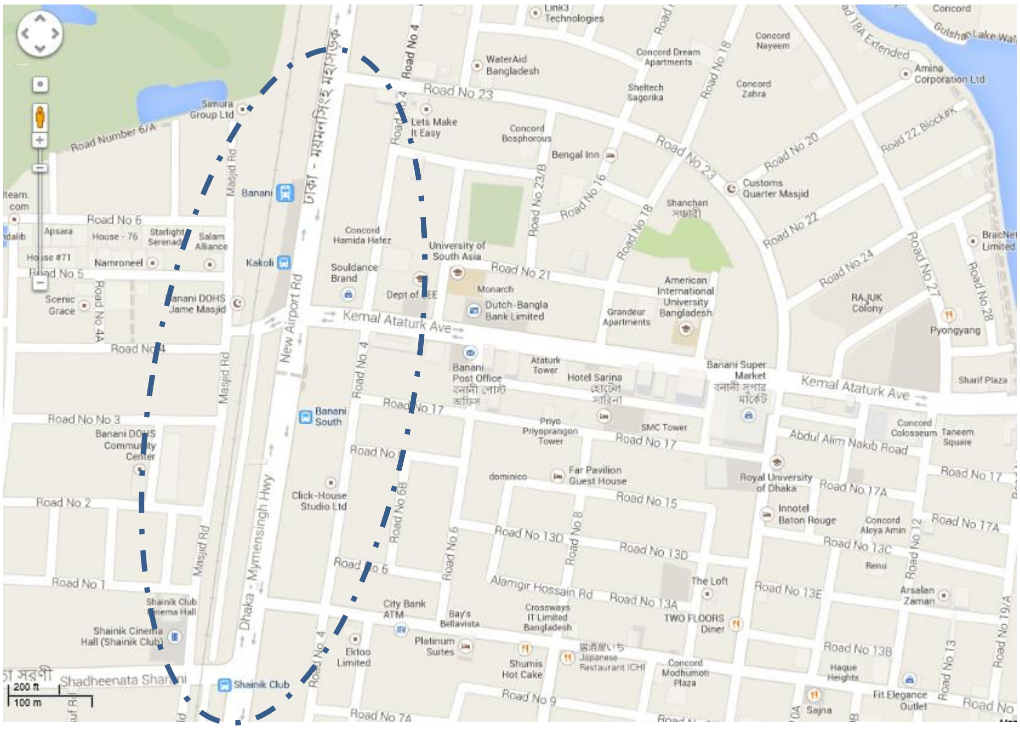

Figure 5.3: Map of the location of Kakoli-Banani study area

Source: Googlemap, modified by author.

The area of study location A covers around 1,100 m in length and 400 m in width. Mohakhali Bus Terminal is about 2 km in the south, Navy Office is about 1 km in the north, and Gulshan Circle 1 is about 2 km in the east. Most of the buildings in and around the study area are 4 to 8 storeyed height. Buildings along the proposed BRT corridor (BRT Line 3 in Figure 4.9) and Kamal Ataturk Avenue are used for commercial purposes, but along the connecting branch roads are mostly used for residential. Many commercial and business establishments as well as several private universities are located along the Kamal Ataturk Avenue. Figure 5.4 shows the land use of study location; the map is presented in another orientation where Mohakhali-Airport corridor is portrayed along the east-west and Kamal Ataturk Avenue is along the north-south direction.

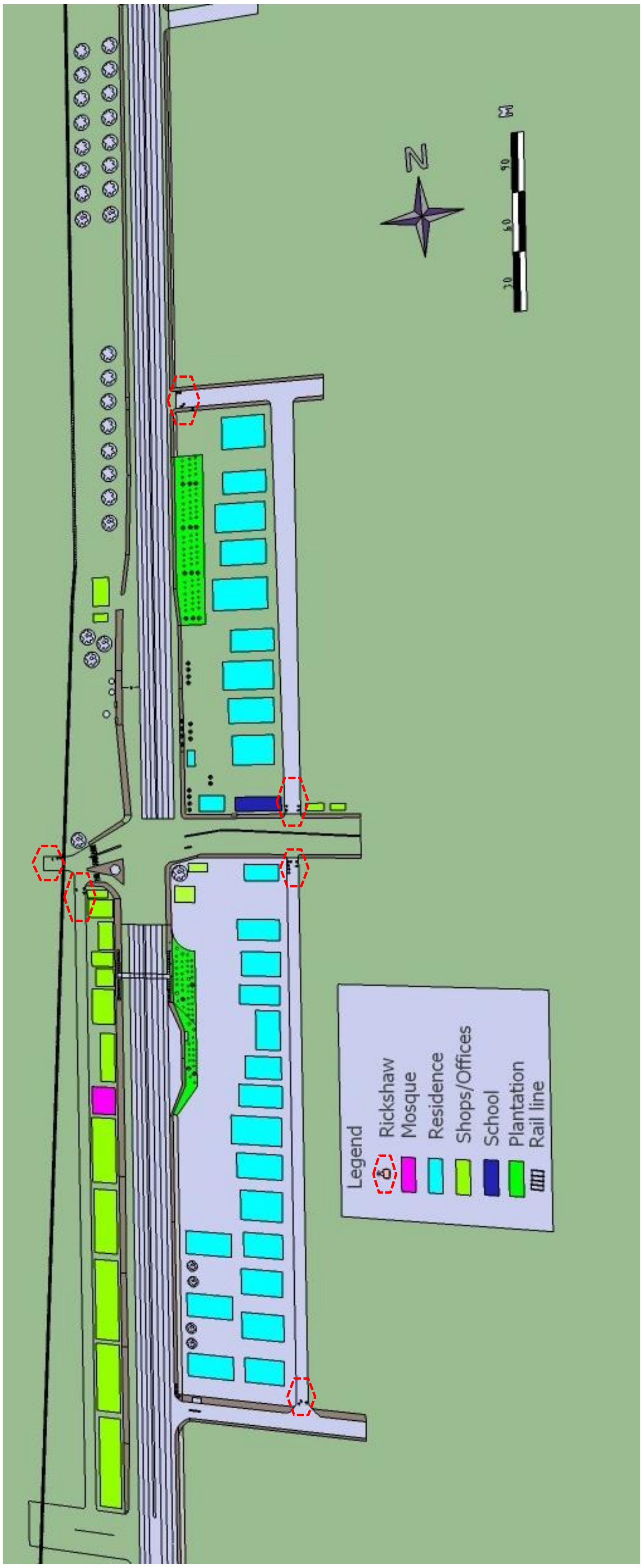

Figure 5.4: Land use of the study area of location A (Kakoli-Banani area)

There is a very busy existing bus stop and a small train station at Kakoli-Banani. The rail line passes along the road is just about 30 m away from the Kakoli-Banani road intersection. Two bus bays are available, one for each direction along Mohakhali-Airport corridor, at this intersection. There are many trees beside the bus bays, and a nursery of plants in the opposite side of the northbound bus bay.

During the field observation it was measured that the ROW of the Mohakhali-Airport corridor at Kakoli involves a road width of about 95-100 feet (29-30.5 m) plus an additional 24-32 feet (7.35-9.75 m) bus bay areas at the station and provides four lanes (as can be seen in Figure 5.5) in both directions. The width of the existing traffic lanes in this corridor are: 8.5-10 feet (2.6-3.05 m) for the central or middle lanes, 10-14 feet (3.05-4.25 m) for the kerbside lanes.

Figure 5.5: Traffic lanes of Mohakhali-Airport corridor at Kakoli-Banani location

Peak hour passenger flow at Kakoli-Banani is 5,000 passengers per hour per direction (pphpd) toward northbound and 6,100 pphpd toward southbound (ALG, 2013). Pedestrians flow is very high, particularly during morning and evening peak times.

There are footpaths available in both sides of the corridor and Kamal Ataturk Avenue, but none on the connecting branch roads. During field observation it was found that the widths of the existing footpaths are mostly 11 feet (3.35 m) although at some points it is only 6 feet (1.82 m). Surface quality of the existing footpaths is very poor, many potholes and garbage are spreaded on footpaths, trees and hawkers are positioned in the middle of the footpath (as seen in Figure 5.6). High number of pedestrian and narrowness of footpaths combined with existence of shops/hawkers on footpaths create problems for pedestrian movement.

Figure 5.6: Footpaths at study location A (Kakoli-Banani area)

A pedestrian overpass is available between southbound bus bay and road intersection for crossing the corridor. The width of the stairs of overpass is 4 feet (1.22 m). Though several people are using this, it was observed that many pedestrians are crossing the road at-grade when traffic signal lights or traffic police stop the vehicles. Even, some pedestrians cross the road ignoring the traffic lights, as seen in Figure 5.7. Several pedestrians gather at footpath, start moving slowly and then the motorists are forced to slow down and the pedestrians keep walking and other pedestrians also join with them as a funnel to cross the road.

Figure 5.7: Pedestrian overpass (left) and pedestrian crossing the road at-grade ignoring (stopping) the oncoming vehicles (right)

Figure 5.8: Rickshaws waiting at narrow streets in Kakoli-Banani location

Rickshaws are prohibited for operating both in Mohakhali-Airport corridor and Kamal Ataturk Avenue. Therefore, the rickshaws that operating in Kakoli-Banani area usually wait in the corner (mouth) of connecting/branch roads (Figure 5.8). Rickshaws operate only in the branch roads within the locality or neighbourhood. Moreover, rickshaws operating or waiting in one side of the Airport road or Kamal Atartuk Avenue cannot cross the road and thus unable to operate or serve trips in other side of the road.

5.2.2 Description of Location B: Sayedabad Area

Sayedabad is located on the Gulistan-Jatrabari corridor (seen in Figure 5.2 and Figure 5.9), Gulistan in the west and Jatrabari in the east. This east-west corridor connects the eastern and southern part of the country with the capital city. Another major road towards the north, named Kamalapur Road, connects Sayedabad with Khilgaon area and makes a very busy intersection (Mukti Sarani) at Sayedabad. Proposed BRT Line 1 and BRT Line 2 in the STP for Dhaka terminate at Sayedabad (as seen in Figure 4.9).

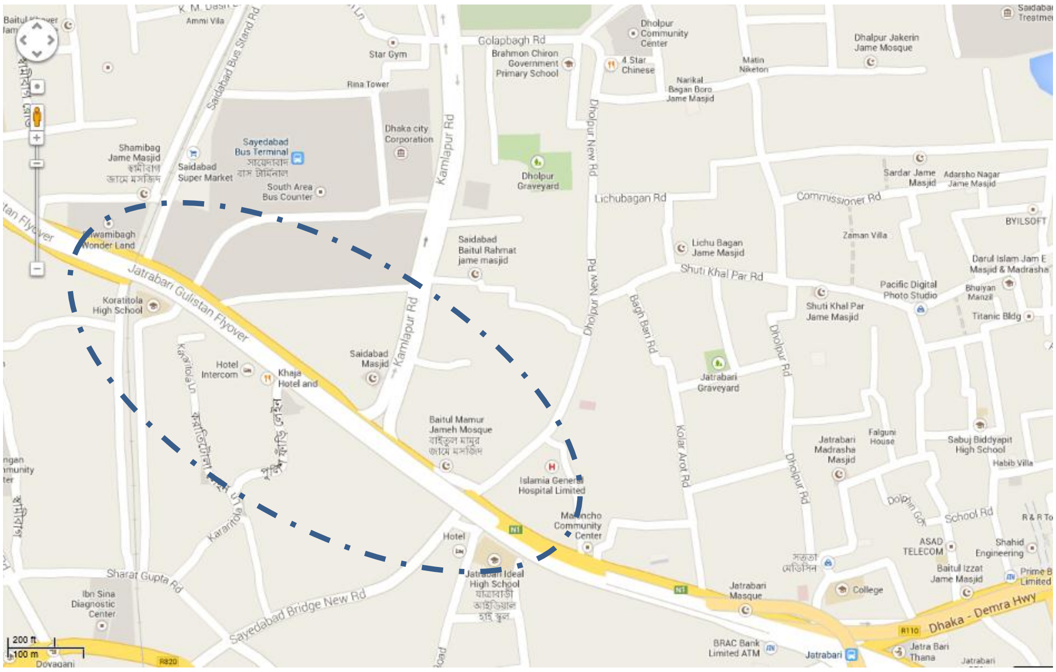

Figure 5.9: Map of the Location of Sayedabad study area
Source: Googlemap, modified by author.

The study area of location B covers an area around 1,200 m in length and 450 m in width. One of the largest inter-city bus terminals is located at Sayedabad. Jatrabari is about 1 km towards the east, Kamalapur rail station is about 2 km towards the north, Gulistan is about 1.5 km towards the north-east, and the Kamalapur-Narayanganj rail line is about 0.5 km towards north-east. Figure 5.10 shows the land use of study location; the map is in another orientation where Gulistan is portrayed towards the east and Khilgaon in the south. Most of the buildings are two to four storeyed height in and around the study area. The buildings along the main corridor mostly have shops and ticket offices of inter-city bus operators. There are also several hotels, restaurants, schools and mosques. The surrounding residential areas (i.e. Jurine, Narinda, Badda, Jatrabari, Dhalpur, Kamalapur, and so on) are unplanned and spontaneously developed where people are residing mostly middle or lower-middle and poor income brackets.

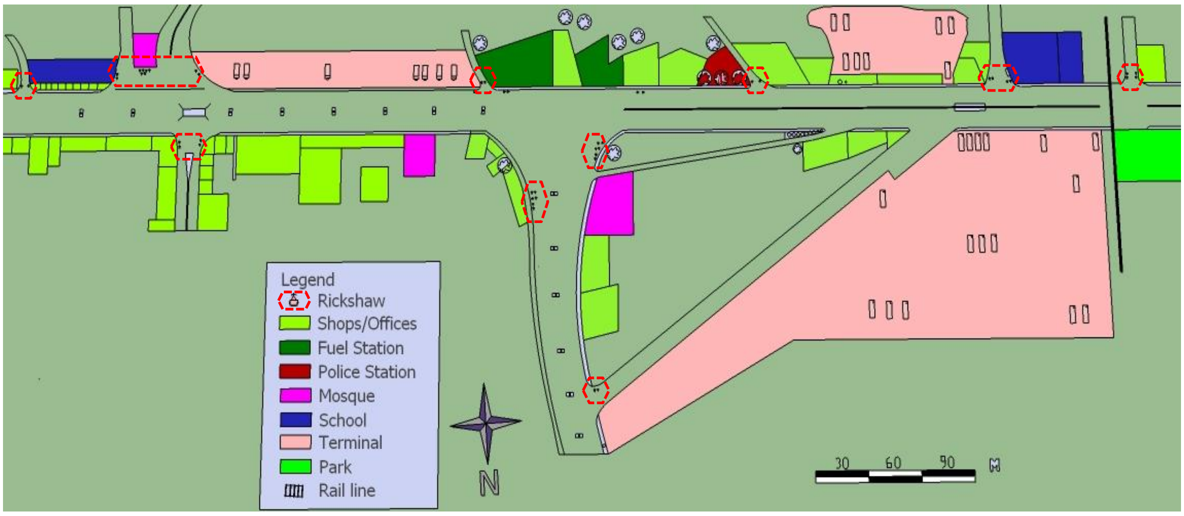

Figure 5.10: Land use of the study area of location B (Sayedabad area)

The ROW of Gulistan-Sayedabad corridor at Sayedabad, as measured during field observation, is about 90 feet (27.5 m). The corridor has three lanes in each direction. However, the width of road is rising to 100 feet (30.5 m) at a few points within the study area. Construction of a flyover (Gulistan-Jatrbari Flyover) is on-going (Figure 5.11) and it was scheduled to be completed by 2013. Once the flyover is in place, the middle portion of the road for a width of about 13 feet (4 m) throughout the corridor will not be usable for traffic because of the flyover's pillars.

There are footpaths in both sides of the Gulistan-Sayedabad corridor, but none on the connecting branch roads. However, during field observation it was found that the widths of the existing footpaths are mostly 5-6 feet (1.5-1.8 m); quality of the surface is very poor (as seen in Figure 5.12) and many potholes and garbage on as well as hawkers in the middle of footpath.

Figure 5.11: Flyover and its pillars at Sayedabad location

Figure 5.12: Existing pedestrian paths

Figure 5.13: Existing pedestrian underpass

Figure 5.14: Rickshaws waiting on carriage way at Sayedabad study location

There is no Zebra-crossing or signalised crossing or pedestrian overpass available at Sayedabad. Though there is an underpass available in front of the school (about 100 m further away from the intersection), people are not using it (Figure 5.13). Observation revealed that the underpass is dark, dirty (garbage are everywhere and), bad smelly, and it has inappropriate location. Pedestrians seldom use this underpass and most of them cross the road with their own risk by observing the vehicles on road or cross at intersection when traffic police stops the flow of vehicles of one direction.

There is no restriction on operating rickshaws on Gulistan-Sayedabad corridor at Sayedabad. Therefore, rickshaws share the same lane along with other traffic. Often rickshaws wait on carriage way (curb side lane), mostly at the corner of intersection or connecting roads to pick up passengers (Figure 5.14). As there is no restriction on operating rickshaws at Sayedabad, they are able to cross the main corridor and can serve all the areas surrounding Sayedabad.

5.3 Preparation of the Initial Plan for Modal Integration

After selecting the two case study locations, an initial plan of the proposed (hypothetical) BRT station for each location was prepared to ensure modal integration between rickshaws and BRT systems. This section describes the design of initial plan prepared for BRT station areas to integrate rickshaws with BRT systems.

5.3.1 The Method for Preparing Plan of BRT Station

Of the methods reviewed in Section 3.2, review of literature was applied for preparing the initial plan of BRT station for modal integration with rickshaws. Literature review is easy and simple compared with other methods and requires less time and resources. For instance, literature review does not require recruiting any specialist’s participation as needed for design charrette.

An initial plan was prepared based on literature review and global good practices of BRT systems currently available as well as the local spatial and traffic contexts (i.e. road width, land use, traffic, behaviour of road users) of study location (as seen in Figure 5.15 and Figure 5.20). Design aspects of a given BRT station depends on the decision options for BRT systems, as discussed in Section 2.2.1, as well as space availability in that particular location. Following sections describe a brief detail on design aspects of the initial plan of BRT station area.

5.3.2 BRT System Decision Options for Dhaka

Due to having the frequent connections of branch roads to the major corridor and thus frequent left-turn vehicles, a median configuration of BRT lane and station was considered for the initial plan of Dhaka city. A closed system was considered to ensure better speed and service quality of BRT where the BRT lane should allow only the emergency vehicles (e.g. ambulance and firefighting) but no other vehicles. A trunk-feeder service of BRT was considered where BRT would operate only in major corridors and rickshaws and other small-size para-transits would serve as feeder in narrow connecting/branch streets. Therefore, the decision choice for the initial plan of BRT system in Dhaka have been considered are:

- Median configuration of station and BRT lane;
- Closed system BRT; and
- Trunk-feeder services.

A similar choice options of system design (medium configuration and closed system BRT) have also been decided for two on-going BRT projects for two different routes of Dhaka being implemented by DTCB and Roads and Highways Department (RHD) respectively. However, those current plans for BRT (as discussed in Section 4.3) have not coverd the issues of rickshaw integration so that they could serve as feeder to BRT.

Once the basic service options of the BRT system for initial plan have been decided, then the specific design criteria for BRT of case study locations were determined before designing the station. Because, the specific design of a BRT station will vary widely for different factors such as levels of demand, speed, ROW, vehicle configuration. For example, a BRT system that only needs to handle 3,000 pphpd will be significantly different than a system for 35,000 pphpd, or a system operating in 30 km per hour (kmph) will be different than a system of 10 kmph. The design criteria considered for the BRT are following:

- BRT capacity: 10,000 pphpd; and
- Operating speed: 25 kmph.

The design capacity of BRT mentioned above would able to serve the passenger demand flow both at Kakoli-Banani and Sayedabad location. To achieve the design capacity and speed, the system specification chosen for initial plan are following:

- Articulated (18.5 m) vehicles to be used;
- Two stopping bays per direction at station; and
- BRT service frequency or headway to be 60 minutes.

In addition to the above mentioned system decision choice, it was further considered for the Dhaka BRT to have the platform level boarding, off-board fare collection and validation. Nevertheless, the specific design solutions of a BRT station may vary widely depending on its spatial location, width of ROW and the surrounding area of the station. Therefore, following sections describe various design aspects of BRT station specific to case study locations.

5.3.3 Initial Plan of Location A: Kakoli-Banani Area

This section briefly explains the design of BRT station prepared in Kakoli-Banai location, as seen in Figure 5.15.

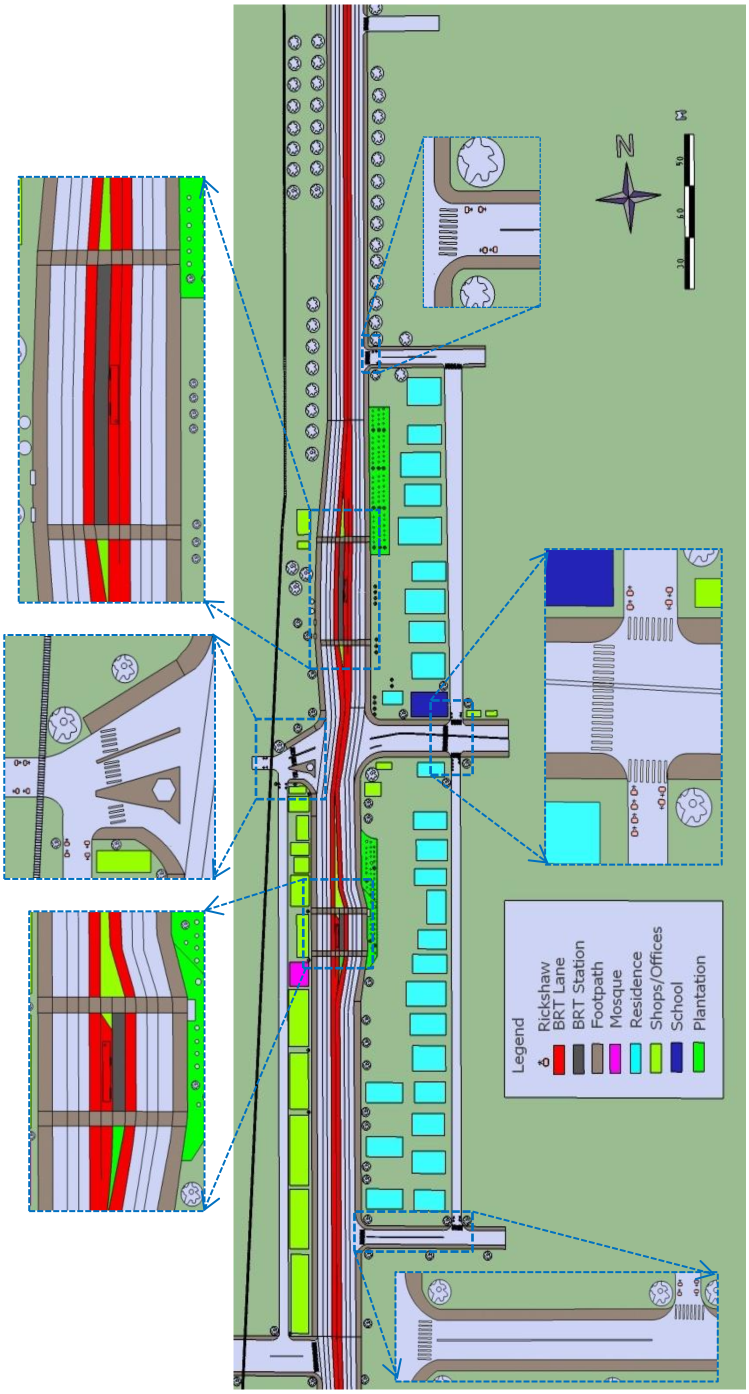

Figure 5.15: Initial plan of BRT station for Kakoli- Banani location

BRT Station Location

Two staggered stations were provided, each for different direction of bus-way. BRT stations were placed before the intersection (seen in Figure 5.16) where the ROW is much wider (due to existing bay area for conventional buses) to utilise the extra width of road space. This configuration of BRT station and its physical placement at Kakoli-Banani is believed to be the best according to the discussion made earlier in Section 2.2.2.

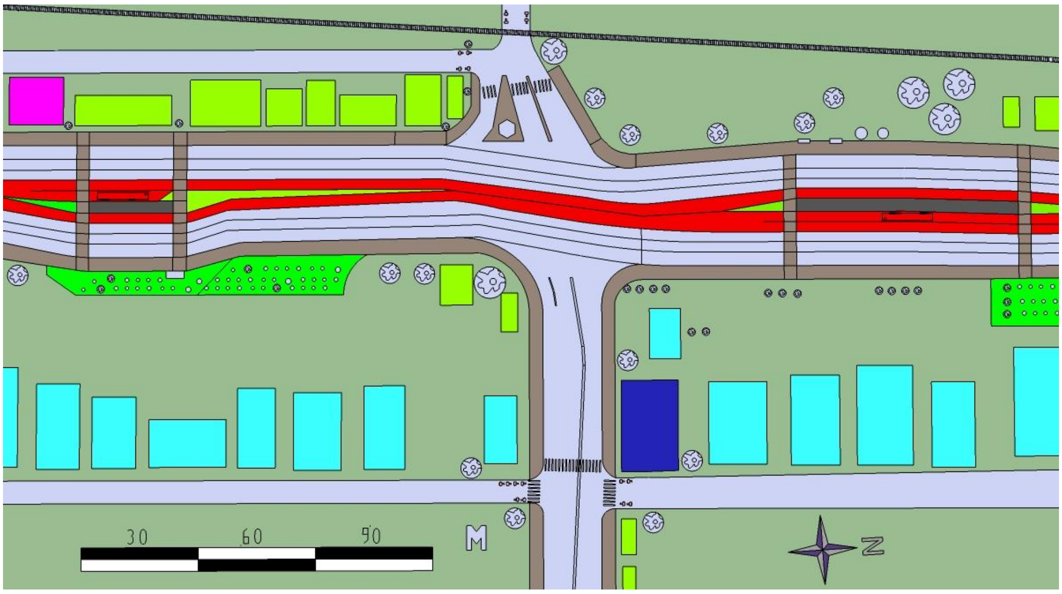

Figure 5.16: Physical placement of BRT station at Kakoli-Banani location

BRT Station Platform

Following dimensions were considered for Kakoli-Banani location:

Length: Length of station platform for northbound was provided 20 m long whilst for southbound was 100 m long. This length would be sufficient for a single-bay station and two-bay station respectively to operate articulated vehicles.

Width: The width of BRT station platform was assigned 12 ft (3.65 m).

Other Aspects of BRT Station

Passenger shade: A shade was provided for shelter/protection of passenger from heat of sun and rain.

Platform height: The station boarding platform was made 90 cm high to match the height of the bus floor and thus allow platform level boarding.

Bus docking at station: Drivers will align buses as close as possible to the boarding platform with the help of wheel guidance tracks on the ground. This will ensure space efficiency at stations and avoid incidents when buses dock at platforms.

Ticketing system for BRT services: Ticket counter placed at station entrance to collect fare and validate fare so that only the passengers having a valid ticket for trip will be allowed to access in station. The ticketing system will use entry/exit gates with turnstiles in stations and the access for passengers to BRT station will only be through the authorised entrances/exits. At least one flap barriers will be provided with spacing of 900 mm at each station for wheel chair access. After entering into stations, the passengers will be able to board on the next bus arriving at station. Tickets could be sold and checked either automated or manual or both.

Fencing: As it is a common practice for residents in Dhaka to cross the road at points even if no traffic light exists or no pedestrian crossing are allowed; a fencing of steel bars was provided to prevent unauthorised entry to the station as well as to restrict random crossing of BRT lane by pedestrians. The inner sides of footpaths will be suitably fenced on either side of the stations for a stretch of minimum 100 m to prevent unauthorised entry to the BRT station as well as to restrict pedestrian's random crossing of the road.

BRT Lanes and Mixed Traffic Lanes

One BRT lane for each directions and a bypass lane at station (to allow overtaking the vehicle waiting at stopping bay) was provided. The remaining ROW of road space was allocated for three lanes for mixed traffic and a footpath in each direction.

Width of the lanes

Figure 5.17 shows the cross-section of ROW at Kakoli-Banani location; the width for BRT lane was provided 9 ft (2.75 m) at station whilst 9.5 ft (2.90 m) at midblock. Even though a BRT lane of 2.7 m wide would work for a guided bus way, it was decided not for choosing a guided BRT for Dhaka to reduce its infrastructure and maintenance costs.

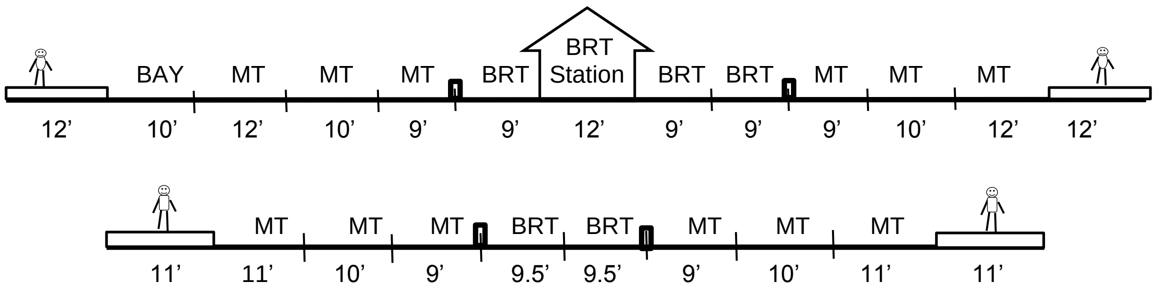

Figure 5.17: Cross-section of ROW of Banani-Kakoli location at station (above) and at midblock (below)

The width of mixed traffic lanes was provided 9 ft (2.75 m), 10 ft (3.05 m) and 12 ft (3.65 m) respectively for the lanes next to BRT lane, middle one, and curb side lane at station whilst at midblock of the corridor (other points, except station) it is 11 ft (3.35 m) for curb side lane and for remaining two are same as at station. Width of the mixed traffic lanes is reasonably low, less than 3 m, as multiple lanes had to accommodate within a relatively narrow ROW of road space. However, relatively narrow lanes for mixed traffic would not be a problem because width of existing mixed traffic lane is (as seen in Section 6.2.1) is 9 ft (2.75m) or 10 ft (3.05m) wide in this road.

Convenient Distance for Modal Changes

It was hypothesised that a distance up to 200 m, which a person can walk within three to four minutes would be convenient for passengers for modal changes between rickshaws and BRT systems. Therefore, a distance of about 50 m to 200 m was considered for modal changes between rickshaws and BRT systems. However, the distance passenger would need to walk at BRT station for modal changes to/from rickshaws will depend on where the rickshaws are dropping passengers at BRT station and where rickshaws are waiting to pick up passengers.

Spaces for Rickshaw Waiting

Designated spaces for rickshaws (waiting areas to load and offload BRT passengers) were provided in the corner of connecting branch roads, as seen in six points (numbers 1 to 6) in Figure 5.18.

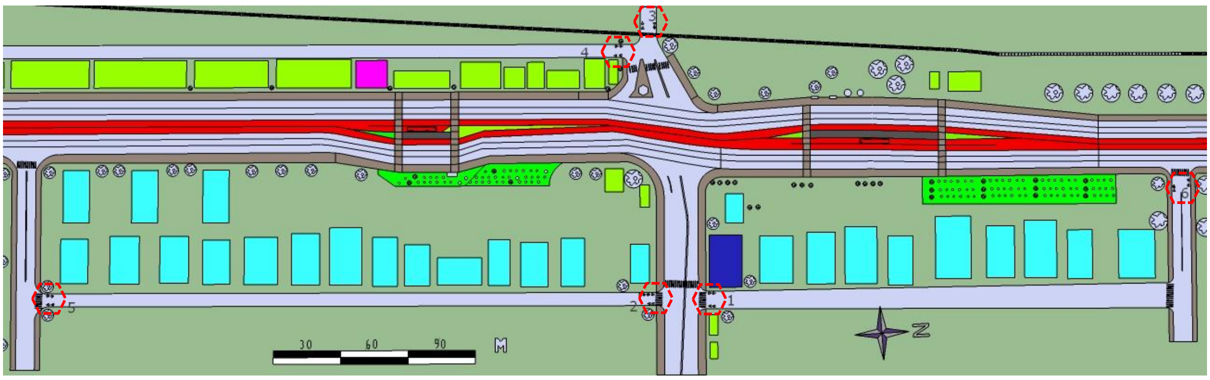

Figure 5.18: Rickshaw waiting areas at Kakoli-Banani station

The distance would need to walk for passengers from rickshaw stands to BRT station is ranging from 73 m to 220 m. The distance for modal changes between rickshaws and BRT in different point is like: from point 1 and 2 is about 330 ft (100 m) to southbound BRT station and 280 ft (85 m) to northbound BRT station, from point 3 is about 290 ft (88 m) to BRT station of both directions, from point 4 is about 270 ft (82 m) to southbound BRT station and about 240 ft (73 m) to northbound

BRT station, from point 5 is about 720 ft (220 m) to northbound BRT station, and from point 6 is about 550 ft (168 m) to southbound BRT station.

Organising Rickshaws for Queuing at BRT Station

At least 10-15 rickshaw spaces were provided in each of the rickshaw stands. However, about 30 rickshaw spaces are provided at point 1 and 2 (refer to Figure 5.18) due to more demand (as observed many rickshaws waiting). Road marking (a demarcation line) was given at rickshaw stands to show where rickshaws should wait and follow a tidy queue while waiting for picking up and dropping off passengers. Moreover, fencing was provided to make channelization of rickshaws to form a tidy queue at rickshaw stand when waiting.

Pedestrian Access to BRT station

Considering the high pedestrian flow, the width of footpaths was set 12 feet (3.65 m). Pedestrian road crossing to access into median BRT station was provided by both at-grade crossing and overpass. Width of overpass or underpass was provided for 16 ft (4.88 m) wide.

At-grade crossing

At-grade crossing was provided with Zebra-crossing. Two crossings were provided in both horizontal edges of the station platform (as seen in Figure 5.19). The width of Zebra-crossing is 4 m wide to allow crossing a large volume of pedestrians at a time. As the stations are adjacent to road intersection, pedestrian could cross the mixed traffic lane during red phase of the intersection traffic signal.

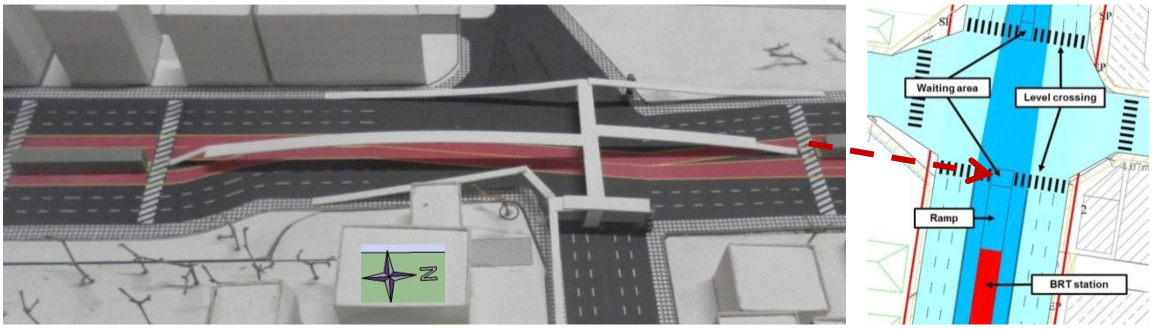

Figure 5.19: Pedestrian road crossing and waiting area at Banani-Kakoli Station

A waiting area was provided in the middle of the level crossing, which will have two functions: allow people to access the BRT station from the intersection, and allow people who want to cross the street to wait until they have a green signal to cross. The waiting areas were connected to the station platform with an access ramps so that passengers could access to the BRT station platform. The width of access ramps was made same as the station width and the length was at least 10 m.

Overpass

Overpass was designed to connect between both stairs and sloped ramps to provide access from rickshaw stands to the BRT station platform as well as slope ramps connecting both BRT station platforms. Width of the overpass was 13 ft (4 m) to allow smooth pedestrian flow in both directions. The vertical clearance of overpass was kept at a height of at least 5.5 m to allow vehicle movements underneath it. The ramps are provided with a sloping of 1:8 gradient. As the ramps to overpass would incur longer walk, some passenger may not willing to use it and instead expect something quicker for using overpass. Therefore, two stairs (in circular shape) were provided in two corners of intersection. The escalator or elevator was not suggested as these will increase cost and there is regular shortage of electricity in Dhaka. A shade was also provided over the overpass to protect passengers from sun and rain.

Passenger Facilities at BRT station

Following passenger facilities were considered to be provided at BRT station:

- The station open to the flow of air to ensure natural wind circulation and ventilation. High enough ceiling of the platform for the installation of fans.
- Tiled floor with a non-slippery surface and tactile pavers to guide people with vision impairment.
- Direction sign towards BRT and rickshaws for ensuring a smooth flow of passengers at modal interchange area; information screen provided at BRT station to keep passengers constantly informed about BRT services.

5.3.4 Initial Plan of Location B: Sayedabad Area

This section briefly explains the design of BRT station for Sayedabad location, as seen in Figure 5.20.

Station Location

Single elongated BRT station to serve for both directions of bus-way of a ‘closed system’ BRT was considered for Sayedabad. The station platform was placed about 180 ft (55 m) away from the intersection in one side and about 450 ft (135 m) away from the rail line in the other side (refer to Figure 5.20), but very close to the inter-district bus terminal which is potentially would be origin or destination of a large number of BRT trips.

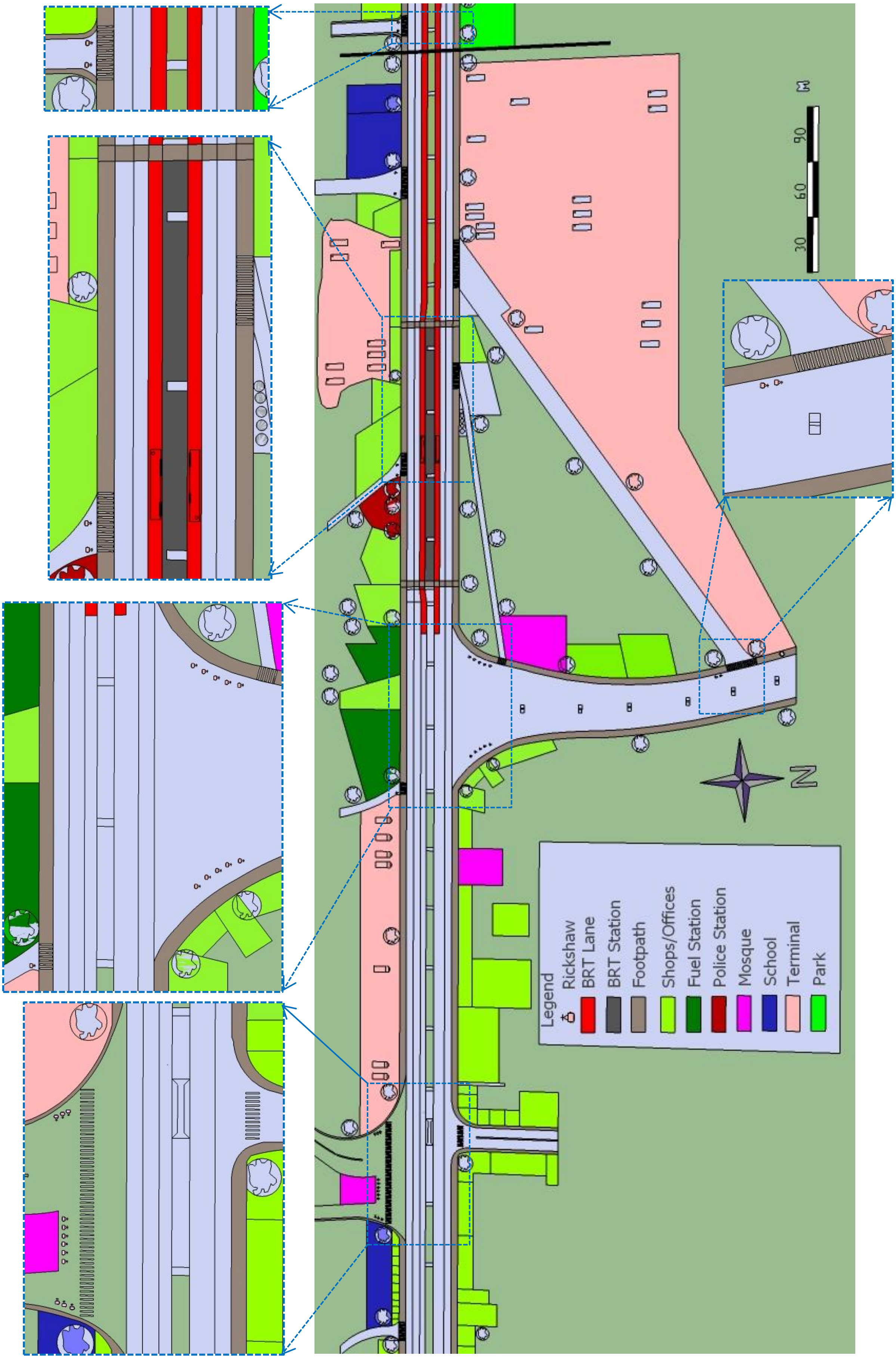

Figure 5.20: Initial plan of BRT station prepared for Sayedabad study location

BRT Station Platform

Following dimensions of station platform was considered for BRT station:

Length of the station: The length of station platform was provided 120 m to accommodate two bus-bays per direction. This length is sufficient to operate 18.5 m long articulated vehicles.

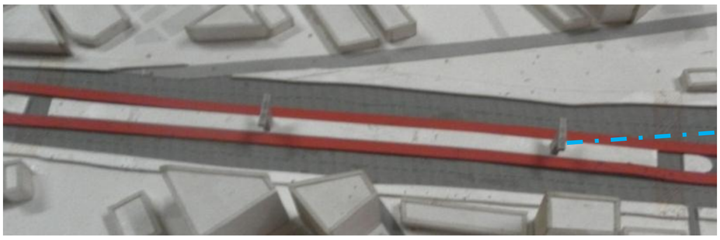

Figure 5.21: Station platform at Sayedabad utilising road space width taken by pillars of the flyover

Station width: The BRT station platform was placed in the middle of the road, underneath of flyover, to utilise the unused road space due to pillars of the flyover. However, there will be three or four pillars at station platform as there are pillars in every 80-90 ft (24.5-27.5 m) interval along the flyover. Therefore, if station width is same as width of pillars then it would not be possible for passengers to move from one side to other side of BRT station platform. Hence, BRT station was provided 16 ft (4.9 m); the flyover's pillars will take up about 13 ft (3.95 m) width of the station and 6 ft (1.85 m) at longitudinal direction for four times (Figure 5.21).

Other aspects of BRT station

Other aspects such as platform height, bus docking at station, ticketing and fencing for Sayedabad location are same as Kakoli-Banani, that is discussed in previous section (Section 5.3.3).

BRT Lanes and Mixed Traffic Lanes

One BRT lane was provided for each direction. No overtaking lane was provided as it is the first or last station of the BRT route. The remaining width of road space was allocated for two lanes for mixed traffic and a footpath in each direction.

Width of the lanes

Figure 5.22 shows the cross-section of ROW; the width for BRT lane at station is 9 ft (2.75 m) whilst at midblock it is 10 ft (3.05 m) wide. The width of the mixed traffic lanes both at station and at midblock was provided 9 ft (2.75 m) for the centre lane and 12 ft (3.65 m) for the curbside lane.

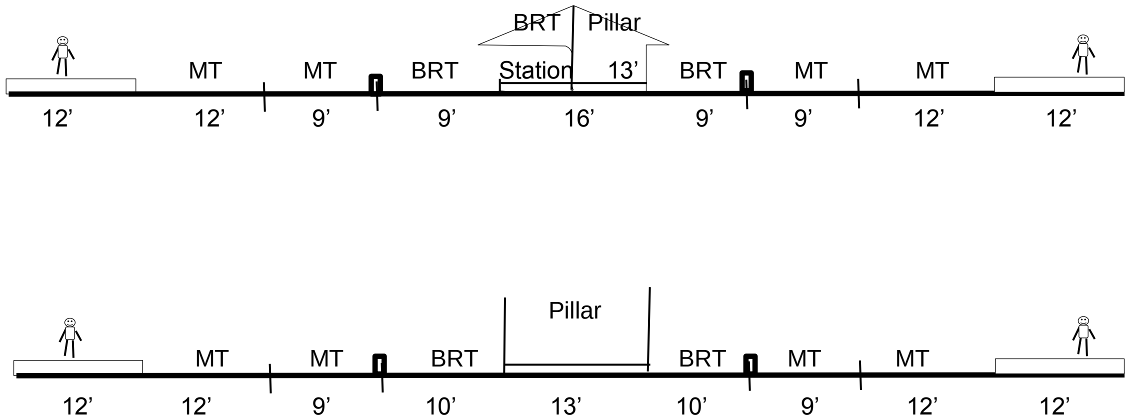

Figure 5.22: Cross-section of ROW of Sayedabad location; at station (above) and mid-block (below)

Convenient Distance for Modal Changes

A distance of about 50 to 200 m was considered for modal changes between rickshaws and BRT systems. It was hypothesised that a maximum distance of about 200 m, which a person can walk within 2-4 minutes, passengers would willing to walk for modal change.

Spaces for rickshaw waiting

Spaces for rickshaws (waiting to load and offload BRT passengers) were provided in the corner of all the connecting branch (narrow) roads, as seen point 1 to 10 in Figure 5.23. It was estimated that modal interchange between rickshaws and BRT will involve a maximum 200 metres of walking (or 2 to 4 minutes of walk) for passengers.

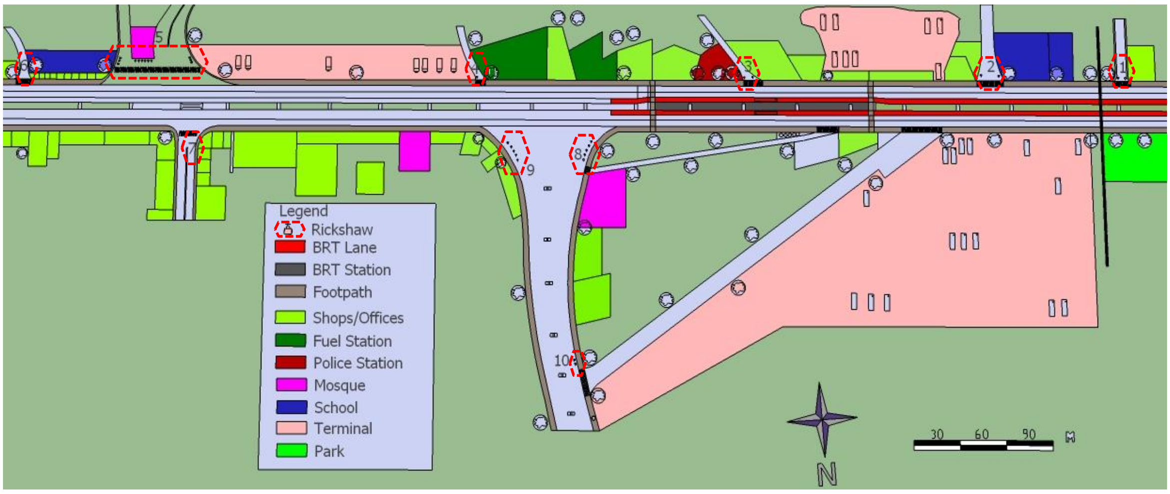

Figure 5.23: Rickshaw waiting areas at Sayedabad station

Figure 5.23 shows that walking distance to BRT station from point 1 is about 530 ft (161 m), from point 2 is about 270 ft (82 m), from point 3 is about 100 ft (30 m), from point 4 is about 320 ft (98 m), from point 5 is about 750 ft (228 m), from point 6 is about 820 ft (250 m), from point 7 is about 700 ft (213 m), from point 8 is about 180 ft (55 m), from point 9 is about 280 ft (85 m), and from point 10 is about 590 ft (180 m) for modal changes between rickshaws and BRT.

Organising Rickshaws for Queuing at BRT Station

At least about 10-15 spaces for rickshaws were provided in each rickshaw waiting areas (refer to points 1 to 10 in Figure 5.23). However, due to more demand about 30 spaces were provided at point 5. Road marking (a demarcation line) was given showing where rickshaws should wait and follow a tidy queue.

Pedestrian Access to BRT station

Considering that Sayedabad is the existing inter-district bus terminal and possibility of high pedestrian flow, the width of footpaths was set 12 feet (3.65 m). Width of overpass or underpass was provided for 16 ft (4.88 m) wide.

The flyover would not provide enough room to establish an overpass and the existing underpass is seldom used by passengers. Therefore, at-grade pedestrian crossing was provided by Zebra-crossing for pedestrian road crossing to access into BRT station.

Passenger Facilities at BRT station

Following passenger facilities were considered to be provided at BRT station:

- A tiled floor with a non-slippery surface and tactile pavers to guide people with vision impairment.
- Direction sign at modal interchange area to guide passengers towards BRT and rickshaws for ensuring a smooth flow; information screen at BRT station platform to keep passengers constantly informed about BRT services.

5.4 Deriving Public Opinions about the Plan

After selecting the study location and preparing the initial plan of BRT station for those locations, public opinions were derived about the initial plan prepared for modal integration and fare integration of rickshaws with BRT systems. The methods and tools applied for deriving public opinions are discussed below.

5.4.1 The Method for Deriving Public Opinions

Various methods for exploring public opinions have been reviewed and described in Section 3.3. Of the methods discussed, deliberative methods, similar to the method Marsden and King (2009) used, through focus group discussions (FGDs) were applied to explore public opinions and incorporate their views in designing BRT station to integrate with rickshaws. Deliberative methods are better than any other methods for presenting or showing the design to the public and then allowing them time to discuss about the plan. It is expected that the "experts should act on the results of participation when those who have participated are representative of the interested parties (all of them) and when their opinions are informed and considered" (Cohen, 2005: p.8). Often the views of rickshaw pullers (or weaker group of society) and the issues of informal modes are not considered in traditional transport planning and decision-making process in developing countries. Deliberative method with FGDs is a good choice for inclusion of ordinary or oppressed people like pullers in collective decision-making process. Providing power to the ordinary and oppressed people through participatory research for knowledge generation will contribute towards critical reflection of social reality (Selener, 1997). Thus, the outcomes of participation will allow social inclusion and social justice or improved participation of users in design and delivery of services (Healy, 2006; Chataway, 1997). Therefore, deliberative methods (focus groups) were used for this research to explore public opinions.

Exploring public opinions about the design of BRT station involved two major aspects: *firstly*, issues related with groups (i.e. identifying the stakeholders and groups, group size, group dynamics, recruiting the participants) and *secondly*, issues related to the techniques for presenting the plan to the participants during discussion. The details on these aspects are discussed in following sections.

5.4.2 The Groups and the Participants

The following aspects were considered while forming the groups and conducting the FGDs, as of the discussion in Section 3.4.

Homogenous Group

People of poor income bracket and women in Bangladesh are not vocal in public due to traditional culture of society and hierarchy in power-structure. Therefore, for conducting FGDs, each group was kept homogenous in terms of income and gender to ensure active participation of all of the members in discussion.

Category of the Groups

Considering the purpose of the research, the passengers of rickshaws and public transport (particularly the existing bus service or potential BRT systems) as well as the rickshaw-pullers are the key stakeholders and considered for FGDs. Given that the provision of transport facilities is highly gendered and that often the voices of women are not listened to in a mixed-group (Turner and Grieco, 2006; Turner and Fouracre, 1995; Hamilton *et al*, 2005; Hamilton, 2001), as discussed in Section 3.4, groups of 'men only' and 'women only' were formed. However, all the participants of 'rickshaw-puller' group were male, as there are no females pulling a rickshaw in

Dhaka. Beside this, passengers of ‘middle-income’[19] and ‘poor-income’ bracket were considered in separate groups. Because, there might be difference in usages of rickshaws and public transport depending on household income as research on transport reveals that there is a relation between travel pattern and income.

A separate group was formed for disabled people because planning and design of public transport must consider their particular accessibility needs in transport usage. However, like the other groups, the ‘disabled-group’ was not location specific (one group discussed about both study locations) and included both men and women. Even though this is a mixed-users group, a back-up procedure was followed through effective facilitation to extract female member’s voice. Thus, the different groups for FGDs in the two study locations are summarised in Table 5.2. Resource were available for conducting 11 sessions of FGDs, therefore, only one session per group was conducted.

Table 5.2: Different groups for FGDs

Category of the Stakeholder Groups	**Location A (Kakoli- Banani)**	**Location B (Sayedabad)**
Middle-income men-only group	FGD 1	FGD 6
Middle-income women-only group	FGD 2	FGD 7
Poor-income men-only group	FGD 3	FGD 8
Poor-income women-only group	FGD 4	FGD 9
Rickshaw pullers	FGD 5	FGD 10
Disabled (gender balanced)	FGD 11	

Group Size and Dynamics

There were 5 to 8 people in each group (e.g. as seen in Figure 6.4), which matches with the group size of King (2010). The groups were kept small so that it would provide opportunity for active participation and discussion among the members.

As already mentioned, the participants in a group for a single session were kept homogenous in terms of income and gender. However, in each group (outlined in Table 5.2) it was ensured that the members varied in age, educational and employment characteristics. For example, except the disabled group, each of the user groups included at least a student[20], an elderly[21] person, an employed person,

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[19] Classification of income brackets in Dhaka based on monthly income was defined by STP (2005) Household Survey; low-income group BDT 12,500 or less, middle-income group BDT 12,500-55,000, high-income group over BDT 55,000. This research considered BDT 10,000 or less as poor-income and BDT 10,000 to 30,000 as middle-income bracket.

[20] As the students of elementary or secondary school often do not have their authority for choosing their travel mode (mostly dependent on their parent’s decision), the mature students who can decide themselves for their travel (i.e. college or university students) were considered.

a teacher, an unemployed or job seeker, a housewife (only for ‘women-only’ groups), and a business person. On the other hand, the disabled group consisted a blind woman, a wheel-chair using lady, a dumb man, a crutch using man, and a wheel-chair using man.

Recruiting the Participants

The participants of different user groups were identified and recruited by using snowball[22] technique. The qualitative sampling requires identification of appropriate participants who can best inform for the study (Fossey *et al*, 2002). Therefore, while recruiting participants for user based FGDs it was ensured that each participant either living within 1 km of the study location or regularly travel through that location (and walk or interchange modes to/from rickshaws) so that (s)he has sufficient experience or knowledge about the traffic and spatial contexts and related issues of that location. However, these criteria were not considered for disabled group - a group was considered for discussing for both locations. On the other hand, for rickshaw-pullers’ group, at least one or two pullers were considered from different points surrounding the study location where rickshaws were waiting.

Participants for two groups, FGD 11 and FGD 6 (refer to Table 5.2), were recruited by ‘third’ party whilst for the rest nine groups were recruited by the researcher. For disabled group (FGD 11) it was done by National Grassroots Disability Organisation (NGDO)[23] and for middle-income men-only group for Sayedabad location (FGD 6) was done by Work for Better Bangladesh (WBB)[24] Trust. In the beginning, the researcher explained the criteria about the participants to be recruited for the respective group. However, during FGD the researcher realised that the participants who were recruited by WBB are very familiar and easy going with such type of group discussions or participatory research and half of them were involved with WBB activities or regularly participate in meetings and discussions. Thus, participants recruited by third party (for one group), all of them were not representing the ordinary public of society (not error-free). Nevertheless, for all other groups it was ensured that the participants recruited for FGDs fulfil the criteria for selection and represent the ordinary public of society.

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[21] Employees in Bangladesh retire at the age of 60 years old; therefore, elderly people for this research has been considered if someone is over 60 years old.

[22] Snowball sampling technique is one in which the researcher collects data on the few members of the target population (s)he can locate, then asks those individuals to provide information needed to locate other members of that population whom they know. It is a non-probability technique.

[23] Non-governmental organisation (NGO) working in Bangladesh for the betterment of disabled people; http://www.ngdobd.org/about-ngdo/

[24] NGO working with local people in Dhaka on various urban issues; http://www.wbbtrust.org/

5.4.3 Presenting the Design to Public During FGD

The major challenging task was how to present the initial plan of BRT station in FGDs so that all of the participants can understand it and can discuss its various aspects. Before going to the field, a seminar presentation about the methods and tools for this research was made at the Institute for Transport Studies (ITS), University of Leeds where the audience suggested that showing a three dimensional (3-D) physical model of the proposed design may help the lay-person for better understand the plan and this may enhance their effective participation in discussion. Furthermore, discussion in Section 3.5 showed that 3-D visualisation techniques make it easier for the viewers (layperson) to understand the representation and spatial context of the proposed project more realistically. The 3-D animation and modelling probably could be better for understanding the every detail at micro level. However, preparing 3-D virtual models involves high cost and using computer-based virtual techniques in developing countries is risky; hence, a 3-D physical model would be better rather than a virtual model for public participation in transport planning.

It was hypothesised that a 3-D physical model would be helpful to explain the proposed development (how BRT looks like) to the participants of FGDs and help them understand better (or more easily) what changes might occur in the locality. Therefore, a 3-D physical model for each case study location was prepared (as seen in Figure 5.24) and used in FGDs for public participation. The details about 3-D physical model are discussed below.

Physical 3-D Model Displayed in FGDs for the Study

An initial 2-D plan of the proposed BRT station was prepared with AutoCAD; and then it was printed in a large size paper and placed on a hard base. To construct the 3-D model, then the building blocks, trees, and other objects of the study area were made with hard paper and materials and then placed on the map and stuck with glue which gave a 3-D view (seen in Figure 5.24).

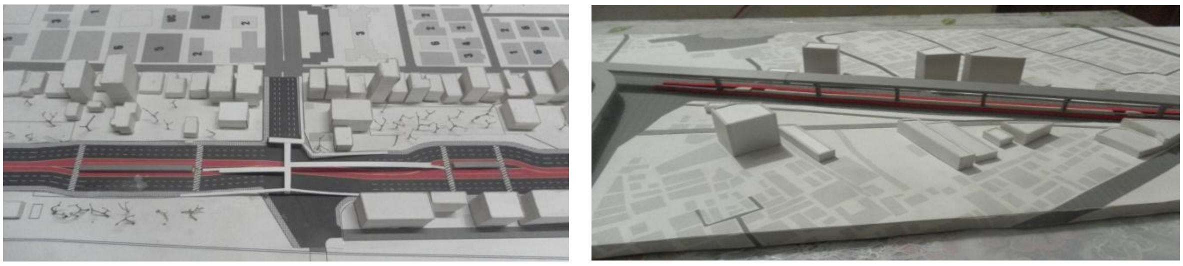

Figure 5.24: The 3-D physical model of the initial plan of BRT station area; location A (left) and location B (right)

Cost

In order to reduce costs, the model was prepared by undergraduate (4th year) students of architecture school in Bangladesh University of Engineering and Technology (BUET). The model prepared was of a lower standard than is used for professional purposes in architecture. However, it was of a sufficiently high standard to help laypersons (general public) to understand how the study area (particularly the spatial arrangement of the location) and the proposed development of BRT would look. Thus the model enabled better discussion and participation of the public in FGDs. The students were given only BDT 5,000 (equivalent to GB£40) for each model to cover their expenditure for purchasing materials required to prepare the model and a token lump sum as a gift for volunteering their time (three students spent two days). In comparison, the researcher ascertained from professional architects that preparing each of these models to a professional standard would have cost BDT 25,000 to 30,000.

Colour

Colours of a model are very important. A few researchers mentioned proper consideration must be given about colouring of a model. For instance, Gibson *et al* (2002) emphasised the necessity of realistic colouring. This is because, “Just as the materials and colours of a real architectural space influence human perception, the colouring of architectural models substantially determines the way they are perceived and understood” (Knoll and Hechinger, 2007: p.107). As mentioned earlier, the purpose of the 3-D model was more about showing the existing spatial contexts and proposed development of BRT to facilitate the discussion; hence, the distinct colours for the BRT lanes, BRT station, roads, pedestrian paths and pedestrian crossings were given in the model (e.g. as seen in Figure 5.24). All other structures (buildings) were recognizable by their different size and heights.

Scale

The scale of a map or a model could be of various sizes. However, its choice depends on how much detail is needed. A small scale model could be of 1:500, whilst the figures in profile could be 1:100 to 1:10 and the figures of paper and pins could be 1:200 to 1:100 scales (Knoll and Hechinger, 2007: p.96). The scale of the model prepared for this study was 1:700. With this scale, it was possible to keep the model to a reasonable size (about 1m by 0.5m) to transport it to the venue for FGDs conveniently on public transport. This scale also allowed visualising and distinguishing the major aspects of the BRT station (modal interchange areas for integrating between rickshaws and BRT systems) and the surrounding area. However, the model prepared was not in a great detail.

5.4.4 Administering the FGDs

The FGDs for this research were conducted between November 2011 and February 2012. FGDs for location A (Kakoli-Banani) were conducted on Wednesdays afternoon between 2 pm and 5 pm whilst for location B (Sayedabad) were conducted on Saturdays morning between 10 am and 1pm.

The researcher himself played the role of moderator for facilitating discussion for all FGDs. Similar to the technique of Morris *et al* (1998), a large map was used for showing different locations and the detail of the case study locations to the participants. Visual displays of the case study locations and their existing traffic situation were done by showing photographs previously taken by the researcher. Along with the display of study locations, some photographs of good practices of BRT systems (from other developing countries) were also shown. A 3-D physical model of the initial plan (prepared for BRT station) of case study location was always kept in front of the participants, in the middle of the group (as seen in Figure 6.4 and Figure 6.7), during discussion.

Discussion of each session lasted for about 90 minutes. A break for about 10 minutes in the middle of discussion session was given; and during the break (when the discussion was half-way through), tea and refreshments were provided for the participants of each FGDs except the rickshaw-puller groups. In the end of discussion, all the participants of each FGDs have received a small token remuneration of BDT 200 (equivalent to GB £1.65) as gratitude for their volunteering of time and participation.

Discussion Protocol and Note Taking

A standard discussion protocol (see in Appendix A) was followed by the moderator during FGDs to cover different aspects of the research and to have an efficient facilitation for discussion. However, the protocol was not rigid so that the researcher was able to accommodate diverse issues while discussing with different groups.

The discussion was made in the local language (Bengali), which helped the participants in discussing effectively. Along with note taking, the discussion of whole session for each FGD was recorded in video tapes.

Venue for Conducting FGDs

The venue for conducting FGDs was unfamiliar to the participants but very close (within 100 m) to the site (study area). Furthermore, the venue was widely known to all of the participants and easily accessible for them by public transport or walking. FGDs for the user based groups were held at Banani Club of Roads and Highways Department (RHD) for Kakoli-Banani location and Jatrabari Krirachakra (Club) for

Sayedabad locations. For the disabled group, it was held in the office of National Grassroots Disability Organisation (NGDO), located at Banani Road 11. There were table and chairs for seating and discussion both in Banani Club, Jatrabari Club, and NGDO Office. Comfortable seating arrangements of the participants were arranged in a circular shape so that everyone could see each other and the papers, pens and markers were provided for facilitating the discussion. On the other hand, FGDs with rickshaw-pullers were held beside the road on pedestrian path (or open space), participants seating on ground.

5.5 Deriving Policymakers’ Opinions

The methods and tools applied for deriving policymakers’ opinions regarding rickshaw’s integration with BRT systems are discussed below.

5.5.1 The Method for Deriving Policymakers’ Opinions

Of the methods reviewed in Section 3.6, interview of the key informants was applied in this research for exploring policymakers’ opinions about the initial design of BRT station prepared for case study locations. Face-to-face in-depth interview of the policymakers and transport professionals were conducted based on a semi-structured open-ended questionnaire format.

5.5.2 Recruiting the Participants

Total 24 policymakers and transport professionals were selected as the key informants and interviewed. This size of sample is sufficiently adequate as the number is larger than the sample size used by Zemp *et al* (2007) and Hull (2008). While selecting the key informants, it was considered that the following category personals (a detail list of interviewees is available in Appendix B) are included:

- Official of the city transport authority; traffic police; ministry of transport; ministry of environment;
- Transport experts, academia;
- Project manager and the consultant of on-going Dhaka BRT project;
- Urban planner of the city development authority and municipal authority;
- Traffic enforcement officer of municipal authority and the Department of Environment (DoE);
- Development activist or civil society or non-governmental organisation (NGO);
- Elected public representatives.

As the number of female in policymaking in Bangladesh is very few, the female member of a position (if available) were considered first for the interview to accommodate gender dimensions.

An initial contact was made with the prospective interviewees over telephone and an appointment was secured for a visit. In the first visit, the researcher briefly explained about the research and then both of them agreed on a specified date, time and venue for interview. Until the specified date of interview, every week the researcher informed the prospective interviewee over telephone to follow up and to remind the scheduled date and time. In average it took about four to six weeks from the first contact with interviewee to accomplish the interview for a sample (informant). Often it was found that having previous contact with any friend or family member or colleague of the prospective interviewee was very helpful for recruiting.

5.5.3 Administering the Interviews

The interviews were conducted between September 2011 and March 2012. The researcher visited to the interviewee's office or house where (s)he preferred in an agreed date and time. The in-depth interview was conducted face-to-face, following a semi-structured open-ended questionnaire (see interview prompts in Appendix A3). The questionnaire format was structured in different sub-sections to cover different aspects of the research questions; both on generic aspects and particularly concerned with case study locations of Dhaka city. While conducting the interview, the researcher showed the photographs of the study locations and the initial plan of BRT station area with PowerPoint slides in a portable computer. Each interview was for a duration of about 30 to 60 minutes and had been audio recorded along with note taking.

Beside the 24 interviewees of key informants mentioned above, informal discussions were also done with the owners of rickshaws and transport workers (i.e. auto drivers, easybike drivers, e-rickshaw pullers).

5.6 Analysis of the Data

After completing the FGDs and interviews of the key informants, collected data were transcribed and then translated from Bengali to English. There were about 16 hours of video data (from FGDs) and about 24 hours of audio data (from interviews). Qualitative analysis of all the data (collected from the field as well as from other secondary sources) was done to fulfil the research objectives and for preparing the report.

Transcribed and translated data were organised and analysed both in manually and using computer based technique NVivo. Descriptive summaries and categorisation of collected data were done under the topics or themes of discussion and then explanation-building (explanatory) analytical technique was folloed to report the findings.

5.7 Summary of the Chapter

This chapter discussed the research design for the case study conducted in Dhaka city. First, a conceptual design of the research was presented. Second, two case study locations were identified and selected for detailed in-depth study. One location (Kakoli-Banani) is planned developed area and surrounding areas are used for residence of higher or upper-middle income bracket and for trade/commerce, the major corridor is rickshaw free (operation of rickshaws and other NMT modes are prohibited). Another location (Sayedabad) is spontaneously developed and surrounding areas are used for residence of poor or lower-middle income bracket, the major corridor (where proposed BRT will operate) is mixed traffic. Third, the initial plan of BRT station for case study locations were prepared for modal integration of rickshaws with BRT systems, based on literature review and global best practices of BRT systems as well as local spatial and traffic situation. Fourth, FGDs of the passengers of various socio-economic groups as well as rickshaw-pullers were conducted to explore public opinions about the initial plan prepared for modal integration as well as the possibility of integrated fare for trips involving both rickshaws and BRT systems. About five to eight participants were recruited for each group and the participants within the groups were homogenous in terms of socio-economic class and gender. A 3-D physical model of the initial plan, BRT station and its surrounding area, was prepared and it was used in FGDs (always kept in the middle of group) so that participants understand the plan better with spatial contexts and take part in effective discussion. Fifth, face-to-face semi-structured in-depth interviews of the key informants (e.g. transport professionals and policy makers) were conducted to derive the policymakers’ opinions about the initial plan prepared for modal integration between rickshaws and BRT as well as about the integration of fare for trips involving both rickshaws and BRT systems.

Next chapter will discuss the public opinions derived from the FGDs conducted in case study locations in Dhaka city.

Chapter 6
Public Opinions – Results from the FGDs

This chapter describes the public (passengers and pullers) opinions derived from the focus group discussions (FGDs) about the initial transport plan which was prepared for modal integration in case study locations as well as public opinions about fare integration between rickshaws and bus rapid transit (BRT) systems. First the chapter discusses the major findings about the method itself applied for conducting FGDs (e.g. using 3-D physical model) and then reports on the results (public opinions) derived from the FGDs concerning various aspects of physical design of BRT station area for modal changes and fare integration between rickshaws and BRT systems.

6.1 Using a 3-D Physical Model During FGDs

Using a three-dimensional (3-D) physical model would be better for public participation in transport planning or designing transport infrastructure in developing countries, as already been discussed in Section 3.5. Therefore, a 3-D physical model of the case study location was prepared and used in FGDs for the public participation. This section reports the major findings from two case study locations concerning the use of a 3-D physical model during the FGDs to facilitate the discussion. The main topics and issues covered here are:

- How a 3-D physical model enables explaining the spatial contexts of an area;
- How a 3-D physical model helps the public for understanding the proposed development;
- How a 3-D physical model facilitates discussion on spatial contexts in focus groups; and
- What are the difference among various socio-economic groups about the understanding of 3-D physical model.

Physical 3-D Model Enables Explanation of the Spatial Contexts

The 3-D physical model was a very useful tool, enabling the facilitator to discuss and easily explain features of the study area, the spatial location of the major buildings and roads as well as the proposed BRT station and BRT lanes. For instance, he could point to the model and show where the bus terminal was, or explain that the red lanes on either side of the bus terminal are for the BRT (Figure

6.1). The participants of FGDs just looked at the model and listened to what the facilitator was saying. They were also using their visualisation skills as well as knowledge from their previous travel to that location to understand whether the spatial contexts of the reality were represented in the model. The participants were also asking questions to the facilitator to clarify whether their understanding about the model was right. For instance, for the case of Sayedabad location, pointing to the model a participant of the poor-income women-only group correctly identified the rail line and the nearby junction of Janapath, indicating their ability to relate the spatial context in the model. Another participant of middle-income men-only group pointing towards Janapath junction, as seen in Figure 6.2, asked whether it was Janapath. Similarly, almost all the participants in each groups of FGDs were able to relate the spatial contexts of the study area with the help of a 3-D physical model.

Figure 6.1: A participant pointing to BRT station of Sayedabad in model

Figure 6.2: A participant pointing to Janapath More of Sayedabad in model

It was observed that the majority of participants in FGDs were able to understand and recall the area very well with the help of a 3-D physical model. However, a few of the participants needed some time to relate the spatial contexts correctly and exactly at the precise points in the model. Nevertheless, after the facilitator had explained or clarified a few locations in the model they were able to navigate the 3-D physical model very well with reference to those points.

Figure 6.3: A participant pointing to a road in model of Kakoli-Banani location

Figure 6.4: A participant pointing to the BRT lane in model of Kakoli-Banani location

It was observed that the rickshaw-pullers, who are mostly illiterate, knew the location and roads very well and were also very good at navigating in the 3-D physical model. For instance, one participant of Kakoli-Banani location pointing in the model was able to name the specific roads (Figure 6.3). On the contrary, participants who travels less often or mostly use private cars for their trips were very poor at navigating the 3-D physical model. Such as, a housewife (participant of middle-income women-only group) of Sayedabad location who mostly uses private car showed the wrong side of direction while coming from Jatrabari and requiring a change of mode from rickshaws. These indicate that ability of a person to navigate in a 3-D physical model is not related to his/her education attainment but how often make trips (familiar with road network and neighbourhood) and mode of the travel.

Physical 3-D Model Helps Understanding the Proposed Development

The physical 3-D model helped the participants to understand the new things or proposed development in the study area – how it would appear after the implementation of the project. For instance, a participant of middle-income women-only group of Kakoli-Banani location wanted to understand the proposed BRT; hence, pointing in model (Figure 6.4) she asked whether the bus would move on red lanes in the middle. Later while discussing about modal interchanges between rickshaws and proposed BRT, a participant of poor-income men-only group showed the points in model (Figure 6.5) where he has to go after alighting from a rickshaw. These are few examples how using a 3-D physical model helped to the participants for their understanding about proposed development. Similarly, having a 3-D physical model was helpful to understand the proposed development for almost all the participants in each groups of FGDs. Without having a 3-D physical model it would be impossible for them to understand the spatial arrangements of proposed BRT and to explain these properly.

Figure 6.5: A participant pointing the interchange area in the modal of Sayedabad

Figure 6.6: A participant showing in model where a rickshaw stand is required

Figure 6.7: A participant is showing the circulation path of rickshaws in Sayedabad

However, explaining spatial contexts of any well-known or prominent point might be possible without having a 3-D physical model or 2-D map. A participant of middle-income women-only group of Sayedabad told rickshaws will wait in “that side, beside the Ideal School”. As she had mentioned a well-known point, the school, this might be possible to explain without having a 3-D physical model. Nevertheless, a 3-D physical model provides better reasoning with the location and spatial contexts of other objects. On other occasions it was found that participants of middle-income women-only group mentioned referring to Kawranbazar and Farmgate, which are not in the model, that “underpass is safer” and “all pedestrians are bound there to use overpass for crossing road” respectively. These reveal a few participants can navigate in their memory (mind map) and able to talk about their previous experience; hence, someone may think that it is not necessary to have a 3-D model during discussion. However, this should be kept in mind that it may be possible for someone (who travels very often) to discuss about some aspects without a map or 3-D model but it would not be possible to explain the spatial contexts. For example, to mention the necessity of rickshaw stands (for boarding and alighting of rickshaw passengers) at particular points of BRT station participants of puller’s group showed pointing in the model (Figure 6.6) where they need a place for rickshaw parking for queuing and dropping passengers. In another occasion, pointing in the model and demarcating an area they said “rickshaws will come from this side; after arriving here and dropping the passenger again [will take passenger and] pass through that side towards there” (Figure 6.7) or “rickshaws of this point will serve only within this area”. Above discussions reveal that the 3-D physical model helped the participants for understanding the proposed development about BRT and relate it with the spatial contexts of the location.

Physical 3-D Model Facilitates Discussion on Spatial Contexts

It was observed that using a 3-D physical model in the FGDs was very helpful to facilitate an effective discussion with spatial reference. For example, about pedestrian access to the proposed BRT station of Sayedabad, participants were showing in model where the pedestrians will cross the road to access into BRT station and where the rickshaws will wait to drop off or pick up passengers. On same topic, participants of the poor-income women-only group explained very quickly and easily what they want and where. Such as, pointing in the model (Figure 6.8) one of them told “here give a traffic signal”. Without having a 3-D model it would be very difficult for them to explain the spatial locations and even they would not able to realise what is required in a particular place.

However, this should be noted that using the 3-D physical model always did not ensure effective discussion among the participants automatically. When the facilitator asked the participants to discuss about the proposed design of BRT station; participants of the poor-income groups did not discuss much compared to the middle-income groups and they often mentioned the model is “ok” or “seems ...... right”. Even, surprisingly a participant of poor-income men-only group of Sayedabad told that the researcher prepared this model considering the specific measurement and requirements, so this is correct. Therefore, the facilitator had to play a crucial role to make them discuss further on the topics.

Figure 6.8: Pointing in the model where traffic signals needed in Sayedabad

Figure 6.9: A participant demarcating an area of Kakoli-Banani in the model

Nevertheless, it was found that using a 3-D physical model in FGDs was very useful for the participants to explain the spatial location or demarcating a particular area very easily and conveniently. For instance, participants of the middle-income women-only group was explaining from which points and locality usually the pedestrians walk towards Banani bus station. Demarcating the area in model (Figure 6.9) one of them was telling “people of this side will come from here ...… from this side”; and again pointing the location in model she added “during [morning] office hours from this point toward this direction goes the majority...…”. These explanations would not be possible without having a 3-D physical model during discussion.

Difference in Understanding the 3-D Physical Model among the Groups

Previous sections explained that using a 3-D physical model in FGDs helped discussing with spatial contexts as well as understanding the possible spatial changes from proposed developments and facilitating effective participation while discussing with spatial reference. However, it was found that the understanding or usefulness of the model varied in different socio-economic groups; which have been summarised in Table 6.1.

Participants of the middle-income groups and the puller groups were able to relate spatial contexts in model themselves whilst other groups required some initial clarification from the researcher or facilitator. This ability of understanding themselves reflects the amount of questions they have raised or asked to the facilitator for understanding the model. Participants of the poor-income groups and middle-income women-only groups asked many questions where poor income women-only groups asked a significant amount of questions. Understanding about the proposed development was also poor among the participants of poor-income women-only groups and moderate for disabled people whilst it was very good or good for the participants of all other groups. The 3-D physical model helped participants engagement during discussion very well for middle-income groups and puller’s groups; they also frequently pointed in the model to locate spatial contexts. Engagement of the participants was good in the FGDs of poor-income men-only groups and the disabled people, even though they did not often pointed in the model. Participants' engagement in poor-income women-only groups was moderate and very rarely they have point the spatial contexts in the 3-D model.

Table 6.1: Difference of usefulness in using a 3-D physical model among the various groups

Observations or criteria	**Middle-income groups**		**Poor-income groups**		**Disabled (mixed gender) group**	**Rickshaw -puller groups (all male)**
	Men groups	**Women groups**	**Men groups**	**Women groups**		
Participants able to relate spatial contexts in model themselves	Yes	Yes	No	No	No	Yes
Participants asked questions to understand the model	Not many	Many	Many	Too many	Not many	Very little
Participants pointed to the model to locate spatial contexts	Frequently	Frequently	Not often	Very rarely	Not often (dumb, blind)	Frequently
Participants understanding well the proposed development	Very good	Very good	Good	Poor	Moderate	Very good
Participants had effective discussion with spatial contexts	Very effective	Very effective	Effective	Less effective	Less effective	Very effective
Participants referred to other parts of city during discussion	Yes	Yes	Yes	No	No	Yes
3-D model helped to progress discussion	Yes	Yes	Yes	Yes	Yes (very challenging)	Yes
Participant's strong engagement during discussion	Very good	Very good	Good	Moderate	Good	Very good
Suggestions about proposed development	Suggested many	Suggested many	Suggested less	Suggested very less	Suggested less	Suggested less

Nevertheless, using a 3-D physical model in FGDs helped to progress discussion very well for all the groups. However, it was a very challenging task FGD of disabled people. The model was also effective in facilitating discussions with spatial contexts. However, compared with other groups it was less effective in poor-income women-only groups as well as in disabled group. About the proposed development, only the participants of middle-income groups suggested many aspects and other groups suggested less where it was very less in poor-income women-only groups. While discussing on different aspects of the study location, participants of all the groups except the poor-income women-only groups and the disabled group referred to the aspects in other parts of the city.

6.2 Public Opinions about the Physical Design

This section reports the public reactions derived from the FGDs about the physical design of BRT station and its surrounding area which was prepared for modal integration of rickshaws with BRT systems. When considering such integration, the design of planning of BRT stations is crucial for two reasons. Firstly, the design of BRT stations is anyway very important for ensuring high levels of ridership. Secondly, the integration with rickshaws will involve different (special) planning and design requirements. Moreover, the physical design for integration should ensure close proximity of the modes for convenience of passengers. Hence, this section at first discusses public opinions about the physical design of BRT station and then discusses how rickshaws could provide feeder services (i.e. rickshaw waiting, organising rickshaws at station) of BRT system and finally discusses about traffic signs and symbols or information for road users related to BRT to improve the overall traffic flow as well as pedestrian's access to BRT.

6.2.1 Planning the BRT Station Area and Design of Station

The topics or main issues covered on planning the BRT station area and design of station are:

- What would be the convenient distance at BRT station for modal changes between rickshaws and BRT;
- How to provide convenient, safe and secure pedestrian road crossing to access into BRT station; and
- What facilities would be required for passengers at BRT station.

Convenient Distance for Modal Changes

A distance of less than 200 metres or a walk of a maximum 2-3 minutes was reported by the majority of participants as a comfortable walking distance for changes between BRT and rickshaws. However, for disabled or older people this distance for modal changes is very short - 50 m or less. For instance, the participants of disabled group reported that they would expect other modes at the same place where they are alighting from rickshaws/BRT whilst the women-only groups also reported that they would like the modal interchange area to be very short to avoid many other problems (such as physical harassments or pick pocketing). Nevertheless, most of the participants in all the FGDs of different groups mentioned that a distance of 50 m or a walk for 1-2 minutes would be better for passengers.

Several participants in FGDs mentioned that the convenient distance for modal changes would vary from person to person and depend on their physical fitness and mentality as well as the built environment of the walkways. They reported that if the walking paths at the interchange area is nice (e.g. clear, clean, and tidy with a smooth surface), then they would be willing to walk a longer distance. However, it was suggested that the maximum distance should not be more than 250 m whilst a few mentioned about 500 m.

Among the groups, it was observed that the men-only groups would walk a longer distance than the women-only groups; of the men-only groups people of poor-income bracket would walk more than the middle-income bracket. However, a few participants of the poor-income groups reported a very short distance, such as 10-15 m, they would like to walk at modal interchange area. This is probably because they rarely use a rickshaw to go to a bus station and have less idea or experience about the spatial arrangements of the modal interchange area.

Pedestrian Access to BRT Station

Concerning pedestrian access to BRT station, in general it was mentioned in all the FGDs that the at-grade crossing would be easy, convenient and fast for the pedestrians. However, the safety issues of pedestrians while crossing the road, mainly due to poor behaviour of drivers and their ignorance or disrespect of traffic signals, was reported as the main drawback of at-grade crossings. Hence, an underpass or overpass for pedestrian crossing was reported on several occasions as a safer option and alternative to an at-grade crossing. However, the older people of all the groups said that they feel tired and discomfort while climbing the stairs of an underpass or overpass. Other participants in each of the groups also acknowledged that climbing the stairs is inconvenient and time consuming for everybody, particularly for the older and disabled or sick people. To solve this problem, it was suggested in FGDs either to have sloping ramps, escalators and/or lifts at underpass and overpass (grade separated crossing for pedestrians) or to ensure a safe at-grade pedestrian road crossing.

Grade separated pedestrian road crossing

At-grade pedestrian road crossing to access into a BRT station was opposed by one or two participants in each of the groups. They oppose at-grade crossing mainly for the following two reasons:

- At-grade pedestrian crossing would obstruct the flow of motorised traffic and thus create congestion; and
- At-grade pedestrian crossing may create safety problems.

They have also claimed that in an at-grade crossing within a few minutes a large number of pedestrians will concentrate and wait on the footpath at the crossing area; which would require enough space to accommodate this large volume of waiting pedestrians intending to cross the road and there may create a chaos and congestion. Hence, they favour for a grade separate crossing and argue that pedestrians should be diverted either over or under the road for crossing the road without disrupting traffic flow. Their opinions seems that they are giving more priority to the movement of vehicles than the movement of pedestrians. It was raised by the facilitator whether pedestrians could cross the road at a traffic signal of an intersection when vehicles of that particular direction are waiting at signal. However, they further added that at-grade pedestrian crossing is not safe for pedestrians. It was claimed that even though climbing the stairs of an underpass or overpass is difficult or tiring, it is a safer way for them to cross the road. For instance, a participant of poor-income group stated that climbing the stairs in order to cross the road is not a problem because it is safer.

Table 6.2: Summary on different options of pedestrian road crossing to access BRT

	At-grade crossing	**Grade separate crossing**	
		Underpass	**Overpass**
Benefits	• Convenient / easy • Fast	• Safer than at-grade • More convenient than overpass but less convenient than at-grade	• Safer than at-grade • Visible than underpass (secure for women)
Drawbacks	• Safety problems • Waiting or delay at pedestrian crossings point/area	• Dark (need lighting) • More time required than at-grade but less than overpass • Longer distance than at-grade but shorter than overpass • Need to provide ramps/ lift/ escalator for wheelchair access	• More time required than underpass and at-grade • Longer distance than underpass and at-grade • Need to provide ramps/escalator/lift for wheelchair access
Issues	• Pedestrians could cross at traffic signals • Awareness generation to follow traffic rules	• Need to provide continuous lighting and ventilation • Insecure for women	• Need to provide a shade on pedestrian crossing • Longer ramps than underpass

Underpass Vs. Overpass

Provision of a grade separated pedestrian road crossing to access into BRT station would require either an underpass or an overpass. Several participants in the FGDs mentioned that an underpass is more suitable for pedestrians than an overpass. This claim is rationale as crossing with an overpass would require more steps than an underpass. However, a participant of the poor-income women-only group opposed it saying that the loses from the damages, if happens due to earthquake or any other incident, for an overpass would be lower than for an underpass.

Nevertheless, the purpose of discussion in FGDs was not to consider the financial costs rather the passengers' convenience between using an underpass and an overpass for pedestrian road crossing to access into a BRT station. It is worth mentioning to report that most of the participants in all the FGDs mentioned if the given underpass is clean, adequate lighting are provided at night and safe (no hoodlums or harassments) then many pedestrians would use it. Otherwise, an overpass would be better than an underpass for pedestrians road crossing.

Almost all the participants of FGDs mentioned that at present many people in Dhaka city do not use an underpass or overpass where it is available for pedestrian road crossing. Instead of using the underpass or overpass, pedestrians just walk at-grade to cross the road. They claimed that pedestrians are doing this mainly for the following reasons:

- Climbing the stairs of an underpass or overpass is exhausting or tiring. Particularly, for the older people, children, sick, and fat/bulky people it is very difficult to climb the stairs;
- Crossing the road through an underpass or overpass takes more time than crossing at-grade, so it is not convenient for people who are in a hurry;
- The mentality of some people is different and they would always walk at-grade to cross the road;
- Lack of awareness for many people about where and how to cross the road safely;
- The existing overpass or underpass are not wheelchair accessible; and
- The existing underpass or overpass is very dirty, dark at night, and attracts *chintai* (hoodlums). Hence, women usually avoid using an underpass at night because they are often scared to be harassed physically by male or attacked by hoodlums (pickpockets or bag snatchers).

Earlier as it was already mentioned that participants in FGDs suggested for providing sloping ramps and/or escalators or lifts at the underpass or overpass. These probably could solve the problems of pedestrians' discomfort in climbing the stairs as well as providing access for wheelchair users. However, one or two participants of middle-income groups mentioned that providing an escalator or lift at underpass or overpass would not be suitable because:

- Construction and maintenance cost will become higher;
- Not affordable for poor countries like Bangladesh;
- Regular power cuts (electric black outs) will hamper the operating; and
- Dusts will create problems of effective operations.

On the other hand several participants, almost in each group, were concerned about the sloping ramps (of underpass or overpass) that this would involve walking a longer distance and thus more time required to cross the road. Moreover, many participants in different FGDs mentioned that providing a ramp would not be a good option because it will be slippery (particularly if it rains and algae will develop) and pedestrians would fall down while walking. This claim indicates that they are conscious about its regular maintenance - might be similar to the usual poor maintenance of transport infrastructure carried out by the responsible government/local agencies.

At-grade pedestrian road crossing

The older participants of all the groups, most notably the women-only groups, mentioned that at-grade pedestrian road crossing should be provided to access into a BRT station for the convenience of passengers. It was further mentioned by several participants that along with the traffic light signals and Zebra-crossing, there should be deployed traffic police at pedestrian crossing points. Otherwise, the motorists or pedestrians in Bangladesh, particularly in Dhaka, may not obey the traffic signals. Therefore, awareness generation program among the road users was also mentioned by a few of the participants. Moreover, one participant suggested to provide all the options of pedestrian road crossing to access into BRT station such as at-grade crossing (with traffic signals and Zebra-crossing), underpass and overpass at a given BRT station.

It might have been assumed that the disabled group would argue for the at-grade crossing as the ramps of an underpass or overpass are very tiring to cross and require tremendous physical labour/energy for pedestrians particularly for the wheel-chair users. However, surprisingly, the disabled group mentioned that the underpass with ramps would be better for them than an at-grade crossing with Zebra-crossing or traffic signals. Such a preference was made due to two reasons:

(i) Often the disabled people seek help from the traffic police (to stop the moving vehicles or to support them while crossing the road) or public for their road crossing in an at-grade option; and
(ii) There are safety concerns for at-grade pedestrians crossing due to poor attitude/behavior of motorists in Bangladesh.

The disabled group wanted a system where they would be able to cross the road safely without any fear of being run over by vehicles and without any dependency on others (i.e. asking help from traffic police). This indicates their desire to act as an independent person while travelling even though it requires more effort and labour. Nevertheless, in future, if the behaviour of people changes (i.e. motorists respect traffic signs and signals, and there is a strict enforcement of traffic rules) then their priorities may also change: for example, at-grade crossings with traffic lights or Zebra-crossings might be preferred.

Above are generic discussion on participants' opinions about pedestrian road crossing to access into BRT station. However, the design choice about pedestrian road crossing may depend on various aspects such as: traffic characteristics of the locality; pedestrian volume; road width, traffic volume, vehicle speed and traffic composition of the BRT corridor; existing land uses pattern and the availability of space surrounding the BRT station; and behaviour of the pedestrian or traffic of the area. Therefore, it is important to know the participants' opinions for specific location: Kakoli-Banani and Sayedabad.

Pedestrian road crossing for case study locations

Table 6.3 shows the summary of findings and followed by the discussion about pedestrians access to BRT station and participants' opinions specific to Kakoli-Banani and Sayedabad locations.

Table 6.3: Pedestrian road crossing to access into BRT for generic station, Kakoli-Banani and Sayedabad station by different groups

Groups	Generic BRT Station	BRT Station at Kakoli-Banani	BRT Station at Sayedabad
Middle-income men-only	At-grade with Zebra-crossing or traffic signal	Overpass, with stairs and ramps plus escalator or elevator	Both at-grade (Zebra-crossing or traffic signal) and underpass (with stairs and ramps plus escalator or elevator)
Middle-income women-only	At-grade with Zebra-crossing or traffic signal	At-grade, with Zebra-crossing or traffic signal	At-grade (with Zebra-crossing or traffic signal) or underpass (with stairs plus ramps)
Poor-income men-only	At-grade with Zebra-crossing or traffic signal	Underpass with stairs plus ramps	Underpass with stairs
Poor-income women-only	At-grade with Zebra-crossing or traffic lights	Overpass with stairs	At-grade with Zebra-crossing or traffic signal
Disabled	At-grade with Zebra-crossing or traffic signal	Overpass with ramps	Underpass with ramps

Considering the nature of traffic in the proposed BRT corridor (mostly high speed motorised vehicles) and the safety issues for pedestrians, the participants diverged on the appropriateness of an overpass or an underpass, or an at-grade crossing to reach the median BRT station at Kakoli-Banani location. In general participants in the middle-income men-only group and the poor-income women-only group suggested an overpass; the poor-income men-only group suggested an underpass, whilst the middle-income women-only group suggested an at-grade Zebra-crossing. Though an underpass was mentioned by poor-income men-only group, mainly because it is not so tiring to climb (the stairs) as it is for overpass, they admit that there would be many problems at an underpass particularly when it is dark. Several participants suggested that there should have provision of enough lighting at underpass. However, due to black out of power there is no guarantee of continuous electricity in Dhaka; thus, the underpass probably would become a spot of hoodlum or physical harassment to women. If such happens, as most of the participants of the women-only groups mentioned, nobody would use an underpass. Though an at-grade crossing was suggested by the majority of middle-income women-only group, several participants mentioned that due to a large volume of high-speed motorised vehicles in this corridor and poor traffic behaviour of the drivers as well as pedestrians the Zebra-crossing would not work and signalised crossing (traffic light) would not be effective in this (Airport) road. On the other hand, it was reported that an overpass is usually open or visible where pedestrians could see outside of it while walking and thus (s)he would feel secured than in an underpass. Furthermore, the overpass would be cheaper to construct than the underpass. However, a few people are always in a hurry and they would not want waiting at traffic signal for at-grade crossing. Nevertheless, it was suggested by the majority of participants in FGDs that there should be given pedestrian ramps to the overpass or underpass.

On the other hand, for the case of Sayedabad location, it was suggested that the pedestrian road crossings to access into BRT station should use an underpass on one side of the station (close to the bus terminal) and an at-grade crossing on the other side (close to the T-junction) (refer to Figure 6.11). People in Dhaka city, especially women, usually avoid using underpass at night because they are often scared to be harassed physically by male or attacked by hoodlums (pickpockets or bag snatchers). Despite this, participants in FGDs suggested for having an underpass at Sayedabad because a large number of people will be available there all the time (as the bus terminal is very big and busy) and thus people would feel the underpass secured. The participants also added that the underpass should be connected by both ramps and stairs, should have enough lighting and a security guard for all the time, and should be clean and well maintained. Moreover, women-only groups mentioned there is a need to provide a Zebra-crossing or traffic signal along with traffic police for pedestrian road crossing to access into BRT station at Sayedabad. One of them further added that pedestrians of working class people, who usually travel every day, are used to with crossing the road at-grade even without having any Zebra-crossing or traffic signal. They would not use the underpass/overpass and also the older people would not use, so a Zebra-crossing should be provided. It was suggested that both options (at-grade and grade-separate) of pedestrian crossing should be provided at Sayedabad so that pedestrians could use either one.

Safety and Security at Modal Interchange Area

Safety and security for passengers at modal interchange area (safe and secure access to the BRT station) was given a high importance by the participants in all the FGDs. They have suggested the following:

- A clear footpaths (free from shops or trading and hawkers) so that pedestrians could walk conveniently;
- Smooth and even (without having any potholes) surface of pedestrian paths;
- Width of footpaths wide enough so that 3-4 persons can walk at a time in a row;
- Presence of a traffic police (warden) or guard at BRT station or pedestrian crossing area; and
- Enough lighting, particularly at night.

For Kakoli-Banani location, several participants of FGDs suggested not to allow operating rickshaws in the major corridor for safety ground and to remove the existing plant nursery for the security of passengers. As already mentioned in Section 5.2.1, this corridor (Airport road) is currently rickshaws free. The surrounding area of plant nursery becomes very dark and quiet at night, lighting is inadequate there particularly at night, and becomes a point for hoodlums. About the width of footpath, several participants mentioned it should be at least 10 feet (3 m) wide whilst the others mentioned the current width is fine. However, they have suggested that the footpath should be for pedestrians: free of hawkers and traders. On the other hand, a participant who is owner of a small shop on footpath of poor-income group said only removing the shops from footpath would not solve the problem; they would settle again in other part of footpath. Removal or eviction of shops or traders from footpaths without rehabilitating them would have negative impacts on their livelihoods; so rehabilitating them by providing a designated space behind the footpaths is desirable. Having a large number of pedestrians at Kakoli-Banani location, particularly at morning and afternoon peaks, a participant of middle-income men-only group advised to have a 2-way pedestrian paths (one for pedestrian flows of different direction) in both sides of the road.

For the case of Sayedabad location also participants suggested similar at in Kakoli-Banani about safe and secure pedestrian access to BRT station, particularly at modal interchange area. They suggested for a clear footpath (free from shops and hawkers) and the existing shops should be placed beside footpath in a tidy queue without encroaching the pedestrian paths and hampering pedestrian flows. About the width of footpaths, they mentioned that this should be at least 5-6 feet (almost 2 m) wide. As the width of existing footpath at Sayedabad is already 4-6 feet wide that may work to meet the demand only if it is always kept clear. Furthermore, one participant suggested for not operating any rickshaw on the main road such as the proposed BRT corridor (Sayedabad-Gulistan Road). It was also suggested that there should have a physical barrier or barricade at the median of road where grade-separated facilities are provided so that pedestrians can not cross the road haphazardly at any point at-grade.

Facilities Required for Passengers at BRT Station

The facilities such as passenger shade, toilet, seating arrangements, a small shop or kiosk to purchase drinks or light foods and ticket counter have been commonly suggested by the participants of FGDs to be provided at any BRT station platform. All the groups suggested for having a toilet in the BRT station. At present there are not many public toilets available in Dhaka city; hence the participants agreed that having a toilet at BRT station would provide benefits to passengers. However, several of them noted that a toilet may need only at major stations where passenger volume is very high. A few of the female participants mentioned to provide separate toilets for men and women. All the participants emphasised to have a continious water supply to the toilet and importance on maintaining cleanliness or hygiene of the toilet. The participants in disabled group suggested for providing the toilet, ticket counter, and seating facilities at BRT station in such a way that these are disabled-friendly.

Except the middle-income men-only groups, participants in all other groups suggested to provide seating arrangements for the passengers at BRT station. A few participants of the women-only group mentioned to have a separate seating arrangement for women at BRT station claiming that this would help them to feel comfort while waiting for bus. However, having a very high frequency (a small headway) of service, about one minute, it is unlikely that the BRT passengers would require waiting a longer time at station. Consequently, the idea of having any seating arrangements at BRT station was opposed by a few participants, particularly in the men-only groups.

To have a shade on BRT station was suggested by the participants so that the passengers could get a shelter or protection from rain or heat of sun. Furthermore, having a transparent shade, such as made of glass or plastic, would be better because the passengers could see outside. On the contrary, it was said that a non-transparent shade may create some other problems related to lighting (remain dark due to black out of electricity) and safety (i.e. hoodlums, physical harassments of women).

Table 6.4: Summary of the passenger facilities required at BRT station

Facilities	Location		
	Generic BRT Station	**Kakoli-Banani Location**	**Sayedabad Location**
Essential	• Shade (transparent) • Toilet • Ticket counter	• Shade (transparent) • Toilet • Information and map	• Toilet • Information and map
Less priority	• Seating arrangement • Kiosk or shop • Newspaper and TV • Security • Smoking zone	• Seating arrangement • Kiosk or shop	• Seating arrangement • Kiosk or shop

Many participants in the FGDs mentioned to provide a small shop or kiosk at BRT station so that passengers could purchase light food or get drinking water from there if needed. Even, an older participant of the poor-income men-only group suggested that basic medicine (i.e. pain-killer or anti-vomiting) should be available in the kiosk/shop.

A participant respectively from the men-only and women-only groups of poor-income suggested for providing newspapers and TV at BRT stations so that the passengers could have entertainment and enjoying the time while waiting at station. Participants of middle-income men-only group mentioned to provide information and inquiry service at station highlighting the directions or major destinations with a large map to help the newcomers or who do not travel on a regular basis. Furthermore, one participant suggested to provide a smoking zone at BRT station whilst other participants opposed the idea of providing it claiming that not everybody smokes. However, he argued that “I don’t smoke; but there should be a provision, this could discourage for smoking”. Another participant of the same group also suggested to provide a space for pray/worship beside the seating area so that around 10-15 person could pray during the worship time.

Given the limited space available on road, it is likely that the width of BRT station platform would be limited and it may not be possible to accommodate all the facilities and services suggested by participants. Therefore, the participants were asked to mention the most important facilities needed and they have suggested: a passenger shade, a toilet, a ticket counter, and enough lighting as well as security at night. Nevertheless, the middle-income groups gave very importance on the cleanliness or hygiene of the BRT station area. Particularly the women mentioned that the station should be clean and maintain cleanliness for all the time; there should be designated places for throwing or collecting garbage. Moreover, participants of the women-only groups highlighted the importance of security in and around BRT station as well as provisions of enough lighting at night.

6.2.2 Rickshaws for Feeder Services in BRT Station

Participants of the FGDs mentioned that rickshaws could play a vital role of feeder services to BRT systems. Most of them also added that already rickshaws are serving as feeder to buses in Dhaka city. However, rickshaws often wait in a disorganised and chaotic fashion, particularly in and around public transport stations or shopping malls for picking up and dropping off passengers. If rickshaws are to act as feeder services for BRT, some planning requirements (i.e. planning of BRT stations to accommodate rickshaws, organising rickshaws at BRT stations, pre-determined fare structure for rickshaws) should be addressed first. Furthermore, it is important to have a discipline among the rickshaw-pullers: rickshaw waiting areas should be properly maintained with rickshaws forming a tidy queue at public transport stations.

This section reports the results from case study into planning BRT stations to accommodate rickshaws (spaces for rickshaws waiting to picking and dropping passengers) and organising them at stations to maintain a tidy queue while waiting.

Spaces for Waiting Rickshaws

Rickshaw-pullers during FGDs reported that usually they wait close to the bus stoppages or the shopping centres or beside the major road intersections because there are more potential passengers available for picking. At present there is no space (waiting areas for picking or dropping off passengers) designated for rickshaws, rickshaw stand, in Dhaka; therefore, all the participants of rickshaw-puller groups mentioned that rickshaw stand should be provided at BRT station. Participants of other FGDs also suggested to provide a space for rickshaw stand, however, several participants questioned whether there would be enough room available on the existing road or junction area to accommodate this. Nevertheless, the rickshaw-pullers mentioned even if the current road width is not sufficient the space for rickshaw stands should be created.

The FGDs suggested that in each of the rickshaw waiting area or rickshaw stand should be limited to a certain number of rickshaw spaces to wait at a time. However, it is likely that BRT station will generate a large number of passengers and thus the rickshaws would be concentrating in front of the BRT station. Thus, it might be very difficult to accommodate all the rickshaws, providing waiting space, at one location. To tackle this problem, participants suggested for providing several (3 to 5) rickshaw stands surrounding the BRT station to help in segregating the flow of passengers to/from BRT. Rickshaw-pullers showed three to five locations surrounding the proposed BRT station in the study area where they usually wait for picking passengers and would be preferred as the rickshaw stands, providing spaces for about 10 to 50 (variable in a specific location) rickshaws waiting at a time in each of those locations. Figure 6.10 and Figure 6.11 shows the suggested locations for rickshaw stands and the number of places by different groups respectively for Kakoli-Banani and Sayedabad location. However, it should be noted that given the limited width of rights-of-way (ROW) of existing road it might be very difficult in certain rickshaw stands to provide 40 or 50 spaces for rickshaws.

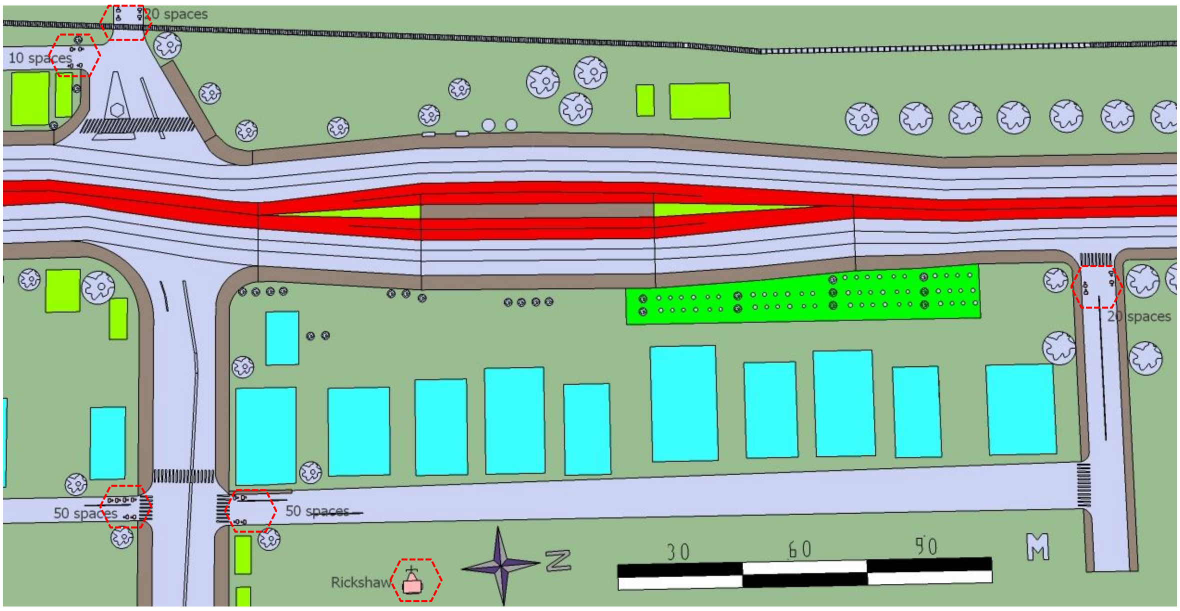

Figure 6.10: Location of the proposed rickshaw stands and the number of spaces in each stand at Kakoli-Banani location by participants of FGDs

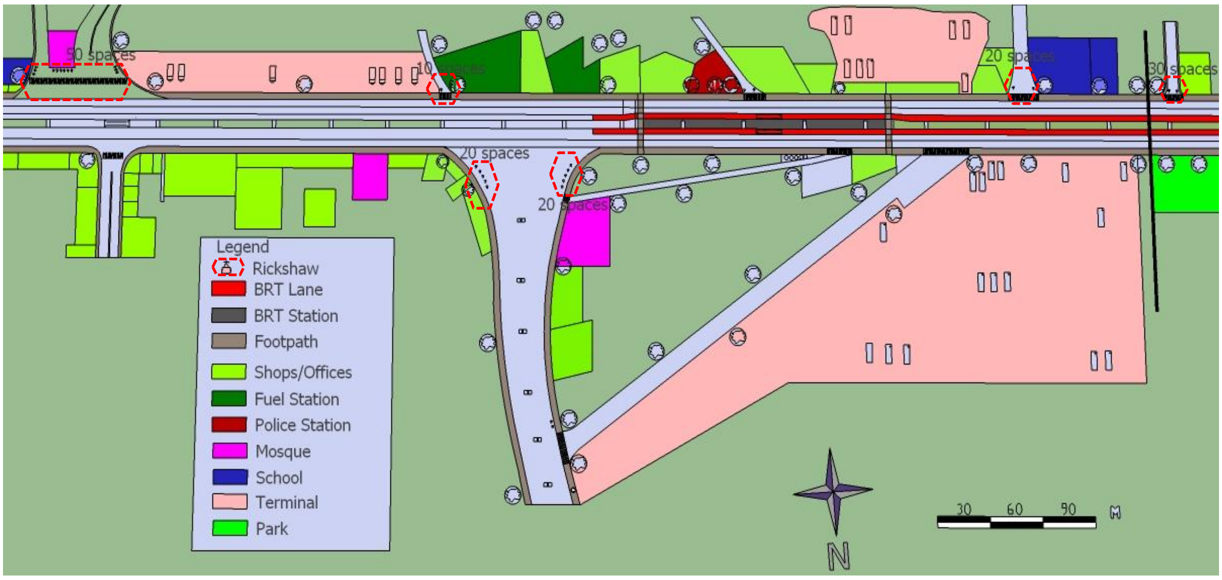

Figure 6.11: Location of the proposed rickshaw stands and the number of spaces in each stand at Sayedabad location by participants of FGDs

Only just having the rickshaw stand or rickshaw bay at BRT station would not bring any benefit unless the pullers use it or maintain the queue while waiting. The major issue is: what will happen if the pullers continue waiting in unauthorised locations instead of the given designated places, or if there are more rickshaws waiting than the allowable limit (or spaces provided) for a certain location? Several participants of middle-income men-only groups suggested that the extra rickshaws waiting beyond the number of allowable limit should be removed through enforcement. Two participants of the puller's group also emphasised on regular monitoring by the enforcing agency as well as awareness generation among the pullers about the benefits they may get from following this. However, the critical issue is who will be enforcing this and how? Furthermore, a few participants of men-only groups suggested that an empty rickshaw should not wait in the rickshaw stand for a long time; a rickshaw will just come to drop the passenger and then would pick up another passenger for a new trip (rickshaws should go anywhere where the passengers want to travel) and leave the place. However, again the critical issue is - how to ensure that? An option could be to provide the places for rickshaw stands where the pullers are waiting now or discussing with them where they want and make them aware so that all of them do maintain themselves.

Organising/Queuing Rickshaws at BRT Station

Rickshaw-pullers during FGDs agreed that they often create a chaotic form while stopping for dropping off or waiting for picking up passengers. Almost all the participants in FGDs of all other groups mentioned that this chaotic situation of rickshaws makes trouble and inconvenience for their movement whilst they walk at modal interchange area. They have suggested for an urgent need for organising rickshaws so that they wait more systematic way or in queues. Because, only providing a space for rickshaw stand would not bring any substantial positive change to the traffic situation at BRT station if there is no discipline achieved among the rickshaw-pullers. Therefore, the rickshaw stands or waiting areas should be properly maintained with rickshaws forming a tidy queue. The pullers also agreed that organising rickshaws at BRT station to follow a tidy queue would be better for them. Even though they did not mention particularly in what aspect it would be better for them, they told that following a queue for rickshaws would be better for all the pullers as well as for passengers. Presumably, they are thinking that this may help reducing the chaos on streets, and thus help changing the negative perceptions of policymakers towards rickshaws. However, several pullers during FGDs were found confused about how the queuing of rickshaws would be followed or practiced by the pullers themselves; who mentioned it would be very difficult to apply. For instance, one of them asked how this will be monitored or enforced, and what would be done if a puller do not follow; probably some pullers will not follow the queue. Nevertheless, participants' opinions from the FGDs revel that the engineering design along with effective enforcement and awareness generation among the rickshaw-pullers would help towards achieving this.

Channelization of rickshaws by infrastructure provision

Providing traffic markings (i.e. signs and symbols) or engineering design and infrastructure provision may help up to a certain level in forming a tidy queue of waiting rickshaws at BRT station or modal interchange area. However, very poor behaviour in following the traffic rules and marking by road users, particularly the drivers, in Dhaka city suggests that the pullers are not likely to maintain a queue just following a traffic marking or signal. Three pullers out of seven for Sayedabad (out of six for Kakoli-Banani) mentioned that they would not maintain a queue while waiting at station just following the traffic marking. Therefore, an effective engineering design of BRT station area (where rickshaws will be waiting) or effective enforcement or a change in behaviour of the pullers might be needed for maintaining the tidy queue of rickshaws while waiting or dropping passengers at BRT station.

The participants in FGDs suggested for providing a physical barrier (through fencing or concrete pillars) for channelization of rickshaws in a queue at the BRT station. In such case, the channelized narrow lane dedicated for rickshaws would not be possible for overtaking and thus the pullers would be bound to form a queue where the fencing is provided (as seen in Figure 6.12).

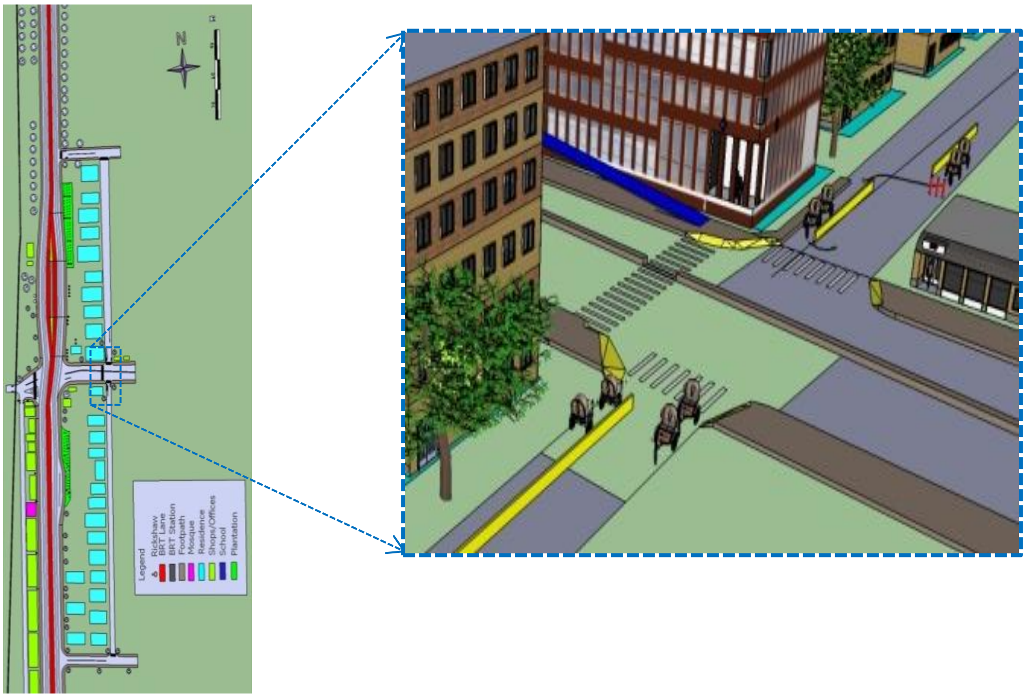

Figure 6.12: Physical barrier for channelization of rickshaws at Kakoli-Banani

Figure 6.12 shows, as suggested by the participants in FGDs for Kakoli-Banani location, fencing or physical barrier placed to channelize rickshaws at the designated rickshaw stands close to BRT station. As the proposed BRT corridor (Airport Road) and Kamal Ataturk Avenue is rickshaw-free, rickshaws are not allowed to cross these roads and move from east to west of Airport Road or *vice-versa* and from north to south of Kamal Ataturk Avenue or *vice-versa*. Hence, rickshaws operating in the ally roads have to take a ‘U-turn’ in the junction of Kamal Ataturk Avenue (as seen in Figure 6.12) after dropping or picking passengers. For instance, in the north of Kamal Ataturk Avenue, rickshaws will be channelized for about 100 m (in both side of the road) and rickshaws would stop in the left side of the road for dropping passengers and then wait in the right side of the road forming a tity queue for picking up passengers. After picking up passengers, the rickshaw will take ‘U-turn’ and then will move towards north.

Enforcement for maintaining the queue

Several participants in FGDs suggested to deploy a traffic police or a staff (e.g. traffic warden) at BRT station to monitor and ensure that all the pullers do maintain a tidy queue of rickshaws in an organised way at rickshaw stands or modal interchange area. The staff could be employed either by rickshaw pullers or owners association or by the BRT operator. It was further mentioned that the legitimate administrative powers of the government (local government authority) could be applied to force the pullers maintaining or practicing a queue at BRT station. Several participants of the pullers’ groups also suggested for having a traffic police at BRT station to monitor and enforce that the pullers maintain a queue. Because, they think pullers themselves would not be able to maintain (or would not follow) queues. Furthermore, most of the participants in all the groups mentioned that within Cantonment Area all the pullers follow the tidy queuing while waiting; mainly due to fear from the presence of a traffic warden from law enforcement agency and strict enforcement of law. It was further added that presence of such traffic warden at BRT station may ensure additional security to the passengers - they may feel more secure against hoodlum at station or modal interchange area.

However, always having a traffic warden does not give any guarantee to the solution unless all the pullers become aware and everybody do maintain a self-enforcement of the system to follow the queue. For instance, a puller during FGD for Kakoli-Banani location reported that the traffic warden currently responsible for enforcing/maintaining the queue for rickshaws at Banani Kamal Ataturk Avenue sometimes taking a bribe. The warden asks for BDT 5 or 10 from the pullers who are waiting almost in the end of the queue for picking passengers to allow him to go in the front of the queue to pick passengers without waiting for any considerable time or to allow a rickshaw to cross the Kamal Ataturk Avenue (which is not allowed for rickshaws to cross) for going from north to south or *vice-versa*.

Awareness generation among the pullers

Rickshaw-pullers mentioned that an advocacy program to raise awareness among the pullers may help in forming tidy queues voluntarily and organising rickshaws at BRT station. If the pullers become aware about the benefits they may get from maintaining the queues while waiting compared to without following a queue, they would follow queuing themselves. Hence, there is a need to educate and aware the rickshaw-pullers so that they could organise themselves and maintain queuing. Participants in FGDs of other user groups also mentioned the importance of awareness generation for the pullers.

Several participants in FGDs of user groups suggested that the government could take initiatives so that non-governmental organisations (NGOs) come forward to help the pullers towards forming an association for them and awareness generation. The pullers association could regulate and manage some aspects of rickshaw operation (e.g. queuing and management on the streets) themselves. The puller's association must be formed in an area wise - within the local community. Both the city government and traffic police could sit together with puller's association as well as with the owners association to determine or regulate various aspects of rickshaws in a specified road or within a certain area or locality. Participants further mentioned that in certain areas of Dhaka city there is already an association (mostly formed for rickshaw owners and a very few for pullers), which is performing certain management tasks such as issuing rickshaw numbers within that area. For instance, a puller for Kakoli-Banani case study who operates in Banani Cantonment DOHS Area said there are only 20-25 pullers operating within Banani Cantonment DOHS; all the rickshaws follow a queue while waiting at Cantonment Gate for picking passengers and the pullers all know each other. This shows to a certain extent rickshaws in certain areas of Dhaka are organised and these associations could be strengthened more to make aware the pullers for maintaining queues at BRT station.

Rickshaw-pullers in the FGDs who are renting their rickshaws from an owner mentioned that usually they obey the general instructions or orders of the owner; such as: what time to start and finish the work, in which locality or area to operate or not to operate, etc. They said if the owner of his rickshaw would ask him to maintain the queues while waiting at BRT station then he would do so. They further added that most of the pullers who is renting the rickshaw would follow the owner's instructions; otherwise, the owner may not allow him pulling his rickshaw (will not rent the rickshaw). This suggests that the owners could play a very crucial role in making the pullers following queues at BRT station. However, for doing this it would require first to make aware the owner about the issue and then develop him as an advocate for rickshaws maintaining queues. If an owner of rickshaw becomes aware and mentor, he would give instructions/advise to the pullers (whom he is renting the rickshaws) to follow a tidy queue of rickshaws while they are waiting at BRT station.

6.2.3 Information for Road Users Related to BRT

This section reports on participants' perception and knowledge about existing traffic signs, signals and symbols, and then identify what type of road use signs and symbols would be required at BRT station for ensuring a smooth flow of traffic, particularly for pedestrian movements between rickshaws and BRT systems for modal change.

Road Users' Knowledge about Traffic Signs and Signals

The FGDs revealed that knowledge about existing road traffic signs and symbols among the participants is very poor. The participants reported that they have seen the following signs and symbols in Dhaka and do understand what those means: Zebra-crossing, pedestrian paths, left/right turning direction, U-turn, arrow sign for direction, traffic lights, prohibited blowing horn (in front of hospital or school), speed limit, location of bus stoppage, etc.

In the middle-income groups, several participants told passengers may not know the traffic signs and symbols but generally the drivers or pullers do understand. However, this claim was opposed by others because many drivers in Bangladesh do not understand or not know anything about traffic signs and symbols. Nevertheless, it was noted that travelling on the same route in a regular basis makes a person aware and familiar with the road environment to understand the available road signs.

A set of regulatory and informatory signs and symbols (see in Appendix- F) available in the streets of Dhaka were photographed and then shown to the participants during FGDs. Participants were asked to tell if they understand the meaning of those traffic signs and symbols. The majority were unable to tell these correctly. Only a few of them, particularly who are literate, were able to understand some of those (which had written texts along with symbol). This should be noted that the literate people understood the symbol by reading the accompanied texts but not from the knowledge of symbol. Even it was found that pullers, who drive rickshaw regularly, do not know some of the basic traffic signs.

Participants in the poor-income groups and puller's groups were very reluctant to tell that they do not know the meaning of a given sign or symbol. Even if someone did not know any particular sign or symbol, was pretending that (s)he knows and understands it. Whilst the facilitator asked particularly to a participant to tell his/her understanding about the given sign/symbol, he/she was either repeating (copying) the answer what others already said earlier or telling something dozy (or wrong).

Requirements about Road Use Signs and Symbols

For easy movement and flow of pedestrians as well as for the traffic, it was suggested in FGDs that in general following traffic signs or markings should be provided at modal interchange are:

- Rickshaw waiting areas;
- Direction of BRT station (indicating the distance);
- Pedestrian paths; and
- The pedestrian road-crossings, particularly at the points where pedestrians should cross the road to access into BRT station.

Particularly it was mentioned that where passengers have to go for boarding in BRT or rickshaws, that directions should be provided very clearly (and adequate numbers) at modal interchange area. The majority of the participants suggested for providing both the symbol and written texts so that the illiterate people also would able to understand from the symbol. It was further added that the symbols should be provided in such a way that they reflect the pattern of that object; for instance, the symbol of BRT should be similar to a bus and the symbol of rickshaw should be of its similar pattern or shape. This means, symbol of rickshaw along with direction arrows should be placed at BRT station to guide BRT passengers where they have to walk for rickshaws; and similarly, symbol of bus along with direction arrows should be placed at rickshaw stands to guide pedestrians towards BRT station. It was also mentioned in FGDs that the traffic signs and symbols (including texts) should be provided at numerous places surrounding the BRT station within its 1 km radius. For instance, one participant said the direction of BRT station (including the distance to BRT station from that point) should be provided at four to five points within 1 km of each BRT station.

Beside these, regarding traffic signs and symbols participants also suggested following:

- The texts accompanying the traffic sign/symbol should be written very clearly and in local language, Bangla. Texts should include the brail system for the blind and a provision of sound (preferably Bangla talk) which would be helpful for the blind and illiterate people.

- A symbol/marking indicating passengers should “alight first and then board, following a queue” should be provided; as well as providing the marking sign of Zebra-crossing so that pedestrians could cross the road.
- A large map of the area to be provided at BRT station showing the major attractions within that area as well as the BRT station and rickshaw stands.
- Information about BRT services could be disseminated through ticketing system from the BRT ticket counter/booth. For instance, passengers could be informed while purchasing tickets - if purchase this ticket then could travel in those places or directions.
- Displaying or announcing at BRT station about the services operating in different or particular route (e.g. the next stoppage of that service or route).

To improve road users’ knowledge and practice of traffic signs and symbols, participants suggested:

- Need for behavioural change through education and training; and
- Need for information dissemination through publicity campaign.

Importance of education or learning in school was mentioned by several participants. Though in 1980s or 1990s students at school could learn very basics of traffic signals (e.g. meaning of green light or red light), current curricula at school does not cover anything about traffic signs and signals. In school everyone should learn about road use rules and traffic signs. Education and training may help to bring positive change in behavior of road users. Those who have knowledge or have learnt they should practice it otherwise probably would forget over the time. A strong publicity campaign could help wide dissemination of information. There are many diverse and strong media in Bangladesh. If traffic signs and symbols are shown or broadcast in media it may help to educate or aware public. For instance, there should have some program on traffic signs, road use behaviour on TV.

6.3 Public Opinions about Fare Integration with Rickshaws

As a rickshaw journey has no specific fixed route, and also because means are not readily available to measure the distance for each trip, it is a challenging task to have a pre-determined and fixed fare structure for rickshaws. However, unless a pre-determined fare structure is established for rickshaws, it would not be possible to implement an integrated fare system for journeys involving both rickshaws and BRT systems.

This section reports on public opinions derived from the FGDs about fare integration of rickshaws with BRT systems. The main points covered here are:

- Whether there is any possibility of having pre-determined fare structure for rickshaw trips; and
- Whether there is any possibility of fare integration of rickshaws with BRT systems, and if possible how.

Pre-determined Fixed Fare Structure for Rickshaws

Is it necessary?

Results from the FGDs shows that there are arguments both for and against of having a pre-determined fare structure for rickshaws. On the one hand, the users would expect a pre-determined fare structure; mainly for the following reasons:

- It would be convenient for passengers; such as no need to wait and arguing with pullers before boarding.
- No more dispute between pullers and passengers, as there would be no more argument for determining fare of any given rickshaw trip;
- Passengers would know the fare for a particular trip in advance, hence they would able to make a tension free journey.

Most of the participants in user-based FGDs reported that they do not like the bargaining process to fix the rickshaw fare for each trip, particularly because often the pullers ask for a higher amount. At certain times and in particular locations pullers act like a *syndicate* (or monopolistic market). In such a situation, any passenger wishing for a rickshaw trip has no other alternative except walking but paying the amount rickshaw-puller is asking for. Furthermore, it was mentioned that the pullers do bad comments towards female passengers whilst bargaining to determine the fare. Therefore, almost all the participants in user-based FGDs mentioned that it would be better for them if the fare for rickshaws are pre-determined. Furthermore, rickshaw-pullers will maintain a queue while waiting at BRT station only if there is a pre-determined fare structure for rickshaw trips.

On the other hand, rickshaw-pullers often like the bargaining process to fix the fare so that they could charge more from the passengers (particularly those that are new in the area, or seem to be rich, or who have no other alternative mode available). The participants in puller-based FGDs mentioned a pre-determined fare structure for rickshaws would not be profitable for them as they will not able to ask for any extra amount from the passengers; so they do not want a pre-determined fare.

Would it be possible in Dhaka?

Participants in FGDs mentioned that the rickshaw fare in a particular route or between major locations in Dhaka is already becoming determined at an acceptable rate (for both the pullers and users) through the market force itself. Majority of the public become familiar with the acceptable standard (rationale) fare for the distance between an origin and a destination and almost everybody pay that rate. Thus, rickshaw fare between certain locations becomes settle for a period of time by the demand-supply of market. For instance, a puller told that many passengers do not bargain to determine the fare before making the trip but after the trip they pay themselves the acceptable fare. However, in such a case if either the passenger or puller, any of them, tries respectively to pay less or collect more than the standard amount then there is a possibility of arguments and disputes in the end of trip.

Furthermore, a participant mentioned that she travels on easybike (battery driven auto), operating in a specified route between two locations, and pay a pre-determined fixed fare for the trip. The drivers of easybike decided for a fixed fare rate for the trip; all the regular passengers know about that fare rate and pay it without any bargain. The fare is same for any distance wherever she gets off between the origin and destination of the route.

These above examples give valuable insights that if a rationale fare rate for any particular rickshaw trip is pre-determined that may function in Dhaka city. Furthermore, a few participants during FGDs mentioned there are examples where rickshaws have or had pre-determined fare structure in certain areas of Dhaka such as cantonment DOHS and Kamalapur.

How to determine fixed fare structure for rickshaws?

Participants in all the FGDs mentioned a similar technique to determine a fixed fare structure for rickshaws – fare based on the distance. It was suggested that the fare structure could be either of the following types:

- Variable rate for different distance between origin and destination of the trip;
- A flat rate within a demarcated area.

The fare would need to be based on an agreed pre-determined (tentative) distance, not the true distance in km, between two locations. This is because it would not be possible to measure the true road distance for each rickshaw trips. So, it was suggested by the participants to determine the distance between two locations or from BRT station to different locations and then determining the fare for those trips (based on per km or unit rate). Doing this might be possible at neighborhood or local level but would be very difficult in a city wide scale. It was further mentioned that this system of a pre-determined fare structure for rickshaws could be possible only if the rickshaws operate within a locality. Furthermore, even if rickshaws operate within a locality, they operate not only between two major (known) points or locations but also provide door to door services in narrow alley streets. Therefore, a few of the participants in user-based FGDs mentioned a fixed flat rate or minimum fare for rickshaw trips within a demarcated area could be done. Trips within that demarcated area would be one rate and trips going beyond that area is another rate. It was suggested that the rickshaws operating within an area could be of a different colour or design than that of in another locality. This also reveals that it might be possible to have a pre-determined fixed fare if possible to make the rickshaws more localised such as serving only within the neighbourhood area or for short distance as access or egress legs to public transport. This localisation will enforce rickshaws to ply only within a locality or neighborhood and not offer any city-wide long distance journeys.

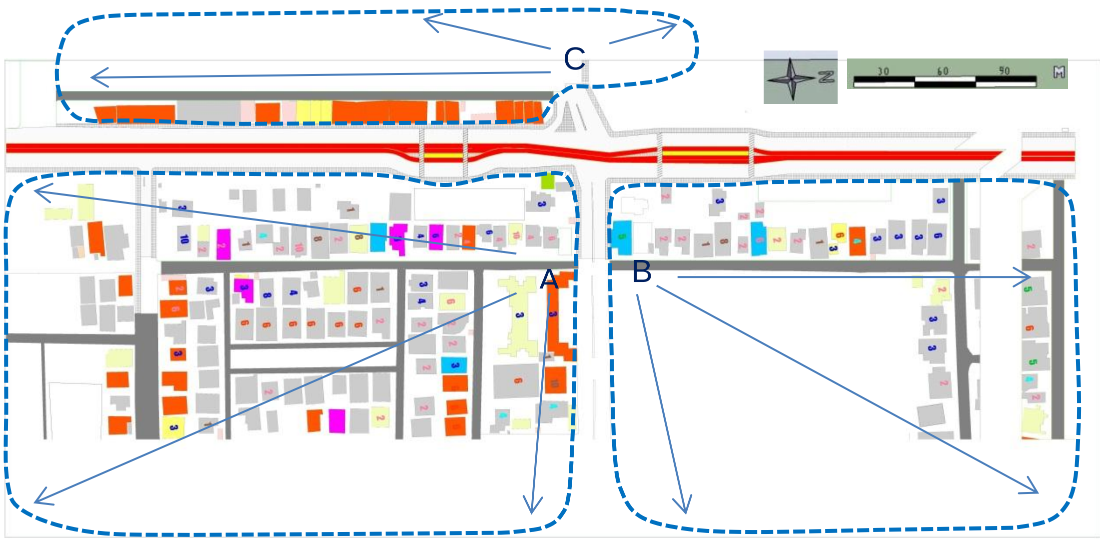

Figure 6.13: Localising rickshaws for pre-determined fare structure at Kakoli-Banani

Figure 6.13 shows the demarcation line of three different neighborhood areas (i.e. A, B, C) at Kakoli-Banani location where rickshaws’ operation already become localised due to provision of physical barrier and enforcement. Rickshaws operating in one of these areas are not able to move in another area. The participants of

FGDs mentioned the maximum rate of rickshaw fare from the proposed BRT station at Kakoli-Banani to the far end of area A or B, say Gulshan 1 or Gulshan 2, would be BDT 30 whilst towards Naval Office (within the area B) would be BDT 15; these rates could be pre-determined within the respective demarcated locality.

At neighbourhood level, responsible local government authority could identify the distance between major points and after consultation with different stakeholder groups (i.e. users and pullers) they could determine a fare list for different distances/routes. Rickshaw-puller groups mentioned to determine the fare structure either by government or by the owners' association because it would not possible for pullers themselves to fix a fare rate; as one of the pullers said, "we [pullers] can't make this". The user-based FGDs mentioned local authority would determine fare rates after consultation/discussion with different stakeholders. The person responsible for local authority (i.e. chief executive or mayor of the city or ward commissioner) could take initiative and consult with puller's association or committee. However, participants of middle-income women-only group mentioned importance of support from the top level government or ruling party towards determining the fare rate structure whilst poor-income groups mentioned importance of administrative power as well as incorporating the social elites or power-groups in deciding fare rates structure. Nevertheless, participants in most of the groups mentioned to have discussion with all the stakeholders, particularly the rickshaw pullers and owners.

Participants in all the FGDs mentioned to provide a large size billboard at BRT station and major locations showing the chart of fare lists for different destinations from that point so that everybody could see it and understand the fare for their rickshaw trips. However, participants in poor-income groups raised that many pullers as well as passengers are illiterate who would not able to read or understand the fare mentioned in chart. Hence, one of them suggested for deploying a person (employed by the owners of rickshaw) at BRT station who would know the fare structure for different locations from that point and will tell (to both the puller and user) the amount will be charged for their trip. However, this seems impractical that one person will inform passengers and pullers; what if there are many passengers approaching to different pullers at a time for different trips. Moreover, who will pay the salary of that person? So, all other participants opposed this claiming that illiterate people would ask to others in the initial few days and later they will be familiarised. Several other participants in different FGDs mentioned that a fare chart could be placed in the back of each rickshaw. Nevertheless, most of the participants in all FGDs suggested for providing a fare chart in a large billboard.

This would help everybody to see and understand the fare for a rickshaw trip before it is initiated even if someone is newcomer or stranger in that locality.

Variable or fixed fare rates for Rickshaws?

Participants of the user-based FGDs reported that during certain peak times of the day (i.e. morning 9 am) or when it rains the pullers charge an exorbitant rate compared to the normal time. Hence, a participant was suggesting for having two sets of pre-determined fare structure: one for peak hours and another for off-peak hours. However, this would create other problems such as: deciding on which time would be peak hours, how to enforce different rates, and if any trip starts in off-peak time but terminates in peak time or *vice-versa*. Thus, the groups have decided for only a standard fare structure for throughout the day.

Another issue about pre-determined fare for rickshaws is: whether the fare would be applicable for single passenger or two and including children or goods or not. After having a thorough discussion, participants in the middle-income women-only groups have suggested that standard fare rate should be for a maximum of two adults and two accompanying infant children travelling together; however, if a single person travels (s)he should pay the standard fare.

Will the pre-determined fare rates for rickshaws be followed?

Several participants of the user-based FGDs raised their doubt whether in practice a pre-determined fare structure for rickshaws would possible to implement. For example, referring to auto and taxi-cabs a participant of middle-income group mentioned that rickshaw-pullers will not follow the pre-determined fare. Auto and taxi-cab drivers in Dhaka are not following a metre for charging the trip and instead they rely on bargaining so that they could charge more. Another participant told bargaining to settle the fare of a rickshaw trip have been practiced for so many years and it almost become a part of culture; it is not necessary to have a pre-determine fare. The pullers also reported that the pre-determined fare structure for rickshaws would not function because of the following reasons:

- It might be possible to unite a small number of puller but about 400-500 pullers would not be united;
- Pullers do operate and make trips in different areas so it would be difficult for pullers to follow; and
- Price of the commodities, which has a strong influence to rickshaw fare rates, increase very frequently in Bangladesh.

How to execute or ensure the pre-determined fare for rickshaws?

To ensure that a pre-determined fare rates for rickshaws are followed by pullers, different suggestions were made by different participants (and groups) are:

- A very strong law and effective enforcement as well as to bring under the law both the puller and owner if a puller does not follow the prescribed fare.
- Owners' responsibility to give order/advice to the puller, to whom rickshaw is rented out, as a precondition to follow the prescribed fare structure.
- Deploying a guard (traffic warden) at BRT station to monitor and enforce that pullers are taking the exact amount which is mentioned in fare chart.
- Awareness generation among the pullers so that they are willing to follow the prescribed pre-determined fare rates.

However, instead of law and enforcement it would be better to make the pullers aware so that they are willing to follow the prescribed fare. Using media such as radio and TV was suggested for awareness generation of pullers about the benefits they may get from following the prescribed fare structure. Participants also mentioned media could help disseminating information about the prescribed fare structure (of different locations) among the users and pullers. Participant pullers further mentioned if they were sufficiently aware they would follow the prescribed fare-structure. They further added that the pullers who are renting the rickshaws would follow the prescribed fare if they receive an order/instruction to do so from the owner of rickshaw.

It is important to know why the pre-determined fare structure for rickshaws that was introduced in a few places of Bangladesh did not function for long time. The main causes are: fare structure was not revised regularly despite the rise of commodity price and stakeholders (mostly pullers) were not consulted while determining the fare rates. For example, a participant from user-based group for Sayedabad location said "If I ask the puller in Kamalapur Mullarpur why he is not following the chart of fare structure and asking for extra, he would reply those who have written the billboard whether they will feed me or did they ask me before writing this". A puller from Kakoli-Banani location mentioned that in Cantonment DOHS area it is almost a year the pullers are not following anymore the prescribed fare chart because the price of commodities has increased but not the fare rates mentioned in billboard. Participants in all the FGDs reported that the fare for a rickshaw journey increases over time with the increase in price for essential commodities (i.e. rice, oil, vegetables); the commodity price in Bangladesh changes very often hence the fare structure for rickshaws also need to be updated or revised frequently.

How often the fare structure should be updated?

The user-based FGDs suggested for revising or updating the fare rates for rickshaws once in a year, particularly during the time of national annual budget. Similar to the users, one group of the pullers also mentioned for updating once in a year whilst another group suggested for 3-4 times per year. However, it would be quite impossible and unrealistic to revise the fare rates more than once in a year.

In summary, this pre-determined fare structure for rickshaws should be backed with smart[25] planning with effective stakeholders' involvement, regular monitoring and enforcement, periodic updates, awareness generation of rickshaw-pullers and wider publicity campaigns.

Fare Integration Between Rickshaws and BRT

Fare integration between BRT and rickshaws probably could be done following any of the following different models or options:

- Rickshaw services to be provided by the BRT operating company within the locality and the pullers would receive a monthly or daily salary;
- Passengers would use pre-paid tokens to pay the fare for rickshaw trips, which the pullers could reclaim his earning from the company;
- BRT tickets are sold through the pullers where passengers will pay the total amount charged for both rickshaw and BRT to the puller to get BRT ticket.

However, there were not much discussion on this topic among the participants in user-based FGDs. On the other hand, participants in the puller-based FGDs mentioned that the pullers want hard cash - money to be paid just immediately after finishing the trip - as the wage for their labour. They are not willing to wait for receiving their wage, not even for a couple of hours. For instance, one of them said "We, the rickshaw-pullers, are pulling rickshaws mainly because [among many other reasons] get the money [wage] immediately". This issue makes it more difficult to implement an integrated fare for BRT/rickshaw trips. Nevertheless, pullers were asked to discuss if there was any way or possibility for fare integration, and what if the authority (or government) impose them following an integrated fare mechanism otherwise prohibit operating rickshaws. Most of them were not responding or participating in discussion regarding this issue whilst a few mentioned that would be concern of owners rather than pullers. They added, if the government prohibit operating they either have to look for alternative work and owners may help them for doing such or have to go back home at village.

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[25] Effective and efficient planning considering the socio-economic dynamics for the sustainability.

6.4 Summary of Findings from FGDs

Consultations with the participants in FGDs revealed that the initial design prepared for the BRT station of Kakoli-Banani and Sayedabad location is almost ok – they are located in right place. Table 6.5 shows the summary of findings derived from FGDs of different groups conducted for two case study locations: Kakoli-Banani and Sayedabad.

Table 6.5: Summary of the findings from FGDs

Topics	Generic BRT Station	BRT Station at Kakoli-Banani	BRT Station at Sayedabad
Convenient distance for modal change	• Less than 200 m • Maximum 250 m, a few mentioned 500 m • 50 m would be the best	• Less than 200 m • Maximum 300 m	• Less than 200 m • Maximum 400 m
Pedestrian road crossing to BRT station	• At-grade crossing	• Overpass with ramps and stairs (if possible escalator or lift)	• Both at-grade and underpass with ramps and stairs
Required facilities at BRT station	• Passenger shade • Toilet • Kiosk (shop)	• Passenger shade • Toilet • Kiosk (shop) • Limited seats	• Toilet • Limited seats
Information related to BRT required for road users	• Direction of BRT station and rickshaw stands • Pedestrian path and pedestrian crossing	• Large map of area showing direction of BRT station and rickshaw stands • Pedestrian path and crossing	• Large map of area showing direction of BRT station and rickshaw stands • Pedestrian path and crossing
Space for rickshaw waiting	• Provide several rickshaw waiting areas • 10-50 spaces at rickshaw stand	• Provide 3-5 rickshaw waiting areas • 10-50 spaces at rickshaw stand	• Provide 3-5 rickshaw waiting areas • 10-50 spaces at rickshaw stand
Organising rickshaws at BRT station	• Channelization by infrastructure • Traffic warden • Enforcement	• Channelization by infrastructure • Traffic warden • Enforcement	• Awareness generation among puller for self-organising • Traffic warden • Enforcement
Pre-determined fare structure for rickshaws	• Localised rickshaws • Based on distance • Based on demarcated area	• Localised rickshaws • Based on demarcated area	• Based on distance
How the method of using 3-D physical model worked	• Good understanding • Active participation	• Good understanding • Active participation	• Good understanding • Active participation

The difference between generic BRT station, Kakoli-Banani BRT station and Sayedabad BRT station are mainly on the following topics: convenient distance for modal changes, pedestrian road crossing to access into BRT station, passenger facilities required at BRT station platform, organising rickshaws at BRT station and pre-determined fare structure for rickshaws.

- Maximum distance for modal changes are 300 m and 400 m respectively for Kakoli-Banani and Sayadabad whilst it was 500 m for generic design.
- An at-grade pedestrian road crossing to access the median BRT station was suggested for generic design. However, considering the nature of traffic (mostly high speed motorised vehicles) in BRT corridor and traffic behaviour as well as safety issues of pedestrians an overpass for the Kakoli-Banani whilst for the Sayedabad location both an underpass and at-grade crossing were suggested. The underpass or overpass need to be connected by both ramps and stairs, and if possible an escalator or lift should be provided. Nevertheless, in future, if the behaviour of people changes (i.e. motorists respect traffic signs and signals and there is strict enforcement of traffic rules) then their priorities may also change; for example, at-grade crossings with traffic lights or Zebra-crossings might be preferred.
- Facilities such as a passenger shade, toilet, a small shop (kiosk) and limited seats are required at BRT station. However, passenger shade for Sayedabad BRT station would not require as it is underneath of the flyover.
- Knowledge about traffic signs and symbols of road users in Dhaka is very poor. Traffic signs and symbols (including texts) indicating the directions of BRT station and rickshaws to be provided at modal interchange area.
- Provision of space for rickshaws in and around BRT station depends on land use, RoW, connecting branch roads and the number of places for rickshaws in each space depends on volume of traffic and demand.
- Channelization of rickshaws by providing physical infrastructure (as seen in Figure 6.12) and effective enforcement for Kakoli-Banani whilst by awareness generation of pullers and effective enforcement for Sayedabad.
- Rickshaws need to be localised and operate within the neighbourhood to have a functional pre-determined fare structure for rickshaws. Suggested fare structure is based on delineated area for the case of Kakoli-Banani location and based on pre-determined (tentative) distance of two locations for Sayedabad location. A large size billboard showing the chart of fare lists for different destinations should be placed at BRT station.

6.5 How the Methods Worked

The FGDs conducted for exploring the collective views and opinions of the public of different socio-economic groups who travels on public transport and rickshaws as well as the rickshaw-puller group on various aspects and issues of this research worked very well. However, it was observed that during the discussion, particularly for the poor-income groups, a few participants copied or repeated the answer what another member of the group already said. Particularly when the facilitator was showing different road signs and symbols whether they are familiar with it and know its meaning, they were feeling shy or not willing to tell that they do not know. Rather, they were pretending that they know it and trying to tell something (which obviously was wrong, in most case). Several of them also just copied or repeated what the other person (who told at first) mentioned; presumably thinking that the person told first is right or know this symbol.

While designing the research methods and tools, it was hypothesised and expected that using a 3-D physical model (refer to Section 3.9) would greatly help to progress the discussion and participants would use it frequently while talking particularly about the case study areas to point to the locations. The model helped to progress the discussion with spatial contexts very well. For instance, during the discussion participants frequently used the words ‘this’, ‘here’, ‘this side’, ‘that area’ and pointed to the respective location in model. Without having the model it would be difficult or impossible for them to explain properly those locations. Rickshaw-pullers have used the same roads several times a day over the last few years – hence they were very familiar with the spatial contexts of the area. Even so, they pointed to the model while discussing about different locations.

However, using a 3-D physical model in disabled group, particularly for the blind and dumb, was very challenging. It was assumed that as the blind could not see the model, they would not take part in the discussion. However, the blind participant asked the facilitator to explain the model and she was able to touch it for realising the location of different structures and took part in discussion. This indicates she can navigate the model through her previous experience of travel in that area and touching the model even though she is unable to see with her eyes. For the case of dumb, he showed physical expression pointing in model and made a sound (Figure 6.14), which the facilitator did not understand but other disabled people understood and explained.

Figure 6.14: Physical expression of dumb person during FGD

Figure 6.15: A participant is holding (along with facilitator) the model

While conducting the FGDs, participants of all the groups were very active and supportive. For instance, the facilitator was holding the model during discussion with rickshaw-pullers at Sayedabad and with disabled-group; and the participants were also holding the model to support him (Figure 6.15). Participants in FGDs were very engaged with the 3-D physical model; while talking, they were pointing the respective locations in model. Even, in addition to model, in a few occasions participants of middle-income groups were using paper and marker to draw and write what they were discussing. While a member of the group was talking and pointing in model, others were listening or watching what (s)he was telling and showing. However, there were a few occasions when several members either started to talk, or were pointing to the same location at the same time and arguing one against another. It was noticed that almost everybody in the middle-income groups looked at 3-D model very carefully whilst the facilitator was showing and discussing the proposed BRT station and the spatial aspects of its surrounding area. In contrast, the poor-income groups, particularly the women, were not so attentive. For instance, a few of the participants of Kakoli-Banani were whispering or talking among themselves or laughing on a few occasions while discussion was going on. Therefore, it should be noted that even though a 3-D physical model facilitates effective participation; there is also a risk that the participants may talk over cell-phone or look away from the model (outside, something else) during discussion unless the facilitator is capable of managing the group effectively.

The facilitator had to explain the model several times to the poor-income groups, particularly to the women-only group, to make them understand the proposed plan. Participants of Sayedabad location asked many questions to understand the model and spatial contexts, but did not give many suggestions and opinions; rather, often they mentioned what have shown in the model is all right. Similarly, in Kakoli-Banani location, apart from the student all other participants mentioned the location of proposed BRT station is in right place. Beside this, it was observed that compared to other groups (apart from the student) the participants of poor-income women-only group of Kakoli-Banani did not point the locations in the model so much. Surprisingly, even whilst they were talking about ‘here’, ‘middle of the road’ and ‘there’, they did not point in model. Nevertheless, participants in the men-only groups used the model very often while discussing the spatial contexts of the case study location.

It is interesting to find whether the size or scale and colour of the model had any influence on understanding and discussion of the participants. The colour was important to distinguish the different objects with different colours (e.g. the red lane was used to show the BRT lanes). This helped very well for the participants to understand different objects in the study area and distinguish them. Hence, even though the model was not in a quality of professional standard (as discussed in Section 5.4.3), there was no problem for understanding to navigate the model and locating the spatial contexts on it for the participants.

However, it was found that the scale of model is very important. A few of the participants were showing (or trying to show) outside the model whilst talking. For instance, a rickshaw-puller was trying to show on the ground (land) beside the model (see in Figure 6.16) to explain the queuing of rickshaws and space requirement at Kakoli-Banani. From this, it could be understood that the model was small size and hence the width of lanes in model is not wide enough to put fingers and showing the vehicle circulation. Having a bigger size model could solve this problem as the participants could show the circulation of traffic in each lane on the model. However, a bigger size will cause problems of higher cost and transporting the model to the venue of FGDs and moreover the participants would not able to point to the locations in the model with their hands. So, a trade-off is needed between the size (or scale) of model and convenience of transporting as well as cost. Nevertheless, one lady of the middle-income group was pointing outside the model and told "if the bus stops here, if get off here, and ……" about the location of BRT station at Sayedabad. As the facilitator reminded her to show within the model, then she was pointing in the model. This, in the contrary, reflects the size of model was not a problem but a few participants were just not pointing on it.

Figure 6.16: A participant trying to show on ground outside the model

Figure 6.17: Participant pointing a location outside the model and study area

In another occasion, while discussing about walking distance for modal changes, a professional lady of 'middle-income' group was telling about a location from where she walks to Kakoli-Banani bus station and tried to point in the model. However, as the model covered only about 650 m by 300 m of the study area, that point does not fall within the model. So, she showed that location outside of the model but in the same direction (and with approximate proportional distance). For example, showing outside the model (Figure 6.17) she told “not only here; for this point,..…. from this point also, here”. This indicates, it would be better if the model could cover a bigger area (large catchment area of BRT station). However, again, there should be made trade-off with other issues if the model is of a bigger size, as mentioned earlier.

Nevertheless, in summary it could be said that the FGDs with the help of 3-D physical model went well. The participants understood the plan of proposed development and the spatial contexts of the location as well as actively participated in the discussion.

6.6 Conclusions

This chapter discussed the findings on various aspects of physical design of BRT station area for modal integration and fare integration between rickshaws and BRT systems derived from FGDs. Using a 3-D physical model in 11 FGDs for two case study locations in Dhaka, the topics been discussed are: convenient distance for passengers for modal changes between rickshaws and BRT, pedestrian road crossing to access into BRT station, facilities required for passengers at BRT station platform, providing spaces for rickshaws at BRT station and organising rickshaws in and around BRT station to serve rickshaws as a feeder of BRT systems, information on traffic signs and symbols at BRT station for smooth flow of passengers, pre-determined fixed fare structure for rickshaws to implement an integrated fare systems for trips involving both BRT and rickshaws. It was also explained that using a 3-D physical model during FGDs helped very well for facilitating and progressing discussions with spatial contexts as well as effective involvement of participants’ engagement during discussion.

Next chapter will discuss the results on same topics derived from in-depth face-to-face interview of key informants.

Chapter 7
Policymakers' Opinions – Results from the Interviews

This chapter describes the policymakers' opinions derived from the key informants interview about modal integration between rickshaws and bus rapid transit (BRT) systems, particularly about the plan prepared for case study locations, as well as the possibility of fare integration and if possible then how to implement or function that integrated fare for trips involving both rickshaws and BRT.

7.1 Policymakers' Opinions about the Physical Design

This section reports on policymakers' opinions about the physical design of BRT station and its surrounding area which was prepared for physical integration of rickshaws with BRT systems to ensure easy and convenient modal changes for passengers. First, discusses the aspects for planning and design of BRT station and then analyses whether rickshaws could serve as a feeder of BRT systems and for doing that how to accommodate rickshaws at BRT station, followed by information for road users required at BRT station to improve the overall passenger flow for modal changes between rickshaws and BRT systems.

7.1.1 Planning the BRT Station Area and Design of Station

The topics covered on planning the BRT station area and design of station are:

- What would be the convenient walking distance at BRT station for modal changes between rickshaws and BRT systems;
- How to provide convenient, safe and secure pedestrian road crossing to access into BRT station; and
- What facilities would be required for passengers at BRT station.

Convenient Distance for Modal Changes

The distance needed to walk from a rickshaw to BRT or *vice-versa* at a modal interchange area would depend on the availability of space surrounding the BRT station where rickshaws could be accommodated for dropping and picking up passengers. Almost half of the respondents reported that passengers would like to be able to change the modes at the same point without walking any distance; but in reality that may not be possible. The respondents were asked about their opinion on acceptable walking distance for passengers for modal changes at BRT station; Figure 7.1 shows the results.

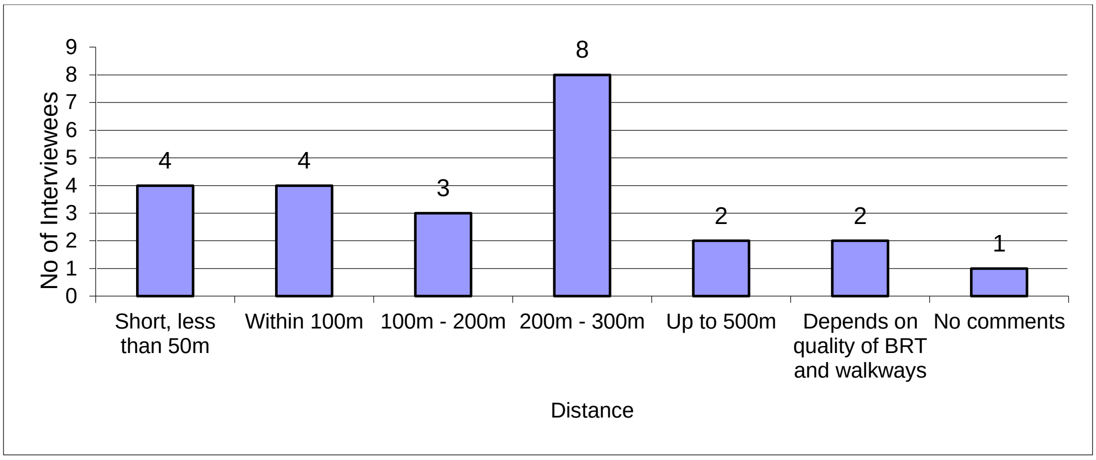


Figure 7.1: Respondents' opinions about acceptable walking distance for modal changes between BRT systems and rickshaws at BRT station

It was argued by the respondents that two to three minutes or even up to five minutes of walk at interchange is acceptable for passengers and about a quarter of a km is possible to walk within five minutes. Even up to 500 m has been said to be acceptable (maximum) distance for walk between two modes provided that rickshaws are available everywhere. It should be noted that though a few respondents gave a longer distance (e.g. 500 m as the maximum distance), the majority mentioned that a distance of less than 100 m would be better for passengers for modal changes. The distance between modes at modal interchange area or BRT station should be short, otherwise, instead of taking a rickshaw as access/egress legs passengers may walk straight to BRT station (because rickshaw trips are usually short) or look for alternative modes for the entire trip.

Nevertheless, it was reported that the distance passengers would accept to walk at BRT station for modal changes would depend mainly on following two aspects:

- Quality of the BRT services;
- Quality of the physical environment at modal interchange area.

Quality of the BRT services: If the BRT service is very good, such as fast and reliable, then it would be worthwhile for passengers to walk relatively a longer distance at modal interchange area to get the benefits of travelling on BRT.

Quality of the physical environment: A good quality of the physical environment at modal interchange area, such as a well maintained connectivity between modes through wide pedestrian paths and traffic signs or markings, pleasant walkways, etc. may encourage passengers to walk relatively a longer distance. For instance, three interviewees gave importance on the quality of physical environment and comfort of walking rather than the absolute distance needed to walk at modal interchange area.

Regarding the design of BRT station for Kakoli-Banani location, all the respondents but two mentioned that walking distance for modal changes between rickshaws and BRT would be within 200 m; therefore, it is reasonable and would be acceptable for the passengers. Two of them initially said the distance between rickshaw waiting areas and BRT station in the plan that has been prepared would be longer, about 300 m, but later mentioned that this is acceptable for that location. On the other hand, for the case of Sayedabad location, the respondents mentioned most of the areas for rickshaw waiting would be within 150 m whilst a few within 250 m of BRT station and the distance is reasonable for passengers to walk for modal changes.

Pedestrian Access to BRT Station

It was reported by all the interviewees that as a general principle, at-grade is the best option for pedestrian road crossings to access into BRT station and then underpass and lastly overpass. However, it was found that the opinions of respondents diverged about pedestrian road crossing to access BRT station or safety at modal interchange area in the case study locations of Dhaka. Table 7.1 shows that seven interviewees are pedestrian-friendly who preferred at-grade crossings; 13 interviewees are car-friendly who mentioned there are problems with at-grade pedestrian crossings hence suggested for grade separated (either overpass or underpass) pedestrian road crossing; and the remaining four of the interviewees are neutral who mentioned the choice of option should vary case to case - depending on space (width) of the road, location, and traffic situation.

The pedestrian friendly respondents claimed that using an underpass or overpass is inconvenient for pedestrians and some people (i.e. disabled, elderly, pedestrians carrying goods or luggage, cyclists) cannot use it. According to them, providing overpass or underpass for pedestrian road crossing would be an impediment for the users, so efficiency and ridership of BRT may drop. It was further added that aesthetic view of an overpass would look ugly whilst an underpass would not be feasible in Dhaka due to flooding problems. They argue that transport system is not only the movement of vehicles but the main thing is movement of people; as one of them said “pedestrians should get highest priority at-grade, so make delay for cars but not for the pedestrians”.

On the other hand, among the car-friendly respondents, seven have suggested for an overpass whilst six have suggested for an underpass for pedestrian road crossing to access into BRT station. They oppose at-grade pedestrian crossings because this will slow down the speed of BRT, may increase delay or congestion in mixed-traffic lanes as traffic has to stop with regular interval at pedestrian crossing signals, and thus road capacity may reduce.

Table 7.1: Interviewees' response about options for pedestrian road crossing to access BRT station

Category of Respondents	Descriptions	Number of Respondents	Reasons for the Opinions
Pedestrian friendly respondents	At-grade pedestrian crossing: along with zebra-crossing a pedestrian prioritised signal light 'puffin crossing' should be provided.	7	▪ Underpass or overpass are inconvenient and some people (i.e. disabled or elderly or if carrying luggage) cannot use them. ▪ Foot-overbridge will not be useful for the cyclists. ▪ Efficiency and ridership of BRT could drop as over or under-pass is very inconvenient for pedestrians. ▪ Transportation is not the movement of vehicles but movement of people; so at-grade pedestrians should get priority and cars could be delayed.
Car friendly respondents	Grade separated pedestrian crossing: underpass or overpass. For the convenience of people carrying goods or older and disabled: Escalator or elevator or ramps should be provided; Or Traffic police will stop the vehicles and then escort the pedestrians, waiting in a designated area to cross, without using overpass.	13	▪ At-grade pedestrian crossings would slow down BRT speed and road capacity may reduce, may increase delay/congestion in mixed-traffic lanes as vehicles have to stop in about every 2-3 minutes interval at signals. ▪ Due to high volume of traffic and pedestrian's behaviour (crossing the road without following signal) at-grade crossing will not function in Dhaka. ▪ Not providing any option for at-grade crossing because people will think "as it is possible to cross at-grade so why should I go on overpass"? ▪ Provision of escalators, lifts, ramps etc may solve problem of convenience for many users. ▪ Both men and women are using Kawran Bazar underpass; women feel safe if there are many people (in busy hours) but the problem comes when it is quiet time and dark. Underpass would be a part of BRT management or operation to keep it clean and safe.
Neutral respondents	Choice of option for pedestrian road crossing should vary case to case: depending on road width, location, and traffic situation.	4	▪ Somewhere in Airport Road (like a motorway standard) an underpass might be suitable but a place somewhere in Old Dhaka (very crowded, many rickshaws and slow vehicles, lack of space) underpass may not be suitable but at-grade.

Furthermore, car-friendly respondents claimed an at-grade crossing will not function in Dhaka due to high volume of traffic and the culture of pedestrians who are crossing the road without following the signal. Two of them were very extreme; suggested not to provide any option or scope of at-grade crossing. Because if at-grade crossing is possible passengers may think 'why should I use overpass?'.

However, the interviewees who suggested for a grade-separate crossing are aware about difficulties of pedestrians, particularly for the older and disabled people, in using underpass or overpass. They mentioned there could have provision of different facilities at overpass or underpass so that passengers' difficulties or discomfort could be removed or convenience could be enhanced for using those. For example, there could have a designated waiting area for disabled and older people who wants to cross the road, they will wait in that area and then traffic police would escort them (after stopping the vehicles) for crossing without using overpass. Provision of escalator or ramps to the overpass or underpass could overcome the discomfort for passengers. Providing escalator seems to be expensive for the short-term but not in the long-run; as one of the participants said "if there is energy security (power supply), it (escalator) is not a luxury anymore". However, another interviewee said "escalator would not be feasible for Bangladesh".

Those who have suggested for an underpass; they claimed that compared to overpass it is more convenient for passengers in using an underpass which requires fewer steps and thus less time for passengers to cross the road, to design or create space for an underpass is easier than an overpass and given the landscape of Dhaka city it would be easier for providing or accommodating an underpass in roads. However, most of them are aware about existing pedestrian underpasses of Dhaka – poorly designed and become water logging if it rains, regular maintenance is missing, women usually avoid using due to safety and security problems specially when it is dark. Nevertheless, two interviewees mentioned both men and women are using the underpass at Kawran Bazar; women feel safe if there are many people (in busy hours) but the problem comes when it is quiet time and dark, it is not suitable then. Thus, they suggested that the underpass would need to be a part of BRT management or operation to keep it clean and safe for pedestrians. It was further suggested that the BRT station needs to design and control passenger's access such that all the passengers have to use the underpass to access into BRT station.

Neutral respondents mentioned the choice of option for pedestrian road crossing to access into BRT station would differ in locations. According to them, in roads with less traffic volume could have at-grade but with high traffic volume should have overpass or underpass for pedestrian crossing. Such as, somewhere in Airport Road (almost like a motorway standard) an underpass might be suitable but a place somewhere in Old Dhaka (very crowded, many rickshaws and slow moving vehicles, and lack of space) underpass may not be suitable but at-grade crossing would. Nevertheless, they further added that an overpass is the most difficult option for pedestrians.

Pedestrian road crossing to access into BRT station of case study locations

For the case of Kakoli-Bananii location, as seen in Figure 7.2, only two interviewees suggested for an at-grade pedestrian crossing to access into BRT station whilst an underpass and an overpass was suggested by four and five interviewees respectively and the remaining 13 did not give any opinion. Those who suggested for an at-grade crossing, they recognise that would be very difficult to regulate or enforce and manage, however, by any means pedestrian crossing should be provided at-grade. The respondents who have suggested for an underpass, mentioned that it would enable to provide more room for pedestrians by creating enough space and the length of ramps needed to walk would be shorter than in an overpass. On the other hand, an overpass was suggested for pedestrian road crossing to access into BRT station because this is a busy highway where a large number of high speed vehicles are moving. They also mentioned to provide ramps at overpass. Some other suggestions they made about the initial plan of BRT station for Kakoli-Banani are:

- Ramps of the overpass need to be in the same direction of road, parallel of the BRT corridor. Otherwise, the way how ramps in the initial plan is provided in different directions, pillars of the ramps in the centre of road may cause problems to traffic flow.
- Both the ramps and stairs should be provided to an overpass. Disabled people or who needs convenience could use the ramps whilst the stairs would allow alternative options for those who are physically active, energetic and in a hurry.
- Providing elevators or escalators along with stairs for overpass would be better for convenience of passengers.

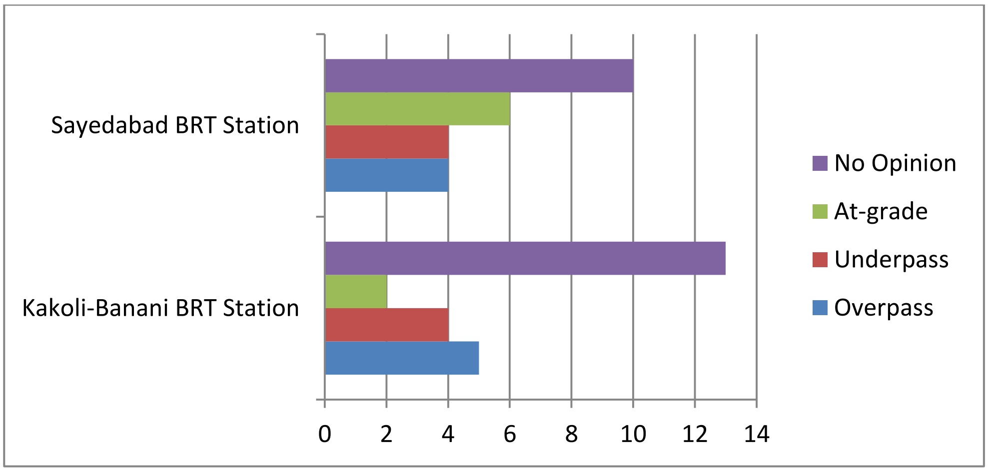


Figure 7.2: Suggestions for different options of pedestrian road crossing to access BRT station at Kakoli-Banani and Sayedabad location

- As the proposed elevated highway of the city is planned to pass through this location, there could be a conflict between the elevated highway and the overpass for pedestrian crossing, so needs to think it again.
- In the future, according to the transport plan, there will be U-turn ramps at Kakoli-Banani for the right moving vehicles along Kamal Ataturk Avenue; so the existing junction will not remain here as it is now. Vehicles will use U-turning ramps but the pedestrians would need to walk to reach BRT station.

About Sayedabad location, four interviewees suggested for an underpass and six interviewees suggested for an at-grade pedestrian crossing whilst an overpass was mentioned by four other interviewees (as seen in Figure 7.2). As the on-going construction of flyover is already in place, it is not clear how it would be possible to provide an overpass for pedestrian crossing. On the other hand, respondents who mentioned for an underpass was mainly because provision of pedestrian overpass would not possible due to presence of the flyover at Sayedabad. Those who have suggested for an at-grade pedestrian crossing have also mentioned:

- This may cause problem in traffic flow and capacity of the road; and
- A few suggested to have only one Zebra-crossing instead of two provided in the initial plan whilst a few others mentioned to provide two: one at close to the rail line and other at close to the *Janopoth More* intersection.

Ten respondents did not give any opinion about pedestrian road crossing to access into BRT station for Sayedabad location. Many of them mentioned this location is very critical in terms of road network, traffic movement, and road side activities; road space required for implementing BRT system would not be remain after the space of road width taken up by the pillars of on-going construction of flyover.

Safety and Security at Modal Interchange Area

Almost all the interviewees mentioned that the modal interchange area should be in such a way that it becomes very user friendly and convenient as well as safe and secure for pedestrians. The walkways should be even and smooth, clean, and should not have any potholes or should not be slippery or narrow. It was suggested that a pedestrian prioritised signal light 'puffin crossing' to be provided at BRT station along with Zebra-crossing if at-grade pedestrian crossing facilities are given. Both signalised crossing and Zebra-crossing were suggested because they would enhance visibility of pedestrian crossing point among road users. As the pedestrians in Dhaka city usually do not follow any traffic signs, signals and rules while crossing the road, five of the interviewees mentioned a need for awareness generation and educating people about crossing (where and when to cross the road) at first and then strong enforcement (both policing and device control).

Width of the walkways is very important for a convenient walk. Five of the respondents mentioned to have at least 3 m wide footpaths. One of them suggested the width should allow walking of 2-3 persons at a row whilst another mentioned for 4-6 persons at a row. However, the width would depend on the volume of pedestrians or demand as well as availability of road space or width to create room for footpaths. Nevertheless, a pedestrian-friendly respondent argue that walkways should be wide enough and for doing so even if it is required space from existing vehicle carriage way or traffic lane should be taken off by narrowing them. A few other interviewees advised not to have a fixed width of footpath; arguing for only the minimum width of 2 m all walkways but not the maximum width (maximum will be based on actual pedestrian demand).

Concerning about security of passengers at BRT station or modal interchange area, the respondents made following different suggestions:

- To deploy security guards at BRT station – either deploying extra personal or having BRT staff/attendant at station (and existing law enforcing agency should be extra vigilance) without deploying any extra personal;
- To install hi-tech closed-circuit (CC) cameras;
- Designing a multi-purpose interchange area incorporating people - if a shop is provided at station this will help passengers to feel safe and not isolated;
- Ensuring continuous lighting, especially at night, because insecurity of passengers usually happens when it is dark. So, a stand-by electricity or alternative emergency power supply required as power cut (load shedding) is very common in Bangladesh; and
- The responsibility for maintaining security of interchange area should be given to the BRT management or operating team as a part of overall BRT management because it might not be possible ensuring security of passengers only by physical design.

Particularly for the case study locations, interviewees gave similar opinions as mentioned above for the safety and security of passengers at BRT station. For the case of Kakoli-Banani location, it was mentioned that a wider and dedicated footpaths would be necessary. One respondent added that the width of footpaths at Kakoli-Banani is about 10 feet (3.2 m) wide – that is good for pedestrians. On the other hand, for the case of Sayedabad location, almost all the interviewees mentioned: a good quality of lighting would be required as the BRT station is underneath the flyover and trees should be planted on footpaths to provide shade for passengers against the heat of sun. Initially two respondents were asking whether it is necessary to provide a footpath of 8-9 ft wide; as one said “as the existing footpaths are about 6-7 ft (2 m) wide, it would be better to provide another extra lane for mixed traffic movement instead of widening the footpaths". However, in the end they mentioned the bus terminal at Sayedabad would generate many passengers so a wider footpath is needed there.

Facilities Required for Passengers at BRT Station

Regarding the facilities required for passengers and would need to be provided at any BRT station, the following aspects were outlined by the respondents:

- The facilities required at a BRT station would depend on passenger demand (i.e. flow) and size or importance of that particular station. It would not be possible to consider all the stations in a same size or uniform - one could be a major terminal point whilst another could be a small station or just a change point. More facilities for passengers may require in a major or large station compared with a smaller one.
- Not many facilities would require to provide in a BRT station because the frequency of BRT services would be very high and thus only for a very short period of time passengers will wait there.
- A station platform of about 3 m wide would not allow providing many facilities except the essential ones such as ticketing (automated or digital) and passenger entry control.
- The ticketing and passenger entry control should be very fast so that there do not form a long queue while purchasing tickets. It was further noted about the possibility of arranging the ticketing facilities outside of the BRT station platform, on walkways, and allowing access to the BRT station only to people having a valid ticket.
- A simple/easy system of ticket collection for passengers should be available because many people are illiterate. The public should be educated and informed if there are any technical or automated ticketing arrangements.

In general, almost all the interviewees mentioned that in any BRT station should have the following passenger facilities:

- A shade to give a shelter for the passengers against heat of sun or rain;
- A toilet;
- A kiosk (shop);
- A ticket counter or ticketing facilities.

A kiosk or a few shops have been suggested by the respondents so that passengers would able to buy small items (i.e. drinks, chips, chocolates, phone cards, etc.) as well as it could ensure sense of security for passengers. Furthermore, this could generate extra revenue from rent or advertising. However, it was suggested that the number of shops should be limited to avoid over-crowding.

On the contrary, two interviewees opposed to have a shop or toilet in BRT station arguing that passengers would wait there just for a minute or half of a minute and it would not be like a national rail station. Nevertheless, a toilet could be provided only in a busy station, like a junction where many passengers, but not in all the stations.

Almost half of the respondents suggested for providing seating arrangements in BRT station. They mentioned for a very limited number of seats (i.e. 10-15 seats) to provide only for the older, disabled or sick people, and women with babies if they want to seat and rest while waiting. However, mentioning the high frequency of BRT services another respondent opposed to provide any seat; as said “who will seat and who will stand - that would create another problem in station”.

The interviewees suggested for a pleasant environment of waiting area at station. In line with this, two respondents mentioned that BRT station should have barrier to control unauthorised access (without a valid ticket) of passengers. The design of BRT station should allow natural air/wind circulation or there should have air conditioner (AC), fan etc. for cooling. A few of the respondents also suggested to provide: a display board for information, newspaper, and telephone booth, etc. and special arrangements for disabled people. Few others mentioned for escalator or lift. Nevertheless, one interviewee mentioned that he is not worried about the facilities required at BRT station but about the pedestrians’ access to BRT station; as the demand for BRT would be very high, probably the station platform of BRT will be overcrowded soon. So crowd management in BRT station would be important, otherwise there would be a chaos.

Table 7.2: Summary of the facilities required for passengers at BRT station

Facilities	**Location**		
	Generic BRT Station	**Kakoli-Banani Location**	**Sayedabad Location**
Essential facilities	• Passenger shade • Ticket counter • Toilet • Kiosk • Information display	• Passenger shade • Ticketing • Toilet • Kiosk • Map showing the major attractions	• Passenger shade • Ticketing • Toilet
Additional facilities	• Limited seating • Pleasant environment • Air-conditioning • Newspaper and telephone booth	• Limited seats • Boarding and alighting points • Newspaper • Trolley to carry goods	• Limited seats • Signs & symbols indicating boarding & alighting points • Trolley to carry goods

As already explained earlier that the respondents mentioned passenger facilities required in a BRT station will vary depending on its size and location, they were asked what particular facilities would be needed for the case study locations. Particularly for the BRT station at Kakoli-Banani, most of the respondents mentioned a passenger shade and a toilet (as it is one of the busy intersections but have scarcity of public toilets) would require. Other suggested facilities by several respondents are: limited seating arrangements, a kiosk for small items, newspapers, signs and markings indicating the boarding and alighting points of BRT and rickshaws, a map of the BRT station showing the surrounding area and local major attractions, pedestrian access facilities (including provision of wheel-chair access) to BRT station, and trolleys for carrying goods. Having a shop or kiosk at pedestrian underpass or station may provide employment as well as a sense of security for passengers. However, the idea of providing kiosk at station was opposed by one respondent mentioning his fear - if the shops become the prime concern of BRT operating agency instead of providing the passenger facilities in station.

For the case of Sayedabad, the interviewees mentioned to provide a passenger waiting shade as well as signs and symbols indicating the boarding and alighting points of BRT and rickshaws. A respondent further added that the symbols should include both the distance and the direction and should be pictorial so that illiterate people can understand because there are many illiterate people in Bangladesh. A few other respondents emphasised on having a toilet and trolleys for carrying goods at this station because it is a major part of the city where inter-city bus terminal is located and there would be a large number of passengers. Another respondent argued that instead of providing a toilet in BRT station this could be arranged at a nearby shopping centre and giving an arrow/direction to the toilet. Provision of a toilet in the shopping centre could be ensured by making it one of the compulsory requirements of planning permission of the building construction from RAJUK. The responsibility for its management (i.e. cleaning) should be given to the shopping centre managing authority which will ensure cleanliness and better service.

7.1.2 Rickshaws for Feeder Services in BRT Station

All the respondents interviewed mentioned that rickshaws could play a vital role of feeder services to BRT systems. Even, two of them argued for incorporating rickshaws within the BRT project to increase BRT ridership; otherwise if rickshaws are not well integrated with BRT systems to ensure passenger convenience, passengers may look for alternative modes for door-to-door services instead of using the BRT system. The main reasons the respondents gave in favour of their argument about rickshaw’s role as feeder services are following:

- Rickshaw is a very necessary mode in Dhaka city. There is no alternative mode except rickshaws for the poor or middle-income bracket who does not own a personal vehicle. The rickshaw is like a taxi - not only as a normal travel mode but also carrying goods or older and sick people as an ambulance; its importance is countless. Moreover, if it rains the roads in Dhaka become water-logged and people can travel only on rickshaws. It was further noted that the importance of rickshaws at present is very much but in future would increase much more. Rickshaw is inherent in Dhaka and already became a part of social or travel behaviour, therefore, transportation planning in Bangladesh must be different than in other countries.
- There are many roads in Dhaka city which are very narrow and their width would not allow operating the standard public transport vehicles. Even a small-size bus of 20-25 seats would not be possible to operate in those narrow streets. BRT or any other form of mass public transport in Dhaka would operate only in the main corridors or major roads. Hence, it would not be possible to make available public transport within walking distance as many of the narrow streets would deny access of public transport mode. Thus, feeder services are needed for passengers as access/egress legs to/from BRT station and this should not be auto-based but NMT based - walking and cycling or rickshaws.
- Many people in Dhaka use rickshaws instead of walking. Passengers moving with goods, women and children or older people will be dependent on rickshaws for their travel even for short distance.
- There is a need for ‘pedestrian first’ priority; walking then next to walking is cycling and rickshaws. Rickshaws would be the best or most useful mode as feeder among all the alternatives available in Dhaka; because:
    - People are already using rickshaws;
    - Except the major arterials most of the roads are narrow where only rickshaws are suitable to operate;
    - Rickshaw provides door-to-door service and usually for short-distance;
    - Compared to other modes (i.e. taxi or auto), rickshaws would be cheaper for short distance trips; and
    - Rickshaws are already playing an important role as a feeder service of bus or train and will remain as a feeder in future. One of them further added that rickshaws could provide feeder services not only for BRT, even if there is metro or rail-based transit systems rickshaws would able providing feeder services.

On the other hand, five respondents mentioned socio-economic roles of rickshaws and why they should be planned as feeder services of BRT. First, rickshaw is one of the important sectors of informal economy in Dhaka. Each rickshaw supports livelihood of more than two families (two pullers pulling a rickshaw in two different shifts) and many people are engaged in different supply chain network such as rickshaw garage or repair mechanics. Second, there is a hidden urban dynamics – most of the pullers are rural migrants who pull rickshaws during the off season in agriculture or farming activities and again return to villages during agricultural work. Third, rickshaws are functioning in private sector and the government do not need to invest anything for this sector. Therefore, it was argued that these social aspects should be incorporated while planning for transport in Bangladesh.

However, except one all the interviewees mentioned that rickshaws should operate only in neighbourhood roads but not in major roads where would need high capacity buses or minibuses. However, it is a challenge how to keep rickshaws outside the major corridor. Three of them mentioned that at present there is no functional hierarchy of roads in Dhaka. Having a functional hierarchy of roads is a pre-requisite for such trunk and feeder services where one mode would feed to complement other. Moreover, as other respondents mentioned, need to provide designated space for rickshaws (rickshaw stands) on the service lane or feeder roads closer to BRT station for dropping off and picking up passengers.

Nevertheless, eight interviewees argued for having a cap (only up to a certain number is allowed) on rickshaws for the city. They have emphasised on only having rickshaws of the allowable amount permitted by license and the extra illegal ones should be removed from roads. In a similar vein, it was further mentioned to have a cap on rickshaws operating within the neighbourhood or the number of rickshaws should be minimised on corridors; otherwise, there will be too many rickshaws. However, one respondent opposed for having any cap claiming that the demand and supply of market would determine the number of rickshaws whilst the remaining had no comments.

Finally, rickshaws to be served as a feeder of BRT would require BRT station to accommodate rickshaws for convenient changes between rickshaws and BRT, organising rickshaws at station, and fare integration for passenger convenience.

Organising/Queuing Rickshaws at BRT Station

All the interviewees mentioned a need for organising rickshaws in and around BRT station to function in a more systematic way and follow a tidy queue while waiting. It was further suggested that there must have a designated space for rickshaws (to wait for picking up and dropping off passengers) at BRT station and provision of this space (rickshaw stand) should be a part of BRT station design. Apart from the rickshaw stand at BRT station, rickshaws should not be organised in other areas of neighbourhood for waiting at certain places; rather they should be allowed to be scattered for providing door-to-door services. One respondent added that during his childhood there were rickshaw stands both in small cities as well as in Dhaka; however, now-a-days these are no more available probably because of combination of factors such as increased land price, reduced width of the rights of way (ROW) of road, increased pressure from more vehicles than the capacity of road. Consequently, the rickshaws wait on streets occupying the carriage way as there is no waiting or parking space for rickshaws. Hence, as one respondent mentioned, the empty rickshaws are more problematic than a moving rickshaw because they occupy half of the carriage way.

Eight respondents suggested that there should have three to five designated places for rickshaws (rickshaw stands) surrounding the BRT station for dropping and picking of passengers at BRT station. It was further mentioned that in each of the rickshaw stands should be limited to a certain number of rickshaw spaces (i.e. 5 or 10) to wait at a time and more than that number should be removed through enforcement. Four of them added that the empty rickshaws should not wait in rickshaw stand for a long time; they will just come to rickshaw stand or rickshaw-bay, drop off the passenger and then pick up passenger and leave the place. They also suggested that rickshaws waiting in stand should go anywhere where the passengers want to travel. Almost all the respondents emphasised on regular monitoring and strict enforcement of the rickshaw waiting places at BRT station. Furthermore, if the fare of rickshaw trips is fixed then the passengers could board on first available rickshaw waiting in the queue without any hesitation.

Enforcement of administrative powers to make the pullers maintaining queues in disciplined manner at stations was emphasised by two respondents. For instance, pullers should have a license which could be cancelled if they do not practice the organised queuing. However, given the reality of more than three-quarter of existing rickshaws operating in Dhaka or Delhi are without a valid registration (and the pullers do not have a licence to it), it is unlikely to make any positive impact. Nevertheless, if it proves possible to determine fixed/limit their numbers, it could be possible to issue the registration number and ID (identification) for each rickshaw and puller respectively (within community level), which could ensure more security of passengers (as they would be possible to identify easily). Obviously, this licensing and ID for the pullers should be done in a local area or community level. However, a respondent opposed that enforcement will not help the pullers to maintain a queue. Referring to the location Uttara Mascot Plaza where rickshaws are forced to maintain a queue, he claimed that rickshaws are often facing there a problem of ‘last-in first-out’ (when a rickshaw comes to drop passenger, came at last, but pick another passenger for another trip ahead of the waiting pullers); hence pullers will not follow the queuing. On the contrary, citing the example of Cantonment Area where all the pullers are following a tidy queue, another respondent claimed that if there is proper enforcement then pullers must follow the queuing. As he said, "it is very interesting, a small enclave within Dhaka city where everybody follow all the rules and regulations. It is the same Bengali people - when he is inside the Cantonment Area behaves one pattern and when outside of Cantonment then behaves different pattern". It was discussed in Section 4.2.3 how rickshaws with the proper enforcement are following a tidy queue in Cantonment Area.

Organising or queuing of rickshaws at BRT station probably could be done up to a certain level by engineering design or infrastructure provision and enforcement of administrative powers. However, almost all the interviewees mentioned to educate and aware rickshaw pullers so that they understand the benefits they may get from following a tidy queuing while waiting and thus become motivated and could organise themselves and maintain queuing. Three of them mentioned in some areas of Dhaka there is already an association of pullers and association of owners; they are issuing rickshaw numbers within that area. This reveals, to a certain extent rickshaws are already organised and these associations could be strengthened more. Two respondents suggested that government could take initiatives so that NGOs come forward to help rickshaw pullers to form their association at community level so that they could regulate some aspects among themselves. The respondent from transport regulatory agency mentioned representatives of rickshaw pullers and owners could be involved in city transport committees (which is dealing with fare determination or issuing license), and both DCC and traffic police could sit together with pullers' association and owners' association to determine the maximum number of rickshaws that should be operating in a certain road or area or locality. Furthermore, five respondents mentioned there is very recent example of easybikes operating in a few areas of Dhaka city which have organised themselves and maintaining a tidy queue at stops. Next sub-section will explain elaborately how easybikes have been organised themselves at one stop.

Easybike drivers organised themselves

Easybikes are operating as a public transport mode with a fixed fare structure in a few fixed routes (i.e. Mirpur 10 to Parish Road, Mirpur 10 to Cantonment, Mirpur Purabi to Rupnagar) in Dhaka. The drivers of easybikes themselves organised, determined the fare, and maintaining the tidy queuing at station. Easybikes waiting at Mirpur 10 were observed and informal discussion with two drivers operating between Mirpur 10 and Parish Road (Avenue 5, Mirpur) were done.

Figure 7.3: Easybike drivers are organised and maintaining a tidy queue themselves while waiting for passengers at Mirpur 10 (to Parish Road)

30 easybikes are operating between Mirpur 10 and Parish Road. For the first time in the beginning of 2011 only two easybikes started operating in this route. The drivers organised themselves to maintain a tidy queue while waiting for passengers at stop - Mirpur 10 or Parish Road. According to Mr Zaman, driver of an easybike operating in this route, “we do not have any leader, we all are same. We know each other and do care for others. We understand that maintaining and following the queue would be better for all of us, and so we do”. They follow the simple rule of ‘first-in-first-out’ – who will arrive first at Mirpur 10, he will go first (wait in the front of queue for picking passengers). If someone needs to go into the front of the queue to take the trip first without waiting, in any special or urgent case, he should request to the driver who is in front of him in the queue, and if allowed then he could go first otherwise should wait in the queue where he is. All of them are following a tidy queue themselves while waiting for passengers. At first the vehicle waiting in the front of the queue start boarding passengers and when all the seats are filled up it starts for destination and leaves the queue; then the next vehicle waiting in queue start boarding passengers. At Parish Road they follow a serial number for the queue (who will go first and who is next) through maintaining a diary (log book). The drivers themselves maintain the log book; when a driver is leaving from Parish Road to Mirpur 10 he leaves the log book to another driver next to him who will be waiting there in queue for a while for boarding passengers. Thus, the log book for keeping the serial at Parish Road rotates among all the 30 drivers.

Similar to easybikes operating between Mirpur 10 and Parish Road, auto-rickshaw and easybikes operating from Mirpur 10 to Mirpur 14 or Kachukhet or Sainik Club also maintain a tidy queue while waiting for passengers at Mirpur 10 (see Figure 7.4). However, it should be noted that there is a warden (employed by the owners of easybikes and autos operating in these three routes) to monitor and enforce the queuing of easybike and autos at Mirpur 10.

Figure 7.4: Easybike drivers and auto drivers maintaining a tidy queue while waiting for passengers at Mirpur 10 (to Mirpur 14, Kachukhet, Sainik Club)

7.1.3 Information for Road Users Related to BRT

This section reports on respondents' perceptions about road user's knowledge on traffic signs and signals and what type of road use signs and symbols would be required at BRT station or modal interchange area for smooth flow of passengers between rickshaws and BRT systems for modal changes.

Road Users Knowledge About Traffic Signs and Signals

Figure 7.5 reveals the respondents' opinions about the road user's knowledge on traffic signs and symbols; nine of them mentioned the majority of road users in Dhaka do not know anything about traffic signs and symbols or have a very poor knowledge whilst five respondents mentioned the majority of road users know and five others mentioned road users of Dhaka know only the simple or basic ones. Four respondents mentioned very poor behaviour or lack of awareness about traffic signs and symbols of road user's whilst one respondent mentioned there is very minimal implication of road signs and symbols in Dhaka because those who are providing (usually contractors) they do not know - design, planning and implementation is faulty. Participants claimed that road users in Dhaka do not care about signs and symbols – driver's behavior is very poor (there is no lane discipline) and the behaviour of pedestrians is very unpredictable (cross the road at any place without following the signs/symbols and the designated places for crossing). In general, nobody in Dhaka thinks about signs and symbols; as a participant mentined "This is our character; probably someone is standing here under a given sign post but will ask to another person about the direction. Probably the direction sign is given but it is built in your head, there is no idea in your head that this information could be given there".

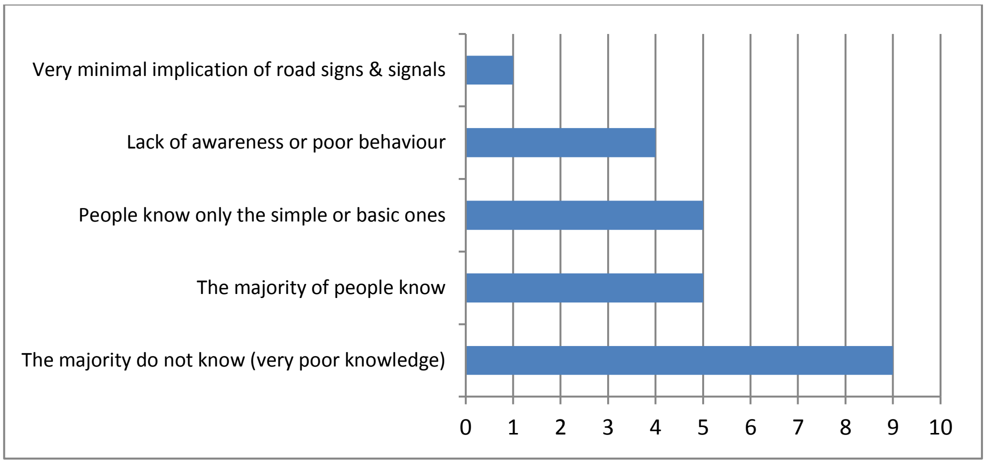


Figure 7.5: Respondents' opinions about the level of road users' knowledge on traffic signs and symbols

The respondents who mentioned the majority of road users in Dhaka do not have any knowledge about road signs and signals, they also added that even the drivers of motorised vehicles do not know. As one of them said "during a survey conducted by Accident Research Centre (ARC) a driver had been asked showing the symbol of 'School Ahead' and he replied that he does not know" whilst another said "I have asked a driver what is the meaning of a line marked on road and he replied 'the authority thought a line marking should be given so they have provided it". Another respondent assumes that about 95% of drivers, who have a valid driving license, do not know the meaning of any particular symbol. This is probably because as the drivers do not receive any refreshers training they cannot remember those. A few of the respondents also mentioned that despite the poor level of knowledge the road users do not have any interest to know about the traffic signs and symbols.

On the contrary, it was mentioned that the drivers and pedestrians who are literate or residents of Dhaka should know the road signs and symbols. However, even if someone knows they do not obey that due to negligence of enforcement. For instance, passengers know the important or basic ones (i.e. green light, stop sign, one-way street, etc) but there is no enforcement. Hence, the problem in Dhaka is not about the lack of understanding but the lack of enforcement. Thus, one of the respondents raised the question for implications of the signs and symbols – it is not clear what are the benefits if someone is following or not.

Requirements About Road Use Signs and Symbols

The respondents mentioned traffic signs and symbols need to be provided for easy movement of passengers at BRT station or modal interchange area are as follows:

- The direction (i.e. arrow sign) to rickshaws or BRT to direct passengers where they should walk;
- If possible, direction sign with information of distance (how far is located);

- Information of the major attractions or destinations (i.e. Airport, High Court, Parliament) from that station;
- BRT service information (which vehicle will move on which direction);
- Pedestrian crossing (i.e. lighting or other signals); and
- 'Pathfinder' - at least 1 km away from the station passengers should able to know where is BRT station and which direction he/she should go.

The respondents mentioned the signs and symbols required at modal interchange would depend particularly on the situation of a station. Symbolic information was suggested by one respondent so that illiterate people also could understand whilst another respondent mentioned majority of the BRT passengers will be familiar with it and if someone is not then (s)he could ask someone where is the BRT. Nevertheless, it was emphasised that the signs and symbols should be synchronised both in tactile and visual impacts and should be placed at correct place. Beside these, the respondents also suggested following:

- As BRT is the main service, it would be the responsibility of BRT operator to provide information (i.e. what is waiting time for a particular route, distance from here to another point) to its passengers and the basic information should be provided at the key points within catchment area of a station; and
- The signs and symbols need to be placed at proper location and they need to be maintained regularly, otherwise soon after providing they would be covered with posters; hence, provision of signs and symbols should be minimal.

To improve road user's knowledge and practice of traffic signs and symbols, respondents suggested:

- Need for educating and awareness generation of public;
- Practical demonstration; and
- Importance and necessity of publicity campaign.

Incorporating traffic signs and how to move on streets in course curricula of academic institutions were suggested by respondents. Two of them mentioned they have studied civic behaviour at school but now it is no longer available in curricula and they are surprised why. To teach some basic aspects at school, say from Class V to VIII, was suggested and these topics should be compulsory. Other two respondents also added that children should learn traffic laws at school and there should have practical demonstration by traffic police or professionals at school.

Media could play a strong role whilst another participant mentioned illiterate people could be aware through television (TV), media, non-government organisation (NGO), and community level school.

Nevertheless, the responsibility would be more on drivers of motorised vehicles because usually non-motorised transport (NMT) and pedestrians are more vulnerable or fatal. So, the responsibility is mainly on a driver that he should follow and wait at a Zebra-crossing or signalised crossing whilst the responsibility of others are least. At first the drivers of motorised vehicles should follow the signs and symbols and then the rest would possible to achieve easily.

7.2 Policymakers' Opinions about Fare Integration

Fare integration is also very important for integrating rickshaws with BRT systems; as one of the respondents said there is a law something like that to reduce hassle of passengers and unpleasant bargaining. On the contrary, another interviewee opposed the idea of having a single integrated fare claiming that in such a system rickshaws should have a device and again the collected fare revenue would be required to distribute to rickshaws; which will be complicated and cost of the device might be more than the cost of a rickshaw. Nevertheless, three respondents mentioned it would be possible to have an integrated fare if the rickshaws become localised and serve within a delineated area with a pre-determined fare rate or rickshaw service is provided by the BRT operators within the locality (an area delineated) of each station. As the pre-determined fixed fare structure for rickshaws is the crucial one for an integrated fare, the following paragraphs describe about this topic and the opinions of respondents.

Pre-determined Fixed Fare Structure for Rickshaws

While discussing on whether a pre-determined fare structure for rickshaw trips is possible or not, most of the respondents talked about the necessity of controlling or regulating the fare whilst only three others argued it is not good to try to control the fare of rickshaws. Five interviewees were claiming that rickshaw fare should be determined, and pullers should not be allowed to charge an exorbitant rate because: now a days pullers ask very high fares and passengers have no alternative except to pay the overpriced fare; due to high increase of fare, arguments between pullers and passengers are happening regularly; it is becoming difficult to afford for many people, especially for lower-middle income bracket. One of them further argued that it is good to bring the fare of any public transport mode under regulatory measures; hence rickshaw fare should be controlled through administrative power. These arguments indicate they were talking just like as a passenger, not an expert of the field. Nevertheless, the issue/topic for discussion was not controlling the fare; it is about whether or not having a pre-determined fixed fare structure for rickshaws.

Is it necessary to have a pre-determined fare for rickshaws?

Three interviewees mentioned having a fixed fare rate for rickshaws would give benefits; such as passengers would know their monthly travel cost as well as whether pullers were charging extra for a specific trip, pullers could know how long they have to work to earn a certain amount.

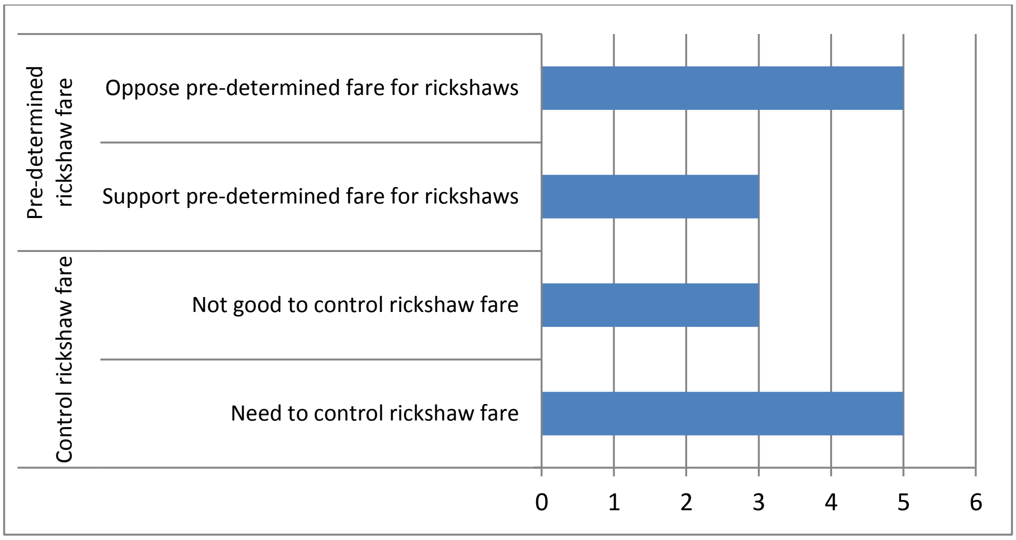


Figure 7.6: Respondents' opinions about controlling and pre-determining fare for rickshaw trips

On the other hand, a pre-determined fare rate for rickshaws was opposed by five interviewees who think it would not be possible to implement because very difficult to enforce and to determine what should be the correct fare as the fare of a rickshaw trip depends on multiple aspects. Hence, the pullers or owners of rickshaw will not agree with a pre-determined fare rate. Moreover, rickshaw fare is constantly changing; if food prices go up then it must go up and the government could not be so responsive. In Bangladesh, economy is not stable and price of commodities are increasing so frequently that the fare rates may need to be revised in every 2-3 months interval. Above all, they argue that being a nature of para-transit it would not be wise to determine the fare for rickshaws; demand supply in market should do it. Most people know about the reasonable fare; if the pullers ask for more, then they could walk. Furthermore, doing a pre-determined fare structure for rickshaws would be hard work logistically, and a single integrated fare will involve administrative costs for fare collection and again distributing revenue to rickshaws.

How to Determine Fixed Fare Structure for Rickshaws?

Fourteen respondents mentioned it would be possible to have a pre-determined fare structure for rickshaws. Four of them were very optimistic and enthusiastic about it; saying this is happening in a few areas of Bangladesh, such as outside the train station of Gazipur a billboard shows a chart of rickshaw fares for different destinations; hence it is also possible in Dhaka. Of course, fare structure for rickshaw would not be metreing like taxi cabs, but could be done by various techniques as mentioned by the interviewees.

Table 7.3 shows different methods of determining a fixed fare rate for rickshaws mentioned by 14 interviewees. It was suggested by the interviewees that a pre-determined fare rate for rickshaws could be possible based on trip distance or travel time or demarcated area of various distance or a flat rate within a demarcated area.

Table 7.3: Methods of determining a fixed fare rate for rickshaw trips

Methods	Description	Respondents
Based on area or locality	Delineating or demarcating neighbourhood and a fixed rate for trips within the area or outside the area	5
Based on time of the rickshaw trip	Measuring the time of rickshaw trip and determining a rate for per hour or minute	3
Based on distance of trip	Identifying tentative distance between two locations and determining a fare for that trip distance	7

- Fare based on distance: Five interviewees mentioned it would be possible determining a fare for rickshaws based on distance. One of them said about a per km rate; citing example of his home town Dinajpur, before 1978 there was written ‘50 poisa[26] per mile’ in the back of a rickshaw. He also added that at the end of a trip it would be possible to have an idea about the distance, probably it could be more or less of about 200 m. However, three others mentioned that determining the fare for rickshaws would not be possible by measuring the exact distance (in metre or time) rather should be based on tentative distance between origin and destination of the trip. According to them, a tentative distance between two major points/locations could be identified (the true distance could be more or less) and fixing a fare for that distance whilst distance of the rest through mutual understanding.
- Fare based on travel time: One respondent mentioned that a clock or simple machine could be attached with rickshaw to measure start and end time of the trip and the duration of trip time would be multiplied with a pre-determined rate or cost of unit time to calculate the trip’s fare.
- Minimum flat fare: The BRT project manager mentioned a minimum flat rate fare, such as BDT 10 for any distance, could be done for rickshaw trips within a demarcation line or locality. He further added that it is difficult to measure the distance of rickshaw trip hence it would not be possible

[26] Poisa is the lowest unit of Bangladeshi currency; 100 poisa makes 1 taka.

determining a fare based on distance travelled and it would be difficult to disclose the information about fare rate. However, a guideline of possible fare structure for rickshaw trips could be given.

- Fare based on local demarcation line: Four respondents mentioned about a hypothetical demarcation or boundary line of the locality within a certain distance where rickshaw fare within a demarcation line would be same. For instance, one of them mentioned within 1 km or up to 2 km or more than 2 km could have different fare whilst another one said a fixed fare within the locality but trips outside the locality would be another rate or sum of the fare both of the locality.
- BRT station and demarcated hinterland: Three respondents mentioned to demarcate the hinterland or locality of BRT station (i.e. neighbourhood or ward) through a road or physical barrier and differentiate rickshaws within that barrier with a distinguish colour and a minimum flat rate for rickshaw trips within that area. They added that rickshaws must be localised and operate only within the local community or hinterland (a separate colour for rickshaws in each hinterlands), otherwise would not possible to implement.

Will the Pre-determined Fare Rates for Rickshaws be Followed?

After determining the fare structure for rickshaws, a large fare chart mentioning all the major areas could be placed at station or major areas. It was claimed that if the fare is determined based on distance then the chart of fare rates will be very long.

Almost all of the respondents mentioned that rickshaw's operation should be localised otherwise it would not be possible to determine a fixed fare structure. Two of them further added that rickshaws in Dhaka already became delineated within the neighbourhood area; in few cases, pullers also do not want to move out of the neighbourhood. However, it was raised that the idea of pre-determined fare for rickshaws based on demarcating a localised zone is good but would be difficult to implement as there is no local body or institution; claiming "in our society metred fare rate of any para-transit such as taxi-cabs and autos (CNG) is not functioning".

Nevertheless, a more participatory approach in decision making process including the pullers and owners of rickshaws along with local representatives may help functioning the pre-determined fare rates of rickshaws. A strong enforcement as well as willingness of the pullers will be needed. If an association is formed (i.e. owners' association), they could sit with local government and discuss about a fare structure to be determined. Local government could fix a rate for rickshaw fare and public representatives of each area could be involved to monitor and report if the fare rate is being violated.

Learning From Other Examples and Previous Experiences

Following paragraphs describe pre-determined fare structure prepared for easybikes by easybike drivers which is functioning, for rickshaws by Gazipur municipality and by Sacar municipality which is not functioning now.

Easybike drivers determined the fare rates and following it

Informal discussion with the drivers of easybikes that are operating between Mirpur 10 and Parish Road in Dhaka city reveal that the drivers sat together and discussed themselves to determine the fare structure. They decided a fixed flat rate for the trip. Initially the fare was set for BDT 10 per person and carrying four passengers; however, later the fare reduced to BDT 5 and carrying eight passengers (in same seat). They set the fare as BDT 5 to get more passengers and to fill up the seats within short time so that waiting time in queue would be less. The drivers mentioned that if they decide a fare rate, the passengers accept that fare and within few days passengers become familiar about the fare for that route. The fare is same for any distance within this route and if a single passenger want to travel alone he has to pay the fare for eight passengers.

Rickshaw fare in Gazipur City Corporation

There are billboards at 12 different points of Gazipur city showing a chart of rickshaw fares for different destinations. Each billboard shows a list of fare from a point to major destinations; for instance, there are list of fare rate for 91 different destinations from Muktomoncho, the prime point of the city (Figure 7.7).

The fare was determined considering the distance between two locations, usually well-known points, as well as the condition or quality of roads. If any trip goes beyond the mentioned point in chart, say going up to the door steps, then assuming for the extra distance from that point the passenger has to pay additional amount on top of the fare mentioned in chart. The current fare charts were prepared in 2009, though previously there were other charts before these. At first the charts were introduced in 2002-2003, then again in 2006, and finally the existing one in 2009.

In the beginning, before introducing the fare chart, the residents of Gazipur city complained to the city authority that often disputes and arguments happening between pullers and passengers about the fare of rickshaw trips. They claimed that the pullers were charging more from the passengers; such as probably pullers are charging BDT 5 but the rationale fare for that distance/trip is BDT 3. The residents asked to the city authority what could be done about this. The then city authority arranged a meeting with the respected/eminent citizens including various NGOs and institutions, educational institutions, rickshaw pullers where they set together and decided to prepare a chart of fare lists. In the meeting, after a long discussion and debate everybody unanimously decided a fare rate of rickshaw trips for various destinations and prepared a chart of fare lists.

Figure 7.7: Billboard at Gazipur Muktomoncho shows a list of fare rates for different destinations for rickshaw trips

However, the pre-determined fare rates for rickshaws mentioned in the chart was functioning for a short time, just about for a year since its inauguration. After that, it is been a while that the fare chart for rickshaws is not functioning. This happened that after the increase in price of essential commodity goods, the pullers are not following the fare suggested in the chart and demanding extra amount. Therefore, after increase of commodity prices again the city authority sat together in a meeting and all the members, including pullers, unanimously decided another revised chart of fare lists. Thus continued one chart after another. Disobeying of fare mentioned in chart begins from both side, pullers and users; however, mostly by the pullers. Pullers would follow the chart mentioned fare only if police are deployed at stations to enforce and if they could sue against pullers or cancel the license for not following. However, pullers at Gazipur are not local people, most of them are migrant from outside such as Rangpur, Kurigram and Gaibandha and today they are pulling rickshaws here but probably tomorrow would not be here again.

Rickshaw fare in Savar Paurashava

In 1994-95, Savar Paurashava authority introduced a pre-determined fixed fare rates for rickshaws. There is a rule or by-law that empowers paurashava to determine rickshaw fares within its jurisdiction. However, not any other paurashava of the country has ever done this before Savar has introduced.

The Savar Paurashava Board (mayor and councillors) decided the fare for rickshaw trips with the assistance of officials (i.e. tax officer, licence officer). The fare was based on distance. However, the distance was not measured or not the true distance; tentative distance between two location points was assumed and then considered for determining a fare for that distance or trip. Thus a list of fare for different distance or trips between various origin and destination was prepared. The list of fare rates was provided in a billboard and placed at major locations.

After introducing the pre-determined fare rates, about initial two years everybody followed the fare rates mentioned at billabord or chart. Later, rickshaw pullers started asking for an extra amount than it was mentioned; claiming that the quality of roads became bad (broken and potholes) and otherwise they will not serve the trip. Three main reasons for not following the pre-determined fare rates by pullers were:

- (i) Road condition was poor (badly damaged in certain parts and many potholes) which made pulling a rickshaw very difficult;
- (ii) Price of everything have increased; and
- (iii) Attitude of pullers, ferocious or pullers syndicate, to get more money.

Thus, it is important to maintain a good quality road, increase or revise the fare structure periodically (particularly if price of other commodity changes), and enforcement so that pullers are bound to follow the prescribed rate of fare for rickshaws. Price for commodities changes almost in every 3-6 months whilst house rent increases 1-2 years interval; however, re-scheduling of rickshaw fare rates would not be possible very frequently but probably could be done in every 2 years.

How Often Should be Updated?

The experience in Gazipur and Savar suggests that fare rates for rickshaws should be revised regularly, particularly when price of commodities increase or fuel prices increase or salary of people increase. All the respondents as well as participants of informal discussion gave emphasis on regular or periodic update and revisions of the pre-determined fare rates for rickshaws. For instance, one interviewee mentioned updating would require particularly when price of commodities increase rapidly or fuel prices increase or salary of people are increased whilst others suggested for an annual or twice per year or once in every two years. Nevertheless, the majority suggested for an update of fare rates once in every year.

7.3 Summary of Findings

Interviews of the policymakers and transport professionals revealed that the initial design prepared for the BRT station of Kakoli-Banani and Sayedabad location is almost okay. However, little changes were suggested from the interviews as well as informal discussions with easybike drivers and rickshaw owners. Table 7.4 shows the summary of findings derived from interviews and informal discussions for two case study locations in Dhaka.

Table 7.4: Summary of findings from interviews and informal discussions

Topics	Generic BRT Station	BRT Station at Kakoli-Banani	BRT Station at Sayedabad
Convenient walking distance for modal change	• 100 m or a walk for 2-3 minutes • Average 200-300 m • Maximum 500 m • Depends on quality of BRT service and built environment	• Distance in proposed design is mostly within 200 m (or 300 m in a few case); which is reasonable and acceptable	• Between 150 and 250 m distance needed to walk for modal changes
Pedestrian road crossing to access into BRT station	• At-grade (signalised or Zebra-crossing) as a general principle • At-grade will not function in Dhaka; need overpass or underpass • Choice depends on road width and traffic (volume and speed)	• Overpass or underpass with both ramps and stairs • If possible, to provide elevator, escalator or lift	• Both at-grade and underpass • Both signalised and Zebra-crossing for at-grade • Underpass should have ramps and stairs
Passenger facilities required at BRT station platform	• A shade for passenger shelter • A toilet • Kiosk (shop) • Limited seats • Signs of direction to BRT and rickshaws	• Shade • A toilet • Kiosk (shop) • A map showing major attractions around BRT station and destinations of BRT	• A toilet • Trees on walk ways • Signs and symbols indicating boarding and alighting points
Rickshaw stands (spaces for rickshaw waiting) at BRT station	• Provision of rickshaw stand should be part of BRT station design • 3-5 rickshaw stands surrounding BRT station • Each rickshaw stand limited to certain number of rickshaw spaces	• Rickshaw stands at all the connecting roads	• Rickshaw stands at all the connecting roads

Organising rickshaws at BRT station	• Educate and aware pullers, pullers' association • Enforcement	• Enforcement: traffic warden or administrative power of local government • Educate and aware pullers	• Awareness generation among pullers, pullers' association
Pre-determined fare structure for rickshaws	• Localised rickshaw • Fare rates based on: - Distance - Demarcated area - Trip time	• Based on demarcated area or tentative distance of trips	• Based on tentative distance (from BRT station to different locations) of trips
How the method of interviewing worked	• Less time and effort required • Detail and spatial context discussion not possible	• Discussion always did not referred to detail spatial contexts	• Discussion always did not referred to detail spatial contexts

- Location of the proposed BRT station for both at Sayedabad and Kakoli-Banani location is in right place.
- At Kakoli-Banani location a single BRT station should be provided (as seen in Figure 6.10) for both directions instead of two staggered stations. Furthermore, the future plan of the expressway (passing through this location) and U-turn loop (for right-turning vehicles at this intersection) that the government is thinking for implementing should be considered while designing BRT station.
- Considering the nature of traffic and pedestrians, overpass (with stairs in one side and ramps in other side) for Kakoli-Banani station whilst both underpass and at-grade pedestrian road crossing for Sayedabad station have been suggested for pedestrian road crossing to access into the median BRT station.
- Where underpass or overpass is given, escalators and/or elevators would be provided for ensuring access of handicap or older people to BRT. However, use of the escalator and elevator should be regulated or controlled only for needy people (i.e. sick or old) but not for all the passengers.
- Walking distance at interchange area for modal changes would greatly depend on the quality and environment of walking path as well as quality of BRT services. Nevertheless, a distance of less than 100 metres walk would be convenient whilst a 5 minutes of walk or up to 200 to 300 metres would be the maximum distance for modal changes between BRT and rickshaws.

- Walkways, particularly modal interchange areas at BRT station, should be wide enough, smooth and clear for safe, secure and convenient movement of pedestrians as well as convenient modal changes. It was suggested that the minimum width of walkways should be 2 m so that at least 2-3 people could walk at a row; however, depending on pedestrian flow or road side land use activities (i.e. shops) width should be more.
- Rickshaws need to be organised and maintain a tidy queue while waiting for picking of passengers. There is a need to provide designated places for rickshaws to drop off and picking passengers. Monitoring and enforcement of the rickshaw waiting areas as well as self-awareness and motivation among the pullers are needed.
- Traffic signs showing the direction of BRT and rickshaws need to be provided at modal interchange area. Both the symbol and texts should be given for easy understanding of all the groups of passengers.
- Raising awareness of the road users (i.e. pedestrians and drivers) through education at school and wide media campaign for advocacy to change their behaviour on street.
- The facilities needed in a particular BRT station depends on different aspects such as the size or importance of the station and the number of passengers catering. In general, it was suggested to provide a passenger shade, a toilet, a small shop (kiosk) , and a few seating arrangements for older or disabled people. A trolley was also suggested at modal interchange area for ease and convenience of carrying goods.
- A pre-determined fare structure for rickshaws could be done based on an agreed (tentative) distance, not the true distance in km, between two locations or a flat rate within a delineated local area. It was further suggested that the rickshaws should operate only in the feeder roads within the locality or neighbourhood and a designated space should be provided for rickshaws waiting close to BRT station. If the rickshaw fare is determined based on distance, a large billboard showing the chart of fare lists for different destinations from a location could be placed at different points so that everybody could see and understand the fare for his particular trip.

7.4 How the Techniques Worked

From the experience of conducting unstructured in-depth interviews of key informants in Dhaka, it was found that:

- Initial email correspondence done with the potential interviewees before going to Dhaka for recruiting them and fixing a time for conducting interviews did not work effectively. Hence, after arriving in Dhaka the researcher had to do telephone correspondences with the interviewees at first, then visited their office/home for arranging a date and time of the interview after explaining the brief of the research. After finalising the date and time, the researcher had to keep informed him/her regularly about the date of interview until it was done. Often it happened that the government officials and elected public representatives (politicians) postponed the date at the eleventh hour; again and again. Hence, the researcher had to be flexible enough about time schedule for conducting interviews.
- Having connections with someone of the potential participants' colleague or friend was very crucial for recruiting the participants.
- Government bureaucrats and politicians did not allow audio recording of the discussion; gave personal opinion in informal way but not as a formal office bearer or representative.

Unstructured in-depth interviews worked well to explore the opinions of policymakers. The interviewees gave their individual personal opinion from their professional experience. Thus it happened that often the respondent was trying to focus or divert discussion into the topic or area of his own interest or expertise. In a a few occasion it happened that the participant did not continue cooperation or discussion on the topics or aspects he does not like. For instance, one respondent did not like at all the on-going construction of flyover at Sayedabad and he did not give any comments on BRT station design for that location.

The interviews allowed two-way communication between researcher and interviewee. The discussion was very easy for generic levels of the topics; however, it was not efficient to discuss particularly with spatial reference to case study area. During the discussion it was not possible to show or indicate the detail spatial locations at micro scale. Sometimes participant also hesitate to comment on a specific spatial context as (s)he had no data or information about a particular issue. The interviews were audio taped (notes were taken for those who did not allow for recording) only, hence it was not possible to record facial reactions of the interviewees on a specific topic and analyse at a later stage. Nevertheless, each of the discussion was possible to complete within an hour. Furthermore, it was easy to re-schedule the time of interview if any scheduled interview was postponed or was possible for re-visiting the interviewee later if it was required for any further clarification.

On the other hand, informal discussions were very flexible; allowed to conduct at any place at any time. However, in the beginning the respondent was suspicious about the researcher whether he was representing any government regulatory or enforcement agency or not. Furthermore, they have reported only the positive aspects of their activities but did not mention any negative things. For instance, an easybike driver mentioned that by organising themselves and following a tidy queue while waiting they are solving the chaos of traffic problems at intersection but did never mentioned that till now the easybike is an unauthorised or illegal mode.

7.5 Conclusions

This chapter described the key informants' opinions about: modal integration between rickshaws and BRT systems, particularly about the plan prepared for case study locations; how to implement or function a pre-determined fare rates for rickshaws to enable integrated fare for trips involving both rickshaws and BRT.

The physical design of BRT station covered the topics on: planning or designing of BRT station and its surrounding area for case study locations, convenient distance for modal changes, pedestrian access to BRT station, safety and security at modal interchange area, facilities required for passengers at BRT station, and information for road users' knowledge about traffic signs and signals and their requirements. Then it discussed on rickshaws as a feeder services in BRT station, organising of rickshaws at BRT station so that they follow a tidy queuing.

The key informants' opinions about pre-determined fare structure for rickshaws covered the issues: whetehr it is necessary; if necessary how to determine; whether the pre-determined fare rates will be followed; learnings from other examples or experience; and how often the rates should be updated or revised.

Finally, the summary of findings was provided and then discussed how the techniques worked while conducting the case studies in Dhaka.

The next chapter will provide a comparison of the findings derived from key informants interview (this chapter) and from focus group discussions (FGDs) (previous chapter) as well as with literature (discussed in Chapter 2).

Chapter 8
Comparison of the Findings from FGDs and Interviews with Literature

This chapter gives a comparison of the findings derived from the focus group discussions (FGDs) of public from various socio-economic groups as well as pullers and from the interviewees of the key informants discussed in Chapter 6 and Chapter 7 respectively. Furthermore, the findings from FGDs and interviews are analysed (compared and contrasted) with the literature (been discussed in Chapter 2 and 3). This chapter also provides a suggested plan for the case study locations for physical integration and fare integration between rickshaws and BRT systems based on the results from FGDs, interviews as well as spatial contexts and traffic situation of the locations.

8.1 Comparison of Results from FGDs and Interviews

Table 8.1 shows the comparison or differences of results derived from FGDs and interviews. Results from both FGDs and interviews revel that rickshaws could play a vital role as feeder services of BRT systrems provided that rickshaw's operation is localised, BRT station is designed in such that it accommodates rickshaws (rickshaw station or waiting area is provided at BRT station and ensure convenient modal change for passengers between BRT and rickshaws), rickshaws follow a tidy queue while waiting at BRT station, and an integrated fare structure for trips involving both rickshaws and BRT systems.

Regarding physical integration, with few exceptions results from FGDs and interviews are almost similar: preference for a walk of 2-3 minutes (or less than 200 m) as convenient distance for modal changes between rickshaws and BRT, in genearl preference for at-grade pedestrian road crossing to access BRT station (but grade-separate crossing by overpass at Kakoli-Banani location due to nature of traffic and pedestrian safety), effective width (wide enough and no obstacle such as trading and non-traffic activities) and smooth surface quality of footpaths, passenger facilities required at BRT station platform, continuous lighting at night and presence of security personels at BRT station, road use information (traffic signs and symbols) at interchange area, and organising rickshaws to form and maintain a tidy queue at BRT station.

Table 8.1: Comparison of results from FGDs and interviews

Topics	Results from FGDs	Results from Interviews
Whether rickshaws can serve as a feeder service of BRT systems	• Some planning requirements should be addressed first. • Rickshaws in Dhaka already serving as a feeder of bus services. • Localised rickshaws.	• Need space for rickshaw stands and organising rickshaws to follow tidy queues at BRT station. • Current positive roles of rickshaws. • Localised rickshaws; cap on number of rickshaws.
Physical integration of rickshaws with BRT systems: BRT station		
Convenient distance for modal changes between rickshaws and BRT	• Less than 200 m (or a walk for 2-3 minutes). • 50 m or less for disabled or older people. • Maximum 250 m (a few mentioned 500 m). • Depends on passenger, BRT services and quality (built environment) of interchange area. • Men would walk more than women; poor-income would walk more than middle-income does.	• 100 m or 2-3 minutes of walk. • Average 200-300 m • Maximum 500 m. • Depends on quality of BRT services and built (physical) environment at modal interchange area.
Pedestrian road crossing to access into BRT station	• In general, at-grade crossing is preferable because it is convenient, easy and fast to use for pedestrians. Required traffic warden at traffic signals or Zebra-crossings and awareness generation. • Disabled people preferred underpass/overpass (with ramps/lifts/escalators) rather than at-grade crossing. • Many people in Dhaka currently do not use underpass or overpass. • Overpass with ramps and stairs at Kakoli-Banani; both at-grade crossing and underpass with ramps at Sayedabad.	• In general principal, at-grade pedestrian crossing is the best option. • At-grade - pedestrian friendly (7 respondents) • Underpass/overpass with ramps/lifts/escaletore - car friendly (13 respondents) • Depends on contexts/situation – neutral (4 respondents) • Consider other infrastructure projects planned to implement and integrate with them (i.e. elevated expressway, U-turning at Kakoli-Banani). • Underpass, overpass and at-grade at Sayedabad.
Safety and security for passengers at modal interchange area	• Safety and security was given high importance by participants in all groups. • Effective width of footpath, clear footpath and even (smooth) surface. • Participants gave absolute measurement for width of footpath – 10 ft (3m) at Kakoli-Banani and 5-6 ft (2m) at	• Participants gave relative measurement for width of footpath - to allow 2-3 or 3-4 persons can walk in a row. • Minimum width 2 m; maximum would be based on actual demand. • Design multi-purpose interchange area incorporating people; pedestrian prioritised signal (puffin crossing) with Zebra crossing.

	Sayedabad. • Ensure enough lighting at night and presence of security guard.	• Responsibility of ensuring security should be given to BRT operating team (as a part of overall BRT).
Passenger facilities required at BRT station	• Passenger shade, toilet, ticket booth, kiosk, limited seating arrangement, information display, and entertainment facilities. • All facilities should be disabled friendly as mentioned by disabled group. • Other facilities: Information inquiry services, room for pray (worship) and smokers zone.	• Passenger shade, toilet, ticket booth, kiosk, limited seating arrangement, information display, and entertainment facilities. • Facilities required will depend on size or importance of the station and passenger demand. • Fast ticketing entry control so that not form a long queue; pedestrian access (crowd management). • Signs and marking for passenger boarding and alighting points. • Trolleys at major BRT stations to carry goods.
Rickshaw stands to load/unload passengers at BRT station	• Provide space for rickshaws (rickshaw stands) at BRT station. 3-5 rickshaw stands surrounding the BRT station at mouth of connecting roads. • Each rickshaw stand should have 10-50 spaces; empty rickshaws should not wait for long time.	• Provision of rickshaw stand as a part of BRT station design. • 3-5 designated rickshaw stands surrounding BRT station. • Spaces for rickshaw in each rickshaw stand: 5-10; but it depends on demand or traffic situation. Did not comment as it requires traffic study.
Organising (queuing) rickshaws at BRT station	• Awareness generation among the pullers: through NGO, pullers association. • Rickshaw owner's role: instruction to puller (who is renting) to follow (awareness generate). • Enforcement (i.e. traffic warden). • Infrastructure provision for channelization of rickshaws.	• Educate and aware pullers. • Learning from easybikes operating (pullers themselves organised and follow a tidy queue while waiting). • Association of pullers/owners of rickshaws. • Enforcement (administrative power) of local government (i.e. in Cantonment area).
Information for road users	• Road users' knowledge about traffic signs and symbols is very poor in Dhaka. • Passengers travelling regular basis know basic signs. Literate people understand the sign/symbol by reading the texts. • Poor-income group and pullers are reluctant to tell that they do not know; repeated (copied) others what already told about the sign/symbol. • Direction signs to/from rickshaws and BRT (both symbol and texts). • Behaviour chance of users;	• The majority of road users in Dhaka do not know the signs and symbols. • Literate users/drivers or people of Dhaka know, but don't obey/follow. • Very poor behaviour of users, especially drivers; mainly due to low enforcement (low implication). • Direction signs to/from rickshaws and BRT (if possible, with distance); BRT service information. • Synchronised (both in tactile and visual impacts) signs and symbols; should be placed at correct place. • Education and awareness of users; publicity campaign; practical

	publicity campaign; education (at school) and training.	demonstration.
Fare integration of trips involving both rickshaws and BRT systems		
Pre-determined fare structure for rickshaws.	• All the user-based groups prefer pre-determined fare but usually pullers' do not prefer pre-determined fare. • In certain routes of Dhaka market force itself determined rickshaw fare; learning from easybikes operating in a specific route. • Fare structure based on pre-determined tentative distance or flat rate for a demarcated area. • Pullers group mentioned they would not able to do this; should be done by local government with consulting all stakeholders. • Fixed (not variable) rate for different time/day. • Several participants doubt; may not function in Dhaka because commodity prices increase very often and para-transits not following pre-determined fare.	• Respondents diverged for and against the idea of having a pre-determined fare. • Opposed by few because it would not be possible to implement (difficult to enforce); not wise to determine fare of para-transits. • Fare structure based on tentative distance, travel time, minimum flat rate within demarcated area. • Learnings from easyrides operating between Mirpur 10 and Parish Road, Gazipur City Corporation (distance between locations), Savar.
Integrated fare of trips involving both BRT and rickshaws	• Rickshaw service provided by BRT operating company and pullers receive monthly/daily salary. • Passengers pay pre-determined tokens to rickshaw pullers and he reimbursed it. • BRT tickets sold by pullers.	• Not applied (not discussed).
The method used		
Using 3-D physical model in consultation process	• Helped participants for better understanding of proposed development. • Facilitate effective discussion with spatial contexts.	• Not applicable
How the method worked	• For disabled group it was very challenging. • Participants were very active and engaged with 3D physical model. • Scale (size) of model is very important; colour helped to understand different object.	• Not effective to discuss detail with spatial reference to case study locations. • Correspondence with respondents to recruit took long time. Having connection with colleague or friend was helpful to recruit.

Table 8.1 revels that regarding fare integration the results derived from both FGDs and interviews are also similar: rickshaws should have a pre-determined fare structure to implement an integrated fare (and rickshaw's operation must be localised for having a pre-determined fare structure) and the fare rates should be revised every year, and there were arguments among the respondents both 'for' and 'against' of pre-determined fare structure for rickshaws.

8.2 Comparison of Results with Literature

This section provides a comparison of the findings that were suggested in previous section for integrating rickshaws as feeder services to BRT with the literature discussed in Chapter 2. As this research is confined only on modal integration and fare integration, this section discuses the aspects of modal integration and fare integration of rickshaws with BRT to enable easy transfers through their close physical location and multi-modal journeys with a single ticket or payment respectively.

8.2.1 Rickshaws as a Feeder Service to BRT

Participants of the FGDs and interviews mentioned that rickshaws could play a vital role of feeder service to BRT system. This result is similar to Gallagher (1992), Rahman *et al* (2008) and Sood (2012) where they have mentioned rickshaws could play a significant role in sustainable transport, particularly as a feeder to complement the public transport, if they are planned properly and the required facilities are provided. How to plan BRT station for rickshaws and what facilities would be required for rickshaws to serve as feeder will be discussed later in this section and next section. While discussing about potentials of rickshaws as feeder services, the participants in FGDs and interviewees gave diverse reasons why rickshaws should be planned in Dhaka for serving as feeder of BRT systems. First, rickshaws would be suitable to serve in the narrow streets whilst BRT would be serving in major arterials. Cervero and Golub (2007) also stated that only the NMT and para-transits are able to enter in narrow alley-ways. There are many narrow alley-streets in Dhaka where except walking and cycling only rickshaws would be able operating and providing transport services. Second, improved feeder services along with easy and safe modal changes would help to increase BRT ridership. Third, several interviewees mentioned the feeder services of BRT should be NMT based to maintain the environmental aspects of broader sustainability issues of transport. Similar view was expressed by WBGEF (2003) that there is a need for shift towards low emissions vehicles and NMTs whilst Sahai and Bishop (2010) stated that rickshaws being an emission free mode they could play a crucial role for sustainable transport. Fourth, several participants mentioned that rickshaws are serving a major share of trips in Dhaka and it is the only available travel mode for many people, and providing door-to-door services. Statistics in DHUTS (2010) and STP (2005) reveal that the claim is true. Fifth, rickshaws are playing an important role in socio-economic aspects of the country; it is a major sector of informal economy, absorbing the rural migrants of agricultural labour and providing their livelihood. Facts similar to this information was given by researchers namely Samanta (2012), Kurosaki *et al* (2012), Begum and Sen (2005), Bari and Efroymson (2005). Finally, it was reported by the participants both in FGDs and interviews that rickshaws already become a part of inherent culture or travel behaviour of the society in Bangladesh, particularly in Dhaka. This is justified given that during the inaugural session of the Cricket World Cup 2011 held in Dhaka (Bangladesh), millions of viewers watched on TV whilst the captains of each team took a rickshaw ride when entering the stadium to give a lap-of-honour (Busfield, 2011; Sportsmail Report, 2011). As has been reported by Wipperman and Sowula (2007), rickshaws are a symbol of Bangladesh and foreign visitors know them.

However, almost all the interviewees as well as participants in FGDs suggested rickshaws to operate only at neighbourhood level or on narrow streets. This opinion of the participants is similar as to Kurosaki *et al* (2012) where they have stated a reasonable restrictions of slow-moving vehicles from busy arterials or highways should not be opposed to prioritise high speed and mass transits. Replogle (1991) suggesting a broader economic analysis of each trip on different modes for different lengths at different speeds and traffic levels to justify the efficiency on a particular road. In similar direction, it was found that three interviewees were asking to have a functional hierarchy of urban roads which is not currently exist in Dhaka. These indicate a need for multi-modal urban transport system where BRT would serve in major arterials and rickshaws to serve as feeder services in the narrow streets. Moreover, several interviewees suggested for imposing a cap on rickshaws operating on a certain corridor or neighbourhood; which is similar to the ITDP's (2009) recommendation of limiting the number of rickshaws in major arterials.

Participants of FGDs and interviewees mentioned a need for planning rickshaws and importance of planning rickshaws as feeder services of BRT, which reveals they are suggesting for a multi-modal transport system. This is similar to many other researchers (i.e. Kubota and Kidokoro, 1996; Tiwari, 2003; Samanta, 2012; Schipper, 2004) who argue for considering and treating all the available travel modes (including NMTs) together in a multi-modal transport system to maximise synergies with existing transport and built infrastructure.

Organising (Queuing) Rickshaws at BRT Station

It was suggested by the participants of FGDs and interviews to provide three to five rickshaw stands in and around BRT station for stopping/waiting rickshaws to drop off passengers and picking up of passengers. It was further suggested that, depending on demand and available road space, spaces for about 10 to 50 rickshaws should be provided to wait at a time in each of those rickshaw stands.

All the participants both in FGDs and interviews reported that it is important to have discipline among the rickshaw-pullers as well as the passengers: rickshaw waiting areas should be properly maintained with rickshaws forming a tidy queue at public transport stations. Road markings and lines may help for traffic, particularly for rickshaws, forming a queue while waiting at rickshaw stand. Similarly, during FGDs it was suggested that among others there should be provided traffic signs and markings indicating the space for rickshaws waiting at BRT station. This is similar to Paulley *et al* (2006) where they have mentioned that appropriate signs, symbols, and markings are important for easy movement and flow of pedestrians as well as traffic, particularly in the modal interchange areas.

However, behaviour of the road users', particularly the drivers, in developing countries is often very poor; for instance Sahai and Bishop (2010) and Mfinanga (2014) reported that Zebra-crossings are routinely ignored and often disregarded by the drivers. This clearly suggests that the pullers are not likely to maintain a queue just following a traffic marking or signal. Participants both in the FGDs and interviews suggested for placing a physical barrier (through fencing or concrete pillar) for channelizing rickshaws in a queue at the BRT station in Dhaka. Such fencing for channelisation of traffic or protecting entry of other vehicles into BRT lanes is available in cities of China or in Asia (i.e. Jakarta BRT).

Beside these, it was also mentioned in FGDs and interviews that an advocacy program to raise the awareness (through education and media campaign) of pullers about the benefits of forming queues at station may help for queuing voluntarily. Agarwal (2006) claimed, with example of Bhagidari Scheme in Delhi, intensive awareness campaigns can educate people. Nevertheless, effective enforcement is also needed along with infrastructure provision or awareness generation for queuing rickshaws at BRT station was mentioned.

8.2.2 Modal Interchange Area: Physical Design of BRT Station

Public transport terminals need to be carefully designed so that modal interchanges become convenient, faster and safer for passengers. Transfer quality and reducing transfer times of a linked trip were emphasised by Tyrinopoulos and Antoniou (2008), Rivasplata (2008), Wardman *et al* (2001), Harmer *et al* (2014). Transfer times between modes may greatly depend on distance need to walk between two modes as well as the spatial contexts and pedestrian facilities of interchange area.

Distance Need to Walk at Interchange

A distance of less than 200 m or a walk of a maximum 2-3 minutes for modal changes between rickshaws and BRT was reported as a comfortable walking distance by the participants in FGDs and interviews conducted in Dhaka city. There is no literature available on acceptable or comfortable distance of walk for modal interchanges. However, certainly the distance for changes between modes should be less than a complete walk trip. There are a large volume of transport literature suggests acceptable distance of walk trips (see Rastogi and Rao, 2003; Munoz-Raskin, 2010; Krygsman *et al*, 2004; Sahai and Bishop, 2010) as access or egress to public transport is variable about 0.5 km to 1 km or a 10-minute walk.

Pedestrian Access to BRT Station

Passengers will need to cross the road at the modal interchange area, at BRT station in this case, to access into a median BRT station platform. In general, at-grade crossing would be most convenient for pedestrians. However, overpass was suggested for pedestrian road crossing and access to BRT at Kakoli-Banani station. It was mainly because of the nature of traffic (high speed and high volume of motorised traffic) of the road and poor behaviour of drivers. This suggestion is similar to Zagger *et al* (2004, cited in NelsonNygaard, 2005) that Zebra-crossings are not safer at higher volumes or speeds or high number of lanes. Many traffic engineers recommend grade separation for pedestrian road-crossing. Jakarta BRT provides pedestrian access to the station crossing the road by a bridge connected with sloping (1:8 gradient) ramps (Sutomo *et al*, 2007). Except overpass, no other options (i.e. at-grade Zebra-crossing or underpass) were suggested at Kakoli-Banani station because several participants mentioned people may not use the overpass if it is possible for crossing the road at-grade. Similar claim was made by Tiwari (2001); a pedestrian or NMT would often prefer not to use underpass or over-bridge even when it is safer to do so.

On the other hand, for Sayedabad BRT station both at-grade crossing and underpass were suggested. As mentioned earlier, underpass would be connected with ramps of 1:8 gradient sloping. Fencing at pedestrian paths were suggested to prevent pedestrians' road crossing at unauthorised points except at-grade Zebra-crossing. It is similar to one of the many techniques (NelsonNygaard, 2005) for providing safer and effective pedestrian crossing at-grade or zebra-crossings.

Quality of pedestrian paths

Modal interchange area should have a good environment for walking to ensure a convenient change. Better walking environment and facilities for pedestrians were suggested by participants of FGDs and interviews. However, in many developing cities most of the roads do not have pedestrian refuges or footways and even if they exist they are often narrow or unusable due to encroachments or obstructions of non-traffic activities (i.e. trading), potholes, and high kerb heights (see Sahai and Bishop, 2010; Lorenz, 2002). In Dhaka, to create more comfort while walking, passengers wish to have a clear footpath (free from shops or other non-traffic activities) and more natural shade (trees) along the walk-ways, particularly at the interchange area.

The widths of the footpaths were suggested by participants to be widened to 10 feet (3.05 m) respectively at both locations, Banani-Kakoli and Sayedabad, for easy movement of pedestrians. The required width of the sidewalks depends on the flow of pedestrians and the level of service (LOS) (Pitsiava-Latinopoulou *et al*, 2008; NelsonNygaard, 2005).

Facilities Needed at BRT Station

The suggested facilities required at BRT station of Kakoli-Banani and Sayedabad location are: a passenger shade, toilet, ticket booth, kiosk, limited seating arrangement, information display, entertainment facilities such as TV and newspaper. Similar facilities were mentioned by Harmer *et al* (2014), Hine and Scott (2000), Grothenhuis *et al* (2007), Terzis and Last (2000), Lyons and Urry (2005). Ensuring safe and secure bus stops with provision of shelter for passengers and designated areas for vendors were also argued by Sohail and Maunder (2007). Paulley *et al* (2006) also claimed that passengers prefer waiting for a trip in conditions of comfort, safety, and protection from the weather.

Concerning the road traffic sign and signals, directions where passengers need to go for boarding into BRT buses (including the bus direction and next stops serving) and rickshaws should be provided. It was further mentioned for providing a large map of the area surrounding BRT station and indicating the major attractions.

8.2.3 Fare Integration of Rickshaws with BRT

Globally there are many examples of integrated fare of different modes; however, yet there is no such example which demonstrates an integrated fare for trips involving both rickshaws and BRT or other public transport mode.

A pre-determined fare structure of rickshaws operating in study locations in Dhaka was suggested based on distance. A tentative distance of different locations from

Sayedabad BRT station would be identified and a pre-determined per km rate would be applied whilst a demarcation line of different distance from Kakoli-Banani station would be identified and a pre-determined flat rates for different zone or area would be applied. A similar fare structure of zone-basis, based on distance (km) of trip within/between locality, has been implemented by Fazilka Ecocabs (a charity NGO for rickshaws based in India) and functioning well (Asija, 2012). However, the fare functioning for Fazilka Ecocabs is only for the rickshaw trips and it is not integrated with any other public transport modes.

A few of the interviewees mentioned about the possibility of determining the rickshaw fare rates based on travel time. Though it was not recommended for the study locations; Wipperman and Sowula (2007) suggested such an option of pre-determined fare for rickshaws. Few other interviewees also suggested about rickshaw services - should be provided by BRT operators as a feeder to BRT within a particular route or neighbourhood level. This suggestion also reveals similar to Wipperman and Sowula (2007); where they have suggested to nationalise all the rickshaws and the passengers would pre-pay by purchasing 'tokens' for using rickshaws.

8.3 Final Plan for Integrating BRT with Rickshaws

This section explains the final plan of physical design of BRT station area of case study locations and a plan for implementing an integrated fare for trips involving both on rickshaws and BRT systems. This final plan is the modification of initial plan considering the results derived from the FGDs and interviews.

8.3.1 Physical Design of BRT station

The final plan of BRT station design for physical integration of rickshaws with BRT system at study locations of Kakoli-Banani and Sayedabad station are shown in Figure 8.1 and Figure 8.2 respectively. The major attributes/features of the plan are following:

- One single median station for BRT; with a station platform width of 12 ft (3.65 m) for Kakoli-Banani and 16 ft (4.88 m) for Sayedabad station. In Sayedabad, the station would be just under the flyover and using the width of unutilised road space due to pillars of flyover. Figure 8.3 and Figure 8.4 shows the cross-section of road both at station and at midblock in Kakol-Banani and Sayedabad locations respectively. No overtaking BRT lane provided at Sayedabd as it is the end/first station of the route. An extra BRT lane is given at Kakoli-Banani station; BRT buses serving in both directions of Kakoli-Banani station would use that lane for overtaking at station.

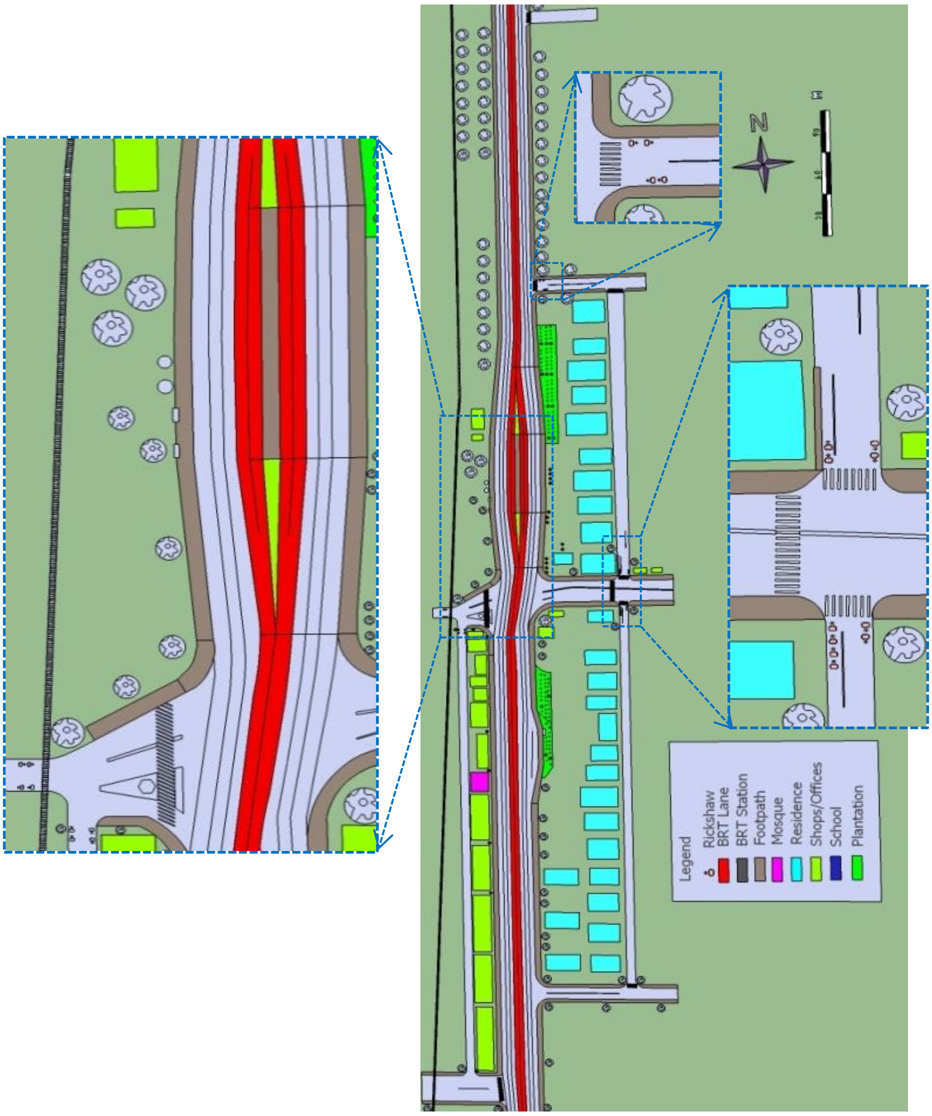


Figure 8.1: Final plan of the BRT station at Kakoli-Banani location

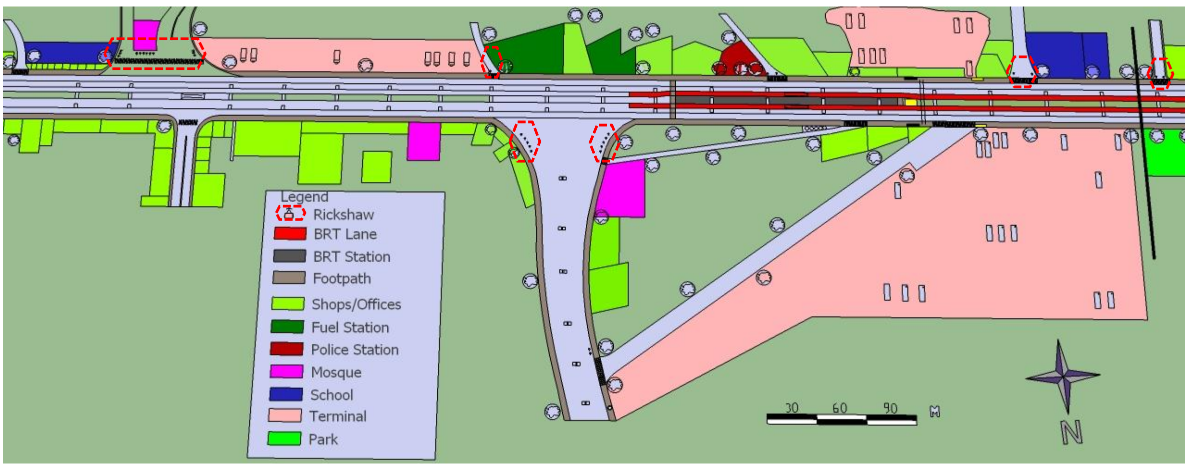


Figure 8.2: Final plan of the BRT station at Sayedabad location

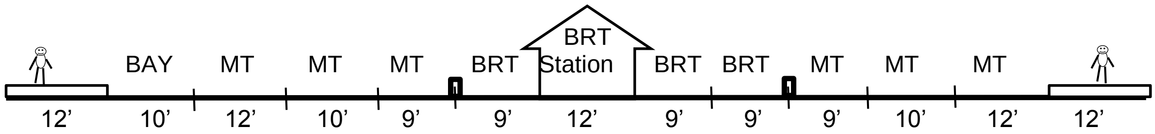
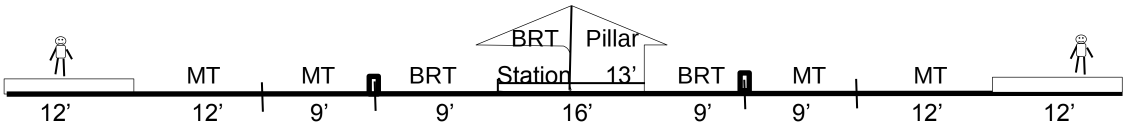


Figure 8.3. Cross-section of road width at Kakoli-Banani location; at BRT station (above) and at midblock (below)



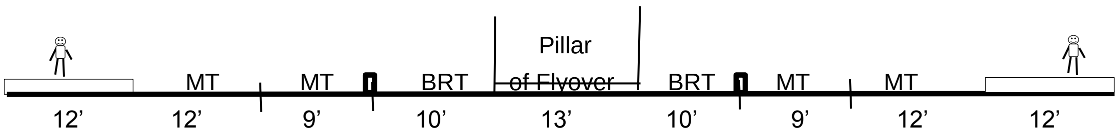


Figure 8.4: Cross-section of road width at Sayedabad location; above at BRT station and below at midblock

- Length of the BRT station platform is 100 m for Kakoli-Banani and 120 m for Sayedabad station. This length would allow to stop two articulated (18.5 m long) buses of the same direction at a time.
- Pedestrian road crossing to access into the median BRT station at Kakoli-Banani location is provided by an overpass whilst both an underpass and at-grade Zebra-crossing have been provided at Sayedabad location, an underpass on one side (close to rail line) and at-grade crossing on the other side (close to Janopath More intersection) of the BRT station. The underpass or overpass would be connected by both ramps and stairs, as well as an escalator or lift. There would be fencing at pedestrian paths to prevent pedestrians access to carriage way and road crossing except the dedicated points (i.e. Zebra-crossing, traffic signals) for pedestrian crossing.

- Space for rickshaw waiting (rickshaw-stands) for dropping or picking passengers provided at three to five designated places or close to BRT station. In each of the rickshaw stands there is a certain limited number of rickshaw spaces to wait at a time. Figure 8.5 and Figure 8.6 showing rickshaw stands provided for BRT station of Kakoli-Banani and Sayedabad locations respectively.

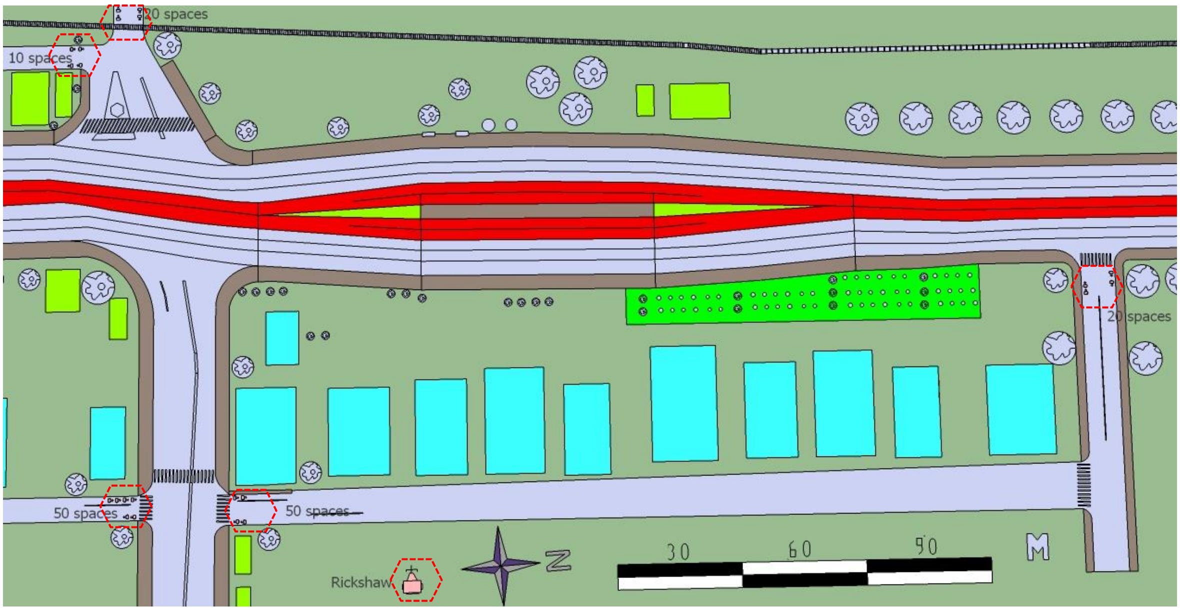


Figure 8.5: Designated rickshaw stands at Kakoli-Banani BRT station

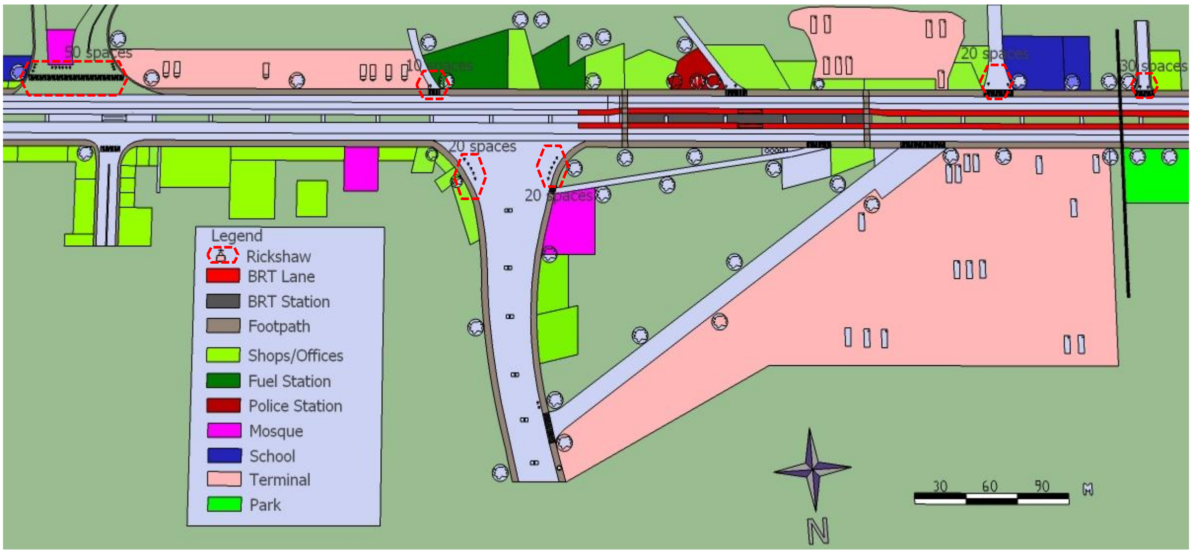


Figure 8.6: Designated rickshaw stands at Sayedabad BRT station

- A physical barrier (through fencing or concrete pillars) would be provided at rickshaw stands close to BRT station to channelize rickshaws in a single lane (as seen in Figure 6.12 in Chapter 6). Furthermore, rickshaw-pullers will be trained to make them aware and become organised for maintaining self-responsibility in maintaining queue at rickshaw stands at BRT station.

- A distance of less than 200 m or a walk of a maximum 2-3 minutes for modal changes between BRT and rickshaws have been provided. Figure 8.5 for Kakoli-Banani and Figure 8.6 for Sayedabad location reveal that the distance between rickshaw stands and BRT station is within 200 m.
- Width of the footpaths is 10 feet (3.05 m) for both locations, Kakoli-Banani and Sayedabad. For safe, secure and convenient movement of pedestrians, particularly at BRT station for modal interchanges to/from rickshaws, the footpaths should be with smooth surface, clear (no shops or any other activities that obstacles pedestrian flow), and with enough lighting at night. The width of underpass or overpass is 16 ft (4.85 m).
- Facilities such as a passenger shade, toilet, small shop (kiosk), and about 10-12 seats would be provided at BRT station for each location.
- Traffic signs and signals (both symbol and written texts) indicating the directions towards the BRT station and rickshaw waiting areas would be provided at modal interchange area. A display of information about the direction of BRT services and the serving stations in each direction would be provided at BRT station.

8.3.2 Fare Integration

It would be impossible to implement an integrated fare system for journeys involving both rickshaws and BRT unless a pre-determined fare structure is established for rickshaws. The suggested plan for having a pre-determined fare structure for rickshaws are:

- Rickshaws should operate within a locality or neighbourhood but not in the city wide network.
- A pre-determined fare structure for rickshaws could be determined either based on an agreed pre-determined (tentative) distance, not the true distance in km, between two locations or a demarcated area within a distance. The fare rates for Sayedabad location has been suggested based on a distance based rate whilst for Kakoli-Banani location it is based on a demarcated area. Figure 8.7 shows rickshaws from three different rickshaw stands (A, B, and C) would operate only within the respective demarcated area and the fare would be flat rate within each demarcated area.
- A large size billboard showing the chart of fare lists for different destinations from that point would be placed at BRT station as well as at major locations so that everybody could see and understand the fare structure what it may cost for their rickshaw trip.

- Local authority (i.e. Ward Commissioner of DCC) needs to take responsibility, discussing with all stakeholders, in determining a fare rate for rickshaw trips. A participatory approach in decision making process including the pullers and owners of rickshaws along with local representatives may help functioning the pre-determined fare rate of rickshaws. If association is formed (i.e. owners association, pullers association), they could sit with local government and discuss about a rationale fare to be determined.
- Awareness and training of rickshaw-pullers and owners are needed. Furthermore, regular monitoring and enforcement of the prescribed rickshaw fare would be done by local authority and puller's association. Public representatives of each area would be involved to monitor and report if the fare rate is being violated by pullers while charging passengers.
- Fare rates for rickshaws would be revised/updated in every year.

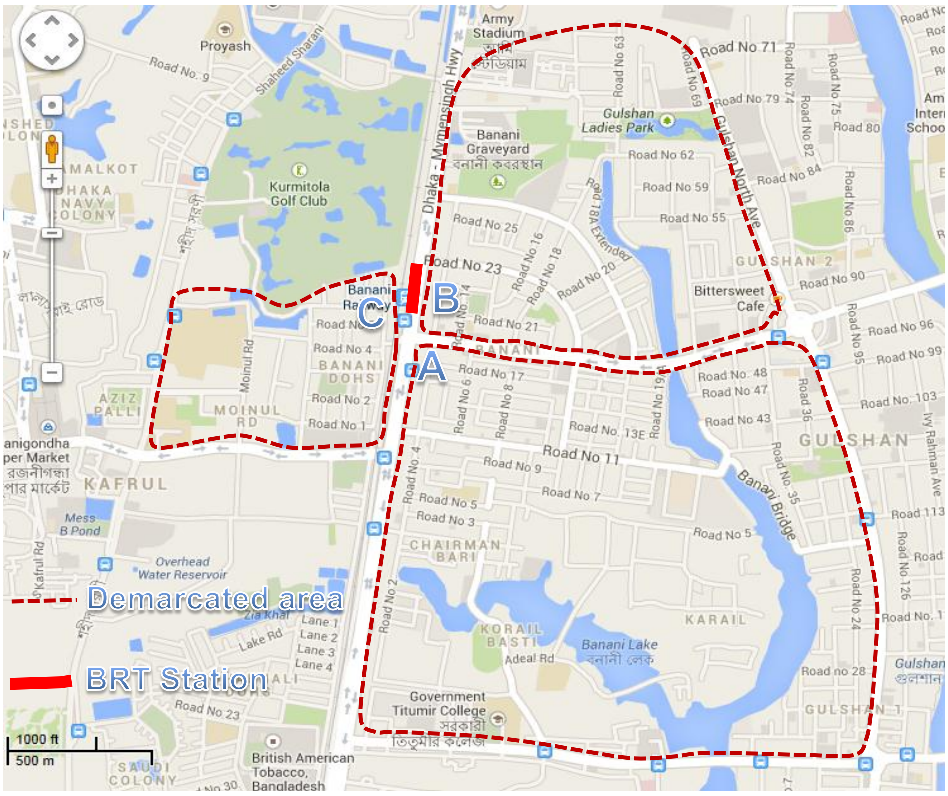


Figure 8.7: Demarcated area for pre-determined fare structure for rickshaw trips in Kakoli-Banani location

After determining the fare structure for rickshaw trips, the next issue concerns integrating this with the tickets of BRT system. It is very crucial for an integrated fare structure to decide on: what would be the mechanism for integrated fares and how to collect the fares as well as what would be the mechanism for distributing the revenue among different modes (particularly to the rickshaw-pullers). Suggested two techniques are:

- Passengers should use a pre-paid tokens to pay for the trip; which the pullers would reclaim his earning from the BRT company. There would be provision to reclaim every day.
- BRT tickets would be sold by pullers, as a vendor of BRT ticket seller, passengers will pay the total price (for trips both on rickshaws and BRT) to the puller and get the ticket while boarding on rickshaw.

Nevertheless, fare integration with rickshaws should be backed with planning, regular monitoring and enforcement, awareness generation of rickshaw-pullers, and wide publicity campaigns.

8.4 Summary of the Chapter

This chapter first discussed the comparison of results derived from FGDs and interviews from case study in Dhaka city and then compared with the relevant literature. Finally, presented the final plan for integrating rickshaws with BRT for case study locations were prepared.

It was found that rickshaws could play a crucial role as a feeder of BRT system if they are planned effectively and they are organised at BRT station. Thus, it is possible to a potential solution for a common problem (arguments between fast and slow transport or between NMT and motorised transport) of urban transport that exists in many countries. This solution involves providing a multi-modal integrated transport system where the formal mass public transport (i.e. BRT) should get priority in the major arterials, with rickshaws (or NMTs and other para-transits) operating in other (narrow) streets to provide feeder services or access/egress legs of BRT.

There are good arguments that rickshaws should be planned in such a way that they could play a vital positive role in the modern city transport instead of restraining or prohibiting them. However, an effective design or plan of the BRT station, particularly the modal interchange area, is very critical for integration of rickshaws with BRT systems to ensure easy and convenient modal changes for the passengers. Furthermore, for such feeder services to operate efficiently, rickshaws should be well organised in queues at the waiting areas close to the BRT stations and to be able to feed the public transport the pullers should be aware about the road discipline.

Next chapter will describe the transferability of findings derived from case study conducted in Dhaka city into other ‘rickshaw city’.

Chapter 9
Transferability of the Findings to Other Cities

This chapter provides insights on how the findings of this research that was carried out into two locations of a case study city (Dhaka) could be helpful for or transferable into other locations of the city as well as into other rickshaw cities. First a review of literature on transferability is presented to understand various aspects and issues of transferability, and then discussed the extent to which the findings of this research can successfully transfer across socio-political boundaries.

9.1 Key Aspects of Transferability

Much of the literature on policy transfer or transferability of lesson drawing has originated in the US and Europe and typically focuses on the convergence of policies between countries; however, to date, there has been relatively little attention to policy transfer in the field of transport (Marsden and Stead, 2011). Marsden *et al* (2011) claims that there is considerable interest in identifying good practices in urban transport whilst a little tradition of studying the process of the development and transfer of policy ideas. However, recent academic interest (e.g. Marsden *et al*, 2011; Marsden and Stead, 2011; Rye *et al*, 2011; Stead *et al*, 2008; Timms, 2011; Timms, 2013) has been shown in the theory and practice concerning the transfer of transport policies.

Policy transfer does occur in the transport arena (Marsden and Stead, 2011); as Marsden *et al* (2011: p.510) claims "cities are actively looking to learn one another and the search for policies and practices across cities in the transport sector is an important process in policy development". As Marsden and Stead (2011) mentioned lessons are drawn from local or regional, national or international.

Marsden and Stead (2011) gave a review of the concepts of the issues of policy transfer process, which puts particular emphasis upon a framework developed by Dolowitz and Marsh (2000) who list seven questions concerning policy transfer that help others to pinpoint attention on various aspects:

(i) What is transferred?;

(ii) Why do actors engage in policy transfer?;

(iii) Who are the key actors involved in the policy transfer process?;

(iv) From where the lessons drawn?;

(v) What are the different degrees of transfer?;

(vi) What restricts or facilitates the policy transfer process?; and

(vii) How is the process of policy transfer related to policy 'success' or policy 'failure'?

With a very few exception, almost all the research in transport are explaining transferability between developed country cities or from a developed country city to a developing country city. In transport literature, only Matsumoto (2007) deals with transferring policy measures between developing country cities while a few (e.g. Timms, 2013; Wang, 2010) explained policy transfer from developed country cities to a developing country city. Furthermore, almost all the research provided transferability of policies as well as 'Dolowitz and Marsh Framework' mainly concentrates on policy transfer with respect to the 'receiver location' or 'target' city (analysing the receiving city). However, analysing the 'receiver location' of the 'rickshaw city' is out of the scope of this research; hence need to mention the issues and concerns to be considered while transferring the findings into other locations. Macario and Marques (2008) provided a logical framework of *10-step transferability process*, the guidelines for transferability, to be used by cities when formulating their transport policies. They claims "transferability of a measure from a particular city (origin city) to another particular city (target city) is only predictable with a detailed understanding of its enabling context" (p.146). This 10-step transferability process could be a guiding principle while transferring the results into another city. However, the importance of understanding the context is at the heart of the issue of 'transferability' because the replication of measures in a target city can succeed only if the favouring context is correctly understood. Therefore, concentration should be given on 'origin' or 'source location' how the findings derived from case study locations could be standardised and become easy to adopt at different locations. Following are the issues need to be considered for transferability of findings from a case study location (or city) to other locations or cities.

Issues to be Considered for Transferability:

- Concerning 'what is transferred?' Marsden *et al* (2011) mentioned it is challenging to trace the details of exactly what is transferred from where. Nevertheless, eight different categories of transfers identified by Dolowitz and Marsh (2000) are: policy goals, policy contents, policy instruments, policy programs, institutions, ideologies, ideas and attitudes (cultural values), and negative lessons. "A range of different concepts, regulatory frameworks, infrastructure design and planning techniques have been transferred in the transport arena" (Marsden and Stead, 2011: p.497).

- The preconditions for transferability or the grounds for potential transfer of policy measures to other cities is ‘if the right conditions are met’. This means, the conditions under which a specific measure or package of measures can be applied with a comparable degree of success elsewhere.
- A direct borrowing or transfer is difficult as the local institutional contexts and (mobility) culture of the ‘exporter’ and ‘importer’ are different (Marsden *et al*, 2011; Rye *et al*, 2011); hence, there is a need to tailor solutions to local conditions while adapting policies, practices and technologies brought from elsewhere.
- It is important to examine whether the operational environment is favourable to the implementation of a given measure; including qualitative analyses to check the viability of the proposed measure in the given setting (Macario and Marques, 2008).
- It may not be possible to transfer all the factors to other countries that made the policy relatively successful; for instance, creative thinking may simply not be transferable and this reality must be accepted (Rye *et al*, 2011).
- Ideology or views about general applicability is very crucial in policy transfer. Marsden and Stead (2011) mentioned institutional, acceptability, and political constraints as the major constraints of policy transfer process. The cultural values of people has an impact on the acceptability of the new ideas, in the different contexts into which they were introduced (Rye *et al*, 2011).
- Different kinds of transferability may be recognised in terms of transfer of policy instruments between territories; such as scale of application of policy - local measures or nation-wide measures, or degree of transfer - within a city, between cities, between countries, etc (Macario and Marques, 2008). To begin transferring experience and practice from one country to another, the key requirements are a knowledge of that practice and the political will or interest to make the transfer and try something new (Rye *et al*, 2011). Further, it is suggested that “the transfer process has to change from one that is international to one that is within and between the institutions of a single country” (Rye *et al*, 2011: p.542).
- Cities and countries often look to close geographic and cultural neighbours as a source of learning (Kern *et al*, 2007; Marsden *et al*, 2011; Rye *et al*, 2011). There is potential influence or some support from cities which are philosophically very close (Dolowitz and Marsh, 2000, Ward, 2007). However, Marsden *et al* (2011: p.508) claimed “…. geography alone though

does not define comparability. In particular, the commonality of policy context has some influence on where staff and others are prepared to look for lessons and new ideas".

- Factors such as language and some uncertainty are restricting urban transport policy transfer within European Union (Timms, 2011).

9.2 Transferability of the Findings

The findings derived from the case study locations in Dhaka city (Bangladesh) could be useful learning to apply in other locations. This section discusses the transferability (e.g. what will be transferred and where, assessment of the measures for transfer, barriers and facilitators of transfers) of the findings to other locations.

9.2.1 Where to Transfer?

The findings derived from the case study locations could be transferred in other locations of the same city or in other cities within the country or in other cities of other countries. Discussion in this chapter on transferability of the findings from case study locations in Dhaka is limited to transfers only in other rickshaw cities (refer to Table 1.3 in Section 1.3), namely, Chittagong (Bangladesh), Delhi (India), Kolkata (India), Bandung (Indonesia) and Yogyakarta (Indonesia). The name of cities indicates that the transfers will be both within the country and between country.

9.2.2 What will be Transferred?

From this research it is expected that the two broad category of findings would be transferred are:

- The research methods (concepts) applied for researching in case study locations; and
- The results (policy measures) derived from the research.

The former one covers the methodological issues and concerns while conducting similar research again or into other locations or cities whilst the later one covers the possibility about transferability of the results, attributes and measures derived from the study locations into other locations and what issues and concerns should be considered while doing so.

The policy measures that were derived from the case study locations of Dhaka in this research need to assess transferability into other 'rickshaw city' are:

1. Integrating rickshaws with bus rapid transit (BRT) systems.
2. Convenient distance for modal changes.

3. Pedestrian road crossing to access into BRT station (at-grade or grade separate - overpass/underpass).
4. Passenger facilities at BRT station.
5. Physical design of rickshaw stands for waiting to load/unload passengers.
6. Enforcement of organising/queuing rickshaws at BRT station.
7. Pre-determined fare structure for rickshaws.
8. Integrated fare of trips involving both BRT systems and rickshaws.
9. Information for road users related to BRT.

9.2.3 Assessment of Measures for Transferring in Other Location

The research methods applied for researching in case study locations in Dhaka, namely focus group discussions (FGDs) of different groups and interviews of key informants would be possible to re-apply in other locations or cities. However, in order to be able to understand the potential usefulness of this type of methods for other locations it is necessary to conduct the whole process in that 'destination' location for exploring the end results.

In general, the policy measures or good practices has been successfully implemented within a given geographical, demographic, socio-economic, cultural, technologic, institutional and organisational setting can be achieved in areas characterised by a similar setting (Macario and Marques, 2008). This indicates policy measures would be transferable between similar settings (environments). Hence it is worthwhile to assess similarity of the context or 'Conditions of Comparability' between the locations of origin and destination. Therefore, a diagnosis of the situation in the target city, in this case the 'rickshaw cities', is required followed by a pre-selection of the possible measures addressing the problems (barriers) and facilitators. However, Macario and Marques (2008) claimed that no significant predictions can be made whether measures may be transferred; to a large extent transferability depends on the characteristics of measures themselves in relation to the target city as well as the relationships between measures that may enhance their impact. Nevertheless, a summary assessment of the appropriateness for transfer of each of the policy measures into other rickshaw cities is given in Table 9.1.

Table 9.1: Assessment of the measures for transferring policies into other locations

Policy Measures	Assessment for Transfer to Other Rickshaw-Cities
1. Integrating rickshaws with BRT systems.	Rickshaws are available as a mode of travel and the city is planning for BRT or already has BRT systems.
2. Convenient distance for modal changes.	Care needs to be taken that walking distance at modal interchange between BRT and rickshaw is not too long.
3. Pedestrian road crossing to access into BRT station (at-grade or overpass/underpass).	Design of BRT station is in such that BRT is accessible for everybody and pedestrian access to/from BRT station is convenient, safe and secur.
4. Passenger facilities at BRT station.	Passenger facilities and passengers' need about facilities, maintenance of facilities and room available at BRT station platform needs to be taken into account.
5. Rickshaw stands for waiting to load/unload passengers (physical design).	A good design of BRT station area is needed that provides designated places surrounding the BRT station for rickshaw's waiting.
6. Organising/queuing rickshaws at BRT station (enforcement).	Rickshaw pullers follow a tidy queue while waiting at rickshaw stands surrounding to BRT station.
7. Pre-determined fare structure for rickshaws.	On what basis the rickshaw fare would be determined (simple method so that everybody can understand), the unit rate for rickshaw trip, enforcement (acceptability by pullers and monitoring by local authority) needs to be taken in account.
8. Integrated fare of trips involving both BRT systems and rickshaws.	The methods of ticketing (charging to passengers) and revenue distribution between BRT and rickshaws need to be taken into account.
9. Information for road users related to BRT.	Relevant information (signage and symbols) needs to be taken into account for improving flow of passengers and traffic at BRT station. Information needs to be relevant to the users' knowledge/expectations and also need users' training/awareness.

9.2.4 Barriers and Facilitators of Transfers

Marsden and Stead (2011: p.499) claimed "there is little evidence or prospect of 'copying' of one policy from one area to another", particularly outside national boundaries. Instead, local adaptation is very important because different contexts demand different policy responses. This claim is justified as "the 'same' policies tend to be associated with different effects in different places" (Peck and Theodore, 2010: p.173); due to difference in local economic, social, and institutional environments. Rye *et al* (2011) also added the influence of different legal and other framework conditions, and different national traditions. Institutional differences have an influence on the nature of the adoption of policies (Marsden *et al*, 2011; Rose, 2005; Stead *et al*, 2008); for instance, in countries where there is less control by higher levels of government, the implementation of any national/regional policy will be more variable (Rye *et al*, 2011). Therefore, high caution both in terms of the appropriateness and effectiveness of standard policy solutions needs to be taken when policy measures are being exported from one context to another.

According to Macario and Marques (2008), the most important drivers in a successful transferability process to different cities are the replicability of its context, namely physical, cultural and institutional conditions. They identified five core aspects of each measures (e.g. city objectives, legal framework, political framework, public acceptability, and enforcement issues), where issues of political and public acceptability are the key. Thus, “how to adapt the policy or practice is a matter for local judgement, based on knowledge of how it is used in another country, and what the differences are in the new country” (Rye *et al*, 2011: p.542). The following table (Table 9.2) is giving a summary of the possible barriers and facilitators of transferring the policy measures into five other ‘rickshaw city’.

Table 9.2: Barriers and facilitators associated with the measures transferring in other ‘rickshaw city’

Policy Measures	City	Barriers	Facilitators
1. Integrating rickshaws with BRT systems.	**Chittagong**[1,2,4]	Hilly topography. City authority banned operating rickshaws in certain roads.	Increasing number of rickshaws. Narrow roads. Cultural behaviour of people are similar as in Dhaka.
	Delhi[14,15,16]	Previous restriction on rickshaw license numbers. Rapid growth of personal cars and motorcycles.	BRT is operating; rickshaws at BRT/metro station increased. Delhi high court judge decision about rickshaws.
	Kolkata[16]	Rapid growth of personal cars and motorcycles.	Available regulations (i.e. pullers in few roads following one-way path). Rickshaws waiting area at existing metro station.
	Bandung[21]	-	Culture of BRT operating in other cities of the country.
	Yogyakarta[20]	Increasing number of motorcycle and decreasing number of rickshaws.	Promoting rickshaws as heritage and providing facilities for rickshaws. BRT system in operation.
2. Convenient distance for modal changes.	**Chittagong**[1,2]	Rickshaws are used even for a very short distance. Congestion and non-traffic activities at modal interchange area.	A large number of walking trips. Distance need to walk in existing public transport modal changes are longer.
	Delhi[13,16,17]	Increasing personal cars and desired luxury of travel.	Distance for modal interchange at existing BRT and metro station.

	Kolkata[18]	Narrow streets; other modes may not be possible to accommodate within close proximity of BRT.	Walking distance existing modal interchange (i.e. metro station).
	Bandung[20]	-	Informal modes are operating.
	Yogyakarta[21]	-	Existing modal interchange area at BRT station.
3. Pedestrian road crossing to access into BRT station (at-grade or overpass / underpass).	**Chittagong**[5,6]	Policy makers' prioritisation between motorised traffic and pedestrians or non-motorised traffic. Cultural barriers; tribal people and tourists.	Availability of existing overpass/underpass and signalised crossing at major points for pedestrian road crossing.
	Delhi[11,12]	Criticisms or drawbacks of Delhi BRT. Cultural barriers.	BRT is already in operation; lessons learn if there is any problem or failure.
	Kolkata	Cultural barriers; behaviour of road users.	Pedestrian access to metro station.
	Bandung	-	-
	Yogyakarta[21]	-	Existing BRT station.
4. Passenger facilities at BRT station.	**Chittagong**[2,3]	Lack of finance; poor maintenance. Width (narrow) of roads.	Involvement of private sector in financing and maintenance of the facilities.
	Delhi[11]	Lack of finance. Width of road space in certain areas of Old Delhi.	BRT is operating; possible to explore the facilities currently available at station and the passengers' expectations.
	Kolkata	Lack of finance.	Available mass transit like metro; existing passenger facilities available at station.
	Bandung	Lack of finance.	Small population size, hence low passenger demand and facilities required.
	Yogyakarta[21]	Lack of finance.	Facilities available at existing BRT station.
5. Rickshaw stands for waiting to load/unload passengers (physical design).	**Chittagong**[2,5]	Perception of planning authority: ignoring NMT. Physical barriers such as topography and narrow streets.	Rickshaws concentrate in certain points (i.e. train station or bus stops). Infrastructure provision for NMT.
	Delhi[12,14,19]	Conflict with other road-side activities to provide space and maintenance of the space .	Rickshaws are waiting in specified areas such as close to BRT/metro station. Infrastructure provision for NMT.
	Kolkata	Physical barriers; narrow streets.	Increasing pressure groups for promoting sustainable transport modes.
	Bandung	-	-

	Yogyakarta [21]	-	Rickshaw waiting area in existing BRT station.
6. Organising / queuing rickshaws at BRT station (enforcement).	**Chittagong** [2,7]	Lack of enforcement. No rickshaw stand. No parking management.	Presence of puller's(owners) organisation or cooperatives. Participatory approach in planning.
	Delhi[12]	Lack of enforcement. Bribery taken by enforcing authority.	Existing BRT station. Outside of the metro station rickshaws are organised.
	Kolkata	Bribery by enforcing authority.	-
	Bandung[20]	-	History of cooperation between LG and stakeholders.
	Yogyakarta [20]	-	History of cooperation between LG and stakeholders.
7. Pre-determined fare structure for rickshaws.	**Chittagong**[2,7]	Taxi, auto and other para-transits are not following prescribed fare rate. Lack of enforcement.	Functioning in a few places; initiated by operators. Citizens accustomed with participatory approach. Zone with controlled access of rickshaws.
	Delhi[10]	Lack of enforcement.	Distance based fare for rickshaws functioning at other cities of India.
	Kolkata	Lack of enforcement.	Stable fare for rickshaws.
	Bandung	-	Fare determined by local government. Small city size.
	Yogyakarta [20]	-	Small city size.
8. Integrated fare of trips involving both BRT systems and rickshaws.	**Chittagong**[7]	Acceptability - no example in practice.	Available institutional frameworks.
	Delhi	-	Cooperation between local government and stakeholders.
	Kolkata	-	-
	Bandung	-	-
	Yogyakarta	-	Political will and leadership.
9. Information for road users related to BRT.	**Chittagong**[8,9]	Traffic signs and symbols are not synchronised. Road users lack of knowledge about traffic signs and signals.	Certain traffic signage are available. Wide range of media and NGOs are available.
	Delhi[12]	Multiple language are in use. Road users lack of knowledge about traffic signs and symbols.	Existing BRT and related information. Availability of education institutions.
	Kolkata	Poor behaviour of road users.	Wide range of media and NGOs are available.

	Bandung	-	-
	Yogyakarta [21]	-	Existing BRT and related information.

Note: ' - ' indicates not relevant or applicable.

Source: [1]Shamsher *et el, 2*013; [2]Al-quadery and Muhibullah, 2008; [4]Das, 2013; [5]Mahmud, 2013; [6]MOC*;* [7]IDS, 2007; [8]Moinuddin, 2010; [9]Biswas, 2007; [10]Asija, 2012; [11]DelhiBRT, nd; [12]ITDP, nd; [13]Sing, 2006; [14]Tiwari, 2003; [15]Samanta, 2012; [16]Gupta and Agarwala, 2005; [17]Rastogi and Rao, 2003; [18]Kundu, 2003; [19]Sahai and Bishop, 2010; [20]Kidokoro and Kubota, 1997; [21]GlobalWorks, 2011.

The rickshaw cities face similar transport challenges and problems (i.e. growing traffic and congestion, poor public transport services, air pollution, accidents, etc) but they are all different and each of them exist within a different political/legal and institutional framework. Presence of association or cooperatives of pullers, strong local government, availability of wide range of media and NGOs in a city will make easy to adapt the policies than a city without having those. Because, the process of consultation is influenced by the extent to which citizens are accustomed to being involved (Schwedler, 2007). Thus, the cultural values and social behaviour of people also often differ in different city.

9.3 Summary of the Chapter

This chapter described how the findings derived from a case study could be helpful for (or transferable into) other cities. First, described the key aspects of transferability from review of literature and then described the issues and aspects for transferability of findings of this research into other 'rickshaw city'. A summary assessment of the appropriateness for transfer of each of the policy measures into other five 'rickshaw city' is given.

Results of this research conducted in a 'rickshaw city' in Bangladesh which is very large in terms of population size and land area, and these conclusions should only be extrapolated beyond this context with caution. Just simple extrapolations to other cities or regions would be risky because what is best for a city (e.g. Dhaka) is not necessarily best for another city (and v*ice-versa*). A case-by-case adoption of the policy measures would be required for transferring in other cities. Further, the adopted city may also look into other policies from other cities and make the policy 'hybrid'; as Marsden *et al* (2011) found around three-quarters of the innovations were 'hybrid' solutions they have studied.

Next chapter will provide the conclusions and recommendations of this research.

Chapter 10
Conclusions and Recommendations

This chapter presents the summary of findings, suggesting some recommendations based on the findings, then drawing the conclusions and finally outlining further research directions.

10.1 Summary of Findings

The results derived from both the focus groups discussions (FGDs) and interviews of key informants in this research reveal that rickshaws could serve as a feeder service of bus rapid transit (BRT) systems if they are planned properly and required facilities are provided. Therefore, for the rickshaw cities an alternative approach to placing outright restrictions on rickshaws could be to integrate them into the public transport system by using them as feeder services. When considering such integration, the design and planning of BRT stations is crucial for two main reasons. First, the design of BRT stations is anyway very important for ensuring high levels of ridership. Secondly, the integration with rickshaws will involve different (special) planning and design requirements. Furthermore, beside the design and planning of BRT station it is also important that rickshaws form and maintain a tidy queue while waiting at BRT station and follow a pre-determined fare structure for rickshaw trips. Following are the summary of major findings:

- Rickshaws provide important role of transport services for many people in developing cities, particularly in the 'rickshaw city'. They also have important socio-economic roles. Therefore, almost all the participants both in FGDs and interviews suggested not to restrict/abolish rickshaws. Instead of placing outright restrictions rickshaws could be planned and providing supporting facilities so that they could play an important role of feeder modes for the formal public transport such as BRT systems.
- Rickshaws' operation need to be localised; should operate within the locality or neighbourhood area as access or egress legs of BRT systems but not in major roads to provide services in city-wide network. Operating rickshaws limiting within locality or neighbourhood area is also very important to have a pre-determined fare structure for rickshaw trips.
- Rickshaws need to wait in designated places (or rickshaw stands) at BRT station and space for rickshaw stands needs to be created. About three to five rickshaw stands were suggested to provide surrounding the BRT station. This will also help to accommodate a large volume of rickshaws at

the BRT station. Location of the designated rickshaw stands for both study locations are almost similar – in the mouth of connecting branch roads. However, for Sayedabad location, where rickshaws are also operating in main corridor, rickshaw stands also provided at corner of main corridor. In each of the rickshaw stands should be limited to a certain number of rickshaw spaces, for 10 to 50 rickshaws, to wait at a time and more than that number should be removed through enforcement.

- Rickshaws need to maintain and follow a tidy queue while waiting in a rickshaw stand at BRT station for picking up or dropping off passengers. In general, pullers in Dhaka city do not form or maintain any queue while waiting or stopping. However, a few examples are available in Dhaka Cantonment Area where pullers are following a tidy queue of first-in-first-out and strong enforcement is the main reason behind this. This shows that the Hypothesis 4 mentioned in Section 2.5 is true. Hence, effective enforcement or presence of traffic warden is required to ensure and enforce/monitor that rickshaw pullers do form and follow the queue while waiting. Nevertheless, it was found that easyrides operating in a few routes of Dhaka have organised themselves and forming/maintaining the queue, without having any enforcement, while waiting at station. Similarly, rickshaw pullers themselves could maintain a tidy queue as the easyride drivers are doing. For doing so, pullers need to be organised and to become aware about the benefits they may get from following a queue. Moreover, owners of rickshaws could play an important role to aware pullers for maintaining queues. Providing appropriate infrastructure such as channelization for rickshaws can also help rickshaws forming a tidy queue. Thus, providing infrastructure for rickshaws at station, effective enforcement and awareness generation among pullers are necessary for rickshaws forming a queue while waiting as well as not wait more than the number of rickshaws allowable to wait at a time in a stand. Nevertheless, instead of other measures such as enforcement or infrastructure provision it would be sustainable if pullers become aware and organised themselves and form/follow the queues themselves.
- A distance of less than 200 m or a walk for a maximum 2-3 minutes is to be comfortable walking distance for passengers for modal changes between BRT and rickshaws in Dhaka. (Full discussion made in Section 6.2.1 and Section 7.1.1). However, it would be better for passengers if the distance for modal changes at BRT station is lesser; such as several participants mentioned 50 m and 100 m respectively in FGDs and interviewees. On the other hand, the passengers' acceptance of walking distance at BRT station for modal changes would depend on various aspects. Among others, the

major aspects are: the quality of BRT services, quality of the built environment, age or physical strength of passenger and whether carrying goods or children. Nevertheless, a few participants both in FGDs and interviewees reported that the passengers would accept to walk up to 500 m at BRT station for modal changes between rickshaws and BRT systems. Thus, the Hypothesis 1 mentioned in Section 2.5 is true and accepted.

Table 10.1: Summary of the findings

Topics	Major Findings	Comments
Rickshaws in city transport	Rickshaws should be planned as feeder services of formal public transport such as BRT systems. Rickshaws' operation should be localised.	Rickshaws as a feeder of BRT
Distance for modal changes between rickshaws and BRT	Less than 200 m or a walk for 2-3 minutes is acceptable. Maximum distance could be 500 m. Depends on factors: passenger, BRT service and quality of interchange area.	Hypothesis 1 (refer to Section 2.5) is true
Pedestrian road crossing to access into BRT station	In general, at-grade crossing is preferable. In Kakoli-Banani, overpass with ramps and stairs. In Sayedabad location, both at-grade crossing and underpass with ramps.	Hypothesis 2 (refer to Section 2.5) is true
Passenger facilities required at BRT station	A toilet, passenger shade, kiosk, ticket counter, and limited seats.	Hypothesis 3 (refer to Section 2.5) is false
Rickshaw stands to load/unload passengers	Need to provide space for rickshaws' waiting (stands). 3-5 rickshaw stands surrounding the BRT station (in the mouth of branch roads). Each space should have 10-50 spaces.	
Organising (queuing) rickshaws at BRT station	Awareness generation among the pullers. Enforcement. Infrastructure provision for channelization.	Hypothesis 4 (refer to Section 2.5) is true
Information for road users	Knowledge about traffic signs and symbols is very poor. People travels regularly know basic/general traffic signs. Direction signs to/from rickshaws and BRT should be provided.	Hypothesis 7 (refer to Section 3.9) is true
Pre-determined fare structure for rickshaws	Usually pullers' do not prefer pre-determined fare structure. Fare structure based on distance or demarcated area.	Hypothesis 5 (refer to Section 2.5) is false
Using 3-D physical model in consultation	Helped participants for better understanding. Facilitate effective discussion with spatial contexts.	Hypothesis 6 (refer Section 3.9) is true

- In general, at-grade pedestrian road crossing to access into BRT station is the most preferable option for passengers because it is easier, convenient and faster than an underpass or overpass and provides universal access. However, given the poor behaviour of motorists as well as pedestrians (i.e.

ignorance and disobey of traffic rules) and thus safety problems of pedestrians in Dhaka city, participants both in FDGs and interviews proposed for a grade-separate (underpass or overpass) pedestrian road crossing to access into median BRT station (full discussion in Section 6.2.1 and Section 7.1.1). Even the disabled group mentioned that an underpass or overpass with sloping ramps would be better for them than an at-grade pedestrian crossing. However, in future if the behaviour of people changes (i.e. motorists respect traffic signs/signals and there is a strict enforcement of traffic rules) then their priorities may also change: for example, at-grade crossing with traffic lights or Zebra-crossings might be preferred. Preference between the options of underpass and overpass - though mostly preferred option was found to be an underpass, often the choice was determined based on different factors and aspects of the particular location. For instance, participants mostly suggested for an underpass at Sayedabad and an overpass at Kakoli-Banani location. The choice for option of providing pedestrian road crossing would depend on traffic situation, motorists behaviour, spatial contexts and road width. For the case of grade-separate crossing in Dhaka it was suggested for providing provision of both the stairs and sloped ramps whilst a few participants (both in FGDs and interviews) mentioned for an escalator or a lift if the resources are available. Thus, the Hypothesis 2 (mentioned in Section 2.5) is true and been accepted.

- Safety and security at modal interchange area is important for passengers. Presence of security guard, enough lighting and continuous supply of electricity particularly at night and multi-purpose interchange area incorporating with people for the security of passengers were mentioned both in FGDs and interviews. The responsibility of maintaining security at BRT station or modal interchange area could be given to the authority/company of BRT management. Beside the security aspect of passengers at BRT station, it is important that footpaths are: clear (no obstacles or shops and not occupied by non-traffic activities), smooth surface, and wide enough for comfortable walk. The minimum width of footpath was mentioned to be at least 2 m wide whilst the maximum width would be more and needs to be determined based on pedestrian volume as well as available rights of way (ROW) of the road.
- Regarding passenger facilities required at BRT station, participants both in the interviews and FGDs mentioned a passenger shade, a toilet, a small shop (or kiosk), a ticket counter and limited seating arrangements need to be provide (detailed discussed in Section 6.2.1 and Section 7.1.1). However, as the headway of BRT services would be very short (one bus in every

minute) it was hypothesised that there would not be required any seating arrangements for passengers at BRT station platform (refer to Hypothesis 3 in Section 2.5). Nevertheless, it was found that having a limited seating arrangement in BRT station platform would be helpful for passengers particularly who are old or sick or holding children or carrying goods. Therefore, Hypothesis 3 is false.

- Information related to BRT services and locations of rickshaw stations as well as a large map of the surrounding area showing the major attraction points need to be provided at BRT station. Level of understanding about existing traffic signs and symbols is very poor for road users (both pedestrians, rickshaw pullers and drivers of motorised traffic) in Dhaka city (see Section 6.2.3 for details). Road users who knows about existing traffic signs and symbols, are only familiar with the basic ones. In the FGDs it was found that the participants who travel more (i.e. rickshaw pullers) are more familiar about traffic signs and symbols compared with those who travel less. This knowledge or understanding is related with frequency of travel but not with literacy or education attainment. Thus, the Hypothesis 7 mentioned in Section 3.9 (Literate people know better than the illiterate people about the existing traffic signs and symbols) is not true and therefore rejected. However, it is necessary to introduce education program in every institution and publicity campaign through media to improve knowledge and understanding on traffic signs and symbols for public/road users.
- Even if the physical design of BRT station or modal interchange area ensures rickshaws following a tidy queue while waiting and convenient transfers for passengers to/from rickshaws; without having a pre-determined fare structure for rickshaws or an integrated fare for trips involving both rickshaws and BRT systems would not provide the ultimate benefits or convenience to the passengers. Because, as rickshaw fare is usually determined through a bargaining process, a passenger may have to approach many pullers (one after another) until he finds one willing to carry him with his desired rate. This will create crowding and congestion in front of BRT station, delay in transfer trip, and inconvenience of passengers. Moreover, it is certain that unless a pre-determined fare structure is established for rickshaws, it would be impossible to implement an integrated fare systems for trips involving both rickshaws and BRT. It was hypothesised that both the pullers and passengers would prefer a pre-determined fixed fare structure for rickshaws. However, the results show that though passengers would prefer the pullers do not prefer it as in such

case they will not able to ask for any extra amount from passengers. Hence, the Hypothesis 5 mentioned in Section 2.5 is not true and thus rejected.

- Determining a pre-determined fixed fare structure for rickshaws could be possible in various options: fare based on area or locality, fare based on the tentative distance of rickshaw trip, fare based on time of the rickshaw trip. Fare based on locality or based on tentative distance would be possible only if the rickshaws are localised (operate within the neighbourhood or local area but not provide city network wide services). A flat rate for rickshaw trips within the locality or different rates for different (hypothetical) demarcated area could be done. Responsibility could be given on local government authority to identify the distance between major points or demarcated area after consultation with different stakeholder groups. The standard fare rate for rickshaws would be same for throughout the day and applicable for maximum two adults travelling with two accompanying infant children. Role of pullers and their acceptability and effective enforcement are vital for implementing a pre-determined fare structure for rickshaws. Participants both in FGDs and interviews as well as rickshaw pullers mentioned that pullers will not follow the pre-determined fare rates. No para-transit mode currently in Dhaka is following a pre-determined fare structure. Pullers awareness generation; forming an association of pullers at neighbourhood/local level may help them to become aware and to take some responsibility for implementing and enforcing themselves similar to easyride drivers doing in a few routes - collecting appropriate pre-determined fare. Local authority (e.g. *ward* of the city corporation or *paurashava*) could take the initiative and responsibility of enforcement and practicing their administrative power within jurisdiction. For instance, Gazipur City Corporation and Savar Paurashava had established a pre-determined fare structure. Cooperation between local authority and the pullers association may provide better result for enforcement though presence of traffic warden was also mentioned. Moreover, the fare rates for rickshaw trips need to be updated/revised regularly.
- Fare integration between rickshaws and BRT could be done by any of the following different options: rickshaw services provided by BRT operating company within the locality, passengers to use pre-paid token to pay for the rickshaw trips, BRT tickets are sold by pullers and passengers would pay the total amount charged for the trip (both rickshaw and BRT) to the puller to get ticket for BRT. However, the pullers mentioned that they expect hard cash (immediate money) as the wage for their labour - want money to be paid just immediately after finishing the trip. Moreover, the issue is how the

revenue generated would be distributed among the modes – BRT and rickshaws.

- Using a three-dimensional (3-D) physical model during FGDs helped the participants for better understanding of the proposed development of BRT station area. The 3-D physical model also facilitate discussions with spatial contexts and improved public participation during the consultation process. Section 6.1 and Section 6.5 discussed more detail on this topic. These results indicate that Hypothesis 6 (mentioned in Section 3.9) is true or can be accepted. However, this should be noted that using a 3-D physical model was very challenging for consultation with people having physical disability (i.e. disabled group). Compared with other groups it was less effective using the 3-D physical model in FGDs of poor-income women-only groups and disabled group.

10.2 Recommendations

This research suggests in rickshaw cities instead of abolishing or prohibiting rickshaws need to be planned to integrate with formal public transport such as BRT systems. Because rickshaws provide important role of transport and its abolition do not solve traffic and transport problems. Following are the recommendations made of this research; grouped in two categories: results (or findings) and methodology.

Recommendations on Methodology

- Policy decisions about rickshaws should be based on scientific or technical grounds. Designing BRT station area for modal integration as well as fare integration of trips involving both rickshaws and BRT should be based on effective participation of public, rickshaw-pullers and policymakers.
- Recruiting the right participant for FGDs is the crucial for getting the opinions of laypersons of society. If no personal connection is available or it is not sufficient for recruiting the desired participants, then a third party could be employed but rigorous referencing and cross-checking of the recruited participants should be done before conducting the FGD to ensure that the recruited participants represent the desired sample.
- A 3-D physical model should be used while conducting FGDs in developing cities to ensure participant’s better understanding about the proposed development and effective participation of layperson in discussion on transport.
- Conducting an additional FGD with participants such as traffic police or traffic warden, beggars or traders occupying walkways and officials of the

local government who are involved or responsible for clean/free walkways and management of traffic at modal interchange area.

- The methods applying in other rickshaw cities should be done with caution; any other important actors relevant to socio-cultural or traffic situation of the ‘target’ city should be included in FGDs.

Recommendations on Results

- While planning for rickshaws to serve as a feeder service of BRT system, this should be ensured that they operate only at neighbourhood or local level. Providing a physical barrier (i.e. by providing road divider, traffic island) to delineate the demarcation or boundary of the neighbourhood would be easier for enforcement. If necessary, traffic warden could be deployed to ensure that rickshaws are not operating beyond the area they are allowed to do so. However, implementing through puller’s association would be more effective.
- Spaces for rickshaws (rickshaw stands) should be created and provided at BRT station. About three to five rickshaw stands need to be provided surrounding the BRT station. In each rickshaw stands there should have at least 10 spaces (or maximum 50 spaces) for rickshaws.
- Rickshaw stands should be placed in such locations that the distance need to walk for passengers for modal changes between BRT and rickshaws are within 200 m or a walk for a maximum 2-3 minutes. However, if it is difficult or impossible to provide rickshaw stand within this distance then this should not be more than 350 m long.
- The provision of pedestrian road crossing would depend on factors such as traffic situation, motorists’ behaviour, spatial contexts and road width. Provision of pedestrian road crossing to access into median BRT station is suggested by underpass with stairs and sloped ramps. If resources are available then lifts or escalators could be provided.
- Pullers need to be trained and awareness generation so that they become aware and do self-enforcement in forming a tidy queue while waiting at BRT station. Moreover, in each BRT station there should have a traffic warden who will be responsible for monitoring and enforcement that rickshaws form a tidy queue when waiting at BRT station, an empty rickshaw do not wait for a long time in a rickshaw stand, ensuring security of passengers.
- Width of the walkways should be at least 2 m wide. However, the maximum width would be based on traffic flow and pedestrian level of service (LOS). Walkways should be clean, smooth surface and for pedestrians only.

- A toilet, BRT ticket counter, a kiosk (shop), transparent passenger shade, a large map of the surrounding area showing major attraction points and limited seating arrangements should be provided in the BRT station platform. It is suggested not to provide more than 12 seats (only for older or disable or in-need people).
- Infrastructure in rickshaw stand should be provided in such a way that pullers are forced (bound) to follow a tidy queue while waiting.
- Information about rickshaws (including the direction of rickshaw stands) should be provided at BRT station.
- Rickshaw fare should be pre-determined and following a fixed structure. The fare would be determined by local government with consultation of pullers and public and should be determined based on tentative distance of trip. Fare rate should be revised or updated each year. A large billboard mentioning fare for different locations should be placed in BRT station. Rickshaw pullers will be encouraged through awareness generation so that they follow themselves the pre-determined fare for rickshaw trips.
- Transferring the design of BRT station and policy measures that were derived from the case study in Dhaka city to other 'rickshaw city' should be based on assessment of the barriers and facilities of transfers in that city.

10.3 Conclusions

Rickshaws are available as a travel mode in many cities, particularly in Asia, and playing a crucial role in city transport. In the past, many cities (i.e. Jakarta, Surabaya, Karachi, Manila, and Bangkok, Delhi, Dhaka) have tried to restrain or prohibit rickshaws from the entire city or from certain roads or parts of the city on the grounds of either reducing congestion for smooth flow of motorised vehicles or enhancing the city image by eliminating traditional modes. However, there are arguments that decisions to ban rickshaws have not been based on scientific or technical grounds (see ITDP, 2009; Gallagher, 1992; Bari and Efroymson, 2005), but rather upon ad-hoc 'political decisions' taken from the top (bureaucrats and richer car-owners). The decision of such rickshaw bans in most of the rickshaw cities have been highly controversial; opposed by environmentalists, rickshaw-pullers and users.

An alternative approach to placing outright restrictions on rickshaws could be to integrate them into the public transport system by using them as feeder services. This research is concerned with providing a solution that reconciles the two sides of the controversy - 'for' and 'against' the rickshaw bans. This solution involves providing a multi-modal integrated transport system where the formal mass public transport such as BRT systems should get priority in the major arterials, with rickshaws (or NMTs and other para-transits) operating in other (narrow) streets to provide feeder services or access/egress legs of public transport. Such a solution recognises that access/egress legs are very important for public transport trips because, in many developing cities, public transport is not available within walking distance, and passengers need to take NMTs or para-transits to reach a public transport station.

There are good arguments that rickshaws should be planned in such a way that they could play a vital positive role in the modern city transport instead of restricting or prohibiting them. This research showed that rickshaws could serve as the feeder services of BRT systems. However, for such feeder services to operate efficiently, rickshaws should be well organised in queues at the waiting areas, close to the BRT station and pullers should be aware about the road discipline and systems to be able to feed the BRT. Moreover, various design requirements of BRT stations are needed for modal integration between rickshaws and BRT to ensure easy and convenient transfers for passengers. This research has further explained that a pre-determined fixed fare structure for rickshaws would be possible at local or community level of the city, which could help for fare integration of trips involving both rickshaws and BRT systems. Participatory methods and qualitative analysis was used for deriving public reaction and policymakers' opinion about the design of BRT station and its surrounding area prepared for modal integration with rickshaws to ensure easy transfers for passengers to/from BRT system as well as their opinion about fare integration between rickshaws and BRT systems.

This research gives a potential solution for a common problem (arguments between fast and slow transport or between non-motorised and motorised transport) of urban transport that exists in many countries. The outcome of the research would be helpful for other rickshaw cities that have (or are planning for) BRT systems how to integrate rickshaws with BRT. The methods applied for this research as well as the major findings are transferable in other rickshaw cities. Although the main policy implications concern rickshaws, the insights of this research could be helpful for formulating policy for other informal modes in developing cities that might, from the perspective of city transport managers, be operating in a disorganised and haphazard way.

10.4 Further Research

This research of integrating BRT systems with rickshaws, applied participatory methods using a 3-D physical model in a rickshaw city, provides avenue for further research directions. Further research could be following:

- Comparative analysis of public participation during FGDs (same study with same group) with and without having a 3-D physical model.
- Using computer-visualisation techniques (3-D virtual model) to test if possible to apply in conducting FGDs in developing cities; whether there is similarities or dis-similarities in public understanding and participation level while using a 3-D physical model or 3-D virtual model.
- Using design charrettee method for designing BRT station area for modal integration with rickshaws to test if the results are similar or what are the difference.
- Quantitative analysis of the BRT station area and modelling or simulation of the design of BRT station area to test the extent to which the users benefit from different design parameters or standards.
- Financial analysis of the BRT station area to estimate the costs may occurred a BRT station integrated with rickshaws.
- Conducting the same research using the same methods in another ‘rickshaw city’ to test if the results are similar or what are the differences.
- Testing the transferability of the designs and policies described in this research for integrating rickshaws with BRT systems in Dhaka to other ‘rickshaw city’.
- Evaluate if the physical integration of rickshaws with BRT systems improve the safety for passengers at BRT station (or interchange area).
- Implications of increasing the numbers of e-rickshaws (electric-rickshaws) and the consequence changes in rickshaw sector or city transport.
- Applying the same research methods used in this research for formulating policy for other informal modes in developing cities that might, from the perspective of city transport managers, be operating in a disorganised and haphazard way.

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Appendix A
Discussion Topics (Prompts) in FGDs and Interviews

Different discussion topics (prompts) for interview of key informants and focus group discussion (FGDs) for user groups and rickshaw pullers were used.

A.1 FGDs of User Groups

Following are the prompts used in FGDs for user groups.

1. Introduction

i) Welcome

ii) Brief explanation about BRT system and showing some photographs

2. Usage of rickshaw and BRT (bus)

i) What is frequency of bus use? What will be frequency of BRT use?

ii) What is frequency of rickshaw use? Do you use rickshaw to arrive bus stoppage? Will use rickshaw to/from BRT station?

3. Requirements for rickshaw to serve as feeder service of BRT

i) Overpass or crossing at grade?

i.e. steps/ramps/escalator/lift traffic light/policing/Zebra-crossing

ii) Comfortable walking distance and walking time for change?

iii) Safe and secure changes between rickshaw and BRT for the users?

i.e. width of walkway or overpass, covered, accident, guard (traffic police)

iv) Facilities (or services) needed at BRT station?

i.e. waiting shade, walkway, seating, lift/escalator, toilet, road-side activities, others

4. Requirements particularly for this location?

i) Showing the map and photographs of case study location

ii) Requirements particularly for this location?

Repeat Question Number 3 particularly for the case of case study area.

5. Possibility of pre-determined (fixed) fare for rickshaw?

Why need? How?

6. Signs and signals related to BRT for improving access and traffic flow

i) Understanding about existing signs, signals, symbols

ii) Expecting the signs, signals, symbols, road marking

i.e. location (positioning) of signs or symbol and their size

7. Discussion about the design prepared for BRT station

i) Showing initial plan of BRT station

ii) Discussion about the design prepared for BRT station. **(Cover issues 3, 4, 5 & 6)**

8. Summing up the whole discussion

i) Write (or speak) the summary and show (if they agree)

9. Thanks and concluding

A.2 FGDs of Rickshaw Pullers Groups

Following are the prompts used in FGDs for rickshaw pullers groups.

1. Introduction

i) Welcome

ii) Opinion and effects about recent rickshaw-banning on some roads

2. BRT System

i) Brief explanation about BRT system and showing some photographs

3. Requirements for rickshaw to serve as feeder service of BRT

i) Proportion of passengers to/from bus stoppage?

ii) Facilities required for rickshaw at BRT station? For safety?

iii) Space requirements (how many rickshaws) for rickshaw?

iv) Possibility of pre-determined (fixed) fare for rickshaw?

v) How to organise (disciplined) rickshaw?

4. Case study location

i) Showing the map and photographs of case study location

ii) Requirements particularly for this location?

Repeat Question Number 3 for the case of case study area

5. Signs and signals related to BRT for improving access and traffic flow

i) Understanding about existing road signs, signals, symbols

ii) Expecting the road signs, signals, symbols, road marking

i.e. location (positioning) of signs or symbol and their size

6. BRT Station design

i) Showing the initial plan of BRT station

ii) Discussion about the design prepared for BRT station. **(Cover issues 3, 4, 5 & 6)**

7. Summing up the whole discussion

i) Write (or speak) the summary and show (if they agree)

8. Thanks and concluding

A.3 Key Informants Interview

Following are the prompts used during interviews of key informants.

1. Introduction

i) Brief explanation about BRT system and showing some photographs

ii) What is your job responsibility?

2. Rickshaw as a feeder to BRT

i) Do you think rickshaw could provide access/feeder service to BRT system? (Will people use rickshaw to/from BRT station?)

ii) Particularly in Dhaka City? Why and how?

3. Requirements for rickshaw to serve as feeder service of BRT

What design requirements of BRT station are needed for accommodating rickshaws as a feeder service?

i) Overpass or crossing at grade?

i.e. steps/ramps/escalator/lift traffic light/policing/Zebra-crossing

ii) Comfortable walking distance and walking time for modal change?

iii) How interchanges between rickshaws and BRT could be faster?

iv) How to ensure safe and secure changes between rickshaw and BRT for users?

i.e. width of walkway or overpass, covered, accident, guard (traffic police) - Will physical integration of rickshaw with BRT improve the safety of passengers?

v) How to ensure rationale road space utilization of different travel modes?

vi) Facilities (or services) needed at BRT station?

i.e. passenger waiting shade, covered walkway, seating, lift (escalator), toilet, road-side activities (land use), any others

4. Case study location

i) Showing the map and photographs of case study location

ii) Requirements particularly for this location?

Repeat Question Number 3 for the case of case study area

5. Fixed fare for Rickshaw (Also discuss Case study area)

i) Any possibility of pre-determined (fixed) fare for rickshaw?

- Why and how?

ii) How rickshaws could be organized to provide feeder service?

- How to accommodate large volume of traffic at BRT station?

6. Signs and signals related to BRT for improving access and traffic flow

i) What do you think the level of understanding of road users about the existing road signs, signals, marking, etc.?

ii) What type of road signs, signals, and symbols related with BRT would be easy understandable for passengers and rickshaw pullers to improve the overall access and traffic flow?

7. BRT station design

i) Showing initial plan of BRT station

ii) Discussion about the design prepared for BRT station. **(Cover issues 3, 4, 5 & 6)**

8. Summing up the whole discussion

i) Speak the summary (if he/she agree)

9. Thanks and concluding

Appendix B
List of Key Informants

1. Project Director, BRT Project for Airport-Sadarghat BRT, DTCB, Dhaka.
2. Urban Planner, Dhaka City Corporation (DCC).
3. Transport Planner, Dhaka Transport Coordination Board (DTCB).
4. Ward Commissioned, Ward 86, DCC.
5. Transport Planner and Consultant, JICA (Metro and DHUTS) Project.
6. Transport Consultant (international) for Sustainable Transport.
7. Professor of Urban and Regional Planning (URP), and General Secretary of Bangladesh Institute of Planners (BIP).
8. Deputy Director (Technical), Bangladesh Road Transport Authority (BRTA).
9. Professor of Urban and Regional Planning (URP), and President of BIP.
10. Transport Planner and Consultant for BRT Project (Airport-Sadarghat).
11. President of a non-governmental organisation (NGO) which works for better environment and awareness generation.
12. Program Officer of an NGO which works for sustainable transport in Dhaka and awareness generation.
13. Transport Planner and Fellow of Centre for Policy Dialogue (CPD).
14. Urban Planner, RAJUK (Capital Development Authority).
15. Deputy Director (Planning), Urban Development Directorate (UDD).
16. Traffic Engineer, Roads and Highways Department (RHD).
17. Transport Planner, World Bank Dhaka Office.
18. Director (Technical), Bangladesh Road Transport Corporation (BRTC).
19. Former Director, Accident Research Institute (ARI), Bangladesh University of Engineering and Technology (BUET).
20. Professor of Civil Engineering and Transport, BUET.
21. Transport Planner and NMT Consultant for Airport-Sadarghat Project.
22. Traffic Commissioner, Dhaka Metropolitan Police (DMP) North.
23. Deputy Chief (DS), Ministry of Transport and Communication, Bangladesh.
24. MP and Chairman of Parliamentary Committee for Transport.

For Informal Discussions

1. Official of DCC Wheel Tax Department.
2. Official of Gazipur City Corporation (GCC)
3. Pullers of Battery rickshaws in Gazipur
4. Official of Savar Paurashava
5. Rickshaw owners at Banani area.
6. Rickshaw owners at Sayedabad area.
7. Traffic police working at Kakoli-Banani intersection.
8. Drivers (3) of Battery driven Auto (Easybike).

Appendix C
Bus Rapid Transit (BRT) Systems

C.1 Background of BRT

The BRT, in fact, has its origin in Curitiba, Brazil. In 1975, Curitiba decided to spruce up a low-cost-high-quality bus-based transit system with exclusive right of way (ROW) and elevated platforms for solving the growing transport problems of the city. After more than two decades of Curitiba's initiative, Quito was the first Latin American City tried to replicate the Curitiba experience. However, TransMilenio in Bogota, Columbia introduced the "state-of-the-art technologies" never been used before in public transport in the developing countries. It has changed the face of Bogota from a congested and polluted city to a model transport system. Most of the TransMillenio stations are 48 m long and located every 500 m with pedestrian and bicycle access through overpasses, tunnels or signalised intersections and bicycle parking facilities at station (Hook, 2004).

BRT is a cost-effective transit alternative and a high capacity BRT systems, most notably the Bogota in Columbia and Guangzhou in China, offer capacities almost equal to the metro systems (ADB, 2010). To date, a total of 82 BRT systems are in operation globally (21 in Latin America, 21 in Asia, 24 in Europe, 9 in North America, 4 in Oceania and 3 in Africa); however, many cities (10 in Latin America, 21 in Asia, 3 in Europe, 12 in North America, 1 in Oceania and 16 in Africa) are implementing or planning for it (Wright, 2010).

C.1.1 Definition of BRT

The BRT is a bus service that operates like a suburban rail system on exclusive bus-ways using one or two lanes in each direction. The BRT systems usually include additional design and operational features to increase passenger capacity, such as well-designed bus stops, organised operations, and efficient collection methods of passengers. The major features of BRT are (Vincent, 2004; Wright and Hook, 2007; Wright, 2010; Levinson *et al*, 2003; PADECO, 2008; Polzin and Baltes, 2002):

- Dedicated ROW or priority infrastructure;
- Rail-like station facilitate rapid boarding and alighting;
- At-level, platform boarding;
- Low floor vehicles;
- Off-vehicle fare collection and fare validation;
- Fare integration between routes, corridors, and feeder services;
- Frequent and rapid service;
- Integrated route 'network' and well-designed structure;
- Intelligent transport system (ITS) technology; and
- Multi-modal access, including feeder services and NMT and pedestrians.

C.2 BRT Systems Options

The options of BRT systems could be of various types and forms - different options have different pros and cons on particular aspects – are discussed below.

C2.1 Median Vs. Kerbside configuration of BRT lane and station

The BRT lanes and stations may be placed in the median or along the kerbsides of the road. However, the median option to locate the busway in the centre of the roadway or corridor is the most common practice globally. The other options of locating the busway or BRT lanes could be:

- Multiple lanes along corridor side (lanes for both busway directions on the same side of the roadway);
- Counter-flow option (BRT buses operate in the opposite direction of mixed traffic);
- Busway-only corridor (complete priority to public transport where the entire roadway space is given to BRT lanes, as in transit malls).

This might be possible to use several different configurations mentioned above in a single BRT system. For instance, Curitiba BRT in Brazil uses centre lanes, both lanes on the same side, and busway-only corridor. Counter-flow option of busway poses a potential serious problem with increased pedestrian accidents; hence, generally BRT systems not employ this type of configuration. Bus lanes for both directions of the Miami busway in USA are placed along the same side of the roadway.

The kerbside configuration poses conflicts with turning traffic, stopping taxies and rickshaws, delivery vehicles, and other NMTs; hence, achieving a capacity over 5,000 passengers per hour per direction (pphpd) is quite difficult if turning vehicles are frequently interfering with busway operations (Wright and Hook, 2007). On the contrary, the main advantages of the median lanes are:

- Reduces conflicts with left-turning vehicles (in countries that drive on the left-hand side of the road); and
- Allows a central station to serve busway of both directions.

Table C1: Comparison of Median and Kerbside BRT

	Median Configuration	**Kerbside Configuration**
Description	• Bus lane is provided in the centre of the corridor.	• Bus lane is provided along the curb-side, with the mixed vehicle lane at the centre of the corridor.
Pros	• Reduces conflicts with turning traffic. • Allows a central station to serve both directions; common facilities (i.e. overtaking and breakdown lane) can be shared. • Easy for passengers transferring to other BRT services.	• Allows use of the existing infrastructure (e.g. bus stops). • Easier to integrate with pedestrian movements (pedestrians do not need to cross the road for the direction next to footway).
Cons	• Pedestrians have to cross the road to access into BRT.	• Conflicts with turning traffic; reduced operational speed. • Requires overtaking/breakdown lanes for buses on both sides. • Complicated for passengers transferring between BRT services.
Examples	BRT in Bogota, Guangzhou, Ahmedabad	Lagos BRT
Comments	A median configuration can provide higher speeds than kerbside. Most of the successful BRT systems operating in different countries are median configuration.	

The kerbside stations usually create problems for passengers to change directions into other BRT routes with paying a single fare. Kerbside configuration would also require two separate stations, each serving different directions. However, the kerbside stations do not inhibit transfers in the BRT systems with just a single corridor since there are no other corridors for transfers to take place. On the other hand, the configuration of a median station gives following advantages:

- As a central station serving both directions, reduced infrastructure costs compared with separate kerbside stations for each directions;
- Possible to place at surface or underground or overhead station.
- Permits passengers to select multiple routing options from a single platform – passengers are able to change directions by simply crossing the station platform;
- Allows integration between busway routes, particularly when two routes cross on perpendicular streets, in providing pedestrian infrastructures; and
- More conducive to ease of transfers.

Pedestrian access to a median BRT station could be either by at-grade crossing (i.e. Zebra-crossing or signal lights) or by grade separate crossing (pedestrian underpass or overpass (as shown in Figure C1).

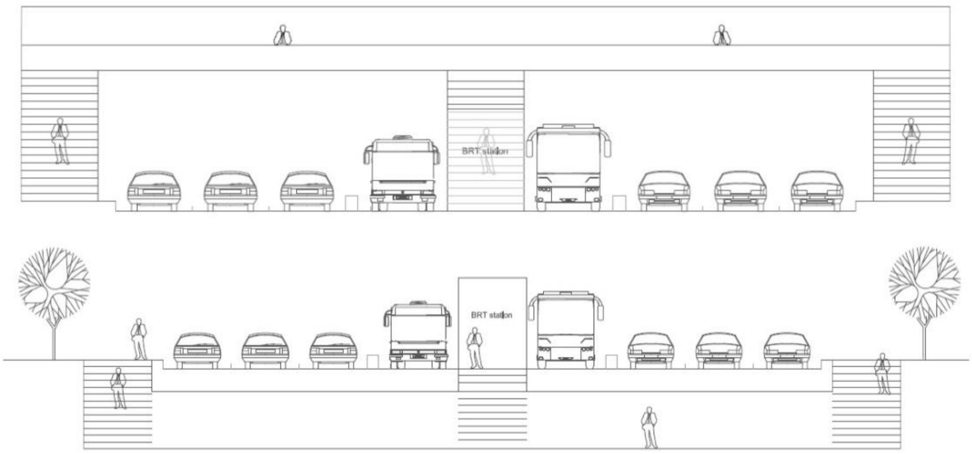

Figure C1: Synoptic scheme for grade separate pedestrian crossings to access BRT station - overpass (above) and underpass (below)

C2.2 Open Vs. Closed systems

The BRT systems could be 'open systems' or 'closed systems'. Systems that limit access to prescribed operators only to operate special BRT vehicles and no other vehicles are allowed to enter in the dedicated bus lanes are known as 'closed systems'. In closed systems, the private operators compete for the right to operate for providing bus services under a competitive tendering process. The highest quality examples of BRT such as BRT in Bogota and Curitiba, Jakarta BRT and Ahmedabad BRT are the closed systems. In contrast, the systems without any exclusivity are known as 'open systems'.

In open systems, any bus operator that previously provided services does continue operating on the new BRT lanes. The operators largely continue to use the same routes as they did previously; tend to utilise the BRT infrastructure whenever it coincides with their previous routing and also operate parts of their existing routes without busway infrastructure. The BRT in Delhi, Taipei, Lima, and Porto Alegre operate as open systems.

Wright and Hook (2007) mentioned that since the number of operators and the number of vehicles are rationally selected and carefully controlled in a closed system, it tends to be designed around the optimum conditions for passenger preferences such as minimising travel time and waiting time. On the contrary, open systems tend to be designed principally around the preference of existing operators but not necessarily around the optimum conditions for passengers.

C2.3 Trunk-feeder services Vs. Direct services

The service structure of BRT systems could be either direct services or trunk-feeder services, as shown in Figure C2.

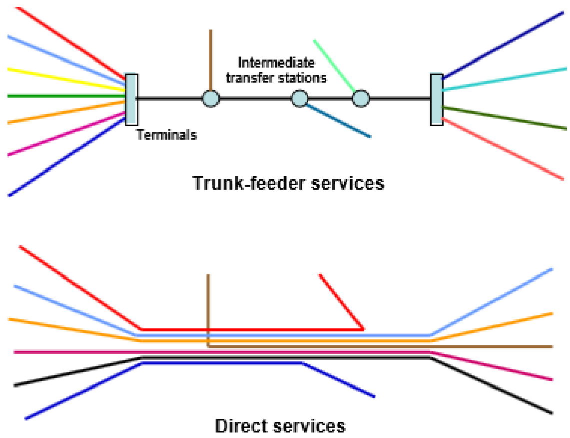

Figure C2: Thematic sketch of trunk and feeder service networks

In a direct service passenger can travel from their origin to destination without having any change or transfer of vehicle whilst in trunk-feeder services the smaller vehicles (operating in lower-density areas or narrow roads) feed passengers to the larger vehicles operating along high-density trunk corridors.

C.3 BRT Corridor Capacity and System Design

C3.1 BRT system capacity

A high quality BRT system can carry about 45,000 passengers per hour per direction (pphpd). For example, TransMilenio BRT in Bogota has a practical capacity of between 43,000 and 48,000 pphpd with a commercial speed of 22–24 km/h (Hidalgo *et al*, 2013). The main factors that affect the capacity of a BRT system are discussed below:

Vehicle capacity

In general, utilising a larger vehicle carrying passengers as much as double of a small-sized vehicle would simply produce 2-fold of the corridor capacity. A variety of standard vehicle sizes (Table C2) are available for BRT systems. Though the capacity of a bi-articulated bus is the highest; their heavier weight reduces fuel efficiency and ability to accelerate rapidly, and also higher length can cause difficulties with regard to available length of ROW at station.

Table C2: BRT vehicle options

Vehicle Type	Vehicle Length (m)	Capacity (passengers)
Minibus	6	25 – 35
Bus (standard bus)	12	60 – 80
Articulated bus	18.5	120 – 170
Bi-articulated bus	24	240 – 270

Source: Wright and Hook, 2007.

Load factor

Load factor is the percentage of a vehicle's total capacity that is actually occupied. The actual load factor of any BRT system is determined by the frequency of the vehicles and the demand; thus, the desired load factor may vary between peak and off-peak periods.

Service frequency or headway

The service frequency refers to the number of buses operate per hour. If there are more frequent services available, waiting time for passengers would be less. The waiting time between vehicles is also termed as 'headway'.

In general, it is desirable to provide frequent services in order to reduce passenger waiting times. However, a very high frequency (or very low headways), would increase the danger of stopping bay congestion and slower speeds.

Stopping bay

Stopping bay is the designated area in a BRT station where a bus will stop and align itself to the boarding platform. Each stopping bay serves a different set of services or routes; thus multiple stopping bays allow many different types of services (i.e. local services, limited-stop services) operating from the same station. The services at each stopping bay must be properly scheduled and spaced to limit congestion, grouped the routes having destinations in relative geographical proximity to one another.

Dwell time

The amount of time that a vehicle is occupying a given stopping bay is termed as the dwell time. The dwell time, or the amount of total time per vehicle, will affect the system's overall efficiency such as average commercial speed. The dwell time consists of three separate delays:

- Boarding time;
- Alighting time: and
- The dead time.

Some of the factors affec dwell time include: passenger flow volume, number of vehicle doorways, width of vehicle doorway, entry characteristics (stepped or at-level entry), and open space near doorways (on both vehicle and station sides), doorway control systems. BRT systems are able to reduce total stop time to 20 seconds or less (Wright and Hook, 2007).

Renovation factor

The renovation factor is defined as the average number of passengers that are on a vehicle divided by the total boarding along a given route. Hence, the lower the renovation factor, the higher the usage rate of the vehicle.

Station saturation

The saturation level of a station means the percentage of time that a vehicle stopping bay is occupied. Generally, BRT stations should be less than 40% saturation otherwise the risk of congestion increases significantly (Wright and Hook, 2007). A saturation factor of 0.40

corresponds to approximately 60 vehicles per hour; hence, operating more than this number of vehicles will make the lane congested.

Average boarding and alighting time per passenger

Average boarding and alighting time per passenger is directly related with the total number of passengers boarding/alighting in a given stop and the design of vehicle-station interface.

Off-board fare collection gives advantages of reducing boarding and alighting times, facilitates free transfers within the system, enhancing transparency of the process of fare collection, as well as to some extent another level of security. Platform level boarding also reduces boarding and alighting times and provide added customer confidence; it is safe and convenient for the passengers, and is user-friendly to passengers with physical disabilities, wheelchairs, and strollers (Wright and Hook, 2007).

The vehicle acceleration and deceleration time is influenced by the closeness in docking required. Manual alignment contributes to both slower docking time as well as greater variability in docking distance; use of a boarding bridge requires drivers to only dock within 45 cm of the platform whilst the close precision requires achieving a gap of only 5-10 cm will slow this alignment process (Wright and Hook, 2007). On the other hand, automatic docking technologies (i.e. mechanical guide-way systems, optical docking systems, magnetic guidance systems) can increase the speed and accuracy of vehicle platform alignment.

Providing several doorways dispersed along the length of the vehicle multiplies the capacity of the boarding and alighting process. In general, it is most efficient to distribute doorways as widely as possible. However, BRT Planning Guide (Wright and Hook, 2007) shows, in reality there are relatively sharp diminishing returns for each additional door after four. For the articulated bus of 160-passengers (18.5 m) and four sets of 1.1 m doors is becoming the standard configuration for BRT (Wright and Hook, 2007). The size and layout of the station platform will have a distinct impact on system capacity and efficiency. If the platform hosts two service directions along one another, then the sum capacity requirements of both directions must be factored into platform sizing (Wright and Hook, 2007).

Different type of services

A given BRT system can provide different types of services, such as, local services, limited-stop services, and express services. The limited-stop services and express services do not stop in all the stations.

Passing (or overtaking) lanes

Vehicles must be able to pass or overtake one another at the station in order to allow operating different types of services and routes as well as to enable multiple stopping bays functioning properly. So, a passing lane should be provided at the station if multiple stopping bays are functioning. It is suggested that on BRT systems with very high demand (over 10,000 pphpd), an overtaking lane is required at each station in order to allow multiple stopping bays. However, the difficulty of providing a passing lane is the limited ROW or road space. Nevertheless, a staggered or elongated station design may help to permit passing lane.

The passing lane could be provided only at the station area, or could be extended all along the road as an additional lane. Again, the additional lane along the corridor is subject to availability of ROW. Furthermore, whether the passing lane is needed beyond the station area would depend on the saturation levels along the corridor and the congestion levels at intersections (Wright and Hook, 2007).

Convoying

The 'convoying' or 'platooning' of vehicles could work to improve the capacity when it is impossible to provide a passing lane but the corridor requires multiple stopping bays due to high capacity requirements. In a convoy system the order of the vehicles is typically set so that the first vehicle stops at the far stopping bay and the next vehicle stops at the subsequent stopping bay. Developing and comparing two scenarios, BRT Planning Guide (Wright and Hook, 2007) showed convoying has potential to reduce saturation from 0.653 to 0.566, which represents a reduction of 13%. Thus, convoying can increase the capacity of a single lane corridor operating with a single stopping bay from 9,700 pphpd to a maximum of 13,000 pphpd without any reduction in the level of service (Wright and Hook, 2007). However, the convoying of vehicles is always difficult to manage and control; often the non-ordered convoys add stress and confusions to customers.

C3.2 Optimisation of BRT Station Location

Possible locations of a BRT station in relation to the intersection could be (Wright and Hook, 2007):

- At the intersection before or after the traffic signal;
- At the intersection but before the traffic signal in one direction and after in the other direction (if using a split station configuration);
- Near the intersection but not at the intersection;
- Mid-block; and
- Under or over the intersection (elevated).

Each of the above configurations does have some particular advantages and drawbacks. Obviously the station at intersection reduces walking times for transferring passengers. Placing the station before the intersection increases the chances that boarding and alighting time can overlap with the traffic signal red phase; thus obvious benefit of time savings since the station dwell time coincides with the red signal phase. To utilise this benefit, for the case of split stations, the station for one direction can be placed on one side of the intersection whilst the station for other direction on the other side of the intersection. Generally it is suggested to separate the BRT station and the intersection if the volume of mixed traffic or bus is very high (Wright and Hook, 2007).

Some general guidelines to obtain a preferred station location, as outlined in the BRT Planning Guide (Wright and Hook, 2007), are:

- The BRT station should be situated far enough away from the intersection if mixed traffic turns are allowed, and turning volumes are high, and the number of boarding and alighting and transferring passengers is low.
- If a popular high volume pedestrian destination exists along the corridor, proximity to this location may be more important than proximity to the intersection.
- If the system operates with kerbside stations, then stations may need to be located near intersections in order to facilitate transfers to perpendicular roads; this situation

is not relevant to the median stations since transfers are accommodated at the platform.

C3.3 Fruin Index

Fruin (1971) provided the minimum width of walkways or public transport station required for certain level of services (LOS) considering passenger flow. Table C3 shows the requirements of average area per passenger for different LOS level and Figure C3 shows its schematic presentation.

Table C3: Fruin Index Standards

Fruin Index Level of Service (LoS)	**Average area per passenger (Sq feet)**	**Average area per passenger (Sq metre)**
LOS A	>=13 ft^2	>=1.3 m^2
LOS B	10-13 ft^2	0.93-1.2 m^2
LOS C	7-10 ft^2	0.65-0.93 m^2
LOS D	3-7 ft^2	0.28-0.65 m^2
LOS E	2-3 ft^2	0.19-0.28 m^2
LOS F	<=2 ft^2	<=0.19 m^2

Source: Fruin, 1971.

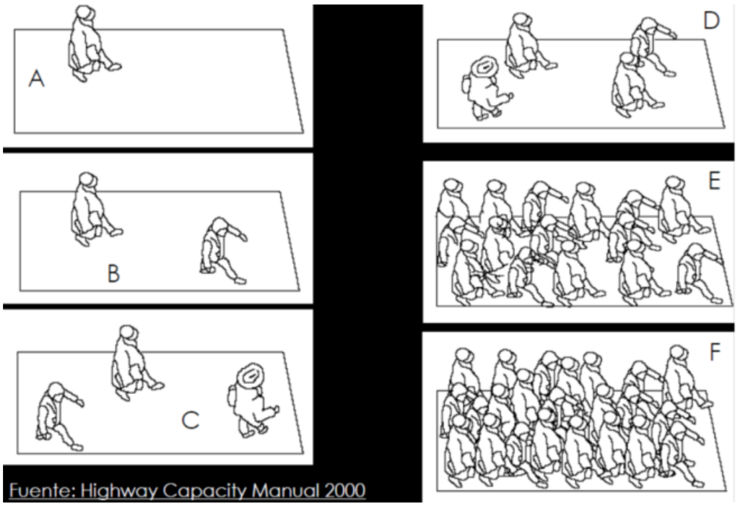

Figure C3: Fruin index of different level of service (LOS)

Source: CIHT 2000

Appendix D
Secondary Information on Dhaka City

D.1 Location of Dhaka city

Dhaka is located in the central region of the flat deltaic plain of the three large rivers: the Padma (the Ganges), the Brahmaputra, and the Meghna. Dhaka became the national capital of Bangladesh evolving from a provincial capital after independence in 1971. This city is located almost in the centre of the country and well connected with the rest of country by road network.

Figure D1: Boundary of Dhaka city by different organisations (Source: STP, 2005).

The elevation of Dhaka lies between 2 and 13 m above mean sea level (msl); most of the urbanised areas are located at an elevation of 6 to 8 m above msl on comparatively higher land within this city (Alam and Rabbani, 2007). Much of Dhaka and its surrounding areas are susceptible to flooding of various types related to tidal and typhoon conditions, heavy rainfall, and river flooding arising from conditions in the mountains to the north outside the country (STP, 2005).

D.1.1 Land Use

Table D1: Land use composition in DCC Area.

Land Use Category	Area (ha)	Percentage (%)
Residential Area	5,722.16	44.35
Commercial	533.06	4.29
Industrial Area	259.16	2.01
Mixed use Area	535.52	4.15
Public facilities	1,027.80	7.97
Road / Railways	1,350.05	10.46
Park / Play Ground / Urban Green area	154.78	1.20
Restricted Area / Brick Field	1,086.30	8.42
Open space / Cultivated Land / Forest	1,015.36	7.87
Swamp / Marsh / Char / Island / Water Bodies	1,194.74	9.26
Information not available	3.42	0.03

Source: JICA, 2010.

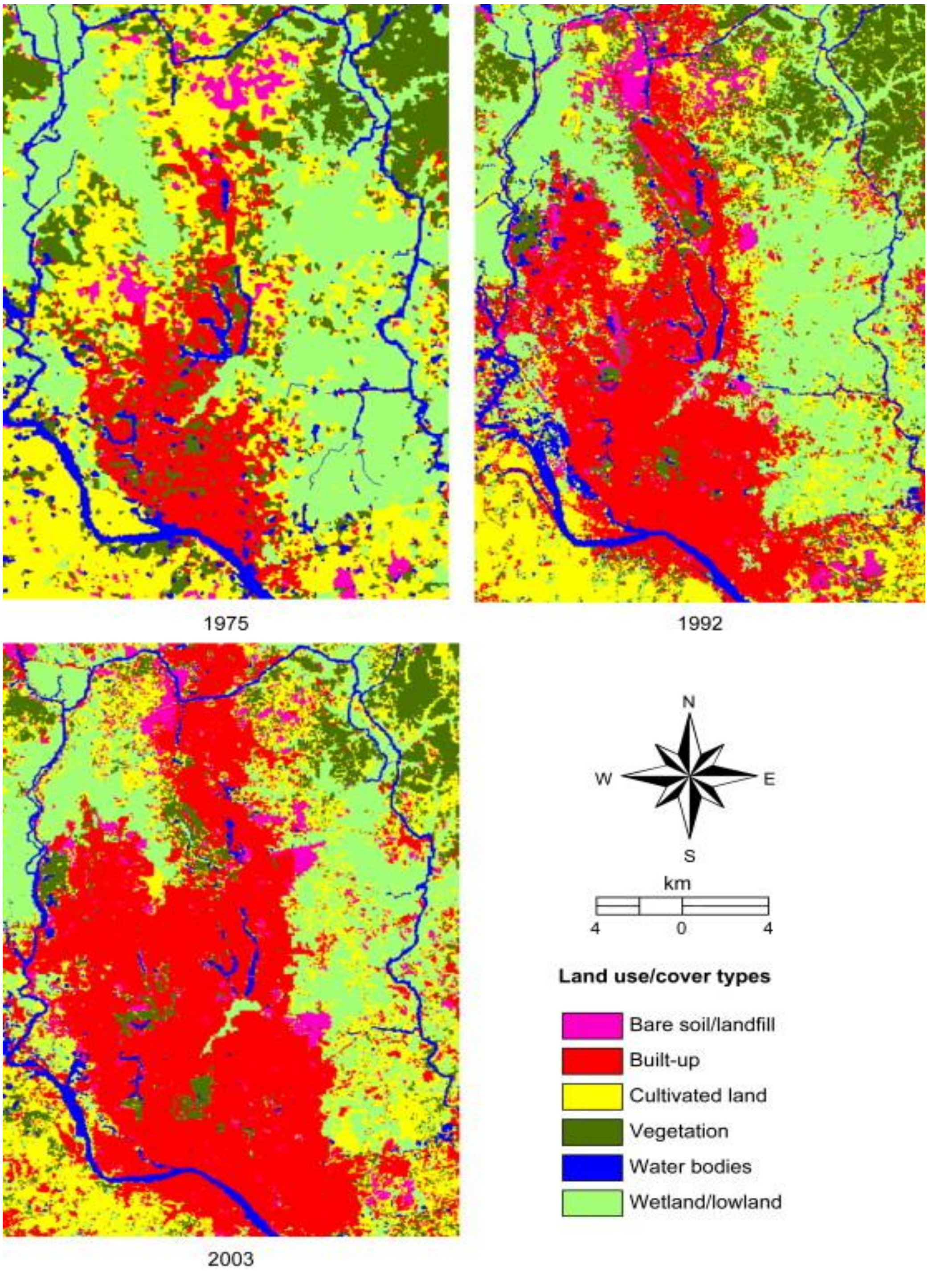

Figure D2: Land use map of Dhaka and growth towards North.
Source: Dewan and Yamaguchi, 2009.

D.1.2 Employment

The main occupations in Dhaka are the service (31.49%), which is the main occupation of the labour force, commerce (23.05%) whilst the other occupations with less weight are agriculture (7.62%), agricultural laborer (4.41%), wage laborer (2.71%), industrial laborer 1.87%, construction (2.76%), house renting out (2.23%) and transport 8.53% (ALG, 2013).

D.2 Transport Infrastructure

D.2.1 Road Hierarchy

Table D2: Road hierarchy and length of network in Dhaka city

Road Type	Length (km)	Percentage (%)
Local street	1,968	82.90
Main street	272	11.46
Motorway	134	5.64
Total	2,374	100.00

Source: ALG, 2013.

D.2.2 Station and Terminal Facilities

Dhaka is served by three inter-district terminals: Mohakhali in the centre, Gabtoli in the west, and Syedadad in the east. Due to absence of garage and separate depot facilities for the operating buses, these terminals are also being used as depots for the intercity buses. Moreover, repair, overhauling, denting, painting etc works of the buses are also carried out at the terminals. Thus, due to lack of proper management, these terminals could not be optimally used. There are facilities to interchange from the intercity buses to the city buses at Gabtoli and Syedabad terminal, but the facilities are not adequate for all of the city bus services.

There are six railway stations within Dhaka city, between Kamalapur Central Station and Tongi. Those stations are connected with a variety of access/egress transport modes like city buses, taxis, auto-rickshaws and rickshaws. The majority of the railway passengers are long-distance travellers.

Sadarghat, the largest river port of the country, is located in the southern extreme of Dhaka. Every day nearly 120-130 passenger vessels of different sizes are operating from this port. Most of the vessels arriving at this port are medium-sized have approved capacity to carry up to 600 passengers (but in reality, they normally carry 2 or 3-fold extra passengers). There are also a few big-sized vessels that have modern facilities to carry about 5,000 passengers. Every day this river port is handling around 40,000-50,000 passengers arriving from 17 southern districts. There are also 8 ferry *ghats* around this terminal which are mainly used for the passengers crossing the river from other side. Facilities for nearly 250 cars' parking are now available on the eastern side of the terminal building of Sadarghat river port and parking facilities for other 250 cars are being developed. Due to narrow roads and existing chaotic traffic conditions a very few buses can go up to Sadarghat terminal; hence, some buses go up to Bahadurshah Park which is about 500-600 m away from the port. Due to absence of appropriate and adequate public transport facilities, passengers are bound to use different para-transits (e.g. rickshaws, auto/CNG, human haulers) as an access or egress leg for their trips to and from Sadarghat (ALG, 2011a).

D.2.3 Policies on NMT and IMs in Dhaka City

The main policy features towards rickshaws:

- To reduce the number of rickshaws and the modal share of rickshaws;
- To ban the use of rickshaws progressively on all the major roads;

- To segregate rickshaws from motorised vehicles on the main roads or where possible to provide service roads or special lanes for NMVs by the side of national highways; and
- To restrict operating of rickshaws only as a ‘feeder mode’ or in the neighborhoods/suburbs.

An experimental project is being undertaken through the Clean Air and Sustainable Environment (CASE) project to introduce separate rickshaw lanes on some important city roads (i.e. New Eskaton Road, Outer Circular Road, Khilgaon to Bangabandhu Avenue).

Policies towards auto-rickshaws:

- To ban auto-rickshaws progressively on the major arterial roads;
- To encourage its use only as a feeder mode to bus and rail; and
- Ultimately to phase out auto-rickshaws.

Policies towards pedestrians:

- To supply footways and pedestrian facilities (i.e. safer at-grade crossing);
- To enforce traffic regulations as signal-controlled pedestrian crossings; and
- To launch children’s road safety program.

Policies related to multi-modal integrated transport:

- To encourage physical integration between all modes (including rail and water);
- To develop a better modal interchange facilities with modern and improved passenger facilities;
- To establish a mechanism of financing and coordination of activities between agencies for aiding multi-modal schemes; and
- To encourage construction and operation of parking facilities.

D.2.4 Easybike

Figure D3: Easybike operating between Mirpur 10 and Parish Road

Appendix E
Pre-determined Fare for Rickshaws

E.1 Sample Fare Chart in Gazipur Municipality

জয়দেবপুর মুক্তমঞ্চের সম্মুখ হইতে পৌর এলাকার বিভিন্ন স্থানে
রিক্সা ভাড়ার তালিকা নিম্নরূপ ঃ

ক্রঃনং	নির্ধারিত স্থান	নির্ধারিত ভাড়া	ক্রঃনং	নির্ধারিত স্থান	নির্ধারিত ভাড়া
০১.	শান্তি পল্লী	৫.০০	৪৭.	সানঘাটা ব্রীজ	১৫.০০
০২.	পৌর ভবন	৫.০০	৪৮.	উত্তর ছায়াবীথি/শশ্মান ঘাট	৮.০০
০৩.	ছোট দেওড়া স্কুল	১০.০০	৪৯.	পূর্ব ভুরুলিয়া প্রাঃ বিদ্যালয়	১০.০০
০৪.	সায়রুপুর	১২.০০	৫০.	পূর্ব ভুরুলিয়া ব্রীজ	১২.০০
০৫.	তরুণপাড়া	১৫.০০	৫১.	মহিলা ঘাট	১৮.০০
০৬.	ধীরাশ্রম রেল ষ্টেশন	২০.০০	৫২.	রাজবাড়ী পানির ট্যাংকী	৬.০০
০৭.	কাশিম খান	২৫.০০	৫৩.	কালাই শিকদার ঘাট	৮.০০
০৮.	রথখোলা	৫.০০	৫৪.	ভুরুলিয়া তরুবীথি স্কুল	১০.০০
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বিঃ দ্রঃ- অভিযোগ থাকলে যোগাযোগ করুন।
মোবাইল ঃ ০১৭১১-৫৮৬৫২৯, ০১৮২০-০৭৫৮৯৭, ০১৭১১-৪৮৯৫১৮

মেয়র (ভারপ্রাপ্ত)
গাজীপুর পৌরসভা, গাজীপুর।

Appendix F

Regulatory and Information Signs and Symbols

Appendix G
Sample Transcribed Data from FGD

G1. Kakoli-Banani Location: FGD of Middle-Income Men-only Group

Date and Time: 30 November 2011 (03:00pm – 05:00pm)

Participants:

F – Facilitator Mr Shafiq
1 - Businesses (from Left in the photo): Mr Zakir
2 - Private Job: Mr Shahin
3 - Government Job: Mr Makit
4 - Elder Person: Mr ABdullah
5 - Private Job: Mr Maruf
6 - Student: Student of City University

F: Introduction & brief explanation about BRT and showing some photographs.

Usage of rickshaw and BRT

F: What is frequency of bus use? What will be frequency of BRT use?

1: Actually, just if we go out of home there comes necessity of a bus. Which is, if we just go out of the allay street then bus, we are like us, usually travel on bu. Beside this there is no other alternatives of bus here for us.

F: We just need to tell the average number for a week.

2: He is in business, so it may be for him…… Like me, I am in job; I do come everyday morning and return again afternoon. Office is five days and everyday 2 times, 10-12 times per week. Sometimes may go out in weekends.

3: For me also 10-12 times per week.

4: For me also it becomes 12 times in a week, office is for 6 days.

5: It becomes 10-12 times per week when there is duty at university, usually 6 days; in fact, while coming often does walk – not always take bus. I fall in huge jam from Natun Bazar. About 5 to 6 times in a week.

6: For me, actually it depends on my class; as I had 6 classes in this semester, one was on Friday, in this count I had to come 8 days, 8 times in a week.

1: I have to come all the 7 days of week; if use direct route of Bengal Paribahan, 2 times, up & down, and if take different route then have to walk and then need to take transport. Minum 14 times in a week.

F: We have seen the BRT systems, special type and improved service. Now you discuss if this is in place, your frequency of uses bus will be same or may increase?

5: No, that will increase, certainly, yes.

6: When I come to Uni from home, there are 2 routes- one bus come under the flyover at Mohakhali and other comes over the flyover. There is BRTC bus in front of our uni, stoppage there; and there is another vehicle which is bit smaller, Grameen. So, I feel better to ride on BRTC, but it does not come frequently, makes huge delay, possibly it is found that it is coming at 15-20 min interval- came 2 bus together Or again not coming for the last 50 min or 1 hour; so, for this reason I do prefer Grameen. Small vehicle, not comfortable but it comes quickly.

F: Will increase the frequency of travel on BRT or remain same as in bus now?

6: Obviously it could increase. Because, here, it mainly depends on the service. Now, if here the thing what is happening for me, um, one transport, cannot depend, not reliable because it does not come time to time – sometimes coming earlier or late. So, we use variable transport vehicles. But if it comes frequently or available always then we will try on that, .. means, will increase.

5: No, the frequency will increase certainly if the quality of service is better. This BRT service seems better, however, if we get more updates..

1: If there in BRT, probably their frequency of use will increase; because our own few mentality and behavior, coz, you will not able to make available the stations where I need to get off. As I want instead of getting of at Mohakhali, and before reaching at Kakoli, I will get off in the middle. For this, that 3rd class buses, which I am meaning, will use and pay less and get off at the exact point where I want to. This tendency is very high on us and we do practice this for various reasons. And, this modern bus or special bus, it’s fare might be higher compared with those; and the intervals between stations will be more. If I want to alight here but have to get off 1 mile further ahead, so, I’l try to board on such from where I could jump off for alighting in from of my shop.

2: My opinion is that, this system, actually, will increase. Many passengers I observe, while coming from my home, I do ride bus, people thinks about alternative ways when they are unable to board in a bus. Travel on various modes, and spend money also. Ya? People want to pay even more to reach on time. And, start the journey well in advance. If this system comes, it will be possible to arrive on specified time. There will be no congestion. Saving their time, money, everything is their subidha (convenient). Whatever, very good.

3: Will increase, indeed. Such as, let me tell about myself- on 2 days of weekends usually ride on bus very less, so, I think I’l go out those days. If I feel free and space is wide, certainly I’l ride on bus.

4: The frequency will not increase for me due to my occupational reason. Nevertheless, if get better services during off days, what other modes are using now, may be…

2: I have a question regarding this. In this system, the bus is going fast and stopping at stoppages. But, at the signal points, the intersections, this will go through overpass or will stop?

F: What is frequency of rickshaw use? Do you use rickshaw to arrive bus stoppage? Will use rickshaw to/from BRT station?

2: Ok, let me say; rickshaws, ya, almost regular days I ride, ya, daily 2 times. But, now sometimes don’t use rickshaw. Go on foot. If take rickshaws- become stuck at jams, again fare is Tk 10 if you just get in. Fare has increased, again can’t reach on time. The days, when I am free such as on Friday going from market along with goods, going slow and steady. When want to go on time, going for bus and for that small distance go on foot instead of taking a rickshaw.

3: Around 3-4 times in a week, usually ride on rickshaw.

5: Rickshaws, but not willing (echha hoy na) to ride on rickshaw, for most of the time get sttucked on traffic congestions. The destination for about 5 minutes where needed to go, if have to pay Tk 10 then it is better rather walking, feel more convenient (subidha) comfort.

1: Ride on rickshaws. For my shopping, almost every day, for going Kachukhet Market 2 times have to do up-down. And for a short distance give a high fare. Many times go on food but while coming back it is not possible.

6: Actually, almost it does not happen for me that I am riding rickshaws. Because, my communication is very good; from Sewra Para to my university can travel directly by bus.

F: Do you use rickshaws to reach at bus station or vice-versa?

6: Shaking head (no, no).

5: It happens for me; sometimes have to go to Airport for different work. That case mostly take counter bus service. Use rickshaws after alighting from bus.

4: It doesn’t happen; location of my house is very close to bus station.

3: Me, 2 days, maximum. Because of tiredness, while returning home and do some shopping after alighting from the bus, that time, just.

2: For me, that, when I start from home to go office, to reach on time in office, almost everyday use rickshaw. But, while returning, I am free and that time don’t ride rickshaw.

1: Me also same position, if sometimes it becomes late. Me, as I told, I need Tk 15 to come from the bus station, furthermore, sometimes take a rickshaw but while going often just go on foot.

F: Will you use rickshaw or walk to/from BRT station?

3: Good bus, basically, I do ride on rickshaws about 2 days; while travelling on bus had to get inside after a struggle/fighting ha ha ya so sometimes feel tired and if there is such facilities available, I think, will not feel tired like that. Hu hu.

6: My case, I had opportunity to visit, from there what I observed that from that place going is bit easy but returning is troublesome. There I have to go with multiple shorter trips; instead if it would direct I could go through. For this reason, I am thinking about using motorcycle.

F: Requirements for rickshaw to serve as feeder service of BRT

F: Overpass or crossing at grade?

3: To use zebra-crossing, that ……

4: This, in my opinion, this climbing stairs up, than this which I prefer is we observed before in Dhaka that is zebra crossing. There is stoppage and we could cross the road through zebra crossing. I don't like do go down or up to cross the road. Ya, it is tiring (kosto) painful, my age is more, and takes more time.

2: Escalator, if it is there then more people could use. Done. In such case time will also required less compare to stairs.

4: If it is, then also ok. Time in zebra crossing will require very less.

6: Having the zebra crossing means, this will create obstacle for moving buses etc on road. There is another fact, there will be another chaos and also fact of accidents, so this will be either over or under the road.

1: I am also agreeing with the brother. If needed to walk, special bus should have a special track, but beside other lanes there will be other vehicles moving. When I'l cross through the zebra crossing, that time these vehicles should be stopped. For this, the speed, ya, will be disrupted. These facilities – probably becoming ya for our physical convenience subidha (convenient), ha ha, so going through underpass or overpass.

3: Me also same, actually, the zebra crossing, there exists the risks. So, to avoid that.

5: Even if it takes little bit more time, I think, using over-bridge would be better. The student, what he mentioned, I agree with that.

1: This special bus you are talking, ya, for the simple bus provided by counter service, sometimes it is observed that 500 people are waiting, to get into a bus; so, if those people go to enter through the zebra crossing, then the traffic congestion will create there. Oh ya, painful, yeas, this is for me and for him also, but you want to make the journey smooth…

2: No, the service, if want to avail the service and get the better service, then people will go there even if there is pain (kosto) pain to go. The zebra crossing, those existing foot over-bridges, people are crossing behind those with taking risks but not climbing up; because it takes more time and tiring. For this, small distance, just to come in the middle of road. For crossing such a small space, people will not go up, they will just walk across the road.

1: If you want to do this, then, the total road should be in such that there is no option for crossing at grade - the road should be build like that. Because, in maximum over bridges, people, as well as me also had crossed at grade along with the mob within the vehicle crowds. But, if you go in Kachukhet Cantonment over-bridge, will they permit you? You will not be allowed. The army will send you back and ask to go over this. That one, we all are crossing following the discipline; but, here I have two over-bridges but I didn't go over it and in the middle within the crowded (vir) I am taking risks and crossing the road. Risks. If needed to go either up or down, have to climb the stairs, no other way.

F: Possible for convenient but safe?

4: No, that's not happening. Signaling, the system, used to see in many places before, the traffic signals light.

F: People are not following the system in many places.

4: That is also right. We need to bring changes in our character or behavior. Should be changed our habits.

6: Actually, not necessary to bring changes. It is more environment related. If the environment is changed, people will change automatically.

4: My behavior should be changed.

6: If a Bangladeshi goes to USA, (s)he obviously will use over pass or the signal light to cross the road. Here should have the system. The legal arrangements should have stronger. No way to go at grade.

F: That means the system should be such that only option to cross through over-bridge and nobody is allowed to cross at grade or when the lights in signal are on for pedestrian crossing and other times nobody should be allowed to cross.

1: Yes, yes.

2: No, if the service, the car system- bus service, is better then I will do little kosto (pain) to get the benefits. Ya, now if I try to cross the road with flyover or signals, I am in trouble/pain kosto (pain) but not receiving any other benefits. If going the normal way or going over, getting the same subidha (convenient). But, there will be going to take the service, so, people will go over.

Another one think let me tell, we are going to the middle of road for boarding in the bus, not going from this side to other side of road. We are going just half way of road width to board in bus, there should be such a system that people can go there only by using that or that stairs, something like this. There is no other alternative to reach there directly, so we must have to use.

F: But if it happens that nobody is going there for catching BRT?

6: No, for getting the services, have to go there for bus.

2: There are many passengers for bus, many people wants better services with less money. But we are not getting. Not even with paying more money. Such as, the counter systems taking huge money till many people travel hanging way, so much crowded. And, for these, at the stoppage, if there is no way/possibility to enter in the station from behind, then people will come through overpass.

4: Not with less money, paying more money but not getting better services on bus. In that counter buses have to travel in a overcrowded situation.

F: With this we have to think about elder people how to climb stares.

2: Ya, so that can go up and down with the stares, for this, if possible to arrange the moving stares (escalators), better.

F: Comfortable walking distance and walking time for change?

2: In my opinion, it is 1 km. If it is more than a km, say 2 km, then I need another mode. If it is within 1 km, I'l go on foot.

F: Usually you will walk up to 1 km, but how long for interchanges?

5: Actually, this will depend on road. Me, when I come from Banani to to Kakoli to catch a bus, we can't come to Kakoli by a rickshaw. Here, when it is a little further before Kakoli, the rickshaws are dropping off, that portion of rod must be walked. 3 to 4 minutes. (200-300 m) Normal, just the time required for crossing the over-bridge from one side to other for catching the bus, if it is more than that..

4: Should not be (uchit na) more than 200 m. If I go on bus and want comfortable journey, wouldn't walk more than 2-3

5: 3 t0 4 minutes. minutes.

3: Um, within 1 km would be ok. Our weather is such that after walking 1 km, the body, um, maximum become fade up, not want to suit any more, like this. Anyway, within 1 km will be ok.

1: After alighting from the bus or to go to bus, within 200 m is good; however, further that if think needed to come than within 1 km is enough.

6: Another one thing I wanted to say, as there is bus station then obviously there will be rickshaws also. And, another information is, 5 to 10 years from now, there will be no more rickshaws; instead there will be battery-driven rickshaws.

F: Safe and secure changes between rickshaw and BRT for the users?

3: To have separate footpath, good, certainly. Me, oriented, what we will say- where one direction will go and other direction will come. It's two-way.

F: How wide needed for that?

2: Footpath generally is about 8 feet wide. But, we will go from bus to rickshaws or from rickshaws to other modes, up to that path, in the narrow streets if it is taken 6ft and 6ft for footpaths, there will not more space available for vehicles. So, our existing roads, their width, the possible normal footpaths that could be done; more than that to provide, I mean, there is no system here.

6: From me, which is; first is, the probonota (convention) of churi (steal) and chintai (hoodlum) is due to hawkers in footpaths. This incidence happens more in the crowded situation. Hawakers should not sit in footpaths, so, it will be clean. Another thing is the camera system; should have webcam controlled centrally, like in other countries been used. Up to that road who will go will be able to see on that.

4: Yes, that is certainly, footpaths; not rationale uchit (logical) to have, otherwise will become vir (crowded). The number two is lighting at night, that should be arranged.

1: Bus stoppage, the place where will be constructed bus stoppage, in that place only the bus passengers can have obade (seemless) access; not any hawkers or rickshaws and vans etc can create jotla (congestion) - if these are not done, easily anybody could do up and down. It is such that I am not able to get down; the rickshaws are standing in front of my door or another sealing the peanuts badam (penuts), or another trying to get inside the bus carrying a bag (a hawker), I am not able to alight. Where there will be the stoppage, there these type of things should be totally stopped. The bus where it will stop, that place should be used only by the up & down passengers of the bus.

5: Enough light should be provided at night. Chintai (hoodlum) at night happens mostly because of this reason; during the dark, for various reasons. When we cross through the over-bridge, at night, there is no provision of lights. In such case, even on over-bridge we also chintaikarir kobole pori (affected by hoodlums). In this case, the provision of light should be given priority.

2: Regarding the safe and security, our the police personnel - not necessary to be deployed in the roads, but if they keep their normal activities then these incidents will reduce

Facilities (or services) needed at BRT station?

2: Well, at station, as it is not the station of highway; here seating or resting is not jorori (emergency) necessary but to have a toilet is jorori (emergency) important. Toilet is important, and the information also. If it is a larger size station, to have highlighted where to go or having the ticket counter, ya, these things should be.

4: More or less if these things are provided, its OK and the shade, shade should be better so that people get protection from the sun, rain, and storms. As you are providing a good, nice bus, this should also be clean.

3: Cleanliness.

5: Another one thing, we throw garbage on the footpaths. What DCC is doing, there should be some specified points for garbage disposal and not beside the footpaths- this also may create better for our travelling.

F: Shade, only in station or the path of interchange area between rickshaw and BRT?

2: No, for that path it is not necessary. But, if it is underpass then not required but if overpass it will require a shade. It is better to have the transparent shade.

6: If it is transparent, this will not able to protect sun heat and cause problem.

2: This is matter of short time, transparent shade would be better. If it is non-transparent, there might be some other problems.

F: Possibility of pre-determined (fixed) fare for rickshaw?

5: In different roads, usually the fare is determined; however, sometimes if it rains or the road is cut/whole the pullers try to charge more. In such case, probably we don't want to give or if want to give little, can't.

F: Is it necessary to have a pre-determined fare for rickshaw?

2: This is that, our babytaxi and cab, ya CNG, they have meters. Having this, we are not able to travel on meters. And the rickshaws, they are more…hu… to give them meter or travel using meter, now there are few rickshaws are available with battery, ya, very good, pullers labor required very less and goes very fast. In future, the rickshaws might be transforming like these. If so, then the meter also could be used, ya, like auto-rickshaws. If use the meter, we can't implement it immediately; which is joruri (emergency)- the CNG, auto-rickshaw and cab, ya, they never goes with meter.

F: The cab is not happening because of private drivers. Passengers want. What is opinion of rickshaw passengers about fixed fare?

6: Yes, this is uchit (logical) should be. Would be better, there will be no more bargain.

4: Would be known for what distance, from here to that place and from that place to another location how much is fare.

2: They ask fare according to their wish.

3: If it happens, it would be better because in our DOHS few such options are observed like that if goes with this area then fare is this much and beyond that rod would be more and nobody asks more than that. And nobody also gives, so there is no bargaining.

4: Once upon a time, there was, in Dhaka also, from Gulistan to Sadarghat rickshaw fare was Tk 2 and nobody asked more than that; passengers also had no problem.

1: Absolutely we want the determined fare. And another thing, that, if any passenger asks will you go to that location he should have say that I'l go. He is seating and seating with raised his legs on rickshaw; will you go- no, will not go; will you go – no, will not go. Where shall go?

4: This is another problem, does not want to go all the places or always.

F: Why you are saying that needed for determined fare?

2: This, one thing is, he asks for fare according to his wish. Such as, before I used to come bus station from home with fare of Tk 5. That fare, due to rise of jinis potro (goods) price, told Tk 8, Tk 10; now even if just get in asks for TK 15. And, will ask for Tk 20 during the office time. Normally comes with TK 10, don't bargain. When see it is 9 am, if you ask 'will you go' - Tk 20; 'will you go' means Tk 20. Increases.

4: He increases it according to his wish.

5: If the fare is determined, they will not be able to increase according to his wish.

3: Economics does not say that; when demand will increase price will drop.

2: If demand increases, price will also increase and supply will also increase. Now, according to our demand how many rickshaws are available, rickshaws, it's number, but, it is good if this things are available more; travelling with bargaining.

1: No, this thing, assume that sufficient number of rickshaws are available and passengers also. As it was said, when it becomes 9 AM, what is reason behind this? They also have few times- if they can earn enough money within a short time, than they sent rest of the time seating and taking rests; no problem.

4: As it was mentioned, 'will not go' because he had earned the mony in the peak hours and now he can do without going/working.

6: There could be such a system that a fare rate for peak hours and another rate for off-peak hours.

F: Then another question will come up- which times are peak hours.

4: Yes, there will be the questions.

2: Such as, once I went to Rajshahi. After arrival there, in bus station rickshaw pullers are seating. 'How much is the fare?', not going with trip. Why? We are, this number of rickshaws, enlisted with the city corporation and serving between 12 midnight and 6 am, during this off-peak time instead of sleeping we provide services. There is logic in their talk. I could not walk, so started carrying me.

F: How it would be possible?

1: On road, you, if 2 CNG says 'no, I'l not go'; if I tell to the people of law, it's written in his car's body if anybody disagree to go then call on this number. Who wants to contact to that number, its not known, ya? At least, can tell to person of law enforcement that by force he should go. As he is riding the vehicle of city corporation, permitted by city corporation, he must go with the meter. This could be done with the help of law enforced people.

F: One is saying about law and enforcement. But do you think that it would be possible to obliged everything by enacting laws?

1: Why, your, if the car is fined Tk 20 for cross that road, if I am fined Tk 50 for my thutu (spittle pick) here, then automatic will be better. If I do something against the law, and if immediately the law enforcement authority takes against that, he will become good automatic.

2: Well, for rickshaws, about fixing that fare; if meter is placed on the battery driven rickshaws- that would be more convenient subidha (convenient).

F: We are talking about normal human-pulled cycle-rickshaws.

2: If it is with wheel, possible metering- in CNG require fuel but here not necessary fuel but need human labor, so considering with labor and distance…so,

5: The discussion about law, actually, we follow the law only for the initial 2-3 days when it is enacted. After that, we ignore. For example, while driving motorcycle using the helmet; initial 3-4 days it worked but after that nobody is using.

1: Now look during any police week, complete neat and clean.

5: Now, if the police did follow this- the helmet, ya. If become alert little bit, but, many things happen.

1: There is coming about law and law enforcement. Will give example from abroad. The system in abroad, the line mark, if somehow you cross the line at signal there will be fine, generate fine computerized, ya, and here you will go violating the law without hesitation and nothing will happen for you.

F: Any other comments about fare?

2: In my opinion, the fare of rickshaw has become, a, our culture, ya, to determine this; doing bargain, if the living standard of people increase than rickshaw fare may also increase, ya. If there is inflation mulla sphethi (inflation), the rate will increase must, hu. And, this to make fix, which one should be done - we are not able doing that.

F: Signs and signals for improving access and traffic flow

F: Existing signs

3: Let me tell one, there are indications, the directions, but less. Traffic signals, those things- lights.

2: Hurn, surrounding areas of hospital it is found that blowing horn is nesed (not allowed).

4: Left turn, ya, indication of left-turn. These are, normally see; left-turn,

1: On the road, there are speed-breakers. Before this, there is given a symbol. For the pedestrian crossing, this speed-breaker may be given slightly angle.

3: Zebra-crossing also can be found.

4: Speed limit, in many space of road it is mentioned that limited speed. Which is speed control, that is.

3: Hospital, um

1: Hospital, school, etc

4: Road sign, at Mogbazar this direction that thing, etc. Location sign, ya information.

2: Bus stoppage

1: Here bus stoppage, 10 rickshaws could stand here.

4: Speed of the vehicle, rail crossing.

F: Knowledge about the existing signs

2: The educated, almost everybody knows. Those who lives in slums or lower level they don’t kheil (notice) these.

1: They neither notice nor understand.

5: In that case, that, we have many media; in that media if sometimes the traffic things or symbols are shown, then it may be happen.

1: Pedestrians or the passengers, there are many who may not know but those are related with vehicles or transport they know. Ya? Say the rickshaw pullers, say the baby-taxi drivers, ya, they understand the indication.

2: In our country who drivers, ya, who drive car or tempo or rickshaw; many of them don’t understand anything, even don’t know.

5: Sometimes in TV there should have some programs on these.

2: And the rickshaw puller, pullers are from the villages the farmer class and come here, now work and come, they tell bring me showing the way to destination and give the fare whatever you want to give. ya.

4: In general, the bus drivers bujhe (understand/know) better, those drive cars.

1: This happens due to they travel continuously in a same route, they become used to and understand about it.

F: What signs, signals, symbols, road marking needed at Interchange Area

6: This could be if get in a bus here, where could be gone by bus from this place.

1: In which locations; if I board from here, in which areas could be gone. Me, if I board here, Mohakhali, then to which areas I can go.

5: Written, but if given as map that would also be better.

1: Map would not be understandable; Or at the counter this should be thrown in ticket system, that, if purchase this ticket could be gone to those places by this ticket.

2: One is to indicate at bus stop that the buses are going on this routs. From bus stops, within 1 km, where I am alighting, at those areas could be indicated that BRT station is there – this far is BRT from here. If give in 4 points or 5 points, from there it could be seen that BRT is that far.

F: Should these be in writing or symbol?

2: BRT, could be a sign of BRT. So that, the illiterate people can understand the sign, or could have both writing and symbol.

5: Ya, this will be ok if these types of signs are available.

1: The stoppage, that for doing…ya, I think, from where I'l take the bus myself would be obvosto (used to) familiar that how far is the station. Shall I go to other side of Kallyanpur or towards the Bangla College to get the closest one.

5: We, but we know within short distance, that is.

4: The destinations, to which places could be gone, that is. Important.

F: Discussion about the design prepared for BRT station

2: Two in different two directions.

7.2. Discussion about the design prepared for BRT station.

1: This, this the station (showing in model, 01:39m@V2) - in this, why will you not provide in both sides for going and coming in same station? Will be no problem for this, just the two will pass in two different sides, and, this will happen.

F: Possibly will have 2 problems. Buses going towards Uttara

1: Bus going towards Uttara, it's gate will be in opposite side.

F: Would not be required to stop twice. What is happening now- buses stopping at signal and again for boarding passengers.

1: This signal, you have thousands of signals, ya. Signal, one ya, it's not a matter. My distance from here to there (showing in model) is long, my, for me if I come out from here to go towards there and go that place, so my distance, this, becomes longer. Ya. So, if I want to come here (showing in model), whatever in the direction I do move, if I can board from here it's convenient for me. And those people of that side (showing in model), if they comes, if given in both sides

F: I understand what you saying, but there is not enough space to accommodate both directions in a same station.

2: Now, the space is not enough; to this direction when it will go there is one signal. Vehicles stopped in this signal (showing in model) and gone again vehicles stops in that signal and gone through.

1: The car is coming one-way (showing in model); this is stop in that place as well as in this place.

2: No, this not like, won't stop this here. This will just pass away this, will not halt here. Will not stop, alight passengers before.

3: This will just go.

1: Means, because of this. Why? My, in my this signal any other vehicles are not entering. Not any other vehicles are entering in my this (showing in model) route.

2: Will not be fall in the signal due to the vehicles in the next lanes? This signal, I have crossed this signal and went that direction, ya. Means, when you were in this signal, you could do that job is done.

F: It may not happen that someone came from Farmgate to this station and again catch bus from this stop to go back Farmgate.

2: Even if such happen for 1 or 2 incidents, after crossing they could do it from here.

1: This, this is just unnecessary. Nevertheless, this has a distance. A long distance.

F: Now discuss one by one from beginning.

F: About pedestrian crossing.

2: In overpass the distance becoming very long. Hu.

1: The total, you could walk towards there on overpass and could go down either this or that station, ya. So, all the general pedestrians also who are not the passengers, will also use it.

5: Everyone would be able to use.

1: This, when all the pedestrians, who are not passengers, will use this to cross the road from that point to here (showing in model) – this is not becoming beneficiary only for the passengers.

3: Ya, this will become common.

F: That means you people not want that?

3: Ya, certainly.

1: No, want that. This type of system is already in place. But, when you, you will not be able to do a thing in such a huge; for that how much support can you give that the whole people will use? When all the people will start using this, this will behato (hamper) the passengers- would not be able to use any more, would be asubidha (problematic). If you go to do it for their convenience, if you start to do like that over bridge, then, your, this would be a huge matter. Now, in which way to do is your idea, no, that is along with our work lets the public also getting some subidha (convenience) benefits.

4: They will take some benefits; you wouldn't able to stop this.

F: How the bus passengers will cross road to reach in BRT Station?

6: Over pass is better. Even if under pass is constructed, there is a matter of ventilation. If it is over pass- this will be open, could see, transparent, and the safety indeed exists. And better not to use zebra crossing; because if zebra crossing is used, then, the other vehicles should have to stop.

3: Here one thing could be done. Hu, those who are in this lane, hu, as it is modern technology, so, there is a punching system, there a gat; who will go there they- a card, after punching.

F: That means, you are saying that only the passengers having ticket will go to the station?

3: Ya.

2: The zebra crossing, it requires many obligations; such as the vehicles should be stopped, fear of accidents. If it is over pass, it was found that you are going like foot path just over. But, what this is happening, the buildings, ya, the roads, footpaths we have in our country, these are very narrow. There large portions of space are becoming wastage. Then, if I can do underpass within a limited space, if provided wide, people could cross the rod through underpass but there should have a gate from underpass towards the bus station. There, who will enter through the gate, they will give the card. Otherwise, this straight other people could cross and pass. Not everybody will be able to go up at the bus station, only those having bus card they would be able to go.

F: Another thing, for overpass stairs is about 20 and for underpass it is about 10, overpass is more height.

2: For underpass, its half height than overpass. Kosto (pain) is less and can be done within a limited space.

4: These are ok.

6: For underpass, that is, to construct it takes more time. And here, what it is existing, if provided just the steel plate, this will work.

1: Now, among these two, which is, under pass..

4: If given sloping, it (showing in model) could be possible to use steel plate; but concrete, that is.

2: Concrete, and taking longer time, becoming wastage of time and space. We don't have enough road space.

6: If underpass is given, we will not be able straight to board from Kakoli, we have to come from the side; and if coming from other side, 2: Footpath is available here (showing in model), we should have come through footpaths, means, must use footpaths.

F: Comfortable walking distance.

2: Coming from the end of Kakoli, but this distance is becoming far.

5: This distance is becoming longer.

1: This is from 11, becoming far. From 11, you, if this, from here will move to this direction. This will move there. From Kakoli to that point, distance is becoming more.

2: This is Kakoli (showing in model) and this is Mohakhali?

F: No, Mohakhali is further ahead. Kakoli is further there, this is Road 11.

2: Well, from Road 11, this distance people will be able to go on foot. If our…

1: For us, not Kakoli, after crossing Kakoli it is going further back.

3: Here should get off from rickshaw instead of that place.

5: Not getting here, in this road, here (showing in model) and then

4: For this (showing in model) road, they should get off here.

2: This system is for subidha (convenience). For getting subidha (convenience) people will do little kosto (pain).

5: Will do little kosto (pain).

F: Existing footpath is narrow and trees, hawkers. What do you want to do?

2: This is (showing in model) one subject, from getting off rickshaw and to go until the bus stoppage, this footpath should be bit wider and clear.

5: Nothing should be allowed there.

F: Wider means, how much wide?

2: Width, in our country it is about 8 ft.

5: 6 to 8 feet.

F: Existing width here is

4: No, the width of existing footpath is enough. Only, this area if it is cleared, it would be ok.

1: Hawakers, or any type congestion, rickshaw or van, or any.

5: That I told, at night, there should have enough light.

4: As long as it is clear, then ok.

1: Your station, there would be stands for the local vehicles also? They will be using there also, so they will do, ya, aa. That, passengers, except them, none should be accessible.

F: The rickshaws waiting and standing now here, want same thing or any special arrangements?

2: If the rickshaw stands at the corner, it creates beghat (problem) for moving other vehicles. This should be placed little bit far, slightly far from the corner, and in straight queue. That one not with another one.

F: How far from the corner?

2: The space required for moving the vehicles. Often it happens that the rickshaws are standing at the corner and create congestion that there is no space left for moving other vehicles.

F: That means one building or 10-15 ft far.

2: Yes, 10-15 ft.

4: About 20 ft away.

5: 50 meter.

F: Rickshaws should stay in a serial?

2: Yeas, in the serial.

1: Who comes first, will get serial first and he will go first; in a serial wise.

2: The road is small, narrow, so it would not be possible to create a stand here.

4: The road should be widening little bit more.

2: Ya, so, this should be managed within this space, should have sharing.

4: You can’t do widening the road.

F: The rickshaws waiting in different sides, these should be allowed to move in both sides or just in a side?

5: No, if you allow crossing the rickshaws, certainly there will be problems of congestions.

4: No, let they serve them in this area (showing in model) and those in that area.

1: You will not be able to control the rickshaws. Control, what it is, if you try to provide one stand there and another here to control, even that will not be possible by you. This is going to another, ya, subject.

2: If you give the divider,

1: It is for their interest, the rickshaws of other side should stay in there area only. They should go back from the side from where they came.

5: Ya, when a rickshaw wants to go from this side (showing in model) to other side, it may fall in an accident at any time, any time. That case, it would be better not to go.

1: Now, for this purpose if I start from the beginning, from that point of back, these systems should be built from that place also. Not follow a little bit, so, it's not like that, that will provide them this. He will be brought under the system. When I come out from home, there are many problems.

2: No, with the availability of BRT, the number of cars will be reduced. Will reduce sharply, now there is many cars. Many people will switch to BRT. The road is reducing here (showing in model), ya, passengers are doing kosto (pain) here, and again if he has to drop the rickshaw there and again has to board in rickshaw here, ya, then, here the rickshaws in a line..

1: This, here, you are taking off a special, ya, taking. But, you have to advice more for getting government's help. Such as, at lane, the rickshaw is standing in front of the bus! The bus comes behind the rickshaw.

2: No, in this road rickshaws will not come at all.

1: Not that, on the other paser (neighbor/next) lanes, general road. They also should follow the lane, such as, the high speed buses should run in one lane, local buses and rickshaws should run in one lane.

F: What facilities at station?

1: Having a toilet is shavabik (normal), should have a shade

5: Passenger shade.

4: If it rains

1: Shade so that 2-4 minutes whatever needed to wait for 5-10 minutes, it is raining or after alighting from bus staying in shade, this should have. Enough, more than that?

2: Ticket counters. If there is ticketing systems, what I am saying, the passengers will enter there punching their tickets here.

F: That means, you want the ticket checking before the passengers shade so that except the passengers other people don't have access?

2: Yes, ticket check to keep before the passenger shade of BRT. There, means, for seating and standing of the passengers, and having the shade, and arrangement for having a toilet.

4: There should not be any other gatherings. Only the passengers who will travel.

F: Frequency of bus will be high, so may not very essential for having seating arrangements?

1: In all stations toilet is not necessary. Not all the buses will go to the all routes.

2: Not necessary toilets in all the stations. The station which is bigger, there could be a toilet.

F: How about Kakoli station, want a toilet?

4: Kakoli is a main station.

2: Kakoli is a main station. A toilet should be given in this station.

3: Security will be needed.

5: Even if not provided security for 24 hours, particularly at night should have.

6: For security, guard, if one or 2 person are there it would be ok.

1: Why again about security in this? Because, as the system is becoming different; I am going the, entering after paying more money to get better service, the chintaikari (hoodlum) may not go there inside. He will not be able to go inside, if want to go, he should become a passenger also.

2: No, there is already a counter and there will be people at counter.

F: Fare integration in this area?

1: Fare determining, this from local government, responsible commissioner. Through the Commissioner, it is, from this corner up to that road is Tk 10 and if go further that road than, something like, they could do. It's like determining the area or block, from this intersection of rod up to that more e (intersection). These fares could be done locally through the city corporation. Because, each commissioner is well aware about his area and he can seat to appoint local people or representatives. It's like in our locality this is the standard, so we have determined the rickshaw fare in this rate. If required, at the corner points the rate of rickshaws could also be given.

5: Local people could do. Even if public are not managed, if there is given 2, one this side (showing in model) and other in opposite side, then it will be ok about the rates in two sides.

1: Then if the rickshaw pullers come to pull rickshaws in this locality, he will understand that fare in this area is determined and fare is this, he will not be able to take more than that. And me also, after arriving at home I'l go away paying him TK 5 less, this will also be an issue of my prestige.

3: Rickshaw pullers will not able to take more or passengers to give less.

2: What is my opinion, fare of rickshaws not necessary to be fixed. We have been so many years, possibly, our culture is such type. Out of 100 may be incidents of problem happens jut for 2 or 3.

1: But, have you seen that few rickshaw puller do very miss-behave with the female passengers, they are osohay (no hope). Ya? They do mis-behave and demand for un due higher fare. With this, arguments. If they would do like this with me, slowly I could tell the young boys of my neighborhood and then he will ultabe (reverse) the rickshaw, ya, he will be thik (right) taught. But, you will not be able to do that. The young brothers, who I have, if I tell them give him 2 slabs, before telling they will hit him, ya. He will be straight to me, but the problem is if a gentle lady comes, if he takes Tk 10 from me but got Tk 20 from that lady, and she felt ashamed and gave the money, and entered in my house, ya, this can't be.

2: Well, understood. Rickshaw fare, is, to do fixed. And, we, that taxi cab and CNG, those can't be followed even after given a fixed fare, ya? And, this is within a small scale matter. So.

F: Sign and Symbols - what type and where?

3: At the starting (showing in model), we can say, which direction could be gone from where. Marking of directions.

F: Directions? Should be symbol or text?

3: Both should be there.

1: With giving arrow symbol, you can write that BRT.

2: And at the stoppage, these should be mentioned that the vehicle is going in which direction and how far.

1: Which number vehicle will go to which direction?

3: All types of few safety aspects. The cautions could be given- where should not go, the aspects of parapar (crossing) and travel.

1: Or you could provide slight announcement.

2: Announcement.

1: Announcing that this number of vehicle is going to that direction, you board on that.

F: Which would be better- announcing while vehicle is approaching or fixed marking?

3: The marking will be already there.

1: Marking will be there. Many people will not understand the marking, ya. For them, what told, I'l go to there; even after boarding the vehicle at Mohakhali, from Mohakhali they may go to another place but board on the vehicle towards Farmgate. If I tell that this vehicle is going to that place via Framgate, they will understand eventhough didn't know. With understanding the kotha (saying), ya, they can board as this vehicle is going via Farmgate.

2: We want to say that, the counter available below, if go to purchase the ticket he will understand where could go, ya. And another is, he is coming by following the indications, indications of BRT, he will be able to locate the ticket counter in this way and that he will be able to enter. SO, not necessary so much details.

5: It seems, here, it will be expensive. Expensive for the government. If it is given in one place, you have to provide in the whole city. So, the symbol, only that one would be enough.

2: Yes, similarly, there will be marking at station also about the rickshaws, which direction should go. Ya.

6: Or, there could be the display system, like available in the airports. This plane is coming at this time and this will be going there at that time.

2: No, not necessary so much details. One way, this is one way system.

1: When a vehicle stops, immediately another vehicle will not come here. This is number 8 bus, and number 8 will go via Mohakhali and Nabisco, ya, in this route. Another will go via Framgate.

2: Two, is there more than 1 route? Only one route. So, I am going, where going, up to Motijheel. This should be confirmed. If the people for going Uttara ar queing for this, that means, ya?

1: Total there will be one route. Along with this, the stations by serial wise will come.

6: If it is one route, this will not be required.

Summary

F: First we discussed about your usages of bus and rickshaws in a week; mostly bus use is about 10 times per week, someone do 15-16 times and more or less almost all use rickshaws, someone about 4-5 times or someone about 10-12 times. Again, it was said that if BRT is given, then its use may increase because many people are travelling now with many kosto (pain) on buses. And, another one thing you mentioned that to reach at bus station sometimes you use rickshaws or after alighting from a bus use rickshaw to go home; this depends on situation. After that we discussed that the BRT station, as it is in the middle of road, how to cross the road to reach in station. Few mentioned crossing at grade because it is kosto (pain) to go up or down and few mentioned no, either overpass or underpass would be better- will remain safe or secure. Then you have discussed the distance how long you would walk comfortably for interchange. It came up about 200-300 meter or not more than 2-3 minutes of walk. Next, discussed about how to ensure this interchange path safe and secure for the users. Here you have mentioned that the path for walking should be wide enough, hawkers or other things, barriers or objects should not be there, should remain clean always, should have light, security or someone should be there at station. Then discussed about the facilities needed at station and everybody mentioned about toilets. The other things you mentioned are shade, indicators, lighting. Then talked about fare; you all mentioned that it is good if fare if fixed and not necessary to bargain. But, also mentioned that to do such is very difficult; its not happening to follow in other modes. But, someone mentioned few ways; if it is localised, if from one place to another point it is determined, if entry of rickshaw from other are is restricted and given notice or board at points and if everybody follow this, that would be good. Next, discussion was about signs and symbols. You had discussed that usually what type of symbols are available now in the roads of Dhaka. Then we have discussed that the majority of people knows the signs or symbols; but there are few people who don't understand.

3: There are many people who knows but don't follow.

F: It was discussed that the majority of people in our country are like that what should be done we don't do that or don't follow that.

3: Obvostata (habit) of not following.

F: Tendency of not following. Again, someone mentioned that there should be such a system that there is no other option or way without following. Then, will be forced to follow. For the case of Kakoli, what type of sign should be and it was mentioned that the rickshaws should be bit far away, 10-15 feet, from the corner so the vehicles can move without any obstacle. And, the rickshaws should be in organized way. There should have marking for rickshaws, where should go and how far have to go to get BRT. Both symbol and text should be given. Similarly there should be at BRT station also where and how far is rickshaws. And what stations are between, these directions and maps.

F: Thanks