Journal of Civil Engineering (IEB), 42 (1) (2014) 103-117

Journal of
Civil Engineering
IEB

Interchange facilities between different modes of transport in Dhaka city

S. M. Sohel Mahmud[1] and Md. Shamsul Haque[2]

[1]*Accident Research Institute*
Bangladesh University of Engineering and Technology, Dhaka 1000, Bangladesh
[2]*Department of Civil Engineering*
Bangladesh University of Engineering and Technology, Dhaka 1000, Bangladesh

Received 30 December 2014

Abstract

Multi-modal integrated transportation system is crucial for ensuring efficient, safe and sustainable mobility of a modern mega city like Dhaka. Unfortunately, in Dhaka city the existing modes and sub-modes (bus-water-rail-NMT) are acting independently of each other. The share of intercity passenger by different modes bus, train and water are 76, 9 and 15 percent respectively. Besides, there are approximately 18.7 million intra city trips per day among them the share of intra city commuter train and water are only 5000 and 2000 passenger respectively. Continuous focus on road based network system as well as lack of interchange facilities between different modes of transport has weakened potentials of other types of transportation system like rail or water transportation system. In this study, a significant investigation comprising onsite field investigation, questionnaire survey, discussion with the professionals and users has made to integration between different modes of transport of the city. Particular focus has made on the interchange facility of interface between intercity modes, intra city modes and inter to intra city bus service in Dhaka City. Some problems and requirements are also highlighted to improve Interchange Facilities or Interface Facilities as well as to integrate of different modes of transport.

Keywords: Interchange, Interface, Multi-modal, Integrated, Transportation, Facility

1. Introduction

Dhaka, the capital of Bangladesh and the nation's gateway, has now been turned into the 26th Mega city and 10th most populous city in the world (Habib et al., 2005). The development processes of Dhaka city rapidly increased with tremendous growth of population and physical expansion, over 30 and 20 times respectively within the period of 1951 to 2001. Unfortunately, the city experiences the proliferation of scattered and unplanned development

without appropriate guidance resulting in immense landuse and transport deficiencies in the city. Inefficient and malfunctioning traffic management is also one of the major problems of Dhaka city transportation system, which is highly responsible for making the existing system more unproductive. Indeed, for the causes of unplanned and non-integrated road network development, there have very limited scope to apply integrated transport system comprising different modes and sub modes.

Buses are the main player of the mass transit system in Dhaka city but the total road length of the bus operating route is only 120 km comprising 22 east-west links which is covering only around one third of the metropolitan areas. The performance of this service is not quite good and seems very difficult to improve the condition in present situation. In spite of having huge benefit and large potentials, successfully implementation of multimodal transportation system would be very challenging tasks particularly for the causes of insufficient interchange facilities between different modes of transport in Dhaka city. A detailed study has been conducted on the identification of land–use and transport development in Dhaka city (Mahmud, 2009). This paper forms from the part of that broader study.

2. Prevailing Transport and Travelling Scenario in Dhaka Metropolitan City

An assessment of the existing urban transport system of Dhaka revealed that it suffers from major constraints such as – fragmentation of organizational responsibility; inefficient regulatory frameworks; insufficient financial resources; poor allocation of road space; presence of too many low capacity and slow vehicles on major roads; poor traffic control, management and enforcement; underdeveloped public transport system; absence of adequate pedestrian facilities; poor linkage between land use planning and transport development and finally, lack of emphasis on environmentally sound and sustainable transport development.

Various surveys (STP 2004, DITS 1994, JBIC 2000 etc.) undertaken and their analysis revealed the following information about the city:

- The average household income in 2004 was Tk15,000 ($253) per month while 3½% of households was in the “high” income group exceeding Tk55,000 ($920) per month (STP 2004)
- The average number of persons per households in 2004 was 4.12 (STP 2004)
- Among households 7% either have or have access to a car, 4% owns motorcycle, 3% cycle rickshaw, 5% bicycle and 2% auto-rickshaw (STP 2004)
- Almost 84% of household do not have any sort of transport vehicles and depend on public transport and only 16% have some sort of vehicles (STP 2004)
- Among the important purposes (i) home-work 31%, (ii) home-education 25%, (iii) home-shopping and others 36%, and (iv) non-home based trips 8% (STP 2004)
- On average, each household undertook 8½ trips per day by all modes (STP 2004)
- At present, the number of trips that are generated per day is 21.98 million and after 20 years, the trip generation per day that is estimated is 159.63 million in 2024 (STP 2004)
- The average trip length was found to be 5.37 kilometers (STP 2004)
- Buses comprise a small proportion of vehicle numbers (11½%) but carry about 77% of people (STP 2004)
- Rickshaws comprise 28% of all vehicles moving in the city and forms primary travel mode for 34% of all person trips (STP 2004)
- Proportion of trips made by walking is substantial, though according to STP around 22%, DITS estimated that 62 percent and

- Road space occupied by rickshaws is 73%, and by cars, buses and tempo is 19.7%, 4.4%, and 0.4% respectively (DITS, 1994)
- Among the modes, car occupies the highest space for carrying a person which is 75.8%. Rickshaw occupies 21.9%, Baby taxi 17.9%, bus 8.7% and tempo 5% (STP 2004)
- Autos are a low proportion of vehicles comprising less than 10% of travel

3. Existing Transport Network of Dhaka Metropolitan City

3.1 Road Network

An important part of every town is its transport system and particularly its road system for affecting smooth and efficient movement of people and commodities. For good accessibility, the circulation system of a city should meet certain basic requirements. Firstly, the vehicle users should be able to move from one part of the city to the other easily, safely and efficiently. Secondly, the roads should be arranged so that they provide adequate access to every building for vehicles and pedestrians. To meet all these requirements a system of hierarchies in the road network is required, and this hierarchy results in a system which is composed of various types of roads designed for different types of movements according to the function, character and volume of traffic. A well-articulated road network system usually occupies 20 to 40 percent of urban area depending upon the size, function and character of the city. (Choudhury, 2001). There are only 9 percent of the total area are road space where's pavement space only 6 percent in the DCC area of the 1286 km of road comprising 61 km primary, 108 km secondary, 221 km connector, 573 km local and rest narrow road (Table 1).

Table 1
Different Types of Road Length, Pavement Area and Road Area of DCC

Classes of road	Length (km)	%	Pavement area (sq. km)	%	Percent of total land area	Road area (sq. km)	%	Percent of total land area
Primary	61.45	4.78	1.46	16.47	1.08	1.89	15.67	1.41
Secondary	108.20	8.41	1.86	21.05	1.39	2.41	19.94	1.80
Connector	221.35	17.21	1.68	19.04	1.25	2.47	20.42	1.84
Local	573.75	44.61	2.93	33.17	2.18	4.25	35.19	3.17
Narrow	321.27	24.98	0.91	10.28	0.68	1.06	8.78	0.79
Total	1286.02	100.00	8.84	100.00	6.59	12.09	100.00	9.01

**Source: RMMS, 2004 (Analyzed by Author)*

In further analysis, it is found that there are only 107 kilometers road which width more than 24 meters in all over the city of Dhaka among the total 1286 km road. Indeed, there are only 45 km of road which pavement width more than 24 meter. Indeed, among the total road of the Dhaka City Corporation area, 821.61 (64%) km road width is more or equal to 4.75 meter but according to pavement width, that's are only 618.14 (48%) km. So, although 203 (16%) km road width is more or equal to 4.75 meter but their pavement width is less than 4.75 meter, i.e. emergency vehicle could not be entered that pavement width road. So, this 203 km road could be made accessible by increasing the width of pavement of the road. But, other 464 (36%) road pavement width could not be increased without demolishing existing road side development as road entire road width is less than that the desired level of accessibility but that's are almost impossible as this problem is started from very beginning of the planning of the city and both side roads is highly built-up by multi-storied building and huge densified with about 0.1 million people per sq. kilometer. On the other hand, a city could not sustain

with this huge amount of so thin vein which is totally blocked or plugged or out of use. In further analysis, it is found that there are only 2.15 km of road is available for 10,000 of population and pavement space available only 0.015 sq. km. The availability of major roads in terms of either km per thousand populations or km per square kilometer of area is too low as compared to the other cities of developing countries. According to the world bank statistics in the report on road per capita in 9 cities of developing countries and 26 cities of developed countries is 0.5 and 4.5 meter respectively (Ingram and Liu , 1998). Whereas, in Dhaka City Corporation area, per capita road only 0.0213 meters is available. This scarcity of the road length or area will be sustaining until the city remain. That's this is one of the fundamental inherent weakness of the city of Dhaka for their yield land use and transport panning.From the above discussion and facts, it is found that the existing road in the entire city road network is not quite enough and is the one-forth of the minimum requirement of a modern city. Even, after the implementation of newly developed Strategic Transport Plan (STP), total road network would be around 1413.67 km and road and pavement area would be 15 (11%) and 11 (8%) sq.km respectively. Besides this, the roads which are existing are not proper functioned and are not fully operational with full capacity for the causes of huge alignment, layout or orientation problems of the entire road network.

3.2 Circular Waterway

It is a blessing of almighty that in Dhaka city there are a circular natural waterway around the city. The city is surrounded by four major rivers which could bring some positive result as it has the capability to divert traffic from land to water (Figure 1). There altogether 19 landing stations in the circular water way in Dhaka city and only one launch connecting route between two ghat, Shewari Ghat to Kholamora are operating now and this route carry only 1500 to 2000 passenger per day by single deck launch. Indeed, the circular waterway could provide relief to a large number of the city's commuters and the taking of preparation for the swelling number of such commuters. Unfortunately, in spite of having huge benefit and large potentials, successfully implementation of circular water way around the city is a very challenging task particularly for haphazard development along the river and river side, the lack interchange facility with the road and other mode of transport as well as unintegrated transport planning and management.

3.3 Rail Network

In Dhaka city, a north-south directional railway corridor (Shyampur to Abdullahpur) passes through the middle of the city (Figure 1). Railway passengers are served by the three railway station, viz. Kamalapur (6%), Tegaon (1%), Airport (2%) railway station. Kamalapur railway station is the main railway station situated in the middle of the eastern side of the city. To serve the 20-25 thousands incoming and outgoing passengers every day making it an important busy place. Besides, the 10-15 thousands incoming and outgoing passengers serves by the other two stations, Tegaon and Airport. Though there is a great potential, for the lack of integration between road and rail from the planning stage, one is interrupting each other at present. Figure 1 representing the major transport network including road, rail and waterway of the city.

4. Unorganized and Non-Integrated Road Network

Dhaka mainly depends on road-based transportation network system. Road has been evolved due to topography of the city, technical advantage, past network development trend, availability of foreign aid etc. Continuous focus on road based network system has weakened potentials of other types of transportation system like rail or water transportation system.

Hence there is no such inter-linked and mutually dependent multi-modal transport network system for Dhaka City. As a result, no other alternative for the movement of people and goods can be found to meet increasing and diversified demand of the urban community. The situation becomes worst in case of any disruption of road network, particularly the major links of the City.

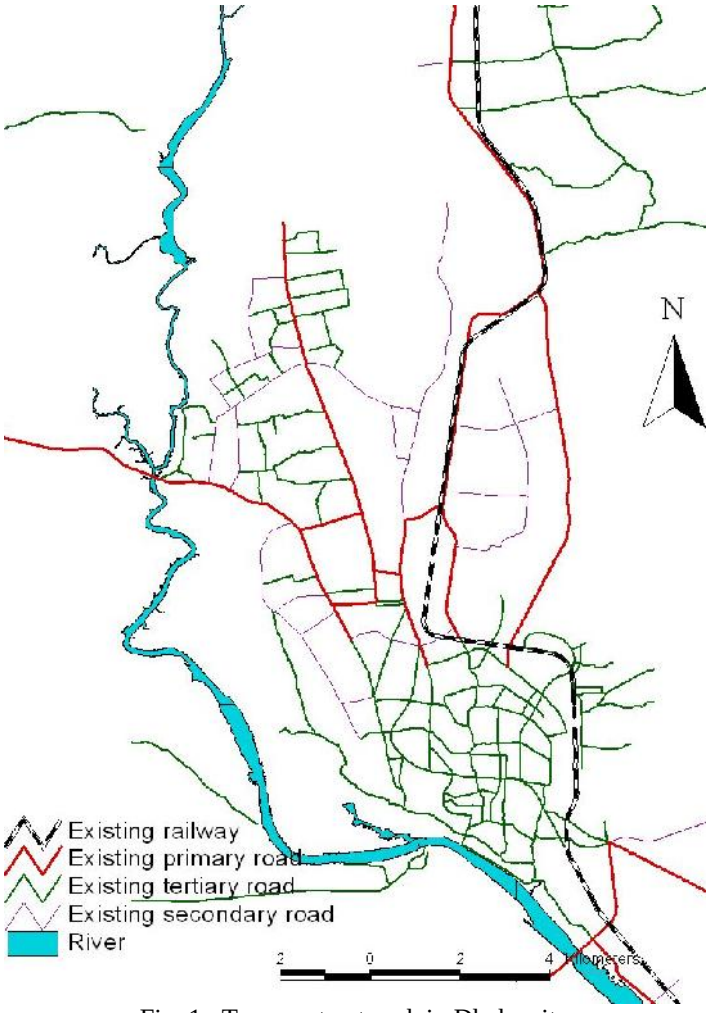

Fig. 1. Transport network in Dhaka city

During last twenty to thirty years, significant road development has been taken place to cope with sudden transformation of the city from provincial town to the capital of a sovereign country. But most of the transport developments have been driven by ad hoc considerations having no explicit focus on analysis of existing demand or future requirements. As a result, the road network of the city is not organized and integrated in terms of connectivity. Many strategic links are missing in the network and many areas have inadequate accessibility to it. Large amounts of residential and commercial development both by public authority and private agencies have taken place after the independence. In most parts of the city, the road network has emerged with relatively wide primary and secondary roads (termed mostly on the basis of road width only) built by public agencies, but narrow tertiary and access roads due to lack of planning and building controls. Consequently, with the exception of a few planned residential areas, in must of the areas the road network is too narrow and alignment is poor to accommodate motorized vehicles, especially the public transport modes. This also poses a serious problem to provide other network infrastructures for utility services.

5. Interchange between Different Transport Modes

From different study on Dhaka city, field observation as well as discussion with the professionals and academician, it is revealed that the existing modes and sub-modes (bus-water-rail-NMT) are acting independently of each other. In this study a significant investigation comprising onsite field investigation, questionnaire survey, discussion with the professionals and users has made to integration between different mode of transport of the city. Particular focus has made on the interchange facility of interface between intercity modes, intra city modes and inter and intra city bus service which is described below:

5.1 Interchange facilities or interface between intercity modes

Table 2 shows that the different facilities and flow of inter city passenger from the different stations of Dhaka city. From the Table it is revealed that the share of intercity passenger by different modes bus, train and launch are 76, 9 and 15 percent respectively. Interchange or interface facility between the three modes are very poor. Total bus passengers are served by the five bus terminal viz. Gabtoli (23%), Mohakahli (6%), Gulistan (7%), Fulbari (15%) and Saidabad (25%) bus terminal. There has not any well functional direct connectivity between these five terminals. Gabtoli to Gulistan and Gabtoli to Saidabad has separate singe bus connecting service but the connecting route is fully circumlocutory comprising several links, right turn, left turn, local road, tertiary road etc. and passes through the commercial, residential, educational as well as CBD. There has not also any connecting service with the Saidabad and Mohakhali bus terminal and Gabtoli to Mokhali terminals. At present condition it is almost difficult to provide direct connecting route for interchange of the passenger terminal to terminal.

Table 2
Different Facilities and Flow of Inter City Passenger from the Different Stations of Dhaka City

Terminal	Bus/Launch/ Train schedule	Passenger (thousands)	Visitors (Thousands)	Parking Capacity	Total Area (Sq.m)	Built up area (Sq.m)	Percent of Passenger
Gabtoli Bus Terminal	2000	80-95	10---12	1000	56800	11500	23%
Mohakhali Bus Terminal	450	20-25	1—2	400	20000	4000	6%
Gulistan Bus Terminal	450	25-30	n/a	125	6000	1000	7%
Fulbaria Bus Terminal	500	50-60	n/a	no	no	no	15%
Saidabad Bus Terminal	2000	80-100	10---12	1000	61000	12500	25%
Kamalapur Railway Station	78	20-25	4—5	8	-	-	6%
Tejgaon Railway Station	26	5—6	-	-	-	-	1%
Airport Railway Station	-	5—7	-	-	-	-	2%
Sadarghat Launch Terminal	300	50-60	10—12	-	-	-	15%
Total							100%

**Source: STP, 2004 and Field survey, 2009*

Railway passengers are served by the three railway station, viz. Kamalapur (6%), Tegaon (1%), Airport (2%) railway station. Kamalapur railway station is eastern side of the city and only 0.5 kilometer away from the CBD. Though there has a radial connecting road between CBD and Kamalapur railway station, almost 90 percent of the people go or come to the station to CBD by rickshaw through circular road for the poor maintenance of the road and for the lack of user friendly footpath. Only option for the people is to use rickshaw. To serve the 20-25 thousands incoming and outgoing passengers every day making it an important busy place. Though there are four connecting bus route with the different part of the city, there has not also any connecting service with the Gabtoli and Mohakhali and Sadarghat terminals. For the lack of well connecting mass transit network, almost 60 percent of the passengers' pre and post travel mode is rickshaw, followed by minibus (16%), Auto rickshaw (9%). Though, there are three intra city (midway, myline and no 6) and one semi-intracity connecting bus service from the front road of the city station, three has not any either bus terminal or bus parking space. A significant amount of passenger (8%) pre or post travel from old Dhaka, but there has not any connecting bus service. There has well designed parking space for rickshaw and auto rickshaw, but there has not a bus loading unloading bay. On the other hand, no connecting bus route is started or ended from the station premises. The station is the via of all of the four bus routes. There are three bus counter and all of them are on the footpath. From the field survey it is observed that all of the buses reached the station counter with full loading condition by other station passenger. As a result, passenger of the railway station are not interested to go by bus and bound to use rickshaw or auto rickshaw.

The airport station is a newly established station in between Tongi and Cantonment stations to serve passengers from northern areas of the metro-city. By introducing operation and stoppage for intercity trains the station has become popular. The reasons for this popularity are quick transportation during pre and post travel short journey, connecting NMT free VIP road at doorstep and ready availability of fast moving motorized taxi and other services at all hours to go to almost all around the city. On the other hand, for the lack of such facility i.e. for the lack well connecting road, the Tegaon station is becoming unfamiliar gradually.

Almost all of the waterway passengers are served by the Sadarghat launch terminal. The nearest bus stoppage is almost 1 km away from the Sadarghat launch terminal. The only one 4 lane undivided main road serving the terminal is extremely congested at all times. From the field observation it is observed that almost 2 lanes of that are occupied by the hawkers and protruded part of the both side commercial activities. Indeed, the intensity of commercial activity on the road is so desnsified that it is difficult to realize the there has or has not any footpath. Unfortunately, the widening of that road is almost impossible at present because of both side high-rise multi-storied commercial building. The accessibility of this important and busy terminal is hindered for ever by allowing construction of such gigantic multi-storied commercial building along the side of the road. At this condition passenger are bound to use smaller vehicles like rickshaw or auto rickshaw for pre and post travel. From the questionnaire survey it is found that almost 55 percent of passenger use rickshaw and CNG in pre and post travel; rickshaw 40% and CNG (15%) (Appendix C). Only 16 percent of people use minibus service and 15 percent use tempo and human haulers after walking almost 1 km from Launch ghat to Victoria Park. There are only three routed buses available in the Park terminal. Among the respondent, almost 33 percent of the passenger's origin/destination is Jatrabai (13%), Firmgate (8%), Kamalapur, Motijheel (6%), Moghbazar & Tejgaon (5%) but there has not any connecting bus route. There is a human haulers service from Victoria park to Jatrabai (Appendix C).. The main railway station Kamlapur is 4 km away from the terminal but does not have any good access or interface. There has not also any connecting bus route with Mohakhali and Saidabad bus terminal. As discussed, in the present condition it

is very difficult to develop any well design interchange infrastructure or interface facility around the Sadarghat launch terminal.

5.2 Interchange facility or interface between intra city modes

According to the estimation by STP, there are approximately 18.7 million trips per day. From the field observation it is revealed that the share of intra city passenger by commuter train and launch are 5000 and 2000 passenger per day respectively. Others all of the trips are road based either by walk, or by bus, rickshaws or other motorized or non-motorized vehicles. The interchange facility between these three intra city modes road, rail and water is also very poor. Actually, for the lack of interchange facility or well interface between intra city road-rail transport and road-water transport are one of the major causes of the very less share of other modes.

There are two intra city commuter train routes one is Kamalapur to Tongi via Tejgaon, Airport and other is Kamalapur to Narayangong via Gandaria. Every day 26 incoming and outgoing (13 incoming and 13 out going) mail train are operating in the Kamalapur to Tongi route and flow of passenger per day in this route around 2000 to 2500. The fare of this route per passenger is 6 TK only which is one fifth compare to bus fare. In Dhaka Narayangong route, 20 trains (10 incoming and 10 out going) are operating per day except holiday (in holiday 4 incoming and 4 out going) (Appendix D) and the flow passenger per day one an average 2500 to 3000. Fare of per passenger in Kamalapur to Gandaria is 5 TK and Kamalapur to Narayangong is 6 TK which is also around 5 times lower compare to the bus fare. Even this, the flow of passenger in this route by train is much lower than the by bus route. From the field survey couple with discussion with the users it is revealed that lack of interchange facility as well as connecting facility with final destination to railway station is the major cause of less demand of the commuter train service. Delay of train or improper maintain of the train schedule is also one of the major issues are found for this less popularity. For example, a special commuter train Kamalapur to Gazipur was scheduled for the office passenger in Gazipur after demanding by the office passenger. But after few days that train becomes unpopular for the delay and other operation problems. Illegal negotiation between the railway authority and bus operators are found one of the factors of such operational problems and this could be for two distinct services provider; one is private and other is public or governmental.

Shawrighat to Khlomor is the only one intra city waterway passenger flow route carrying around 1500 to 2000 passenger par days. For freight transport there are some other extended routes along the circular waterway. In addition, there are almost 30 passenger crossing stations in the both side circular waterway and every day thousands of passenger cross the river using that stations. Almost 60 percent of the stations have not any functional road connectivity. For the lack of connecting road or interchange facility people are bound to go their final destination either by rickshaw or by foot and their share in some selected stations is 50 to 60 percent and 30 to 40 percent respectively. And in present condition, it is almost impossible to develop well connecting facility with most of landing station in present condition.

5.3 Interchange facility between intercity and intra city bus service

There are five intercity bus terminal in Dhaka city i.e. Gabtoli (23%), Mohakahli (6%), Gulistan (7%), Fulbari (15%) and Saidabad (25%) bus terminal. But, unfortunately there has not any designated intra city bus terminal. The interface facility between inter city and intra city passenger is very poor. The major bus terminal, Gabtoli and Saidabad bus terminal are

outside of the city serve almost 50 percent of the total intercity passenger. But there has not any facility for intra city bus parking or loading and unloading. In Gabtoli bus terminal, there are only two connecting intra city bus route is available, one in number 7 (Gabtoli to Shadarghat) and another is number 8 (Gabtoli to Jatrabari) serve almost 65 percent of the passengers. From the O-D survey it is found that in Gabtoli terminal, a significant amount of passenger's origin and destination is Mirpur and Mohakhali area, 23 percent passenger's (Mirpur 14% and Mohakhali 9%) origin towards Gabtoli and 35 percent passenger's destination (Mirpur 19% and Mohakhali 16%) from Gabtoli. But, there has not any direct bus service for Mirpur and Mohakhali which should be provided urgently (Appendix C). All the intra city vehicles including buses, tempo, and human hauler parked on road. Every three to four minutes a number 7 or number 8 buses is leaving the terminal. Besides there has some semi intra city bus, but there have not any loading and unloading facility too. All of buses stand on road, parking on road and loading and unloading from the road. Indeed, there has not well turning facility for both types of vehicles. Right turn and U-turn are taking place on the main road in same place by the both types of intra city and intercity vehicles often creating conflict between them. At present condition, it is almost impossible to provide designated place for intra city buses because of lack of empty space around the terminal.

In Saidabad bus terminal, there are around 12 intra city connecting bus routes but almost 75 percent of the passenger make pre and post trip by other than bus (rickshaw 45%, walk 17% and auto-rickshaw 10%) particularly for the operational deficiency of the bus service. There are very few (20 parking space occupied by Balaka paribahan) designated intra city bus parking space for intra city buses. From the O-D survey it is found that around 15 percent of passenger pre and post travel origin and destination is Sadarghat and Basabo (Sadarghat 9%, Basabo 6%), but there has not any connecting bus service facility from this terminal (Appendix C). On the other hand, terminal is the via of the entire commuter bus route except Balaka paribahan route and reached to the station almost in fully loading condition which also discourage passenger to use this service. Like Gabtoli terminal, all of buses are standing on road, parking on road and loading and unloading from the road and interrupting the through and local traffic each other. However, in spite of 12 connecting bus services with the Saidabad bus terminal from the different part of the city, very few passengers (27 %) are use this facility for the lack of interchange facility as well as huge operational deficiency. Mokhali bus terminal is almost middle in the city connect the northern part of the country and serve every day almost 20-25 passenger. There are about 9 intra city or semi intra city via bus route along this terminal but and almost all of them are ticket system company based bus except 6 and 3 B. But, the nearest ticket counter is almost 500 m away from the terminal. Though there has well design circulating area for local traffic, there has not any intra city bus bay or loading unloading area. The loading condition of the intra city bus also discourage inter city passenger to go to by bus. Almost 11 percent pre and post travel destination is Badda area, but there has not any direct bus service from the terminal. For the lack of intra city bus service facility, almost 75 percent passengers use other mode of transport in their pre and post travel. There have developed some intra city bus terminal around the city. Among them Abdullahpur, Mirpur, Azimpur are dominant and these terminals are the origin of the around 15, 21, and 7 routes respectively. But unfortunately, there has not any designated bus parking space. There has not also any facility for the drivers', helper and other worker. Even there has not any designated ticket counter. All of the buses are parked on road and ticket counter of that buses are on footpath.

5.4 Interchange facilities between inland circular waterway and road

There altogether 19 landing stations in the circular water way in Dhaka city, phase 1 (Ashulia to Shewari Ghat) 10 stations and phase 2 (Tongi to Kanchpur) 9 stations but only 8 stations

have well road connectivity with the city area. In addition, there are 13 crossing station or ghat use for the crossing the river by country boat. Table 3 shows a brief summary of the two phases water circular way. Appendix E presents the passenger and freight in different landing stations of the circular waterway.

Table 3
Length, Expenditure, Income and Landing Station of Circular Waterway

Phase	Area	Length (km)	Expenditure (Crore)	Expenditure of land acquisition (Crore)	Yearly estimated income (Crore)	Landing station	Well road connecting station
1st phase	Ashulia to Shewari Ghat	30 km	35.9	10	3.5	10	5
2nd Phase	Tongi to Kanchpur	40 km	65.9	15	3.5	9	3

**Source: BIWTA, January 2010*

In the first phase of the circular water way in Dhaka city, Ashulia to Shewari Ghat, there are all together ten landing stations. Among them Rayer bazaar are only staircase used only for rainy season and Nawaber Bap ghat only for the crossing facility. Others 8 stations have permanent landing station for both passenger and freight. But from the field investigation it is found that Only one launch connecting route between two ghat, Shewari Ghat to Kholamora are operating now and this route carry only 1500 to 2000 passenger per day by single deck launch. The passenger which has been shown in feasibility study, almost all of that passenger are only thoroughly crossing passenger using the ghat by country boat, not distributed or circulated through the circular route. In this study, it is found that only 11 percent of the total passenger of the Shewari Ghat use the circular route and other 89 percent only cross the river. However, the number of passenger which have been shown in the feasibility study in both phase I and II, (Appendix E) is confusing because from the field study coupled with review of previous study, it is observed that almost 90 percent of the passenger use these stations only for crossing the river not for circulating from one station to another station. So, the demand which has been shown in the feasibility study could be verified which required further in-depth study. They are bound to cross the river for the absence of any alternative like bridge. From the field observation, it is observed that almost 5 landing stations have not sufficient connecting road to go to the destination. In Shadarghat to Rayer bazaar there are altogether 17 stations including 3 circular waterway landing station and every year around 200 lac passenger use this stations but there has not any well connecting interchanging route except embankment road. Although, only one bus route is available on the embankment road, Amin Bazaar to Babu Bazaar, the performance of that route is very poor. The two-lane road is almost occupied by the freight or parking vehicles or vendors and for the lack of radial road; passenger could not circulate throughout the city area. In some of the stations like Shewari Ghat, Waisghat, Kholomora, Raer bazaar have 12-15 feet wide connecting road with the old Dhaka. These connecting roads are also made uncontrolled T-junction with the embankment road and reduce the operational capacity of that road. These roads are not quite straight and continuous. In addition, disposal waste or parking rickshaws or tempos occupy almost one-third spaces of those roads. Some of the stations which have major connecting road but there have not any mass transit route. As a result, it is observed that, almost 80 percent passengers are bound to go to their destination either by foot or by rickshaw. From the O-D survey in some selected landing stations, it is found that almost 30 percent passengers go to new Dhaka like Rampura, Badda, Motijheel from Shewari Ghat, Waisghat, Kholomora or Matbar bazaar by rickshaw expending around 50-90 TK per trip for the lack of alternative cheaper mode like bus. This high fare obviously a great burden for the user that discourages them to use this

route second time. Some of the passenger use tempo through the embankment. From the questionnaire survey couple with the discussion with the local authority, it is revealed that for the lack of well connectivity with the landing station to different parts of the city as well as lack of interface or interchange facility is one of the major causes for unpopularity of these investments. In present condition, most of the spaces are occupied by haphazardly developed multi-storied residential and commercial building and it is almost impossible to develop connecting road or provide well facilitate interchange facility with the city centre.

In Second phase, there are nine landing stations point, among them only three corner points have well connecting national and regional highway route, Tongi, Kanchpur and Demra. Among the other 6 stations, 3 stations have local road connectivity with the Dhaka city and others have not any connection. That could be used only for the some compact local residents. There will have to face same problem as like as phase one i.e. lack of spike or radial connectivity by waterway as well as roadway. As shown earlier, most of the areas of eastern part of the city are the flood runoff area, it almost difficult to construct well connecting road with the landing stations. After all, there have a well connecting radial canal named Rampur canal, which could be potentially use as a mid point connecting facility with the city area. In the first phase, there have also some connecting radial canal like Dholaikal (connecting with the CBD), Rayer bazaar Canal (connecting with the Mohammadpur and Shamoli), but that's are not only history, no geological features are exist in realty as present for the conversion as box culvert and residential area filling by graver for unplanned development. Therefore, the potentiality which have for the well performance of the water circular way are lost for the lack of vision, lack of planning of the city authority. Finally, it is to be mentioned here that the peak hour commuter movement of Dhaka city is mainly road based and other alternative travel systems viz. rail and water has inherent weakness, as they are not aligned with the inner city commuter movement paths. Rail is eccentrically located in the Eastern side of the city and towards N-S directions and not capable of providing service to the other parts of Dhaka city. In its present from, the rail system is neither a competitor nor a suitable alternative of the road based travel modes particularly in case of inner city commuter movements. Rather, to some extent, a large number of at-grate railroad crossing (51) are acting as a great hindrance for efficient operation of road based travel system. On the other hand, since the proposed circular waterways are located at the periphery of the built-up areas, it is also not a viable alternative particularly at the fringe areas. Indeed, there has not well connecting road network between the waterway landing area and city area. In consideration of these, it is obvious that for certain areas of Dhaka city, physically as well as functional integration of different modes of public transport would be a very challenging job and feasibility of which needs a very comprehensive study.

6. Interruption between road and rail operation

There are altogether 51 (Fifty one) railway level crossing from Shyampur high school to Abdullahpur, 37 authorized and 14 unauthorized. Among the 51 level crossing, 13 are in Kamalapur-Narayagonj corridor and others 38 are in Kamalapur-Tongi corridor. From the field observations it is observed that among the 51 level crossing, in 12 point cross the bus operating major route, 5 are in Kamalapur-Narayagonj corridor and others 8 are in Kamalapur-Tongi corridor like Khilgaong, Malibagh, Moghbazar, FDC gate, Mohakhali, Kakoli, Banani and Bishaw road. Everyday 98 outgoing and incoming trains pass through the level crossing in the city. Among them 78 trains move through Kamalapur-Tongi corridor and other 20 moves Kamalapur-Narayagonj corridor . Out of 78 trains in the Kamalapur to Tongi corridor, 54 (67%) operate between 8.30 am to 10.30 pm. One an average a period of 3.5 minutes from Kamalapur to Mohakhali and 3.0 minutes from Bonani to Tongi is required to give a train its passage at each level crossing. In addition, 1.5 and 1 minutes times are

required to come into normal condition of traffic flow at peck period and at off peck period respectively. However train creating interruption during passage of train on both sides of rail gates for an average of 5 to 6.0 hours in each day in each level crossing (Table 4).

Table 4
Delay per Day in Some Selected Level Crossing

Name of Level Crossing	Signal time	Normalization Time		Total Delay per Signal		Queue length (m)		Delay (h)		Total Delay (h)
		Peck hour	Off peck	Peck hour	Off peck	Peck hour	Off peck	Peck hour	Off peck	
F. D. C Level Crossing	3	1	0.5	4	3.5	75	40	3.40	1.58	4.98
Moghbazar	3.5	1	0.5	4.5	4	100	70	3.83	1.80	5.63
Banani Level Crossing	3.25	1.25	0.75	4.5	4	200	100	3.83	1.80	5.63

**Source: Field Survey, 2010*

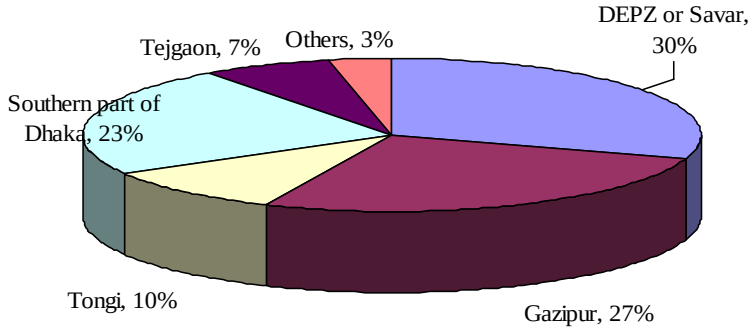

Fig. 2. Distribution of the Trucks from Kalamlpur ICD

Fig. 3. Railway Level Crossing in the Main Road of the City

From the in-depth field survey on Moghbazar level crossing (Photograph 1), it is found that around 5.92 hours interrupting traffic flow every day in Mogh bazaar level crossing. Losses of man hour per day around 150,000 and loses of fuel for that interruption around 300 liter. Economic lose due to man-hour loss and fuel loss around 50,000 TK. per day. On the other hand, 238 employee are engaged for the controlling of the authorized level crossing and excluding other expenditure per month around 7.5 lac taka is losing only for their salary purpose.

On the other hand, every day average 212 trucks or covered is required for the loading and unloading of the freights in Kamalapur ICD. Among them around 150 trucks or covered van distributed around the city as well as out side of the city with full loading of imported freight and around 60 loaded trucks or covered vans enter into the ICD with exported freight. More than 400 large trucks or covered vans trips are creating every day on Dhaka road by the ICD. Whereas from the analysis of the origin and destination of that trips, it is fond that almost 70 percent of that trips (Savar or DEPZ 30%, Gazipur 27 %, Tongi 10%) destination or origin are outside of Dhaka city (Figure 2). Only 30 percent freight movement occur in Dhaka city. However, the city transport system is adversely affected for the ICD by generating huge number of large trucks trips. On the other hand, freight train impact on level crossing is almost double than the passenger train for the causes of low speed but longer size. So, the city transport system is suffering in two ways which essentially suggest that Kamalapur ICD should be relocated in Tongi or Gazipur or new ICD should be developed in that area.

So, the road and rail is not supporting but interrupting each other. If railway facility increases then the road will deprive and vise versa. Whereas, it should be integrated, coordinated and supportive to each other. At present rail and road network condition, it is very difficult to integrate and make supportive to each other. Grade separation by raising the railway tract was one of the possible solution to overcome this problems but after the construction of Mohakhali ramp and Khilgaon interchange, the possibility of the grade separation by elevating the present railway track is become almost impossible. Construction of underground railway track is also become difficult for the deep foundation of the mega structure. So, this interrupting situation would be continued until the construction of flyover or ramp in every level crossing and that would be not only economically less feasible in the existing railway track but also very difficult in the present haphazard and unplanned road network.

7. Conclusion

At present, in Dhaka city the share of intercity passenger by different modes bus, train and launch are 76, 9 and 15 percent respectively. Interchange or interface facility between the three modes are very poor. Though Kamalapur railway station is only 0.5 kilometer away from the CBD almost 90 percent of the people go to the station by rickshaw from the CBD for the lack of well connectivity. There has not also any connecting service with the Gabtoli and Mohakhali and Sadarghat terminals. On the other hand, the nearest bus stoppage is almost 1 km away from the Sadarghat launch terminal. The main railway station Kamlapur is 4 km away from the terminal but does not have any good access or interface. There has not also any connecting bus route with Mohakhali and Saidabad bus terminal.

On the other hand, there are approximately 18.7 million intra city trips per day among them the share of intra city commuter train and launch are 5000 and 2000 passenger per day respectively. Lack of interchange facility as well as connecting facility with final destination to railway station is the major cause of less demand of the commuter train service. Shawrighat to Khlomor is the only one intra city waterway passenger flow route carrying around 1500 to 2000 passengers par day. There are almost 30 passenger crossing stations in the both side circular waterway and every day thousands of passenger cross the river using that stations. Almost 60 percent of the stations have not any functional road connectivity. For the lack of connecting road or interchange facility people are bound to go their final destination either by rickshaw or by foot. In present condition, most of the spaces are occupied by haphazardly developed multi-storied residential and commercial building and it is almost impossible to develop connecting road or provide well facilitated interchange facility with the city center. In addition, there are five intercity bus terminal in Dhaka but there has not any designated intra city bus terminal. In consideration of these, it is obvious that for certain areas of Dhaka city,

physically as well as functional integration of different modes of public transport would be a very challenging job. At present condition, it is nearly impossible to construct bus bay on road side, as most of the side of the road are fully buildup without sufficient setback. The underlying reasons behind this failure are found in this study as the inherent weakness in the landuse and transportation planning and the consequent haphazard uncontrolled development. To cope with the existing demand and to get relief from the deficiencies mentioned above as well as to introduce a integrated multi-modal transportation system through increasing interchange facilities between different modes and sub-modes integrated and holistic measures should be taken encompassing with different sectors related to Dhaka transport system. Some of the measures including both in physical/infrastructural/operation and policy measures to improve the existing system of transport are listed below:

- To ensure sustainable and efficient development detailed land use and transportation plan should be developed on the basis of details observation, analysis and future requirements with a coordinated and integrated approach of different organization.
- Proper and satisfactory use of all of the transport in particularly road, rail and water spaces should be ensured by reclaiming space which is currently occupied by uses other than traffic.
- The widening of road is essential especially at some segment of road and station location. It is very urgent to consider the implementation of BRT otherwise it will be more difficult to implement in the near future and lead to adapt the most costly Metro system.
- Interchange facility between different intercity and intracity modes would be increased through providing connectivity bus service, developing intra city bus terminal facility or bus circulating facility at the inter city terminal, constructing connecting road between the landing station and city center etc.
- Not to allow further deterioration of the level of service of the existing roadway capacity by allowing indiscriminate densification of road adjacent landuse pattern.
- There is an urgent need to develop separate policy and controlling mechanism to control the haphazard development of the low land.
- For better utilization of manpower and to develop responsible vast experience group of expert, large scale capital intensive road infrastructure projects should be developed under a single organization and in this regard this could be done by a single lead agency i.e. city authority.
- It is imperative to integrated transport and land use planning and the responsibility for such an integrated plan should be given to a single authority to ensure its success.
- Encourage consolidation of the transport industry into larger operating units which operate under a company rather than an individual basis.
- Government should give subsidy if the transport modes are owned by a company, so that they are able to maintain a parking, maintenance and management depot of their vehicles.
- There must be a restriction on the import of vehicles for private use, but import of public transport should be encouraged.
- Alternative gate way should be find out to increase the connectivity of the city with the other part of the country and to easy and quick enter and exist of the city.
- To encourage the development of the city in all directions as well as to provide easy accessibility of the all parts city, more than one ring roads/circular roads need to be constructed circulating of the entire peripheral area of the city.
- Relocate of existing ICD and realignment rail line to eliminate the conflict between road and rail through reducing the level crossing.

- Travel demand or exposure should be controlled by increasing ICT or telecommunications facilities. The development of telecommunication infrastructure should be given extra attention and take necessary steps to make it accessible to mass public.
- Finally it is recommended that keeping in view the rapid growth of urbanization in Bangladesh, Government should work out a long term plan to develop large capacity rail based mass transit system (monorail and underground railway) along high-density corridors in major urban areas, with priority action in the context of Dhaka.

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