DEFICIENCIES OF EXISTING MASS TRANSIT SYSTEM IN METROPOLITAN DHAKA AND IMPROVEMENT OPTIONS

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ABSTRACT:

The rapid rise in population along with increased and versatile land use patterns and increase in motor vehicle ownership along with non-motorized vehicles on streets have resulted in enormous travel demand and traffic congestion in Dhaka, the Capital city of Bangladesh. The demographic trends of the last decade that have resulted in rapid population growth (8%) are expected to continue in the coming decades. The impact of such rapid growth has major consequences on the ability of the transport sector to provide mobility for all people as they seek to take advantage of employment, education, health and social opportunities.

The transport sector in Dhaka, which comprised of many different modes of travel - both motorized and non-motorized - often using the same road space – resulting in a high level of operational disorder, that significantly diminishes the efficiency and effectiveness of the existing transport uses. In the absence of a dependable and adequate public transport system, major share of road space remains occupied by the small capacity vehicles. The existing mass transit system has not been able to increase its shares (31% of vehicular trip) of catering demand for the causes huge of road infrastructural, operational, management and maintenance deficiencies like scarcity of road space, lack of accessibility, unorganized and non-integrated road network, mix operation, poor maintenance and management, fragmented ownership etc. Again, due to rapid growth of population in Dhaka, the projected trip generation per day for the next 20 years period is 159.63 million which is about 8 times higher than the current trip generation per day. Therefore, there is an urgent need to introduce a well-organized, properly scheduled rapid mass transit system minimizing the existing deficiencies. In this paper, an attempt has been made to identify the deficiencies of existing mass transit system to put forward for an appropriate rapid mass transit system to recover the huge demand. An overview of the existing modes of travel and operation characteristics has been described. Finally, some potential rapid mass transit options are highlighted with the context of prevailing land use and transport characteristics, socio-economic context of Dhaka Metropolitan city.

1. INTRODUCTION

Dhaka, the capital of Bangladesh is one of the least motorized mega city in the world but most densely populated city with a current population of almost 15 million at annual growth rate of 8% per annum (STP 2004). The population of the Dhaka Metropolitan Area is
presently estimated to be 12 million people (2004), a number that is expected to more than double by 2024. Again, due to rapid growth of population in Dhaka, the projected trip generation per day for the next 20 years period is 159.63 million which is about 8 times higher than the current trip generation per day. For such a large city and huge travel demand, mass transit is a prerequisite for its transportation system. Present contribution of mass transit is only 31% of the passenger trips where as mass transit should share 80% of the total trips to provide an efficient transportation system (STP, 2004). The study deals with identification of deficiencies of existing mass transit system and options to improve the situation.

Dhaka is perhaps the only city of its size without a well-organized, properly scheduled bus system or any type of mass rapid transit system. The transport modes in metropolitan Dhaka are classified in three major groups on the basis of type of operation and usage. These groups are private transport, para transit and mass transit. Para transit and mass transit together are also termed as urban public transport. Trends showed that growth rate for the low occupancy travel modes such as cars and cycle rickshaws, were much higher than that for high occupancy travel modes such as buses and mini buses. Rickshaw, which is an outdated mode of transport for a populous and fast growing metropolitan area, comprised about 53.3 percent of total vehicles. Where as bus, which is the major travel mode in most of the developing countries, composed only of 2.7 percent (Ahsan, 1990). As a result, major share of road space remains occupied by the small capacity vehicles particularly NMT (70%). Road spaces are also occupied by other than traffic such as dustbins, construction materials, hawkers, etc. and reduce the effective width of roadway. There are no priority measures for bus on the road and bus is the only mass transit option in Dhaka. This transport situation consequently has increased traffic congestion, travel delay, and accident and deteriorating the accessibility, comfort, safety, operational efficiency and environment.

At present, passenger transport scenario of metropolitan Dhaka shows that the existing mass transport facilities is not sufficient to keep pace the growing demand. In addition, this service is inefficient, unproductive, and unsafe. Passengers are frequently facing long waiting time, delay on plying, over-crowding, lack of comfort, long walking distance between origin and nearest bus stops and as well as between bus stops and destination. Again, a well planned city should have 25% of total area for its road network where as in Dhaka; only 9% of total area is occupied by road. Therefore, capacity of these roads with respect to the total demand of transport is much lower. That is why; an extensive study is urgent required to identify the deficiencies of existing mass transit system and to find out alternative options for solving the problems to improve the transport situation in Dhaka Metropolitan city. This paper is a part of that extensive study in which tried to evaluate the deficiencies of existing mass transit system and improvement options.

2. EXISTING MODES OF TRAVEL IN DHAKA METROPOLITAN CITY

2.1 Vehicle Ownership

Among households 7% either have or have access to a car, 4% owns motorcycle, 3% cycle rickshaw, 5% bicycle and 2% auto-rickshaw. Auto-rickshaw and cycle rickshaw are for commercial uses. The results revealed that 84% of household do not have any sort of transport vehicles and depend on public transport and only 16% have some sort of vehicles. This explains the importance of and dependency on the public transport system (STP survey, 2004).
2.2 Purpose of Trips

Travel is made for different purposes. 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%. It shows that less than one-third of trips are made for work or business and rest are for non-work or other travels (STP survey, 2004).

2.3 Travel Modes Used

A variety of vehicle and travel modes including private, public and personalized vehicles and walking are used for different trips. For simplified analysis the modes are classified into 4 primary travel modes, walk, rickshaw, transit and non-transit. Transit mode is formal motorized public transport system comprised of bus, rail and waterway services. Non-transit is motorized modes including small motorized vehicles like car and light vehicles, personalized services like taxi and CNG auto-rickshaw and Para-transit like auto-tempo, maxi and human haulers. An STP (Strategic Transport Planning) survey showed that 22% trips are made by walking, 29% by rickshaw, 31% by transit and 18% by non-transit modes.

2.4 Modes of Public Transport Used Other than Mass Transit/Bus

2.4.1 Rickshaw

Rickshaws are three wheeled cycles called cycle rickshaws. It is manually operated giving door to door services to the passengers. The rickshaws normal carrying capacity is two passengers. Because of their size, rickshaws can easily operate on lanes and by-lanes of the city. Although it is slow moving vehicle, rickshaw journey is cheaper and comfortable.

One of the main causes of Dhaka’s traffic jam is the unrestricted playing of rickshaws particularly on the main transport corridor. Reliable estimates of the non-motorized vehicle fleet are difficult to obtain. DCC (Dhaka City Corporation) limits the number of license issued to rickshaw owners to some 87,000. However, unofficial estimate claimed that the number of rickshaw playing in Dhaka is about 500,000.

2.4.2 Auto Rickshaw

The auto rickshaws are three wheeled mechanically operated vehicles, whose body is generally manufactured locally but the chassis along with the engine is imported from foreign countries. The auto rickshaws carrying capacity is three persons at the back and the driver in the front. The auto rickshaws are mechanically operated and can run on long and short distance. They are operated like rickshaws, taking the passengers to their destination and not stopping to pick up other passengers on route. The charge of auto rickshaw is 6 Tk/km and a minimum flat rate of Tk 18 (The Daily Star, 27 April 2008).

2.4.3 Auto Tempo

The auto tempo is like the auto rickshaw based on three wheeled scooter chassis, but instead of three seats behind, it’s seat arrangement is such that it can carry 10 persons at the back and two persons at the front, beside the driver. The auto tempo generally travels on specific routs. The style of operation of the auto tempo is similar to a bus rather than auto rickshaw. They play between defined points and on a defined route and pick up and drop passengers at those points or stoppage.
Like the auto rickshaw the speed is same with the auto tempo as they both have the same engine.

2.4.4 Taxi Cab

The taxicabs are like the passenger cars but are operated by a company or by an individual and available to all persons who meet the conditions of a contract for carriage (i.e. pay prescribed prices). There are mainly two types of taxicab, yellow and black taxicab. The carrying capacity of yellow cab is 4 persons and that of black cab is 3 persons. They run on metering system and fare rate of AC taxi cab is 10 Tk/km and a minimum flat rate of 40 Tk and the fare rate of black cab are 8 Tk/km and a minimum flat rate of 30 Tk (The Daily Star, 27 April 2008).

*Table 1: Parametric comparison of public transport modes in metropolitan Dhaka:

Source: STP 2004

<table>
<thead>
<tr>
<th>Mode types</th>
<th>Passengers boarding at peak hours (nos.)</th>
<th>Load factor</th>
<th>Avg. trip length (one way) km</th>
<th>No. of trips/day/vehicle</th>
<th>Passenger km per day per vehicle</th>
<th>Journey speed (km/hr)</th>
<th>Fare demand (Tk/km)</th>
<th>No. of conductor or helpers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rickshaw</td>
<td>2</td>
<td>1</td>
<td>4.8</td>
<td>35</td>
<td>252</td>
<td>9.3</td>
<td>2.7</td>
<td>Nil</td>
</tr>
<tr>
<td>Baby taxi</td>
<td>3</td>
<td>1</td>
<td>8</td>
<td>22</td>
<td>396</td>
<td>10.8</td>
<td>5.4</td>
<td>Nil</td>
</tr>
<tr>
<td>Mishuk</td>
<td>3</td>
<td>1</td>
<td>6</td>
<td>22</td>
<td>297</td>
<td>15.2</td>
<td>5.1</td>
<td>Nil</td>
</tr>
<tr>
<td>Auto tempo</td>
<td>12</td>
<td>1.2</td>
<td>6</td>
<td>18</td>
<td>927</td>
<td>21.9</td>
<td>0.47</td>
<td>1</td>
</tr>
<tr>
<td>Double Decker bus</td>
<td>102</td>
<td>1.4</td>
<td>14.5</td>
<td>12</td>
<td>8874</td>
<td>15.5</td>
<td>0.25</td>
<td>2 to 3</td>
</tr>
<tr>
<td>Single Decker bus</td>
<td>77</td>
<td>1.5</td>
<td>14.5</td>
<td>12</td>
<td>6700</td>
<td>15.5</td>
<td>0.25</td>
<td>2 to 3</td>
</tr>
<tr>
<td>Private bus</td>
<td>77</td>
<td>1.5</td>
<td>14.5</td>
<td>12</td>
<td>6700</td>
<td>15.5</td>
<td>0.25</td>
<td>2 to 3</td>
</tr>
<tr>
<td>Mini bus</td>
<td>42</td>
<td>1.2</td>
<td>16</td>
<td>14</td>
<td>4704</td>
<td>18.3</td>
<td>0.37</td>
<td>2</td>
</tr>
</tbody>
</table>

2.5 Percent Modal Split

The latest surveys of persons movement in metropolitan Dhaka under the Dhaka Urban Transport Project showed walking as the predominant mode with a share of 62 percent of total person trips. This is followed by rickshaw (13.3%), bus (10.3%), auto rickshaw (5.8%), and car (4%). In consideration of person trips by vehicle, rickshaw takes the highest share, accounting for 35 percent followed by bus (21%), auto rickshaw (1.5%), and car (10.5%) (JBIC, 2000).

It has been observed that rickshaw and walk trips have declined in the form of percentage of person trips in recent years (Hossain, 2002). Trend in change of modal split is towards motorized auto rickshaw from non-motorized rickshaw and walking. Absence of efficient mass transit is responsible for high share of passenger trips taken, by auto rickshaw. It is causing congestion and deterioration of environment (Hoque, 2004)

2.6 Road Space Used by Different Modes
Among the transportation modes, rickshaws dominate the traffic stream particularly in the inner areas of the city. Road space occupied by rickshaws is 73%, and by cars, buses and tempo is 19.7%, 4.4%, and 0.4% respectively. Following table shows the percent of road space occupied by different transport modes (DITS, 1994).

2.7 Road Space Occupied for Transporting a Person by Different Modes of Transport

According to the DITS survey report, 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)

3. EXISTING MASS TRANSIT SYSTEM OPERATION IN METROPOLITAN DHAKA

Existing mass transit system in metropolitan Dhaka is mainly characterized by large bus, mini bus and human hauler/auto-tempo. Bus and minibus routes tend to be concentrated along the limited number of arterial roads, in a generally north-south orientation. Human hauler routes are more dispersed, penetrating narrower roads, and include more east-west linkage.

3.1 Large Bus

Large buses are defined according to regulation as buses with more than 32 seats, but more generally large buses are considered to be ten (10) meters or more in length. The most significant recent change in the bus fleet composition is the increases in the number of large buses. This trend began with Sino Dipon in early 2003. They are now operating on four (4) routes with 105 buses. Green Express, which began operations in April 2004 with 20 buses, currently has 50 buses in operation on two (2) routes, and will shortly add 50 more buses. Beveco, commenced operation of 20 large buses on the Uttara to Motijheel route in August 2004. Dhaka Paribahan, a major mini bus operator in Dhaka, has recently improved 10 large CNG buses from China, which will likely be used to replace existing mini buses. All of these buses are running on CNG.

The BRTC, which operates under immunity from regulation by licensing authorities, owns a total of 306 buses operating on 15 routes in Dhaka. Of these, 203 are double-decker buses (older Ashok Leyland and new Volvo) and the remainders are standard 12 meter single decker buses. BRTC does not actually operate the buses, but sub-contracts out the operations to private operators.

3.2 Mini Buses

Mini buses are defined as buses with 15 to 30 seat capacity, excluding the driver. Most mini buses are around 8 meters in length, with locally manufactured bodies and Isuzu, Hino or Tata chassis and engines. The number of mini buses has increased rapidly since 2000. Current numbers are imprecise, but various estimates indicate that around 5,000 mini buses are in operation in Dhaka, around 2,000 of which are operating without permits or in contravention of allocated routes.

Since April 2004, the Road Transport Committee (RTC) has resolved to limit the issuance and duration of new route permit of mini buses running on diesel fuel or under individual management. Although the permit system has only a limited relevance to the number of buses
actually playing on the route, this change in policy approach appears to be having some effect, as new operators are beginning to use large buses.

3.3 Human Haulers/Auto-Tempo

Human haulers are 9 to 15 seated, generally in the form of a converted pickup truck with two benches added for passenger seating. Most have diesel engines, although some are petrol fueled and a small number have converted to CNG. A total of 1,609 route permits had been awarded to human haulers as of June 2004, operating on 45 routes (STP, 2004).

Human haulers have been allowed to increase rapidly at the same time as the two-stoke auto-rickshaws were phased out, in order to help meet the demand for public transport. However, the government, through the Dhaka Road Transport Committee, is currently discouraging new human hauler route permit applications.

3.4 Use of Bus as Public Transit

An attitudinal questionnaire survey was made by STP in 2004 on public transport. In reply to a question on ‘reasons for using bus as usual travel mode’ respondents said they preferred bus journey because of various reasons. Almost 73% said it is cheaper, 69% said they don’t have any other alternatives, 31% said it is more or less reliable, 21% said it save time, 26% said it is convenient and comfortable too and 22% said it is comparatively safer. Only 10% said that they take bus because they cannot use their car to get to their work place due to the problem of parking.

3.5 Average Trip Length, Travel Time, Speed and Carrying Capacity of Existing Mass Transit System

STP conducted a survey on Average trip length, Travel time, speed and carrying capacity of existing mass transit system and got the following scenario.

Table 2: Average trip length, Travel time, Speed and carrying capacity of existing mass transit system:

<table>
<thead>
<tr>
<th>Mode</th>
<th>Average route length</th>
<th>Average journey time (min)</th>
<th>Average travel speed (km/hr)</th>
<th>Average running speed (km/hr)</th>
<th>Average Boarding (Passenger)</th>
<th>Pass-load at max. point</th>
<th>Average Stops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mini bus</td>
<td>20.12</td>
<td>65.0</td>
<td>17.14</td>
<td>23.19</td>
<td>79.27</td>
<td>39.1</td>
<td>16.56</td>
</tr>
<tr>
<td>Large bus</td>
<td>14.7</td>
<td>71.09</td>
<td>13.7</td>
<td>17.8</td>
<td>89.6</td>
<td>44.9</td>
<td>12.3</td>
</tr>
<tr>
<td>Double Decker</td>
<td>17.81</td>
<td>56.83</td>
<td>17.22</td>
<td>23.45</td>
<td>100.76</td>
<td>83.71</td>
<td>13.67</td>
</tr>
<tr>
<td>School/Staff bus</td>
<td>13.5</td>
<td>37.25</td>
<td>20.9</td>
<td>23.0</td>
<td>44.4</td>
<td>43.4</td>
<td>7.8</td>
</tr>
<tr>
<td>Auto-Tempo/Maxi</td>
<td>5.8</td>
<td>22.0</td>
<td>17.0</td>
<td>20.1</td>
<td>18.4</td>
<td>14.7</td>
<td>5.4</td>
</tr>
<tr>
<td>All mode</td>
<td>14.54</td>
<td>50.6</td>
<td>17.24</td>
<td>21.71</td>
<td>60.3</td>
<td>34.78</td>
<td>12.0</td>
</tr>
</tbody>
</table>

Source: STP Survey, 2004
4. DEFICIENCIES IN EXISTING MASS TRANSIT SYSTEM

Current supply of mass transit is much lower than the actual demand. At present, only 31% of daily trips made by mass transit where as this was only 22% in 1994 (DITS 1994). Not only the lack of this supply, there are also many other deficiencies in the existing system of mass transit. These deficiencies can be viewed from Road limitations, Operational difficulties and users points of view.

4.1 Road and Roadway Deficiencies

4.1.1 Limited Road Space

As in many other cities in the region, systematic bus route planning based on a cycle of monitoring, planning, and implementing adjustments to the network is not in place in Dhaka. The total road length of the DCC area is 1286 km where as primary, secondary, connector, local and narrow roads are 61.348 km, 116.404 km, 219.543 km, 569.868 km, and 318.271 km respectively. There are four types of road surfaces available in the city among them, 70% bituminous road, 25% concrete road, 3% brick and rest 2% earth is road.

Total space occupied by roads and streets of Dhaka Metropolitan City is only 9% of its total space while that of other mega cities cover approximately 25%. Though 9% of road area of the city is available, pavement area is only 6% of total area (RMMS, 2004).

4.1.2 Lack of Accessible Road

The road in which at least one four wheeler motorized emergency vehicle like Ambulance or Fire brigade vehicle can easily move is termed as accessible road. In Dhaka city, there is a lack of sufficient accessible road. It is estimated that among the existing road network about half of the road lacks sufficient width to accommodate motorized emergency vehicles. From Table 5, it is observed that in the 1, 2, 3 and 7 zones more than 50% of road is inaccessible to large sized vehicles particularly to public transports. In Dhaka city out of 1286 km road about 821 km of road is found to be accessible (if road width is equal and more than 4.5 m) to motorized vehicles. Area wise, road and pavement constituted 5.49 and 7.83 sq. km respectively and road density per sq. km area is only 6.12. (RMMS. 2004)

4.1.3 No Road Network Pattern

As road network of Dhaka City evolved haphazardly without any plan and always to meet short term travel need, the total road network does not show any well defined configuration. Instead, it is expanded eccentrically in the north-south direction and allowing uncontrolled ribbon development.

4.1.4 Unorganized and Non-Integrated Road Network

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. This also poses a serious problem to provide other network infrastructures for utility services.

4.1.5 Absence of East-West Continuous Road
In the city, there is not a single continuous main road in east-west direction. The road, which are existing in this direction all are formed as a connecting road or link road. Therefore, vehicle cannot move thoroughly in that direction. Absence of east-west connection has become the major problem for the entire road network of Dhaka. Presently, such requirements are meeting by relatively narrow and poorly aligned roads, which are far beyond to meet the existing demand in terms of capacity, speed and level of service.

4.1.6 Lack of Continuity of Main Road

In Dhaka metropolitan city there are many main roads that are ended at an inappropriate location. For which the road loses its functionality, causes T-junction and thereby loses continuity.

4.2 Operational Deficiencies

4.2.1 Mixed Operation in Major Roads

Road network of Dhaka city is characterized by mix traffic system. All types of vehicles, both motorized and non-motorized vehicles are in operation on each and every road, except some NMT restricted routes. Where, all types of vehicles are played on the road, majority of road spaces occupied by rickshaw as described in article 2.6. Because of the presence of non-motorized vehicles, travel speed is significantly reduced for motorized vehicles and a huge congestion occurred. To realize the facts comparative picture with and without NMT of Azimpur to Technical route (Mirpur Road) are shown below.

Photograph 1: New Market road with rickshaw and without rickshaw

Even where non-motorized vehicles are restricted, the majority of road space is occupied by three wheeler vehicles.

4.2.2 Low Roadway Capacity & Speed

Due to the complex mixture of motorized and non-motorized traffic and non-lane based movement over the Dhaka city road network, the capacity & speed of vehicles has abruptly decreased. The capacity of road lane and speed of the transport mode are very low compared to other capital cities in the world. That is how the city is facing huge traffic congestion at everywhere of the Dhaka city.

| Table 4.11: Existing Road Capacity and Speed of Dhaka City road links |
|---------------------------------|------------------|-----------------|----------------|
| Primary Road                   | Capacity/veh/h   | 1859 Capacity/veh/h | Speed km/h |
| Category                       | 495 vehicles     | 1959 vehicles     | 26 km/h     |
| Primary                       | 495 vehicles     | 2659 vehicles     | 20 km/h     |
| Secondary                     | 926 vehicles     | 1959 vehicles     | 24 km/h     |
| Category                       | 286 vehicles     | 1959 vehicles     | 15 km/h     |


Source: Strategic Transport Plan (STP) study-2004

4.2.3 Absence of Bus Priority Measures
Public transport is currently not given any priority over other vehicle types and road users. Various forms of bus priority ranging from traffic signal priority measures and bus lanes to possibly dedicated bus-ways should be considered for application in Dhaka. There is no bus-only routes or segregated bus lane on roads.

When considering bus priority measures, care should be taken to ensure that measures are devised to improve bus service and travel times rather than being devised to remove obstacles to the flow of other modes of traffic. For example, given the very high flow of buses in Dhaka, bus lanes could be counterproductive and could exacerbate bus congestion if they are poorly designed.

4.2.4 Poor maintenance and surface condition of roads
The surface conditions of most of the roads are very poor. The surface of the roads are not smooth, as a result, journey through vehicles on such roads is not comfortable. Because of the absence of periodic maintenance of the roads, a lot of potholes exist on the surface of the roads. Rain water is stored in these potholes and surface becomes worst. Travel on such roads is very much risky and accidents may occur on such roads. If vehicles are operated continuously on such roads, vehicle’s parts may damage.

4.2.5 Road space occupied other than traffic
Most of the roads are not fully used by traffic. Presence of dustbin on roads is very common in Dhaka city. This significantly reduces the effective road width for traffic use. Road spaces are also occupied by hawkers and retailer traders. In many places, construction materials for building are placed on the road. These cause reduction in effective road width and make the road unsafe for vehicles. Again, on-street parking also reduces road spaces and hinders smooth flow of traffic.

4.2.6 Unacceptable Railway level Crossings
Almost 18 (eighteen) railway level crossing run through the Dhaka city creating interruption during passage of train on both side of rail gates for an average of 4 (four) hours in each day. Suspension of traffic flow due to closer of rail gates serves to compound the prevailing chaos. Everyday 52 outgoing and incoming train pass through the level crossing in the city, out of which 40 trains operate between 8 am to 10 pm. A period of 10 minutes of average is required to give a train its passage at each level crossing, creating convergence, with its fall out effects spreading all over the city.

4.2.7 Lack of Bus Lay on Road
There is very few designated place for bus stoppage in road side of Dhaka city. Most of the bus stop in road side haphazardly with competition attitude and alighting and boarding passenger dangerously. This makes always crowed on road side and influence pedestrian to move on road as well as decreases the effective width of the carriage way.

### 4.2.8 Ownership Problem
Buses, which are main mass transit system in Dhaka, are operated by government authority and by privately. The BRTC, which operates under immunity from regulation by licensing authorities, owns a total of 306 buses operating on 15 routes in Dhaka. BRTC does not actually operate the buses, but sub-contracts out the operations to private operators. BRTC’s financial performance has deteriorated between 2000 and 2003. Revenues have more than doubled; costs have nearly tripled over this period. The loss for the year ending 30 June 2003 was Tk 384,594,000 (USD 6.4 million) although if depreciation and interest payments are not included, BRTC revenues exceed short term operating costs. Revenues from all areas rose substantially but costs increased at an even greater rate in the period 2000 to 2003 (STP, 2004).

The main problem of privately operated bus services is that buses are owned by a large number of operators. There are many operators who have only 2 to 3 buses and some private bus operators have 30 or more buses. Drivers and crew in this category either own the vehicle individually or rent the bus on a daily or monthly basis. They then operate the vehicle at their own revenue risk, requiring enough passengers per day to repay the bus rental fee, cover fuel and basic maintenance costs, and make a profit. No employment guarantees or professional management is provided, and the driver and crew handle all fare payment on the bus.

### 4.2.9 Deficient and Improper Place of Bus Terminal
Dhaka is served by three inter-city bus terminals which are conveniently located with respect to the corridors they serve: Saidabab- Southern Corridor, Mohakhali- Northern Corridor, Gabtoly North-Western Corridor. The areas at Gabtoli and Saidabad (3.15 and 4.10 hectar) are very limited to comply with existing demand. All terminals are poorly designed with respect to terminal system requirements. Many components of the system are totally absent along with some basic amenities. Utter disorder in using the terminal space, lack of management and indiscipline of drivers and passengers are other reasons for congestion all those inter-city bus terminals. Fulbaria Road is the main terminus for intra-urban buses, which also experiences extreme congestion, mainly induced by buses lying over the whole road haphazardly and absence of terminal facilities. Moreover, there is an acute shortage of bus stands with adequate facilities throughout the city (except recently introduced Premium/BRTC services). Hence buses frequently stop here and there affecting smooth flow of traffic. Objectionable Driver's behavior is sometimes responsible for further miseries particularly near intersections. Besides this there are so many deficiencies in regulatory measure like poor loading and unloading, on street ticket counter etc.

### 4.2.10 Less Productive Intersections
Intersection capacity is always reduced by the frequent stopping or public transit vehicles, especially buses, tempos and rickshaws, inside the intersection. Again there is no practice of clearways in Dhaka that severely inhibits the performance of intersections. The performance of intersections are gradually deteriorating and becoming worse due to various reasons like high influx of non-motorized vehicles, especially rickshaws, minimum turning provisions, indiscriminate pedestrian crossing, inefficient signal control, absence of appropriate
channelization devices, roadside land use pattern uses of bus stop, Taxi/Tempo/Rickshaw etc stand, poor enforcement of law etc.

4.2.11 Non-Coordinated Transport System
The existing modes and sub-modes (bus-water-rail-NMT) are acting independently of each other. STP survey data shows that ass a primary travel mode for all trips, only 31% are made by public transport of which most of trips are completed by using bus. Travel share of other transit system viz. rail and water are very insignificant. Nearly 70% of all trips are made either by walk, rickshaw or non-transit modes etc (DITS, 1994). It is to be mentioned here that the peak hour commuter movement of Dhaka city is mainly road based. Other alternative travel systems viz. rail and water has inherent weakness, as they are not aligned with the inner city commuter movement paths.

4.2.12 Absence of Automated and Integrated Traffic Signals
There are about 1932 nos. of signal lights points all over the streets of Dhaka City. The operational and maintenance cost of these lights is about 4 cores Taka. But this huge cost goes almost in vein, because in most of the cases the lights are not functioning now. The traffic police control the flow with the hands. In some cases traffic signals are found to be obscured by hoarding, billboards, branches of trees etc. Thus the influence of signal lights on traffic flow is almost nil (JBIC, 2000).

4.2.13 Poor Interface Provisions
Deficiency in the provisions of interface is largely responsible for much of the operational problem of the city’s transportation system. Passengers of buses require adequate and efficient facilities for changing mode to reach their ultimate destination. Most of them are served by rickshaws, baby taxis, tempos for this purpose. But bus and these modes are hardly linked and appropriately designed for efficient integrated services. Often a large swarm of rickshaws remain standing in bus-stands blocking the way for buses to move forward or come closer to the footpath. Again there provision for baby taxis, tempos, taxi-cabs to park properly and collect passengers from buses and thereby creating a chaotic situation at most of the bus stoppages in the city.

4.3 Deficiencies from User Point of Views
Most of the existing bus services are uncomfortable, inconvenient, and unsafe for the passengers. Most of the buses are owned privately and they operate it completely from commercial point view. They seek more and more profit and don’t care about passengers’ facilities. They always compete with other buses to pick up the passengers from route and try to get the pick up spot first and to do so; they often cause safety problems for passengers. During off peak hour, they wait for long time at bus stops to full the bus and cause a huge delay for passengers to get their destinations. There are many other difficulties for the people who are using the buses such as:

4.3.1 Lack of Passenger Information
Passenger information, in terms of route maps, schedules, or service time coverage, is virtually non-existent. Furthermore, most buses are not identified by route number. Some are identified with display boards showing the origin and destination of the route. For the majority of buses in the city, however, passengers rely either on familiarity with the route, or on the instructions shouted out by the bus conductor/helper while the bus slows down or stops at bus stop.
4.3.2 Inadequate Bus Stops

Bus shelters in Dhaka are generally absent, or, where provided, are generally unused (at least by bus passengers) and often in a derelict condition. Passengers waiting for buses do so in poor conditions unprotected from wind, rain, and sun or passing vehicles. Passengers waiting for buses in Dhaka generally do not have access to bus shelters, passenger information, shelter from weather, or any other facilities.

4.3.3 Problems of Bus Journey

Many of the bus riders express the view that bus journeys in Dhaka are hazardous. In reply to the question ‘what are the existing problems you face in bus travel mode’ they mentioned several problems. About 56% mentioned that bus stop is away from their residence; another 32% said there is no bus service to their localities. Again 20% said the bus take longer travel time and another 18% said they need several transfers. Besides, almost 52% said the bus is not comfortable and another 16% said they are unreliable. About 4% of the respondents feel bus journey is dangerous (attack during political program, fire incident, death and injury, etc.) and 15% feel they are unsafe (pick pocketing, hijacking, robbery, mal-treatment, abuse and physical assault by crew staff).

5. WARRANTS FOR IMPROVING THE MASS TRANSIT SYSTEM

5.1 Growth of Transport Demand

According to the results of the STP home interview survey it was found that in 2004 the daily travel made by an average household is 9.01 trips. According to this estimate 2.2 million city households are making approximately 19.8 million trips per day. Due to rapid growth of population in Dhaka, the projected trip generation per day for the next 20 years period is 159.63 million which is about 8 times higher than the current trip generation per day. For such a large city and huge travel demand, mass transit is a prerequisite for its transportation system.

5.2 Growth of Travel Trips

Since DITS 1994 the growth of travel trips has occurred more than 11% per year considering all modes. The growth of trips by vehicular traffic modes was tremendous. The numbered NMT rickshaw trips have increased from 1.48 million a day to 5.98 million a day, more than 4 times higher than DITS. The motorized transit mode has increased from a tiny 0.38 million a day to 6.13 million a day more than 16 times higher while the non-transit trips also increased from 0.9 million a day to 3.37 million a day representing approximately 4 times higher than previous study. The walk trips on contrary decline from 5.15 million a day to 4.3 million a day in STP, which is 82% of the earlier figure.

The growth of vehicular trips needs special mention as it has increased from 2.76 million a day in DITS to 15.44 million a day in STP, an increase of about 6 times. The unauthorized growth of rickshaws has multiplied the traffic problems in Dhaka.

5.3 Growth of Vehicle Fleet

At present the city has approximately one million vehicles including NMT. If the rate of growth of the whole fleet is considered at random, then the city will have two million in 2010,
three million in 2015 and five million in 2020. Considering the present road space and usual low growth of the city network, this number cannot be accommodated.

5.4 Congestion Cost

The congestion is growing day by day in Dhaka like many other developing mega cities particularly in Asia. The situation here is being complicated due partly to the existence of an overwhelming number of non-motorized slow moving vehicles sharing the same road space. The economic loss due to congestion in Dhaka City was estimated at $140 million per annum in the major arterials and corridors only (Economic Loss Due to Traffic Congestion, DTCB, 2003). If the congestion in the whole city network is considered including narrow roads, NMT roads, lanes and bi-lanes the figure will go up enormously.

6. IMPROVEMENT OPTIONS

To cope with the existing demand and to get relief from the deficiencies mentioned above, integrated and holistic measures should be taken encompassing with different sectors related to Dhaka transport system in different phases like short term, intermediate term and long term. Some of the short term and long term measures to improve the existing system of mass transit are listed below:

6.1 Short Term Measures

- Proper and satisfactory use of all of the road spaces should be ensured by reclaiming road space which are currently occupied by uses other than traffic. In the process, road side hazards should be managed and NMT (rickshaws, etc.) should be banned from all major roads to achieve faster movement of vehicles leading to higher productivity.

- To improve the behavior, ensure competency to handle vehicles properly and promoting awareness of the rules and regulations of the road, drivers’ licensing scheme should be strictly controlled.

- Restructure the bus operations from a large number of small and individual operators into a smaller number of large operators. In order to bring efficiency in the existing public transport system, there is a need to merge fragmented bus owners into cooperatives, to facilitate introduction of bus route franchising system.

- Encourage consolidation of the industry into larger operating units which operate under a company rather than an individual basis. This will ensure regular movement of buses and pick up passengers from the predefined bus stoppages and no competition for getting passengers. Buses that are operated under a company, wages are paid to driver in monthly basis rather than contact basis. So, drivers will feel more secured themselves and drive their buses safely.

- Government should give subsidy if the buses are owned by a company, so that they are able to maintain a bus dipo for garaging their buses. This will reduce garaging the bus on the road and ensure through movement of other vehicles.
• Buses may be owned by government and opened to share market. If the shares are taken by public then automatically sympathy will be gained for the bus since they will think it as their own property.

• Restrict on-street parking that will ensure through movement of traffic without getting hinder by parking vehicles. Therefore, off-street parking needs to be created and at the same time restriction on on-street parking should be strictly enforced for certain periods of the day, and on certain days of the week.

• Considering that substantial number of people use “walking”, as a mode, emphasis should be given to develop required pedestrian facilities in terms of footpaths, zebra crossing and foot over-bridges, to make walking more safe and interesting.

• Improve the intersections such as appropriate signal time with demand basis, channelization of intersections, signalized crossing facilities for pedestrian etc. so that they perform better.

6.2 Long Term Measures

• Alternative routes should be facilitated by constructing some of the east-west missing link to provide continuous connectivity with east part to west part of the city and to distribute traffic in all direction.

• Construction of a few fly-overs across major railway level crossing, namely at Kuril, Moghbazar and Mouchak level-crossings.

• In order to improve the regional highways, depending on traffic volume, private sector could be invited for developing toll based limited access highways together with toll free service roads, using the existing RHD’s right of ways (ROW).

• Provision of bus priority measures such as segregated bus lane, bus only routes, bus-lay at bus stoppage to pick up and discharge of passengers.

• Programs for behavior modification include public education and training, together with enforcements and sanctions.

• High occupancy vehicle like Bus rapid transit (BRT) and commuter train service should be introduced to recover the existing demand and near future demand.

• 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.

Concluding remarks
Inadequate road infrastructure, lack of traffic policy and management practices, absence of a dependable public transport system along with somewhat uncontrolled manner of land use development have resulted a chaotic traffic situation in Dhaka. In this regard some options for improvement were discussed elsewhere including selection of a substantial variety of new modes and concepts of operation. In this paper an attempt has been made to present the operational characteristics and deficiencies of existing mass transit system in Dhaka metropolitan city. It is a well established fact that adequate and efficient mass transit service plays an important role in combating the ever-worsening problems of traffic congestion and improving safety within urban areas. Various approaches should be examined and could be applied to overcome the deficiencies in existing mass transit system in major cities of Bangladesh. Indeed, augmentation of improved and modern mass transit system is an urgent requirement to ensure mobility need, safe, efficient and comfort movement and livable urban environment for the Dhaka city in future. According to JBIC the improvement and expansion of public transportation in Dhaka is largely dependent on the role sharing among the three major modes of buses, auto rickshaws and rickshaws. To meet the existing and future public transportation demand in a large city like Dhaka, the expansion of a mass transit is a must, which in the context of Dhaka refers to “bus”. How to sustainable expand and improve the bus system and service while allowing auto-rickshaw and rickshaw to provide complementary services is the core issue in public transportation development in Dhaka. The improvement of bus system and service is critical. In longer term, rail based rather than road based mass transit system (metro, monorail) seems to be more appropriate with desired service quality of trip makers of Dhaka. The urgent issues like prevailing socio-economic context, the deteriorating environment of Dhaka, serious urban road accident situation, scarcity of road space, population relocation, and future adaptability have been stressed for the introduction of a dependable mass transit system. Detailed study for the introduction of recommended long term options have been suggested given due emphasis on urban dwellers’ characteristics, land use patterns, economic aspects of construction, traffic capacity, route selection and technical characteristics.

REFERENCE

DTCB (2003), “Economic Loss Due to Traffic Congestion”, Dhaka Transport Coordination Board (DTCB), Dhaka-1000
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