

Augmentation of Mass Transit Mode in Dhaka, Bangladesh

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ABSTRACT: Dhaka, the capital of Bangladesh is one of the least motorized mega cities in the world with a current population of over 10 million at annual growth rate of nearly 8 percent. The rapid rise in population along with increased and versatile urban land use patterns have generated considerable travel demand as well as numerous transport problems in Dhaka. It has resulted in deterioration in accessibility, service levels, safety, comfort, operational efficiency and urban environment. The congestion and pollution problems are rapidly growing due to the combined effects of rapid motorization and urbanization. There is now an ever-increasing urgency for mitigating the complex transportation problems in Dhaka by augmentation of mass transit modes. It is observed that share of mass transit is very low which is only 27 percent of vehicular trips and walking still remains as the dominant travel mode with nearly 62 percent of total person trips. 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 in the form of bus has not been able to increase its share of catering demand for its service deficiencies like crowded condition, long waiting time, lack of easy transfer, large distance of bus stops from origin, long boarding time. There is an urgent need for augmentation of present mass transit system to cater for such service deficiencies. In this paper an attempt has been made to venture for a standard mass transit system to provide the desired service characteristics. Dhaka, being a developing city with poor economy, less cost intensive mass transit system has been emphasized. The urgent issues like deteriorating situation of road safety in metropolitan Dhaka, degrading urban environment, scarcity of road space, population relocation from city center have also been given importance in the investigation of augmentation of mass transit system. As a potential mass transit option in Dhaka, rail based mass transit system tramway has been highlighted with description of its inherent benefits of cost and service characteristics with particular reference to the prevailing socio-economic context and in the light of major themes of the conference.

RESUME : Dhaka, capitale du Bangladesh, est une des mégapoles les moins motorisées du monde avec une population actuelle de plus de 10 millions d'habitants et un taux de croissance annuel de presque 8 pour cent. La hausse rapide de la population avec des projets d'utilisation des sols urbains en augmentation et polyvalents a produit une demande de transport considérable ainsi que de nombreux problèmes de transport à Dhaka. Cela a entraîné une détérioration de l'accessibilité, des niveaux de service, de la sécurité, du confort, de l'efficacité opérationnelle et de l'environnement urbain. Les problèmes d'encombrement et de pollution augmentent rapidement en raison des effets combinés de la motorisation rapide et de l'urbanisation. Il y a maintenant une urgence croissante pour atténuer les problèmes de transport complexes à Dhaka par l'augmentation des modes de transport public. Il est observé que la part du transport public est très faible, puisqu'elle représente seulement 27 pour cent des déplacements automobiles et la marche reste toujours le mode de déplacement dominant avec presque 62 pour cent du total des déplacements de personnes. En l'absence d'un système de transport public sûr et adéquat, une grande part de l'espace routier reste occupé par les véhicules de petite capacité. Le système de transport public existant sous la forme d'autobus n'a pas été capable d'augmenter sa part pour palier ses défauts de service tels que l'aspect surbondé, les longs temps d'attente, le manque de transfert facile, la grande distance entre les arrêts d'autobus à partir du point de départ, les longs temps d'embarquement. Il y a un besoin urgent de développer le système de transport public actuel pour faire face à de tels défauts de service. Dans la communication, on a tenté de se risquer vers un système de transport public standard pour fournir les caractéristiques de service souhaitées. Pour Dhaka, une ville en développement avec une économie pauvre, on a mis en évidence un système de transport public intensif à faible coût. On a aussi donné de l'importance aux questions urgentes comme la détérioration de la situation en matière de sécurité routière dans la métropole de Dhaka, la dégradation de l'environnement urbain, la pénurie de l'espace routier, la relocalisation de la population du centre ville dans l'enquête sur le développement du système de transport public. Comme option potentielle de transport public à Dhaka, le tramway, système de transport public basé sur le rail, a été mis en évidence par ses bénéfices inhérents de coût et des caractéristiques de service avec une référence particulière au contexte socio-économique dominant et dans la lumière des thèmes principaux de la conférence.

1. INTRODUCTION

It has become increasingly clear 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. This paper discusses issues and needs for augmentation of mass transit modes in metropolitan Dhaka and forms part of broader study (Hossain, 2002) on introduction of tramway as a mass transit mode in Dhaka. Dhaka, the capital of Bangladesh is one of the least motorized mega cities in the world with a current population of over 10 million at annual growth rate of nearly 8 percent. The rapid rise in population along with increased and versatile urban land use patterns have generated considerable travel demand as well as numerous transport problems in Dhaka. It has resulted in deterioration in accessibility, service levels, safety, comfort, operational efficiency and urban environment. Rapid motorization has been followed by rapid urbanization. From the modal split information it has been observed that trends in change of passenger trips in percentage is towards motorized mode from non-motorized modes in Dhaka. But this rapid growth of motorization with urbanization has been accomplished in an inefficient and uncontrolled way.

The present passenger transport scenario of metropolitan Dhaka shows that the existing mass transport facilities are not sufficient to keep pace with growing population. Growth rates for low occupancy vehicles are higher than those of high occupancy vehicles, such as buses and minibuses. As a result major share of road space remains occupied by the small capacity vehicles. This transport situation consequently has increased traffic congestion, travel delay and accident. The paper argues that the Augmentation of present mass transit system has therefore become a central issue for solving urban transport problem in Dhaka metropolitan area.

2. BRIEF DETAILS OF METROPOLITAN DHAKA

Dhaka, the capital of Bangladesh, is one of the least motorised mega cities in the world. Between 1960 and 2000 Dhaka grew rapidly from 1 million population to 10 millions. The following are the brief details of Dhaka:

- Population –10 million with a growth rate of 8 percent per annum.
- Dhaka as percent of Bangladesh – 8 percent, and accounts for 33 percent of total urban population

- Poverty incidence – 54 percent (highest in Asian cities).
- Dhaka's contribution to country's GDP – nearly 15 percent.
- Road network–3000km (with only 450km primary and secondary/ collector roads).
- Road vehicles nearly 250,000 with huge number of rickshaws (500,000).
- Trip percent catered by Mass Transport – 10 percent.
- Cost of congestion and accidents – Tk. 3,000 crore (US\$ 520 million per annum).
- Air pollution and noise level 4 (in 1-10 scale).
- Urban road accident fatalities – 400 (reported per annum).
- Percent road fatalities who are pedestrians -60 percent.
- Non-existent of qualified traffic engineering professionals.

The combined effects of enormous increase of both motorised and non-motorised vehicles, large scale urbanisation, influx of huge number of people from rural area, absence of adequate, organised, dependable mass transit system, indisciplined and poorly managed traffic control system in conjunction of with inherent deficiency in planning, designing and maintenance of roadway and street systems created a hazardous travel environment in the metropolitan area.

3. DHAKA'S TRAVEL MODAL SPLIT AND ITS IMPACT

3.1 Present 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 (15.2%), car (10.5%) (JBIC, 2000).

3.2 Trends in Modal Split

It has been observed that rickshaw and walk trips have declined in the form of percentage of person trips in recent years (Hossain, 2002). Rickshaw's contribution has reduced from 47.8 percent (1992) to 35 percent (1999) of person trips by vehicle. Walk trips have lessened from 64.9 percent (1992) to 62 percent (1999) of total person trips. But auto

rickshaw trips and trips by car have increased. In percentage of person trips by vehicle, share of auto-rickshaw has increased from 3.3 percent (1992) to 15.2 percent (1999). Bus takes almost the same share of person trips in percentage in between this time period. So 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.

3.3 Traffic Induced Pollution

Air quality in Dhaka has already reached at an, alarming stage in many aspects according to the department of environment (DOE) and other sources. Average hourly concentration of Carbon mono-oxide (CO) and particulate matter (PM), concentration of lead in blood among the residents of Dhaka have exceeded the danger level. In the roads of Dhaka city the concentration of oxides of nitrogen (NO_x), oxides of sulfur (SO_x), carbon mono oxide (CO) and suspended particulate matter (SPM) are 500, 1200, 7500 and 2500 µgm per cubic meter respectively which far exceeds the acceptable limit set by WHO. Bus has contributed significantly to increase concentration of NO, PM, SO₂. Auto rickshaws are the major contributors to CO, HS emission (31%) followed by cars (31%) and motorcycle (24%)(JBIC ,2000). These three modes are also responsible for high concentration of lead in air in Dhaka.

3.4 Urban Road Safety Problems

With the dominance of walk mode in Dhaka, current statistics revealed a deteriorating situation of road safety in the case of pedestrians in metropolitan Dhaka. Pedestrians as a proportion of road accident deaths increased from 43 percent in 1986-87 to 67 percent in 1991-92. In most recent years (1996-1998) the number of pedestrian casualties has increased markedly, from 433 in 1996 to 588 in 1998, an increase of about 29 percent. With fatal accidents 70 percent was 'pedestrian-motorized vehicle' collisions. With continuous growth in urban population in Dhaka particularly the urban poor, the risk to pedestrian safety is expected to be worsened in the future which demands comprehensive safety measures be initiated. Further details about road safety problems could be seen in Hoque and Alam(2002).

4. MASS TRANSIT SYSTEM IN DHAKA AND ITS IMPROVEMENT STRATEGIES

The mass transport facility in Dhaka is composed of individual private sector operators with almost complete dependency on small capacity minibuses, the exception being some standard single deckers and double deckers operating on a minority of routes.

4.1 Bus Transportation in Dhaka

It is observed that bus traffic in Dhaka is on a level of baby compared with other cities (DSM Consultants, 2000). Colombo which has a population of 4.6 million, has over 7600 buses and minibuses while Dhaka with 10 million has around 2000. Today's bus operation in Dhaka is characterized with the existence of 750 individual bus owners. In developing countries the common effort is price control in public transport. Forcing the ticket prices to such that traveling is possible for the poor, makes the private operations unprofitable, unless driving overcrowded buses. So the quality of transport stays poor and not appreciated by the travelers (DSM Consultants, 2000). This is the true scenario of bus transport in Dhaka. Investment is not increasing in enlarging bus fleet in Dhaka for the probability of unprofitable business.

4.2 Factors of Poor Service Quality Transport in Dhaka

The present mass transit mode in the form of bus passenger transport has not been able to be popular and grow its share of catering demand. Japan Bank for International Cooperation(JBIC) data sources reveal that service deficiencies indicated by users of rickshaw are crowded condition of bus, long waiting time, lack of easy transfer, bus stops are not near from origin, long boarding time. Service deficiencies indicated by bus users are discomfort and congestion (Figures 1 & 2 are typical examples). A survey on pedestrians detected service deficiencies in the form of long waiting time, long travel time, lack of comfort, lack of stoppages etc.



Figure 1. City Street Scene in Dhaka



Figure 2. Bus Riding in Metropolitan Dhaka.

4.3 Strategies of Mass Transport Improvement in Dhaka

It is expected that Dhaka will have to accommodate an additional two million people within Dhaka City Corporation and some five million within the metropolitan area within 15 years (JBIC, 2000). The population and its trend in Dhaka is indicating the possible bus fleet need of 10-15000 instead of current 2000 which would take several years to achieve. Moreover, within large metropolitan areas like Dhaka with a population of over 10 million, it is unsuitable and uneconomical to operate only one exclusive public transportation system (Ahsan, 1990). From this viewpoint introduction of improved mass transit is important. Development of bus ways and bus priority facilities, development of LRT are included in mid to long-term measures of urban transportation improvement measures in Dhaka. Recently steps have been taken for finding possibility of monorail (overhead bridge system of transit) and underground railway.

But both the ideas seem to be unrealistic in context of Dhaka. Metro is a very high capital and operating cost system. Besides, metro system is appropriate for city income which is not low, typically at least 1800 US dollars per person (ADB, 2001) which may require a long time to achieve in the context of Dhaka. In the context of low income developing country, bus ways, light rail transits seem to be realistic solutions of urban transportation problem of metropolitan Dhaka.

5. MASS TRANSPORT OPTIONS

5.1 Various Mass Transit Options

Revitalization of public transport is a core issue in the context of rapid motorization. Improving quality of public transport, increasing public transport

capacity and thus relieving traffic congestion are the significant strategies. There are several options in mass transit facility including Bus way; Tram, LRT (Light Rail Transit) and Metros. Their characteristics are briefly reviewed:

- ❖ **Bus way:** Bus ways are controlled access facilities dedicated for bus service separated from general traffic, often with grade-separated rights of way. These are generally segregated sections of roadway within major corridors with horizontal protection from other traffic, and priority over other traffic at junctions, which are generally signalized (Martinelli, 1996).
- ❖ **Tram:** Tram is an urban rail based system operating along streets in mixed traffic. It is a basic form of LRT that has limited rights of way, sharing road space for much of their route length with ordinary traffic. Tramways provide a slow, low capacity but cheap form of transit. The vehicles run on roads flush with the roadway and consist of trams that can carry about 100 to 200 sitting and standing passengers. Trams operating in single units in mixed traffic with headways of one minute are able to carry 6000 passengers per hour per track, journey speed is about 12 km/hr. This capacity can be boosted to 12000 by providing larger trams and can be further increased to 15000 if the vehicles operate on exclusive right of way. Trams and streetcars typically have high floors and steps to street level (like buses).
- ❖ **LRT:** LRT systems have segregated but not necessarily grade separated right of way. These systems usually employ vehicles and track construction that are less substantial than a full metro system. Speeds, capacity and overall performance are generally lower than for fully grade-separated rapid transit. It is economically justified in urban area where conventional rail rapid transit may not be feasible. LRT has a relatively higher frequency of stops when compared to rail rapid transit. It has high platforms similar to a metro. Some systems have at grade crossings (with or without traffic signal priority) and low-level platforms. LRT trains may be made up to two or three cars, with a total capacity of up to 750 passengers (250 passengers per car).
- ❖ **Metros:** A metro is fully segregated, usually elevated or under ground, is often referred to as an underground railway (Subway), but can, in fact, be any grade-separated urban railway. The track and electric vehicles are similar to suburban railways though with closer station spacing. Trains may have 6-8 cars, with a total capacity of up to 3000 passengers, in some cases trains are operated over an extensive network. It has high capacity at an extremely high cost.

5.2 Tramway as a Mass Transit Option

Tram is a slow, low capacity but cheap form of mass transit and it is a basic form of light rail transit. (Gardner Rutter & Kuhn 1994). Tramway has been found to be the cheapest in the systems of light rail transit in terms of total cost per passenger km. Public transport based on tracks like tramway has many advantages over other forms which include the following (TRAMS For BATH Group, 2001):

- ❖ Low operating cost: At a particular level of passenger loading the tram becomes cheaper than bus way. As passenger loading increases, a bus service will find, it needs progressively greater investment in vehicles; running costs will also increase proportionally. The gains due to 'economies of scale' are slight. The bus finds an economical operating point at a relatively high fare and fewer passenger journeys, whereas the tram is most economical when carrying large numbers of passenger journeys at a cheap fare.
- ❖ Fare and tendency of attraction of flexible demand: As tramway is a low running cost high capital-cost business; the major financial outgoings are fixed debt servicing and repayment costs and much more competitive cost can be offered. Tramways are much less susceptible to the running-cost penalty, which would discourage a bus service (where overall expenditure was more nearly proportional to passengers carried) from trying to carry larger numbers of passengers at lower fares. In practice, tram fares are almost always lower than the equivalent bus fares often 50% or even less. This means that the bus carries mainly passengers from the 'inflexible' demand group, whereas tram will capture passengers with a more "flexible" demand -for instance car owners.
- ❖ Increase of frequency: The running cost of a tram is less than a comparable bus, so frequent services can be run at times when a bus service would be cut-back as uneconomical. Trams accelerate more smoothly permitting greater acceleration rates which reduce the time between stops. All these aspects of tram enable increased frequency.
- ❖ Capacity: For meeting increased travel demand, the carrying capacity of a single unit of tram can be increased by attaching a trailer (or several). This is cheap and can easily be detached when it is not needed, economizing in power and wear-and tear. A powered trailer or a double - decked vehicle can also be effective.
- ❖ Environment Friendly Mass Transit: Electric tram/LRT is likely to be developed in cities where environmental issues are uppermost and there is a perceived need to attract car users for an environmentally acceptable component of a package to create a 'livable' city (ADB, 2001). Electric tram is environment friendly. There is no

idle engine combustion cost for tram. Tram braking system does not produce injurious elements. Moreover any transport system with electric propulsion does have the key advantage that the main source of generation of pollution can be concentrated for safe treatment and dispersion.

- ❖ Comfort: Tram rails offer a flat surface, much smoother than a road surface. The curves of a tram track are carefully calculated to lead the tram gently into corners without sudden changes in direction. All these aspects make standing comfortable in tram. Large numbers of standing passengers are permitted in safety which reduces queues during rush hour.
- ❖ Physical accessibility: Tram is easily accessible. The rails will guide the vehicle accurately into place .It stops at a certain place; a steerable vehicle can't do this. Modern low floor trams offer level loading with no significant gap. This means that only a small increase in kerb stone height is sufficient to give level access from a normal pavement. With a steerable vehicle, this would pose a danger, as a gap would have been left between the vehicle and kerb to avoid scraping the doorstep. With a tram, the rails will always guide the vehicle accurately into place, ensuring the gap is minimal. This gives level, safe, easy access for women, children, elderly people.
- ❖ Safety: A tram cannot leave the track and there is no risk of colliding with vehicles on other parts of the road or with track-side objects or pedestrians. The path taken by a tram is clearly marked and the vehicle never deviates from that path. This contributes greatly to safety for other road users.
- ❖ Occupy little space: Segregated or 'reserved' tracks need to be only slightly wider than the tram body -for the proposed Bath trams about 8ft wide should suffice. They can run along disused railway lines, open sites, specially designated streets or the centres of dual carriageway.
- ❖ Enhance outward growth of city: A tramway represents a long-term investment in the infrastructure of an area, it is the perceived permanence and long-term reliability of this, which enhances the value of land and property, and encourages regeneration. Businesses and homes can be relocated to take advantage of the tram routes in the safe knowledge that they will not find themselves at the mercy of a route planners whim.

6. INTRODUCTION OF TRAMWAY IN DHAKA

6.1 The Context

Bangladesh with its resource constraints and significant urban poor is in acute need of augmentation of mass transit to cater for future demand specially in capital city Dhaka. Replogle

argues that income plays a significant role influencing transportation choices people have. People with low-income face extremely limited transport choices. Two thirds of the poorest of the poor in the world live in India, Bangladesh, Pakistan and China. It is critical to choose mass transit option which will meet urgent issues of increased mobility, road accidents, environmental protection, and ability of people to pay for travel. Light rail Transit has been found to be the potential choice for catering future travel demand in Dhaka. Development of LRT is included in mid to long term measures of urban transportation improvement measures in Dhaka. Tramway is a basic type of LRT. It is also the cheapest in the systems of light rail transit which is a positive element in the prevailing socio economic context of Dhaka city. Versatile urban land use patterns in Dhaka city also demand tramway.

Public transport based on tracks like tramway has many advantages over other forms. And these advantages are congruent with the service quality desired by trip makers of Dhaka particularly the share of trips (Rickshaws, auto-rickshaws) that is required to be shifted to reduce congestion and air pollution. Urgent issues like road safety for pedestrians, deteriorating environment of Dhaka, scarcity of road space, population relocation demand rail based form of mass transit rather than road based bus transit.

6.2 Benefits of Tramway in Context of Dhaka

To meet the mobility needs in metropolitan Dhaka in future the following points related to rail based tramway are significant:

- ❖ Tramways are much less susceptible to the running-cost penalty, which would encourage carrying larger numbers of passengers at lower fares.
- ❖ High frequency is permissible by rail based urban transport tramway in the context of economies of scale. Tram permits low operating cost to justify increased no. of round trips, easy acceleration and deceleration to increase frequency of mass transit.
- ❖ Trams accelerate more smoothly permitting greater accelerator rates, which reduce the time between stops. This is why tram can give frequent stops. Multiple stops will give access to more people and ease congestion. Pedestrians and non-motorized rickshaw users desire frequent stops.
- ❖ Rail based mass transit has the advantage of providing comfort to the standing passengers as it runs on fixed track. In Dhaka, a standard level of comfort is desired by users of other mode (rickshaw users). Tram maintains that standard. Large numbers of standing passengers are

permitted in safety, which reduces queues during rush hour.

- ❖ Tram is easily accessible. Easy physical accessibility and inside comfort is a good indication of attracting the flexible demand of transport like rickshaw users, auto rickshaw users, pedestrians in Dhaka.

6.3 Other Urgent Issues

In the light of severe urban road accident problem, environment degradation and scarcity of road the following considerations are significant in the context of Dhaka.

- ❖ A mass transit mode like tramway which cannot leave the track, is safe as there is no risk of colliding with pedestrians, vehicles on other parts of the road or with track-side objects. The path taken by a tram is clearly marked and the vehicle never deviates from that path; this contributes greatly to safety for other road users.
- ❖ Electric tram/LRT is likely to be developed in cities where environmental issues are uppermost even when bus transit and bus ways are more feasible.
- ❖ As tramway occupies little space, it will be advantageous to introduce where there is scarcity of road space.
- ❖ Tramway with its perceived permanence and long term reliability is potential for playing key role in intensification of land use in sub-urban areas outside the CBD, peripheral development.

6.4 Detailed Study

In this paper an attempt has been made to present the service characteristics of tramway that are ideal for meeting the travel attributes of trip makers of Dhaka. For the introduction of tramway more detailed study is required. Feasibility and viability studies should be carried out giving emphasis on urban dwellers' characteristics, land use patterns, road user perceptions, economic aspects of construction, traffic capacity, route selection and technical characteristics.

7. CONCLUDING REMARKS

Augmentation of mass transit system is an urgent necessity to ensure mobility need, road safety, and livable urban environment for Dhaka city in future. Rail based rather than road based mass transit system 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. Rail based tramways, with description of its inherent cost and service characteristics have been highlighted as a potential option for improvements of existing public transport system. Detailed study for its introduction has been suggested giving due emphasis on urban dwellers' characteristics, land user patterns, economic aspects of construction, traffic capacity, route selection and technical characteristics.

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