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Deficiency of Bus Network System in Dhaka City

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Abstract
Transportation system of Dhaka city is under huge challenge of managing growing number of private cars and non-motorized vehicles. Traffic congestion is an everyday scenario of this city. Buses are the only available organized public transport system in Dhaka. This research assesses the quality of service provided by the bus network system and its deficiencies. Under the study, demand-supply conditions and performance of the public buses had been identified by processing field survey data according to a suitable mathematical procedure. For this purpose, 7 different bus routes were chosen and a total of 100 passengers of buses were interviewed with a predetermined structured questionnaire to know their experience, level of satisfaction and opinion about the existing service as well as their expectations. It was observed that the existing bus service quality is very poor. There is no specified time schedule for the buses operating; hence passengers waiting time at station is longer. Except a few bus of seating service, all the buses carry extra passengers than the seat capacity and always remain over-crowded. Thus buses are often not accessible for disabled or elderly persons as well as for women.

Keywords: traffic congestion, bus network system, deficiencies, demand-supply conditions, over-crowded

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 16 million at annual growth rate of 8% per annum (STP, 2004). Anyone living in this city will certainly speak of overcrowded city streets. The roads of the city are clogged with vehicles all day long making travel unbearable. It has become a dream for city dwellers to travel on traffic jam free road. Unfortunately, Dhaka's struggles will prevail as it is growing at the second fastest rate of the twenty most populated metropolises in the world (World Urbanization Prospects: 2006). 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. As Dhaka is also the economic, cultural and administrative hub of Bangladesh, huge amount of people travel daily by pedal rickshaws, auto-rickshaws, tempos, taxis, private cars, and a wide array of buses. Among these travel modes, buses are the only available conveyance medium for dedicated mass transport system in Dhaka city. The bus system mostly financed by private owners. These buses typically ply overcrowded with very low frequency, very poor maintenance and service quality but the extent to which they do so, differs a lot by the type of bus service.

BACKGROUND

Dhaka is a city with a transportation system predominantly road based having absence of any mass transit system like metro rail or bus rapid transit (BRT). As a third world country, the majority of trips in Dhaka are served on public transport and non-motorized transport modes (NMT) or Para-transits because a significant numbers of people are poor who cannot afford personal vehicle. As the fare of NMT (such as rickshaws) or other Para-transits are more expensive than the bus fares (Rahman, M. S. U., 2009); most of the people are heavily dependent on public transport for their travel (Hossain, M, 2006). 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, 2004). Although only mechanized transport buses run the highest passenger-km per day (Rahman, M.S.U and Nahrin, K., 2012), according to 2005 Strategic Transportation Plan (STP) it's only 44%, which is very low. However, the demand of public transport system is increasing with the increase of passengers for the last 20 years (Karim, M. M., and Mannan, M. S.,2008).

As Dhaka is a city with poor economy and low private car ownership, it needs a very sustainable and economy friendly bus transport system. Dedicated bus transport system for mass transit should be the backbone of transportation system in this city. However, at present, passenger transport scenario of Dhaka shows that the existing bus 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 as well as between bus stops and

destination. Again, a well-planned city should have 25% of total area for its road network whereas in Dhaka; only 9% of total area is occupied by road. This paper is an attempt to explore existing service quality and deficiencies of the bus network system of Dhaka city

USE OF BUS AS PUBLIC TRANSPORT

All shapes and sizes of vehicles are part of the traffic. The multiplicity of modes of transport, private cars, motor cycles, buses, taxis, cycle rickshaws, rickshaw vans, trucks, pushcarts and recently revived animal driven transports offers a rich range of choices to travelers and transporters of goods. But lack of relevant measures and firm decisions to cope with the complexity of traffic has created chaotic conditions. Different types of modes using the same road space characterize traffic environment. Current very diverse traffic mix is increasing the traffic delays constantly. **Figure-1** is an illustration of the complex traffic composition in Dhaka (see appendix).

Table-1 Parametric comparison of different transport modes in Dhaka

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

PREVAILING BUS SERVICES AND BUS ROUTES IN DHAKA

In Dhaka, according to services, buses are classified into two types: (1) Counter bus service; and (2) Local bus service. Counter buses have specified stoppages for loading and unloading passengers. Passengers have to purchase ticket before boarding on counter buses. Few of the counter buses are air-conditioned. Whereas, local buses have no defined stoppages. They stop anywhere on the road for loading and unloading passengers. Passengers pay to conductor after boarding on the bus. Both counter and local buses remain over-crowded due to gap between demand and supply. However, there are a few seating service buses operating in certain limited routes which allow boarding passengers only if there is an empty seat available for the person (e.g. Bikalpa having start and end termini at Motijheel and Mirpur 12, respectively as in Table 3).

Again according to size, Dhaka buses can be grouped in to 3 types: (1) Large bus; (2) Mini bus; and (3) Double decker. Large buses are those with at least 32 seats. However, more generally buses with length more than 10m are considered as large bus. 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 different routes with 105 buses. Minibuses have capacity of 15 to 30 seats excluding driver's seat and normally are around 8m long. There are around 9311 numbers of registered large buses and 8459 numbers of registered mini buses in Dhaka city(http://www.brta.gov.bd/) . STP conducted a survey on average trip length, travel time, speed and carrying capacity of existing mass transit system and got the following scenario as shown in **Table-2**

Table-2 Average trip length, travel time, speed and carrying capacity of existing mass transit system in Dhaka Cit

Mode	Average Route length (km)	Average Journey time (min)	Average travel speed (km/hr)	Average running speed (km/hr)	Average boarding passenger	Pass-load At max. point	Average stops
Mini Bus	20.12	65.00	17.14	23.19	79.27	39.1	16.56
Large Bus	14.7	71.09	13.7	17.8	89.6	44.9	12.3
Double Decker	17.81	56.83	17.22	23.45	100.76	83.71	13.67
School/ Staff bus	13.5	37.25	20.9	23.0	44.4	43.4	7.8

METHODOLOGY

Dhaka inter-city bus transport companies have a wide variety of buses. The reactionary behavior of bus staffs (bus driver, bus conductor, bus helper and counter staffs) created a difficult situation to explore the condition of service provided by bus transport system of this city. Although maximum bus staffs were friendly and helpful to share their experience and answer the question asked for survey, a few were afraid of sharing as their buses do not follow the rules imposed by Bangladesh Road Transport Authority (BRTA).

The structure of the study was aimed at certain variations in bus types and examined the way they performed, their physical condition, average journey

speed and passengers comfort level while travelling. The ultimate goal was to explore the level of service provided by bus transport system of Dhaka city by collecting individual experience at certain stops. It was decided that a variety of buses to be captured so that the results represent the bus network system. Counter buses have wider variety of door arrangements. Bangladesh road transport corporation (BRTC) operates some double decker and articulated buses. Local buses have less variation in size and all of them fall in to mini bus category.

The data was collected by discussion with the bus employees (i.e. bus conductors, bus drivers, employees at counter). Data given by bus staffs were cross-checked by riding on that particular company bus three times at different periods. To know the riders opinion on riding bus, a total of 100 persons were interviewed with selected structured questions. The survey form was ten questions long and was conducted through face-to-face interviews. Few questions (e.g. your comfort level, your movement inside the bus) were phrased for satisfactory, moderate and un-satisfactory responses and other questions (e.g. are you a regular passenger on this route) were phrased for yes or no responses. The survey was written in English and translated into Bengali before delivered to subjects. Interview places were selected considering two facts: (1) Starting or ending point of bus route; and (2) Places where counter bus passengers and local bus passengers assemble and remain for a sufficient period to board or alight. By this, counter bus passengers and local bus passengers were easily separated. The interview was conducted during the month of October to December 2013 at sunny days.

Table-3 Survey on selected bus routes

Bus routes	**Bus stops** (*Places where passengers were interviewed*)	**Selected bus services**	**Average journey speed During working days** (km/hr)	**Average journey speed** (km/hr)	**Type of Service**
Motijheel to Mirpur	Mrpur12, Mirpur1, Farmgate, Gulistan, Motijheel	Bikalpa Auto Service (M.B.)	11.48	28.7	Sitting
		Bahan paribahan (L.B.)	8.32	15.33	Local
		Shakalpa paribahan (L.B.)	8.92	14.49	Counter
Motijheel to Gulshan	Motijheel, Malibag, Doinik Banglar Moor, Gulshan 1	Bus no 6 (L.B.)	6.52	10.56	Local
Motijheel to Mohammadpur	Motijheel, Pressclub, City college	Moitri (L.B.)	7.23	13.17	Counter
		Rajacity (L.B)	8.05	14.23	Counter
		Dipon Transport(L.B)	6.87	14.98	Counter
Azimpur to Kuril (Bishwa road)	Azimpur, Kalabagan, Bashundhara city, Nabisco	Winner (L.B)	7.67	18.18	Counter plus boarding
Azimpur to Mirpur.	Azimpur, Kalabagan, Mirpur12,Mirpur1.	Safety bus service(M.B)	7.5	19.54	Boarding
		Bihanga (M.B)	7.45	16.93	Boarding
Azimpur to Uttara	Azimpur, Kalabagan, Farmgate, Mohakhali.	Bus no. 27(M.B)	6.56	14.87	Local
		Duldul(L.B)	8.37	16.29	Counter
Jatrabari to Mirpur	Jatrabari, Gulisthan, Farmgate, Mirpur 10, Mirpur 12	Bus No.14	7.27	17.28	Counter

(Note: L.B. = Large Bus and M.B. = Mini Bus.)

All buses would be ridden only within the city limit. For this, routes were chosen from all parts of the city, and when possible, a route which started and ended within city limits. For this study, the study riding limits were set at Uttara in the northeast, Jatrabari in the southeast, and Mirpur 12 in the northwest of Dhaka. To collect data during journey each route was observed from origin to destination but data which valid within city limits were taken. To assess the condition inside the overcrowded buses, the surveyors ride on the bus and collected necessary data. The number of people standing before the first row of seats and immediately in front of the middle or back doors was recorded as a measure of a bus's crowding levels. The number of people who remained at the bus stop who could not board, the number of passengers with some part of their body outside the doorframe and passengers riding on the roof of bus were also recorded.

It was quite impossible to cover the whole city or all the bus routes and operators of the city due to time and resource constraints. Hence, only the seven major bus routes: (1) Motijheel to Mirpur; (2) Motijheel to Gulshan; (3) Motijheel to Mohammadpur; (4) Azimpur to Kuril (Bishwa road); (5) Azimpur to Mirpur; (6) Azimpur to Uttara; and (7) Jatrabari to Mirpurhad were chosen for this study. While selecting the bus routes, it was considered that they cover the whole city (i.e. the central area and the periphery, the planned and unplanned area, and the higher-income and lower-income residential areas). Ultimately, 90 ticket bus trips and 45 local bus trips were collected.**Table-3** shows the collected survey data.

RESULTS

Overcrowded bus, long waiting line for buses is a common sight in Dhaka city. This is due to low frequency of bus headway and high demand. Waiting time at a bus stoppage was reported less than 10 minutes by 22% of passengers, waiting time greater than 10 minutes but less than 25 minutes was reported by 65% of passengers. However, 13% reported that they frequently have to wait more than 40 minutes to board in a bus. This waiting time is the average of all buses (local and counter buses). Waiting time only for local buses was reported more than 20 minutes by 72% of passenger. This long waiting time is also due to overcrowded buses. It is common sight in Dhaka that a few passengers is unable to board in the bus as there is no room and they have to wait for the next one. **Figure-3** (See apendix) shows the queue of the passengers waiting for bus and **Table-4** shows the number of passengers at bus stops waiting per hour along with the prevailing demand and supply of buses at that particular stop.

Besides waiting at the bus stops, this survey shows that about 83% riders are not satisfied with the delay time incurred at each and every stoppage. And the rest are moderate. Whereas, no one is satisfied with the delay time of the local bus only. A local bus will commonly remain at a stop for several minutes until the conductor feels the bus is sufficiently loaded, which typically means every possible space is filled. Some local buses will leave a stop when a second bus of the same route arrives, but schedules are roughly kept so that the first bus will already be sufficiently crowded by the time of the second bus's arrival. In case of counter buses, counter staff makes the bus wait to sell some more tickets. Passengers on-board often shout at bus staffs to stop this delay. This often creates chaotic situation. Even, they often board and off-load passengers at unspecified stops. These unexpected halt cause unnecessary delay for on-board passengers. Besides, higher alighting and boarding time might be another cause of delay. Passengers reported that average delay time at each station for counter buses ranges from 2 minutes to 5 minutes while for local buses it varies from 3 minutes to sometimes more than 8 minutes. This delay time affects average journey speed. Difference in average journey speed is showed on **Figure-4** (See Appendix). For weekdays this difference is less significant because of traffic jam, all buses are bound to move at same speed. But during holidays, this difference is significant. Delay time while travelling is the main reason of this difference. Compared to local buses, counter buses have fewer stops and less delay at each stop.

Table-4: Demand and Supply in Different Stops

Stops	Total number of awaiting passenger per hour	Total demand of bus per hour	Current supply of bus per hour
Mirpur 12	52	0.35	0.35
Mirpur 10	78	0.65	0.33
Mirpur 1	105	0.88	0.38
Kalabagan	48	0.3	0.35
Azimpur	201	1.68	1.1
Gulistan	426	3.84	3.05
Jatrabari	480	4	3.7
Motijheel	224	2.25	2.25
Press club	55	0.32	0.68
Nabisco	35	0.23	0.36
Khamar Bari	386	3.56	3.18

Considering the bus frequency, only 10% are satisfied where 55% and 35% are respectively moderate and un-satisfactory. However, considering only local buses, un-satisfactory passengers rises up to 70%. Often due to low frequency and high demand, it becomes impossible for older people or women or children to get room

inside the bus. Consequently, these groups of vulnerable people do not have access to bus service during rush hours. Most buses especially local buses carry passenger exceeding their capacity.

Only few buses carry passenger as much as their seat capacity ('no standing passengers') e.g Bikalpa Auto Service (Motijheel to Mirpur12). Due to high demand, passenger boarding in the bus risking their lives (see, Figure 3). Due to overcrowded situation, comfortable movement inside the bus is restricted often impossible. Survey shows that more than 73% of bus passengers do not feel comfortable during travel. This discomfort increases at office starting and ending hours. This situation is worse in local buses where conductor moves inside the bus to collect fare of travel often make the condition of passengers standing miserable. Also, he shouts for passengers to compress more so that he can board in more passengers beyond the bus capacity. **Figure-5** shows overcrowded bus during the typical peak hours (see Appendix) About 27% of the respondents mentioned satisfactory about the behavior of bus staffs (bus conductors, bus drivers, bus helpers, counter staffs), 40% mentioned moderate and the remaining 33% mentioned unsatisfactory. However, if considered only the local buses, about 83% are not satisfied. This indicates the behavior of a staff in the counter bus is much better than the local bus. This might be because often there is dispute between the conductor and passengers to set a fare for a particular trip on the local bus. This dispute sometimes ends with blows creates severe situation.

For female passengers the travelling environment of buses especially local buses is very much unsatisfactory. Not all local buses have special female seats. Compared to local buses, counter buses are much better, have 6 seats in front especially for female passengers. But this number is very few compared to the female passengers travel. This survey found that there is no especial care for pregnant female passengers. So riding buses in Dhaka city for pregnant woman is a matter of great risk. Also sexual harassment to women in crowded buses is a common problem in Dhaka. Many women reported that they experienced physical harassment while boarding or alighting bus by bus staffs, even by male passengers.

Figure-6 (See Appendix)shows the satisfaction level of riders riding on buses.

The main reason of discomfort during bus journey is unavailability of seat and overcrowding of passengers while the minor factors are leakage of rain water, uncomfortable seats, interior of bus, and behavior of bus staff. For example, almost 35% of passengers mentioned that counter bus facilities are comfortable because of good seating facilities. About 37% of the passengers mentioned that seats of buses are not comfortable. They reported that for a large bus with more than 50 seats have almost one fifth of seats are out of order. However, if only local buses are considered, almost all the passengers reported uncomfortable seats: (1) having holes in the seats; (2) back side of the seats broken; (3) no foam in the seats; and (4) bad odor. For local buses, the size of the seat is unsatisfactory. For two healthy individuals more than 5 feet 8 inch tall, it tends to be impossible to sit on the two seat arrangement of local buses.

The physical condition of the buses plying in Dhaka city is not satisfactory. This is because the majority of bus fleet is very old and the maintenance is almost absent or very poor. Despite the poor bus condition riders not feeling it or mentioning about it because their main

concern might be getting a seat or room inside the bus irrespective to its overall condition. For instance, one of the passengers told 'interior of the counter buses are moderate, however, the local bus is very poor'. Not only interior but also bus engine condition is very poor. Due to poor maintenance of the bus fleets, often these become out of order on the way and causing problems for its passengers. About 40% of the respondents reported that they had experience of unexpected breakdown of the bus while travelling, mostly due to fitness problem of bus or staff related problem. Researcher had such experience of sudden breakdown in Dhaka for two times during the survey in 2013. On that occurrence, the passengers had to wait until another bus, which was passing the spot, to pick up them or some passengers either walked to their destination or took alternative modes. This causes serious harassment for passengers by compelling them to find new bus or to find the nearest bus stop to board.

The survey shows that about 47% respondents reported that their closest bus stop is within 0.5 km while 36% mentioned within 0.5 km to 1 km and more than 1km was reported by 17%. So, it is clear that position of bus stops is satisfactory. Even bus stops within half km cause reduction in bus frequency. Although there are sufficient bus stops, the condition of bus stops are not good. Very few bus stops offer protection from the sun, rain, dust, and other elements that have significant implications for health or safety. Passengers shade is almost absent in Dhaka city. There are a few, however, occupied with vendors or shops and no use for the bus passengers. Counter bus stops have big umbrellas for their counter staffs but does not provide any shade to passengers from sun and rain. There is no seating

facility for passengers, often they sit on sidewalks blocking pedestrian movement or stand in a queue while waiting for buses causing temporary bottleneck by blocking a lane of road. Also 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.

Buses, which are main mass transit system in Dhaka, are operated by government authority and private financing entities. The BRTC, which operates under immunity from regulation by licensing authorities, owns a total of 306 buses operating on 15 routes in Dhaka *(1)*. BRTC does not operate the buses directly, rather sub-contracts bus operations to private operators at different routes. 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. 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. So, to keep their business upright they forget about giving minimum level of service to riders.

Dhaka is perhaps the only city of its size without a well-organized, properly scheduled bus system. Dhaka Metropolitan Regional Transport Committee (DMRTC) gives route permits without using statistics, without judging travel demand. There are some routes in the city where more than 5 counter bus companies along with more than three local operators exist. Whereas, there are some routes with only one counter bus operator. So it is obvious that due to too many bus operators and lack of statistical data, no route is operated on the basis of travel demand and supply. In Dhaka, there is no coordinated bus network information center. It is not easy to travel to desired route for unfamiliar riders. Especially for local bus service as there is no counter; passengers have to rely on fellow passengers of same route to collect information. For a vast city like Dhaka with its huge population where bus is the only mean of public transport this is certainly unacceptable.

DISCUSSION

Bus is the only mode of public transport system, the choice for the majority and the only means of mobility that can be afforded by the urban middle and lower economy people. Public transport system by definition is a system which provides scheduled service carrying mass people on a fixed route. However, public transport system of Dhaka city is not maintaining any time schedule. Due to heavy congestion on road and absence of any time schedule, waiting time for the buses is unpredictable for riders. Due to low frequency and supply-demand deficiency the buses remain always overcrowded making the journey experience a miserable one for passengers. Due to the extreme levels of congestion in the streets of the city, buses cannot keep consistent schedules. This means that passengers will prefer to board a crowded bus, even at the risk of their personal safety, rather than wait an unknown length of time for the next bus to start (Katz, Donald and Rahman, Md. Mizanur,2010). However, there are some sitting services but their numbers and routes of operation are very limited. The average journey speed is about 7.5 to 8 km/hr which is few kilometers greater than normal walking speed of a matured human being. Also, there is no organized authority to operate day to day operation of bus system.

The only organized bus transport authority BRTC started with the motto of "*Service is our motto: Comfort is our commitment*"**,** it cannot fulfill any of their objectives(BRTC. 2011). With few exceptions, the bus owners or operators, including government owned BRTC buses in Dhaka City do not pay adequate attention to passengers' comfort(Andaleeb, Syed Saad, Haq, Mahmudul, and Ahmed, Rubina I, 2007). Not only operational deficiencies but also Dhaka bus system lacks of quality bus service. Facilities inside the bus, such as fans and lights are frequently out of order; many of these do not have lights and fans at all. Other requirements, such as airflow and ventilation, lighting during night must be monitored to ensure a desirable environment for riding. Basic passenger's requirements, like comfortable seats and windows for airflow also do not meet up the standard (Rahman, M.S.U and Nahrin, K, 2012). The results derived from the interview of bus passengers suggest that if comfort level could be improved it could also increase significantly the passengers' satisfaction, leading perhaps to greater proclivity to use public buses (Rahman, M. S. U. , 2011)

To reduce demand-supply deficiency authority prefer increasing the number of buses without any sort of research. These unplanned decisions increase congestion thus reduce the flow of buses more. These add up to the waiting time. In Dhaka, the number of bus stops is satisfactory but boarding-alighting system is unacceptable. Most of buses have only one door even if they have two doors, they use two doors both for alighting and boarding. Also the behavior of bus staffs is an important issue for service level. Often they halt

the bus in the center of road for boarding or alighting passengers, causing temporary bottleneck and safety hazard for passengers.

There is no guarantee that anyone can reach to their destination within certain time because of the ever increasing traffic jam, congestion and shortage of public transport service. Public bus is the most affordable mode of transport in developing countries like Bangladesh. According to the study, performance of bus service will not be developed only by increasing bus number. Service regularity, on-time performance and service quality are also mandatory factors to be considered. Traffic congestion and excessive demand are behind all the problems. Reducing the traffic congestion is not in the hands of the respective bus authority but maintenance of the service quality of the bus is still manageable. This study gives a picture about the service condition of the bus that can help the bus authority to take remedial measures to upgrade the present situation of the bus. From the research, it is very clear that, the demand-supply deficiency is prevailed, but not so acute. But still the people are fully deprived from a quality bus service. The results of the research point out that the excessive travel time, waiting time and dreadful services in terms of comfort, regularity and on-time performance mainly hinder the prospect of the public bus transportation in Dhaka. Hence, transport facilities of the city should be provided keeping in mind the population growth, economic development, and future travel demand of the city.

Dhaka is currently trying out new bus transportation options to help maximize the use of the road. BRTC has recently added air-conditioned buses to its fleet at different routes. Articulated buses have recently been purchased to be used by private companies, meaning one bus can carry higher loads if current crowding conditions remain the same. Also plans to institute a digitalized ticket system on the busy Uttara to Azimpur route. All existing companies on that route will run under one name and ticket system instead of competing with each other. Dhaka is also planning for elevated expressway, BRT and Metro Rail inside the city. These new operational implementations should be studied to see their effect on Bus network system of Dhaka.

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APPENDIX

Figure-1 Illustration of the complex traffic composition in Dhaka. (Source: *STP, 2004*)

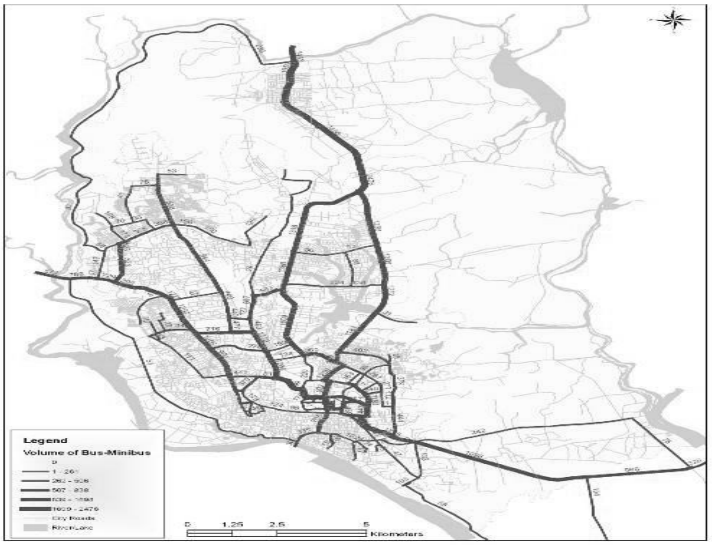

Figure-2: Prevailing bus routes and number of buses operating on those routes.

Figure-3: Passengers waiting for bus

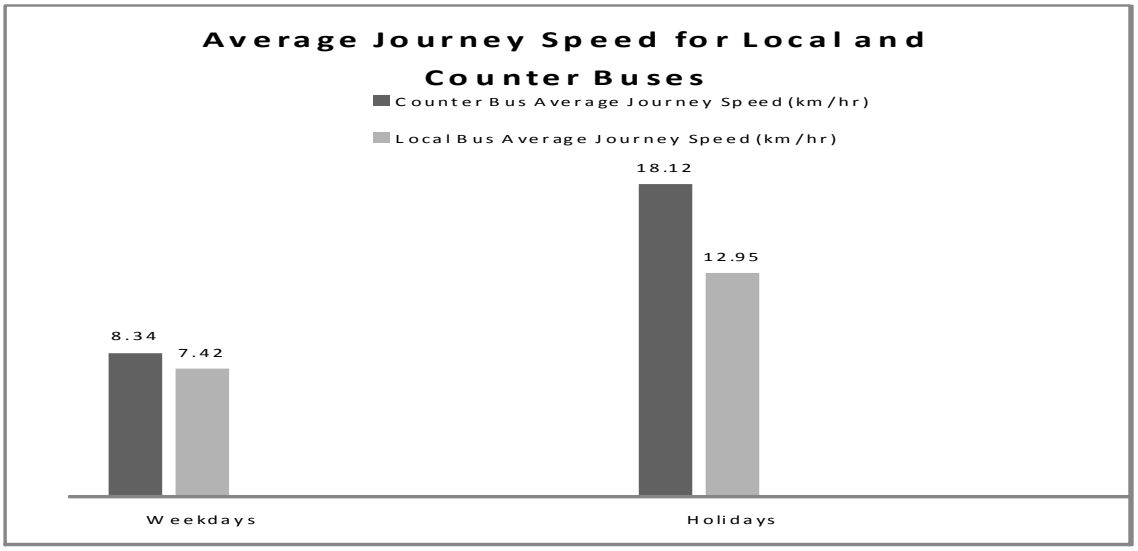

Figure-4: Average Journey Speed for Local and Counter Buses

Figure-5: Overcrowded buses of Dhaka

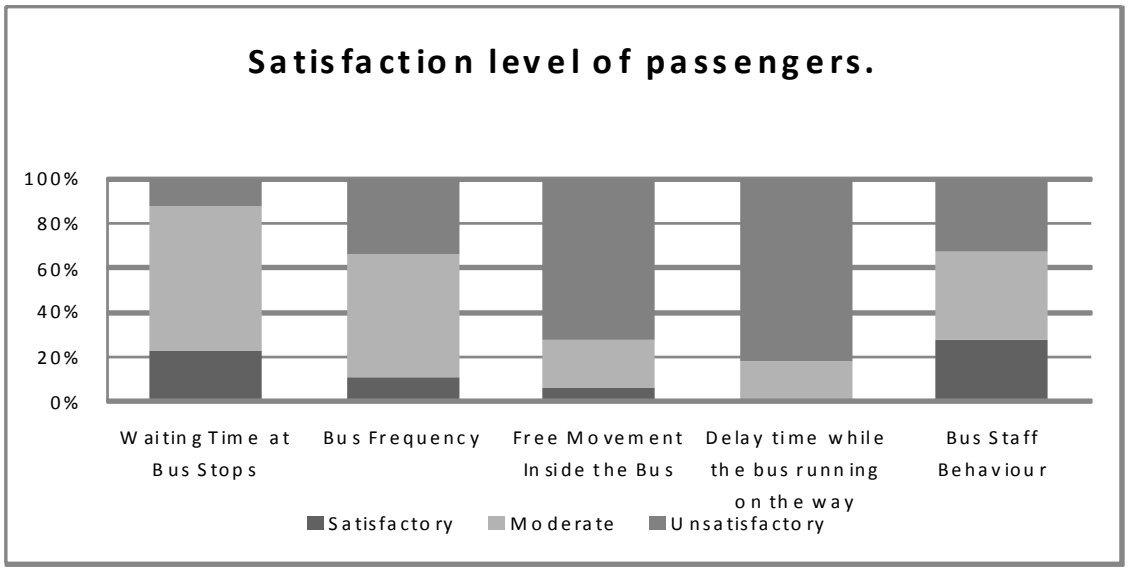

Figure-6: Satisfaction level of passengers boarding on buses