4th Annual Paper Meet and 1st Civil Engineering Congress, December 22-24, 2011, Dhaka, Bangladesh ISBN: 978-984-33-4363-5
Noor, Amin, Bhuiyan, Chowdhury and Kakoli (eds) www.iebconferences.info

Effects of traffic demand management in reduction of congestion in Dhaka city

A. Siddique & S. Iffat
Ahsanullah University of Science & Technology, Dhaka, Bangladesh

ABSTRACT: Transportation system management consists of existing highway facilities, both on the supply side that means changing the facility itself and on the demand side that means changing the way people operated in roads. The basic objective of Transportation Demand Management is to create more efficient use of existing facilities through less costly improved operations and traffic management of vehicles and the roadway. In Dhaka city, acute traffic congestion kills hours every day. Most of the major roads as well as collector roads are blocked in peak hours. This paper discusses the effects of undertaking some specific traffic demand management measures like car sharing, passenger car pricing, movable divider for peak periods etc. Car sharing increase the occupancy of any car and it directly decrease the percentage of car growth. Car pricing will also encourage the people into car sharing. In Dhaka city, the combination of these three measures will be very effective in reducing congestion created by passenger cars.

1 INTRODUCTION

Urban transportation system manipulates movement of passenger and good which is indispensible for social and economical activities. The population of cities increases very quickly due to the opportunities of better educations and employments. In fact, the growth of population, the increased number of vehicles, travelers and freight carriers as well as the pace of globalization have affected travel demand in most of the countries of the world and subsequently have reshaped the travel patterns of commuters and freight carriers in many different ways (Giuliano & Wachs, 1992). When transportation system becomes failure to maintain a satisfactory level of services to the people, several problem arise including congestion, delay and consequent emission of pollutants (Alam & Habib, 2003).To adjust with the hasty increasing transportation need, it is essential to utilize the available facilities properly and some planning must be undertaken. In these circumstances, policy makers and transportation experts have suggested that strategies to manage the travel demand will be more successful to solve the transportation problems rather than strategies to expand capacity or supply of the facilities. IE Aust defined Traffic Demand Management as "an intervention excluding provision of major infrastructure to modify travel decisions so that more desirable transport, social, economic and /or environmental objectives can be achieved and the adverse impacts of travel can be reduced" (IE Aust National Committee on Transport 1995, quoted in Barter et al, 2001).

Dhaka is a mega city, the capital of Bangladesh with 2000 square kilometers of area and about 12 million populations. Dhaka is the administrative, commercial, and cultural centre of the country and also continues to serve as the traditional centre of wholesale trade. The road networks cover about 3000 km (450 km are primary roads and the rests are collector & access roads). Vehicle population of this city is around 450,000. Metropolitan Dhaka accounts for nearly 40 percent of total urban population in Bangladesh. As streets are not increasing with the high demand, congestion occurs every day almost every important points in the city. It is also a matter of great concern that car ownership increasing rapidly which is one of the major issues of traffic congestion in Dhaka city. The cost of congestion and accidents in this city is US$ 520 million/ annum which is quite alarming. As this city continues its growth toward the anticipated 36 million people in 2024 and beyond, the requirement for a sustainable system will become even more acute. The challenge for the transport sector is to deliver a system that is safe, affordable, comfortable and available to a large segment of the population. The negative impact of congestion is so intensive that people suffers waiting hours after hours during traveling and lose time and money every day. This paper discusses how some alternative traffic demand management measures including car sharing, using flexible divider or movable barrier and private car pricing consuming no significant amount of money affect the roads of Dhaka city with better level of service, operation and performance.

2 PRESENT SITUATIONS OF ROAD AND TRAFFIC IN DHAKA CITY

The demographic trends of the last decade have resulted in brisk population growth and are expected to continue in the coming years. 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 existing transportation system is a major bottleneck for the development of the city. Unplanned urbanization, especially poor transportation planning and lower land utilization efficiency has turned the city into an inefficient transport facilities provider. Dhaka is perhaps the only city of its size without a well organized, adequate and properly scheduled bus system or any type of mass rapid transit system. The transportation system of Dhaka is predominantly road based and non-motorized transportation with few alternative connector roads. Different governmental organizations for transport system in Dhaka city includes Dhaka Transport Co-ordination Board (DTCB); Dhaka City Corporation (DCC); Rajdhani Unnayun Katripakha (RAJUK); Bangladesh Road Transport Authority (BRTA); Dhaka Metropolitan Police (DMP); Roads and Highways Department (RHD) and Local Government Engineering Department (LGED). DTCB provides the overall coordination of various aspects of project preparation and implementation.

The areas just surrounding the old city area have a more modern road system conceptually but in the system does not serve that function very well due to poor traffic operations and management as well as high traffic volumes. Well planned for residential areas (e.g. Dhanmondi), with well designed, and implemented road networks to serve low density residential development are now suffering under the poor effect that are the consequence of much higher density residential development complied with the effects of excessive commercial activity. Unplanned, informal, residential areas (e.g. Mirpur and Bashabo) where little or no planning for roads hase occurred, and existing roads are disorganized, narrow and circuitous alleys first established on an ad hoc basis while settlement first started. Current developments like Bashudhara Housing and Uttara Model Town are built with extensive grid networks, the planning and suitability of which will only become evident when fully developed. In the case of Bashundhara Housing, while the internal road network is substantial, the only existing access linkage to/from Pragati Sharani in inadequate. The major roads in Dhaka include: Mirpur Road (north-westerly); Begum Rokeya Sharani (northwesterly); Airport Road and Pragati Sharani (northerly); Dhaka-Chittagong Road (easterly) and Sylhet Road (north-easterly); Dhaka-Narayanganj Road (south-easterly); and Mawa Road (southerly), all leading toward and/or into the main areas of the city centre where these and other roads take on various names that frequently change along their respective alignments (Strategic Transport Plan 2005). The two interchanges at Mohakhali and Khilgaon are the part of the improvement of our transport network but operational activities of Mohakhali interchange is like overpass of the rail crossing which generate itself additional congestion at the entrances of the ramps. The under constructed Jatrabari and Kuril interchanges are well designed but their effects on the networks are still unknown. Rests of the at grade junctions are controlled and regulated either by traffic police or traffic signal where most are not properly demand responsive .

BRTA have predicted the degree of motorization in Dhaka city. The total vehicle fleet registered is 128,000 and the vehicle fleet amounts to 316,000. With a population of approximately 12 millions, this results in an auto ownership of approximately 13 per 1,000 populations and a vehicle ownership (including buses, trucks, taxis, CNGs) of 32 per 1,000. According to the STP(DTCB), 2005, the whole Dhaka city have been equally divided in both north-south (Abdullahpur to Posta Gola) and east-west (Meradia toTurag river) direction by screen lines and traffic counts have been performed along this lines called screen line counts. Those collected data have shown that buses comprise 9.7% of the vehicle mix that combines all vehicles and pedestrians. They comprise 11.5% if the base excludes pedestrians and 16.5% if the base is only motorized vehicles (pedestrians, rickshaws/vans, bicycles and animal drawn carts excluded); Auto-rickshaws (with 36.8%) and Cars/Light Vehicles (with 43%) comprise a substantial proportion of all motorized vehicles crossing the screen lines; Whereas buses comprise a small proportion (9.7%) of the mix, bus passengers account for 77% of all people crossing the screen line. Cars/light vehicles and auto-rickshaws each serve relatively low proportions (9.6% - 4.5%); Information collected as part of the STP(DTCB), 2004, Screen Line Counts indicates that automobiles represent 17% of all trips excluding walk mode, 29% of trips by motorized vehicles, and 45% of trips by 4-wheeled motorized vehicles.

3 TRAFFIC DEMAND MANAGEMENT: APPLICATION IN DHAKA CITY

In transport system supply side tactics are usually adopted which address the increased demand for transportation facilities by supplying more, or in other ways, increasing the capacity of the facilities (Wilson & Shirazi, 1991). Now it is clear that these supply strategies will not be able to meet the long term goals and objectives of the transport planners and policy makers (Mahmood et al, 2009). Traffic demand management measures regulate people to move with the proper method of travel for their journeys, to encourage car users to be less dependent on their cars and to raise awareness of the environmental and social impact of car use. It is implied that traffic demand management facilitate lower cost travel options which is useful for a large portion of residents in developing than in developed regions (Litman, 2004). International fuel prices are likely to increase in future. In this circumstances, when petroleum production decreases while there is an international rise in demand, the economic costs of importing petroleum are likely to increase (World Bank, 1996). So traffic demand management is very important especially under developed countries like Bangladesh which offer very low cost implementation as well as reduce the fuel consumption of private cars that petroleum are being imported complied with high tax from other countries. By 2020, it is predicted that about 60 percent of the major roads will become highly congested with a speed of less than 5 km/hr during peak hours (Alam & Habib, 2003). It is clearly observed that cars/light vehicles with 43 percent comprise a substantial proportion of all motorized vehicles within Dhaka city recorded in STP 2005 but cars/light vehicle passengers serve relatively very low proportions with 9.6 percent. So restriction on private cars could be a good solution to prevent excess use of road space by few people. Car sharing and car pricing can directly involve in reducing the number of running cars and anticipated magnitude of congestion could be stepped down without investing high amount of money. Flexible divider has its own way to utilize the maximum road way efficiently.

3.1 *Car sharing*

A car as an individual transport mode can be interpreted at least in two ways. It is individual because one is free of using it individually and has a complete control over the destination and the route, or because it is individually owned; both in contrast to public transport. In the common perception these two aspects are indissoluble making it obvious that, in the large majority of cases - in order to individually use a transport mode - one needs to own a vehicle. This partially explains why car ownership is so common in our society. Ridesharing refers to carpooling and vanpooling, in which vehicles carry additional passengers. Car sharing is efficient for long trips and for participants who have the same work schedule. It is not available during lunch time. It is only used at before and after works or in emergencies. This type of formation is particularly difficult if numbers of employees do not work at the same or neighboring site (Mahmood et al, 2009). Car sharing or vanpools could be the most cost effective solution for transportation problems which can provide multiple benefits, including redcued congestion, road and parking facility cost saving, crash cost saving, consumer cost saving, pollution rduction and more efficient land use (VTPI, 2005a). Studies have shown that ridesharing program can reduce daily vehicle commute trips to specific worksites by 5-15%, and up to 20% or more if implemented with parking pricing (Ewing,1993). In this sense, car sharing is an example of the growing number of alternatives to private ownership.

In Figure1 it is found that the estimated data of number of cars/light vehicles calculated with the help of least square parabola method has almost matched with the BRTA data. The number of cars was 1,20,000 in the year 2007. It is predicted that in the year 2020, the value will be reached at 3,20,000 which is quite large amount for coping with our existing road network. Traffic demand management measures will be indispensible to control these huge number of traffic appeared within ten years. Car sharing can significantly reduce this growth of cars as the capacity of cars will be fully occupied. In Figure 2, considering the average car occupancy 2, from the base year 2009, the percentage of growth of cars has reached at 170 in the year 2020. If the car occupancy is raised to 3 and 5, the percentages of growth of number of cars decline to 113 and 68 respectively. The occupancy of five can reduce the growth of cars more than 102 percent with respect to the considered occupancy in the year 2020. Increase of vehicle capacity utilization by introducing car sharing is significantly effective in traffic demand management measures in Dhaka city.

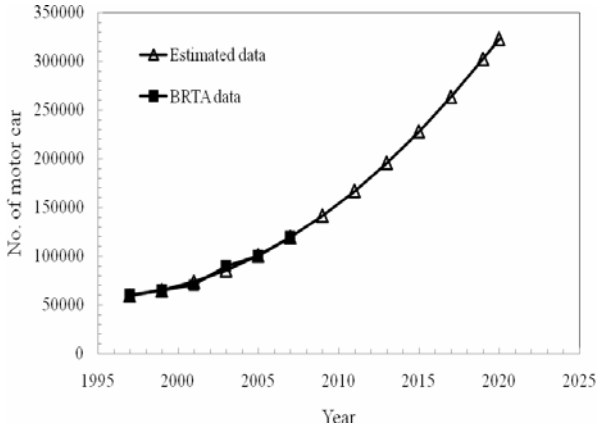

Figure 1. Comparison between BRTA and estimated number of cars.

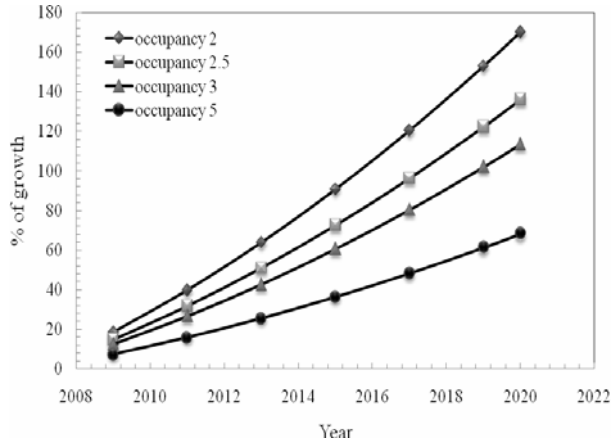

Figure 2. Growth of cars in percentage from the base year 2009.

3.2 Private car pricing

Congestion pricing reduces the number of vehicles on a highway at peak periods by charging drivers for using the highway during those periods. When successfully applied, congestion pricing makes better use of highways' capacity by allocating it more efficiently (CBO Study, 2009). Congestion pricing could be charged to discourage people from using their own vehicles. This type of pricing has the potential to reduce the need for new highway capacity, improve air quality, relieve peak traffic congestion, increase the use of high-occupancy vehicles, reduce automobile use in highly congested urban environment, raised revenue for much needed transportation improvement and establish a rational pricing system following sound economic principles (Zupan, 1992).

Transport for London and various academic organizations established a five year monitoring program to evaluate the congestion pricing in London city. Over 85 percent of these trips are by public transport. Prior to the congestion pricing program about 12 percent of peak period trips were by automobile. During the program first few months automobile traffic declined about 20 percent, resulting in a 10 percent automobile mode share. Most people who change their trip pattern due to the change transfer to public transport, particularly bus. Some motorist who would otherwise drive through Central London during peak periods shift their route, travel time or destination. Others shift mode to taxis, motorcycle, pedal cycles or to walking. Peak period congestion delays declined about 30 percent and bus congestion delays declined 50 percent.

This type of example should be followed within Dhaka city. The city road especially primary and collector road would be the area of passenger car pricing. When car runs, it has to pay certain amount of money every day for creating congestion on the roads. This congestion charge is only applicable to private cars in case of using the city road once in a day but not who parks, to make running unpopular and this system generate more bus rider. The charge can be paid through online, mobile text messaging, phone, at shop or by post. A governmental website of car pricing must be created where sufficient updated information and facilities of payment are given. A good system for monitoring of registration plate of vehicles like CCTV (closed- circuit tel-

evision) at different locations on the roads in the city is also necessary for catching the violators. Besides this, traffic police can also manually petrol at the different locations to maintain this system operated. Charging against the motor car only affect very few users (9.6%) but if the consequences of pricing would occur like in London city, the overall congestion will be reduced in a very significant rate. Temporary program can be initiated to observe the reaction among the city people. Some people could stand against this program as they may say that they have to pay car tax and again congestion pricing but this charging is only distributed who make congestion on the road in a particular day. That is why this system is very comprehensive distribution of charging who are particularly responsible for congestion. It is highly recommended that public transport must be improved its infrastructure & passenger information to cope with the induced or shifted traffic. The money of pricing are to be used to improve only the public transport e.g. bus transport or proposed metro service.

3.3 Flexible divider

A major reason influencing the increase the number of private cars is the construction of new roads. A classical dictum says that "supply creates its own demand". Traffic demand management tries to resist building new construction by utilizing the existing facilities with efficient ways. Fixed divider prevents the maximum utilization of the existing lanes during peak periods. Flexible dividers or movable barrier are those dividers that moved laterally depending on the traffic distribution. By borrowing lanes from the off-peak traffic direction, more lanes can be provided to peak traffic without the costs and time constraints of new construction. It is a mechanism that would allow traffic flow in such a way that maximum amount of road-space is utilized. By using this flexible divider we can manage the traffic according to demand. For example during peak hours we can offer four lanes instead of three lanes for the peak direction. Similarly we can manage traffic in opposite direction in off-peak hours. So this flexible divider will help us to reduce congestion in peak hours.

Plastic Road Barriers in Figure 3 offers impact resistant, non-fading, UV-stabilized plastic road barriers. These are highly visible because of their bright colors around work zones or roads. These plastic road barriers are quite lightweight without sharp corners, allowing only two workers to quickly put up a wall. The use of water or sand inside these barriers reduces loss of life & damage to vehicles. The carrying of these dividers is easy and cheap with respect to the fixed divider.

Moveable Concrete Barrier in Figure 4 is an innovative technology that uses one metre long steel-reinforced concrete barriers that are chained together to form a continuous divider (ITS International, 2009). A barrier transfer machine (BTM) lifts the barriers by a modified "T" top and moves the wall one or more lanes to reconfigure the roadway to manage the peak traffic needs. It can transfer a kilometre of high performance concrete barrier up to two lanes in four minutes, offering road agencies an innovative strategy to make congested roadway systems more efficient, safe and functional.

Figure 3. Plastic road divider

The primary roads of Dhaka city like Mirpur road, Kazi Nazrul Islam avenue, Airport road & Pragati Sharani, Begum Rokeya Sharani etc. are built with three or more lanes in each direction. The average capacity of roads in Dhaka city is 1,697 vehicles per hour per 3.5m lane. The result for old Dhaka is lower capacity at 1,601 vehicles per lane per hour, while the rest of the city showed higher capacity at 1,881 vehicles per lane per hour (STP, 2005). But the demand is much higher than that capacity during the peak hours. Fixed divider or somewhere median make sufferings to traffic in peak periods due to be stuck in congested direction but the road beside them has much space to move. Adding two lanes with the existing lanes increase the capacity for four times (Wright, 2007). The proposed divider, manually or automatically movable, are suitable for the

short range and quickly applicable solution which demand no large amount of money and the extra added lanes could be also used as high occupancy vehicle lane or bus lane only. This helps to reduce the use of private cars, rather more bus riders will be generated.

Figure 4. Concrete movable road barrier and BTM (Source. ITS International, 2010)

4 CONCLUSION

Apart from different traffic demand management measures, the effect of car sharing, car pricing and movable divider can significantly reduce the number of passenger cars whose users are few. This paper particularly discusses about some methods of reducing passenger car users. Car sharing increase the occupancy of any car and it directly affect the percentage of growth. Car pricing is another form of tax which only applied when car use the road. It will affect using road as our country is underdeveloped. Car pricing will also encourage the people into car sharing. These two inter contributing factors can more decelerate the use of cars. Bus having major users in Dhaka city, will be charged free to make it popular. But adequate infrastructure, favorable route to users and information facilities are must for bus or metro rider. Movable divider helps to borrow one or more lane from off peak direction and this extra lane will be used only for bus or high occupancy vehicle. The combination of these three measures will be very effective in reducing congestion created by passenger cars in Dhaka city.

REFERENCES

A CBO study:Using pricing to reduce traffic congestion. 2009. The Congress of the United States O Congressional Budget Office. Pub. No. 3133.

Alam, M.J.B & Habib, K.M.N. 2003. *Effects of alternative transportation options on congestion and air pollution in Dhaka city.* Journal of Civil Engineering, The Institution of Engineers, Bangladesh, Vol. CE 31, No. 2, pp. 165-175.

DTCB. 2005. Startegic transport pl an for Dhaka. Government of the Peoples Republic of Bangladesh, Ministry of Communication.

Ewing, R.1993. TDM, growth management and other four out of five trips. Transportation Quarterly, Vol 47, No. 3,. 343-366.

Giuliano, G., & Wachs, M. 1992. Transportation demand management as part of growth management. In J. M. Stein (Ed.), *Growth Management: The Planning Challenge Of The 1990s*. London: Sage Publications.

Litman, T. 2004. Efficient vehicles versus efficient transportation: comparing transportation energy conversion strategies. Transport policy, Vol-12, No-2, pp121-129.

Mahmood, M., Bashar, M.A. & Akhter, S. 2009. *Traffic Management System and Travel Demand Management (TDM) Strategies:Suggestions for Urban Cities in Bangladesh.* Asian Journal of Management and Humanity Sciences, Vol. 4, No. 2-3, pp. 161-178.

VTPI . 2005a. *Why Manage Transportation Demand?* Retrieved from http://www.vtpi.org.

World Bank, 1996. Sustainable transport: Priorities for policy reform. World Bank. Retrived from http://www.worldbank.org.

World Highways & ITS International. 2010. Sustainability for road infrastructure: Transportation responds to environmental challenges, Route one publishing Ltd.

Wright, P. H. & Dixon, K. 2007. Highway engineering. Georgia Institute of Technology. Seventh Edition.

Zupan, M. 1992. *Transportation demand management: A cautious look*. Transportation Research Record No. 1346 (Highway Operations, Capacity, and Traffic Control). Transportation Research Board, USA.