

APPROACHING SUSTAINABLE URBAN TRANSPORT

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1. INTRODUCTION

- 1.1 Urbanization appears to be the accepted agenda of population and nations spread across the globe. With larger proportion of population opting for urban culture as way of living, more and more nations are accepting higher levels of urbanization as the assured way to prosper economically and grow physically. In this race of globalization and rapid urbanization, cities are growing in size, area and physical dimensions with fastest growth taking place in the developing world. Phenomenon of urbanization is not new because cities have not only existed as integral part of human history but have also scripted the growth story of mankind right from its inception. Cities have existed in the past and shall continue to exist in future too.

Recognizing the critical role and importance of urban areas, *U N Habitat Report on State of the World Cities, 2008-09* have defined cities in terms of one of humanity's most complex creation, never finished, never definitive and like a journey that never ends. Evolution of cities is determined largely by their ascent into greatness or their descent into decline. Cities have also been recognized as the past, the present and the future. Looking at these aspects, cities have proved to be great places, determining the vocabulary of ideas and innovations. As economic drivers, cities are known to be major contributors to the national economy and wealth besides generators of large employment opportunities.



- 1.2 India, despite low level of urbanization placed at 31.1% in 2011, has emerged as the second largest urban system in the world after China, thanks to its large population base of 1.21 billion. However, India is urbanizing rapidly under the impact of migration, industrial growth and spread of service sector. The pace of urbanization is picking up with more and more people making cities as their place of residence and place of work. In India, cities are on move and are designated to play critical role in the growth and development of the country. India is projected to have population of 1.6 billion in 2050 with half of them living in urban areas. The urban population is projected to the level of 800 million by 2050, as against 378 million in 2011.
- 1.3 As per *Mckinsey Global Institute Report - India Urban Awakening: Building Inclusive Cities-* Urban India will house 590 million people by 2030 (as against 377 million in 2011), which is twice the present US population. Cities will

generate 70% GDP, 80% Revenue and 70% (170 million) of new jobs, which India as a nation will generate. Cities will also create enormous wealth at the individual level with 91 million urban households joining the select band of middle class, more than four times the number of existing households (22 million). Number of metropolitan centres will rise to 68 (53 in 2011), which is twice the number of metropolises entire Europe has (35). However, India will need to invest considerable amount of resources to create appropriate level of infrastructure and services to sustain the additional and existing population. Investment, estimated to the tune of \$ 1.2 Trillion will be needed to meet projected infrastructure demand, whereas 700-900 million Sq mts of residential/commercial area will be needed on annual basis- a new Chicago to be created -to meet the built area needs of the urban India. In addition, 2.5 billion Sq mts of roads will have to be paved, which is 20 times the road network created in last decade with 7400km (350-400 km/year) of metro needed – 20 times created in last decade, to meet the projected transportation/mobility demand of cities by 2030.

- 1.4 In this era of liberalization, cities have emerged as the major drivers of national economies using transportation as the mechanism because movement of both people and goods have been observed to be a necessary condition/component of development. In the process, traffic and transportation has gained importance because of its critical role in promoting economic development and social integration of a region and country. In addition to bridging the gap between demand and supply of goods and services and providing mobility for its citizens, transportation has been considered vital for leveraging employment, promoting industries besides contributing to the prosperity of a nation. If cities are known as engines of economic growth then transportation has rightly been called wheels of such engines.



- 1.5 Transportation is fast emerging as the critical element of urban development, considering the concentration of large population and activities in a relatively small area as compared to rural settlements, leading to generation of high traffic volume and large travel demand. With rapid growth of population and pattern of urban growth characterized by the sprawling conurbation, scattered and unstructured physical expansion of urban centers in general and metropolitan centers in particular, traffic volumes have been leapfrogging. The physical expansion of cities has led to larger distances between place of work, place of living, place of trade and commerce, place of leisure etc, placing large demand on transport network to ferry large number of people from one place to another. Considering the overall scenario of urban growth and development, emerging transportation pattern in India is likely to be problematic and complex, marked by large number of dualities and contradictions. Despite poor road geometry and low

holding capacity, vehicular population on Indian roads is increasing rapidly. Despite lack of parking areas, more and more vehicles are being added into the cities, occupying every available road space including all possible open spaces. In the planning parlance, parking and park have become synonymous, one replacing the other over a period of time. In the process, Indian cities are marked with high degree of vehicular congestion leading to long delays and raising the cost of business; extremely low vehicular speed; high degree of air pollution threatening the life /health of the people; large number of road accidents leading to loss of precious life and property and emission of large volume of green house gases and global warming. Instead of providing high degree of mobility and operational efficiency, urban transportation has emerged as the major roadblock and threat to the mobility, economy, environment and sustainability of majority of cities. With millions of precious man- hours lost in everyday travel, transportation is adversely impacting the productivity of human beings. In the process, travel and traffic blues are fast emerging as two major threats to the operational efficiency and sustainability of the urban centers.

- 1.6 With Indian transportation scenario showcased by large variety of heterogeneous and contradictory travel modes involving varying sizes, speed and characteristics, operating in the urban centers and competing with each other for adequate space on already highly stresses road network, the problems of traffic and transportation are assuming complex and alarming proportions. Majority of these problems are concentrated in core areas, which house major commercial activities besides large chunk of population. With limited space, inadequate road network and limited holding capacity, these areas are already under enormous stress causing numerous operational problems. Considering the role and importance in overall economic and social growth, it becomes important that urban transportation, as a sector and as a essential human activity, is critically looked at and appropriate strategies put in place on priority to make it safe, affordable, faster, comfortable, reliable, sustainable, effective and efficient in order to improve accessibility to jobs, healthcare, education, recreation and other day to day needs of human beings. This would involve looking objectively at the entire mechanism of transportation. Since transportation is the product of rapid urbanization, size and shape of cities, human behavior, increased travel demand and defined land uses, accordingly it would call for making urban transportation integral part of urban planning and development process. In addition, it would also require re- defining our transport priorities, vehicle ownership, planning strategies and traffic management options in the urban sector in order to rationalize the travel demand and traffic patterns.

2. INDIAN TRANSPORTATION SCENARIO

- 2.1 Transport, as a sector, makes substantial contribution to the Indian economy. As per statistics available, overall contribution of transportation sector to the national GDP was placed at 6.4% in 2006-07. Major contribution came from the road transport whose share was placed at 4.5% (70% of total share). Contribution of railways stood merely at 1.2% (20%) whereas rest of the modes accounted for

only 0.7% (10%). Further, the entire increase in percentage share of transport to GDP since 1999-2000 has come from only road transport sector with share of other modes remaining constant. This clearly indicates the criticality of road transport in the Indian economy and urban growth. However, this also indicates the marginalization of the other means of transport which needs to be leveraged to promote speedier transportation of goods and services in the urban sector.

2.2 Post-independence period has witnessed enormous production and growth of vehicles on the Indian roads . Number of registered vehicles at the end of 2005-06 stood at 89.6 million with largest concentration recorded in major urban centres of Delhi, Kolkata, Mumbai, Chennai, Hyderabad and Bangaluru. Urban centres also



recorded large mismatch in growth of population and number of vehicles. Six major metropolitan centers, where population increase was merely of the order of 1.9 times during last 2 decades , the number of motor vehicles went up by over 7.75 times during the same period. Besides increase in numbers, pattern of vehicle ownership has also undergone rapid change with personalized mode accounting for more than 80% of total vehicles. Maximum growth has been recorded in the category of two wheelers whose share has gone up from 8.8%, in 1951 to 72.2% in 2006. During the same period, share of buses have gone down from 11.1% to merely 1.1%. Considering the fact that India is fast emerging as the global manufacturing hub of automobile, Munich based Roland Berger Strategy Consultants Report has estimated that vehicle penetration in India will grow six fold in next fifteen years from 12 vehicles in 2010 to 72 vehicles per 1000 persons in 2025 as against 187 for China, 221 for Brazil and 388 for Russia. Vehicle market in India is expected to grow to 5 million units and two wheeler market will become 29.5 million units in the year 2020. With rising income and greater demand for mobility, the personalized mode of transport is likely to grow rapidly in number and importance in the coming years. Proliferation of the personalized mode of transport is likely to have serious implications in terms of traffic congestion, parking, energy inefficiency, carbon footprints, green house gas emission, global warming and pollution. Strategies need to be evolved to reduce, minimize, control and regulate the ownership of personalized vehicles and promote public transport and other modes of eco-friendly travel to reduce congestion on urban roads.

2.3 Rapid increase in number of vehicles has not only led to overcrowding and congestion, it has also made road travel in the Indian cities highly risky and unsafe and prone to disasters with number of accidents going up rapidly. As per data available, 1.6 lakh accidents were recorded in 1981, whereas number of accidents recorded in 2001 were of the order of 3.9 lakh- a 250% increase in the

last two decades. However during the said period, number of casualties increased from 28,400 to over 80,000. The majority of casualties in terms of loss of life and injury were found to be among the cyclists, pedestrians and pavement dwellers, showing the vulnerability of these classes of road users. The transport related casualties are rapidly increasing in India making the travel highly unsafe and travelers/road users highly vulnerable.



- 2.4 The Indian transport sector is marked with high degree of mismatch between the number of vehicles and available road capacity. The growth of vehicles and vehicular traffic has been observed to be much faster as compared to growth of capacity and road network. During last 53 years (1951-2004), motor vehicle population has recorded a CAGR growth close to 10.9% compared to 3.6% in total road length with National Highways increasing merely by 2.3%. This mismatch between vehicular growth and road capacity has lead to high degree of congestion and capacity saturation, resulting in creation of numerous operational and environmental problems. In addition to congestion, motor vehicles are largely responsible for generating green house gasses in terms of CO₂, promoting global warming on large scale. As per a recent study made, cities produce 70% of global green house gas emissions, largely from energy consumption by transportation and buildings. Thus if we have to create **Smart cities** which are not only eco-friendly and energy efficient but also environmentally sustainable, we have to create innovative and state of art options for effective, efficient and eco-friendly transportation within the urban areas besides making buildings green.
- 2.5 Looking at the existing patterns of movement in urban areas, it can be clearly observed that Indian urban scenario is largely dictated by road transportation; increasing individual vehicle ownership; low road capacity; poor road geometry; high degree of fuel inefficiency; large obsolete vehicular population; heterogeneous traffic; inefficient and inadequate public transportation; high degree of environmental pollution; low priority for traffic planning; low priority to eco-friendly transport modes; poor traffic management; large mismatch between vehicle density and road capacity; multiplicity of agencies involved and absence of unified traffic regulatory authority; acute problems of parking; high rates of accidents etc. These peculiarities of urban transportation require innovative strategies to be put in place to address effectively the transportation issues and make urban transportation promoters of economic growth, operational efficiency and urban productivity besides creator of environmental sustainability.

3. STRATEGIES

3.1 Urban transportation in India needs immediate review and rationalization. Strategies for rationalizing would have to be a combination and mix of preventive, curative and innovative options. It has to be based on both hard (infrastructure) and soft (planning) options. The strategies for traffic rationalization in urban sector should essentially revolve around and focus on:

- Minimizing travel demand
- Rationalizing travel demand
- Minimizing trip length.
- Minimizing mechanized movement.
- Minimizing pollution.
- Minimizing personalized vehicles on roads.
- Minimizing personalized ownership of vehicles
- Minimizing congestion.
- Minimizing accidents
- Promoting safe, comfortable and affordable travel
- Promoting sustainable transportation.
- Promoting highest order of traffic managements

3.2 To achieve the above objectives, the options suggested would be:

- Redefining Urban Planning.
- Redefining shape and size of cities
- Making cities compact
- Making transportation integral part of city planning
- Promoting sustainable communities
- Reordering prioritization of modes of travel .
- Promoting pedestrianisation.
- Promoting bicycles
- Making public transport more equitable, reliable, affordable, safe, comfortable, efficient and user friendly
- Equitable allocation of road space.
- Integrating public transport system
- Traffic Calming
- Road Pricing
- Creating public awareness
- Involving communities/ stakeholders
- Promoting sustainable urban transport.
- Involving state of art technologies
- Promoting innovations through R&D
- Deregistration of Old Vehicles
- Creating unified traffic and transportation Authority

3.3 Redefining Urban Planning

Traffic and Transportation has been considered essentially the function and product of the land use planning and accordingly it becomes critical that land use

planning is rationalized and carried out in a manner which generates minimum travel and minimum traffic. Master Plans, which primarily define and lay down the agenda for the pattern and intensity of urban land uses, should be used intelligently and effectively for integrating the land use and transportation. Considering the present chaotic urban transport scenario, options and patterns used for working out land use planning in the master plans need to be reviewed, revised and redefined with new options put in place to make urban mobility more effective and efficient. In the past, the cities have been planned for vehicles whereas the new strategy should be planning for people and not for vehicles. In the new order of planning, priority should go to people with travel made supportive of the basic human needs. Planning should aim at minimizing traffic and travel, the two worst gifts of urbanization. Pattern of city development should be dictated by the mechanism of *Transit Oriented Development (TOD)* which has been found to be of immense value in rationalizing and reducing travel and to promote highly efficient living-working relationship in urban areas. In this pattern, urban planning is dictated by placing high density development along the major transport corridors, where compatible land uses are permitted in terms of commercial, residential, institutional, offices, recreation, healthcare, education etc. Activities generating maximum volume of traffic are accordingly placed along the major transport arteries of the city within a walkable /cycleable distance of 400-600 meters in order to facilitate easy access to the public transport, without involving any personalized mode. This pattern has been found to be of immense value in rationalizing traffic and to make cities green and healthy. This pattern also reduces the travel time and takes off most of the vehicles from the road. City of Chicago in USA has launched a plan for 2040 by which city growth is being restructured in a manner so that 75% of the residents will be living within 10 minutes walk of the mass transportation network. Concept note prepared for the Smart Cities by the Ministry of Urban Development, also states that accessibility to mass transportation by walking/cycling should be made a priority. Eco- City of Tianjin, in China, has been planned and developed following this pattern.



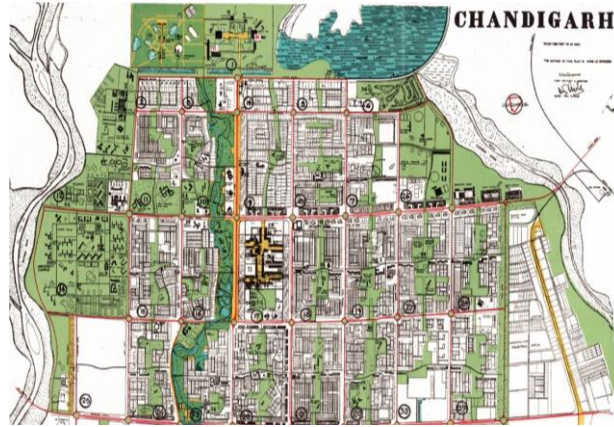
Pure land use, used by many cities in planning, has been observed to be promoter of increased travel demand, making people travel longer distances for living, working and approaching education and healthcare facilities. Accordingly, pure land use planning should be avoided to reduce travel and traffic on city roads. *Mixed land use planning* offers better options of providing majority of facilities in close vicinity, cutting down on the travel needs of the communities and making them self-contained and self-sufficient in basic day to day needs.

Further, in order to rationalize the travel, it would be critical to *make transport planning as an integral part of the urban land use planning*. In fact entire land use

planning should be based on the transport planning, if travel demands are to be rationalized. Transport plans should enable a city to evolve an urban form that suits the topography and best supports the key social and economic activities of the residents. Making transport plans integral part of land use plans would help in rationalizing the transportation within the urban centres. If future growth of any city is dictated by a pre-planned traffic network (rather than developing a transport system after uncontrolled sprawl has taken place) the city has much better chance/opportunity of serving its entire population and yet minimizing travel needs. Thus the intent, content and approach to prepare master plans for urban areas need to be re-defined in order to make master plans supporters and promoters of rational transportation options. Master plans should also invariably address the issue of regional connectivity in order to rationalize both inter and intra city traffic and save cities from the traffic blues.

3.3 Redefining shape and size of the city.

Travel in a city is closely linked to shape and size of the urban centres. It has been observed that there are shapes which promote larger travel and large transportation, whereas there are shapes which minimize road network and make city more travel friendly. Accordingly, in order to rationalize the travel demand, it will be critical to look at the shape and size to be adopted for the city while planning. *Grid iron pattern* should invariably be avoided because it promotes more travel and is highly unsuitable for an efficient mass transportation system. City of Chandigarh, known for its planned development, is facing major problems of traffic and transportation which has its genesis in the grid iron road pattern which has been used for its planning. Grid- Iron pattern where used, should be superimposed with diagonal road network to reduce the trip length. *Ring and radial pattern* offers better options for reducing travel demand within the city and to promote mass transportation.



Inherent advantages of *Linear Cities* can also be thoughtfully explored for effectively managing the travel demand. Accordingly, while preparing the development plans/master plans, it would be important to look at the shape of the city being adopted to rationalize the traffic and transportation. In addition, *size of the city* would also be critical. Larger the city, larger would be the trip length; accordingly cities must be made *small and compact* in order to reduce travel demand and promote energy efficiency. Small and medium cities offer better and simpler options of managing the traffic and transportation within urban centers as compared to metropolitan centres. In case of larger cities, options of *decentralization* could be used to create *self-contained communities* for

minimizing travel. Chengdu . a westernmost mega city of China, is following a new concept of city planning in which 80,000 residents will be living and working in a circle of half-square mile, where any location will not be more than 15 minutes walk. City has been designed to be a *pedestrian city* supported by efficient public transport system.

3.4 Making Cities Compact

Reducing travel and traffic within urban areas would largely depend upon the extent and footprints of the city. Low density and large sized plots with higher allocation of land to other uses invariably lead to poor utilization of land and increase the footprints of the city. Increased footprints results in increasing distances between different corners of the city which makes people travel more. In order to reduce



and rationalize the travel, it will be important to look critically and objectively at the *density pattern* adopted for the city planning and development. Promoting higher residential densities will make the city more compact by housing large number of people within small areas. This pattern automatically reduces travel distances and promotes non-mechanised vehicles for commuting. Higher densities would involve reducing plot sizes and changing pattern of city planning. It will also involve prescribing higher Floor Area Ratio and larger heights for buildings in order to create larger volume of built up area and optimum utilization of land, housing more people and activities in a smaller area. Promoting group housing instead of plotted development also helps in better utilization of land resource creating more dwelling units in the same area making cities more compact besides avoiding the land speculation. Higher densities not only reduce the travel needs but also considerably reduce the cost of services making city development cost-effective. *Compact cities* have been considered to be more energy efficient and eco-friendly because they reduce mechanical travel and make communities green and more sustainable with reduced carbon footprints. It is not only new cities to be developed, which can be made more compact , existing cities also offer enormous opportunities of re-densification provided their existing densities are re-looked, rationalized and re-defined , with a proper policy framework put in place, duly supported by additional infrastructure and services. Singapore increased the capacity of the city by scientifically identifying the plots which were low rise/underutilized and encouraged owners to promote high density development. New York city encouraged refurbishment of existing housing units by dividing larger plots into smaller units and adding studio apartments on the roof tops to create additional living space. Hong Kong also used the mechanism of *re-densification* to achieve higher densities. Indian cities, with extended municipal boundaries containing large open spaces and low density development, offer enormous

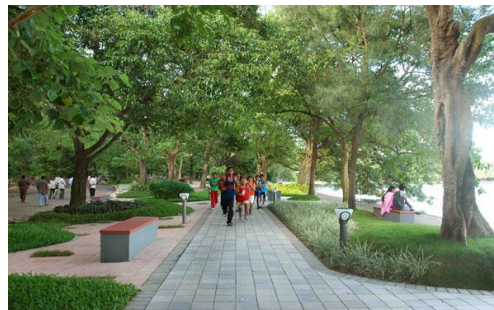
opportunities of looking inward for development to create large built up space without extending the city boundaries. Density pattern needs to be clearly and urgently defined by all states, to ensure creating/developing compact cities in the country. Creating high density communities offer a distinct and realistic option for making cities compact, improving environment, promoting better utilization of resources and allowing people to walk/use cycle rather than cars.

3.5 **Re-ordering prioritization of travel modes.**

Travelling options and preferences exercised, globally and locally, by people have also led to creating traffic blues in the urban areas. Globally it has been seen that passenger cars have dominated the travel preference and are responsible for 75% of passenger kilometers travelled whereas their average occupancy is close to one. Further, less than 10% passenger trips are performed by the public transport which has the highest carrying capacity. Walking and cycling is fast decreasing in cities. Less than 5% of passenger trips are being made by bicycle. Indian transportation scenario is no different. Despite the fact in India, pattern of trips is still being dominated by pedestrians and the cyclists, they have least recognition, priority, provision and safety in the parlance of traffic and transportation. In the absence of clearly defined and dedicated right of way, Indian roads follow a system of first come first serve leading to occupation of majority of road space by personalized vehicles, marginalizing in the process all other road users. Major problem facing the Indian transportation is also the outcome of the highest priority being accorded to personalized vehicles which occupy maximum available road space, have very low load capacity and cause maximum congestion and pollution. Accordingly, for rationalization of transportation needs and demand we have to reorder our priorities in city planning. *Transport Planning must focus on people and not on vehicles.* Accordingly, cities should be planned with highest priority given to pedestrians to be followed by cyclists. Public transportation should be accorded third priority whereas personalized vehicles should have the least priority. If the plans are prepared with this hierarchy, cities will have better options/chances of rationalizing its traffic demand and creating *sustainable transportation*. This would also help in making cities more eco-friendly besides least consumers of energy.

3.6 **Promoting Pedestrianization**

Despite the fact that pedestrian traffic constitutes considerable proportion of the city traffic, still it has the lowest priority in the transport planning. Accordingly, it will be critical that pedestrian traffic is appropriately catered to in the planning process in order to promote pedestrianisation. The most rational



measure, to make people adopt walking as the preferred mode of travel for shorter distances, would be the creation of *pedestrian zones* and dedicated pedestrian ways. Most of the central/ crowded areas, having high degree of traffic congestion and limited road space offer best options for creating such zones. Core areas and walled cities need to be pedestrianized with appropriate planning and design options. Vehicles in the core areas could be discouraged by introducing metered parking with high parking charges prescribed. However, these areas need to be linked with an effective and efficient public transport system for providing high degree of accessibility. Pedestrian zone is the best option for improving the travel conditions and promoting safety for pedestrians in urban areas. Further linking major activity nodes and residential areas of the city with efficient public transport by planning exclusive pedestrian pathways will help in rationalizing the traffic in the city. All local communities should also be effectively linked with nearby eating joints, shopping areas and other public places, which are in common use on day to day basis, to promote pedestrianization. Pedestrian pathways will, however, have to be planned intelligently, with prior community consultations, in order to make them more attractive and usable. They need to be made integral part of the green belt with attractive visuals, duly supported with appropriate level of amenities and street furniture to make it user friendly. Activity areas also need to be planned with places for people, to gather and socialize, to make them more attractive. Promoting pedestrianization should be high on the local agenda because this mode of travel has enormous capacity to rationalize traffic besides having zero carbon footprints.

3.7 Promoting Bicycle Traffic

After pedestrianization, most preferred mode of travel should be bicycle. Besides being economical, flexible and environmental friendly, *bicycles* are essentially zero emission vehicles (ZEV). They occupy minimum road space and require limited parking space. In addition, cycling is also the healthiest



transport mode. Despite having distinct advantages, bicycles have been neglected by transport planners as preferred mode of transportation. Its enormous potential remains unexplored. As per the data available, cycling still has the largest share of urban transport not only in India but even in developed countries. In China, highest priority is given to bicycles by creating *express cycle ways* and creating exclusive lanes dedicated to the cycle traffic. Cycle lanes form integral part of city road network including the major arterial roads in order to facilitate safe movement of bicycles in the urban centres. Majority of car trips of less than 5 kms can be conveniently made by bicycles, which can go a long way in reducing traffic problems in the urban areas. Most of the developed countries are now

promoting use of bi-cycles for shorter trips and trips undertaken for education and shopping. However, in order to promote bi-cycle it would require the creation of dense network of bi-cycle lanes in cities along all the major road network; creating a ring road around the most congested areas; preferential positioning of cyclist at the crossing and junctions; declaring certain roads as bicycle streets; allowing cycling along pedestrian zones; creating bicycle stations; supervised parking lots; integrating it with other systems of transportation including railway/metro stations, inter/intra bus stations and connecting important destinations including schools, offices, industries, leisure etc. City of Copenhagen is known for its bicycling culture and supporting infrastructure. Over the years, city has created 388 kms of cycling routes catering to 50% of the city trips. In order to make city more bi-cycle friendly, City of Copenhagen is now putting in place a unique traffic system by the name, *Green Wave*, which would ensure that cyclists will never encounter a red light during travel. Many cities are promoting bi-cycle rides by offering free use of bi-cycles to residents/visitors for travelling in the city. Corbusier, the master Architect and Planner, in the planning of Chandigarh redefined the system of 7Vs to include 8bc for catering to two wheeler traffic, peculiar to the new city. However the same has not been put in place and Chandigarh is now suffering from major traffic problems. Promoting bicycle traffic would require launching public campaigns on regular basis to involve communities and people to use bicycles. However, technology related to cycle would also require upgradation on regular basis besides making cycle affordable and efficient. Despite all limitations, bi-cycle offers the best option as cost-effective, non-polluting and energy efficient mode of urban transportation, occupying minimum road space to solve majority of urban traffic problems.

3.8 Making Public Transport more efficient

Public transport holds the key to rationalization and effectively catering to larger proportion of traffic demand in the urban areas. However, despite enormous potential, public transport remains largely a neglected area and least preferred mode of transportation. Unfortunately, in India public transport has been considered as a mode of travel largely used by poor or who do not own any vehicles. This has led to keeping the fares low, leading to large resources going as subsidy to keep the system going. This approach needs rationalization, review and re-look. Low allocation of resources has been one of the major factors for perpetual neglect of public transport in the urban areas. Vesting power with the local authorities to run the public transport at local level has emerged as the major bottleneck in its rational growth due to lack of expertise and inadequate resources. Making public transport a preferred mode of



travel, would require re-defining the entire approach and framework of public transportation including its planning, operation and management. Promoting public transport would require putting in place higher frequencies; improved regularity; better safety; higher comfort; more effective communication with users; provision of new buses/trains/LRT



systems besides competitive and easily comprehensible fare levels; dedicated right of way; prioritization at traffic lights and integration with other modes of traffic etc. Identification of potential corridors for mass transportation would help in rationalizing the traffic demand in urban centres. Use of eco-friendly mass transportation vehicles using non-polluting fuels (CNG) can usher a new era of sustainable transport in the urban centres making them free from major problems of vehicular pollution. In addition to providing an efficient, effective, affordable and cost-effective means of transportation, public transport has been found to be highly effective in reducing road congestion and air pollution and accordingly requires higher priority. Consideri

ng different categories of clientele, different travel options must be offered to divert people using cars/two wheelers to public transport.

Promoting public transport on large scale would also involve creation of state of art infrastructure including improved bus stations/terminals; improved passenger information system; use of intelligent transport systems for monitoring and control; affordable ticket pricing; e-ticketing; using single ticket for all modes of travel making any number of changes; carrying out maintenance during the night and introducing comfortable buses (air conditioned buses) etc. Ahmadabad BRTS has already demonstrated its strength in solving the traffic problems of the metropolis. Delhi metro has already achieved the mark of moving 2.8 million passengers in a single day and is now gearing to reach 6 million mark when all the phases will be completed. Study made about the impact of Metro on Delhi by the CRRRI, has revealed that Metro has helped in not only taking away 3,90,000 cars off the city roads but has resulted in reducing travel time of users by 32 minutes. In addition, it has resulted in saving valuable fossil fuel besides saving the city from the emission of green house gases. The net saving has been estimated, on account of fuel, time, reduced carbon footprints, to be of the order of more than 10,000 Crores on annual basis. In addition, it has made Delhi safe and travel friendly by reducing loss of human life and property on account of reduced accidents besides increasing the productivity of city. Mumbai sub-urban trains have proved to be lifeline of the city to keep it running even in all adverse conditions. To effectively solve the problems of traffic, Copenhagen has developed world class public transport system from where all residents will be living within a distance of 400 meters to minimize use of private cars and to promote public transport. City of Chicago is also extending its suburban railway

network to ensure that 75% of the city residents should have houses within a walking distance by the year 2040 under 'Go to 2040' plan to rationalize travel. Thus public transport has enormous potential which needs to be thoughtfully and rationally explored to solve the traffic problems of urban areas.

3.10 Equitable Allocation of Road Space

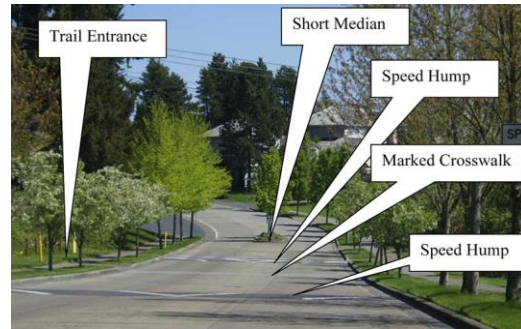
Indian transportation scenario is distinctly marked with multiplicity of vehicles occupying, sharing and competing for the common road space. In the absence of any clear allocations, road space occupation is largely governed by first come first serve basis. With focus on vehicles, majority of road space is being occupied by personalized vehicles that outnumber the other vehicles. This leads to high degree of congestion because of low capacity of these vehicles and squeezing other vehicles out of the road space. Bus, carrying more than 50 people requiring merely 2.5 times the road space that is occupied by a car carrying 2-3 people, has very limited space available to move on urban roads. Disproportionate space allocation leads to higher travel times and higher travel cost and most of the people suffering from this paradigm belong to lower income groups. The existing trend need rationalization with an appropriate mechanism of *rational allocation of road space* immediately put in place. The focus of the road space allocation has to be based on equity and the carrying capacity of the vehicles in order to rationalize the traffic and minimize the congestion. It has to be redefined with focus shifting from being vehicle centric to the people centric. Vehicles carrying large commuters should be allocated more space in order to ensure their speedier movement. Further based on equity, all the modes of transportation should be given priority in terms of their carrying capacity. This objective can be achieved by reserving lanes and corridors exclusively for public transport, non- motorized modes of travel, high occupancy vehicle lanes, pedestrians, bicycles depending upon their share in the overall traffic. However, preferential allocation to public transport and cyclists will help in diverting more traffic to these modes from personalized vehicles leading to higher order of operational efficiency and better capacity utilization of road network besides promoting sustainable transportation. Many cities in the world have used, both successfully and effectively, the mechanism of reserving stretches of roads exclusively for the use of public transport to reduce congestion, air pollution and improving efficiency of rapid bus transit system. Istanbul dedicated 42 kms of existing road lanes for the newly introduced Bus Rapid Transit System. This helped in two fold increase in speed of buses as compared to other vehicles. With buses arriving at 30-45 second interval providing



continuous service, city was able to effectively and efficiently move 6,20,000 passengers a day.

3.11 Traffic Calming

Traffic Calming is another concept being followed in developed countries to minimize the hazards of traffic, promote quality of life in urban centres and eliminate environmental pollution. Major elements involved in the concept are redesigning of streets and roads for a reduced vehicular speed not exceeding 30 kmph; giving priority to public transport; promoting pedestrianisation and bi-cycle traffic; enhancing the social quality and vitality of cities; allocating large road space to vehicles other than personalized mode of travel; creating large green areas as integral part of transportation network; management of car traffic through re-routing, parking management, signaling ; surveillance and sanctions besides communication and participation by the public. Feedback received from the communities has given distinct appreciation of the concept in terms of reduced noise & air pollution besides promoting increased road safety and improved quality of life in all residential areas.



3.12 Road Pricing

Road pricing is a new concept which has been used effectively to rationalize traffic, minimize congestion , promote public transport , minimize use of personalized modes of travel, promote environment, reduce pollution and generate resources. Singapore, which uses a unique system of traffic information to guide and educate the drivers and road users, has used the road pricing mechanism effectively to tackle the problem of congestion on city roads. It has put in place a Unique Electronic Road Pricing System which makes road users to pay a variable congestion charge according to the prevailing traffic conditions and distance travelled. It not only generates revenue for the city government but also encourages drivers to take less congested roads. Levy of charges has discouraged use of personalized cars, promoted preference for car pooling and use of public transport. The system also generated a revenue of \$ 125 million in 2010, which was used for promoting and rationalization of transportation in Singapore. This mechanism can be used effectively by metro cities on critical roads/stretches facing large volume of traffic and posing perpetual problems of congestion.



3.13 Creating Unified Transport Authority

Indian transportation scenario at the local level is distinguished by existence of multiplicity of authorities with overlapping areas of operations in large urban centres and absence of such agencies in the smaller towns. It has led to a scenario which is both chaotic and irrational. Available agencies lack in capacity, competency, expertise and requisite manpower to study, analyze, plan, develop and manage the entire gamut of inter and intra city traffic, with the result urban transport is being run and managed by proxy. This calls for creating a dedicated and unified agency for managing traffic and transportation at the state and local level in order to holistically address the problems, issues and traffic blues. The dedicated agency must be fully equipped with appropriate level of manpower having in depth, knowledge, expertise and experience of peculiarities of urban traffic and provide solutions to rationalize them. Research and Development should be made integral part traffic planning in order to bring innovations in traffic management. National Transport Policy, provides for setting up UMTA (Unified Metropolitan Transport Authority) in all 53 million plus cities in order to facilitate co-ordinated planning and implementation of urban transport programs and projects on time bound basis besides promoting integrated management of transport systems at the local level. Policy further recommends setting up these authorities under state laws to make them more effective, efficient and meaningful. Number of states has already set up such Authorities.

3.14 Involving Technologies

Technology can play major role in rationalizing and planning the urban traffic. Unfortunately potential of technology has been used to a limited extent in India to manage traffic. In developed countries, technology has been extensively leveraged in monitoring, planning and designing the transportation policies, and programs and their implementation. In addition, it has been used effectively to monitor the traffic conditions in the city and its various parts, to minimize the problems of congestion and to ensure smooth flow of traffic. Use of IT and ITES have also helped in generating valuable data for planning, framing realistic short and long term policies and programs based on ground realities. Placing cameras at intersections to optimize the traffic lights and cut transit time while reducing air pollution and cost of tackling it; dimming/ switching street lights automatically by using real time data to save 30% on energy cost and creating *solar powered bike lane* to make cycle even greener, have been effectively used globally to improve traffic and transportation. In London, transport operator, 'Transport for London' has shared its data to encourage the development of service oriented apps such as '*Bus I T London*', which suggests best bus route for any journey in the city depending upon user's location. *Road Pricing mechanism* evolved by Singapore has its genesis in the I T technology. Thus IT needs to be extensively and innovatively used in rationalizing, planning and managing urban traffic.

3.15 Singapore Experiment with Traffic Management

Singapore is known for its urban development and traffic management strategies, which it has evolved over a period of time. It accepts the critical role transportation plays in promoting urbanization, economic growth and the quality of life. In the initial period of growth, it faced numerous urban and traffic related problems in terms of haphazard, unplanned, sub-standard development, serious congestion, poor traffic management, lack of driving skills, poor infrastructure, inadequate and inefficient public transportation system and lack of transportation planning.



To overcome traffic related problems, Singapore, initially adopted the strategy which revolved around increasing the size of the roads/ number of lanes to increase the road capacity. However with increasing economic and population growth, projected high volume of traffic, availability of the limited geographical area, it was considered prudent to change this strategy and adopt two fold option, *involving promoting efficient public transport and controlling number of privately owned vehicles on the roads.*

For managing the transportation within Singapore, which is primarily land based, Land Transport Authority (LTA) was created in 1995 by merging four different public transportation agencies with the objective of establish a sustainable land transport system for Singapore. The LTA was to ensure:

- *Developing road network to include maximized capacity;*
- *Improving quality and efficiency of existing transportation modes (i.e. rail and bus);*
- *Managing car population and demand of road usage to reduce the congestion*
- *Minimizing the need of travel by incorporating transportation in land use planning*

The most innovative part of strategy was to control the number of privately owned vehicles on the roads which was done through the mechanism involving *Vehicle Quota System (VQS), Electronic Road Pricing (ERP), Certificate of Entitlement (COE)*. Under this system, no person could own a vehicle in Singapore unless he had obtained a Certificate of Entitlement (COE) from LTA which was priced and further linked to Vehicle Quota System (VQS) released by the Authority under which only pre-defined number of vehicles could be added on the roads every year. Since people wishing to own vehicles were more than the vehicle quota, people were asked to bid for the same. In certain cases, the cost of obtaining the COE is more than the cost of vehicle which made owning a vehicle in Singapore both difficult and highly expensive.. This approach has worked very effectively. Since the implementation of VQS the growth of vehicle population

has reduced from 3% (2009) to 0.5 % in 2014. Further, with the introduction of Electronic Road Pricing (ERP), every individual vehicle owner has to pay price based on the duration of road used, distance travelled and the population of vehicle density on the road used, making car ownership very expensive. Further, the COE is issued only for a period of 10 years, which can be further extended for a period of 5 years, based on the payment of additional money. After the expiry of COE, the vehicle is de-registered and cannot be retained in Singapore. It has to be sold and exported out or destroyed. This makes the vehicle ownership most difficult and expensive.

The loss of privately owned vehicles has been compensated by Singapore's public transport system, which is highly developed, effective and efficient. The network of Mass Rapid Transit (MRT) comprising of trains, buses and taxis serves to shuttle population across the city state every day, at relatively inexpensive and affordable fares. MRT is the backbone of the Singapore transport system, which provides seamless transfer for reaching any part of Singapore, the moment you step onto an MRT train. In addition, an highly efficient fleet of 4,050 buses move about 3 million people to their destinations daily in a clean, air conditioned comfort at the most affordable fare. For making BRTS more effective and meaningful, 200 kms of road lanes have been dedicated exclusively for the buses with waiting time to be reduced to 8 minutes during peak time by the year 2017 as against prevailing 10/15 minutes. Out of 12 million daily week day trips, 60% are performed through public transport, indicating the acceptance and preference for this mode of travel.

In addition, large network of cycle tracks have also been laid in order to promote cycling on large scale for travelling shorter distances and also for accessing the public places and public transport nodes with dedicated space provided for parking of cycles. People with foldable bi-cycles are also permitted to carry them in the public transport subject to the safety of co-passengers.

Singapore also provides intelligent traffic information system which can be accessed by the road users to source information on the traffic status in any area/road and decide about the best travel options in the city. Singapore, with a land area of 710 Sq Km and a population of 5.3 million, is supported by 3300 /177 kms of road/rail network and vehicle/car population of 9,69,000/6,20,000 with 12% area placed under the road network for meeting the daily needs of mobility in the island. The role of government in this transformation is pivotal, followed by public participation. The bold policies opted by the government are based on technology, innovations, which has helped the city to maintain its transportation health. Singapore offers numerous options, messages, good practices and lessons for creating smart and sustainable transportation, which can be adopted by Indian cities with appropriate modifications.

3.16 Conclusion

In 2006, the transport sector produced 6.4 Gigaton CO₂ emission, or 23% of world energy related CO₂ emission. With the use of traditional fuels, transportation sector alone will be contributing 45% of all total carbon emissions coming from developing world. With numbers of personalized vehicles recording high degree of growth and



exhaust from cars and buses being the single largest contributor to the green house gas emissions, challenges posed by transportation sector accordingly remain daunting and formidable. To overcome these challenges options would clearly hinge on promoting sustainability of urban transport in order to make it as collaborative partner in the process. Sustainable urban transport would essentially call for minimizing use of personalized vehicles; promoting non- mechanized/ non-fuel based options for travel; using public transport with large capacity run essentials on non-polluting fuels /electricity ; using state of art technologies making vehicles zero-emission; making cities more compact to limit the need of mechanized travel; using land use planning to rationalize the travel pattern etc. It would also involve use of information technologies as one of the mechanism to reduce travel by using homes as offices, schools, libraries etc. Use of multi-storied buildings for making cities more compact can also be considered a distinct option for minimizing travel needs of the city. Draft Concept note evolved by the Ministry of Urban Development for the Smart Cities have defined the transportation parameters for a smart city in terms of maximum travel time; creating continuous unobstructed footpaths; dedicated and physically segregated bicycle tracks; high quality and high frequency mass transport within walking distance;. However, creating sustainable urban transport would require a multi-pronged strategy based on leveraging the advantages of all modes of travel, involving communities and stakeholders besides professionals engaged in urban/transport planning, development and management. Increased use of environmentally- friendly public transport systems and halting of urban sprawl in cities to substantially reduce emissions and make cities cleaner, greener and sustainable. Our capacity to create sustainable urban transport, through state of art cleaner and greener technologies with innovative city planning, development and management options would hold the key to the productivity, economy, quality of life, sustainability and operational efficiency of human settlements.

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