

METROPOLITAN TRANSPORT – PLANNING AND POLICY ISSUES

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1. INTRODUCTION

Problems of cities have existed from times immemorial. Solutions to problems have been based on current perceptions. Every generation works with the tools developed by it. Planners in the past had to make a good deal of use of their intuition. Our generation makes a greater use of mathematical and statistical techniques. With the help of these techniques, the real situation is perceived as closely and minutely as possible. In the context of transportation, this is all the more relevant. Transportation however is the base not the bias. The transportation should be integrated in the planning process and it is one of the many aspects of total planning in which all aspects interact, influence and aggregate.

2. PLANNING ISSUES

2.1 Present planning

In India, it is only now that integrated planning is really making headway in our metropolitan cities. By and large, in most of the metropolitan cities and in all the non-metropolitan cities where plans have been, or are in the process of preparation, the need-based approach is followed. The land use or the Master Plan for the horizon year considers short-falls and anticipates need on the basis of simple trends of extrapolation which are programmed usually for quinquennial period of implementation. Unit standards still form the basis of infrastructure and community facilities requirements. Integration of activities is attempted in a hierarchical settlement pattern self-sufficient within the scale of functions. Review of plans is however absent in most cases as also is updating. Horizon years come and go but the once prepared Master Plan goes on for ever or so it seems. Sanctioning and statutory enforcement take so long as to invalidate many of the assumptions. New plans are started ab initio. A fundamental constraint to leave the “existing area alone” negates the fundamental philosophy of planning, in fact makes a mockery of the “integrated approach”. Plans by and large emerge as successive cataloguing of shortfalls.

Planning effort in transportation has been the rudimentary arterial circulation proposals in the land use plans. Even the widths of the right-of-way and carriageway are never realized. No strip acquisition is done on the existing roads. Lower categories of roads are not considered in planning and development. Efforts are made in a few cities to optimize the road-based mass transportation and also introduce high capacity rapid mass transport system.

2.2 Constraints

There are a number of criticisms of the present approach, some of them valid. There is for example no clear cut enunciation of precisely 'who' is the client for the innovation. However, the procedure involves set of alternate plans and economic criteria can be modified to consider 'social goals' also with the itemization of client groups, the range of conflicts and the socially 'best' solution. There is also certainly a good deal of truth in the criticism that the predictive procedure ignores pedestrian traffic, intra-zonal traffic and frustrated travel demand. The early transportation plans did indeed idealise existing travel patterns to assess future requirements and above all a significant bias was seen in favour of individual (personalized) transport to the neglect of mass transportation. Criticisms of the reliability of the collected data and the effectiveness of the predictive techniques to simulate reality are more fundamental. Certainly planners have for long been pressing for a centralized agency for collection and storage of data.

3. POLICY ISSUES

3.1 Decentralisation of activities

The *raison d'être* of a city is the fact that the multifarious activities are clustered together and people do not have to go large distances in pursuance of these activities. The fact of minimal transport is implicit in the functioning of a city. Increasing distances, increased problems of travel, congestion, delays and accidents and increasing cost of travel are a pointer that strategies are required to be evolved so that the primary function is fulfilled. Out of all the types of trips according to purpose, the most inelastic are the work and back home trips from work which have to be performed in any case. Much of the exercise so far has been to bring people to jobs. It is time now that jobs are taken to the people. More generally activity areas have to be made proximal to residential areas. Activity land use location has acquired a new dimension and the neighbourhood concept deserves attention. Compartmentalised land use zones must give way to integrated sectors with facilities like hospitals, schools, post offices and shops in residential areas near job centres.

Scientific decentralization of all activities must be the order of the day and judicious mixture of land uses is required. Within a metropolis, small cities or sectors have to be created and made self sufficient in the hierarchy of all functions. The metropolitan core consists of city level functions only. The focus of activities must be removed from the main centre to the sub-centres. This technique of non-transportation means to solve transportation problems should be encouraged.

3.2 Halting further densification of city core

The central part of the city occupies a very important position in the land use map of a city and is characterized by dense land use development and very high land values. Due to its central location and dense development, it attracts huge volumes of traffic. Studies have shown that about 40 percent of all the passenger trips of a city have origin or

destination at the core area. With the increasing concentration of activities in the core areas of the cities, the volume of traffic to and from the city core is bound to increase and immobilize traffic conditions. From the point of view of traffic circulation, the city centre should have ease of access and the internal movement should be safe and convenient. At present, the roads do not satisfy either of the functions properly. Under the existing conditions, the accessibility is seriously hampered. Most of the main arterial roads in the metropolitan cities have volume capacity ratio in the range of 2 to 3, and hence it is difficult and also costly to augment the capacity of arterial road corridors. The remedy is to provide high capacity mass transport system on selected corridors with a network concept, but this is very cost intensive. So the experience has shown that the **cities have become liabilities rather than assets**. Any attempt to further intensify the land use of these corridors will be suicidal, as there will not be any reserve capacity in the system to meet even the normal growth of traffic taking place in the cities. In view of the above, there is an urgent need for halting further densification of the core areas of the city and evolve planning solutions at the city and regional levels. Only this can save the city core from the chaotic traffic conditions of the type witnessed today.

3.3 Restrictions on metropolitan growth

The burgeoning growth of our metropolitan areas is due to large scale migration. The growth rates of metropolitan cities over and above urban and national growth rates testify to this. It is well nigh impossible to restrict the natural growth of population within our metropolitan areas. Short of draconian measures it is equally impossible to turn back migrants. We must use non-metropolitan means to solve the metropolitan problem.

There have been attempts at restricting metropolitan growth. All our States have certain disincentive schemes to prevent further industrial growth in larger cities or belts along with incentive schemes for backward districts. However, improper implementation has nullified the effects. Markets and skills have not been developed commensurate with requirements. This is because all the inputs have not been provided for sustained growth.

3.4 Economic factor

The problem of augmentation of supply of transport and all other facilities becomes increasingly difficult because of continual increase in demand. At one stage, cost of addition and maintenance of services is far in excess of any tangible and intangible returns expected from it. Introduction of services in small and medium sized towns costs far less but has greater returns. Inputs of growth must be provided in such towns, together with shifting some of the activities from metropolitan cities. These towns will be able to attract migrants away from metropolitan cities. It is true that counter magnets have so far been unsuccessful. However, I doubt if we can honestly say that counter magnets have really been given a chance to develop. Simultaneous decentralization and growth inputs could provide socio-economic stability to both metropolises and small towns.

3.5 Prevention of migration

The integrated approach also calls for non-metropolitan methods to solve metropolitan problems. The source of migration is our villages and for various reasons village people migrate to the largest city in the region in the expectation of livelihood. Natural increase in rural population, farm labour redundancy and lack of gainful employment in the villages force people to leave. We have spectre of village problems causing people to leave thereby denuding the villages and migrating to cities, which results in urban problems. Hence economic inputs must be introduced in villages so that people move only by choice and not by compulsion. To provide these inputs, transport links to these villages is the prerequisite.

3.6 Urban policy

Whenever a facility is provided, activities reorient to take advantage of the facility. Just as one facet of the problems cannot be tackled without creating or intensifying other problems within the metropolitan cities, so also the problems of metropolitan cities cannot be tackled in isolation. They have to be dovetailed with an overall human settlement or urbanization policy. If conditions are improved in our cities, it will attract yet more people. That is what is in fact happening. For the deprived villager with no work, cities at least offer some hope of job opportunities. A simplistic corollary would be to suggest that the cities be left as they are and villages be tackled. But to argue in this fashion would be to negate centralized markets, education and technology. The whole spectrum of human settlements must be tackled to produce a viable rural-urban continuum. Transportation can help to a great extent in the development of hierarchical human settlements.

4. CONCLUSION

Transport has contributed largely to the growth of metropolitan cities. The lack of it has contributed largely to the problems. A balanced approach is needed to solve these problems. High capacity rapid transit within and in peripheral areas of metropolitan cities have the capacity to attempt solutions. Spatial reorganization using the modern techniques has to be tried out.

Ultimately we have got to learn to live within our means, especially in metropolitan cities. More and more, cities and conglomeration of cities have to plan on the basis of resources they can generate with marginal assistance from the State. Salvage programmes tend to perpetuate.

At the government level, it must be clear that viable metropolitan areas are inextricably linked with viable hinterlands. Use of transportation to achieve an interlinked scale of a hierarchy of human settlements is important to achieve a viable rural-urban continuum. Economic inputs along with transportation links must form a part of the urbanization policy. In fact, there can be no planning of metropolitan areas without planning of medium and small towns and rural areas.

Urban Transportation Infrastructure: Challenges and Opportunities

Case Study: Comprehensive Transportation Study for Mumbai Metropolitan Region (MMR)

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1. Background

In 2001, about 286 million persons (27.8% of total population) were living in urban areas and it was the second largest urban population in the world. The urban population is expected to rise to about 38% by 2026 (534.8 million). Urban India will continue to concentrate in 1 million and above cities, as number of these cities will increase from 35 to 61 during 2001-2026. As per UN-Habitat (2008), eleven cities, namely, Ahmedabad, Bangalore, Kolkatta, Chennai, Hyderabad, Mumbai, Pune, Surat, Jaipur and Kanpur will have population over 4.0 million by 2025 and these Mega cities will have total population of 127 million (over 24% of total urban population). India has to improve its urban areas to achieve objectives of economic development and creating sustainable humane habitat. Huge investments, institutional reforms and efforts from political, bureaucratic, technocratic and private systems are required in India's urban sector.

Most of the cities in India have been facing urban transport and other infrastructure problems for last many years, affecting the mobility of people and economic growth of urban areas. The Government of India approved the National Urban Transport Policy (NUTP) in April, 2006 to address the issues of transportation problems of urban areas. The policy primarily focuses on the mobility of people not the mobility of vehicles. This requires the public transportation system to be more attractive to use. The challenge for improved public transport is to provide good quality service at an affordable price. All the million plus cities needs one or the other forms of public transport systems or combination depending on the size of the city/ region to contain the traffic congestion, reduce the pollution levels, providing affordable, safe and secure transport facilities.

Mumbai, the financial capital of India has witnessed phenomenal growth of population and employment during the last few decades. Mumbai Metropolitan Region (MMR) is one of the fast growing metropolitan regions in India which extends to 4,355 sq.km. Population and employment (formal and informal) of MMR assessed for the year 2005 is 12.9 and 7.9 million respectively. The region comprises 8 municipal corporations, 11 municipal councils (Vasai and Virar municipal councils and other few villages together has been made as municipal corporation recently) and 996 villages. The dominant feature of the passenger movements in Mumbai is overwhelming dependence of the traveling by foot and public transport modes. In MMR, public transport systems are overcrowded and the road network is congested as there is a large gap between the demand and supply.

The Government of Maharashtra through MMRDA with technical assistance from World Bank under MUTP has carried out Comprehensive Transportation Study (CTS) for MMR known as TRANSFORM (TRANSPortation Study FOR the region of Mumbai) with prime objective of identifying travel pattern of residents in MMR and recommend long term comprehensive transportation strategy for MMR up to 2031. Further Business Plan has been carried out addressing the other infrastructures needs of MMR (Water Supply, Housing, Solid Waste Management, Power, etc.) for the horizon period upto 2021. These studies have been concluded in 2008 and 2009 respectively.

Mumbai Metropolitan Region Development Authority (MMRDA) has carried out Comprehensive Transportation Study (CTS) for MMR also called as **T R A N S F O R M** (Transportation Study for the Region of Mumbai) during 2005-2008 to assess the long-term (2031), medium-term (2021) and short-term (2016) transport infrastructure needs of MMR, institutional framework and resource mobilisation for transport infrastructure delivery.

In this paper, the Challenges MMR facing and brief details on Comprehensive Transportation Study carried out during 2005-08 towards evolving transportation plans for the horizon period upto 2031 and other recommendations of the study have been presented.

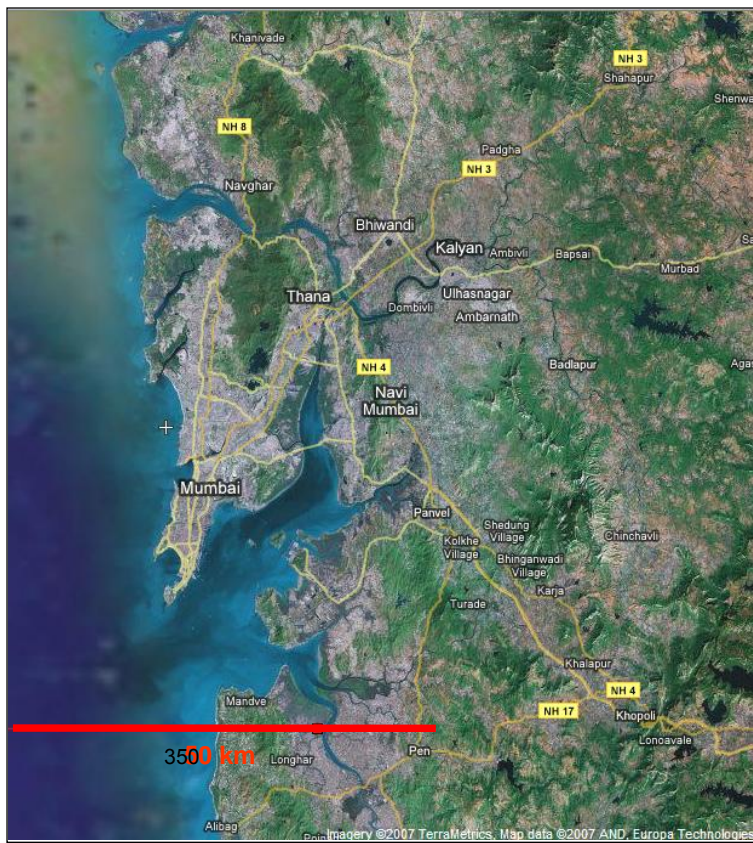
2. Challenges facing MMR

The major challenges to achieve the prime objective “Transforming MMR into a world class metropolis with a vibrant economy and a globally comparable quality of life for all its citizens” are presented in the following sections.

2.1. Physical Challenges

Difficult Landform and Geography

The MMR is geographically very diverse with relatively narrow valleys and shoulder plains sandwiched between the ocean, estuaries, rivers, creeks and hill ranges. As various generations built bridges, particularly the railways, the urban structure took the initial form of linear communities, along the railways, acting almost as umbilical cords. Then



road bridges replaced ferries, but the linear urban form prevailed. The core of the city is an island connected to mainland through limited number of linkages. The immediate suburban areas are divided by the Sanjay Gandhi National Park as well as several rivers, lakes and creeks. Other municipalities in the region are spread over a very large area. While some, such as Thane and Mira-Bhayandar are contiguous with the urban structure of Greater Mumbai, others, such as Bhiwandi and Vasai depend on single or very few transport linkages with Greater Mumbai.

There are a number of other municipalities, whose connectivity with rest of the region ranges between these two extreme examples. Also, there are many hilly areas as well as large creeks which cut across the region. The initial impression is a region full of almost insurmountable constraints. On the other hand, as compared to other similar regions, this diversity makes MMR unique and interesting. Many other large metropolitan regions, which have grown from a port base, have had to contend with a difficult topography and were forced to build major civil engineering structures to more fully integrate physically separated land masses. In many respects MMR has not faced up to this stark reality and this has resulted in extreme crowding and congestion. **T R A N S F O R M** addresses these issues that will become even more pronounced as the region rapidly reaches the forecasted population of 34 million by 2031.

Scarcity of Developable Land

While the gross land area of MMR is large, encompassing some 4,355 sq. km, only about 12.5% of this land can be categorized as being potentially developable. Some 1,134 sq.km are under the jurisdiction of various municipalities and their respective development plans, spread over various geographically diverse areas ranging from wetlands to mountains. The existing built-up area is about 418 sq.km, leaving a balance of the 718 sq.km.. However, since this also includes water bodies and green zones, the actual developable land within municipal boundaries is about 168 sq.km. Further potential urbanisable zones, identified in Regional Plan for 1996-2011, under two categories i.e., U1 and U21, contribute another 182 and 180 sq.km respectively. In total, this means that there is about 530 sq.km of land, which is currently deemed suitable for future development, or a mere 12.5% of the total MMR land area. Within Greater Mumbai 41% of 438 sq.km land area is considered as “No Development Zones” for a number of reasons largely related to environmental constraints or for park/open space preservation. There is less than 10 sq.km of designated land yet to be developed in Greater Mumbai.

State of Good Repair and Functional Efficiency

A high priority needs to be given to maintaining existing transportation systems in a state of good repair and functional efficiency. Funding to achieve this objective is rarely adequately budgeted as the same agencies have responsibility for both maintaining and expanding the systems. In this competition for funding, good repair typically loses out to system expansion. In MMR, the state

¹ U1 zone covers areas where more intensive urban development and economic activity is expected in future. U2 zone has areas which have potential for urbanization. It includes lands within 1 km on either side of important roads and within 1.5 km radius from railway stations.

of good repair and functional efficiency of the transportation systems have reached crisis levels. Regional infrastructure is unsafe and of low quality, and is very counterproductive to the aspiration of being world class. But perhaps more important, the inadequacies impose severe stress on the travelling public, undermining the health and well-being of MMR's greatest strength, its people. The poor state of infrastructure is already leading to the worst signs of demand suppression. Crowding on suburban rail coaches is worse than standards specified for transporting animals in the same system. As for safety, on an average day, 15 persons are killed on the road and rail systems, predominantly on the suburban rail network. This loss of life is deplorable and can be largely attributed to overcrowding. Some investments are now being made to improve service levels on the rail network but these will not significantly redress the present deficiencies. Perhaps the most impressive characteristic of the suburban rail network is its reliability, its speed and very low fares.

Road transportation is no better with traffic snarls and all day congestions. Despite this, between 1991 and 2005, there has been an increase of 140% in the number of cars and 300% in the number of two wheelers on the road. And there are no indications that the desire by the public to own vehicles is diminishing.

Vulnerability

Functioning transportation networks are crucial in times of natural and other calamities including floods, earthquakes and terrorist attacks. There is no element of redundancy in the existing systems and it is only with the heroic efforts of operating staff that disasters are so well mitigated. Existing public transport and road network in MMR is composed of long uni-dimensional corridors without adequate alternatives to fall back upon in case these arterial communication lines are severed.

A level of redundancy in the network can go a long way in ensuring a quick recovery in case of disaster by ensuring that supply lines are not completely cut-off. This aspect has been taken into account while framing the future transportation network for the region under **T R A N S F O R M**.

2.2. Social Challenges

Heterogeneity

With more than 50% of population living in slums and working in the informal sector, the region presents formidable social challenges as well. In many respects, MMR consists of many different social and economic strata each having distinct transportation needs and aspirations. It is now recognized that in large urban areas, governments have to attempt to provide transport choices with a "public transport first" agenda. However the maintenance and management of an efficient road network is also critical for the social and economic functioning of the city. Achieving the right modal balance is a key investment issue that has been addressed in **T R A N S F O R M**.

In terms of governance, while Greater Mumbai is under a unified and strong municipality (MCGM), the rest of the region comprises many heterogeneous urban, semi-urban and rural areas governed by a range of urban local bodies. To tie together transportation needs of such diverse groups along with keeping up with the aspiration of the region present challenges of its own including the need to maintain social inclusion. The regional transport needs are large and fiscally demanding, which may call for institutional restructuring to deliver the **T R A N S F O R M**. This is not to suggest that the present governance arrangements in the MMR should be radically changed, but that a different overarching mechanism needs to be put in place to plan, finance, build and operate regional scale and regional level functioning transport systems.

Slums

There is no other metropolitan area in the world that has such a large and diverse socio-economic milieu as MMR, particularly the number of poor residents. This is a manifestation of the historical magnetism of MMR in attracting rural populace from across India. This, coupled with unaffordable and restricted supply of housing, has resulted in large increase in slum population over last 20 to 30 years. **T R A N S F O R M** household surveys (2005) indicate that, about 41.3% of the population of MMR lives in slums. This slum population of about 8.6 million people in about 2.0 million households represents an enormous housing deficiency in the Region.

Slum dwellers are an integral part of the economic and social fabric of MMR. Rising education standards and income levels of slum dwellers over the next 25 years will inevitably materialize into a generational shift in housing from slums to regular, more permanent accommodation. This shift will be accompanied by increased demands for motorized travel with more people working in formal sectors. Predicting these generational socioeconomic changes, is a key factor in travel demand forecasting for the Region.

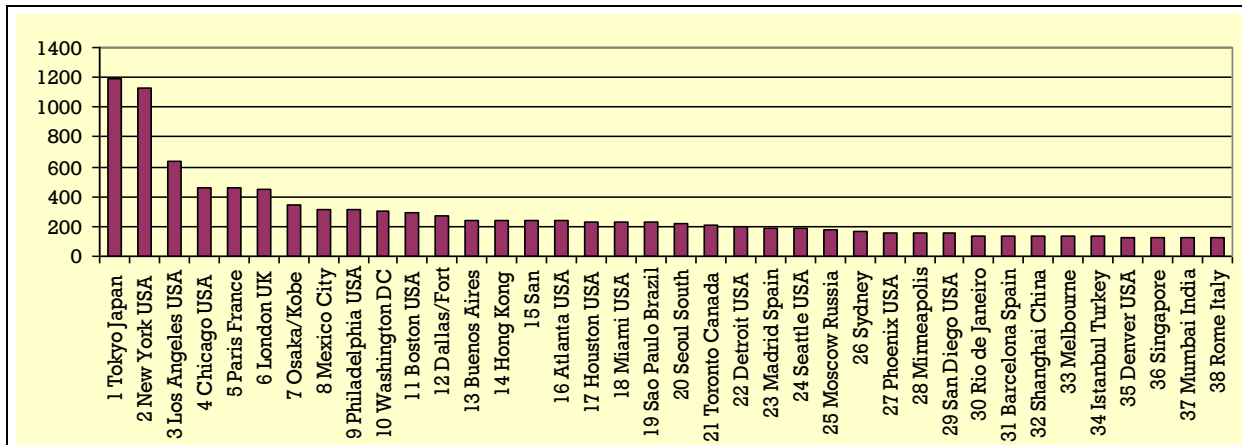
2.3. Economic Challenges and Opportunities

Growth

Greater Mumbai, a major part of MMR, is the largest city of India and sixth largest in the world. It is also the densest city of the world due to many people living in slums or slum like conditions. In spite of this, MMR has a unique role to play in the economy of the nation as country's most important financial centre and one of its most important service and logistical hubs. It contributes a disproportionate share to the national GDP, thus benefiting the whole country. Income of MMR² was estimated to be about INR 1295 billion in 2004-05 which comprised 40% of the state of Maharashtra. Per capita income, at about Rs 45,000 was three times that of an average Indian in the same year.

² The economic data (national accounts) are available for administrative districts. MMR comprises the districts of Greater Mumbai and parts of Thane and Raigad. Data for precisely defined MMR are therefore not available. Hence, the income of Greater Mumbai, Thane and Raigad districts have been considered for calculation of MMR income.

It is estimated that the region has a population of 20.8 million (2005) and employment of 7.6 million. By 2031, this population is expected to grow by 1.5 to 1.7 times and employment by 1.9 to 2 times, making MMR world's second largest metropolitan area. By estimates of M/s PriceWaterhouseCoopers made earlier this year, Greater Mumbai ranks 37th richest city of the world with a total income of US\$ 126 billion (in PPP terms) (Figure 1). Further, the same study observes that by the year 2020, Greater Mumbai will improve its position to 24th richest city of the world with an estimated income of US\$ 300 billion³.



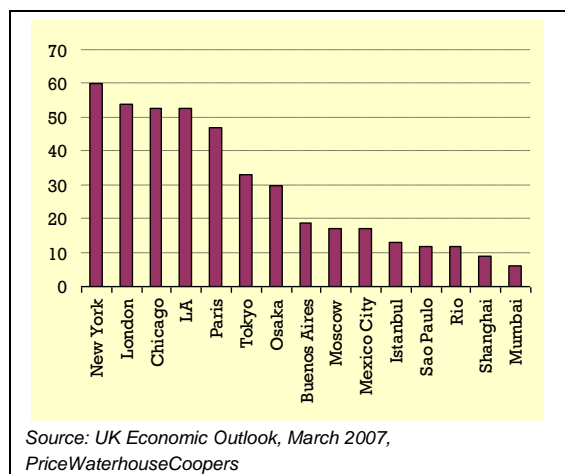
Source: UK Economic Outlook, March 2007, PriceWaterhouseCoopers

Figure 1: Estimated Total income in Year 2005 of top 38 cities (Billion US\$ in PPP terms)

Even in per capita terms, it was estimated that Greater Mumbai had a per capita income of about US\$ 6000 in the year 2005, highest in India or any other country in the SAARC region.

Competitiveness Issues

Status of the region as a financial centre and economic engine is fast eroding due to expensive housing and poor quality of transport and other infrastructure. If the region is not able to keep pace with the rest of the cities of country, it will fast lose the status it has enjoyed, making it go through the vicious circle of economic decline and lowered quality of life. Catching up with world cities is still a far cry. Even with this scenario, no organisation is responsible for planning for economic growth of the metropolis at an appropriate metropolitan scale. Constitutionally, all ULBs are responsible for social and economic growth in their areas. But with backlog of infrastructure deficiency and limited capacity, they are generally



Source: UK Economic Outlook, March 2007, PriceWaterhouseCoopers

Figure 2: Estimated income Per Capita in 2005 in Selected Major Cities ('000' US\$ in PPP terms)

³ UK Economic Outlook, March 2007, PriceWaterhouseCoopers

busy catching up on the shortfall. As of now, even basic statistics on economic parameters, which are important for measuring competitiveness, are not available for MMR. This is because these parameters are reported at district level, and the boundary of MMR does not match with the boundary of any of its constituent districts.

Many of the challenges associated with maintaining competitiveness are closely related to the physical challenges. Chronic shortage of affordable housing as well as a state of bad repair of metro's infrastructure remains the main stumbling blocks for MMR to continue as the preferred choice for doing business. Already, existing leading cities of the world have started taking note of the growth and impending competition. Thus, competing with world cities will continue to be a challenge for MMR.

2.4. Institutional Challenges

The recently completed Business Plan for the MMR observed that there is no strong metropolitan agency in MMR. For a metropolis aspiring to be world class in a short time frame, this presents the most formidable challenge. It becomes all the more challenging when the absence of a strong metropolitan level organisation is coupled with presence of too many not-so-strong ones.

The MMR comprises various habitations of varying sizes. It is governed by a multitude of Urban Local Bodies (ULBs) responsible for these different areas, posing enormous coordination issues. About twenty municipal corporations and councils govern major urbanised parts of MMR. Rural areas are governed by village level bodies that are coordinated by district level coordinating authorities. While most of the urban habitations are contiguous, there are few small ones that are interspersed in the region. Contiguous parts are recognised by the Census of India as Greater Mumbai Urban Agglomeration for reporting demographic statistics.

Physical development plans are prepared independently by each of the ULBs. At the metropolitan level, till recently, planning is being done by MMRDA, an authority created in early 1970. As of now, metropolitan planning is to be done by a "Metropolitan Planning Committee (MPC)" assisted by MMRDA although no working MPC has come into existence as yet. It is noted that there are also "District Planning Committees" (DPC) to plan for the entire districts. In MMR there are some full and part of districts. DPC relationship with MPC or MMRDA is not so far clear.

About ten different departments of the provincial government and eight ministries of the federal government are directly responsible for providing various social and physical infrastructures in the MMR. Many of these have either exclusive or overlapping functions with ULBs and MMRDA. Till recently (upto 2003), MMRDA was restrained from doing any development work in area under Municipal Corporation of Greater Mumbai. Thereafter, although it did act proactively in the area of transportation, many hurdles still exist to let it function as a true coordinating authority at a metropolitan level.

2.5. Financial Challenges

In spite of Greater Mumbai being the 37th richest city of the world, it lacks resources for creation and upkeep of matching transport infrastructure. MMR may need in the range of US\$ 25 to 30 billion by the year 2016 to have a world class transport infrastructure, necessitating expenditure in excess of INR 3 billion every year till 2016. (This has to be seen with the approximate size of MMR economy with income of INR 20 billion).

Compared to this, overall capital expenditure of all the ULBs in MMR in the year 2006 was about US\$ 420 million. MMRDA contributes about US\$ 5 million every year. World Bank funding under the project, Mumbai Urban Transport Project (MUTP), amounts to US\$500 million (out of total project cost about US\$ 945 million) over a six year period from 2002 to 2008 (averaging about US\$ 160 million per annum).

It can be quickly seen that the sums are small in comparison to the requirement. The recently concluded Business Plan for MMR identifies problems related to sources, collection as well as utilisation of funds. Sources are limited to octroi (dependent on buoyancy of economy) and property tax (tagged to the rate and base revision because of restrictive laws such as Rent Control Act). In addition, there are inefficiencies in collection. Even the capacity to borrow gets restricted due to laws restricting base revision. ULBs are not allowed to borrow on the strength of their balance sheets.

The Business Plan Study also mentions problems related to utilisation of funds and highlights issues such as weak internal processes for project identification, preparation and tender approvals. MMRDA's own balance sheet is about US\$2 billion with more than half of it in bank deposits. Borrowings are insignificant. Funds are not leveraged to secure resources from the capital market at competitive rates, a necessity to increase the rate of investment in infrastructure.

Funds created by MMRDA to lend to ULBs remain unutilised to the extent of 50% due to lack of bankable projects, limited debt servicing capacity of ULBs and unwillingness to levy and collect user fees. Further, funds of MMRDA are mainly from leased land that is not a very buoyant resource. Development Charge, which can form a sustainable source of revenue, cannot be collected by MMRDA, since it is not vested with the power to do so. Only special planning authorities are allowed to collect development charges.

A good development in recent years is that MMRDA has acquired expertise in putting together public transport projects in PPP format. This is a potent method of attracting private equity on the basis of its own participation. But, overall, financial scarcity as well as structuring is likely to remain one of the major challenges in implementation of the proposed transportation plan.

2.6. Transportation Challenges

To support the anticipated scale of economic development there are many inter-related transport challenges. The first challenge is to improve MMR's public transport system to accommodate the growth of population and employment and consequent travel demand⁴. This can be achieved by capacity enhancements to the existing suburban railway system; creating new metro corridors; connecting major existing and planned activity centres of the region; providing exclusive bus lanes to reinforce rail based transit with a higher order road based public transport system. Transit First is therefore considered as the guiding principle in preparation of transportation plan for MMR.

The second challenge is to create a hierarchical system of roads and freeways to meet a wide spectrum of travel desires, including goods vehicles and the projected large increases in traffic entering and leaving the MMR.

The third challenge is to structure the most effective institutional arrangements to efficiently implement the proposed regional transport plan in a timely and prioritized manner. An integral part of process is the mobilization of resources from traditional as well as new funding opportunities. International experiences in resource mobilization did provide useful insights into successful financing mechanisms.

3. Comprehensive Transportation Study for MMR

The Comprehensive Transportation Study (CTS) for the Mumbai Metropolitan Region (MMR) or **T R A N S F O R M** (Transportation Study for the region of Mumbai) articulates a vision for MMR's future transportation as a seamless, integrated system, in which commuters can make their journeys throughout the region safely and conveniently by various modes of transport with strong emphasis towards public transit. **T R A N S F O R M** outlines long term (2031), medium term (2021) and short term (2016) transportation strategies and guidance necessary to attain this vision. **T R A N S F O R M** is an initiation from World Bank and MMRDA to formulate comprehensive transportation strategy for the metropolitan region. MMRDA with technical assistance from World Bank under MUTP embarked on **T R A N S F O R M**. It has been over 25 years since the last comprehensive regional transport study is undertaken for the region. This study has provided insight to the current challenges of commuting in MMR, addressed the issues and prepared an infrastructure and investment plan for the next few decades.

T R A N S F O R M stresses the need for MMRDA's continuing efforts and expanding on its commitment recognizing the varying needs and priorities of different transportation users, in developing MMR's major transportation infrastructure. **T R A N S F O R M** by recognising the significance of transport for the economic growth and social well-being of MMR, proposes developing integrated multi-modal transportation system. It advocates focusing on the, development of metro corridors throughout the region, optimising and expanding the suburban

⁴ Total travel during morning peak period (6:00 to 11:00 AM) is expected to increase from 4.75 million motorized trips to 10.00 million trips by 2031. Most of these trips need to be supported by public transport modes.

rail network and reducing sub-human crowding conditions and providing an integrated network of access controlled highways. **T R A N S F O R M** strongly supports increased cooperation and coordination by all the transportation providers in the MMR and emphasizes the need to be sensitive to the people and environment. Suggestions are made for more immediate solutions to current mobility problems to improve the existing transportation network's efficiency, reliability, and cost effectiveness that are currently impairing the region's prosperity and well-being of its citizens. It advocates increased participation in transportation decision making by regional and local authorities and public. It encourages Public Private Partnerships (PPP) that can help to meet the travel investment needs of the future.

Addressing the above, the **T R A N S F O R M** plan formulation work is undertaken and salient features of the study is presented in the following sections.

3.1. Travel Demand Modelling and Analysis

Forecasted population and employment figures for the year 2031 are 34 and 15.5 million respectively. If account is taken of the need to provide new housing for slum dwellers and the expected growth in population, this shall be equal to almost the existing population of MMR, existing population of Mexico city, existing population of Greater Seoul, 1.5 times population of London. As part of the study, the major surveys carried out are Home Interview Survey (66,000 sample size), Road Network Inventory Surveys (2,300 kms), Outer Cordon/ Sub Regional Cordon/ Inner Cordon/ Mid-block count surveys (93 locations), Rail Passenger surveys, Speed-Flow surveys (for developing Volume-Delay functions for 16 carriageway types), Terminal surveys, Journey Speed Surveys (550 kms), IPT surveys (50 locations), Pedestrian count surveys (50 locations), Workplace Surveys (5000 sample size), etc. and collected secondary information on transport systems operating in MMR. Based on these surveys, a database on household socio-economic and travel characteristics of the region has been prepared for detailed travel demand modelling to study the future transport network requirements of the MMR.

Population and employment figures for the horizon years 2021 and 2016 have been estimated based on the likely growth of different clusters of the region during the planning period 2005 to 2031. Travel demand for these years has been estimated similar to the procedure adopted for the horizon year 2031. The travel demand of the year were assigned on to the resilient transport network proposed for 2031 and network was pruned wherever the flows are well below the established capacity criteria and proposed transport network for 2021 has been arrived. In the process, some of the metro corridors which were proposed for 2031 were proposed to be Exclusive Bus Lanes on the nearest parallel highway corridors for the year 2021. Similar procedure was followed for identification of the required transport network for the horizon year 2016.

3.2. Proposed Transport Network and Broad Cost Estimates

The proposed metro, sub-urban and highway network for the horizon year 2031 is 450, 241 and 1740 kms respectively. The proposed transit and highway network for the horizon year 2031 is presented in **Error! Reference source not found.** The total cost of transport infrastructure for the horizon year 2016, 2021 and 2031 is approximately INR 1.33, 1.63 and 2.08 lakh crores respectively estimated @ 2005-06 prices. The details are presented in the following table.

Component	2008- 2031		2008- 2021		2008- 2016	
	Length km	Cost Rs Crores	Length km	Cost Rs Crores	Length km	Cost Rs Crores
Metro System	450	1,10,095	316	82,707	204	59,623
Suburban Railway System	241	30,978	231	28,670	231	27,920
Highway System	1660	57,412	1114	44,844	836	31,173
Highway Corridors with EBL	77	1,670	111	2,000	147	11,079
Bus System		4,280		2,150		1,104
Passenger Water Transport		480		480		480
Truck Terminals, Inter-Bus and Rail Terminals		3,040		2,038		1,126
Total	2,429	2,07,956	1,772	1,62,890	1,418	1,32,504
		US \$ 50.72 Billion		US \$ 39.73 Billion		US \$ 32.32 Billion

Capacity & Safety Enhancement Measures

The proposed capacity and safety improvements under short and medium term transportation strategy are addressed through the following measures:

- Maintain high priority for implementation of suburban rail improvements including station modernization;
- Widening of roads to meet traffic requirements;
- Strengthening of roads and removal of right-of-way encroachments to fully utilize the traffic carrying capacity of regionally significant roads and provide safe and unrestricted public footpaths;
- Improve overall network continuity by removing bottlenecks or constructing a missing system links;
- Intersection improvements and traffic signal installations including modern corridor traffic control systems;
- Grade separation of major intersections where at-grade improvements would be inadequate;
- At-grade and grade separated pedestrian facilities particularly in the vicinity of rail stations and transport terminals;
- Provision of protected raised footpath facilities on either side existing major road corridors;
- Full grade separated railway crossings for vehicular traffic (ROBs/ RUBs); and
- Grade separated crossings for pedestrian traffic (FOBs/ Subways) to minimize pedestrian trespassing across rail corridors or at high intensity pedestrian corridors and major roads.

Traffic Management Measures

- Public transport (bus) priority, optimisation of traffic signals (i.e. coordination of traffic signals), installation of traffic actuated signals, etc. to improve traffic system capacity, quality and safety;
- Demand management measures (parking controls) to secure maximum social value from network use; and
- Improving the enforcement efficiency and incident management capability.

Station Area Traffic Improvement Measures

- Improving the access to the sub-urban railway stations;
- Enhancing the parking facilities;
- Providing pedestrian walkways; and
- Improving the pedestrian circulation and free-flow within the station area by providing additional FOBs.