PLANNING FOR PUBLIC TRANSPORT IN CITIES

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Estimation of transport needs

Trips, modes and income

Table 1 shows the number of cities in India that hade a population of more than 1 million in 2001 (Census 2001). Thjs number is likely to increase significantly in the next two decades. Three of these have populations in excess of 10 million and another two may join them. Another 5-8 of these may reach populations of 5-10 million.

1	Greater Mumbai	19	Ludhiana
2	Kolkata	20	Kochi
3	Delhi	21	Visakhapatnam
4	Chennai	22	Agra
5	Bangalore	23	Varanasi
6	Hyderabad	24	Madurai
7	Ahmadabad	25	Meerut
8	Pune	26	Nashik
9	Surat	27	Jabalpur
10	Kanpur	28	Jamshedpur
11	Jaipur	29	Asansol
12	Lucknow	30	Dhanbad
13	Nagpur	31	Faridabad
14	Patna	32	Allahabad
15	Indore	33	Amritsar
16	Vadodara	34	Vijayawada
17	Bhopal	35	Rajkot
18	Coimbatore		

Table 1. One million plus cities in India 2001.

Therefore, it is necessary to plan for providing efficient access and mobility to citizens of a large number of cities and not just the national capital or a few state capitals. This makes it imperative that the role of external subsidy be minimized and plans developed that are locally sustainable.

Transportation "needs" cannot be considered an independent variable. The needs are greatly influenced by urban form and access policies. Table 2 shows mobility patterns in 8 high income cities.[1] These data show the tremendous variation in car use, distances traveled, public transport use at similar levels of income. It has been shown that people may use different modes and technologies, public or personal transport, but the daily average motorised travel time varies relatively little. The travel time for all modes, including journeys by foot and by bicycle, differ little as everyone has the same time constraints – twenty four hours with 8-10 hours work day. In low-density cities which are car dominated and have high road space, car owners travel long distances relatively fast, but have high travel times (Houston and Melbourne in Table 2). It is difficult to establish efficient public transport systems in such cities. Those who do not have cars, cannot get to work easily and can be excluded from economic activities. On the other hand, those cities that have a dense

[1] Jean Vivier (2001) Mobility and Accessibility: Complementary or Contradictory Objectives? *Public Transport International*, 5:4-10.

Cities	*Motorised mobilty (Private) km/year/person*	*Motorised mobilty (all modes) km/year/person*	*Daily motorized travel time, minutes*	*Share of the journeys by foot, bicycle and public transport, percent*	*Density persons/ha*
Houston	25,400	25,600	90	5	9
Melbourne	12,100	13,100	70	26	14
London	5,600	7,700	60	51	59
Paris	5,500	7,300	50	56	48
Munich	6,300	8,900	60	60	56
Tokyo	4,300	9,900	70	68	88
Singapore	4,700	7,900	60	48	94
Hong Kong	1,300	5,000	50	82	320

Table 2. Mobility patterns in igh income cities (*Source: Jean Vivier, 2001*)

settlement pattern, tend to be more public transport friendly and more citizens use non-motorized forms of transport (Tokyo, Singapore and Hong Kong in Table 2).

These world wide experiences tell us that access needs (as opposed to mobility patterns) remain similar across cities of different sizes and populations. Basically, during the peak period, every worker and student needs to get to work and school/college using one trip each. Since transport needs have to worked out for the peak period, one can say that needs do not change per person over time. What may change are modal shares – and this can be influenced by policy. Since the travel budget remains same for most people, majority trip distances change not so by change in city size, but by change of mode. In most cities of the world, majority of trip distances are less than 10 km. In India, a majority of trip distances are still less than 5 km in Mumbai (Figure 1).[2]

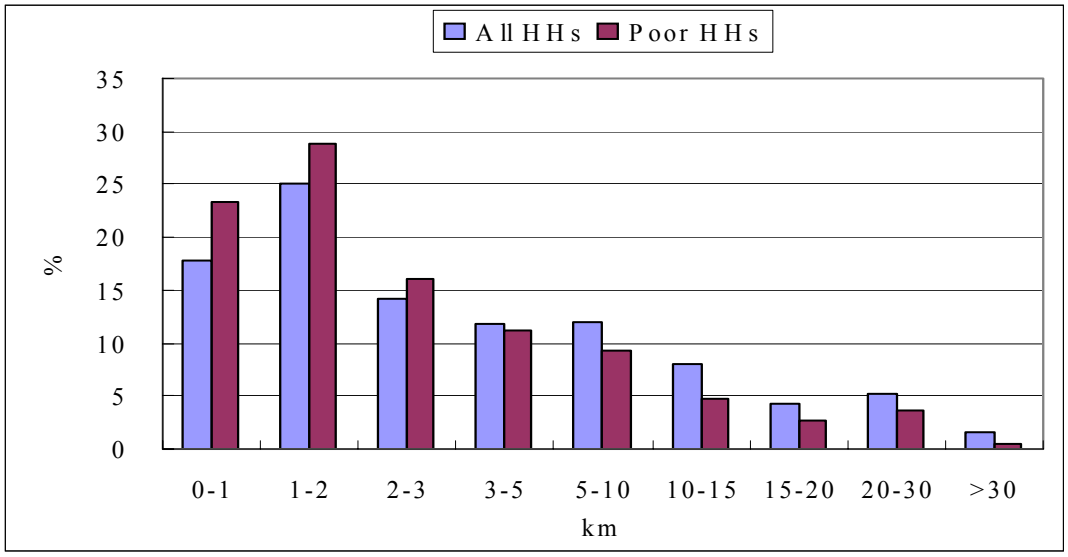

Figure 1. Trip distances by different modes in Mumbai

[2] Baker, J. et al (2004) Urban Poverty and Transport: The Case of Mumbai. The World Bank.

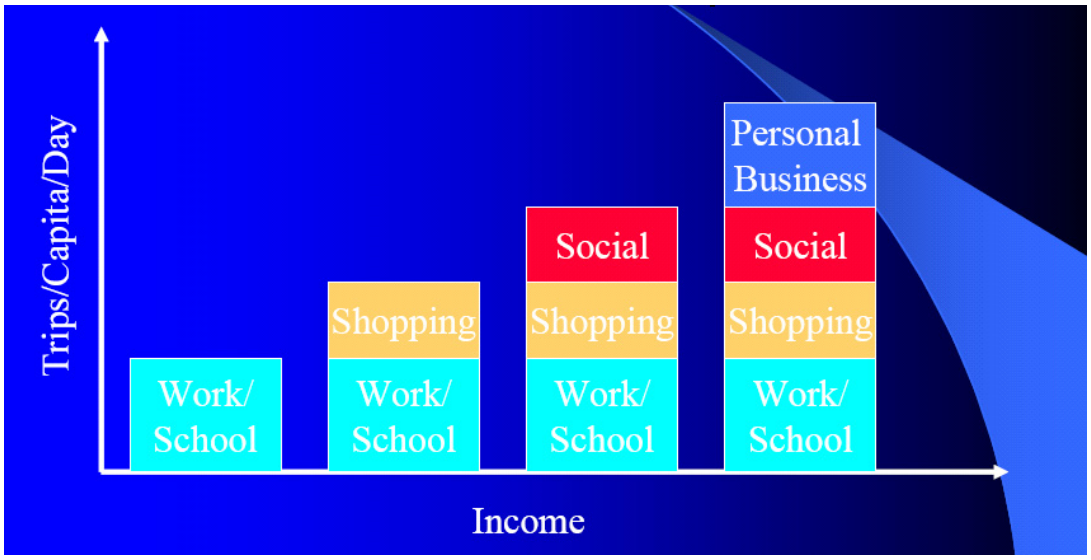

Figure 2. Income and accessibility – demand for trips

Figure 2 shows the relationship between income and demand for trips. As is obvious, the demand for trips changes with income, but the compulsory trips – work and school - remain the same. Therefore, the total number of trips during the peak hour – if limited to work and school – does not increase with increasing incomes. However, with increasing incomes, heavy traffic will be observed over larger parts of the day to accommodate for discretionary trips.

City size and transport modes

All the old European and American cities that have extensive rail based public transport, developed the same in the period 1900-1950, before large scale private vehicle ownership. This resulted in the natural development of Central Business Districts (CBD) which were fed by metro systems. Typically, cities likeTokyo, New York, Paris and London provided exceedingly large central business districts. These cities have CBDs with more than 750,000 jobs. Virtually no other urbanized area in the developed world has a central business district with more that 400,000 jobs, and most are in the range of 50,000 to 200,000. The massive central business district employment numbers and densities support a high degree of substitution by rail of automobile use that is not possible in smaller central business districts (because there is too little demand and it is too dispersed). The prerequisites for rail success are thus high residential population density and massive central business districts.[3]

There are no cities in India where the CBD is expanding or increasing in density to provide 750,000 jobs. According to the 2001 Census of India, the main workers in India constitute about 30-35 % of the population. Of these workers, a significant proportion (say about 30%) are self employed, daily wage labour, hawkers, etc. who are not likely to use any form of motorized transport. Therefore,

[3] Keys to Urban Rail Success. 2001 www.publicpurpose.com --- Wendell Cox Consultancy.

workers as the potential motorized transport users would amount to about 20% of the population. This means, that a city to have a CBD to attract 750,000 workers by motorized means would need to have a population in excess of about 5 million, if all of them go to the CBD.

Since development in all Indian cities is taking place on the periphery, it is unlikely that any city India will develop a CBD of the size mentioned above. This is not surprising as all Indian cities have been planned as poly-nuclear cities. If this is so, no Indian city will be able to feed very high capacity (>30,000 pphpd) mass transit systems. As public transport needs up to 25,000 pphpd can be met by Bus Rapid Transit (BRT), all future public transport needs can be met by BRT in large Indian cities. Therefore, arterial corridors of all cities should be considered for development of BRT systems.

Taking the above into account, the transport needs of different sized cities can be summarized as shown in Table 3.[4]

Table 3. Transportation options for cities of different sizes.

City Size Population in million	Priorities for optimal modal mix		
	Short term	**Medium and long term**	**Actions required**
0.1 – 1.0	Non motorised transport (NMV), shared taxis, motor vehicles (public and private)	NMV, Motorized Intermediate Public Transport (IPT) like three-wheeled scooter taxis, minibuses, etc.	Road planning, traffic calming, regulatory mechanisms for safe and clean IPT
1.0-5.0	NMV, Motorized IPT(feeder trips), HCBS PT (Buses), rationalize private vehicle parking	NMV, taxi system with IT support, HCBS expansion and integration with rail based system serving intercity trips with satellite towns	All the above and planning for one or two rail corridor to be implemented in future
>5.0	NMV, Motorized IPT(feeder trips), and taxi systems,HCBS PT (Buses), rationalize private vehicle parking	NMV, taxi system with IT support, HCBS expansion and integration with rail based system serving intercity trips with satellite towns, congestion pricing	All the above and planning for one or two rail corridor to be implemented in future

TRIP ESTIMATES

Census of India data for 2001 show that students constitute about 25-30% of the population and workers about 30-35%. If educational and office hours are

[4] Adapted from: Tiwari, G. (2005) *To develop a framework for modeling the optimal modal mix for urban passenger transport, given considerations of congestion, pollution and lack of safety*. Transportation Research and Injury Prevention Programme, Indian Institute of Technology Delhi.

staggered, we can plan for peak periods based on number of workers in a city. We can assume the following for all workers in Indian cities in the future:

Unable to use motorized transport due to low income:	about 20%
Use of private transport:	about 30%
Use of Public transport:	about 50%

In other words, under almost ideal conditions about 15% (50% of 30-35%) of the population of a city will need public transport. This amounts to a maximum of 1.5 lakh trips every morning and evening each (peak period) by public transport per million population. Over a period of 1-2 hours, this demand can be met by 3-4 lines of BRT (30, 000 trips in two directions per line per hour).#

Planning guidelines:

1. Safe bicycling and pedestrian facilities on all major arterial roads reserving about 4-5 m in each direction for these modes. Provision for safe road crossing every 500-700m are a pre requisite.
2. Provision of optimized ITS enabled paratransit modes including clean three-wheelers in all cities. System design for optimization of shared taxis and other low cost vehicles. These modes will remain the backbone for cities < 1 million, or < 5 km in diameter.
3. About 3-4 corridors (30 km) of BRT per million population
4. Provision of suburban rail services along existing rail corridors.

Measures so as to ensure that appropriate comprehensive city development plans with integrated traffic and transportation plans

LMC cities have very mixed land use patterns and a very large proportion of all trips are walk or bicycle trips; of the motorised trips more than 50% are by public transport or shared para-transit modes. For sustainable transport policies we need to arrest the increasing trend of the adverse health and environmental effects of road transport. The following issues need to be addressed:

- Motor vehicles have killed more than 20-30 million people and injured more than 500 million worldwide in the last one hundred years. This is not sustainable.
- Emissions will reduce significantly only if more people walk, bicycle and use public transport. This will be possible only if walking and bicycling is made much safer in our cities.
- Cities will aesthetic, humane and human scale only if streets include large numbers of people walking and playing safely. Since walking and bicycling trips are essential for use of public transport streets must be made safe from crime, disabled friendly and include public amenities including shops and restaurants (street vendors included). These conditions can be fulfilled only if special attention is given to speed reducing measures along with street designs fulfilling traffic calming designs.

Safety of road users in general and pedestrians in particular has not been maximised given the present state of knowledge. Land use policies that encourage greater use of cars per day and transportation policies that promote personal transport increase exposure rates and thus the overall risk of death and injury even

though risk rates per km travelled may be low. This tends to offset the advantages gained by provision of safer cars and roads. Once these systems are in place, it is difficult to reduce death rates per capita.

Road safety in general and safety of vulnerable road users in particular has to given as much importance as vehicle emissions for ensuring cleaner and more liveable cities. Unless cities are made safer for pedestrians and bicyclists on one hand, and women, children and the elderly on the other, it would be impossible to obtain optimal use of public transport facilities in the futures. Therefore, road safety has to be included as a necessary condition for healthier life in cities. For sustainable transport policies it would be essential that Indian cities do not get locked into systems that encourage high speeds and greater use of personal car transport.

JNNURM proposals should be required to have a compulsory component for provision of safe and adequate pedestrian and bicycle facilities on all roads and BRT on arterial roads.

Evaluation of public transport modes

1. All proposed public transport systems must be financially viable without requiring substantial external subsidy. A subsidy if necessary must be met by taxation of local city residents (eg pollution tax, road tax, congestion charges, etc from private vehicle owners and transportation tax from employers).

2. The choice of technology is only limited to grade-separated systems vs. at-grade systems. Buses, trams, trains, Maglev, electric trolley buses, light rail, monorail, <u>all</u> can be run on both the systems. There should be no confusion regarding this issue.

3. Since grade-separated systems can be 30 to 50 times more expensive than at-grade systems, there needs to be a very special justification for use of the former snowing that all possible options have been exhausted.

4. EIA and safety audit must accompany all proposals and it must be shown that the system proposed can cover all major arteries of the city within a reasonable period.

Review of policies, performance of various schemes and programmes in the Tenth Plan

The following investments have been made in the past few years in attempt to improve transport I the past decade:

1. Construction of flyovers in a large number of cities
2. Widening of roads
3. Construction of MRTS in Delhi

a. The construction of flyovers and widening of roads have not produced the desired improvements in all locations. These policies have to be reviewed critically and best practices adopted taking into account the experience of cities considered "good" internationally.
b. The construction of flyovers ad widening of roads has been accompanied by removal of pedestrian facilities. Considering that India has very high pedestrian mortality rates, this practice must be stopped immediately. It must be mandatory to provide at least a minimum of a prescribed area for pedestrian and bicycle facilities on all arterial roads (say 4-5m combined in each direction)
c. The MRTS in Delhi is operating at about 20% projected capacity for December 2005 (4-5 lakh passengers per day vs. projection of 21.8 lakh passengers per day). The Kolkata MRTS is operating at 10% capacity. Therefore, the operating experience of MRTS systems in India is not very rosy.
d. The above should cause a serious re-examination capital intensive projects that are not cost effective.

Objectives, policies, strategies and programmes for the improvement of urban transport during the Eleventh Five Year Plan period.

a. Considering that 40% or more trips in all cities are by non-motorized transport and are likely to remain so in the future. If pollution and energy consumption has to be controlled, this also a desirable feature.
b. All cities must submit plans for establishment of adequate and safe pedestrian and bicycle facilities on all arterial roads.
c. All cities must prepare a master plan for non-motorised transport.
d. Street vendors and hawkers are essential service providers for non-motorised modes and they are also essential for maintaining low street crime rates. Therefore, all cities should formulate a realistic hawker policy on roads.
e. All cities should prepare a plan for traffic calming to reduce emissions and road accidents rates.
f. All cities should prepare BRT plans to cover 30 percent of the population in the next 5 year plan period.
g. All cities should upgrade taxi and three-wheeler fleets and use ITS for the same.

Financing mechanism

a. At 8-10% constant growth rates, the per-capita income of India is likely to be in the range of Rs. 10,000 per month in 2025. Since families should not spend more than about 10% of their income on transport, this will limit the investment on transport projects, irrespective of the way the funds are raised. If we consider the fact that only half of this amount can be spent on public transport, we will be restricted to about 5% of the per capita income for investment and operating costs. This should form the basis for calculating the expenditure possible on urban transport.

b. The widespread use of motorized two-wheelers has ensured that we cannot expect middle class citizens to opt for public transport, unless the fare is similar to the marginal cost of using a two-wheeler. At present this is about Rs. 0.80-1.00 per km. This cam be the maximum that can be charged indexed to inflation and economic growth. Most grade separated systems (like MRTS etc) cost more than Rs. 5.00 per km to build and operate. Therefore, we will have to stay with efficient at-grade systems to minimize the subsidy component, if any.

c. All attempts should be made not to use land as a resource for building of public transport systems. This distorts markets and can give incentives for the transport system to run inefficiently. Using land as a resource can also encourage corruption in land deals when private parties are involved. It is also difficult to justify why land should be used as a resource for this purpose and not for health or schooling.

d. Financing mechanism that use the user or polluter pay principle should be preferred over other modes. These include: road user and pollution tax on private vehicle owners, congestion tax, and transport tax on businesses and companies.

The above considerations will force us to think of systems that the economy can tolerate at our levels of income.