6 URBAN TRANSPORT

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The burgeoning urban population of India is engaging in a variety of economic activities in rapidly expanding cities, which are, therefore, encountering fast escalations in urban travel demand. A variety of transport modes, such as, walking, cycling, two-wheelers, para-transit, public transport, cars, etc. are used to meet these travel needs.

Travel demand is determined by a number of factors, the primary one being the size of the population. Other determinants include: average number of journeys performed by a resident each day (per capita trips) and the average length of each such journey (trip length). Travel demand has, thus, grown faster than the population because it is a function of both the rising number of trips undertaken by the incremental population as well as increased trip lengths necessitated by expanded city size. Further, it has been found that residents, on an average, tend to perform more trips per day as per capita income levels go up. A study carried out for the Ministry of Urban Development, covering 21 cities in the country, suggests that more than 75 per cent of the trips in a city are on account of either employment or education. Per capita trip rates range from 0.72 to 1.79 per day (RITES 1998). Over 30 per cent of the total trips are undertaken by walking and the share tends to reduce as city size grows and the share of trips by public transport goes up significantly as city size goes up (Figure 6.1).

Issues in Urban Transport in India

Congestion

Congestion is an outcome of twin factors, (a) growth in number of vehicles on road, (b) limitations to expansion of road space.

Views expressed in the chapter are of the author.

Growth in number of vehicles

The increased travel demand has resulted in rapid growth in the number of motor vehicles in the cities. In the six major metropolises of India, growth in motor vehicles has outpaced population growth. On an average, while the population in India's six major metropolises increased 1.89 times during 1981 to 2001, the number of registered vehicles went up 7.75 times during the same period (Figure 6.2). Thus the growth of motor vehicles was almost four times faster than the growth of population. Cities without good mass transit systems, like Delhi, Chennai, Hyderabad and Bangalore, showed a higher

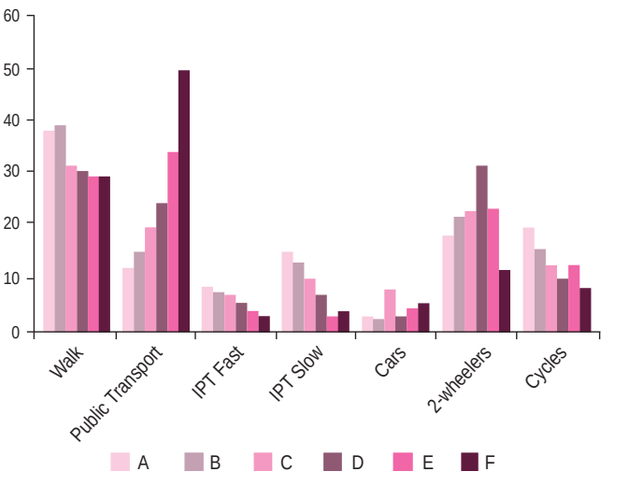

Fig. 6.1 Share of Trips by Different Modes in Class I Cities (per cent)

Note: City classes as per population size in millions: A 0.1–0.25; B 0.25–0.5; C 0.5–1.0; D 1.0–2.0; E 2.0–5.0; F >5.0; IPT: Intermediate Public Transport
Source: RITES (1998)

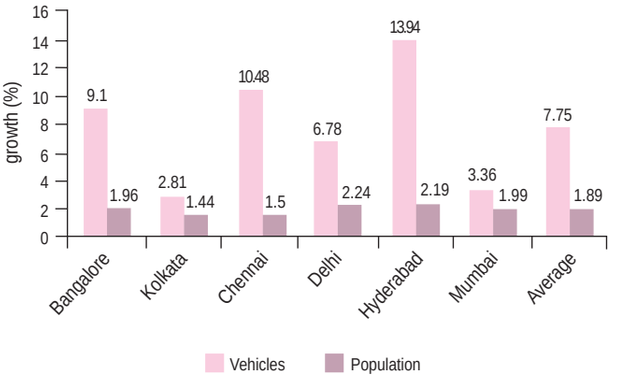

Fig. 6.2 Percentage Growth in Population and Vehicles (1981–2001) in Select Metro Cities

Source: Motor Transport Statistics of India, 1999, 2002–03, Ministry of Shipping, Road Transport & Highways, Government of India.

growth rate in vehicular population as compared to those with mass transit systems[1].

This growth has been largely driven by the growth in the number of two-wheelers. Figure 6.3 shows that the sale of two-wheelers has dominated the vehicle sales between 1993–4 and 2001–2. The largest share of the vehicular fleet in the six metropolises also comprises of two-wheelers. Cities with better public transport systems, especially those with rail based mass transit systems—Kolkata and Mumbai—show a relatively lower share of two-wheelers and total registered vehicles (Figure 6.4).

The popularity of two wheelers seems to be largely due to the following factors:

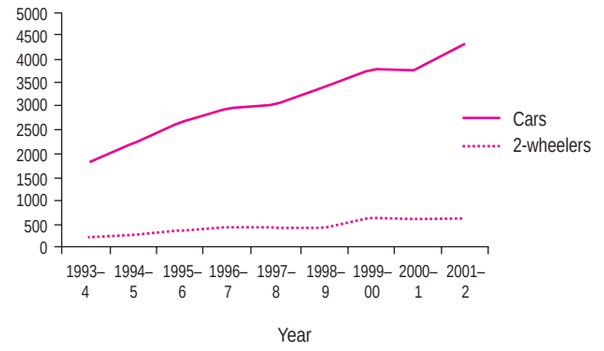

Fig. 6.3 Sale of Cars and Two-wheelers, 1993–2001 (in '000s)

Source: Automotive Component Manufacturers Association of India, 2001–2

[1] First line of DMRTS was commissioned in 2003. The statistics in Figure 6.2 is prior to that. Chapter 1 notes success of DMRTS in Delhi in the last couple of years—Editor

- In developing economies such as India, as income levels go up, the first step away from non-motorized modes of travel, or from public transport, is usually a motorcycle or scooter.
- Two wheelers offer considerable advantages over public transport through reduction in travel time as well as flexibility in timing one's travel.
- They are economical to operate as compared to a car.
- They require very little space to park.

Limitations to road expansion

Growth in the number of motor vehicles cannot be matched by a corresponding expansion in road space, as there are limits to how much road space can be provided within a city. Resource constraints have come in the way of adequate investments in increasing road capacity and even in undertaking timely repair. Inefficient systems of construction coupled with poor maintenance have resulted in poor road infrastructure.

The situation is further exacerbated by unimaginative design of roads that do not allow segregation of vehicles travelling at vastly different speeds. Mobility is thus restricted to the speed of the slowest vehicle. Even at low proportions (10 per cent of the traffic mix), non-motorized vehicles reduce the operating speed of motor vehicles significantly (Moazzem and McDonald 1998). Smaller towns with narrow and poorly maintained roads face this problem more acutely.

The length of urban roads in India has grown by 134 per cent during 1971 to 2002 and rural roads have grown by 460 per cent during the same period. While the road length in urban areas was only 7 per cent of the total road length in India, in 2002, the number of registered motor vehicles in the

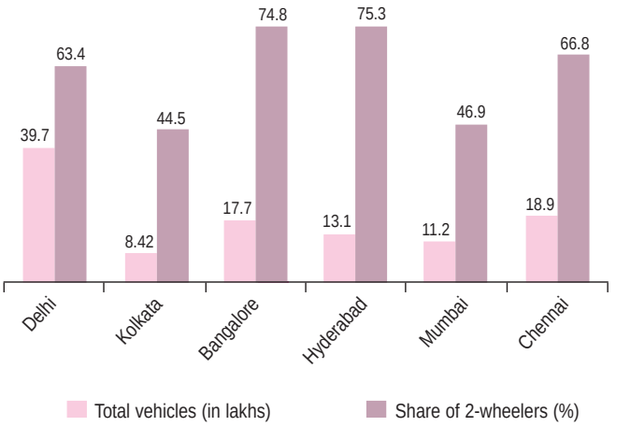

Fig. 6.4 Share of Two-wheelers in Total Registered Vehicles as on 31 March 2003

Source: Motor Transport Statistics of India, 2002–03, Ministry of Shipping, Road Transport & Highways, Government of India.

23 largest cities alone was 30 per cent of the total registered motor vehicles in the country. Thus, urban congestion is a serious problem and has severely constrained mobility (GOI 1999).

Declining Reliance on Public Transport

An associated problem has been the declining reliance on public transport vehicles, with a corresponding rise in the dependence on personal motor vehicles. For example, in Delhi, while the number of personal vehicles per 1000 population has expanded about 3 times (between 1981 and 2001), the number of buses per 1000 population has increased only 2.3 times (Table 6.1). (These figures project a higher figure of bus growth as they reflect only the number of registered buses. In actual practice the number of buses on the roads is far less as buses more than eight years old are not allowed to ply on the city roads. There is no such limitation on personal motor vehicles.) This holds true, more or less for other cities in the country as well.

Table 6.1
Personal versus Public Vehicles per 1000 population in India

	1981	2001
Cars/two-wheelers per 1000 population	81.4	245.4
Buses per 1000 population	1.4	3.24

Source: Transport Department, Government of the NCT of Delhi

Further, the share of public transport vehicles in the total vehicle fleet in India has been declining whereas the share of buses in the total motor vehicle fleet was 11 per cent in 1951; it came down to only 1.1 per cent in 2001 (Table 6.2).

Declining Importance of Non-motorized Modes

Non-motorized transport seems to have lost its earlier importance in the larger metropolises. Statistics show that the share of bicycle trips out of the total trips in Delhi has declined from 17 per cent in 1981 to 7 per cent in 1994 (Mohan and Tiwari 1999). This is perhaps due to increasing trip lengths and the increasing affordability of motorized personal vehicles. Yet another factor is that non-motorized modes are exposed to greater risk of accidents as they share a common right of way with motorized vehicles. Studies show that 56 per cent of the road accident fatalities in Delhi involve cyclists and pedestrians (Mohan and Tiwari 1999).

Table 6.2
Share of Buses in Total Motor Vehicles in India

Year	Total registered vehicles ('000)	Registered buses ('000)	Share of buses to total (per cent)
1951	306	34	11
1961	665	57	9
1971	1865	94	5
1981	5391	162	3
1991	21,374	331	2
1996	33,786	449	1.3
1997	37,332	484	1.2
1998	41,368	538	1.3
1999	44,875	540	1.2
2000	48,857	562	1.1
2001	54,991	634	1.1

Source: Motor Transport Statistics of India, 2001–02, Ministry of Shipping, Road Transport & Highways, Government of India.

High Levels of Air Pollution

The large cities have faced major problems, which the smaller ones have, so far, not been noticeably affected by. Most prominent among them is the high level of air pollution caused by motor vehicles (Table 6.3 and Figure 10.1). Suspended Particulate Matter (SPM) levels in the six major metropolises

Table 6.3
Air Pollution Levels

	SO_2 (µgm/cu.m)			NO_2 (µgm/cu.m)			SPM (µgm/cu.m)		
City	1993	1998	2003	1993	1998	2003	1993	1998	2003
Delhi (Nizamuddin)	13.70	15.60	12.20	30.10	35.10	43.30	362	342	315
Mumbai (Bandra)	49.50	15.90	7.70	32.30	14.70	18.70	475	211	219
Kolkata (Lalbazar)	65.10	47.20	18.0	62.00	39.70	75.50	507	283	244
Chennai (Gen. Hospital)	10.30	10.30	6.60	27.10	15.40	7.50	73	131	149
Bangalore (Anand Rao Circle)	–	41.60	10.80	–	28.40	44.90	–	239	198
Hyderabad (Abids)	7.30	7.60	9.70	11.00	22.10	19.50	156	152	139
National Ambient Air Quality Standard (Residential areas: annual average)		60			60			140	

Source: Compiled from data contained in the website of the Central Pollution Control Board (http://www.cpcb.nic.in)

is well above the National Ambient Air Quality Standards. Nitrogen oxides and Sulphur dioxide are currently within limits but could cross acceptable levels unless kept under control.

Pavement dwellers, road side hawkers, cyclists and pedestrians are most dangerously exposed to motor vehicle exhaust. With a formal specification of emission standards in 1991, a progressive tightening of emission norms has taken place resulting in improvements in the SPM levels in almost all the cities. However, the initial improvement in air quality is slowly getting reversed with pollution caused by the increased number of motor vehicles.

Road Accidents

The number of road accidents has increased, from about 161,000 in 1981 to over 400,000 in 2001. The number of fatalities has gone up from 28,400 to almost 81,000 during this period affecting the poor most adversely. About 57 per cent of the persons killed in road accidents in Delhi during this period were pedestrians and cyclists. Another 21 per cent were scooter/motorcycle users (Figure 6.5).

Increased Consumption of Petroleum Fuels

The emerging pattern of urban mobility has also had its impact on the consumption of petroleum products, which has gone up substantially (Figure 6.6). The net foreign exchange outflow on importing crude oil and petroleum products increased from about Rs 5250 crore in 1980–1 to Rs 1,12,000 crore in 2004–5 (GOI 2005). The rising trend in the consumption of petroleum products has a bearing on India's energy security, especially because India depends on imports for a large share of its crude oil requirements.

Motor Vehicles Act, 1988

Major changes are necessary in the Motor Vehicles Act, 1988 as it is not adequately equipped to deal with the problems of urban congestion and pollution. This is perhaps because such rapid urbanization and consequent growth in the number of motor vehicles had not been visualized at the time the current Act was enacted. Similarly, changes are called for in the constitutional provisions relating to the responsibilities of the central government and state governments in dealing with urban transport issues. In particular, the inclusion of Railways in the Union list needs to be reviewed as the responsibility for purely urban and suburban rail transit systems needs to be entrusted to the states, with some safety standards and regulatory mechanisms prescribed as part of a central legislation.

Capacity Building

Urban transport planning is a very complex and specialized subject. Unfortunately, there is an acute shortage of trained manpower in this field. It is, therefore, imperative that immediate steps be taken to build up adequate capability within the states. Till such time, a pool of qualified persons should be created at the national level for assisting the states in formulating state and city specific plans for meeting current and projected urban travel demand.

The virtual absence of a database on urban transport statistics has severely constrained the ability to formulate sound urban transport plans and reliably assess the impact of the different initiatives. The reliability and accuracy of even the available data is suspect at present. Besides, the data available is scattered over a multiplicity of different organizations and often difficult to obtain; it is neither collected regularly nor kept up to date. Much of the data in current use is either part of a specific study or collected with a specific project in mind, which is a limiting factor for larger policy and planning functions. In any case, it is not available at regular intervals and does not lend itself to any kind of trend analysis. It is, therefore, essential that a good city transport database be developed and made easily available to planners, policymakers and researchers, etc. so that their responsibilities can be discharged in a more informed manner.

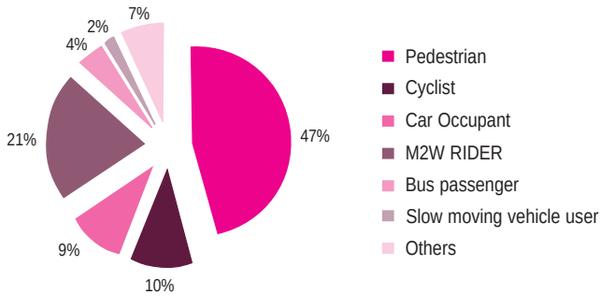

Fig. 6.5 Profile of Persons Killed in Road Accidents in Delhi

Source: DTP (2001)

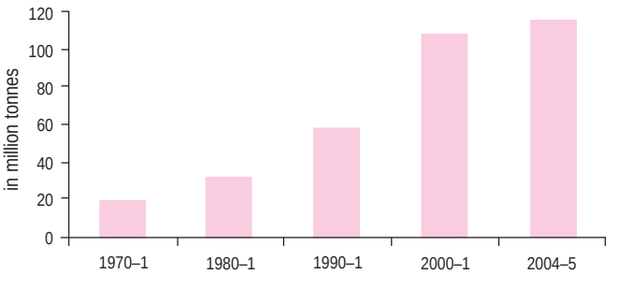

Fig. 6.6 Consumption of Petroleum Products

Source: GOI (2005)

Further, several problems relating to urban transport in India are peculiar to the country which may not have parallels in other parts of the world. Thus, there is a need for regular research for better understanding of mobility patterns and mode choice criteria in an Indian context. This would enable better formulation of mitigation strategies, as well as adoption of strategies most suitable to Indian conditions.

Urban Public Transport in India

Current Status

Most experts acknowledge that persuading people to shift from personal vehicles to public transport is amongst the most important elements of any strategy to meet the growing urban travel demand in a sustainable manner. This is because public transport occupies less road space, consumes less fuel and emits less pollutant on a per passenger basis for every unit of travel demand that it satisfies, compared to other motorized modes of travel.

All states have public bus transport services. While in some states there are dedicated services for larger cities, other states serve urban areas as part of the state wide public bus services. While in a few states the services are dominated by private buses, in a few others they are owned and operated by a government department directly. In some cities, especially in Maharashtra and Gujarat, the public bus transport system is owned by the municipal corporation. In most states, however, a high share of public bus services is operated and managed by state owned Transport Corporations, set up under the Road Transport Corporations Act, 1950.

Contract Services

Since the late 1980s, there has been a rapid rise in the share of the private sector in bus transport services. A larger involvement of private operators has been encouraged in many cities primarily because State Transport Corporations are faced with mounting deficits and are unable to finance capacity enhancement measures. The share of buses owned by the private sector compared to public sector has changed dramatically over the years (Figure 6.7).

Although the trend of using private operators has gained momentum, privatization efforts are still not as well structured as in UK or Argentina. Most cities have a mix of private as well as STC services. Most private operators own only a few buses with no corporate house or large operators in the business. For instance, almost 70 per cent of the private bus owners in Delhi own only one bus (Figure 6.8).

Larger cities have a variety of bus service providers. Delhi has bus services provided by the Delhi Transport Corporation (DTC) using its own fleet, Blue Line services provided by small private operators operating on specified routes on the strength of permits issued by the State Transport Authority (STA) and chartered buses which are a privately operated contract carriage service, largely catering to peak period traffic. Similarly, Bangalore and Hyderabad have basic services and premium services (Pushpak and Metro-liner respectively). Bangalore has private buses contracted out on per kilometre basis by the Bangalore Metropolitan Transport Authority. Kolkata too has several private operators.

Determination of Bus Fares

Fares for public bus transport are generally determined by the state government, through the STA. Fare determination is rarely

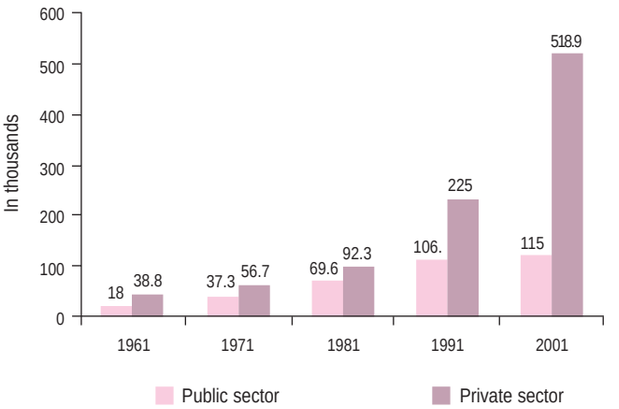

Fig. 6.7 Ownership of Public and Private Buses in India (1961–2001)

Source: CIRT (2004)

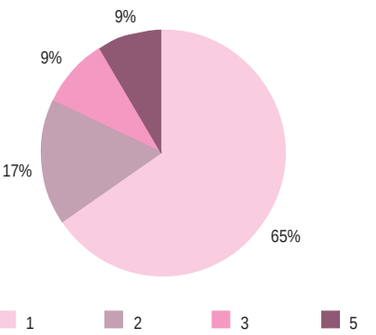

Fig. 6.8 Ownership Patterns of Private Buses in Delhi

Note: 1: percentage of owners running one bus; 2: percentage of owners running two buses; 3: percentage of owners running three buses; 4: percentage of owners running four buses; 5: percentage of owners running five buses.
Source: TERI (2002)

based on scientific assessment of operating cost recovery or the need for a reasonable return on investment. Various interest groups clamour and bargain to reach some sort of agreement. While users demand low fares, the operators lobby for higher fares. There is no clear policy on fares except that they are sought to be kept low to remain affordable to the poor. Fare structure as it prevails in the six major metropolises for public transport buses, therefore, shows wide variations (Table 6.4). There is considerable debate on whether the fares are too low to earn profits or are the state owned transport corporations inefficient. While some point out that private operations are profitable at the same fares, others claim that private operators compromise on safety and reliability to get there. In short, it is generally not recognized that while there is justification in keeping fares low to be affordable to the poor, it is also necessary to ensure a reasonable quality of service so that people do not give up using public transport and thereby add to the congestion and pollution by using their personal motor vehicles.

Table 6.4
Fare Structure for Public Bus Services

City	Class of service	Fare 4 km (Rs)	Fare 20 km (Rs)	Fare 30 km (Rs)
Hyderabad	Ordinary	3.0	7	10
	Metro express	4.0	8	11
	Metro liner	6.0	12	16
Mumbai	Ordinary	4.0	10	12
	Limited stop	4.5	11	14
	Air conditioned	15.0	31	39
Delhi	Ordinary	2.0	10	10
Bangalore	Ordinary	3.0	6	6
	Pushpak	6.0	7	8

Source: CIRT (2004)

Table 6.5
Performance Parameters of Select Public Bus Services and all Urban Bus Services

Parameter	APSRTC urban	BEST Mumbai	DTC Urban	BMTC Bangalore	All urban average
Financial performance (figures for 2002–3)					
Total cost per effective km (paise)	1258.7	3746.7	4283.1	1560.9	2783.5
Revenue per effective km (paise)	1245.3	3107.9	1917.3	1714.7	2202.0
Profit/Loss per effective km (paise)	–13.4	–638.9	–2365.8	153.8	–581.5
Surplus before tax per effective km (paise)	96.1	–480.6	–2316.4	200.3	–498.0
Physical performance (figures for 2002–3)					
Buses held	3352	3380	2196	2775	
Fleet utilization (per cent)	99.6	91.0	89.3	95.7	83.5
Effective km to gross km (per cent)	99.8	98.8	94.9	97.5	97.2
Bus utilization (km) of buses on road	249.1	211.8	187.3	228.6	225.3
Load factor (pass. km to carrying capacity per cent)	59.96	57.15	72.51	74.12	65.89
Passengers per bus on road per day	1032	1391	1158	1187	548

Source: CIRT (2004)

Financial and Physical Performance Parameters of Urban Bus Services

If we compare the financial and physical performance parameters of public transport in Hyderabad, Bangalore, Delhi, and Mumbai with the average for all urban transport services we see wide variations (Table 6.5).

Hyderabad and Bangalore have vastly superior performance parameters compared to Delhi or Mumbai, even though there are no city specific reasons for such differences to persist. Clearly, considerable improvements can be brought about through improved management and innovation.

Apart from public bus services, Mumbai, Kolkata, Chennai, and Delhi also have rail transit systems to accommodate the rapidly increasing demand for public transport. While the Mumbai, Chennai and Kolkata rail systems are owned and operated by the Indian Railways, the Delhi metro is owned and operated by a corporation registered under the Companies Act. A few other metros are also in the process of drafting plans for rail transit systems.

Recent Developments in India

Of late, there has been increased recognition of the importance of public transport as a means to mitigate congestion and air pollution in urban areas. New mass transit systems are therefore being planned in several cities. Bangalore proposes to construct a rail based mass transit system to cover 33 km in two lines. Mumbai proposes to construct a 15 km line from Versova to Ghatkopar on a BOT basis. Two sections of the 65 km long Phase I of the rail based system in Delhi have been commissioned and the third section is scheduled for

completion in March 2006. A second phase of the same system, covering another 53 km, is proposed to be taken up shortly. There are also proposals for extending the Delhi metro to Gurgaon and Noida, though the precise modalities are yet to be finalized. Proposals have also been initiated for rail based systems in Hyderabad and Ahmedabad. Ahmedabad is also exploring a Bus Rapid Transport System for the city.

Administrative Issues: Allocation of Responsibility for Urban Transport

Under the Constitution of India, responsibility for urban development, and therefore, urban transport, rests with the state government. Yet, the central government plays an important role in many respects. The main legislation that regulates road transport, namely the Motor Vehicles Act, is administered by the central government. Production and quality specification of petroleum fuels rests with central government agencies. The Indian Railways works under the central government. The automobile industry is regulated by the central government, which lays down motor vehicle specifications. Finally, and most importantly, the central government alone has the financial muscle to support investments in mass transit infrastructure.

Unfortunately there is no clear allocation of the subject of urban transport to a particular department within the state. While in some states the transport department undertakes urban transport planning, in others it is done by the department responsible for urban development/municipal administration. In the Central government too this responsibility is somewhat diffused. The Government of India (Allocation of Business) Rules, 1961 as approved by the President of India, has entrusted the responsibility for planning and coordination of urban transport systems to the Ministry of Urban Development. However the responsibility for the technical planning of rail based systems rests with the Ministry of Railways. Even this allocation came about only in 1986. Prior to this, urban transport was not assigned to any ministry as a specific subject and the transport needs of urban areas were met as part of the general transport responsibilities of the concerned ministries dealing with road transport and rail transport.

Current Practices in Governance

The entire gamut of activities required to manage and regulate the city transport system can be divided into three levels. First, the strategic and policy functions that will have to be performed directly by a government department. These are followed by the regulatory and short term planning functions, which can be discharged by a government department or by a specially constituted public agency. Finally, the actual operation of transport services, which can be undertaken by a public agency or even private agencies (Table 6.6).

Table 6.6
Responsibilities of the Government or a Public Agency

Level 1	Strategic and Policy functions	• Strategic planning • Policy formulation • Capital financing
Level 2	Regulation of commercial issues	• Fixation of fares/tariffs • Monitoring quality of service
	Health and Safety regulation	• Setting standards • Ensuring adherence to safety standards • Ensuring adherence to environmental standards
	Procurement and provisioning of public transport	• Network and route design • Identification of demand • Franchising/route allocation • Planning and provisioning of services • Contract monitoring
Level 3	Supply of common infrastructure and other services	• Inter-modal coordination • Passenger information systems • Data collection and management • Dispute resolution • Management of common infrastructure • Public relations • Security services • Management of common ticketing facilities • Management of revenue sharing arrangement between operators
	Operation of services	• Operation of publicly run bus services • Operation of privately run bus services • Operation of the Rail based systems

The state government, largely through its Transport Department, currently discharges the strategic and policy formulation responsibilities. Coordination with other agencies/ wings of the government is only through the office of the Chief Secretary/Chief Minister/state cabinet. Unfortunately, there is no formal institutional forum for effecting such coordination on a regular basis. There is no specialized cell or group that supports the efficient discharge of this responsibility. Scientific management and analysis of data, so critical for the sound discharge of this responsibility, is lacking. Thus, the responsibilities related to urban transport are discharged through amorphous links at state level.

Regulatory functions themselves fall into two categories. One involves safety and health issues whereas the other involves commercial issues like the determination of fares and the monitoring of service quality. Safety aspects in turn cover driver

licensing, driver training, adoption of safe driving practices, proper maintenance of vehicles, enforcement mechanisms, penalties, vehicle registration, and road-worthiness certification. Health issues cover prescription and enforcement of emission standards and fuel standards.

The key enactment for regulation of safety of motor vehicles in India is the Motor Vehicles Act, 1988, which is a national enactment with jurisdiction all over the country. This is supported by the Central Motor Vehicle Rules, 1989 and further supplemented by state level rules that apply within individual state jurisdictions.

Section 3 of the MV Act states that no person can drive a motor vehicle unless he/she holds a licence authorizing him to do so. Section 39 of the MV Act requires that every motor vehicle should be registered before it can be driven on public roads. Section 110 of the MV Act requires the Central government to regulate the construction and maintenance of motor vehicles. These Rules could, inter-alia, cover matters relating to the size of motor vehicles, the size and nature of the tyres, brakes and steering gear, the use of safety glasses, speed governors, and safety belts, standards for emission of air pollutants, etc. Finally, the central government is empowered, under Section 118 of the MV Act, to notify regulations for the safe driving of motor vehicles. These include the prescription of maximum driving speeds for different types of vehicles. The state government can, within this maximum, restrict the speed further. The MV Act also prescribes penalties for unsafe driving. The penalties can be of three types, namely, imprisonment, fines and suspension/revocation of the driving licence. In general, the fines, which are the most common form of penalty, are very mild and do not have a deterrent impact.

Commercial regulation covers the prescription of fares and service delivery standards. Service quality for road transport is prescribed under specific permits granted by the STA/RTA allowing operation on certain routes. Fares for road transport are fixed by the State Transport Authority (STA) and for rail transport by the Ministry of Railways. Safety of rail-based systems is regulated under the Indian Railways Act, 1989. Fares for the Delhi metro are fixed by a fare fixation committee provided for under the Delhi Metro Rail (O&M) Act.

It is necessary for a public agency to ensure that there is adequate coverage of public transport. If left entirely to a commercial organization, which has profit as its primary motive, only those routes that are commercially viable would be served and others would be neglected. Similarly, the profit motive would only permit services during peak periods and would discourage services during off-peak hours. As against this, the universal service obligation requires that services be available during off-peak hours and also on the relatively less profitable routes.

The provisioning function seeks to fulfil this requirement. The activities covered under the provisioning function are:

- the design of a suitable network;
- a priori assessment of the demand on different portions of the network;
- allocation of responsibility for supply of services to less profitable portions of the network;
- entering into contracts for the supply of services;
- monitoring compliance with contracted terms;
- continuous assessment of demand to identify needed changes;
- making appropriate changes in supply arrangements to ensure that demand is met.

At present, there is no systematic exercise for network and route design. The precise allocation of the responsibility for route design is also unclear. The STCs usually decide the routes on which they would operate services on the basis of public pressure, rather than a scientific assessment of the demand, and the STA tends to go merely by the routes applied for by individual operators. This could result in a sub-optimal allocation of routes, with surplus capacity on some and a deficit in others.

Common services are essentially those that cannot be provided economically by multiple agencies and are, therefore, natural monopolies. Examples of such common services are passenger information systems, provision and upkeep of common infrastructure such as public transport terminals, accident recovery facilities, public relations, security services, etc. These services seek to integrate the operations of multiple agencies so that a commuter perceives a unified public transport system in which he can move seamlessly from the services of one agency to another. At present the responsibility for providing these common services is diffused. Information systems in respect of STC services are provided by the STC where as in respect of private services it is virtually non-existent.

As far as common infrastructure is concerned, the STC provides bus stations and terminals where as the Indian Railways build stations for rail transit systems. In Delhi, the DMRC is building stations for Metro operations. Private buses use STC bus terminals and stations. No common parking facilities are available for buses in the city with STC buses using their own depots and private buses having to find their own parking spaces wherever they can. As far as public relations are concerned, the STC has some public relations staff but private operators do not feel the need for any public relations work. Security services are provided by the police as part of their normal activity of crime control. Dispute resolution may be discharged at the informal level by senior officers in the Transport department. However, formal resolution of disputes is only through the judicial mechanism.

The current systems of governance are the legacy of an era when Indian cities had not yet witnessed the kind of transport problems that they are encountering today. There are several weaknesses in these systems that constrain the ability to effectively manage the problems of urban transport.

Multiplicity of agencies

Regulatory and management responsibility is spread over a multiplicity of agencies that not only span several ministries but also multiple jurisdictions. Unlike inter-city transport, intra-city transport requires several functions to be performed in a well-coordinated manner. Unfortunately, these are performed by multiple agencies, some working under the central government and others under the state government with responsibilities impacting urban transport (Table 6.7).

The distribution of responsibility clearly brings out the extent of confusion that prevails in the management of urban transport. Whereas, the Transport Departments of the state governments are responsible for vehicle licensing, registration, inspection and road taxation, the legislative framework is provided by a national enactment. Traffic control and the enforcement of traffic regulations rest with the Police department. The responsibility for road construction and maintenance rests with at least two agencies—the state Public Works Department for the more important roads and the municipal corporation for the smaller roads. In larger cities several central government agencies also get involved in road construction and management, such as the cantonment boards, the Indian Railways, the Border Roads Organization, the National Highways Authority etc. Unfortunately, there is little or no coordination among these agencies, making accountability very difficult. There is no effective coordinating agency where their individual plans can be formulated and integrated keeping an overall goal in mind. A classic example of the lack of coordination and understanding is the dispute on whether urban rail systems should be built on standard gauge or broad gauge tracks.

This weakness seems to have been given cognisance as the proposed National Urban Transport Policy recommends that the state governments set up Unified Metropolitan Transport Authorities for each large city to ensure coordinated planning and implementation of sound transport initiatives in the city.

Limited authority at the local level

Yet another weakness is the limited authority at the local level. The city is the most logical jurisdiction level at which all decisions relating to the management and regulation of city transport ought to be taken. Good management of city transport could, then, become a basis for city residents to elect or reject a city government. But, the city administration is generally inadequate to undertake this task. An important

Table 6.7
Agencies Responsible for Different Aspects of Urban Transport

Central government		State government	
Agency	Responsibility	Agency	Responsibility
Ministry of Railways	Technical planning of urban rail transit systems	Department of Transport	Licences and controls all road vehicles, inspection of vehicles, fixing motor vehicle tax rates
Ministry of Surface Transport	Administer the Motor Vehicles Act and notify vehicle specifications as well as emission norms	Public Works Department	Construction and repair of major roads
Ministry of Urban Development	Overall responsibility for urban transport policy and planning	Local municipality	Management of smaller roads and traffic lights, licensing and control of non-motorized vehicles, clearing of encroachments, provision of water, sewerage and drainage services
Ministry of Environment and Forests	Recommend emission norms for motor vehicles and administer the Environment Protection Act	Police	Enforcement of traffic laws and prosecuting violators
Ministry of Finance	Responsible for fiscal policies	Department of Environment	Monitoring air quality
Ministry of Industries	Responsible for the Industrial Policy	Land Revenue administration	Allocation of land and land acquisition
Ministry of Petroleum	Controls all the oil refining companies	State Transport Undertaking	Operation of bus services
Planning Commission	Provision of funds for capital investments	Development Authority	Land use planning and regulating the growth of a city.

Source: Agarwal (2002)

reason for this is its weak revenue base and dependence on the central government or the state government for most of its financial needs[2]. In such a situation, responsibility passes on to the state government that has responsibilities beyond the city as well.

A marginal function for most agencies

The emergence of problems related to urban transport in India is of relatively recent origin. The issues began to surface largely from the mid-1980s when a number of new and affordable motor vehicles became available in the country. The institutional structures for regulation and management, however, continue to be of older vintage, primarily focusing on inter city transport. Most of the institutions tend to treat their urban transport responsibilities in peripheral manner. Thus, the State Transport Corporations tend to focus on inter-city bus services that are more profitable than on city bus services. The Indian Railways, who are the only agency with technical capability for running a rail based network, have decided not to set up urban rail transport systems due to financial constraints. This has resulted in the Ministry of Urban Development taking over responsibility for such systems despite complete absence of technical capability in this area. Traffic regulation and management functions are considered relatively less important within the police force, whose more important functions seem to be crime detection and security. Municipal bodies tend to focus more on water supply and garbage removal than on managing the transport system of the city. Thus, for most agencies, urban transport is at best a marginal function.

Future Scenario for Urban Transport

While the current problems of urban transport, as highlighted above, are major challenges in themselves, they become even more alarming as projections indicate continued growth. The share of urban population in 2001 was only 28 per cent of the total population and is expected to reach 48 per cent by 2051 (Table 6.8).

While there may be differences in the projections made by various experts, urban population is likely to more than double in the next 30 years. Travel demand problems will compound correspondingly.

RITES (1998) estimated that although the population in A class cities and above is estimated to grow 2.5 times during 1991–2021, the corresponding intra-city travel demand would grow by 3.5 times during this period. Intra-city travel demand in 1994 was 759 million person km (pkm) per day. It is expected to go up to 2511.23 million pkm per day by 2021. The growth in terms of total number of trips and for different categories of cities has profound implications on urban transport planning in India (Tables 6.9 and 6.10).

Interestingly projected share of daily trips by different vehicular modes suggests that the largest share of trips would be by public transport followed by cycling (Figure 6.9) based

[2] Chapter 5 on urban finances in this report deals extensively with this subject.

Table 6.8
Projections of Urban Population in India

Year	Population (million)	Growth rate (per cent)	Urban popln (million)	Growth rate (per cent)	Share of total popln (per cent)
2001	1027	21.7	285	31.3	27.8
2011	1220	18.8	372	30.5	30.5
2021	1390	13.9	473	27.2	34.0
2031	1534	10.4	583	23.3	38.0
2041	1648	7.4	700	20.1	42.5
2051	1732	5.1	820	17.1	47.5

Source: Ribeiro (2003)

Table 6.9
Projected Number of Trips in 2021 Compared to 1994

Year	1994	2021
Trips (million)	183	614
Vehicular trips (million)	126	430

Source: RITES (1998)

Table 6.10
Projected Travel Demand for Different Categories of Cities

Class of city	1994	2001	2021	Growth (2021–1994)
A	103.9	149.43	453.25	4.36
B	75.89	90.43	309.57	4.08
C	109.20	148.66	227.23	2.08
D	94.41	132.07	347.08	3.68
E	92.08	97.22	270.30	2.94
F	284.34	420.99	903.80	3.18
Total	759.00	1038.80	2511.23	3.31

Note: City classes as per population size in millions: A 0.1–0.25; B 0.25–0.5; C 0.5–1.0; D 1.0–2.0; E 2.0–5.0; F >5.0
Source: RITES (1998)

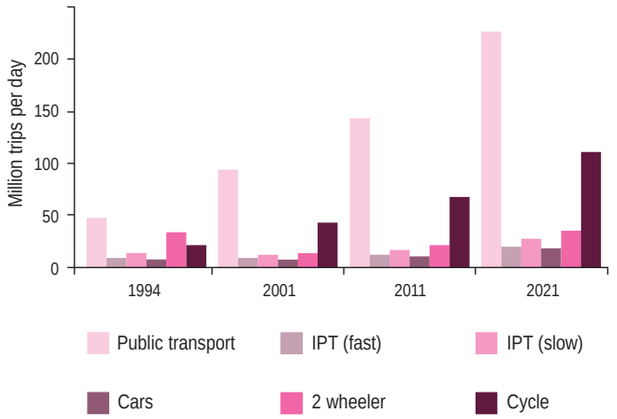

Fig. 6.9 Projected Mode Share of Vehicular Trips per day

Note: IPT: Intermediate Public Transport
Source: RITES (1998)

on growth of different categories of Class I cities and share of trips observed by different modes in those categories as size of a city grows (Figure 6.1).

Projections of the increased urban travel demand require that policy measures be adopted to fulfil this enhanced demand in a sustainable manner. Unless this is done, economic activities would be constrained and the economic health of the nation compromised. Advance action and planning can help in putting together systems that persuade travel demand to be met in a socially desirable manner.

Strategies for Urban Transport

Strategies to meet the urban travel demand cannot succeed without the fullest cooperation of the general public. Such cooperation is best secured if the objective of any initiative is made clearly known to them so that they are able to appreciate the likely benefits of certain travel choices or sacrifices that they may have to make. Mechanisms for greater public participation in the city specific initiatives, such as the Bhagidari scheme in Delhi, would help bring about greater public cooperation and support. Intensive awareness campaigns that educate people on the ill effects of urban traffic congestion, especially on their health and well being could be useful. Such campaigns could also build in modules to encourage individuals, families and communities to adopt 'Green Travel Habits' that would go a long way in making travel less polluting and damaging.

Contain Travel Demand

The first step towards meeting future travel demand is obviously to aim at reducing the travel demand itself through innovative means without compromising economic growth. As stated earlier, travel demand is a function of the population, the per capita trip rate and the average trip length. In a progressively urbanizing developing economy such as ours, there is little possibility of reduction in the per capita trip rate. This is because a larger share of the population would be securing employment (especially women) and a larger share of children would be attending schools. Efforts at reducing travel demand have, therefore, to focus on reducing the average trip length.

The key to reducing trip lengths is through a proper integration of land use and transport planning. Business and residential districts that are well interspersed entail shorter trip lengths as compared to an urban form that has a single business district surrounded by sprawling residential suburbs. Small, self-contained, clusters are considered desirable from a transport perspective, in mega-cities, as people are expected to move to residences that are closer to their place of work, or seek work closer to home. Hence, as a city expands, it would be desirable to channel the growth in such a manner that it takes place around a number of self-contained clusters. It is essential that the transport network guide the urban form, rather than the urban form guiding the transport system. Land use planning would therefore require that transport corridors be developed early so that new settlements come up around these corridors and not in a haphazard manner.

The success of this strategy would, however, depend on the ease with which people can shift residences or employment. Unfortunately, neither of these is very easy in India:

- Buying and selling of houses is complicated and expensive due to the high rates of stamp duty and complicated formalities required to be fulfilled under various Acts.
- The rentals are high and the supply of rented accommodation limited. Ensuring tenant withdrawal from rented premises at the end of the agreed period is difficult.
- Job mobility is limited as employment is difficult to find and having once found a job, many people tend to stay on life-long.

Thus, working members of a household would rather commute longer distances than shift residence. This calls for a review of the Rent Control and transfer of property legislation so that it makes it easier for people to shift houses and seek a residence closer to their place of work. Reductions in stamp duty and easier procedures for the sale and purchase of houses would also make transfer of residences more attractive. Another option would be to encourage a large market for rental accommodation through established property developers and metropolitan development authorities.

In addition to travel demand there is demand for employment, housing, electricity, water supply, schooling, healthcare and every other aspect of human existence that needs to be comprehensively viewed if the dream of self contained clusters is to be successfully realized. The fructification would

need complete cooperation from various interest groups and seamless coordination across government departments, which seems somewhat utopian in the present.

Developing an Optimal Modal Mix

The next exercise in developing an appropriate strategy would be to determine optimal modal preferences for meeting travel demand. This requires an assessment of the likely travel patterns, segmented for different categories of city residents and an identification of the modes that are the most sustainable.

Mode share projections, which do not include walking trips, show a high reliance on public transport and cycling (Figure 6.9). Further, survey-based studies carried out in Delhi and Mumbai show that while high income households rely heavily on personal vehicles in Delhi, the low income households rely more on non-motorized modes. Walking constitutes a high share for both categories in Mumbai followed by a reliance on public transport (Table 6.11).

Modal choices have to be made based on their relative congestion impacts, emission characteristics and energy efficiency if they are to lead to sustainable mobility. It is well known that non-motorized modes emit no pollutants and occupy least amount of road space. Hence, they should be amongst the most preferred modes. However, they are not suitable for trip lengths longer than 6 to 7 km in highly undulating terrains during hot weather. In such a scenario, motorized modes become essential. Among motorized modes, as mentioned already, public transport occupies less road space, consumes less fuel and emits least pollutants per passenger km of travel compared to personal motor vehicles. Hence, there is a need to encourage preference for public transport over personal vehicles.

Table 6.11
Preference Pattern of Modes of Transport in Delhi and Mumbai, 2005

	High income		Low income	
	Delhi (per cent households)	Mumbai (per cent households)	Delhi (per cent households)	Mumbai (per cent households)
Cycle	3	3.5	39	6
Bus	36	15	32	14.5
Car	28	3.6	0	0
SC/MC	29	8.5	3	.7
Auto	2	2.1	1	1.3
Rail		21	2	16
Others		1.1	2.	
Walk	2	45	22	61

Source: Tiwari (2005)

Strategies that channel travel demand towards these modes should adopt a preference for non-motorized modes and public transport. These strategies would also lead to a more equitable allocation of road space—being equitable to people rather than vehicles. Today, road space gets allocated automatically to whichever vehicle occupies it first, regardless of how many people it carries. Thus a big car with only one passenger gets the same allocation preference as a bus with 40 or more passengers. Systems of road allocation that are able to differentiate between such vehicles need to be put in place. Essentially efforts have to be aimed at containing the use of personal motor vehicles for family outings during weekends and special/emergency requirements. Daily commutes to work or school should be undertaken on more sustainable modes. A study carried out earlier corroborates that while people who use cars are captive to that mode, people who use two-wheelers are willing to shift to mass modes, if it is convenient to them (Sarna et al. 1990).

Use of personal vehicles can be discouraged by making its use more expensive and difficult. This can be achieved by a combination of fiscal and control measures. Examples of fiscal measures include charging of a fee for using certain crowded parts of a city, levy of high parking fees, increasing vehicle registration charges and by increasing the tax on fuel, etc. Examples of outright control measures include physical restrictions on the use of personal vehicles on some corridors, limiting the availability of parking space in city centres, limiting the availability of road space for personal vehicles and restrictions on the ownership of vehicles, etc. A good example of control measures is offered by the 'Congestion charging' scheme (Box 6.1) in operation in Singapore and London as well as the quota based 'Certificate of Entitlement' scheme for vehicle ownership in Singapore (Box 6.2). Both measures are forced measures to change preferences of the people and promote the public transport system. It may be noted however that both cities had well-developed integrated public transport systems before the new systems were introduced. This is an essential prerequisite for policy measures to contain the use of personal motor vehicles.

Promoting the Use of Non-motorized Modes

Yet another strategy to reduce personal motor vehicle use is to promote the use of non-motorized modes as they are 'greener' modes of travel. This can be done by investing in a segregated right of way for bicycles and pedestrians, converting crowded areas like market places into no vehicle zones, bringing about improvements in bicycle technology, providing safer parking facilities for bicycles at work places and finally promoting cycling and walking as healthy and exciting activities.

Because cyclists and pedestrians are, on most roads, required to share the same right of way with motorized modes, they

Box 6.1
Congestion Charging

The Singapore Area Licensing Scheme is one of the many anti-congestion policies implemented in Singapore. Introduced in 1975, it charged drivers entering downtown Singapore, and thereby aimed to manage vehicle traffic. In September 1998, the scheme was replaced by the current Electronic Road Pricing system. The Electronic Road Pricing (ERP) scheme is a form of congestion charging through electronic toll collection and is operated by the Land Transport Authority.

The system consists of ERP gantries located at all entrances to Singapore's central business district—areas within central area, such as the downtown core. They may also be located at high-traffic roads to discourage congestion. During peak hours, when a car equipped with an In-vehicle Unit (IU) passes under a gantry, a charge depending on the time and location (varying from S$0.25 to S$3.00 for passenger cars) is deducted from the Cash Card (a stored-value card) placed in the unit. During hours where traffic is not likely to be heavy or congestion unlikely, the ERP charge is not imposed. Law requires installation of IUs in all Singaporean cars. Non-Singaporean cars entering Singapore must either rent an IU or pay a daily flat fee instead.

A similar congestion charge is also levied in London. The London Congestion Charge is a fee for motorists entering the Central London area and was introduced in February 2003. Although London was not the first city to adopt congestion charging, as of 2005 it is the largest. The organization responsible for administering the charge is Transport for London (TfL).

The daily fee has been raised to from £5 to £8 from August 2005. This fee must be paid by the registered owner of a vehicle that enters, leaves or moves around within the Congestion Charge zone between 7 am and 6.30 pm, Monday to Friday. If the charge is not paid by 10 pm on the day of travel the charge is increased to £10.

Some vehicles such as buses, minibuses (over a certain size), taxis, emergency service vehicles (that is, ambulances, fire engines and police vehicles), motorcycles, alternative fuel vehicles and bicycles are exempt from the charge (technically, some of the exemptions are 100 per cent discounts and still require registration). Residents of the zone are eligible for a 90 per cent discount if they pay the charge for a week or more at once.

The stated aim of the scheme is to encourage travellers to use public transport, cleaner vehicles, bicycles, motorcycles or their own two feet instead of motor cars and vans, thus reducing congestion and allowing for faster, less polluting and more predictable journeys. Much of the money raised in the scheme is expected to be invested in public transport.

Box 6.2
The Vehicle Quota System of Singapore

The Vehicle Quota System in Singapore was implemented on 1 May 1990. Under this system, the Land Transport Authority (LTA) determines the number of new vehicles allowed for registration while the market determines the price of owning a vehicle. In determining the number of cars allowed for registration, the LTA takes into account the prevailing traffic conditions and the number of vehicles taken off the roads permanently.

The quota allocated to each vehicle category is in proportion to that category's share of the total vehicle population. The vehicle quota for a given year is administered through the monthly release of Certificates of Entitlement (COEs). The COE System allows a resident to submit his bid for a COE, monitor the current COE price and revise his reserve price. With the real-time information provided by the Open Bidding System, the applicant will be able to make more informed decisions when placing his bids for a COE. There are 2 COE Open Bidding exercises in a month. The bidding exercises usually start on the first Monday and third Monday of the month at 12 pm. It lasts for 3 working days and usually ends on the Wednesday in the same week at 4 pm. If a public holiday falls within the three-day bidding exercise, the bidding period would be extended accordingly. The monthly quota for each category will be divided equally for each exercise.

are exposed to grave risks of accident. As already seen, road accident data from Delhi indicates that most of the road accident related fatalities involve pedestrians and cyclists. Unlike in the developed countries, non-motorized mode users are still a significant number in India and need to be cared for. Unfortunately, most roads do not provide segregated lanes for them. It has been seen that providing separate bicycle tracks has significant advantages, including a more optimal use of the road space. Capacity estimations of a typical arterial road in Delhi show improvement in corridor capacity by 19–23 per cent through providing an exclusive bicycle track (Tiwari 1999). If a high capacity bus lane is also added the road carrying capacity can go up to the extent of 56–73 per cent. Simultaneously, all motor vehicles can experience increased

travel speeds as they are no longer constrained by slow moving vehicles. Time saving to the extent of 48 per cent has been estimated for typical arterial roads in Delhi (Tota 1999). There are positive impacts on congestion with 80 per cent reduction in delays at intersections (Karthik 1998). Safety benefits are estimated to translate into a 46 per cent reduction in accident costs with the segregated facility reducing the risk of injury in accidents by 40 per cent and in fatality by 50 per cent. Energy consumption and pollution also decrease because the motor vehicles have a smoother flow. Estimations show that there is a 28 per cent reduction in fuel consumption and 29 per cent reduction in the health-related externalities of air pollution (Tota 1999).

Reduce Emissions from Motor Vehicles

The strategy of reducing emissions from motor vehicles can be achieved by improving traffic flow, vehicle technology, cleaner fuels, and by reducing emissions from in-use vehicles.

Improving traffic flow

Vehicles travelling at a steady speed emit fewer pollutants than a vehicle requiring frequent starts and stops or spending considerable time in idling. Hence the focus of traffic flow improvements is to enable a vehicle to move at a steady speed and reduce the incidence of starts and stops.

Among the biggest impediments to improved traffic flow in Indian cities is the heterogeneity of vehicles on the roads. The extent of heterogeneity may change depending on the city size, but considerable heterogeneity prevails and will continue to prevail, in all cases, given our diverse ways of life (Figure 6.1).

A host of traffic engineering measures exist that can be employed to smoothen traffic flow. Among them are segregation of slow moving traffic from faster traffic (typically through separate tracks for buses, cycles and pedestrians) scientific design of intersections, bus stops (so that they do not obstruct traffic when they stop to pick up or drop passengers), flexi-laning to allow flexibility in road capacity during the morning and evening peaks, synchronization of traffic lights, etc. In addition, traffic management measures like a network of one-way streets and staggering work hours would also help in improving traffic flow.

While the focus of attention is generally on passenger traffic, cities also generate considerable amounts of freight traffic. Proper management of such freight traffic can also contribute significantly to improving traffic flow. The measures include specifying limited hours during which large commercial vehicles can enter city limits, constructing truck terminals outside city limits, constructing city bypasses that can help in diverting through traffic and shifting wholesale markets and establishments that are major origins and destinations of freight traffic, to the outer fringes of the city[3] .

Improving vehicle technology

Improving vehicle technology requires mandating the phased use of cleaner technologies and laying down a clear and time bound action plan, with adequate lead-time, to allow the auto and oil industry to make the required investments.

Use of cleaner fuels

Cleaner fuels could include both cleaner petroleum fuels and as well as alternate fuels. In respect of petroleum fuels, issues to be addressed are the sulphur content and the content of other pollutants (Box 6.3).

A few questions that arise: is gasoline or diesel, really the best fuel? In fact, is the traditional internal-combustion engine the best technology for urban areas? Do the demands of reducing pollution and conserving a non-renewable resource require that alternative fuels be experimented with? Recently all buses of Delhi have switched to the use of CNG as per the Supreme Court of India directive. This has led to debates on the relative merits of diesel vis-à-vis CNG. It has also led to debates on whether CNG is really the best alternative. All of these are issues that need to be examined in depth by research institutes, industry, and the government. There seems to be a case for setting up a 'Clean Vehicle Task Force' to evaluate the available technology options and promote the development of motor vehicles that are significantly more environmentally friendly and capable of meeting the safety, performance and cost needs in the Indian context (Box 6.4).

Reducing emissions from in-use vehicles

Measures are also necessary to ensure that the vehicles being used currently are properly maintained so that they do not become emissions and safety hazards. So far, these initiatives have largely been directed at commercial vehicles, by way of not allowing those of a certain vintage to operate on city roads or requiring them to be retrofitted to use cleaner alternative fuels. Unfortunately, no initiatives have been taken with regard to personal vehicles. Besides, the Motor Vehicles Act only

[3] In Mumbai, wholesale markets of commodities, fruits and vegetable markets were shifted gradually from the central business districts in 1980s. The NHDP VII envisages the construction of ring roads around cities to avoid the passing of transport carriers through the cities.

Box 6.3

Sustainable Transport Fuels for Urban Transport

Avinash Kumar Agarwal

Fuel demand for sustaining urban transport has grown several folds in last decade and this rate is escalating further and putting additional pressure on the foreign exchequer. By 2050, world population will be approximately 8–10 billion with 80 per cent people living in urban areas. Their average income will be in the range of US$15–US$25,000 per annum. The per capita energy demand in 2050 will be 2–3 times that of the present level. The relationship between per capita income and energy requirement is shown in the figure given below.

The challenge for us in India is to follow a flat trajectory of growth in fuel demand. Alternatives have to be considered in order to undertake import substitution for diesel and petrol fuels. No single fuel can sustain urban transport in foreseeable future.

CNG (compressed natural gas)

City of Delhi has successfully converted its mass transport from diesel driven vehicles to this clean fuel, CNG. CNG is an underutilized resource available in abundance in India. It can be tapped for sustaining urban transport in several mega-cities of the country. CNG needs a separate distribution network involving pipelines and filling stations, which is a capital-intensive proposition. The fuel becomes economically viable only when a large number of vehicles use it for a given transport system. If this distribution network also takes CNG to domestic kitchens, it starts to make even greater economic sense.

However concerns related to emission of fine-particulates with the burning of CNG have been raised. Their adverse health effects need to be investigated thoroughly owing to the large number of vehicles and their density in a given transport system.

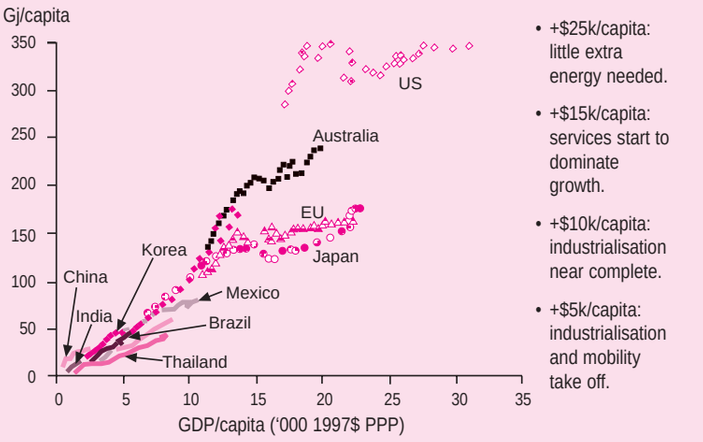

Fig. B6.3.1 Climbing The Energy Ladder: A Continuously Changing Relationship

Source: IMF, BP

LPG

LPG is a very successful transport fuel in several countries in the world. In India, the use of LPG in the transport sector has been legalized now. This fuel is quite popular and is widely used as a transport fuel especially in small urban centres and semi-urban areas. The distribution network for kitchen fuel is being used for the purpose but there is a need for spreading awareness about safety norms related to its usage. Apart from this, the subsidy targeted for domestic users finally ends up in transport sector defeating the very purpose of subsidizing a cleaner kitchen fuel.

Biodiesel

This is a green, carbon neutral fuel produced in farms and has the potential of partially substituting mineral diesel if the biodiesel programme is implemented wisely in India. India is a country blessed with agro-climatic diversity. There are a host of vegetable oils (edible and non-edible) such as Linseed, Castor, Jatropha, Karanja, Neem, Kusum, Mahua, Honge etc., which may be used for localized production of biodiesel. The biodiesel programme in India should be based on the vegetable oils available in excess in particular agro-climatic regions rather than importing a foreign plant species, like Jatropha, which may potentially disturb the flora and fauna.

The existing distribution network of diesel can be used for this fuel and in fact biodiesel can be blended at the fuel storage depot. Localized production of biodiesel will also eliminate the fuel transportation costs and strengthen the agriculture-based economy. The technology for converting vegetable oils to biodiesel is available in the country and numerous studies on engine performance and emissions have been carried out by several institutions and the results are favourable. Biodiesel usage leads to reduction in CO_2 and other emissions.

GTL

Gas to Liquid (GTL) technology can be used for production of liquid fuels (such as gasoline and diesel) from stranded natural gas. Use of this technology makes sense in the current environment if there is 'stranded' gas. This technology can also be used for production of liquid fuels from biogas but there are significant challenges. Extremely high quality diesel with 75–80 cetane number, zero sulphur and aromatics, odourless, colourless, non-toxic, biodegradable can be produced using this technology. There are emission benefits, from pure and blended products, and its performance is well established for existing engine technology. GTL fuel has clear benefits over conventional diesel in NO_x and SO_2, and is neutral on CO_2.

Note: Views expressed here are of the author of the box.

Box 6.4
Vehicular Pollution Issues in India

Avinash Kumar Agarwal

The dominant reasons for higher air pollution in Indian cities are high vehicular density in urban areas, poor and unregulated fuel quality, predominance of two-stroke vehicles, lack of efficient mass rapid transportation systems, uncontrolled growth of vehicular population, improper traffic planning, inadequate maintenance of vehicles, inadequate pollution prevention and control systems and lack of enforcement of pollution standards. A large number of two-stroke vehicles (up to 70 per cent of total vehicle population) run on the roads of NCR Delhi. Rampant adulteration of petrol/diesel makes the situation worse. Numerous small diesel run generator sets (in excess of 150 thousand in Delhi alone) spoil the urban air quality because of frequent power failures. Further, many small-scale industries use furnace oil with more than 3.5 per cent sulphur content.

A number of measures have been adopted by the government to control the vehicular pollution, which include introduction of stricter emission norms (Euro/Bharat norms). Fuels quality has been improved significantly and since 2000 metro cities are supplied with unleaded petrol instead of leaded petrol and 0.05 per cent sulphur content diesel (since 2003) in place of 0.5 per cent sulphur content diesel. All diesel-operated buses have been converted to operate on CNG in Delhi.

These two changes, namely: low sulphur diesel and introduction of CNG in Delhi have improved the urban air quality in the capital significantly. While the introduction of CNG has led to a significant reduction in particulate emission (on mass basis), the size of the particulates has also reduced. Smaller particles emitted by CNG vehicles are invisible and they absorb more poly-aromatic hydrocarbons (PAHs) on their surfaces, since smaller particles have larger surface to volume ratio. PAHs have been recognized as 'probable carcinogens' worldwide. Hence it is not yet clear whether the introduction of CNG on a large scale has reduced the health hazards associated with the vehicular pollution or not. A detailed epidemiological study should be undertaken.

Note: Views expressed here are of the author of the box.

requires commercial vehicles to undergo stringent testing at specified periodicity. There is no requirement for any similar stringent testing of personal vehicles, except for a periodic requirement of undergoing an exhaust emissions test, and this appears to be necessary.

Improve Urban Public Transport

Several measures are necessary to bring about the required improvements in public transport. To begin with a public transport system design, which can be developed within city constraints given the city's topography, time taken to develop the systems and improve accessibility to people would be an ideal system.

System design

The design of an efficient and cost-effective public transport system is a complex task and several system design parameters need to be kept in mind. A well-designed system is one that meets the demand in a cost effective manner, without too much spare capacity or without too much crowding. The following indicators can summarize optimality of a system:

- Least space consumption per passenger-km
- Least energy consumption per passenger-km
- Least emission per passenger-km
- Least accidents per passenger-km

The critical design parameters that need to be taken into account are:

- Line capacity, which is the number of people who can be transported per hour
- Speed, that is, the average speed of the system
- Cost, both capital and annual
- Construction time
- Ease of access
- Load factor, which is defined as the ratio of the number of actual users to available capacity. For achieving low cost per passenger, the load factor should be close to one. Similarly for lower fuel consumption and emissions per passenger, the actual number of users should be close to capacity.

There is also a range of public transport technologies with different cost–capacity–route flexibility characteristics. While bus systems on a shared right of way are the least expensive and the most flexible, they offer the lowest carrying capacity. Dedicating lanes for such buses and using longer, articulated buses can increase the capacity of the system. However, this increases costs and limits route flexibility. At the other end are underground rail-based systems that offer very high capacity but are very expensive and offer virtually no route flexibility. Thus, the choice of technology involves trade-offs in terms of cost and capacity that should be carefully taken into account in designing the public transport system. Any laxity in this can easily lead to a system that is either inadequate or has used up resources in providing capacity that is not required.

Design of a public transport system also requires a prior decision with regard to the type of city. Geographical features like the availability of land, in turn, often determine city type. Highly dense cities, that have severe land availability constraints, would have only one or a few city centres and would require high capacity public transport systems. However, in medium density cities less expensive bus-based systems would be adequate (Box 6.5).

Box 6.5
Choice of Mass Rapid Transit Technology

The selection of technology of a MRT is a conflict-ridden element. Both costs and performance vary from location to location and are functions of inter-stop distance, vehicle and system design, carrying capacity, ownership, etc. By and large, costs of at-grade busway systems formed by the conversion of existing roadways are between $1–8 million per route kilometre; Light Rapid Transit (LRT) costs are between $10–30 million per route km and a full heavy rail metros costs are between $30–100 million per route km, the most expensive being fully automatic underground system. The capacity of a MRT system varies as cities generally have to take into account topography and human geography of the city. Generally, the passengers per hour in the peak direction (pphpd) capacity of busways is 20,000 pphpd at an average speed of 17–20 kilometres per hour (km/h), of LRT is 25 to 35 pphpd at an average speed of 25–35 km/h, and of Metros is 80,000 pphpd at an average speed of 40–50 km/h. Performance and costs variability of some mass rapid transit systems corroborates physical characteristics of a city as well as antecedent and ownership of the system (Table B6.5.1).

Table B6.5.1
Performance and Cost Comparison of some MRTSs

System	Delhi Metro	Bankok (BTS)	Mexico (line B)	Kuala Lumpur	Tunis (SMLT)	Recife (Linha sul)	Quito Busway	Bogota (TM phase 1)
Category	Rail Metro	Rail Metro	Rail Metro	Light rail	Light rail	Suburban rail conv.	Busway	Busway
Technology	Electric steel rail	Electric steel rail	Electric rubber tyre	Electric driver less	Electric steel rail	Electric steel rail	AC electric duotrollybus	Articulated diesel buses
Length (km)	65.1	23.1	23.7	29	29.7	14.3	16.2	41
Vertical Segregation	80 per cent elevated, 20 per cent tunnel	100 per cent tunnel	20 per cent elevated, 55 per cent at grade, 25 per cent tunnel	100per cent elevated	At grade	95 per cent at grade, 5 per cent elevated	At grade, partial signal priority	At grade, mainly segregated
Stop spacing	0.9	1.0	1.1	1.3	0.9	1.2	0.4	0.7
Capital cost ($ million) of which:	2349	1700	970	1450	435	166	110.3	213 (infra-structure only)
-infrastructure		670	560	–	268	149	20	322
-vehicles		1030	410	–	167	18	80	Not included (private op.)
-capital cost/ route km	36	73.6	40.9	50.0	13.3	11.6	10.3	5.2
Initial passenger capacity	20,000*	25,000	19,500	10,000	12,000	9600	9000	–
Maximum passenger capacity	75,000*	50,000	39,300	30,000	12,000	36,000	15,000	35,000
Avg. operating speed (km/hr)	33	45	45	50	13 to 20	39	20	20+ (stopping) 30+ (express)
Ownership	Public	Private (BOT)	Public	Private (BOT)	Public	Public	Public (BOT)	Public infra., Pvt. Vehicles
Year completed	2005	1999	2000	1998	1998	2002	1995 (ext 2000)	2000 (1998 prices)

Source: Gwilliam (2002); *www.delhimetrorail.com*
Note: *As the system is yet to be fully commissioned, these are only estimates.

Accessibility

For a public transport system to be attractive, it is essential to improve access to its services. Safe access is critical for those who have no other travel choices and safe as well as convenient access is an important choice variable for those who do have other travel options and need to be persuaded to use public transport. It is useful to lay down standards for accessibility in terms of the distance within which public transport access points should be available. Typically such distances should be in the range of 0.5 to 1 km in central areas and 1 to 2 km in outlying areas. Such standards are useful for the design of public networks and routes.

A cluster approach in urban planning also makes it easier to provide better public transport coverage, as connecting cluster centres is often adequate to meet public transport needs. Short, intra-cluster trips can usually be performed by walking, cycling or para-transit. Hence, large and sprawling cities like Delhi could be developed as a series of strategically located hubs, which are interconnected by high capacity transport systems. Intra-hub trips could be made by other modes.

One idea that is becoming popular in several countries is that of transit villages. Transit villages are essentially high-density residential or commercial centres close to or on transit stations. They offer the advantage of easy access to public transport services and thereby have the potential to make public transport usage more popular. The development of such transit villages can be facilitated by sound policies regarding land allotment and suitable incentives under the local municipal laws for land use. Permitting a higher Floor Area Ratio (FAR) in such areas would attract investments in such property development and reduce the cost of such property for owners.

It is not always possible to cover all areas with public transport. This necessitates the use of personal transport. However, it is possible to encourage people to use public transport in the busy commercial centres and restrict the use of personal vehicles to the outlying areas. This can be done by planned integration of public and personal transport operations. Typically this calls for good parking facilities at public transit stations and easy access to public transport from there. The park and ride facilities that exist in many developed countries seek to achieve this. In the Indian context, such park and ride infrastructure would need to focus on parking for two wheelers and bicycles more than cars[4].

Similarly, there are many commuters who use suburban systems. Good integration of the intra-city system with suburban systems enhances access to public transport.

Premium services

It is also important to recognize that there is a large segment of personal vehicle users which would prefer to use public transport, even at higher fares, provided the quality of service is acceptable. These people are not willing to face crowds; they value travel comfort and time saved in travelling. With rising income levels the size of this segment is growing. Typically these would be the present users of two wheelers and second hand cars.

In order to wean such commuters away from using personal vehicles and towards public transport, it is essential to introduce a range of premium services, at fares higher than the present but economical to targeted users. Thus, express, air-conditioned bus services, using better quality buses, need to be introduced at premium fares. Proper pricing of such services is essential to keep away crowds. These services are not intended to meet the social obligation of offering affordable transport to the weaker sections of society, but to meet an equally important obligation of reducing urban congestion and air pollution. Such services would also help in improving the social image of bus travel.

To gain key learnings from international experience in traffic management it is important to take a look at recent developments in the world and innovative policy mechanisms employed to tackle the effective provision of urban transport (Box 6.6).

Way Forward

Governance and Regulatory Reforms

Clearly, urgent reforms are inevitable for sustainable solutions to India's challenge of urban transport services. The central government of India has formulated a draft National Urban Transport Policy with the following objectives:

- to bring about better integration of land use and transport planning so as to improve access to jobs, education, etc.;
- to encourage public transport and non-motorized transport so that the dependence on personal motor vehicles is reduced;
- to offer central government support for investments in cycle tracks and pedestrian paths;
- to offer central government support for investments in mass transit systems;
- to have a more coordinated approach to urban transport management through Unified Metropolitan Transport Authorities;
- to offer support for capacity building at the state level;

[4] Park and ride facility has existed at a few suburban stations for the last 35 years or so. It has been improved further now. At Andheri Station (a suburban railway station in Mumbai) Western Railways converted a freight yard into a park and ride facility. Most of the old stations suffer from lack of space but new suburban stations in Mumbai such as Vashi and CBD have park and ride facilities as an integral part of the local station complex. DMRTS has also planned park and ride facilities extensively at stations located in peri-urban areas.

Box 6.6
Recent International Trends in the Supply of Urban Public Transport

The recent trends in the supply of urban public transport in various cities around the world have included:

- greater involvement of the private sector;
- separation of policy and planning functions from actual operations;
- separation of infrastructure from the rolling stock; and
- adoption of innovative bus transport systems that offer substantially higher capacity compared to traditional bus systems but at costs that are considerably lower than rail-based systems.

London has completely privatized its bus operations, with a public entity, namely London Buses Limited (LBL), taking on the role of determining the level of service on different routes and procuring services from private operators to fulfil the level of service decided upon (Box 6.7). They also lay down standards for a uniform bus design and easy interchange between services of different operators so that the commuter sees a seamless and single public transport service. Bogota, in Colombia, has introduced an innovative bus rapid transit system (Box 6.8) where the city authorities have invested in dedicated bus tracks and have contracted private operators to run bus services as per schedules and design specified by a public entity, the Transmilenio. In Singapore, the Land Transport Authority (LTA) undertakes the responsibility of procuring bus services from a range of operators (Box 6.9). The LTA also determines schedules for the metro system in Singapore. In Paris, even though a publicly owned entity, Régie Autonome des Transports Parisiens (RATP)—Paris Transport Company, operates both the bus and the metro services, these are formally procured by a separate public entity, the 'Syndicat des Transports d'Ile-de-France' (STIP). Thus, there has been a separation of the operations function from the policy formulation and planning function as also a greater involvement of the private sector in operations, even as planning remains with public authorities.

Box 6.7
London Buses

London Buses plans bus routes, specifies service levels and monitors service quality. The actual bus services are operated by a number of bus-operating companies, which work under contract with London Buses. Although most of the operating companies are private-sector organizations, one (East Thames Buses) is owned by Transport for London (TfL), and managed at arm's length so as to avoid conflict of interest. Although this originally came about due to the default of a private sector operator, it now seems to be a deliberate policy, partly to act as an exemplar to other operators as to how TfL wishes bus services to be run.

London Buses is also directly responsible for the management of bus stations, bus stops and other support services. It provides passenger information in the form of timetables and maps at bus stops, and produces leaflet maps which passengers can obtain at Travel Information Centres, libraries, etc.

- to design parking facilities in a manner that encourages greater use of public transport and non motorized modes as also financial support for construction of parking complexes;
- to provide concessions for the adoption of cleaner fuel and vehicle technologies so that the pollution caused by motor vehicles gets reduced.

This policy points in the right direction for meeting the challenges of urban mobility in the years to come and should be brought into operation quickly. It should, however, be reviewed after about 3 years of implementation so that any elements that may have been overlooked earlier could be accommodated at a reasonably early stage (GOI 2005).

To implement the policy concerted efforts should be made to reorganize urban transport functions keeping in mind limitations of resources, market failure and plethora of legislations that have a bearing on the urban transport sector. Several of the standard conditions for the existence of an efficient market are not satisfied when it comes to meeting urban travel demand.

There are negative externalities as every additional vehicle on the road translates to an additional cost to society that the user of the vehicle does not have to pay directly.

Public transport has positive externalities that no single user would be willing to subsidize.

Similarly, the infrastructure created for urban transport needs is virtually a public good and no one can be prevented from using, say, the roads that have been built.

Finally, many of the services cannot be provided in a highly competitive market and tend to be monopolistic in nature.

Hence, there are important regulatory responsibilities that the government or a public agency has to discharge.

Box 6.8
The Transmilenio Bus Rapid Transit System in Bogota, Colombia

The Transmilenio System is a bus-based passenger transportation system founded on two general objectives: improving citizen's quality of life, and improving the city's productivity. Prior to the implementation of the Transmilenio system, the transport system of Bogota was characterized by slowness, inefficiency, inequality, contamination, and danger to life.

The average travelling time for an ordinary journey was 1 hour and 10 minutes. Old buses with and low-occupancy levels used to run on long public service routes. Ninety-five per cent of the road network was occupied by private cars totalling to about a million vehicles transporting merely 19 per cent of the whole population. 70 per cent of particles emitted came from motorcars and there used to be a high car-accident rate resulting in a significant number of casualties.

In order to introduce a structural change in these transportation conditions, the local administration decided on an integrated mobility strategy, which apart from the bus-based Transmilenio, also envisaged promotion of non-motorized transport through the creation of public spaces, new pedestrian zones, and 300 kilometres of cycle paths. In addition, plate number-based restrictions for the use of private vehicles during peak hours were established, together with measures like higher car-parking rates, and compulsory car-free days.

The Transmilenio system has been designed to achieve the following:

1. Quality and consistency: by guaranteeing the rendering of urban passenger-transportation services in accordance with the highest international standards and pre-established timetables on a 365-day basis.
2. Affordability: by making it affordable to low-income users, while at the same time being profitable for private operators and fundable by the state.
3. Respect for life: by reducing accident rates and decreasing the presence of contaminating pollutants in the city air.
4. Respect for the user's time: by shortening ordinary travelling time by 32 per cent.
5. Respect for human diversity: by allowing fair access to all citizens, regardless of their physical, social, economic, gender, and age conditions.

The Transmilenio system comprises of the following four components:

- a proper infrastructure, comprising exclusive lines for the system's articulated buses; passenger access to stations through pedestrian bridges and tunnels; platforms, bays, small squares, and avenues.
- an efficient operating system, with articulated buses operating as per centrally planned schedule
- a modern fare collection system, where passengers use contact less smart cards to access the stations where they can board the buses through multiple doors.
- a permanent planning, management and control entity, whose financial requirements are met through 4 per cent of the fare collection and revenues from secondary activities such as advertising at stations to make it an independent regulator of the system.

With the implementation of the system, there has been a 32 per cent reduction in overall travel time, 40 per cent reduction in emissions into the air because of scrapping of over 2100 old public service buses, 90 per cent reduction in accident rates in the corridors where the Transmilenio system operates.

Today, citizens in Bogota are showing a positive change of attitude, reflecting in spontaneous compliance with civic rules, thus generating respectful behaviour and friendly coexistence, cooperation, mutual support and civil commitment. In addition, a sense of belonging with regard to the system is particularly strong among children as privileged witnesses to its birth, and its ongoing growth process.

Box 6.9
Land Transport Authority, Singapore

The Land Transport Authority (LTA) is a statutory board under the Ministry of Transport that spearheads land transport developments in Singapore. LTA plans the long-term transport needs of Singapore, taking care of those who drive as well as those who take public transport. The ultimate goal is to provide a smooth and seamless journey for all. The LTA was established on 1 September 1995 and formed through the merger of four public sector entities, namely the Registry of Vehicles, Mass Rapid Transit Corporation, Roads & Transportation Division of the Public Works Department and Land Transport Division of the then Ministry of Communication.

It has eight divisions supporting its core functions, namely, corporate services, engineering, innovation, and InfoComm Technology, policy and planning, rail, roads, safety and contracts, and, vehicle and transit licensing.

Its stated mission is to provide an efficient and cost-effective land transport system for different needs. Its objective is to deliver a land transport network that is integrated, efficient, cost-effective, and sustainable to meet the nation's needs, to plan, develop and manage Singapore's land transport system to support a quality environment while making optimal use of our transport measures and safeguarding the well-being of the travelling public and to develop and implement policies to encourage commuters to choose the most appropriate transportation mode.

Coordinated Planning and Management for Urban Public Transport

First, it is necessary to have a single agency that would facilitate the integrated planning and development of urban transport systems, a more optimal allocation of resources, better co-ordination of operations and more effective management. It should also facilitate better integration of land use and urban transport planning.

In order that such an agency is able to discharge its responsibilities effectively, it needs to have legislative backing. Central government agencies like the Railways and Telecommunications have to be actively associated with this agency and must be fully responsible to it for city transport matters. It must be given substantial financial powers and all funds meant for urban transport should be routed through this agency.

At the state level, either the State Transport department or the department responsible for urban development should be designated as the nodal department for performing these tasks. However, for proper strategic planning several other agencies have to be very closely involved. Among them would be the Traffic Police, the State Transport Corporation (STC), the rail transit operator (if any), Indian Railways, Municipal Corporation, Metropolitan Development Authority, Planning Department, Finance Department, etc. The involvement of so many agencies can only be ensured through a high level statutory body that has representation on behalf of all such agencies. Such a body should have powers to allocate funds to the different agencies involved in accordance with strategic plans. It should also be empowered to ensure compliance with the strategic plans. The much-talked about Unified Metropolitan Transport Authority (UMTA) needs to be thought of as an appropriate agency for effecting such coordination.

Management System for Public Transport

Since good public transport would be a very important component of any strategy towards a sustainable urban transport system, it is important to review a possible governance and management system to provide these services. These structures are determined to a large extent by how public transport services are provided.

There are three principal models for providing public transport in a city. Model-1 is a monopoly supplier arrangement where only a single agency (usually a public agency, like the Massachusetts Bay Transit Authority (MBTA) in Massachusetts and the Washington Metropolitan Area Transit Authority (WMATA) in Washington) provides all public transport services. In such cases, the single agency performs the entire provisioning function. There is a close linkage between such an agency and the strategic planning body, with a senior official of the strategic planning body often being the non-executive head of the public transport agency. Under this model, a virtual convergence between strategic planning and provisioning results.

In Model-2 there is one large and dominant operator, usually a public agency, with several small operators. The small operators could either be contracted by the dominant operator or could be permitted by a third authority. In such a model, the dominant operator tends to discharge most of the provisioning functions, with a third agency performing a loose supervisory role.

In Model-3 there are several operators, some of which could be publicly owned and others privately owned. This is the situation prevailing in London where rail based services are provided by a publicly owned operator and bus services are contracted by a public agency from a multiplicity of private operators. The operators merely focus on the efficient operation of services in the areas allocated to them as per agreed terms. The procuring authority takes up the responsibility of ensuring availability of services through one or more of the operators. Thus, this model involves a clear separation of the planning and policymaking function from actual operations.

Each of these models has its respective advantages and disadvantages. Model 1 offers the advantage of easy coordination between strategic planning and operations, as only a single operator is involved. There is no confusion of multiple service providers as a result of which it is easy to implement differential pricing schemes for different categories of users as also a scheme for a system wide common-ticket or pass. The necessity to share revenues with multiple operators does not arise. Fare revisions and route changes are easy to implement. However, being a monopoly supplier, a single operator tends to be high cost largely due to the higher than market wages given to employees that are generally agreed upon during difficult wage settlement negotiations. Monopoly operations also lose focus on citizen needs, concentrating more on operational convenience. Besides, the top management tends to get bogged down in operational issues as a result of which policy-making suffers. However, the biggest problem of Model-1 today seems to be the need for considerable support from the public budget.

Model-3 is the virtual reverse of Model-1 where the extent of public budgetary support is far less and operational costs are comparatively lower. Given the competition between several operators, Model-3 is also more sensitive and responsive to citizen needs. However, coordination amongst multiple operators is extremely difficult. Having a common ticket for the entire system and a differential pricing system make it even more complicated and difficult to operate, as it requires an elaborate and expensive mechanism to determine the respective revenue share of each operator's services. Route changes are also difficult to bring about due to fixed period contracts generally entered into with the operators.

Model-2 attempts to offer a compromise between the advantages and disadvantages of Models 1 and 3. While some of the disadvantages are eliminated, many of the advantages are diluted.

Thus, it is clear that Model-1 could be a good choice if public budgets can support a single operator. However, if this is not possible then it would necessitate resort to Model-2 or Model-3, depending on the extent of dominance of a public operator that could be supported. In the case of most metropolitan cities in India, the need for a much higher level of private operations seems to be necessary, as the public budget cannot support the STCs to the extent necessary. In fact, many STCs themselves have been contracting services from private operators to expand their fleet. The balance of advantage would, therefore, seem to lie in starting with Model-2 and gradually moving towards Model-3 for the following reasons:

- It becomes possible to channel scarce public funds into those activities that the public sector is best suited to perform and not use them up in activities that the private sector is well equipped to tackle.
- It directs greater attention to commuters than to operational convenience.
- It allows retention of natural monopoly activities in public hands.

The key to determining the governance structure is to strike the right balance between the extent to which a level playing field needs to be maintained between the operators and the extent of competition that needs to be encouraged. If Model-2 or 3 are adopted, proper and unbiased commercial regulation, provisioning and supply of universal services—the services which are not financially viable but necessary to ensure that economically challenged people are not deprived of socioeconomic benefits of urbanization—becomes crucial for ensuring a level playing field amongst all operators. There seem to be three institutional options for providing these services:

- these can all be provided by an independent regulator
- regulatory and provisioning roles can be performed by an independent regulator with another agency providing universal services
- three separate agencies may discharge the three functions

Establishing a single agency to discharge all the three functions would offer economies in administrative support costs. However, each of these functions is specialized and needs expertise. In particular, provision of universal services should really be a commercial function and not a regulatory function.

Accordingly, a choice between the above options would best be made after taking into account the existing institutional arrangements, with a view to ensuring minimum disruption from current practices. Using this criterion, the best option for metropolitan cities in India would be to have a single agency to regulate commercial issues and perform the provisioning function. This is being suggested because the supply of universal services is a commercial function that would have to be performed in a monopolistic market. Hence, this would also need external regulation to distance it from a regulatory function. As against this, provisioning requires ensuring a level playing field for all operators and is, therefore, more akin to a regulatory function. Besides, the provisioning function offers opportunities for some revenue through licensing fees. Such a revenue mobilization opportunity will allow an independent regulator to be less dependent on the government for its financial needs and thereby enable regulation to be more truly independent.

Thus, an independent regulator could carry out the functions of regulating and provisioning. The STCs would be best placed to provide universal services for all operators, as they already own infrastructure for this purpose. In order that this does not cause a conflict of interest, it would be best if the bus operations of the STCs were entrusted to a subsidiary, with the prime function of the holding corporation being the provision of universal services. Furthermore, over a period of time, the STC's own operations could be reduced to a minimum as efforts are made to move from Model-2 to Model-3 structures. Provision of universal services could be done by the STC on a commercial basis. They have the potential of earning substantial revenue if they are able to take due advantage of their prime property within cities.

Financial Resources for Urban Public Transport

Implementing the strategies outlined above for meeting the future urban travel demand using public transport will, clearly, require large capital investments, whether they are for constructing highly capital intensive Rail Transit Systems or segregated rights-of-way for cycles and pedestrians. Most state governments and local bodies do not have the required resources and, therefore, alternate methods of financing should be explored. A judicious mix of private capital with public funds can competitively deliver urban transport services. This would reduce the financial burden on the state and may even leave a surplus for meeting universal urban transport needs. Services that are currently rendered by the state, at a huge loss, could also be farmed out to the private sector, through innovative public–private partnerships. For example, the greater use of private buses in city areas would reduce the outflow on meeting the annual subventions to the STCs.

The commercial utilization of land resources, available with public transport service providers, seems to offer a promising opportunity for mobilizing substantial resources. Most State Transport Corporations own prime land in the urban areas but such land is not commercially used. Development of commercial property on these would help them to earn revenue and reduce the drain on public budgets.

Conclusion

Urban public transport in India is underdeveloped resulting in congestion on roads due to mixed traffic. Unreliable and rudimentary public transport systems have led to increased dependence on small, motorised vehicles among urban population. This coupled with the decline in non-motorized modes of transport, either due to demonstration effect or affordability of a motorized vehicle has given rise to air pollution and high level of road accidents.

Currently, public transport in India, barring a couple of metropolitan cities, is underdeveloped. Urban transport in most cities suffers from lack of planning as well as amorphous nature of responsibilities assigned to various central, state and local government agencies.

Demand for urban transport is expected to double by 2030, hence, there is an urgent need to develop strategies, which will reduce demand for public transport without constraining growth and provide a healthy environment to urban dwellers. Further, regulatory reforms are essential to form a Unified Metropolitan Transport Authority which is responsible for planning, provisioning and maintaining urban transport services at affordable prices as well as maintaining urban transport services for economically challenged members of the society.

Mass transportation systems especially in a few metropolitan cities have moved from construction to the operational stage. The government has taken half-a-step by preparing a draft National Urban Transport Policy. The next half-step would be taken when regulatory reforms are put in place to provide comprehensive urban public transport services at an affordable price to all.

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