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TRANSPORTATION IN INDIA: DEVELOPMENT AND PROSPECTS

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SYNOPSIS

This paper provides a historical review of the development of road and rail transport in India. Starting from colonial times where railways were constructed to link ports and major inland centres, railways developed first and superseded the inland waterway system. Roads developed after the end of the First World War and duplicated the railways.

After Independence, the State controlled the development of transport giving priority to railways in the movement of long distance freight and passenger traffic. The allocation to road and rail from the successive five year plans are examined in detail.

A description of the technology developments made by Indian Railways is given as efforts were made to increase productivity. These developments have been hindered because it has not been possible to reduce the numbers employed and per capita productivity remains low. Traffic volumes have continued to grow.

The paper describes the staggering increase in road traffic as a result of a massive increase in the number of road vehicles and shows that road traffic is becoming increasingly involved in competing for traditional railway freight traffic. This growth has hidden what is described as the technical stagnation of the road transport industry.

The paper suggests that there is a possibility that transport capacity shortages may inhibit future growth. Transport is facing a dilemma. While government investment is being reduced, the saturation of road and rail trunk routes is already a problem. As the railway concentrates on train load traffic, more and more freight traffic is being carried by road. While some development might be attractive to the private sector, the paper concludes that involvement of the State remains a necessity.

INTRODUCTION

India is a vast country of great geographical diversity. At the time of independence in 1947, the country inherited an economic system and its supportive infrastructure which had been designed to assist colonial rule. The development of transport and communications, two of the most important facets of economic development, was uneven. Over the last five decades, India has been striving to develop its transport and communications systems to facilitate rapid and balanced economic growth. This paper examines the policies and strategies, constraints and opportunities in two modes of surface transport: roads and railways.

Historically, the development of land based transport facilities in India was largely conditioned by the nature of the terrain. Although construction of roads in inhospitable terrain had been achieved, these were the exceptions. The general rule was that a few trunk routes connecting capitals of kingdoms and centres of commerce were constructed to serve the needs of economic activity. These trunk routes were connected to a large set of poorly constructed subsidiary routes. The fertile plains of the rivers Indus and the Ganges, stretching from the north west to the east favoured inland water transport, and until the beginning of the 20th century, boats used to carry goods from the ports on the east coast right up to Delhi.

The railways were introduced in India in 1853, barely 25 years after their advent in Europe. To quote Lord Dalhousie, the then Governor General of India, the purpose was to "haul Indian cotton for English textile mills" and open the "vast market for British manufactures in the most distant markets of India" and obtain "all the important advantages and the increased facilities to be derived from railway transport in the administration of the country and the mobility of the military and other security forces." The first railway lines were thus laid to connect the ports to the hinterland.

The development of the roads received less priority than the railways under British rule. The pace of construction of roads accelerated after the First World War when vehicles became sufficiently developed to compete with the railways in terms of speed. Then too, the main emphasis remained on the development of trunk routes to connect the ports to the major urban centres.

The growth of railways proceeded at a rapid pace and by 1900 there were nearly 40,000 kilometres of railway track. The railways were operated by private companies owned by the British. The Government gave certain concessions such as grants of land, guarantees of a minimum return on the capital etc. Criticisms and complaints against private ownership and management of the railways prompted the Government to start investing in railroads. By 1924, the total track length of the railways had reached almost 60,000 km and the railways had been recognized to be important enough to the national economy for the railways' finances to be separated from the general accounts. This practice continues today. In 1925, the Government took over one major railway company. Gradually, other companies were also taken over. By 1950, the railways in the former princely states were also taken over by the Government and the railways became a State owned enterprise.

The development of the railways led to the collapse of the inland waterways transport system which were privately owned and operated. Over the years siltation had rendered many portions of erstwhile thriving waterways unserviceable.

The transport provided by the railways and the roads thus constitute the backbone of India's transport system. The development and sustenance of these two systems are crucial to economic growth and social integration in the country. It is imperative, therefore, to study the strategies and policies pursued by the country, to analyse their success and ability to meet future challenges and to assess the investments and policy changes which may be necessary.

The association between changes in the transport sector and the evolving pattern of economic development within the area served, has been the subject of detailed academic evaluation. While the importance of transport in economic growth and development has never been doubted, its exact role and influence have been subjected to periodic reappraisals. Traditionally, it was held that transport exerted a strong and positive influence on economic development. Increased production could be directly related to improved transport. Thus Rostow (1960) (Ref 2) maintained that the introduction of railroads has historically been the most powerful single indication of take-offs. It was decisive in Canada, France, Germany, Russia, and the United States. The

linkage between provision of transport services and economic development, according to the traditional approach, could be divided between the direct transport input and indirect multiplier effects. Efficient transport offered low shipping costs which permitted wider markets to be served and the exploitation of large scale production in an extensive range of activities.

This causal view of transport and economic development has been questioned in recent years. A large body of econometric work has offered evidence that the causal linkage should be replaced by the weaker position that good transport permits economic development. Availability of adequate transport is thus a necessary but not a sufficient condition for economic development.

Transport performs five functions in assisting economic development:

(a) The most obvious function is to permit goods and people to be transferred between and within production and consumption centres. The rural to urban movement permits extension of the money economy into the rural areas;

(b) Transport improvements can shift production possibility frontiers by altering factor costs and reducing the levels of inventory tied up in the production process;

(c) Factor mobility is increased permitting factors of productivity especially labour, to be transferred to places where they may be employed most productively;

(d) Transport increases the welfare of individuals, by extending the range of social facilities available to them;

(e) Transport also provides superior public good such as greater social cohesion and increased national defence.

THE ROLE OF THE STATE

In many developing countries, the inadequacy of transport facilities is one of the major bottlenecks to socio-economic development and national integration. Hence, the State takes a keen interest in development of transport infrastructure and usually takes the lead in investing for development of transport facilities.

The concept of centralized planning for the attainment of rapid economic growth had been implicitly accepted by the leaders of the country prior to independence. A National Planning Committee had been formed by Pandit Nehru, the first prime minister of independent India, as early as 1938. After attainment of independence in 1947, the Planning Commission was set up (1950) to enunciate the objectives of planned development and to assess the country's need of capital and human resources to attain the objectives. Broadly, the objectives of planned development were to set up a socialist society based on equity and justice and to maximize the level of national output. The policies adopted for the transport sector were to be congruent with this philosophy.

Central planning which started in 1951 was based on the development of Five Year Plans which enunciated objectives, laid down targets and allocated resources for achievement of the goals. Indian planners accorded high priority to the development of transport. The Industrial Policy Resolution of 1948 had declared the ownership and management of railway transportation to be an exclusive monopoly of the government. In the case of roads, the government at the centre and in the states undertook the construction of roads. Investment in vehicles for transport of freight was left almost exclusively to private initiative. The State governments, however, took active interest in supplying transport facilities for passenger movement at the urban, intra-state and inter-state levels. A number of State Transport Undertakings were formed for this purpose which were fully financed by the government.

Table 1. Rail and road infrastructure in 1951

Roads		*Railways*	
Length of roads	400,000 km	Route km	53,600 km
Surfaced roads	157,000 km	Electrified route	400 km
National highways	22,000 km		
Registered vehicles	306,000		
Goods vehicles	82,000		
Buses	34,000		
Freight output	5.5 BTKM	Freight output	44.1 BTKM
		Passengers	1.3 billion
Passenger output	23.0 BPKM	Passenger output	66.5 BPKM

Sources: Economic Survey of India & PPTD Report* (* Ref 7)

Table 1 shows the relative importance of the railways and roads in the economy in terms of transport output at the beginning of the era of planned development. The output of the roads was low as it was constrained by inadequate development and the scarcity of road vehicles for both freight and passenger transport.

The industrialization of India's economy was launched as a major programme from the Second Five Year Plan (1956-61). It laid special emphasis on the development of basic and heavy industries which naturally called for a massive transport effort. The magnitude of effort devoted to the development of transport in the country is broadly expressed in the allocation of resources for transport in the Five Year Plans.

Table 2. Expenditure on transportation sector in the five year plans

Plans		*Share of transport sector in plan outlay (per cent)*	*Share of railway (per cent) in transport expenditure*	*Share of road (per cent) in transport expenditure*
I	1951-56	22.1	50.0	33.8
II	1956-61	23.5	65.7	22.0
III	1961-66	23.1	66.9	23.6
IV	1969-74	16.0	37.0	39.2
V	1974-79	14.1	37.2	39.8
VI	1980-85	12.8	47.2	37.0
VII	1985-90	13.5	56.1	28.8
VIII	1992-97	13.5	48.5	30.2

Source: VIII Five Year Plan

It is clear that the investment in the railways was greater than that in roads. This was a deliberate strategy of planning which emphasized the importance of movement of bulk commodities by a more energy efficient mode to serve the new industries and the provision of inexpensive and reliable transportation for the large population. To restrict competition between railways and roads, movement of freight by road was controlled through a system of permits and licensing. The planners had defined a specific role for the railways in the economy. It was to play the dual role of a transporter and an agent of social change. The government directed pricing policy of the Indian Railways thus discriminated in favour of low value bulk commodities which were rated at or below the level of corresponding operating costs.

In the case of passenger traffic, the pricing policy subsidized the movement of urban commuters, lower classes of travel and traffic on low density branch lines. The subsidy was paid for by the profitable flows of passenger and freight traffic. This system of cross subsidy continues to be inherent in the pricing structure of the railways.

The basic mineral resources are distributed unevenly over the country. The government adopted a scheme for equalization of the freight component for industries to ensure balanced regional development. The 'freight equalization scheme' was introduced for commodities such as cement, iron and steel and petroleum products. It also operated for fertilizers for which not only freight but total production costs were also equalized by means of a subsidy resulting in a fixed pool price for sale throughout the country. Similarly, the Food Corporation of India distributed food grains in different areas with a built-in equalization of freight rates. The freight equalization scheme was operated by the establishment of self-financing accounts from which excess amounts paid for longer hauls were drawn for which credits were made when freight was moved over less than the average distance – equalization freight being the freight for an average distance over which the commodity moved. The National Transport Policy Committee 1980 (Ref 6) observed that the effects of the scheme were:

(a) The average distance of haul (termed as 'lead' in the literature) of commodities covered under the freight equalization scheme had increased, thus leading to an increase in real transport costs to the economy;

(b) Subsidizing long distance freight had promoted industrial locations in areas where it would otherwise not have been possible.

The monetary cost of transportation thus did not reflect its real cost. Hence, when decisions regarding industrial location were made, the true costs of investment and production were obscured and this absence of a market based pricing mechanism resulted in inflation of transport demand. However, the National Transport Committee concluded that the social gains from the operation of the freight equalization scheme were greater than the increase in transport costs.

The role of the central government with respect to the development of roads was recognized in 1929 when a committee (called the Jayakar Committee) suggested comprehensive schemes for the improvement of the road system. Later, in 1943, the Chief Engineers-in-Charge of Roads met at Nagpur to consider requirements of the road system for a period of 20 years beginning in December 1943. The plan (called the Nagpur Plan) classified roads as national highways, state highways, district and village roads and prescribed standard norms and targets for road development under various categories. At the end of the Second Five Year Plan period in 1961, the overall kilometre targets envisaged in the Nagpur Plan had been achieved. A new road development plan for 20 years, popularly known as the Bombay Plan, was launched in 1961. The target set by the plan was that no village should be more than 7.2 km away from a metalled road or more than 2.7 km from any type of road in developed agricultural areas. While working out specific proposals, consideration of the size of the area, population, regional levels of development and future potential were taken into account. A detailed scheme of priorities was formulated which included provision of bridges, improvement of road surfaces to at least one lane with tar macadam topping for national and state highways, widening of main roads in the vicinity of towns, etc. The plan envisaged an increase in road length from 0.609 million km to 1.051 million km of which over 40 per cent were to be surfaced roads. By 1981, the country had 1.49 million kilometres of roads of which 45 per cent were surfaced. The target for development of national highways was a length of 51,200 km and that for state highways 112,000 km. While the overall target for road construction was surpassed, the construction of national and state highways fell below the target. In 1981, the total length of national highways was 32,000 km and that for state highways was 94,000 km. The target for construction of major district roads, other district roads and classified village roads

taken together was surpassed. An imbalance in national road development was thus emerging with the arterial routes not developing sufficiently fast to absorb efficiently the increasing traffic levels.

Investment by the government in the transport sector reduced after the Third Five Year Plan (1966) due to competing demands from other sectors of the economy and the Fourth Five Year Plan allocated only 16 per cent of the total plan outlay to the transport sector. The expansion of the road network, particularly that financed by the central government (national highways) also slowed down. In the ten years between 1981 and 1991, only 546,000 km of roads were added – an increase of 36.6 per cent as compared to a 62 per cent increase in the previous decade. A remarkable feature of transport planning for road development in India was that in the four decades between 1951 and 1991, the percentage of national highways to total road length actually diminished from 5.5 per cent in 1951 to 1.6 per cent in 1991. The share of state highways remained almost static at about 6 per cent. The development of subsidiary road systems, financed by the state governments, continued at a faster rate than the arterial routes (Ref Table 3).

Table 3. Growth pattern of different categories of roads

(Figures in '000 km)

Year	*Total road length*	*Surfaced length*	*National highways*	*State highways*	*Per cent surfaced roads*	*Per cent national highways*	*Per cent state highways*
1951	400	156	20	NA	39.0	5.0	NA
1961	525	234	24	NA	44.6	4.6	NA
1971	918	397	24	57	43.2	2.6	6.2
1981	1,491	683	32	9.4	45.8	2.2	6.3
1991	2,037	1,012	34	123	49.7	1.7	6.2

Source: Economic Survey of India

* NA Indicates figures not available

As the level of economic activity in the country increased, and feeder routes to the State and national highways developed, the inadequacy of the network was accentuated through increased congestion. The statistics clearly reveal that development of roads was inadequate for the needs and was indeed less than that targeted by the government.

On the other hand, the railway infrastructure had been largely established before the beginning of central planning in 1951. The programme for rapid industrialization of the economy required extension of the network to serve the mineral deposits and new industries. However, as expansion of the network was expensive, it was decided that the capacity of the available network was to be fully exploited. To optimize the utilization of the capacity, technological innovations in the shape of wagons with higher payload and locomotives with higher horsepower were introduced. The sixties saw the beginning of manufacture of diesel and electric locomotives for 25 KV AC traction in India. Route relay interlocking and centralized traffic control were some of the other technological improvements introduced later on the railways. Some new lines were constructed to promote development of backward areas and for strategic reasons. The ability of the railways to generate additional transport capacity was a major catalyst in the growth of basic industries.

Table 4. Indices of growth of traffic output and input (1950-51 = 100)

Year	Output indices		Investment indices		Input indices	
	*Freight traffic (NTKM)**	*Passenger traffic (PKM)**	*Wagon capacity*	*Passenger coaches*	*Route km*	*Tractive effort of locos*
1951	100	100	100	100	100	100
1961	199	110	152	154	105	144
1971	289	159	226	188	112	178
1981	359	279	269	210	114	201
1991	550	394	278	219	116	192
1994	583	384	273	233	117	188

Source: Indian Railway Year Book

* NTKM : Net tonne kilometre
* PKM : Passenger kilometre, here PKM refer to non-suburban traffic only.

Table 4 shows that the increase in the railway network has been slow compared to the increase in freight and passenger traffic. While the route length has increased by only 17 per cent from 1951, the freight transport output has increased nearly six times and that of passenger transport about four times.

Indian Railways

Planning for technology progression on Indian Railways has been largely conditioned by the necessity of maximizing the volumes of traffic transported over the existing network. The volume of traffic that can be transported over the rail network is determined by a number of factors such as: (a) the maximum dimensions of the rolling stock permitted by fixed structures such as bridges, tunnels etc.; (b) the axle load that the rail track can bear; (c) the capacity of the locomotives to haul the trains; (d) the maximum number of wagons that can be accommodated in a siding (loop) at a station.

Fortunately, the predominant portion of the rail network in India was built to broad gauge (5 ft. 6 inches or 1,676 mm) standard which is capable of accepting high payloads per wagon.

At the beginning of the planning era, the average freight wagon was small and had a carrying capacity of only 22.5 tonnes. The payload of an average freight train was 1,700 tonnes. The fixed structures on the broad gauge track of course permit much larger volumes of movement. The introduction of the box wagon in the early '60's increased the axle load dramatically from 16 tonnes to 20.32 tonnes and the pay load of a freight train to 2,500 tonnes. The new wagons also required less maintenance as they were provided with roller bearings instead of plain bearings. The manufacture of diesel and electric locomotives to replace the aging steam locomotives provided the motive power to haul the heavier trains. In the case of passenger traffic, the growth was absorbed by running a larger number of trains and increasing the number of coaches per train progressively to exploit the available length of the sidings and the passenger platforms. Improvements in track, signalling and communications technology progressed concurrently to optimize the output of the system. The strategy was able to absorb the growth of bulk traffic which moved efficiently in train loads. However, for shippers who offered less than wagon load traffic the change in technology proved counter-productive. A segregation began to develop with the smaller shippers slowly shifting to road transport.

The Indian economy is characterized by high transport intensity. Estimates by the World Bank put the freight transport intensity at 0.51 tonne km per $ of GDP for 1984. Though this is less than comparable figures of 0.64 for the United States of America, and 0.78 for China, it is much higher than smaller developed countries such as Germany (0.28), France (0.22) and Spain (0.37) (Ref 9). The elasticity of freight and passenger transport with respect to GNP has been assessed as 1.3 and 1.9 respectively. The growth in GNP and transport output of the rail and road between 1951-1991 were as shown in Table 5:

Table 5. Growth of output in rail and road sectors

Year	*GNP (at constant prices in Rs. billion)*	*Rail freight (BTKM)*	*Rail passenger (BPKM)*	*Road freight (BTKM)*	*Road passenger (BPKM)*
1951	426.44	44.12	66.52	5.50	23.00
1961	625.32	87.70	77.67	35.00	57.00
1971	894.65	127.40	118.12	66.00	169.00
1981	1,227.72	158.50	208.56	98.00	361.00
1991	2,074.88	256.90	314.60	295.00	1,200.00
Multiplier factor 1950-91	4.9	5.8	4.7	53.6	52.2

Source: Economic Survey and PPTD Report

Clearly, the rate of growth of transport output has been very rapid, especially in the road sector. It is pertinent to note that the rate of growth of passenger traffic has been much faster than that for freight traffic. In 1991 the passenger transport output (rail and road) was 2.7 times that of freight as compared to 1.8 times in 1951. The share of the railways in the transport market has declined from a level of 89 per cent for freight and 74 per cent for passenger in 1951 to 46.5 per cent for freight and 20 per cent for passenger in 1991.

Growth of Rail Transport

Nevertheless, the growth of rail transport in India since 1951 has been impressive as shown by the following two basic indices of service performance:

(a) number of originating passengers and passenger kilometres; and

(b) originating tonnage of freight and tonne kilometres of freight carried.

Table 6. Growth of traffic on Indian railways

	1951 (millions)	*1991 (millions)*	*Multiplier factor*
Passengers originating (suburban and non-suburban)	1,284	3,858	3.00
Passenger kilometres	66,517	295,600	4.4
Tonnes originating (revenue)	73.2	318.4	4.3
Tonnes originating (total traffic)	93.0	341.4	4.3
Tonne kilometres (total)	44,117	242,700	5.5

Source: Indian Railway Year Books

Table 7. Density of railway traffic, originating traffic per km of route length

Year	*Freight (tonnes)*	*Passenger (numbers)*
1951	1,735	23,957
1961	2,779	28,339
1971	3,286	40,659
1981	3,595	58,997
1991	5,471	62,212

The density of traffic on the rail network has also increased tremendously. The high density has been further accentuated by the imbalance of the traffic flows. The Indian railway network comprises of three gauges – the broad gauge (1,676 mm), the metre gauge (1,000 mm) and narrow gauge (762 & 610 mm). The broad gauge network comprising 60.6 per cent of the total carries nearly 93 per cent of the freight and 87 per cent of the passenger traffic. Within the broad gauge network, the six routes connecting the four metropolises of Bombay, Calcutta, Delhi and Madras carry 60 per cent of the traffic.

The diminishing support from governmental finances after the Third Five Year Plan (1966) heightened the need for innovation to carry the growing traffic. By the early seventies, the railways had switched over increasingly to transport of train load traffic which had higher mobility. The demand for bulk commodity movement as a percentage of total railway transportation was also growing rapidly. With the increase in the size and capacity of the road network and a growth in the number of road vehicles available, an increasing proportion of high value traffic shifted to road. The shift was hastened by the pricing policy of the railways and the fact that the railways were better suited to transportation of bulk commodities. The changing pattern of the freight traffic carried by the railways is shown below in Table 8.

Table 8. Changing pattern of railway freight (percentages)

Commodity	*1951*	*1961*	*1971*	*1981*	*1991*	*1994*
Coal	27.6%	25.79%	28.53%	32.70%	42.45%	46.55%
Raw material to steel plants (excluding coal)	NA	8.76%	9.59%	10.29%	8.13%	9.31%
Pig-iron & finished steel	NA	3.17%	3.69%	3.84%	3.14%	3.37%
Iron ore for export	NA	2.17%	5.84%	5.65%	4.13%	2.92%
Cement	3.42%	5.43%	6.55%	4.92%	9.07%	9.07%
Food grains	10.66%	10.60%	8.99%	9.35%	7.96%	7.44%
Fertilizer	NA	1.17%	2.80%	4.14%	5.77%	5.44%
Mineral oil	3.69%	3.92%	5.30%	7.63%	7.85%	7.23%
Other goods	54.64%	38.98%	28.71%	21.47%	11.50%	8.67%
Total	100%	100%	100%	100%	100%	100%

Source: Economic Survey of India

* NA indicates figure not available

In the case of passenger traffic, the railways continued with the policy of subsidizing certain classes of travel, especially that of urban commuters. With rapid growth in population in urban areas, the pricing policy led to an explosion in the traffic of urban commuters which increased from a level of 32 per cent of the total number of passengers in 1951 to more than 62 per cent at present (see Table 9).

Table 9. Composition of passenger traffic (in percentage)

Non-suburban	*1951*	*1961*	*1971*	*1981*	*1991*	*1993-94*
II class ordinary	62.0	50.38	42.82	37.14	31.70	28.89
II class mail/express	4.0	6.02	6.38	7.20	9.26	8.45
Upper class	2.0	0.94	0.66	0.30	0.49	0.58
Total	68.0	57.34	49.86	44.64	41.45	37.92
Suburban (all classes)	32.0	42.66	50.14	55.36	58.55	62.08
Grand total	100.00	100.00	100.00	100.00	100.00	100.00

Source: Indian Railway Year book

Indian Railways offers a range of facilities to passengers. The passenger trains have a number of classes such as "air-conditioned first class," "air conditioned sleeper class," "air-conditioned chair cars," "first class (non air-conditioned)," "second class sleeper," "second class ordinary" etc. The trains are also categorized according to their speed. Fast trains are called "mail/express" or "super fast" while other trains are called "passenger". The air-conditioned and first classes are referred to as "upper class" travel. It is clear from the Table 9 that the growth in passengers has been in the II class mail/express and suburban services. The preponderance of the suburban and II class ordinary passengers in the total, coupled with the subsidy provided in the pricing policy, converted the passenger business into a loss making activity.

Improving Railway Productivity

In its continuing effort to optimize the utilization of the railway network, a new generation of wagons, named BOXN, was introduced in the early 1980's. This wagon had a payload to tare ratio of 2.5 and the carrying capacity per train was about 3,350 tonnes. The BOXN also marked the transition from vacuum brakes to air brake systems for freight wagons. The new wagon marked a quantum jump in the carrying capacity of the system and is today the mainstay of freight operation.

Track technology had been upgraded to keep pace with changing wagon designs. The important routes of Indian Railways are equipped with 60 kg 90 UTS rails and concrete sleepers. Signalling technology progressed from manually operated points and kerosene lit semaphore signals to centralized traffic control, route relay interlocking and mobile train radio communication.

Indian Railways operates freight and passenger trains on mixed traffic corridors. With the continuous increase in density of traffic and increasing payloads of freight trains, the speed differential between the passenger and the freight trains has widened. This difference in speeds has limited the number of trains that can be run on a section as a freight train has to be side-tracked to be passed by a faster running passenger train. Though freight wagons are capable of attaining speeds of 80 km per hour, the average speed of freight trains over the whole system is 23.1 km per hour. This is because motive power provided to freight trains is inadequate to maintain high speeds on uneven terrain while the maximum speed of most passenger trains is 90 to 100 km per hour with many running at 110 to 140 km per hour.

The strategy of increasing the speed of freight trains to levels equivalent to that of passenger trains is one of the crucial areas of technological innovation for Indian Railways as this would generate capacity to move more trains on the existing network.

It is in the crucial area of motive power where the progression of technology was inadequate. The 2,400 hp diesel locomotives introduced in the early '60s continue to haul 49 per cent of the freight and passenger

traffic. The progress has been much better in the case of electric locomotives. The Indian Railway's manufacturing unit produces locomotives with 5,000 hp and soon 6,000 hp state of the art locomotives would be manufactured under transfer of technology arrangements with ABB of Switzerland.

The concentration of traffic on a few corridors and the continuous growth in demand has resulted in near saturation of most of the major routes. The next level of technological innovation is to increase the permissible load per axle from 20.32 tonnes to 25 tonnes and to provide a pay load to tare ratio of about 3.0. This would provide approximately 30 per cent increase in payload and could be accepted by the existing track equipped with 60 kg 90 UTS rails with an increase in sleeper density. This new generation of freight wagon is now being designed. The wagons would have facilities for bottom discharge which would reduce significantly the time taken in unloading at terminals. Clearly, the new generation of wagons would highlight the problem of provision of adequate motive power for freight trains.

The change in technology has been in favour of moving bulk freight more efficiently. Yet the indices of industrial production indicate that the industries which generate non-bulk traffic have grown faster. To win back part of the freight lost to road, the Indian Railways created in 1989 the Container Corporation of India (CONCOR) as an independent company specializing in the movement of containerized cargo. The traffic carried by CONCOR has grown rapidly during the last 5 years and in 1994-95 it moved 275,615 TEUs (Twenty Foot Equivalent Units) of traffic.

The progress in technological development in the case of passenger transport has been confined mainly to providing more comfortable, safer and faster transport. The passenger carrying capacity of coaches has not increased significantly. The number of coaches per train have been progressively increased to exploit the available siding capacity. A strategy of increasing the length of passenger platforms has been adopted so that the maximum siding length of 686 metres can be exploited for berthing a passenger train.

As a result of the continuous and intensive effort to optimize the utilization of the system, Indian Railways has one of the best performance indices in the world.

Table 10. International comparisons of railway performance

	Country	*Figures*
Performance indices		
Traffic units per route km (million)	India	12.6
	Spain	2.1
	Germany	3.7
	Conrail (USA)	7.1
Wagon productivity		
Net tonne km per annum for each tonne of wagon capacity	India	24,000 tonne km
	US class I railroads	12,000
	European railroads	5,000 to 7,000
Locomotive productivity		
Tonne kilometre + passenger km divided by No. of locomotives	India	99 million
	Germany	18 million
	France	27 million
	Conrail	55 million

Source: World Bank: India Transport Sector. Long Term issues Report No. 13192-IN

Poor Labour Productivity

It is in the area of labour productivity where Indian Railways suffers in comparison to other rail systems. This was commented upon by the Steering Committee on Perspective Planning for Transport Development, appointed by the Planning Commission in 1988 (Ref 7) : "staff-wise, the Indian Railways' productivity is the lowest in the world" The Corporate Plan for Indian Railways (1985-2000 AD) has targeted that the increase in the labour force would not be more than 0.3 per cent per year. The PPTD report continues: "Even if the Indian Railway succeed in achieving the goal set in the Corporate Plan 1985-2000, the expected staff productivity would improve from 0.92 to only 1.7 train km per man day, which will still be much lower as compared to many other countries." With the introduction of new technology which is non-labour intensive, the problems of retraining and redeploying the large labour force (1.6 million) are becoming formidable. The ratio of the wage bill to total revenue for Indian Railways is 51 per cent as compared to 23 per cent for a more populous country, China. In the long term, the formulation of an attractive early retirement policy will have to be considered to reduce the fixed cost of a large labour force.

ROAD TRANSPORT PRODUCTIVITY

The road transport industry in India has to its credit an impressive record of increases in output. This was made possible mainly by the phenomenal increase in the number of road vehicles – both passenger and freight. Between 1951 and 1971, the rate of increase in goods vehicles and buses had been faster than in the road length. After a pause of a decade, this situation again occurred in greater degree. Thus, between 1981 and 1991, while the road length increased by 36.6 per cent, the number of goods and passenger vehicles increased by 172 per cent and 140 per cent respectively. During the four decades from 1951 to 1991, while the total road length increased by 423 per cent the number of goods vehicles increased by the 1,857 per cent and the number of buses by 988 per cent.

The population of light vehicles, i.e., cars, jeeps, taxis, two and three wheelers and tractors and trailers has increased at a still higher rate. The population of cars, jeeps and taxis increased from 0.159 million in 1951 to 3.13 million in 1991. Similarly, the number of two wheelers increased from 0.027 million to 15 million during the same period.

The much faster rate of increase in traffic than in facilities has resulted of course in an increase in density of traffic. Between 1951 and 1991, the number of goods vehicles per kilometre of road length increased from 0.21 to 0.77 and number of passenger buses per km of road from 0.09 to 0.18. The number of all vehicles per km of road length increased from 0.76 to as much as 10.80 during the same period. As in the case of the railways, the movement patterns are characterized by severe imbalances with 75 per cent of the traffic being confined to less than 10 per cent of the network .

Road freight services are provided almost entirely by individual truck owners in the private sector. During the ten year period between 1981 and 1991, the number of registered goods vehicles increased by nearly 3 times from 0.889 million to 2.661 million (this does not include three wheelers). The utilization of the vehicles, however, has been low – the average utilization not being more than 60 per cent according to one estimate. The PPTD report ascribed the low utilization to four causes:

(a) high proportion of overaged vehicles;

(b) absence of assured loads to truck owners being lone operators;

(c) poor facilities for loading and unloading at terminals leading to abnormal delays;

(d) delays in multi-point octroi posts (octroi is a tax levied on freight movement by road by the state governments at entry points to the state and some urban centres).

Steps have been taken to improve the productivity of the road transport system. Under the Motor Vehicles Act of 1939, the operations of trucks was limited to a single state thereby restricting them to short haul operations. This policy was adopted to protect the railways from competition from road transport and to encourage greater use of the more energy-efficient mode of transport. The State Governments were allowed to issue national multi-state trucking permits subject to ceilings set by the Central Government. The number of permits issued increased steadily, particularly as the transport demand grew and railway operations favoured train load traffic over wagon load traffic. In 1986, the ceiling on national permits was withdrawn by the Central

Government and in one year the number of permits issued increased from 25,000 to 57,000. The octroi levied earlier has also been abolished by a number of States and Union Territories and the Motor Vehicles Act has been amended to liberalize regulations. The positive impact of these changes can be gauged from the rapid increase in freight transport output.

Road passenger services are provided by privately owned vehicles, private entrepreneurs and also by the State Governments. Within the public transport system, the share of the government is slowly declining. There is no uniform pattern of management of bus services in the public sector. Some State Governments have established Corporations under the Road Transport Corporation Act, 1950, while others operate either through companies registered under the Indian Companies Act or departmental undertakings or local bodies. The efficiency and productivity of State Transport Undertakings vary widely. Most of them face serious financial constraints as they need fresh capital contributions from Government for augmentation and replacement of their overaged assets and expansion of the bus fleet. According to the PPTD report, in 1985-86 the percentage of overaged buses with State Transport Undertakings was 42 per cent in the state of Kerala, 22 per cent in the state of Uttar Pradesh and 26 per cent in Rajasthan.

The increased trend of urbanization has resulted in a phenomenal increase in the inter-urban and intra-urban movement of goods and passengers. The overall journey speeds have declined in large cities, dropping to levels of 5 to 10 km per hour in the central business districts whereas the average trip length has gone up. Accident rates have gone up substantially. According to the PPTD report, nearly 124 billion passenger kilometres of travel were undertaken by public transport in 1985, out of which buses accounted for 69 per cent. This is projected to increase to 362 billion passenger kms in 2001 with buses carrying 73 per cent. The increase is of the order of 300 per cent.

The rapid increase in freight transport output camouflaged the technological stagnation in the industry. The reasons for this stagnation are complex and include diverse factors such as:

(a) Government taxes and regulations;

(b) Extreme congestion in urban areas which would not permit operation of multiple axle vehicles;

(c) Low diesel prices and low labour costs;

(d) Oligopolistic structure of the truck manufacturing units; and

(e) Pervasive overloading.

There is little competition in the truck manufacturing industry and thus there was little incentive for technological innovation. According to a report of the World Bank (India: Policy Issues in Road Transport, Report No. 8057 in October, 1989) the two axle rigid truck design most frequently used in India has the following undesirable characteristics:

(a) Tare weight of 8.0 tonnes compared to a gross fully loaded weight of 16.2 tonnes when a tare of 6.0 tonnes is possible and desirable;

(b) Low power to weight ratios of 3.8 to 5.0 hp per tonne compared to a desirable minimum of 6.0;

(c) Excessively high engine speeds;

(d) Engines with high specific weights;

(e) Manifold and combustion chambers which are fuel inefficient and highly polluting;

(f) Crash type transmissions with inappropriate ratios;

(g) Obsolete suspensions, brakes, wheel equipment, body design and components;

The absence of roads capable of taking multiple axle vehicles is also an important factor. In the long term, this is an area which requires serious consideration by the Government.

THE FUTURE PROSPECTS

The structural adjustment initiative currently under way in India is expected to raise the long term growth rate of the economy to about 6 per cent. The rate of growth of freight traffic would, therefore, be at the level of 7.5 to 8 per cent per year. Demographic projections for the 2001 put the population of India at 986,009 million which indicates a rate of growth of less than 2 per cent per year from 1991. The percentage of urban population is expected to increase from 25.72 per cent in 1991 to 33.06 per cent in 2001. The passenger traffic would thus increase at more than 4 to 5 per cent per year.

Transport demand forecasts have been traditionally derived from the Planning Commission's macro economic supply and demand through application of the transport coefficient method (the transport coefficient being defined as the ratio of the originating tonnage to the total production of a commodity). The projected traffic on the railways was determined by applying rail transport coefficients on the basis of judgement. The tonnage was converted to tonne kilometres by multiplying the average distance of haul for the major commodities, the average distance being calculated by trend analysis. These estimates were exogenous to the input-output model and gave no consideration to inter-modal allocation. Passenger traffic forecasts were also based on past trends. This method of transport planning does not take into account spatial distribution and intermodal shares.

A number of expert committees have forecast the level of freight and passenger traffic for 2000 AD. Some of the estimates are:

Table 11. Forecasts of traffic for 2000 AD

Name of Committee	*Freight by rail*	*Freight by road*	*Total (in BTKM)*	*Passenger by rail*	*Passenger by road*	*Total (in BPKM)*
NTPC (1980)						
Scenario I	435	215	650	520	800	1,320
Scenario II	455	195	650	–	–	–
Scenario III	468	182	650	–	–	–
RRC	413	–	–	440	–	–
RTEC	406	–	–	488	–	–
RCP	330-345	–	–	400-410	–	–
PPTD	374-684	571-916	945-1,600	407-1,121	2,354-3,898	2,761-5,019

* NTPC National Transport Policy Committee
* RRC Railway Reforms Committee
* RTEC Railway Tariff Enquiry Committee
* RCP Railway Corporate Plan

The estimates, made at various points in time, differ considerably. The differences in the projections are due to differences in methods and in the assumptions. The PPTD had noted "it is observed that the traffic forecasts have wide ranges – generally time trends provide lower limits and 12 per cent industrial growth rates provide upper bounds of traffic demands. Based on these forecasts, it may be unrealistic to assume that both freight and passenger traffic on the railways by the year 2000 might double while in the case of road transport, the increase may be much higher-perhaps three to four fold. The report had taken cognizance of the relative imbalance of flows in the rail and road networks and had identified the corridors which could be termed as "critical". It is important to observe that the estimates of the inter modal split (between rail and road) also influenced the forecasts. For example, the recommendations of the NTPC were based on the premise of a rail share of 72 per cent in freight and 40 per cent for passenger traffic. The same was true of the Corporate Plan of IR. This was a reflection of the Government's policy of preferring a higher share for rail transport in view of its higher energy efficiency.

There appears to be a real danger of transport capacity shortages inhibiting economic growth in the future. Since most of the transportation infrastructure is publicly owned and operated and directly or indirectly financed by the Government it is imperative to:

(a) determine the future growth of demand in terms of specific origin-destination flows so that creation of capacity can be targeted to the areas of greatest need;

(b) assess the investment required to create adequate capacity;

(c) evolve methods to finance the investments.

DEVELOPMENT OF MULTI-SECTORAL TRANSPORT MODEL

The Planning Commission had undertaken a specific project (1978-82) to develop a multi-regional, multi-sectoral transport model. This model combined inter-regional input-output models, linear programming and gravity models and was a modified version of the Leontief-Strout model. Based on the forecasts for national and sectoral outputs and demands and the input output table of the Planning Commission, the model produced regional allocation of sectoral outputs and demand, traffic distribution and modal split. National supplies were allocated to regional supplies by using the so-called 'shift and share technique.' National demands were allocated among regional demands by using regional input output relations for estimation of intermediate demand, and various econometric techniques were used for regional allocation of final demand. However, the regional allocation attempted by the model was not very successful for want of dependable data. The estimates were not realistic and failed to take into account technological innovations or changes in the transport sector. The PPTD was of the opinion that in view of the state of data availability in the transport sector – "an all-purpose model to determine optimal investment on each link of the transport network on the basis of analysis of perspective economic developments and their spatial distribution would be a highly ambitious undertaking. Experience with modelling even in much smaller countries had not been productive. There is an additional difficulty in India arising from the lack of data. In fact, imbalances between supply and demand are inherent in any transport system due mainly to the indivisible nature of investments. It is, therefore, neither practical nor necessary to develop sophisticated all-purpose models to determine investment needs for the sector." The Committee decided to focus on specific high priority issues in transport planning and to develop relatively simpler techniques for handling these issues. To achieve this task, the Committee decided to concentrate on the need for developing capacity on high density routes, both rail and road. For an assessment of incremental capacity needs on the high density corridors, the Committee had detailed studies undertaken of the present and future distribution patterns of bulk commodities and develop models to forecast traffic flows in these commodities, and also long distance intercity passenger traffic demands. The objective of the models was to assess the additional capacity requirements of the critical rail and road corridors for the horizon years 1989-90, 1994-95 and 1999-2000. The forecasts for 2000 AD were:

		ROAD	RATIO RAIL : ROAD
Total Freight Traffic (in BTKM)	536	316	63 : 37

The PPTD also estimated rail and road freight and passenger traffic at the aggregate level using conventional methods such as trend analysis, elasticities and the transport coefficient method (Table 12).

Table 12. Forecasts under different assumptions made by PPTD

Method	*Freight traffic*		*BTKM*	*Passenger traffic*		*BPKM*
	Rail	*Road*	*(Total)*	*Rail*	*Road*	*(Total)*
Base period projection	223	210	433	256	893	1,149
a) Trend growth	374	686	1,060	446	2,916	3,362
b) Elasticity wrt						
I) GNP 5 per cent	450	571	1,021	548	2,428	29,762
II) GNP 5.5 per cent	482	628	1,110	590	2,673	3,263
III) GNP 6 per cent	516	691	1,207	634	2,940	3,574
IV) GNP 6.5 per cent	552	760	1,312	682	3,231	3,913
Industrial production						
@ 9 per cent	521	644	1,165	788	738	3,526
@ 10 per cent	571	724	1,295	887	3,032	3,969
@ 12 per cent	684	916	1,600	1,121	3,898	5,019
Population growth rate						
@ 1.8 per cent	525	553	1,078	407	2,354	2,761
@ 1.9 per cent	549	583	1,132	417	2,478	2,895
@ 2.0 per cent	575	614	1,189	428	2,610	3,038
@ 2.1 per cent	602	646	1,248	439	2,748	3,187
Urban population	482	725	1,207	601	3,101	3,702
Transport coefficient	516					

It is interesting to observe that the traffic forecast for road freight transport by the disaggregated model is much below all the aggregate level forecasts. In the case of the railways, the aggregate level forecasts assign a share of about 42-44 per cent when demand is computed on the basis of elasticity with respect to GNP and industrial product. Elasticity with respect to total population assigns a higher share of about 48 per cent while elasticity with respect to urban population yields a share of 39 per cent. On the other hand, the disaggregated model assigns a share of 63 per cent to the railways. It is difficult to reconcile such large differences. With the benefit of hindsight, we are aware that today the railways have a share of about 40 per cent in freight and 20 per cent in passenger traffic.

All expert committees which have undertaken exercises in forecasting traffic flows in India have pointed out the lack of adequate data for scientific analysis particularly for road transport. The PPTD and the NTPC have emphasized the need for developing a good data base to facilitate transport planning. The PPTD report devoted an entire section to highlight the limitations of data. This data base has not been created and even today the volume of traffic moving in road is not systematically monitored and published. The implications for assessment of transport capacity and investment planning are serious.

There are two alternative approaches to investment optimization:

(a) The supply and demand for transport services can be determined through market forces;

(b) Planning and regulatory measures can be used to complement planning tools.

Developments in most countries during the last decades have been in favour of liberalization which has permitted flexibility in investment and pricing policies. However, without exception, there is considerable concern for proper policy planning for transport investment. In a planned economy, for optimizing resource allocation, it is important to be able to forecast transport demands fairly accurately and also to have regulatory controls which can influence those demands (through changes in industrial locations, for example). This has been the attempt in India where almost the entire transport infrastructure is owned and financed by the government.

In the absence of adequate data about traffic flows, the problem of capacity planning can be addressed by evolving strategies for the short term and long term. In the short term, capacity planning could be done on the basis of increasing capacity on saturated corridors and corridors where growth of traffic has been noticeably high. This data can be obtained from the district and state levels for roads.

In the case of railways, computerized records based on invoices issued for each consignment and for tickets issued for 80 per cent of the passengers using reserved accommodation is available. Saturated routes are identified and projections for each route based on micro level information is available for 1998-99. The future projections can also be attempted on the basis of past trends for each commodity. The railways are attempting to generate alternatives to the congested routes through the conversion of metre gauge routes to broad gauge.

The Ministry of Surface Transport had commissioned a study to identify the high density traffic corridors and to suggest the routes suitable for development of expressways (Ref 8). The report concluded that that the national and state highways comprising less than 10 per cent of the road network carry 75 per cent of the total road based traffic and that the expressways would be required on the saturated routes identified by the PPTD report.

The investment needs for the medium term (say the next five years) is therefore, known, and the crucial issue which arises is the one of raising resources for the investment.

In a centrally planned economy the amount and sectoral allocation of the investment would determine the rate of development of facilities for a mode of transport. The level of governmental investment in the transport sector would determine the level of resources to be raised from outside the government. The Eighth Five Year Plan document makes a succinct analysis of the problems being faced by the transport sector in India. The document accepts the state of saturation of important links of rail and road modes and asserts that capacity expansion on a major scale has to be planned. The Plan makes the following important policy observations:

(a) The State would continue to play a dominant role in the transport sector;

(b) The government would prefer the railways to have a larger share of the transport market than at present;

(c) The government does not foresee any significant scope for private sector participation in railway investment. However, in the case of roads, it would be desirable to look for non-governmental sources of funds and private participation in road construction.

Though it is normally stated that the railways receive funds from the government for investment, these funds are not in the form of grants but in the form of non-refundable loans which attract a fixed rate of interest (currently 7 per cent). The Indian Railways has not amortized this debt and consequently there is a net flow of funds from the railways to the government. The flow of the funds from the government has diminished after the III Plan period and it is unlikely that it would increase in the near future. At present, the investments of Indian Railways are funded primarily through internal generation of resources and borrowings from the market. For example for the year 1993-94, internal resources provided nearly 81 per cent of the cost of development programmes.

ATTRACTION OF PRIVATE CAPITAL

Indian Railways have initiated a number of schemes to attract private capital. In the case of freight wagons, the "Own Your Wagon Scheme" has been announced under which Indian Railways pays leasing charges for wagons procured by shippers. For construction of track, electrification and conversion of track

from metre gauge to broad gauge, the Build Own Lease and Transfer (BOLT) scheme has been formulated. Under this scheme the investor can construct and operate a line or lease it to the railways. The line can be transferred to the railways after the investor has recovered his investment.

Similar schemes under the concept of Build Operate and Transfer (BOT) have been formulated for road construction. Additional facilities such as development of real estate along the route within a specified limit are also being considered . A number of schemes for construction of toll roads have also been formulated.

Investments in infrastructure are large and involve a considerable element of sunk costs. The capital cannot be withdrawn if the expected traffic fails to materialize. It is for this reason that the transport infrastructure market does not witness the entry and exit of many players. The market is not 'contestable.' Experiments with privatization of railways have not succeeded without considerable governmental support in any country. Even in the USA, Amtrak enjoys large grants from the government. In the case of roads, the experience of developing countries such as Mexico shows that involvement of private capital on a large scale is not always workable as minimum traffic levels guaranteed to the private entrepreneur frequently do not materialize.

There seems to be no escape from the fact that in a developing country such as India, the government would have to pay a leading role in development of rail and road facilities in the near future. Private capital would be attracted only to the areas where traffic volumes are assured. These circumstances would normally not obtain in areas which require development from the social or economic standpoint of national development. The uncertainty about traffic volumes, the practical feasibility of levying tolls and the size of the financial investment is likely to act as deterrents to private investment.

THE TRANSPORT DILEMMA

Transportation in India today is thus faced with a dilemma. On the one hand there has been continuous reduction in central governmental investment in the sector. On the other hand, the saturation on the arterial routes of the railways and roads has created the danger of transport bottlenecks adversely affecting economic growth. The emphasis of the railways on running of unit trains is leading to increasing transfer of freight traffic to roads. There is evidence that considerable volume of long distance bulk freight traffic is moving by road (Ref 8). This scenario has serious implications for the efficiency of energy use in the economy. It has been estimated that if the railway's share in freight traffic could be increased from the projected level of 48.2 per cent in 2009 AD to a level of 71.7 per cent, the overall energy intensity of freight traffic would reduce from a level of 19.16 KTOE/BTKM to 12.43 KTOE/BTKM (Ref 15). The result highlights the possibility of enormous savings in petroleum products as road transport is expected to consume more than 88 per cent of energy in the transport sector.

The policies of industrial development and protection of the environment have stipulated that basic industries would continue to be located in the resource regions, and there would be a ban on the location of large and medium industries in the major urban centres. If this policy is to be dovetailed with the policy of distribution of population (National Urbanization Policy), it would be apparent that Indian railways would have to play a greater role in promoting development in the future. This possibility is strengthened by the forecasts of urban population growth which project a doubling of the urban population within the next decade and a fivefold increase over the 1991 figure by the year 2025. Mass rapid transit could possibly be the only system capable of catering to movement challenges of such magnitude. In the intervening period road traffic would continue to grow at a pace which, at least in the medium term, is expected to be faster than that for railways. Here too, the pressure would be on the arterial routes which are already saturated.

Although the situation is well known, the government is unlikely to be able to provide additional funds by reducing investments in competing and socially attractive sectors. The resources for investment would have to be found by formulating attractive schemes for private sector participation in investment. The possibilities of private sector participation in the railways and road therefore need to be carefully evaluated both from the theoretical and practical standpoints.

The theory of 'contestable markets' has provided the theoretical underpinning for deregulation and privatization in many activities including transportation. Its viability with respect to road transport services is established. This could be an area from which the State could withdraw with beneficial results. The same is not likely to be the case for other areas such as construction of railroads and roads or for operation of railways. In these areas, careful analysis of the extent of private sector participation would be required.

Improved co-ordination between government departments could lead to greater generation of internal revenues. For example, if the structure of urban settlements were based on rail rapid transport systems, the railway could enter the urban land market and this could make capacity augmentation projects self-financing. Improved rail-road co-ordination for providing containerized freight movement provides another area for generating higher revenues. Innovative schemes for encouraging private sector participation in construction activity on the lines of BOT would also have to be introduced.

While financing investment in the transportation sector, the government would have to keep in view other externalities such as energy use, safety, environmental impact, land use and displacement of population. The economic costs and benefits of individual projects would have to be assessed to target the investment effectively.

It is necessary to reiterate that judging by the magnitude of the investments and the characteristics of the transport market, it appears that the State would have to play a leading role in financing the development of the roads and railways. Considerations of conservation of energy, environmental protection and safety would seem to favour a larger share for the railways in the transport market of the future. The investment decisions would have to be taken today. The present bleak scenario of inadequate resources and capacity constraints need not necessarily cloud future options.

ABBREVIATIONS USED

NTKM:	Net tonne kilometre
PKM:	Passenger kilometre
GDP:	Gross domestic product
GNP:	Gross national product
UTS:	Ultimate tensile strength
KMPH:	Kilometres per hour
HP:	Horse power
PPTD:	Perspective Plan for Transport Development
NTPC:	National Transport Policy Committee
RRC:	Railway Reforms Commission
RTEC:	Railway Tariff Enquiry Committee
RCP:	Railway Corporate Plan
BOLT:	Build own lease and transfer
BOT:	Build operate and transfer
KTOE:	Kilo tonnes of oil equivalent
BTKM:	Billion tonne kilometres
BPKM:	Billion passenger kilometres

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PLANNED PROGRAMME FOR SUCCESSFUL IMPLEMENTATION OF URBAN TRAFFIC IMPROVEMENTS

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SYNOPSIS

Practical and immediate solutions to traffic problems can be achieved by maximizing the operational efficiency of facilities through traffic regulation, control and management. But many obstacles and difficulties are being experienced in planning and executing traffic engineering and management schemes in cities. The experience gained by the author in organizing these improvements in Madras city in southern India over the past three years are presented in this paper.

The immediate improvements brought about to the problem areas have helped to sensitize the authorities as well as the public to the potential of scientific application of Traffic Engineering and Management (TEAM) techniques. It was found from these projects that innovations are required not only at the stage of formulating improvement proposals but also in getting them implemented. A planned programme of implementation including participation of local agencies, voluntary organizations, private agencies and the public yield favourable results.

As the traffic planner has to deal with various departments and also the public, he has to improve his overall skill, attitude and approach. Efforts should be made to train traffic planners in their overall capabilities so as to enable them to tackle successfully the challenging traffic problems faced in the cities of the developing countries.

INTRODUCTION

The high rate of urbanization experienced in the developing countries accompanied by an increase in the number of motor vehicles in and around urban areas, has resulted in a large number of road accidents. Due to the absence of proper land use control and regulations in development, very little progress has been achieved in developing a suitable road and transportation network. Moreover, the improvement to roads and provision of facilities lag very much behind the increasing demand of traffic. Due to various reasons the existing facilities have not been able to function efficiently, economically and safely. One of the most obvious manifestations of the quality of the urban transportation system is the level of congestion which directly affects the level of service. The practical solution to such problems lies in maximizing the operational efficiency of the facilities through traffic regulation, control and management. The immediate objective is to reorient the traffic pattern on the existing streets so that the conflicts between vehicles and other road users are reduced. In doing so, alterations to traffic lanes, islands, kerbs, restrictions on entry and turning movements, control of loading/unloading and parking regulations are inevitable. All these measures should be worked out as a part of traffic management for the area as a whole and require a bold and systematic approach in order to evolve cost effective and short term solutions to the existing problems.

Many obstacles and difficulties are being experienced in planning and executing traffic engineering and management schemes in the cities of the developing countries and some of them are:

(a) Road and traffic improvements not given priority;

(b) Even among road and traffic improvements, cost intensive schemes are given priority over the low cost traffic management schemes;

(c) Lack of understanding the benefits of these schemes;

(d) Lack of technical skill;

(e) Divided and overlapping responsibilities among the agencies concerned;

(f) Lack of coordination among the agencies concerned;

(g) Lack of public cooperation; and

(h) Not involving traffic experts in all aspects of the traffic improvement project such as planning, coordination, implementation, evaluation and action on further improvement.

Various steps involved in identification, formulation, implementation and commissioning of the project on Traffic Engineering and Management (TEAM) are shown schematically in Figure 1.

Realizing the need for sensitizing the authorities concerned to the potential of Traffic Engineering and Management (TEAM) measures, involving governmental and non-governmental agencies and the general public in traffic improvement schemes, generating funds for implementation and executing a series of projects in a coordinated and successful manner, the author organized various activities in Madras city in southern India over the past three years. Various stages involved in this programme of activities, techniques adopted, problems and difficulties faced, methods adopted for meeting them, outcome of the activities and results of some of the studies are presented in this paper, to share these experiences with traffic engineers, planners and managers in other developing countries.

GROUNDWORK

Initial steps

The first step was to identify a few active and responsive persons from both the government and private organizations who were willing to participate and also extend financial and other support in the activities pertaining to TEAM measures. With the assistance of these individuals and organizations, a series of group discussions, seminars and brain-storming sessions, were organized with the following objectives:

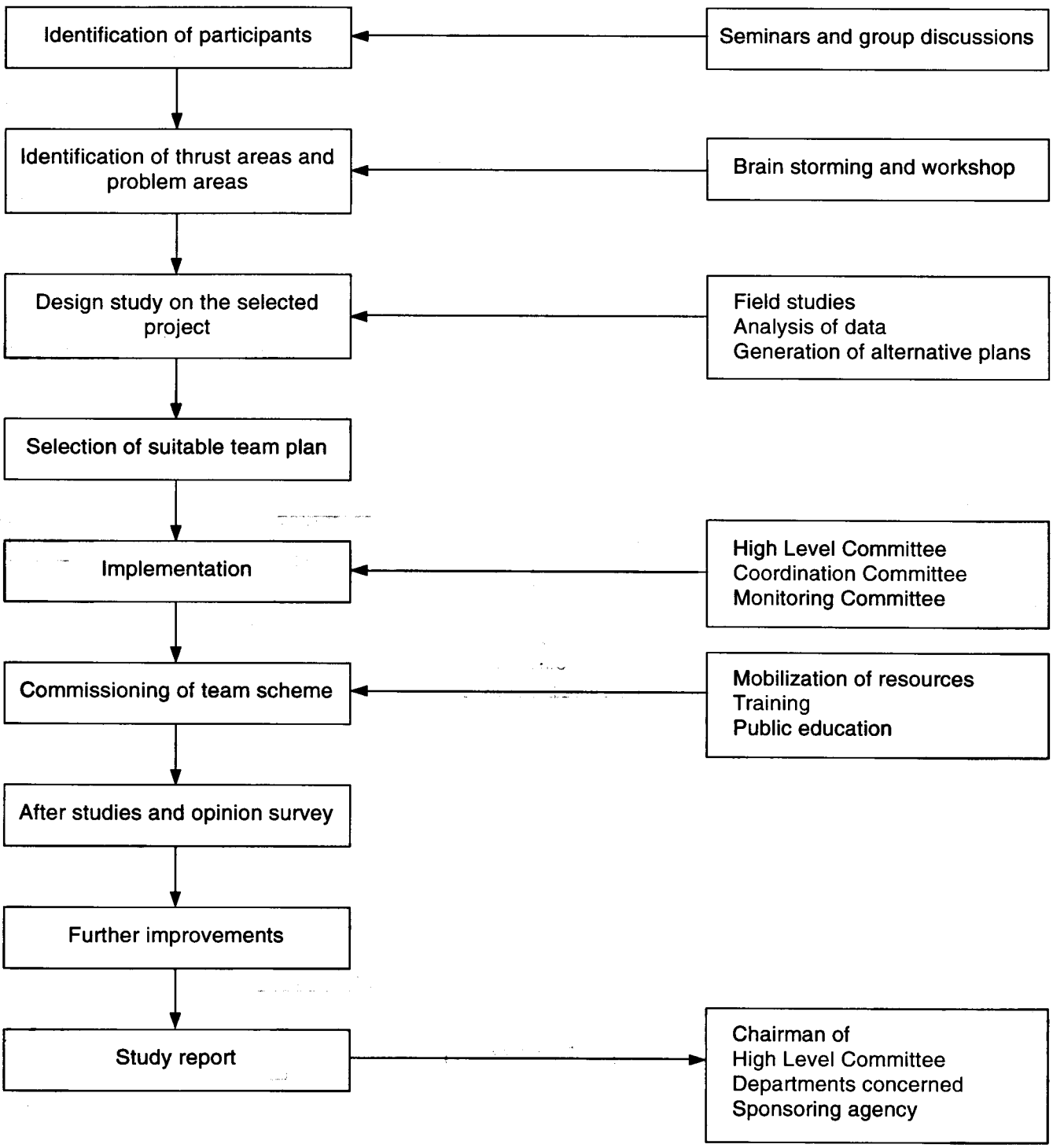

Figure 1. Identification, formulation, implementation and commissioning of team project

(a) to sensitize the Government and private organizations to the importance of TEAM measures;

(b) to identify government officials, private organizations, experts and individuals, who were willing to extend cooperation and assistance in the programme;

(c) to raise funds for various activities; and

(d) to identify thrust areas, problems and study areas.

Workshop on problems

From a critical study of the suggestions made at the above meetings, ten specific problems were chosen. These problem areas were visited, and site plans and traffic data for these areas were collected from the authorities concerned. Wherever necessary, traffic studies were conducted to collect limited data. This material formed the basic input for a Workshop on Traffic Engineering and Management, in which 20 officers from all the departments concerned participated. Instead of the usual programme of lecture followed by discussion, all the sessions were held in the form of brain storming and discussions. Each session was chaired by the Head of a department and the author of the paper acted as the discussion leader. On the basis of the deliberations and recommendations of this workshop, an action programme for taking up further work (Figure 2) was determined.

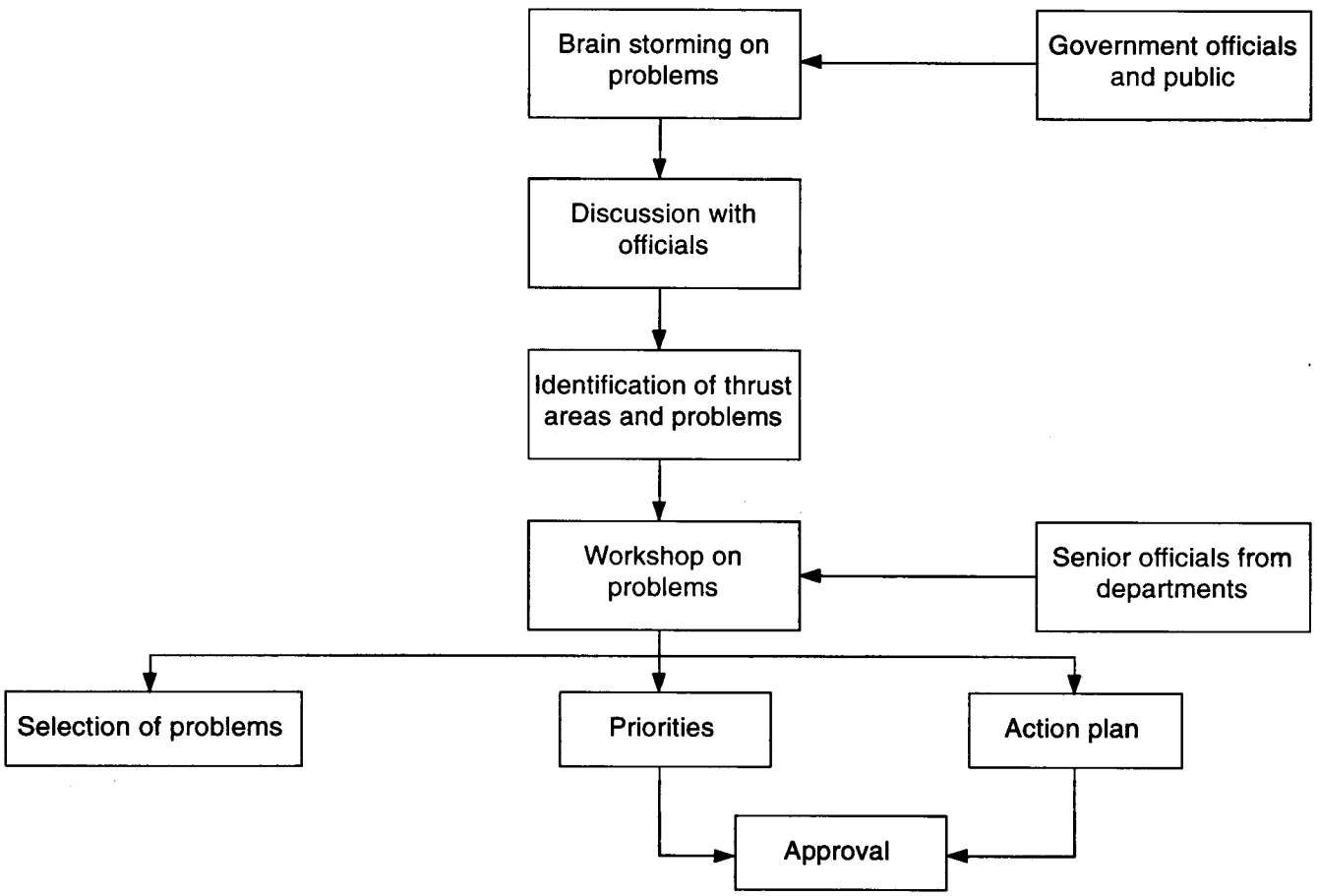

Figure 2. Action plan

DESIGN STUDY

Preliminary work

For each problem area, a study proposal was prepared highlighting the problems faced, the need for improvement, objectives and scope of the proposed study, outcome of the study, possible improvements and benefits accruing from these improvements, phasing of improvements, cost of the studies, period of study, period of implementation etc. This proposal was discussed with concerned departments, and their views and suggestions were sought. A meeting of the representatives of the problem area and a few sponsors was then organized, and a brief presentation with slides and transparencies on the study proposal was made. This meeting was also attended by the representatives from the Traffic Police Department. Besides getting the concurrence of the participants for taking up the study and identifying the sponsors for funding the study, a small core group was set up at that meeting to take further steps including identification of sponsors for participation in the implementation.

Field studies

For each problem, a study area was carefully determined on the basis of a study of the available data and field visits. Though the problem occurred at a particular place, a larger area was covered by the study, so that the problem could be tackled area-wide in a comprehensive manner. For example, in the brain-storming session and also in the Workshop on Traffic Engineering and Management, Village Road – Sterling Road – College Road intersection, which is one of the busiest intersections in Madras, was identified for study, whereas the area chosen for the study was much larger as shown in Figure 3.

The following information was collected by field studies:

(a) Traffic volume counts;

(b) Pedestrian counts;

(c) Speed and delay study;

(d) Parking study;

(e) Bus route operation study;

(f) Accident study; and

(g) Present regulations and control measures.

Traffic management plan

From a systematic analysis of the data collected from the studies, alternative traffic management plans were prepared for the study area, and they were critically evaluated to select the best possible alternative. The most important phase of the project was the communication of findings and recommendations of the study to the authorities concerned. A series of meetings were held where decisions were taken to work out an action programme for implementation. The representatives of the public and the sponsoring agencies were also involved. This was a strenuous and difficult exercise, but it was absolutely necessary to carry out this task to obtain the best possible result in the "decision making" process. Various steps involved in the design study are shown in Figure 4.

Detailed design

For the alternative traffic management plan selected during these discussions, a detailed plan for installation of road signs and route information (Figure 5) was prepared. Detailed design plan was also prepared for the intersections and the major roads. Clear lane markings were provided.

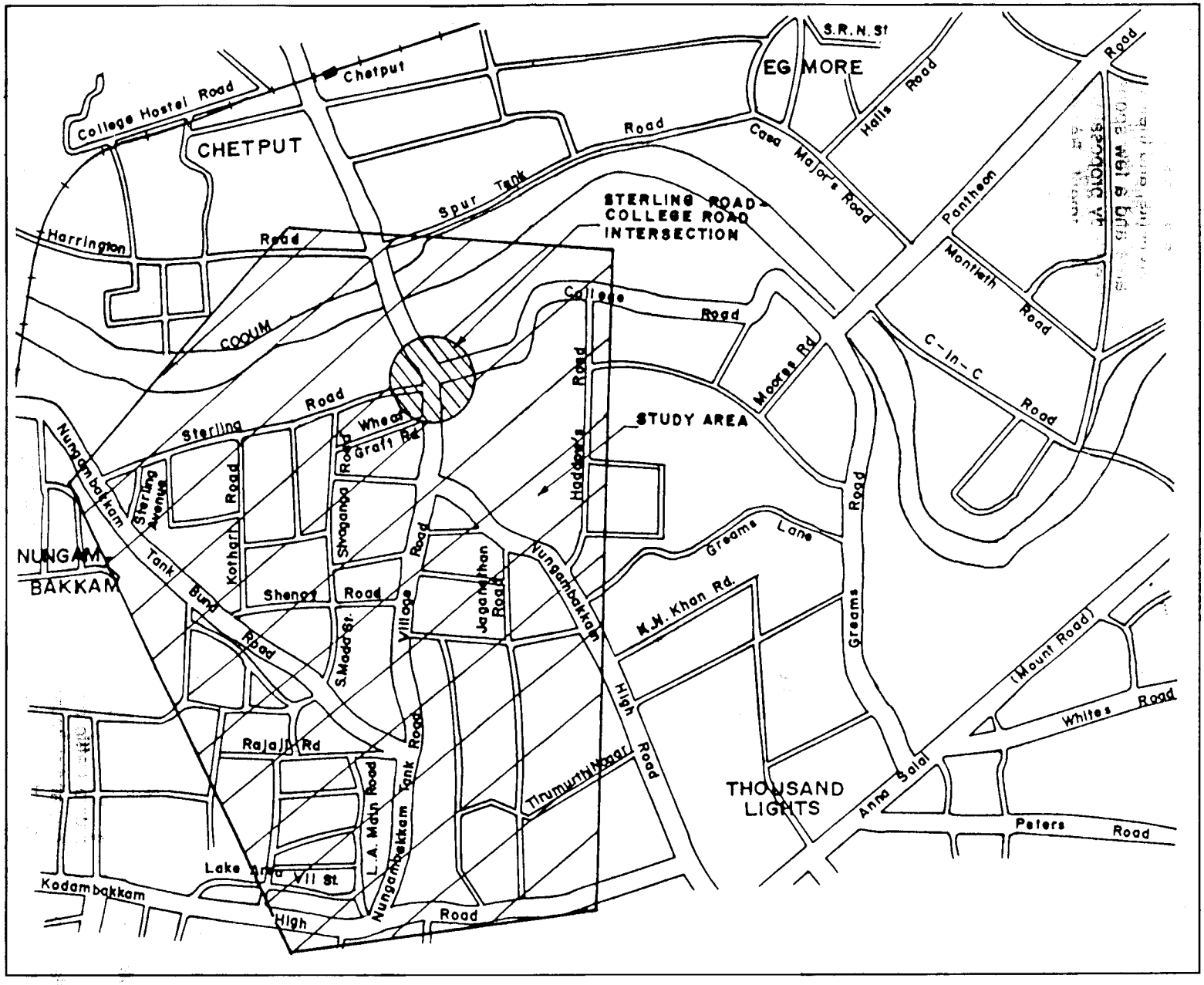

Figure 3. Sterling Road study area

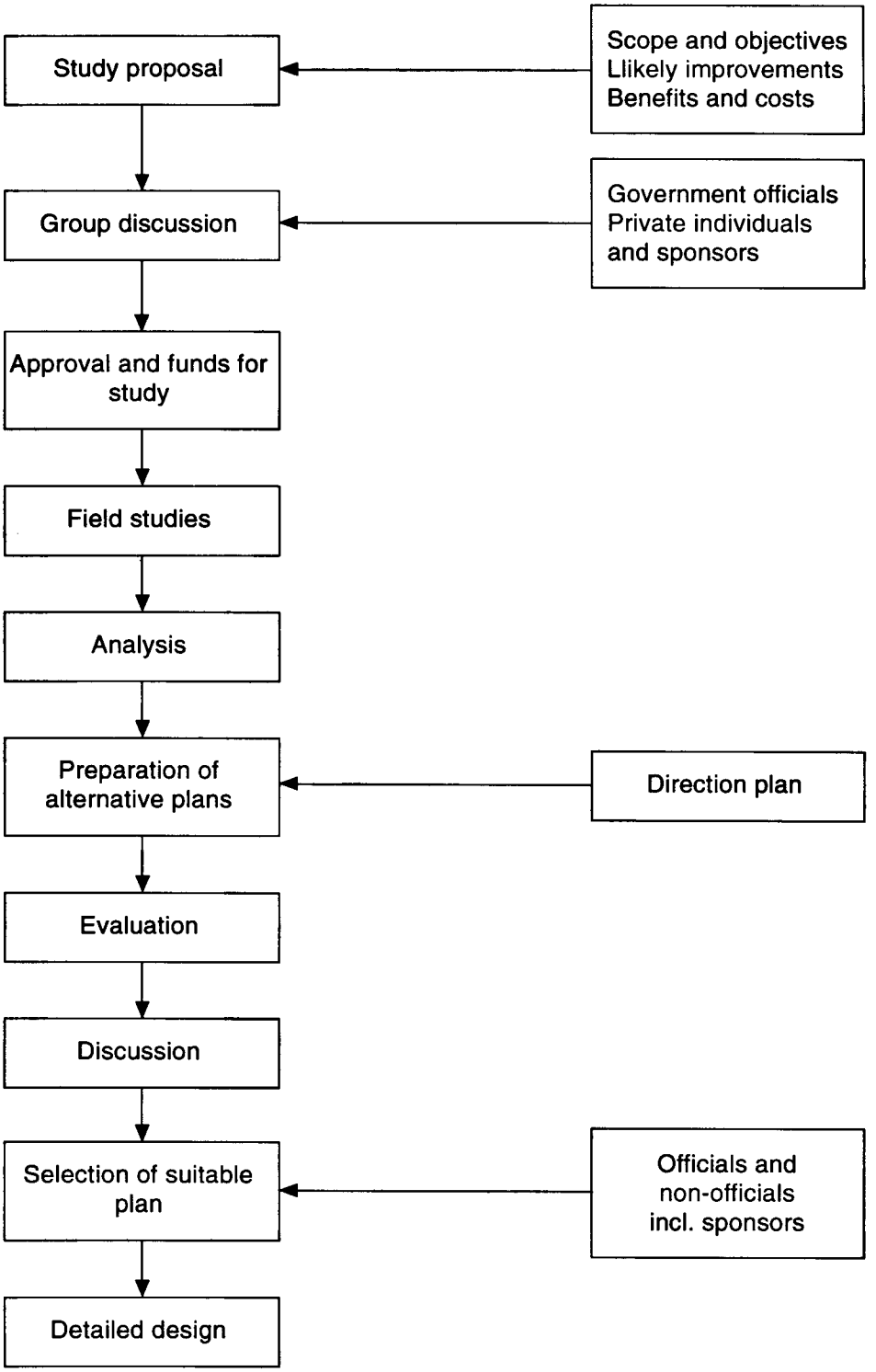

Figure 4. Various steps involved in design study

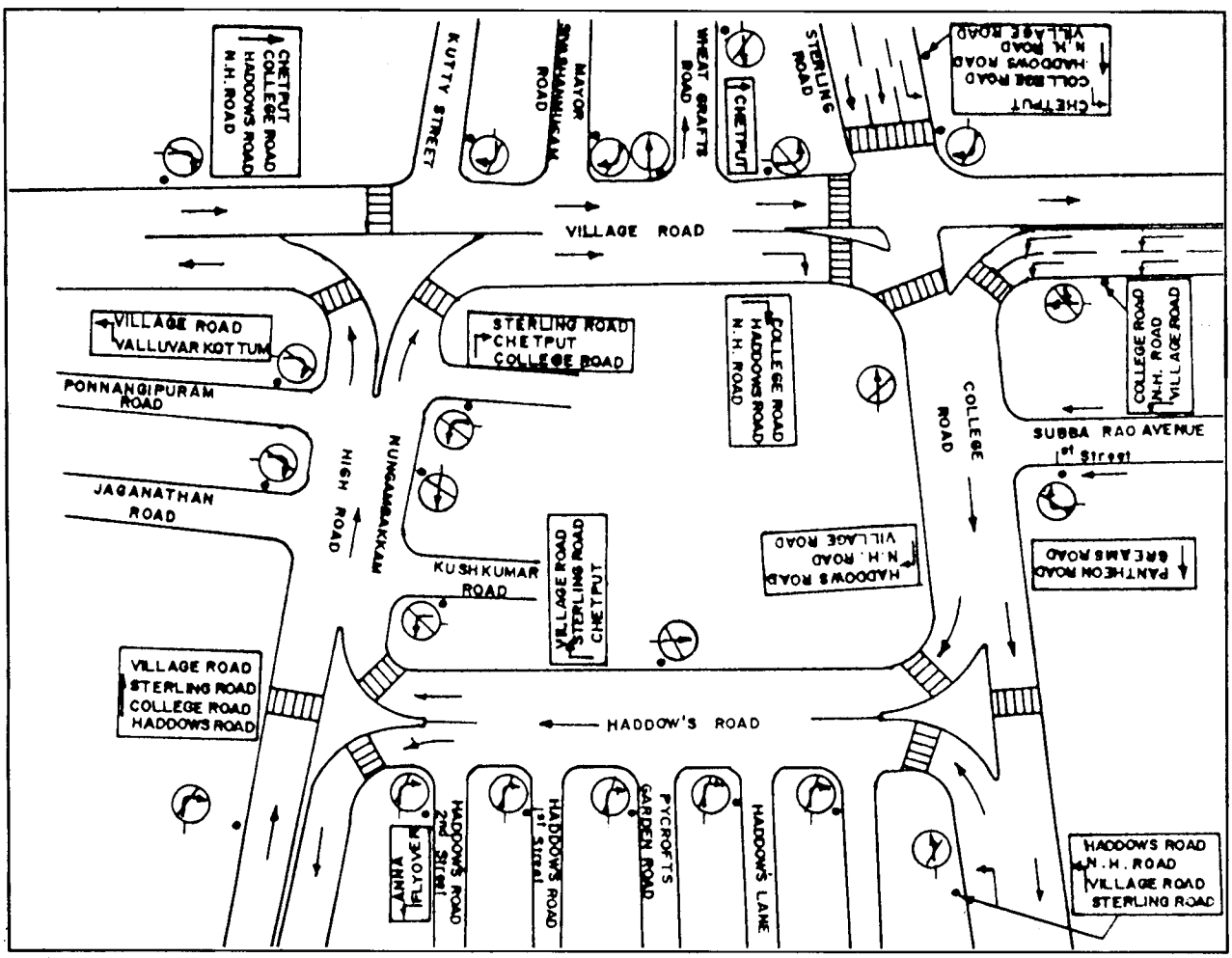

Figure 5. Traffic management plan for Sterling Road area

IMPLEMENTATION OF THE IMPROVEMENTS

Committees

A High Level Committee with the Secretary, Home Department as the Chairman, together with the Heads of all the concerned departments as members, was constituted to take policy decisions on traffic improvements and to oversee the activities. The author of this paper was the only non-official member on this committee. A Coordination Committee consisting of the representatives from the departments concerned such as Police, Transport Corporations, Municipal Corporation, Highways Department, Development Authority, Telephone, Water Supply and Electricity was constituted to meet and sort out the problems faced in the area concerned. A Monitoring Committee was constituted for each project to review the progress of work and report the progress and problems to the High Level Committee.

Action programme

Keeping in view the availability of funds from the departments concerned and the sponsors and also the problems likely to be faced, a phased programme of implementation was prepared, and an action plan was devised for the first phase of the programme. This action plan allocated the work to be carried out by each organization and provided target dates for completion.

The progress of work was reviewed periodically and problems, if any, were sorted out by the relevant committees (Figure 6).

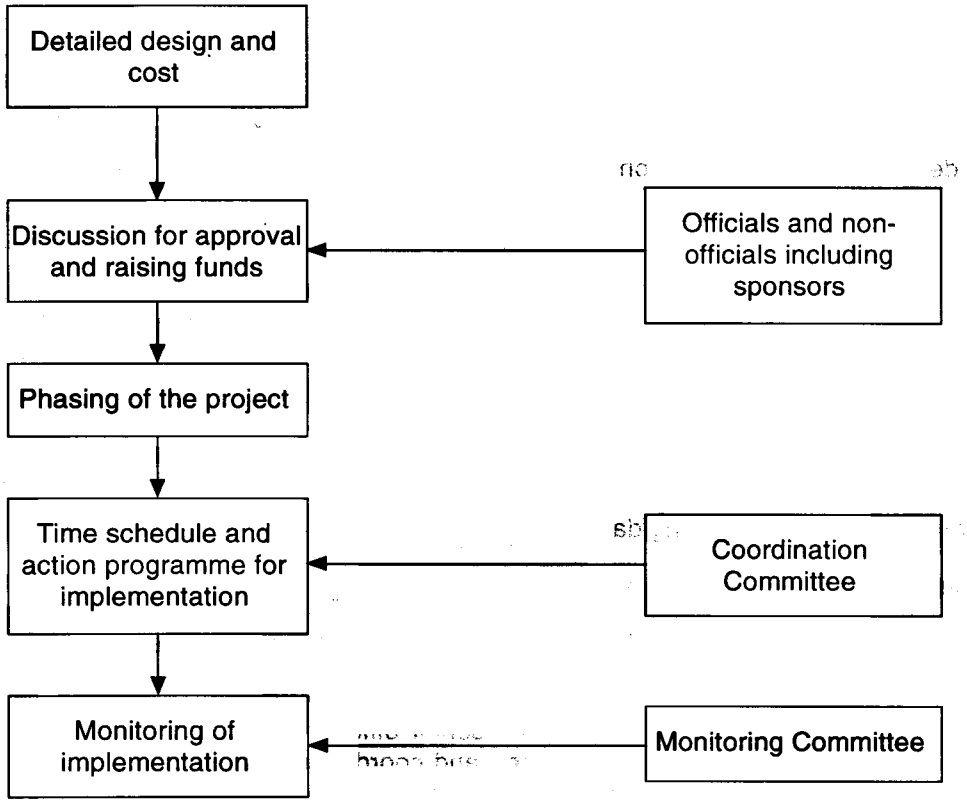

Figure 6. Implementation of team measures

COMMISSIONING OF THE PROJECT

Preparation for commissioning

A lot of ground work was done before commissioning the project, as listed below:

(a) Preparation of documents and materials:

  (i) brief write-up with sketch for circulation to police, public transport and other organizations, with necessary instructions to them;

  (ii) brief write-up with sketch for issue to press, radio and television;

  (iii) leaflet for distribution to public;

  (iv) write-up for legal notification to be made by the government;

(b) Training of officers and staff of the police for proper regulation, and control of traffic;

(c) Training of traffic wardens and other voluntary forces for education of public;

(d) Training of drivers and supervisors of transport corporations;

(e) Discussions with the press, radio and television for public education;

(f) Public announcement on the date of commencement of the new system;

(g) Regular inspection of site by the Monitoring Committee to sort out any problems;

(h) Mobilization of staff, volunteers, vehicles, propaganda vans, loudspeakers for announcement, etc.;

(i) A detailed plan for distribution of staff and allocating duties.

Site inspection before commissioning

Before commissioning the project the Monitoring Committee thoroughly checked all the arrangements. A missing sign or marking was replaced. This checking was also repeated one day before commissioning the project.

Commissioning

The projects were generally implemented on a Saturday:

(a) Saturday, though a working day, carries a comparatively low volume of traffic;

(b) A less busy day for officers; and

(c) Being followed by Sunday, which is a holiday, any further improvements at site could be carried out before the next working day.

On the day of commissioning the project, the senior officers concerned were present at the site to guide the staff, take decisions on any problem faced and coordinate with other departments, if necessary. Their presence was also a source of encouragement to staff and enabled rapid decisions to be taken.

Before noon, the officers concerned met and discussed the performance of the system and also the problems that had arisen. This exercise was also repeated during the evening peak period. At a second meeting, further improvements to be carried out on the next day i.e. Sunday, were identified, and this was done.

As the highest peak hour traffic on any day in a week is experienced in Madras in the morning on Mondays, all the officers concerned were at the site in the morning on the first Monday after commissioning the project. They visited the site in the morning and evening every day at least for a week to review the

performance of the system. Trial runs were also made during these visits to make a proper assessment. They also talked to the public to ascertain their views on the working of the new measures.

During the first two weeks, efforts were made to educate the road users and guide them to use the system properly. During this period, tickets were not generally issued for any violation of the new regulations, and drivers were educated to use the system properly. The details of action taken after commissioning the project are shown in Figure 7.

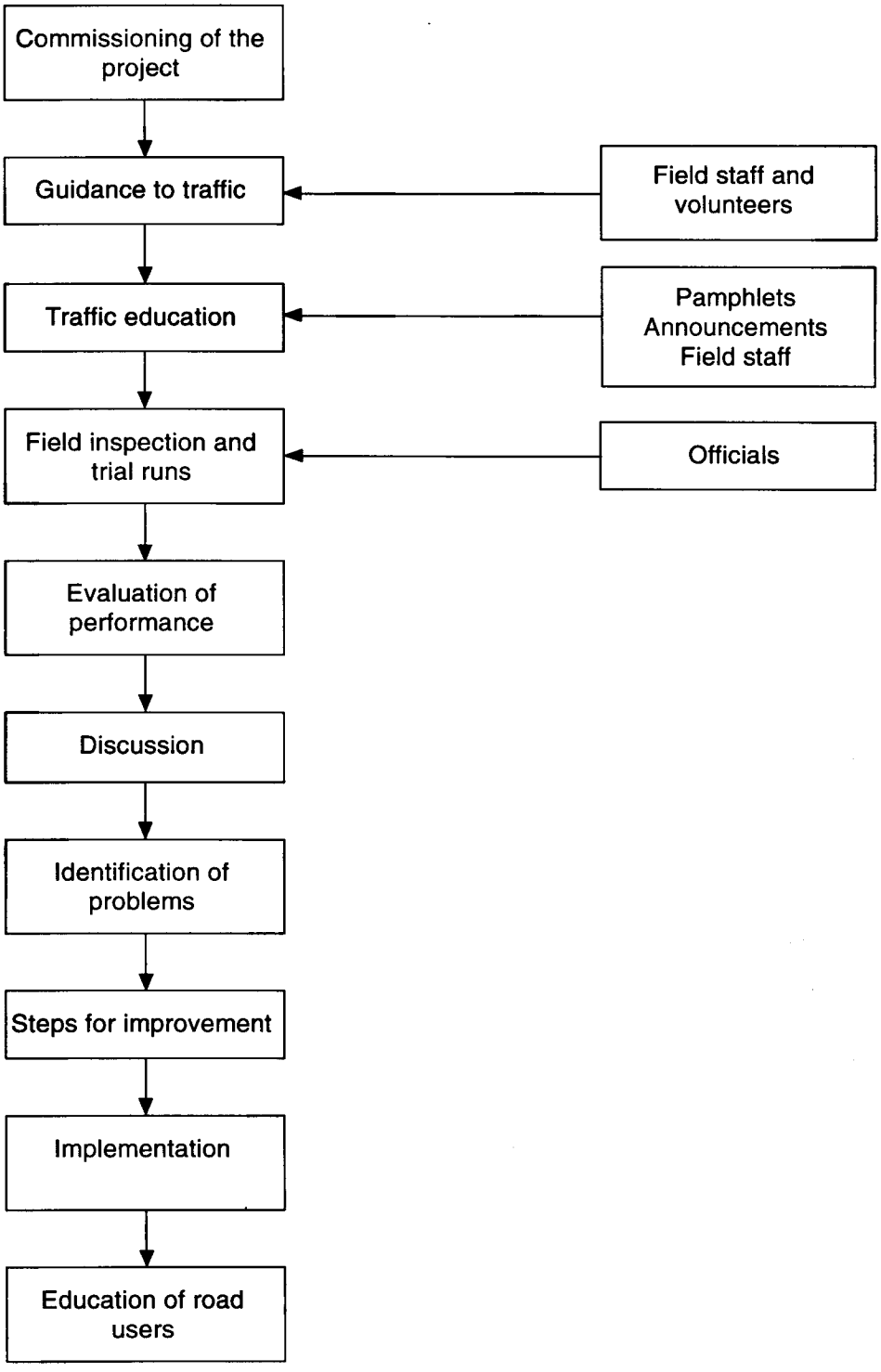

Figure 7. Action taken after commissioning the project

AFTER-STUDIES

Traffic studies

Extensive traffic studies were conducted 3 to 4 weeks after the introduction of the new system with a view to evaluate the performance of the system (Figure 8). The speed and delay study conducted in the Sterling Road area revealed that the journey speed on the one-way system introduced in this area was about 29 kilometres per hour during the morning and evening peak hours, as against the speed of 15 km per hour before improvement. Traffic conditions and level of service also improved considerably after the introduction of the new scheme, whereas before improvement long queues of vehicles caused congestion.

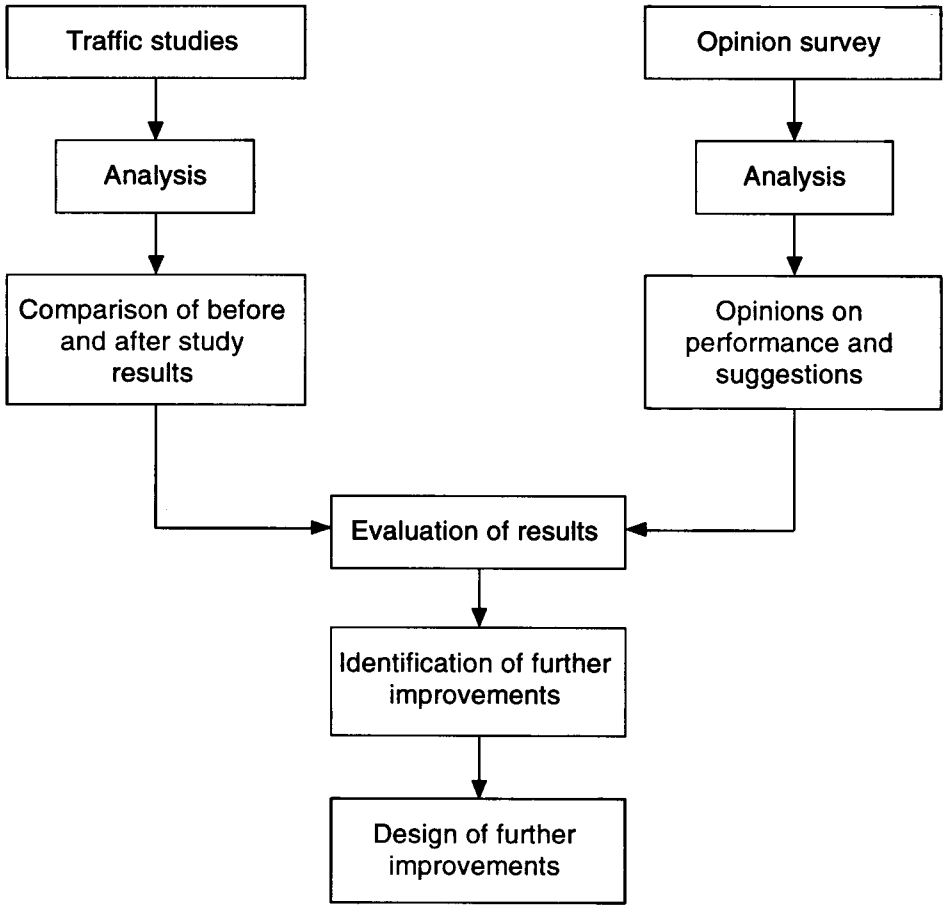

Figure 8. After studies and further improvements

Before and after studies conducted on a stretch of an arterial road in Madras, which was improved in the year 1992 revealed the following:

(a) The total number of violations per 100 vehicles made at mid-block which was 13.96 before improvement, came down to 10.56 in September 1992 and to 8.58 in April 1994 (Figure 9);

(b) The number of violations made by buses at mid-block was 12.30 per 100 buses in April 1994 as against 26.32 that existed before the improvement of the stretch;

(c) The number of violations at road intersections on this stretch after improvement was 15.62 per 100 vehicles as against the rate of 32.90 at other intersections; and

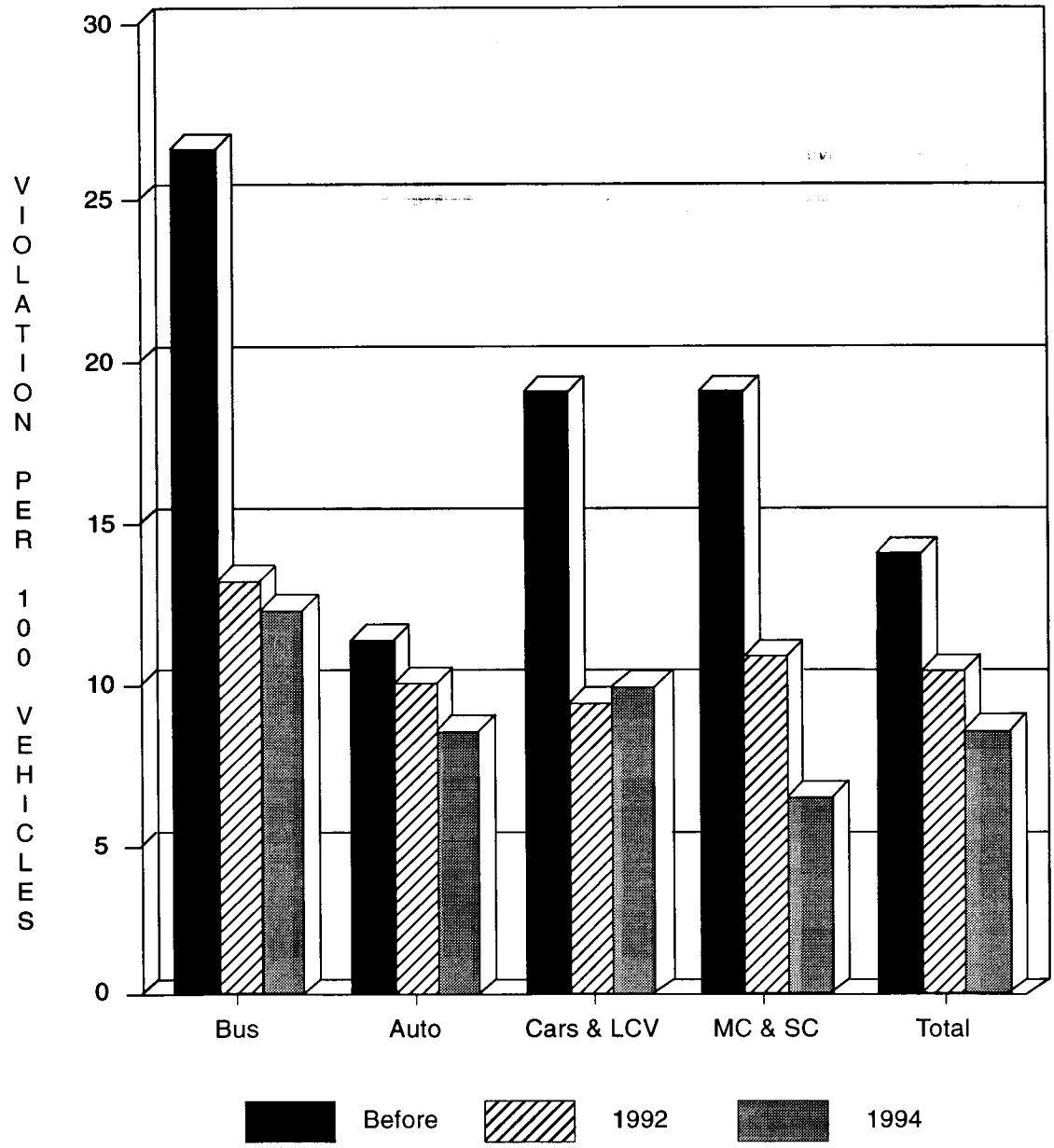

Figure 9. Mid-block traffic violations on the study stretch before and after improvement

(d) The number of violations made by buses at bus stops decreased from 43.50 per 100 buses before improvement, to 12 in September 1992 and to 9.30 in April 1994.

Opinion survey

Car drivers, auto-rickshaw drivers, drivers of motorized two wheelers, cyclists, pedestrians, bus commuters and shop owners were interviewed on a random basis and their opinions on the new schemes and also their suggestions were sought.

The results of the opinion survey conducted in the Sterling Road area are presented in Table 1. Most of the drivers appreciated the system in view of continuous flow of traffic at a moderate and uniform speed.

Table 1. Results of opinion survey of drivers

Mode	Travel time reduced		Continuous flow of traffic		Speed of vehicle increased		Satisfied with one-way system		Average speed	
	Yes	No	Yes	No	Yes	No	Yes	No	Present KMPH	Earlier KMPH
Car	82.6%	17.4%	100.0%	0%	87.0%	13.0%	78.3%	21.7%	40-50	20-30
Motorized two wheelers	85.0%	15.0%	100.0%	0%	95.0%	5.0%	75.0%	25.0%	50-60	30-40
Auto-rickshaw	90.9%	9.1%	95.5%	4.5%	90.9%	9.1%	86.4%	13.6%	40	20-30
Average change	86.2%	13.8%	98.5%	1.5%	90.8%	9.2%	86.0%	20.0%		

Further improvements

On the basis of the results of the after-studies conducted and suggestions made by the public and departments concerned, further improvements to be carried out in the area were identified. Figure 10 shows the proposed action programme for the Sir Mohammed Usman Road area, which is an important and busy shopping centre in Madras.

Study report

A report containing the results of the before and after studies, results of the opinion survey, suggestions made by public and authorities and further improvements was prepared, and a copy of this report was sent to the Traffic Police, other departments concerned, the sponsor of the study and the Secretary, Home Department, who is the Chairman of the High Level Committee.

COMMUNICATION AND INVOLVEMENT

Need for skills

The experience gained in these projects has shown that technical knowledge and ability of traffic planners alone cannot yield tangible results. They should have the skill to deal with all groups and individuals in a constructive manner, communicate with them, establish trust, build credibility and involve them in all stages of a project such as planning, decision making, implementation, evaluation and further improvements. The fact is that the only solution to most of these problems lies in the interdisciplinary coordination and public cooperation. The role of the traffic planner changes over the different phases of work.

Ground work

At this stage of work the traffic planner has to have interaction with officials and others and identify the right persons for participation in the project, and bring them together. To achieve this, he should be able to bring like minded people together and seek their cooperation and help. Thus he develops a closer relationship with human related sciences such as psychology and sociology. Active persons with responsive and cooperative temperament are to be mobilized. In the case of passive and responsive persons, the planner should motivate and involve them in the project. For tackling persons with a hostile attitude, targeted selection and the conflict management approach should be adopted.

Action plan

The main task at this stage (Figure 2) is to involve officials and the public in decision making and identify the thrust areas and problem areas. To start with, it is desirable to bring together a small group of officers and the public who have keen interest to make some useful contributions in this field.

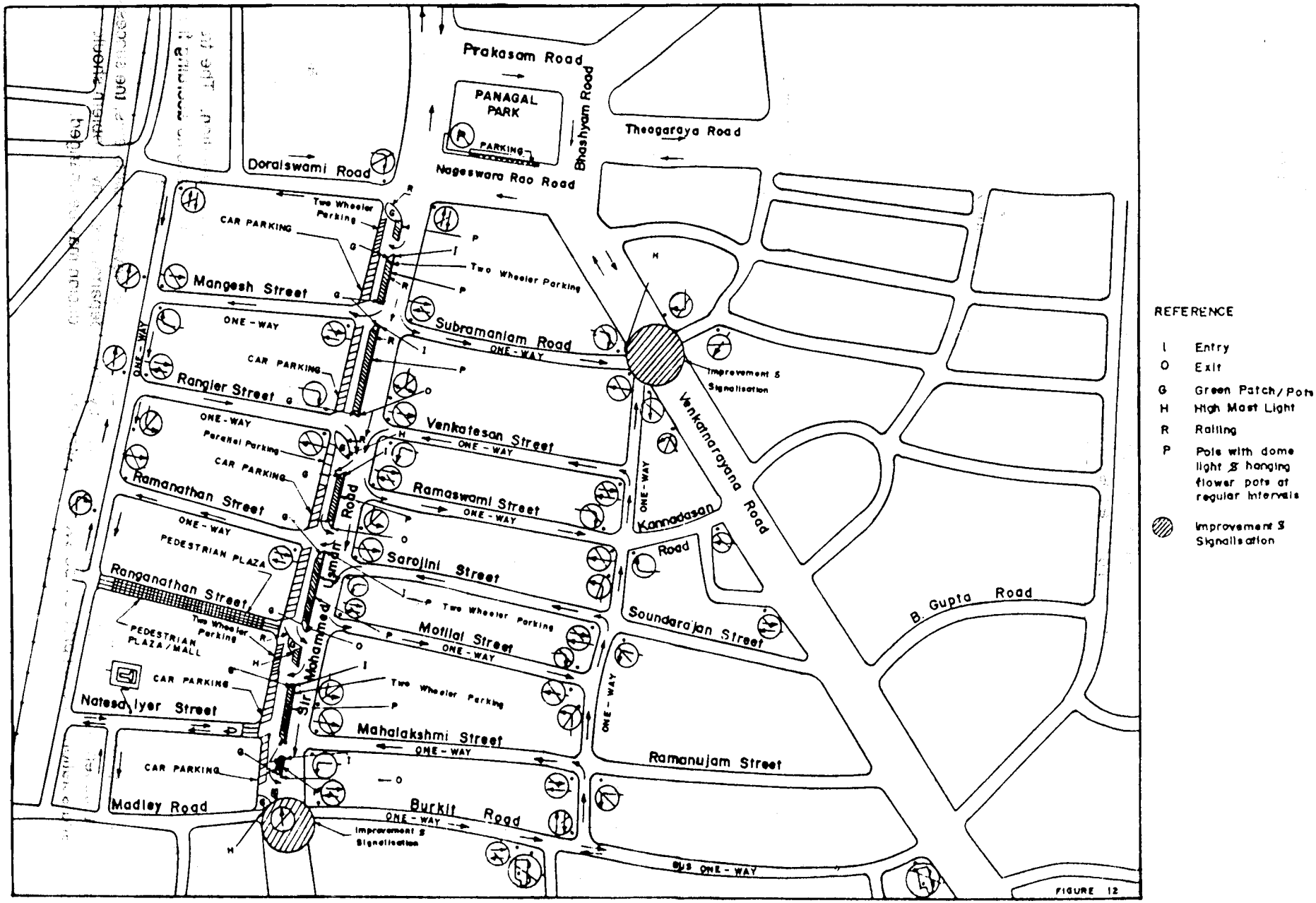

Figure 10. Proposed improvements in Sir Mohammed Usman Road area

These meetings should be organized in an informal and friendly atmosphere. The speakers and Chairman of each session should be chosen carefully, or else the public response will be poor or even negative, if the meeting is run in a highly rigid and authoritarian manner. The organizers of such meetings should have a high level of self-esteem, an open mind to new ideas and patience to listen to officials and the public, as well as being able to organize the meetings in a productive manner.

Design study

At this stage of the project (Figure 4), the traffic planner has to obtain the approval for the project proposal and also raise sufficient funds to meet the cost of the study. This can be achieved mainly by creating awareness in the authorities and sponsoring agencies of the benefits accruing from the project and also the credibility and integrity of the planner.

The traffic planner should be technically competent and practically oriented in working out suitable alternatives and be able to discuss these with the officials and representatives of the public in order to identify the most suitable plan. Figure 11 shows the process of decision making involving authorities and the general public.

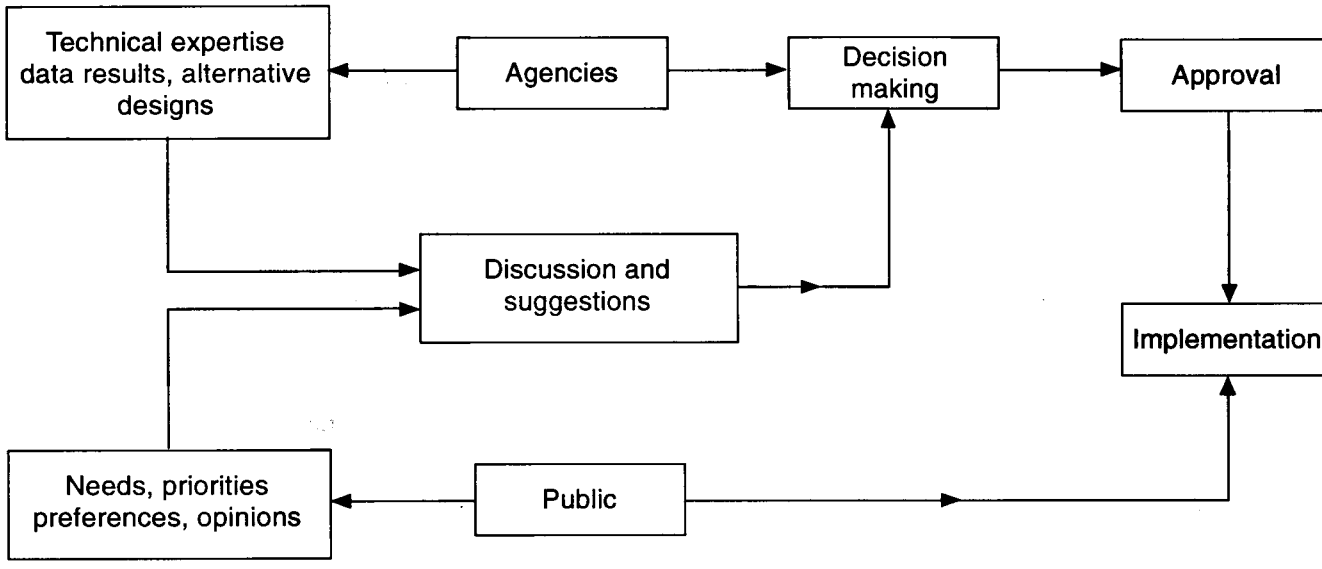

Figure 11. Process of decision making

The final design and recommendations made from the study should be appropriate, practical, legal, easily understandable and economical. Land acquisition should be avoided.

Implementation

The main hurdle at this stage of the project is how to raise funds for implementation. The traffic planner should convince the authorities and the sponsors with facts and figures, the benefits accruing from the TEAM project and mobilize resources. Help rendered should be duly acknowledged.

As the implementation of any TEAM project involves the cooperation of several departments, the success of the project depends on the coordinated efforts taken by these departments. Any problem should be discussed and solutions to such problem be evolved. Alternatively the design may be changed.

Commissioning of the project

The traffic planner should be a good organizer, be able to work out all aspects of commissioning in minute detail and check them on site. The preparations before commissioning including training should be thorough and extensive, and plans should be prepared for any problems which may arise.

After-studies and opinion surveys

At this stage of work, the traffic planner should evaluate critically the system, analyze any suggestions according to their merits and improve the system further. He should also understand that there is an increasing tendency of citizens to question those in authority. Traffic planning is only a technical tool to enable the city to function better.

CONCLUSIONS

The experience gained in organizing Traffic Engineering and Management improvements in Madras city has shown that the immediate improvements brought about in the problem areas have helped to sensitize the authorities as well as public to the potential of scientific application of TEAM techniques, and has also paved the way for making improvements in other cities. For example, in Tanjore, where the Eighth World Tamil Conference was held in January 1995, extensive traffic improvements were carried out using a similar technique.

It was also found from these projects that innovations are required not only at the stage of formulating improvement proposals but also in getting them implemented. A meticulously planned programme of implementation and participation of local agencies, voluntary organizations, private agencies and public yield favourable results. As all groups see themselves as having contributed to solving the problem.

With the alarming increase in traffic congestion and road accidents in the cities of the developing countries, the traffic planner has an important role to play. With the changing situation, traffic management is not limited to the engineering field alone. Efforts should be made to train traffic planners in their overall capabilities so as to enable them to tackle successfully the challenging traffic problems faced in the cities of developing countries.

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