

2.

# ROADS AND ROAD TRANSPORT



# TABLE OF CONTENTS

<b>INTRODUCTION</b>	<b>127</b>	<b>ROAD TRANSPORT</b>	<b>197</b>
Roads as Part of Integrated Multimodal Transport	127	Modernising the Trucking Industry	197
Capacity Enhancement	127	Enhancing Productivity of Commercial Vehicles	199
Maintenance	128	Inspection and Maintenance of Vehicles	200
Human Resources	128	Bus Transport Services in Rural Areas	200
Safety	128	End of Life Vehicles (ELV)	200
Land Acquisition	128	ICT for Road Transport	201
Institutional Arrangements	129	Enhancing Fuel Efficiency and Fuel Quality	201
Inter-Agency Coordination	129	Optimisation of Axle Loads of Commercial Vehicles	201
Funding	129	Control on Overloading	203
Pricing	129	Motor Vehicle Workshops	203
Roads and the Environment	129	Driving Training Institutions	203
		Human Dimension	204
		Standard Road Signs	204
<b>INDIA'S ROAD NETWORK TODAY</b>	<b>130</b>	<b>SUSTAINABILITY</b>	<b>205</b>
National Highways	131	Land Acquisition	205
State Highways	136	Rehabilitation and Resettlement	206
Major District Roads	137	Utility Shifting	206
Rural Roads	137	Road Safety	206
Road Sector Investments in the Past decade	139	Roads and The Environment	207
The Road Network Asset Base	139		
Vehicle Fleet and Traffic Flows	140	<b>FINANCING ROADS</b>	<b>210</b>
Institutions	140	Financing Strategies	210
Funding	141	Road Tax and Fuel Cess Reform	211
Safety	145	PPP Implementation	211
		Review of Toll Policy	213
		Public Sector Financing	215
<b>INTERNATIONAL EXPERIENCES AND LESSONS THEREFROM</b>	<b>145</b>	<b>DATA AND INFORMATION TECHNOLOGY</b>	<b>217</b>
Context	145	Existing Data Collection and Dissemination	217
Design and Operational Standards	147	Data Requirements	218
Road Assets: Preservation and Management	153	Managing Data	219
Direct Charging for Highway Use	154	Pavement and Traffic Management Systems	219
Use of Intelligent Transport Systems	158	Electronic Tolling	219
Road Safety	158		
Capacity and Performance Indicator		<b>GOVERNANCE</b>	<b>221</b>
Framework for Road Agencies	163		
Policies to Encourage Energy Efficient Vehicles	163	<b>RECOMMENDATIONS</b>	<b>224</b>
		Policy and Planning	224
<b>INDIA'S ROAD NETWORK OVER THE NEXT 20 YEARS</b>	<b>165</b>	Road Development	226
A Vision Statement for India's Road Network	165	Maintenance and Asset Management	228
Estimated Demand	166	Capacity Building for Enhancing Delivery Efficiency	229
Policy and Planning	166	Research, Development and Technology Initiatives	232
Strategies for Development of Primary Roads (National Highways and State Highways)	170	Private Financing Initiatives	232
Strategies for Development of Major District Roads	173	Road Transport	232
Development of Rural Roads	177	Road Safety	233
Overall Investments Required	179	Governance	233
Management and Preservation of Road Assets	179		
Implementation Challenge	186	<b>REFERENCES</b>	<b>234</b>
Revisiting the MoRTH	186		
Human Resource Development	187		

# 2.

# ROADS AND ROAD TRANSPORT

It is a matter of some pride that India boasts of the world's second-largest road network, and the densest amongst countries of similar size. Over the years, both accessibility and mobility have improved through construction of new roads and development of existing roads.

## INTRODUCTION

However, as a very broad characterisation, our roads still suffer from a litany of ills. They are capacity-constrained, slow, unsafe, environmentally unfriendly, not maintained or non-maintainable and patchily administered. Meanwhile, efforts to improve the situation are hampered by delayed clearances, multiple overlapping authorities and jurisdictions, frequently changing rules of engagement with the private sector, unyielding land laws, and skill shortages.

Over the next 20 years, India's roads must address these issues to accommodate an economy that will both be substantially larger, and structurally different in economic, social and demographic terms.

## ROADS AS PART OF INTEGRATED MULTIMODAL TRANSPORT

Roads should not be looked at in isolation, but as part of an integrated multimodal system of transport (Chapter 4, Volume II). The planning and development of the primary road network must tie up with planning of the railways' dedicated freight corridors and other segments of the rail network, connectivity with ports, airports, special economic zones, logistic hubs, major tourist centres and linkage with neighbouring countries. Similarly, advantages of lower emissions and fuel consumption in movement of bulk cargo through inland water transport and coastal shipping should be fully harnessed to reduce avoidable burden on road and rail. Further, there is need to promote multimodal transport operators who provide seamless movement between the

consignor and the consignee and they use each mode depending upon its inherent strength and efficiency.

## CAPACITY ENHANCEMENT

Various construction programmes for different classes of roads over the past two decades have yielded a significant expansion in network size. With the notable exception of the National Highways Development Project (NHDP), the major focus of this network expansion has been to improve connectivity rather than to increase network capacity. Under the NHDP, much has been accomplished to build better trunk routes with various phases of the programme aiming for capacity upgradation, and minimum standards for wider and faster roads, though progress has been somewhat slower than anticipated. The bigger hurdles on this front are timeliness in awarding contracts, difficulties in acquiring land, and securing environmental clearances, and the persistent shortages in construction capacity. Increased focus is required in provision of service roads along high capacity corridors to cater for local motorised and non-motorised traffic and social requirements of pedestrian/cattle underpasses. At the other end of the spectrum, rural areas have benefited enormously from the PMGSY which emphasises new connectivity and upgradation of rural roads to meet the growth in traffic demand. In a major shortcoming, however, there is no resolute effort that is dedicated to bringing existing rural roads upto standards of all-weather connectivity.

While National Highway development has been motivated by the necessity of urgently improving trunk capacity, and rural road development by the basic

Existing land laws in India make it difficult and time-consuming to acquire the land required to complete infrastructure projects. The major fault lines lie along issues related to valuation and compensation, acquisition of agricultural, forested, hereditary and tribal lands, and government right to eminent domain.

goal of ensuring universal connectivity, there has been no fundamental stimulus for state highways and district roads. A transport network is only as strong as its weakest links. Consequently, these much neglected roads that connect with newly expanded National Highways create bottlenecks with congestion repercussions across the wider network and pose a deeper problem than is immediately apparent. In similar fashion, inefficient junctions, bridges, and other choke points moderate capacity enhancements from new and improved National Highways.

## MAINTENANCE

At all levels, roads are often found in a state of disrepair, with potholes, poor drainage, weak bridges, substandard pavement and so on. For all the attention given to new construction and upgradation, much less funding and effort is expended on preserving the existing asset base. Regular preventive maintenance has yet to form an integral element of thinking on road investment. Much maintenance occurs when things fall apart rather than as a preventive measure. Rehabilitation requires far more substantial financial resources than preventive measures do. Importantly, rehabilitation imposes higher indirect and opportunity costs since the citizenry and government are more likely to have to contend with catastrophic failure, or with the decommissioning of important links in the network for long periods.

As compared with construction projects, there are fewer institutional incentives to perform, monitor and enforce maintenance. In the case of PPP projects, construction and maintenance contracts are often awarded to the same agency or private enterprise; but monitoring is less rigorous, and the penalties for missed or poor maintenance are smaller than for delayed or incomplete construction. Maintenance earns less political goodwill than the fanfare associated with the opening of a new road.

## HUMAN RESOURCES

As with other sectors, the construction and ongoing maintenance of Indian roads is severely limited by a shortage of skilled professionals. Upon graduation, civil engineers are poached by other disciplines with higher pay scales and better career prospects. At the graduate level, few institutions offer courses or degrees in road network planning, design and construction. Agencies responsible for the roads must

consequently make do with a bureaucracy whose core skills may not run deep enough to contend with the difficult issues posed by modern design practices and construction methods. The paucity of good jobs at these agencies also serves to signal promising engineers away from the road sector. Then, there is huge deficit in availability of skilled construction workers in the road sector. There is hardly any ITI or training centre that imparts training to workers, equipment operators and work supervisors (Chapter 11, Volume II on Research and Human Resource Development).

## SAFETY

Indian roads are grossly unsafe. This statement is made even gloomier as it is closer to being likely conjecture rather than established fact. We simply do not have a good quantitative understanding of the nature and extent of safety-related problems on the roads. Acute under-reporting, poor accident recording, and limitations of the data that are actually collected make it difficult to form an objective view on the severity of the problem. As a qualitative characterisation, consider these everyday observations: over-loaded goods and passenger vehicles, unregistered and uncertified vehicles, unlicensed drivers, and poor compliance and enforcement of road rules. Narrow, poorly maintained roads do not conform to common safety-related design principles such as traffic segregation, divided carriageways, lane markings, and demarcated intersections amongst others. Road design favours motorised vehicles at the expense of vulnerable pedestrians and cyclists. The latter also tend to number amongst the less financially capable, and bear an unequal burden of traffic-related injuries and fatalities. Emergency medical response at accident sites is rarely guaranteed and often delayed, providing the major reason for why disproportionately more injuries on Indian roads end up with fatalities (Chapter 12, Volume II on Safety).

## LAND ACQUISITION

Existing land laws in India make it difficult and time-consuming to acquire the land required to complete infrastructure projects. The major fault lines lie along issues related to valuation and compensation, acquisition of agricultural, forested, hereditary and tribal lands, and government right to eminent domain. The land acquirers' responsibilities with respect to the resettlement and rehabilitation of project affected persons are complex and inconsistent. The new The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act may have clarified some of these issues, but will also make land acquisition more expensive.

With respect to road construction, timely land acquisition is commonly cited as the dominant reason for

delayed project completion. Small changes in alignment can have very large implications for overall project costs, as well as for road safety and the environment. Land acquisition issues are especially pertinent for the several projects seeking to build new roads in tribal lands. Besides providing much-needed connectivity to hitherto neglected populations, these roads are essential for national security and integration. However, acquisition is especially fraught in these areas and must be addressed by sound policy and judicious administration. Road upgrading also suffers from want of land. It is natural for economic enterprise—whether sanctioned or otherwise—to spring up at the edge of existing roadways. This makes it difficult to enforce claims over existing, but unused rights of way or to purchase new land for widening of roads.

## INSTITUTIONAL ARRANGEMENTS

Roads perform a large variety of functions from providing both basic and trunk connectivity to serving as the fulcrum in inter-modal exchanges of passengers and freight. With the road network's distributed nature and role, it is not surprising that an exceptionally large number of institutions and agencies are responsible for design, construction, operation and maintenance at all levels of government. The network's extent, complexity and varying characteristics mean that this model of distributed governance is desirable; no single institution should be expected to successfully negotiate the multitude of responsibilities and functions associated with all classes of roads. However, the current institutional arrangements leave much to be desired and need considerable capacity building for implementation of the government mandate. This is all the more critical now that a good deal of network expansion has taken place and we need to consolidate these gains by focusing on achieving higher levels of quality and imbibing international standards and practices.

## INTER-AGENCY COORDINATION

Successful distributed governance of the roads requires that its various elements be bound together in a common vision of what India's roads should deliver to its citizens. It further requires that there is clear administrative responsibility for the construction and maintenance of each class of road. Horizontal and vertical inter-agency cooperation is lacking. Roads are not always built in harmony with existing or planned land use, to ensure inter-modal connectivity, and to connect well with other parts of the network to boost overall capacity. It is crucially important that professionals and agencies in charge of developing roads also co-ordinate with other agencies and authorities that are responsible for other transport modes, urban planning, village governance, and so on.

## FUNDING

No other piece of transport infrastructure can replace the street outside one's home in its role as the instrument of basic connectivity. Consequently, it is sensible that sources for road funding are principally commitments from gross budgetary outlays, though these may stem from earmarked revenue streams, taxes and cesses, dedicated road funds, or special development programmes such as the Pradhan Mantri Gram Sadak Yojana (PMGSY: Prime Minister's Rural Roads Plan). The desirability of universal accessibility on developmental and nation-building grounds motivates budgetary funding for roads as a redistributive tool.

However, to a significant degree, the benefits from road use accrue to private agents, be it from the transport of goods to market or the movement of people for work or leisure. As such, after accounting for all positive consumption externalities and correcting for all other market failures, this offers good economic support for more direct financing of road infrastructure from user charges including fuel taxes, vehicle registration fees, tolls, etc.

## PRICING

Fuel is subsidised, ostensibly for agricultural relief, but has many unintended beneficiaries. More vehicle-kilometres are driven than would be if fuel were priced at market. Demand has increased significantly for diesel vehicles, with severe environmental implications, given the generally high-sulphur diesel fuel available in India. Further, the method and practice of setting the subsidy is such that required adjustments are delayed until the fiscal implications become untenable, at which point they are made in large jumps causing more pain at the pump as consumers struggle to adjust to hugely increased fuel outlays. Meanwhile, vehicle registration and parking fees and taxes on cars are disconnected from the economic value of the public resources that are used up. The current programme for recalibration of diesel prices to approach consistency with international prices is a welcome move.

Successful distributed governance of roads requires that its various elements be bound together in a common vision of what India's roads should deliver to its citizens.

## ROADS AND THE ENVIRONMENT

This report echoes the major economic and environmental concerns of the increasing share of road-based transport in the carriage of both passengers and freight. Roads also affect the environment more directly. The new roads that India requires must

Independent India inherited about 21,000 km of National Highways. Though expansion was slow over the next 50 years, the period from 1997 has seen more concerted road building than at any other time in India's history

often be cut through sensitive geographies either in terms of the local terrain that will mandate large-scale destructive re-engineering of the landscape, or in terms of disturbing the habitat of local flora and fauna. Current environmental laws seek to address both of these concerns, but the unwavering stringency of their application leads to delayed execution, costly realignments, and curiosities like trees in the middle of an urban road, an outcome of obvious disadvantage to both tree and commuter. More rational solutions to the competing demands between road construction and the preservation of the natural environment are essential.

India's lax fuel and vehicle efficiency standards present more immediate and substantially more dangerous environmental concerns. These loosely enforced norms already lag those in other parts of the world, contributing in no small measure to some of the most polluted air on the planet, and the consequential health effects. The partial rolling out of new standards in certain cities is unhelpful, and only seeks to undermine the credibility and usefulness of the standard-setting process. India already exports vehicles that conform to more stringent overseas standards, but which cannot be sold domestically on account of the incompatibly poor fuel available (Chapter 7, Volume II on Energy and Environment).

## INDIA'S ROAD NETWORK TODAY

*In opening the Indian Road Congress, 15 January 1950, Mr Lal emphasised the urgent need to complete the Nagpur plan. The plan has a target of building or improving 68,000 miles of hard crust roads and 90,000 miles of earth roads. Mr Lal stressed the need for improving the education of road engineers. He gave a detailed account of how technical committees of the IRC established standards, studied economics of highway types, etc. He pleaded for the establishment of a powerful independent Road Board capable of smoothing differences between the Central Government and the provinces.*

—UNESCAP Transport Bulletin, Volume. I, No. 1  
September 1950

Eleven days before India declared itself a republic, the Indian Roads Congress—a 'semi-official' society of highway engineers and other road-development professionals—met for its 14<sup>th</sup> annual meeting in Mumbai<sup>1</sup>. The concerns addressed were as familiar

then as now: the urgent need for rapid expansion of the network, dismay at missed deadlines, funding shortfalls, lamentable inter-agency co-operation, capacity limitations, the necessity of building technical expertise and so forth. The major agenda item was discussion on the progress of the Nagpur Plan of 1943, the first attempt at devising a long-term road development plan. The discussions were fruitful enough for the new republic to provide a fillip to the Plan for its remaining 13 years: the originally promised 200,000 km of road network were delivered on schedule by 1963. Recognising the long-lived nature and enormous cost of road networks, the Nagpur Plan was devised to be implemented over a 20-year period, and road transport policies for individual Five-Year plans have since been hewn from subsequent 20-year plans.

The other enduring outcome of the Nagpur meetings was to lay the genesis for the familiar modern hierarchical division of the road network as determined by certain objective criteria. According to the Nagpur Plan, National Highways would pass through the states, and places having national importance for strategic or administrative purposes. State highways would link state capitals with other large cities in the state, and district roads would take traffic from the main roads into the interior of the district. Road statistics from the Nagpur Plan period aggregate these two types of road into 'state highways'. Finally, rural roads would connect villages with major roads. Hence, the classification of the road network was largely defined by the settlements that a road linked.

Even as the Nagpur Plan period was nearing completion, it was apparent that the quality of the recently enlarged network left much to be desired. Consequently, in 1961, a new 20-year plan—the Bombay Plan of 1961-81—for Indian roads was adopted. This plan made rural accessibility its defining objective and sought to construct rural roads on better technical foundations. It also first outlined a case for the construction of access-controlled expressways. Many of the individual initiatives for network expansion were stillborn, though progress was made in widening roads and in tarring previously unsealed roads. It was during this period that the state highway classification was refined, and district roads—both 'major' and 'other'—were identified separately.

The Lucknow Road Congress of 1984, as part of the third 20-year plan (1981-2001), proposed, for the first time, 'softer' considerations such as energy conservation, environmental impact and road safety as integral elements in the design of road policy and infrastructure together with the usual ambitious goals for expanding the network, raising capacity and improving accessibility.

Then the Ministry of Road Transport and Highways formulated Road Development Plan Vision: 2021

1. 1950 also saw the inception of the Central Road Research Institute, India's nodal road research and development agency.

Table 2.1  
**India's Road Network since 1951**  
 ['000 Km]

ROAD NETWORK	1951	1961	1971	1981	1991	2001	2011
(i) Total Length	400	524	915	1,485	2,327	3,374	4,690
(ii) Of which National Highways	22	24	24	32	34	58	71
(iii) Of which State Highways	-	-	57	94	127	132	164
Surfaced Roads	157	263	398	684	1,113	1,602	2,525

Source: Various issues of Basic Road Statistics of India, Transport Research Wing, Ministry of Road Transport & Highways, Government of India.

for roads by entrusting the task to IRC. The major thrust areas covered related to mobility in respect of main roads and accessibility in respect of rural roads to connect all villages in a time-bound manner. Strategies for capacity augmentation and preservation of assets were brought out together with measures to mobilise resources and capacity building in road organisations, consultants and contractors. Soon, thereafter, the Ministry of Rural Development embarked upon a dedicated Rural Road Development Plan: Vision 2025 with the support of IRC. Building up from the current PMGSY, it laid a road map for achieving universal connectivity to all habitations above population 100 with all weather rural roads.

Independent India inherited about 21,000 km of National Highways. Fifty years later, India celebrated its golden jubilee with 34,298 km of National Highways, having added just over one per cent to the network for each year of independence. However, early road-building priorities lay in other areas, and, happily, there was substantially more progress in building district and rural roads (Table 2.1). By the standards of the first 50 years, the period from 1997—corresponding directly with the 9<sup>th</sup>, 10<sup>th</sup> and 11<sup>th</sup> Five Year Plans—has seen more concerted road building than at any other time in India's history. This is reflected in the significantly increased investment in roads (Chapter 2, Volume II).

## NATIONAL HIGHWAYS

National highways constitute the primary system of road transportation in India, Figure 2.1 gives at a glance the growth of National Highways over the years. These are main highways running through the length and breadth of the country connecting major ports, highways in neighbouring countries, capitals of states and union territories and large industrial and tourist centres, and include roads required for strategic considerations. These highways are under the administrative and financial purview of the Union Government, which exercises jurisdiction through the Ministry of Road Transport

and Highways (MoRTH). The Central Government retains powers to designate any road as a National Highway. The Ministry follows an agency model. There are three agencies for implementation viz. the National Highways Authority of India (NHAI), the Border Roads Organisation (BRO), and the Public Works Departments (PWDs) in the states.

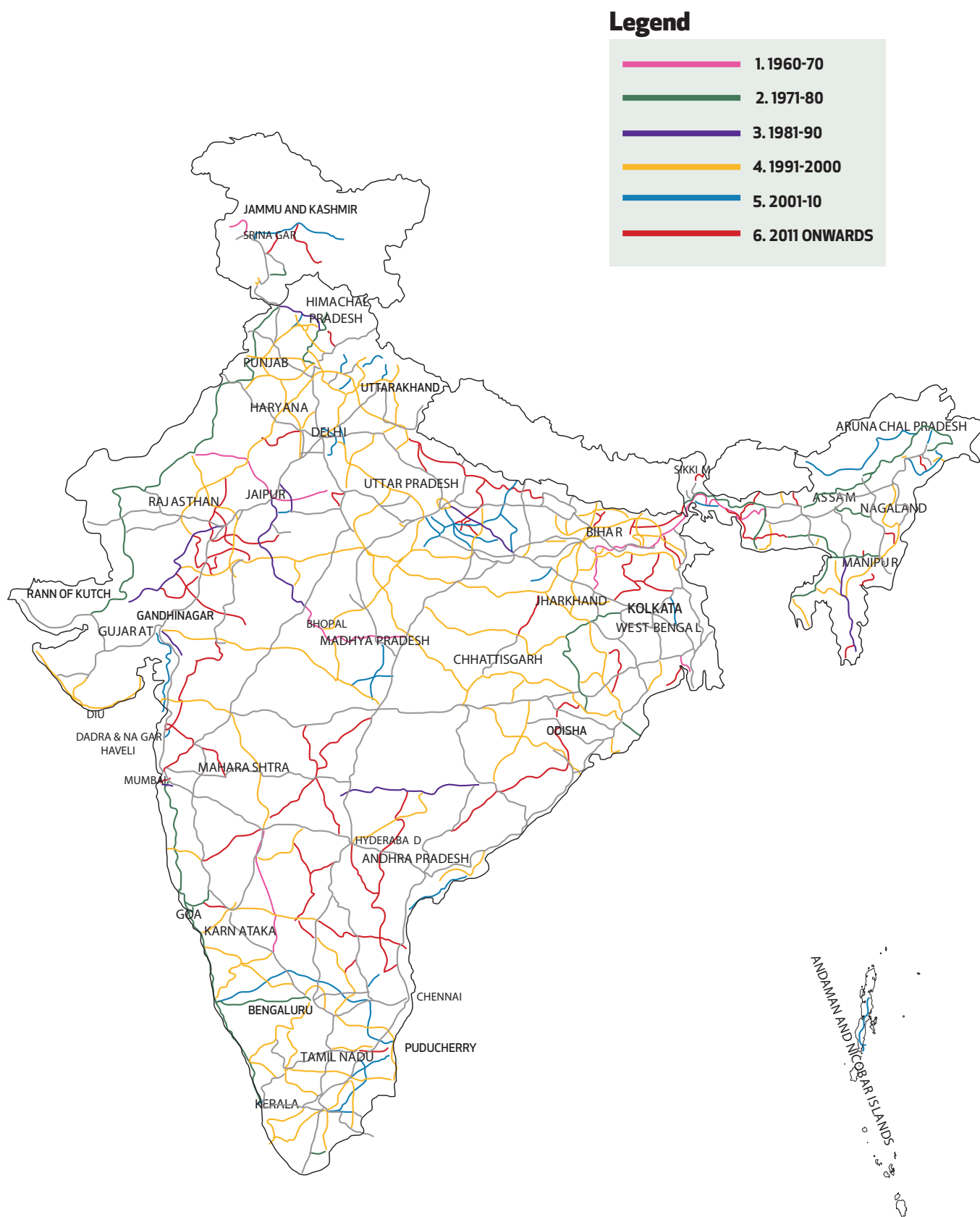
Totalling 76,818 km or 1.9 per cent of the total road network as of March 2012, about 40 per cent of road traffic plies on the National Highways; a figure that is comparable with that of other countries. That the highways constitute a very small share of the overall network is understandable, given the vast rural road network required to connect to India's widely distributed villages and habitations. Better international measures of the adequacy of the size of the network are assessments of the highways relative to land area, population and GDP. International comparisons must be treated with caution since road statistics are not quality-adjusted: one nation's National Highway may well be another's minor road.

Box 2.1 gives a snapshot of the socio-economic impact of development of National Highways on the rural communities, captured by a seminal work undertaken by the Asian Institute of Transport Development.

The construction, improvement, maintenance and general administration of selected current and planned stretches of the National Highway network are carried out under various phases of the National Highway Development Project (NHDP). The project is executed by the NHAI, an autonomous statutory government agency serviced by MoRTH. Other sections of National Highways are administered directly by MoRTH under various smaller programmes, and are collectively demarcated as NH (Original), or NH (O).

Under the first two phases of the NHDP, four-lane highways have been constructed linking Delhi, Mumbai, Chennai and Kolkata (the Golden Quadrilateral), and spanning the length and breadth of the

Figure 2.1  
**National Highway Network of India**



Source: Ministry of Road Transport and Highways.

## Box 2.1

### Highways of Socio-Economic Change

Contrary to the traditional view that a National Highway mainly facilitates intercity travel and transport of goods, it is also an integral part of the road network serving the rural areas. This is borne out by the fact that almost 50 per cent of the total trips originating from the selected villages involve the use of the National Highway.

Proximity to a highway and its upgrading has significant beneficial influence on major aspects of socio-economic well-being of the rural population. Greater opportunities of employment and earnings in non-farm activities are generated. Access to education and health facilities improves. Household incomes rise and so do asset holdings.

The immediate net benefits of an upgraded highway mostly relate to improvement in access to work and educational opportunities: three-fold increase in the share of income from non-agricultural activities; 85 per cent increase in female labour participation; two-fold increase in per capita trip rate for education; and about 50 per cent increase in school enrolment.

The temporal shifts in the related parameters have brought about a distinct structural shift in the rural economy. A development of considerable importance is the noticeable increase in female participation in the workforce as also the school enrolment of girls. These welcome changes would help in the much-desired empowerment of women.

The benefits of the highway mostly extend up to a distance of 5 km on its either side, which may be treated as the influence zone. This approach distance can be covered in 30 minutes on a cycle and an hour on foot. Beyond this distance, the influence of the highway falls off sharply.

The density of population in the nearby villages is generally higher mainly due to the poor staying closer to the highway because of better non-farm job prospects. They are relatively better off in terms of various indicators of well-being vis-à-vis comparative households living away from the influence zone.

The extensive use of the National Highway by the rural population for their social and work-related trips brings out the need for building service roads along the highway to cater to the slow moving traffic comprising pedestrians, cyclists, bullock carts, etc. Equally important is the safe design of road crossings between highways and village roads.

Among other interventions, large-scale public investments in road infrastructure development can also be an effective and viable policy measure for improvement in the well-being and quality of life of the rural population.

Source: Asian Institute of Transport Development (2011).

country through the North-South and East-West corridors. Later, NHDP was expanded and it now covers seven phases. Table 2.2 gives a broad break up of various phases together with current status.

Though admirable progress was made in the early years of the NHDP, especially under Phases I and II, there has been recent cause for concern at the slow-down of implementation. There have been hold-ups in commissioning detailed project reports, in the award of contracts, and in the timely completion of construction activity. The problems besetting the NHAI in ensuring timely delivery of completed projects are:

- i. **Funding** issues including the adequacy of budgetary supply and commercial borrowing;
- ii. **Commercial** issues including shortages of eligible bid concessionaires, restrictive model concession agreements;
- iii. **Shortages of skilled staff** in NHAI as well as at concessionaire and construction firms;
- iv. **Land acquisition** including issues related to the shifting of existing utilities along the right of way, and resettlement and rehabilitation of affected persons;
- v. **Delays in obtaining railway and environmental clearances.**

Figure 2.2  
**The Golden Quadrilateral, and North-South and East-West Corridors**



Source: NTDP (2012).

Table 2.2  
**National Highway Development Project**

PHASE	PROJECT DETAILS	LENGTH (KM)	APPROVED	INITIAL SCHEDULED COMPLETION	CURRENT SCHEDULED COMPLETION	APPROVED COST (RS BILLION)	EXPENDITURE (30 SEP 2013) (RS BILLION)	LENGTH COMPLETED (IN KM)	LENGTH UNDER IMPLEMENTATION (IN KM)	NO. OF CONTRACTS UNDER IMPLEMENTATION (IN KM)	TO BE AWARDED (IN KM)
I	4-laning of Golden Quadrilateral (5846 km), 981 km of NS-EW corridors, 356 km Port connectivity, 315 km other NHs	7,522*	DEC 2000	DEC 2003	Declared complete Jan 2012	303	401	7,514	8	10	-
II	4/6-laning of 6161 km of NS-EW corridors, 486 km other NHs	6,647	DEC 2003	DEC 2007		344	631	5,657	600	52	390
III	4/6-laning of other NHs	12,109	MAR 2005	DEC 2012		806	717	5,692	4,732	89	1,685
IV	2-laning with paved shoulders of selected NHs	20,000	MAR 2005	DEC 2015		278	37	304	4,179	33	10,316
V	6-laning of selected stretches of NHs	6,500	OCT 2006	DEC 2015		412	225	1,634	2,446	28	2,420
VI	Development of expressways	1,000	NOV 2006	DEC 2015	DEC 2015	167	0.2	NIL	NIL	-	1,000
VII	Construction of ring roads, flyovers, bypasses, tunnels, over-bridges	700	DEC 2007	DEC 2014		167	16	21	20	2	659
	<b>Total</b>	<b>54,478</b>				<b>2,476</b>	<b>2,027</b>	<b>20,822</b>	<b>9,539</b>	<b>214</b>	<b>16,470</b>

Source: NTDFC Research  
\* Chennai - Ermore port connectivity two projects (24 km) have been re-awarded, these two projects were merged with other projects (6 km) under Phase - I. Total length increased by 24 km; 14,799 km was assigned to NHAI remaining 5,201 km with MoRTH.

Table 2.3  
**Physical Achievements under Non-NHDP [NH(O)]**

CATEGORY	10 <sup>TH</sup> PLAN (2002-07)	11 <sup>TH</sup> PLAN (2007-12)
Two-Laning	4,177 km	5,161 km
Four-Laning	157 km	341 km
Strengthening Weak Pavement	3,510 km	4,625 km
Improvement of Riding Quality	16,250 km	11,831 km
Bypasses	16 Nos.	16 Nos
Bridges	604 Nos.	480 Nos

Source: NTDP (2012).

At present, a few short stretches of National Highways are designated expressways: limited access motorways of four or more lanes with grade-separated interchanges, and restricted to motorised transport. With their purposefully limited accessibility, expressways are often built as greenfield projects that run parallel to existing roads. Phase VI of the project, approved in 2006, provides funds for the completion of 1,000 km of expressways along certain very highly trafficked corridors emanating from the nation's largest cities, such as from Mumbai to Vadodara, and Bengaluru to Chennai. This phase is scheduled for completion by the end of 2015. Though seven years have elapsed, a detailed programme of implementation and investment decisions has yet to be finalised.

In recognition of the view that overall network capacity and movement efficiency depend crucially on provision of interchanges and bypasses, Phase VII of the project directs explicit attention to this infrastructure. Progress on this phase needs to be accelerated.

#### NON-NHDP NATIONAL HIGHWAYS: NH (ORIGINAL)

MoRTH is also responsible for the upgrade and upkeep of several National Highways that are not accounted for by the NHDP. Lumped together under the moniker NH (O), these NHs are typically lightly trafficked, mostly less than two lanes, and so are lower priorities for capacity-enhancing investment. However, many of these run through economically less developed regions of the country, and assume greater significance. Management of these roads is delegated to state PWDs and the BRO for the most part, and activities include widening, strengthening of pavement, improvement of ride quality, and the construction of bridges and bypasses. Table 2.3 gives a broad picture of physical progress during the 10<sup>th</sup> and 11<sup>th</sup> Plan in respect of NH (O) works. Table 2.4 gives a broad break of expenditure on central sector

roads administered by the MoRTH during the 10<sup>th</sup> and 11<sup>th</sup> Plans.

#### STATE HIGHWAYS

State highways (SH), together with Major District Roads (MDR), constitute the secondary system of road transportation in the country, and are administered and financed by state governments. SHs provide links with NHs, district headquarters of states and important towns, tourist centres and minor ports. The total length of SHs at present is about 166,000 km. Their length is about 4 per cent of the total road network and they carry 25 to 30 per cent of the total road traffic. About 60 per cent of these route-kilometres have carriageways of less than the minimum desired two-lane standards. The SH network is compromised by weak and narrow bridges and culverts, at-grade railway crossings, and poor upkeep and maintenance. Several roads have failed to keep up with changing traffic patterns and have become hopelessly ill-equipped to accommodate increasingly large vehicle volumes.

Table 2.5 gives a broad idea of capacity of state highways by the end of 11<sup>th</sup> Five Year Plan.

An expenditure of Rs 628 billion was incurred on state sector roads during the 10<sup>th</sup> Plan. This got increased to Rs 1,656 billion during the 11<sup>th</sup> Plan.

State governments fund state highways and there is a general shortage of available funding for the maintenance and upgrading of these roads. SHs are important roads. However, a slow-burning campaign exists on the part of many state governments to have these roads declared as National Highways instead. In this event, the Central Government assumes financial and administrative responsibility over these roads, while the states benefit from better roads that deliver localised connectivity and accessibility. Some states

Table 2.4  
**Expenditure on Central Sector Roads (excluding PMGSY) During the 10<sup>th</sup> and 11<sup>th</sup> Five Year Plans**  
 [Rs billion]

PARTICULARS/SCHEME	10 <sup>TH</sup> PLAN (2002-07)	11 <sup>TH</sup> PLAN (2007-12)
NHDP (NHAI) (of which Private Sector Investment)	383	1,278 (653)
NH (O) (of which Private Sector Investment)	91	220 (4)
SARDP-NE including Arunachal Pradesh package	6	50
Left Wing Extremism, Tribal Areas, etc.	--	20
Roads of Economic and Interstate Importance (E&I)	4	8
Strategic Roads	2	4
Miscellaneous Including Research, Training, IT, etc.	0.90	0.37
<b>Total</b>	<b>486</b>	<b>1,581</b>

Source: NTDP (2012).

have benefited from the Central Government scheme of providing viability gap funding upto 20 per cent of the project cost for PPP road projects.

### MAJOR DISTRICT ROADS

MDRs run within districts connecting areas of production with markets, and rural areas with district headquarters and with SHs and NHs. Serving as links between rural and urban areas, SHs and MDRs contribute significantly to the rural economy and to the country's industrial development by enabling movement of raw materials and products from and to regional India. The development and maintenance of MDRs is the responsibility of state governments. The total length of MDRs is about 266,000 km with more than 90 per cent of the network length not meeting two-lane standards.

### RURAL ROADS

Rural roads cover Other District Roads and Village Roads and constitute the tertiary road network. They are a key component of rural development since they provide access to economic and social infrastructure and services, thereby generating increased agricultural income and productive employment oppor-

tunity in rural areas. Rural roads are used as an entry point for poverty alleviation. There is growing empirical evidence that links transport investments to the improved well-being of the poor. A study carried out by the International Food Policy Research Institute on linkages between government expenditure and poverty in rural India has revealed that an investment of Rs 100 million in roads lifts 16,500 poor persons above the poverty line<sup>2</sup>. A joint study by the Asian Institute of Transport Development (AITD) and UN:ESCAP also confirmed close link between accessibility and incidence of poverty and advocated provision of access as an entitlement (Box 2.2).

The Bombay Plan (1961-81) had laid down that all villages be brought reasonably close to a planned system of all-weather roads so that no village is more than 2.5 km from a road in an agricultural area and 8 km from a road in a non-agricultural area. The Lucknow Plan (1981-2001) had envisaged that all villages with population above 500 be brought within 1.6 km of an all-weather road.

The thrust to the development of rural roads was given at the beginning of the 5<sup>th</sup> Plan in 1974 when it was made part of the Minimum Needs Programme (MNP) along with electricity, health care, primary

2. Study on Linkages between Government Expenditure and Poverty in Rural India by Fan, Hazell and Thorat (1999).

Table 2.5  
**Capacity of State Highways**  
 (Km)

LANE WIDTH	AT THE END OF 10 <sup>TH</sup> PLAN (UPTO YEAR 2007)	AT THE END OF 11 <sup>TH</sup> PLAN (UPTO YEAR 2012)
Single Lane or Intermediate Lane	111,995	101,049
Two-Lane	36,405	60,811
Four-Lane (or more)	2,313	4,269
<b>Total</b>	<b>150,713</b>	<b>166,129</b>

Table 2.6  
**Connectivity of Villages with Roads Achieved upto Year 2000**

POPULATION CATEGORY	TOTAL NUMBER OF VILLAGES	NUMBER OF VILLAGES CONNECTED BY 1980	NUMBER OF VILLAGES CONNECTED BY 1990	NUMBER OF VILLAGES CONNECTED BY 2000
1,500 & above	71,623	37,950 (53)	59,722 (83)	70,000 (98)
1,000-1,500	58,229	21,970 (38)	35,362 (61)	50,000 (86)
Less than 1,000	459,465	107,324 (23)	166,311 (36)	200,000 (43)
<b>Total</b>	<b>589,317</b>	<b>167,244 (28)</b>	<b>261,395 (44)</b>	<b>320,000 (54)</b>

Note: Figures within brackets give the percentage of villages in each population category to the total number of villages in that category. The basis for population is 1981 census. For balance unconnected habitations not eligible under PMGSY.  
 Source: IRC (2001).

## Box 2.2 **Access as an Entitlement**

A joint study by AITD and UN: ESCAP has brought out that wherever there is better access, there is less poverty. Hence, the 'public good' aspect of transport assumes an added significance. Fixed transport infrastructure, such as roads, constitutes such a 'public good' and this raises the issue of entitlement. An entitlement is another name for a right. It is necessary that a new perspective on transport—one deriving from the idea of access as an entitlement—is adopted. The study concluded that most of the benefits that flow from rural access projects are likely to be indirect and intangible, generating significant beneficial externalities. Although these benefits pose measurement problems, it is these very benefits which are likely to be of paramount importance in projects like rural roads, irrigation, education, health and housing.

Source: Study on Evaluation of infrastructural interventions for rural poverty alleviation by AITD and UN: ESCAP.

Table 2.7

**Physical and Financial Progress of PMGSY (as on 31 March 2012)**

PARTICULARS	UNIT	TOTAL ELIGIBLE	ACHIEVEMENT DURING 10 <sup>TH</sup> PLAN	ACHIEVEMENT DURING 11 <sup>TH</sup> PLAN (2007-12)	ACHIEVEMENT AS ON 31 MARCH 2012
Habitations	Number	178,181*	36,694	47,809	84,503
Length	Km	367,673	86,716	122,130	208,846
(a) New Connectivity	Km	374,844	33,861	107,726	141,587
(b) Upgradation	Km	742,517	120,577	229,856	350,433
(c) Total					
Expenditure Incurred	Rs billion		210	705	915

Source: NTDPC Research.

\* There are in all 849,315 habitations in the country. Of these, number of habitations remaining to be connected at the time of PMGSY launch was 346,607. Against this unconnected habitations, eligible habitations under PMGSY are 178,181.

school and dwelling unit. Funds were provided by the states. However, there were several states that could not achieve the intended targets. Table 2.6 gives the connectivity of villages of various population groups achieved upto the year 2000.

**THE PRADHAN MANTRI GRAM SADAK YOJANA (PMGSY)**

In order to give a boost to rural connectivity and to promote balanced development of all districts and states, a rural roads programme known as Pradhan Mantri Gram Sadak Yojana (PMGSY) was launched in December 2000. This programme shifted the focus from the village to the habitation since it was realised that a village may consist of several clusters separated by considerable distance, often mirroring socio-economic stratification. As against 589,000 villages (Table 2.6), there are about 850,000 habitations and the programme envisages connecting all habitations with a population in excess of 500 people in the plains, and 250 people in hill, tribal and desert areas, to the road network. It is a fully funded scheme sponsored by the Central Government to provide all-weather connectivity to previously unconnected rural areas of India. Rural road connectivity is also part of the Central Government scheme known as *Bharat Nirman*. The initial goals under *Bharat Nirman* were slightly more modest in targeting habitations with populations exceeding 1,000 in the plains and 500 in hills, deserts and tribal areas. The actual execution of PMGSY construction is delegated to state governments, but a centrally mandated standards and quality control programme is in place. The PMGSY also provides funds for upgrading rural roads in those districts where all the eligible habitations had been provided with new connectivity. Funds for maintenance are to be provided by the states. The physical and financial progress of PMG-

SY upto the end of the 11<sup>th</sup> Five Year Plan is given in Table 2.7.

**ROAD SECTOR INVESTMENTS IN THE PAST DECADE**

The road sector has seen an unprecedented increase in investments during the last one decade (Table 2.8). It would be seen that investments to the tune of Rs 5,600 billion have been made during the period 2002 to 2012. It is essential therefore to consolidate these investments and ensure they provide quality service to the road users.

**THE ROAD NETWORK ASSET BASE**

It is, of course, extremely difficult to quantify how much a given kilometre of road is worth. Even the broadest estimates, however, may be useful if they also permit quantification of the annual loss in the asset base from want of maintenance and other factors. Amongst the many variables that will influence the replacement value of a kilometre, the more important are: the number of lanes, the difficulty of terrain traversed, the date of construction and quality of material used, the degree of periodic upkeep and current condition of roads and bridges. Of course, the true economic cost will also depend on the availability of transport alternatives, and the time- and rupee-value of transport services executed on the road. Table 2.9 presents a broad ballpark assessment of the current replacement value of the road network for taking a policy view on maintenance. The unit replacement cost assumed here are the average costs for constructing or upgrading the road to a particular capacity under each category of road network. These unit costs are on the lower side than is the current experience.

Table 2.8  
**Investments (Expenditure) on Roads**  
 (Rs billion)

PARTICULARS	10 <sup>TH</sup> FY PLAN (2002-07)			11 <sup>TH</sup> FY PLAN (2007-12)		
	PUBLIC SECTOR	PRIVATE SECTOR	TOTAL	PUBLIC SECTOR	PRIVATE SECTOR	TOTAL
Central Sector	486	NA	486	924	657	1,581
National Highways	474	NA	474	842	657	1,498
E&I, LWE, Tribal, etc.	7	NA	7	33	NA	33
SARDP-NE	6	NA	6	50	NA	50
PMGSY	125	-	125	915	NA	915
<b>Sub Total (I)</b>	<b>611</b>	<b>-</b>	<b>611</b>	<b>1,839</b>	<b>657</b>	<b>2,496</b>
State Sector	683	NA	683	1,800	NA	1,800
<b>Sub Total (II)</b>	<b>683</b>	<b>NA</b>	<b>683</b>	<b>1,800</b>	<b>NA</b>	<b>1,800</b>
<b>Total Roads (I+II)</b>	<b>1,294</b>	<b>NA</b>	<b>1,294</b>	<b>3,640</b>	<b>657</b>	<b>4,297</b>
Say	1,300	NA	1,300	3,640	660	4,300

Source: NTDP Research.

## VEHICLE FLEET AND TRAFFIC FLOWS

The number of vehicles per 1,000 people has more than doubled from 53 to 117 between 2001 and 2011, suggesting large increases in ownership penetration, and the rise of multiple-vehicle ownership within households. Meanwhile, relative to the size of the road network, the vehicle fleet has exhibited more moderate increases: in 2001, there were 328 vehicles per 100 km of road; by 2011, this had increased to 388. With a focus on road widening rather than on new construction, it is possible that *aggregate* network congestion has eased, though no certain data on this is available. The caveat to this suggestion is that network congestion is a complex phenomenon, depending on many factors other than the number of vehicles in use.

The number of registered vehicles is not an accurate guide to the number that are actually in-use. Unregistered vehicles ply on the roads, especially in rural areas, and decommissioned vehicles are often not deregistered. Accurate data on the distribution of vehicles by age is not available. Vehicle counts 7-day, 24 hours are available only on National Highways and selected State Highways. These data are important for understanding the overall fuel efficiency and emissions of the vehicle fleet, and for a better picture on traffic flow patterns.

There is a perceptible shift in rural areas from non-motorised rural transport (camel/bullock carts) used in the movement of passenger and agricultural produce to tractor-trailers, improvised vehicles like juggads; and this has implications on energy, environment and safety.

Indeed, in the absence of detailed nationwide traffic and vehicle use surveys, it is extremely difficult to gain a deeper understanding of geographically disaggregated trip length and routes, travel times, origin-destination pairs, congestion, fuel emissions and vehicle efficiency. These factors are critical to effective long-term network planning by enabling realistic and consistent traffic assessments and preparation of DPRs for new projects.

## INSTITUTIONS

A number of organisations are responsible for the administration of the road network at various levels of government. With the exception of PMGSY roads, MoRTH is the overseeing central agency for the nation's road network. National highways and roads constructed under special development programmes for Left-Wing Extremism (LWE) affected states, Jammu and Kashmir, and the North-East are under its direct mandate. The new MoRTH programmes must have the approval of the Cabinet or the Empowered Group of Ministers. Actual execution of MoRTH

Table 2.9  
**The Replacement Value of India's Road Network, January 2013 Estimates**

		KM ('000)	ROUGH REPLACEMENT COSTS (RS MILLION/KM)	ESTIMATED REPLACEMENT VALUE (RS BILLION)
A	<b>National Highways</b>			
	4-Lane or more	19,000	70	1,330
	2-lane	40,000	20	800
	Single-Lane	19,000	8	152
	Total	78,000		2,282
B	<b>State Highways</b>			
	4-Lane or more	4,000	65	260
	2-Lane	61,000	18	1,098
	Single-Lane	101,000	7	707
	Total	166,000		2,065
C	<b>Major District Roads</b>			
	Mostly single lane	266,000	5	1,330
D	<b>Rural Roads</b>			
	PMGSY	400,000	4	1,600
	Non-PMGSY	2,500,000	1.2	3,000
	Total	2,900,000		4,600
	<b>Grand Total</b>			<b>10,277</b>

Note: This excludes urban roads, project roads and other special roads.  
 Source: NTDP estimates prepared by DP Gupta, former D.G. (Roads) MoRTH.

programme roads is delegated to the NHAI, the BRO or state PWDs. MoRTH is also the central agency for classifying National Highways and defining standards across the entire road network, and for compiling network statistics.

State Highways and Major District Roads are administered by the State Public Works Departments. Projects on these roads are executed by state PWDs.

The Ministry of Rural Development oversees the PMGSY programme through its arm National Rural Roads Development Agency (NRRDA). From the bottom-up, Panchayati Raj and state institutions assist in the formulation of district- and block-level rural roads plan for each district. The district Panchayat is considered the competent authority to prioritise the construction of various roads in the plans. State-level agencies such as the PWDs or Rural Engineering Organisations or Rural Works Departments function as the executing agencies. There may be multiple executing agencies within a state, but execution of the plan for a given district is entrusted to only one agen-

cy at a time. State technical agencies (academic institutions) provide technical support to the executing agencies, scrutinise design plans and cost estimates. State Rural Roads Development Agencies have been gazetted within each state to disburse PMGSY funds to the agencies, and to monitor implementation. The NRRDA provides operational and management support to the programme, including standardisation of design specifications, bidding documents and procurement procedures, quality control during execution and monitoring of progress.

At the state level, the Public Works Departments and the Rural Works Departments are the key institutions for bulk of the road network and their capacity and performance need to be enhanced for efficient delivery of government mandate.

## FUNDING

Investment in road infrastructure has a long gestation period, and returns are typically not seen until several years after construction. This, coupled with

Indian road funding agencies cannot access international equity or debt capital markets directly. As no agency has been corporatised or privatised, access to domestic equity funding is also not feasible. The only option that remains is the domestic debt market

the lumpy and large nature of infrastructure investment, and the public goods nature of roads, has meant that the road network was historically funded mostly from government outlay.

Today, the Indian road network is funded through both government and private sources and from multi-lateral agencies. Government sources consist of funding commitments derived from gross budgetary outlays, though these may stem from earmarked revenue streams, taxes and cesses, or from dedicated road funds. Depending on the classification of the road, funding is available from central government, state governments, or both.

Private funding essentially refers to investments made for building a road asset for which the financial return is the right to levy an agreed toll from the users for an agreed period of time. Ownership of the asset usually returns to the government upon expiry of the contracted period. During this period, the concessionaire is also responsible for maintaining the road to a defined performance standard. Agreements between government and private agencies that determine the precise contours of the latter's funding of road infrastructure come in a very wide variety of flavours. For example, they may or may not include viability gap funding, government revenue or traffic guarantees, and may provide annuities instead of tolling rights and so forth. It is an ongoing challenge to ensure that negotiated agreements are fair to all parties, represent value for money for the government, and do not actually increase the government's risk exposure, and provide for proper allocation of risks between the government and the entrepreneur.

Finally, multi-lateral agencies, foreign governments, and non-governmental organisations provide funding to build roads in order to supplement government funds. Over time, this has become a proportionately less important source. In assessing and contributing to road infrastructure investments, these agencies frequently, though not always, combine economic criteria with other development goals such as poverty alleviation, and access to social infrastructure. The institutional strengthening of road agencies, contractors and consultants are also a part of their financial assistance strategy. The entry of international agencies like the World Bank and the Asian Development Bank did help in enhancing the delivery of road development projects and increased capacity of contractors and consultants.

3. 'Road Fund Knowledge Base', World Bank, 2010, <http://go.worldbank.org/G0UXMX7XD0> (accessed 12 March 2014).

4. Ibid.

## GOVERNMENT FUNDING

### THE CENTRAL ROAD FUND (CRF)

Apart from other budgetary resources, this is the principal mechanism by which roads are funded in India, and is legislated in the Central Road Fund Act of 2000. The Central Government is responsible for the general administration, management and allocation of the fund, and for monitoring the outcomes to which disbursements are applied. The CRF is funded from a two-rupee cess on each litre of high-speed diesel (HSD) and motor spirit (petrol) sold in the country. Table 2.10 gives the allocation of the current CRF accruals. The cess was fixed at this level in March 2005.

The CRF is at present an accounting mechanism, under the Ministry of Finance, without any capacity of its own to negotiate work programmes with road agencies, scrutinise disbursement applications, or commission financial or technical audits of expenditure<sup>3</sup>.

With the increase in fuel prices in recent years, the proportional share of the cess in the fuel value retailed has decreased. Expenditure on fuel and fuel-derived products such as bitumen can account for up to 30 per cent of the actual construction cost of a highway, excluding pre-construction activity such as land acquisition.

### STATE AND OTHER ROAD FUNDS

Some states have also established road funds for state road network development and maintenance. Amongst the states to have already done so are Assam, Kerala, Maharashtra, Rajasthan and Uttar Pradesh, and similar initiatives are under active consideration by Tamil Nadu and Karnataka governments. These state road funds are financed from multiple resources: budgetary support from the Central Government and state government, direct road user charges, additional sales tax on fuel, motor vehicle taxes, fees and tolls, indirect road user charges and taxes. Some states like Haryana, Madhya Pradesh, Punjab levy fee on agriculture products for part deployment in rural roads construction and maintenance. Similar to the CRF, the state road funds are used for both development and maintenance of road network. The UP road fund, however, is dedicated to road maintenance<sup>4</sup>.

## PRIVATE FUNDING

### INTERNAL AND EXTRA-BUDGETARY RESOURCES

Agencies such as the NHAI and state road development authorities also raise extra-budgetary funds by appropriating surplus toll revenues, and from lines of credit from banks and the LIC. The PMGSY, NHDP, and the various states also receive supplementary funding from multi-lateral agencies such as the World Bank and the Asian Development Bank. These funds are usually supplied on concessional terms including repayment moratoria, long terms that are

Table 2.10  
**Allocation of Current CRF Accruals**  
 [Rate of Cess: Rs 2.00 per litre on Diesel and Petrol]

CATEGORY	ALLOCATION	PETROL	DIESEL
National Highways (Administered by MoRTH)	(a) 50 paise per litre on diesel and petrol (b) of the remaining 150 paise per litre, distribution is as under:  (i) 57.5 per cent of 150 paise per litre on petrol (ii) 57.5 per cent of 75 paise per litre on diesel	136.25 paise per litre	93.125 paise per litre
State Highways and Major District Roads (Administered by MoRTH)	(i) 30.0 per cent of 150 paise per litre on petrol (ii) 30.0 per cent of 75 paise per litre on diesel	45.00 paise per litre	22.50 paise per litre
Rural Roads (PMGSY) (Administered by MoRD)	50.0 per cent of 150 paise per litre on diesel	Nil	75.00 paise per litre
Railway over/under bridges and manning of unmanned railway crossings (Administered by Ministry of Railways)	(i) 12.5 per cent of 150 paise per litre on petrol (ii) 12.5 per cent of 75 paise per litre on diesel	18.75 paise per litre	9.375 paise per litre

Source: NTDP Research.

commensurate with the life of the asset created, and below-market interest rates. Separately, multi-lateral agencies have also assisted with implementing new PPP funding mechanisms by providing technical assistance on an appropriate enabling environment that is transparent, competitive, and has clear guidelines for dispute resolution.

#### CAPITAL MARKET FUNDING

In line with usual restrictions on Indian corporate entities, road-funding agencies cannot access international equity or debt capital markets directly. As no road funding agency has been corporatised or privatised, access to domestic equity funding is also not feasible. Consequently, the only option that remains is the domestic debt markets. The NHAI has successfully issued bonds that are deductible on capital gains for many years. More recently, new 10- and 15-year bonds that are fully deductible on interest income and capital gains have proved to be overwhelmingly popular. Long-term infrastructure bonds issued by other entities such as IDFC and IIFCL are also directed towards PPP investment.

Commercial borrowing plays a large, but perhaps sub-optimal, role in the debt component of PPP finance given maturity mismatches. Bank funding is typically available only for shorter maturities. Given the long construction and payback periods of infrastructure assets, the maturity mismatch results in increase of the interest rate at which bank funding for infrastructure can be raised.

#### PPP AGREEMENTS

Together with the revamped CRE, the major innovation in the capacity augmentation of main roads over the previous two decades has been the use of

private enterprise to design, build finance and operate road projects See Box 2.3 for PPP policy arrangements for roads in India.

These PPP arrangements are partnerships in the sense that risk is shared between government and private enterprise, and that both must execute certain tasks for project delivery. The government completes pre-construction activity such as the acquisition of land, conducts feasibility studies, tenders contracts, and supplies any necessary funding for a project to become viable. Private enterprise must supply the bulk of the funding and execute the project for which it is compensated by revenues from the resulting infrastructure.

#### THE BOT-TOLL MODEL

Two versions of the PPP model are commonly employed in India. Under the Build-Operate-Transfer (BOT) toll agreements, the concessionaire is responsible for designing, building, operating and financing the infrastructure to be developed, though the government can supply up to 40 per cent of the project's cost as viability gap funding. The concessionaire is permitted to collect and retain an agreed toll. All risks, including construction, finance, operational, maintenance and commercial risks, are borne by the concessionaire. The concessionaire must deliver the project to an assured quality, including on-time construction. BOT toll agreements are generally better suited to highly trafficked routes in soundly administered jurisdictions where there is little scope for revenue seepage to alternative roads.

This provides a cap on the commercial risk that is borne by the private enterprise. In some instances, the government can choose to provide non-VGF

## Box 2.3

### PPP Policy Arrangements for Roads in India

#### Incentives

Over the past 20 years, several new policy initiatives have assisted in making PPP a viable funding mechanism for India's highways. These policy incentives include:

1. Grants and viability gap funding of up to 40 per cent of project cost for marginal projects
2. 100 per cent automatic FDI for all road development projects
3. A 100 per cent income tax exemption for a period of ten consecutive years within a period of twenty years following the completion of a project
4. Agreements to avoid double taxation
5. Provision of encumbrance-free land for road construction
6. Traffic guarantees in some instances
7. Protection for private investors against force majeure type situations including political, non-political and legislative changes
8. Equity participation of up to 30 per cent by the NHAI in a special purpose vehicle (SPV) set up for road development

#### Model concession agreements

In order to specify the policy and regulatory framework on a fair and transparent basis, a Model Concession Agreement (MCA) for PPPs in National Highways has been introduced. The government also approved a new Model Concession Agreement (MCA), which is considered by some 'a very attractive document as far as lenders are concerned', as it allows for grant funding and government guarantees, is high on transparency, and addresses principal concerns of lenders, such as land acquisition and protection in the event of default.

Source: <http://morth.nic.in/index2.asp?slid=17&sublinkid=9&lang=1> (accessed 12 March 2014).

grants, traffic guarantees to limit the commercial risk of the project, and to also prescribe revenue sharing agreements to participate in any revenue earnings upside. To maximise return on equity, the private concessionaire for BOT contracts will typically aim to contribute about 30 per cent equity to their share of project funding. With the complex nature of risks borne by the developer, and the absence of any feasibility of a lien on the underlying asset, the debt component is typically raised with recourse that is limited to the equity contribution of the developer.

#### THE BOT-ANNUITY MODEL

For several projects, especially in roads that are relatively lightly trafficked, viability gap funding at 40 per cent is not enough at which the project becomes feasible. In this situation, the government may choose to supply either a lump-sum payment, or more commonly an annuity in exchange for the private financing of construction and operation of a project. The toll collected accrues to the government, and the private operator is remunerated via a fixed, periodical payment from the government. Under these contracts, the private operator is responsible both for constructing the road, as well as for operating and maintaining it for a fixed period of time (typically 15 years). Because the break-even point for the private operator does not occur until

late in the contract, this form of PPP transfers both responsibilities for bridge financing and performance risks to the private sector. In addition, because the annuity payment is not indexed, the private sector retains any risk associated with higher than anticipated operations and maintenance costs. Annuity concessions are only paid once the road is constructed to agreed quality standards, thereby rewarding early completion and incentives for quality construction that requires less by way of maintenance. However, the Annuity Model is not a sustainable model for development of road infrastructure due to its heavy burden of contingent liability on the government.

#### PPP FUNDING IN THE 10<sup>TH</sup> AND 11<sup>TH</sup> PLANS

During the 11<sup>th</sup> Five-Year Plan, about 50 per cent of the 10,600 km of National Highways completed under the NHDP were funded through the BOT-Toll model. Around 10 per cent of completed length was paid for through a system of annuities to the concessionaire, with the balance largely in the form of traditional EPC contracts. This is in marked contrast with the 10<sup>th</sup> plan wherein the corresponding figures for 5,445 km built under the BOT toll, annuity, and EPC models were around 10, 10 and 80 per cent respectively. This illustrates the huge impact that toll-based private contracts have had on accelerating capacity augmentation of National Highways.

## SAFETY

According to official statistics, 138,258 people were killed in road traffic crashes in India in 2012<sup>5</sup>. The situation in India has worsened in recent years. Traffic fatalities increased by about 5 per cent per year from 1980 to 2000, and since then have increased by about 6-8 per cent per year for the years for which statistics are available. This is attributable partly to an increase in the number of vehicles on the road, and partly to the absence of a coordinated official policy to control the problem. The fatality rate has increased from 36 fatalities per million persons in 1980 to 115 fatalities per million persons in 2012. There is vast under-reporting of road accidents and resultant minor injuries. Given this under-reporting, fatalities which are much more widely reported—may prove to be a better indicator of road safety. Despite the flaws in the data, there is no denying that road traffic injuries are one of the leading causes of deaths, disabilities, and hospitalisations, with severe socio-economic consequences<sup>6</sup>.

It is possible that about three times that number (~400,000) were permanently disabled and 20 times that number (~ 2.5 million) hospitalised. With vehicle numbers, network size, and accessibility to motorised transport, it can be difficult to uncover the true nature of the severity of the safety problem. From the admittedly patchy data, the following facts hold. First, the absolute number of accidents has increased with time. Safety improvements in cars like seat belt, air bags may have been responsible for making car passenger safer. However, these may not have improved safety for other users. Meanwhile, the roads themselves continue to do users few favours, killing and injuring (on a per kilometer basis) with nearly unchanged intensity over the past twenty years. Finally, the effects of increased motorisation are most apparent when we consider per-capita incident rates which have continued to increase over the years.

Roads in India are being designed primarily for motor vehicles exposing vulnerable road users to greater accident risks. The absence or paucity of footpaths, cycle tracks, and traffic calming measures to reduce speed where non-motorised modes of transport blend with motorised traffic, increases the risk of accidents and their severity.

Of the total road network, national and state highways accounted for 55 per cent of road accidents and 65 per cent of fatalities in 2011, reflecting the larger, faster, traffic flows on these networks. 'Driver error', principally in the form of excessive speed, is alleged to be one of the single most important factors in road accidents, injuries and fatalities. A more modern view is that road design should correct driver behaviour towards safer alternatives; that is, by default,

badly designed roads should be held responsible for accidents rather than bad drivers. Beyond this, however, the absence of reliable data and analysis restricts our ability to identify the causes and factors that characterize road accidents.

If the current safety paradigm persists unchanged, road fatalities and injuries are projected to increase inexorably. By 2030, road crash deaths and injuries in low and middle-income countries are projected to be the 4<sup>th</sup> largest cause of healthy life years lost for the total population compared with malaria (15<sup>th</sup>) and tuberculosis (26<sup>th</sup>), and the leading cause of health losses for children (aged 5-14) and the 2<sup>nd</sup> largest cause for men. Low and middle-income countries already bear around 90 percent of this burden, especially among their vulnerable road users. Unless scaled-up and sustained safety measures are undertaken, escalating health and associated economic losses from road crashes are very likely. Over the next 20 years, India must meet the challenge of bringing its road trauma sustainably under control, if it is to avoid the fatalistic pathway taken by high-income countries during the 20<sup>th</sup> century, where, for far too long, road deaths and injuries were accepted as an inevitable price of economic growth and traded off for mobility gains<sup>7</sup>.

## INTERNATIONAL EXPERIENCES AND LESSONS THEREFROM

### CONTEXT

India's road network compares favourably internationally (see Tables 2.11 and 2.12) in terms of the overall route length and density relative both to population and to land area. However, there remains much to be accomplished on several other fronts such as the design standards, quality of the road network, safety, operation and management, interstate movement, energy efficiency, control on overloading, capacity and performance of road agencies in efficient delivery of road programmes.

Road traffic injuries are one of the leading causes of death and disability in India, with severe socio-economic consequences

### CHINA

China has seen one of the fastest growths in road construction recently, driven by the National Trunk Highway System (NTHS) designed to connect all major cities and provincial capitals with population greater than 500,000 through the construction of 12 major highways. This has now been expanded by the 7-9-18 Highway Network which is intended to link all cities with population above 200,000 to those connected by the NTHS.

5. NCRB (2013).

6. Bliss and Breen (2011), Improving Road Safety Performance: Lessons from International Experience. World Bank Resource Paper, prepared for the NTDP. NTDP Research.

7. Ibid.

Table 2.11  
**International Comparison—Road Network 2004-09  
 (Km)**

COUNTRY	EXPRESSWAYS	HIGHWAYS	SECONDARY ROADS	OTHERS	TOTAL ROADS
Argentina					231,374
Brazil	0	93,071	276,776	1,382,021	1,751,868
China	65,055	59,462	300,686	3,435,620	3,860,823
<b>India</b>		<b>66,754</b>	<b>1,017,763</b>	<b>3,025,275</b>	<b>4,109,592</b>
Mexico	7,056	40,509	78,267	240,975	366,807
Pakistan					258,350
Russia					982,000
South Africa	239	2,887	60,027	300,978	364,131
Thailand	450	51,405	44,000	84,198	180,053
Turkey	2,036	31,271	30,948	298,405	362,660
France	11,240	9,020	381,000	550,000	951,260
Germany	12,813	39,887	178,269	413,000	643,969
Japan	7,642	54,790	129,377	1,016,058	1,207,867
New Zealand	183	10,909	83,209		94,301
Spain	13,014	12,832	140,165	501,053	667,064
UK	3,674	49,032	122,543	244,416	419,665
USA	75,643	19,857	1,930,104	4,520,235	6,545,839

Source: International Road Federation, World Road Statistics, 2011.  
 Expressways are access controlled primary roads, highways and primary roads with partial or no control of access.

### MALAYSIA

The Malaysia Highway Authority was established in 1980 to facilitate the construction of a toll expressway from north to south of the peninsular link to all main towns. Most highways are tolled. As part of an overall master economic development plan called Vision 2020, the government plans to widen the implementation of the Private Finance Initiative (PFI) based projects during the Plan period to increase opportunities for the private sector (Box 2.4).

For the National Highway Development Project (NHDP) of India, the World Bank has studied the impact of the multi-laning of the Golden Quadrilat-

eral on the performance of organised manufacturing. Box 2.5 provides a summary of the impact.

Main lessons emerging from this are:

- i. Each country would have its own planning and policy strategy for development of the road network. NHDP in India has given a good boost to the economy. This project should continue. Similar projects should be undertaken for state highways as well.
- ii. Due to land acquisition constraints, greenfield development is considered advantageous both in terms of speed and least social problems. This strategy would need to be pursued for the India's expressway network development.

Table 2.12  
**International Comparison—Road Network Ratios**

COUNTRY	TOTAL		
	KM/100,000 POPULATION	KM/1000KM <sup>2</sup> LAND AREA	KM/\$ 1BN GDP
Argentina	573	84	627
Brazil	899	207	839
China	288	403	651
<b>India</b>	<b>336</b>	<b>1,382</b>	<b>2,379</b>
Mexico	323	188	354
Pakistan	149	335	1,461
Russia	693	60	663
South Africa	728	300	1,000
Thailand	260	352	565
Turkey	498	471	494
France	1,466	1,485	371
Germany	787	1,847	196
Japan	948	3,314	221
New Zealand	2,159	359	744
Spain	1,448	1,337	474
UK	674	1,734	185
USA	2,116	714	449

Source: International Road Federation, World Road Statistics, 2011.

- iii. Delegation of powers to field level functionaries helps avoid delays in project implementation. Simultaneously, they need to be made responsible and accountable for their performance.

## DESIGN AND OPERATIONAL STANDARDS

### DESIGN TRAFFIC VOLUME AND LEVEL OF SERVICE

A road is designed to cater to the traffic expected on it. Average daily traffic projected to some future design year, typically 15 to 20 years into the future, is an important criterion for determining the number of lanes and even characteristics of a highway. At the planning stage of a proposed highway, the design

traffic volume is determined. If this volume exceeds a certain threshold, then the highway is designed for the functional class consistent with that level. The thresholds for China, South Africa and New Zealand are given in Table 2.13. In some cases, there is an overlap between traffic volume threshold ranges for two functional classes. Other factors besides traffic volume are then considered, such as economic development, and environmental, social and political considerations.

Level of service, LOS, is another factor that influences the decision as to when an arterial road should be expanded or upgraded. Traffic volumes associated with expected levels of service can be considered

## Box 2.4

### Summarising Road-Building Programmes in China and Malaysia

	China	Malaysia
Planning	Develop a good effective master plan for an integrated highway network and link it through regular economic plans	Develop a good, integrated master highway plan
Policy	Implement policies to facilitate desired plan outcomes	Implement policies to facilitate desired plan outcomes
Planning Accountability	Plan formulated mainly by provincial governments; they are responsible for administering construction and loan repayments	Plan developed and projects managed by federal highway authority
Land Acquisition	Greenfield development considered fastest and most productive due to lack of interference from existing networks	Greenfield development considered most advantageous with least social problems
Highway Industry Capacity	International contracts bring advanced technology and better management methods; supply chain improved through institutional reform and privatisation	Early network expansion relied on international contractors for expertise and to build domestic capacity; large projects divided into smaller chunks to allow competition from domestic firms
Regulation and Legislation	Aim to develop regulations, and legislation that supports the overall policy	Separate government department to devise and administer regulations; highway authority solely manages the program
Trade Associations	Support the growth of trade associations; ensure open dialogue with government; promote self-regulation; establish a single apex organisation as 'voice of industry'	Maintain the view that trade associations help build much needed capacity
BOT	The privatisation experiment has been unhappy; government aiming to buy back concessionaires to reduce tolls	Extensive use of PPP; some criticism on speed of transfer to privatised arrangements; dissatisfaction with level and extent of tolling
Alternative Contract Arrangements	Preferring to experiment with pure private funding rather than BOT	Preferring to experiment with pure private funding rather than BOT
Operation and Maintenance Contracts	Used for about 40 per cent of toll expressways	
Building National asset base	Considered vital to complete projects with minimal delay; site staff has decision-making authority	Project level staff to make on-site decisions to avoid delay in project addition to asset base
Dispute Resolution	Typically, there are no disputes.	A new adjudication act is under consideration

Source: NTDP Secretariat and papers received from the World Bank on Cost Effective Standards for Roads and Traffic Based Benchmarks for Widening of Highways versus Construction of Expressways.

## Box 2.5

### Impact of Golden Quadrilateral NHDP for Location and Performance of Manufacturing Sector

The Golden Quadrilateral National Highway project sought to improve the connection of four major cities: Delhi, Mumbai, Chennai and Kolkata. It comprises 5846 km connecting several industrial, agricultural and cultural centres of India. The study on the impact of the GQ highway upgrades on the performance of the organised manufacturing revealed that the GQ upgrades have increased new entry the most in high- and medium-density districts that lie 0-10 km from the GQ network. For instance, moderate-density districts, like Surat in Gujarat or Srikakulam in Andhra Pradesh, that lie on the GQ highway registered more than 100 per cent increase in new output and new establishment counts after GQ upgrades. On the other hand, the GQ upgrades are not linked to heightened entry or performance in low-density areas. One interpretation of these results is that the improved connectivity enables manufacturing establishments to efficiently locate in intermediate cities, but that localization economies prevalent for the sector continue to preclude entry in low-density places.

The project improved the connectivity and market accessibility of districts lying close to the highway compared to those more removed. Non-nodal districts located within 0-10 km from the GQ network experienced substantial increases in entry levels and higher productivity. These patterns are absent in districts 10-50 km away. The data suggest that there might have even been declines in entry rates in districts farther away. Dynamic specifications and comparisons to the NS-EW highway system mostly confirm these conclusions, with the most substantial caveat being that the productivity gains may be upwardly biased by a pre-period dip. The GQ upgrades also appear to have facilitated a more natural sorting of industries that are land and building intensive from the nodal districts into the periphery locations; the upgrades also appear to be encouraging decentralization by making intermediate cities more attractive for manufacturing entrants.

Source: Highway to Success in India: The impact of the Golden Quadrilateral Project for the location and performance of Manufacturing by Ejaz Ghani et al., January 2013, World Bank Policy Research Working Paper 6320.

to assess implicit benchmark volumes. The level of service reflects the operating conditions of the road in terms of traffic performance measures related to speed and travel time, freedom to manoeuvre, traffic interruptions, and comfort and convenience<sup>8</sup>. In the United States, as well as in a number of other countries, there are six levels of service from LOS A (least congested) to LOS F (most congested) as shown in Table 2.14.

Table 2.15 shows the maximum density, volume-capacity (v/c) ratio and service flow rates for various LOS for multi-lane highways in the United States. It is seen that for each level of service, there is a maximum acceptable traffic flow for that level of service.

Typically, there is a specified design LOS for each class of highway at the planning stage. The design LOS is the minimum LOS that the highway should provide before it reaches its design year. It also indicates that when the actual LOS of a highway is worse than its design LOS, the highway should be widened or upgraded so it provides the design LOS. For arterials in rural level area, the design LOS is B, which means that if the free-flow speed of an arterial in rural level area is 50 mi/h, the maximum accepted traffic volume is 900 pcu/lane/hr.

LOS performance is based largely on hourly performance.

Tables 2.16 and 2.17 present operational service levels for Freeways in China and in the United States.

For the same level of service, freeways in China and the United States are allowed to have more congestion (expressed as a higher vehicle-to-capacity ratio) than other highways. For example, for intermediate service levels of 2 and 3 for Chinese freeways, the vehicle-to-capacity ratios are 0.74 and 0.88. However, for Chinese Class I Highways, the corresponding values of vehicle-to-capacity ratios are 0.65 and 0.80.

The hourly lane capacities (corresponding to LOS E) for the United States is 2,250-2,400 passenger cars. The corresponding figure for Chinese freeways is 2,000-2,200 passenger cars. For the US Multilane Highways and Chinese Class I Highways, the hourly lane capacities are 1,900-2,200 and 1,600-2,000 respectively. United Kingdom Motorways (Freeways) have a range of hourly lane capacities (1,800-2,000) similar to that of Chinese Class I Highways. However, Single Carriageway (undivided highways) have lower hourly lane capacities.

8. TRB (2000).

Table 2.13  
**Traffic Thresholds**

ROAD CLASS	CARRIAGEWAY WIDTH	THRESHOLD TRAFFIC VOLUME (AVERAGE DAILY TRAFFIC)		
		CHINA	SOUTH AFRICA	NEW ZEALAND
Freeway	4-lane	25,000-55,000	15,000	>8,000
	6-lane	45,000-80,000		
	8-lane	60,000-100,000		
Class I	4-lane	15,000-30,000	8,000-10,000	<12,000
	6-lane	25,000-55,000		
Class II	2-lane	5,000-15,000		
Class III	2-lane	2,000-6,000		

Source: K. C. Sinha et al. (June 2011).

Table 2.14  
**Highway Levels of Service in United States (AASHTO\*, 2004)**

LEVEL OF SERVICE	GENERAL OPERATING CONDITIONS
A	Free flow
B	Reasonably free flow
C	Stable flow
D	Approaching unstable flow
E	Unstable flow
F	Forced or breakdown flow

Source: K. C. Sinha et al. (June 2011).  
Note: \*American Association of State Highway and Transportation Officials.

Table 2.15

## Capacity and Operational Service Levels for Multi-lane Highways in the US (AASHTO, 2004)

FREE-FLOW SPEED	CRITERIA	LEVEL OF SERVICE				
		A	B	C	D	E
	Maximum Density (pc/mi/lane)	11	18	26	35	40
50 mi/h	Average Speed (mi/h)	50	50	50	48.9	47.5
	Maximum v/c	0.28	0.45	0.65	0.86	1.00
	Maximum Service Flow Rate (pc/h/lane)	550	900	1,300	1,710	2,000
45 mi/h	Average Speed (mi/h)	45	45	45	44.4	42.2
	Maximum v/c	0.26	0.43	0.62	0.82	1.00
	Maximum Service Flow rate (pc/h/lane)	490	810	1,170	1,550	1,900

Note: pc/h/lane means passenger car per hour per lane, pcmi/lane means passenger car per mile per lane.

Source: World Bank Paper for NTDP on Traffic-Based Benchmarks for Widening of National Highways Versus Construction of Expressways, by Kumares C. Sinha et al. (July 2011).

Table 2.16

## Capacity and Operational Service Levels for Freeways in China

DESIGN SPEED	CRITERIA	LEVEL OF SERVICE				
		1	2	3	4	4
	Density (passenger cars/km/lane)	<7	<18	<25	<45	>45
Design Speed = 120 km/hr	Speed (km/hr)	>109	>90	>78	>48	<48
	Volume/Capacity Ratio	0.34	0.74	0.88	1.00	>1.00
	Maximum Service for Transportation Volume (passenger cars/hr/lane)	750	1,600	1,950	<2,200	0-2,200
Design Speed = 100 km/hr	Speed (km/hr)	>92	>97	>71	>47	<47
	Volume/Capacity Ratio	0.31	0.67	0.86	1.00	>1.00
	Maximum Service for Transportation Volume (passenger cars/hr/lane)	650	1,400	1,800	<2,100	0-2,100
Design Speed = 80 km/hr	Speed (km/hr)	>74	>66	>60	>45	<45
	Volume/Capacity Ratio	0.25	0.60	0.75	1.00	>1.00
	Maximum Service for Transportation Volume (passenger cars/hr/lane)	500	1,200	1,500	<2,000	0-2,000

Source: Ministry of Construction, China, 2004.

Table 2.17  
**Capacity and Operational Service Levels for Freeways in the United States**

CRITERIA	LEVEL OF SERVICE				
	A	B	C	D	E
Maximum Density (passenger car/km/lane)	7	11	16	22	28
<b>Free Flow Speed = 120 km/hr</b>					
Minimum Speed (km/hr)	120	120	114.6	99.6	85.7
Maximum Volume/Capacity Ratio	0.35	0.55	0.77	0.92	1.00
Maximum Service Flow Rate (passenger car/hr/lane)	840	1,320	1,840	2,200	2,400
<b>Free Flow Speed= 110 km/hr</b>					
Minimum Speed (km/hr)	110	110	108.5	97.2	83.9
Maximum Volume/Capacity Ratio	0.33	0.51	0.74	0.91	1.00
Maximum service flow rate (passenger car/hr/lane)	770	1,210	1,740	2,135	2,350
<b>Free Flow Speed= 100 km/hr</b>					
Minimum Speed (km/hr)	100	100	100	93.8	82.1
Maximum Volume/Capacity Ratio	0.30	0.48	0.70	0.90	1.00
Maximum Service Flow Rate (passenger car/hr/lane)	700	1,100	1,600	2,065	2,300
<b>Free flow Speed = 90 km/hr</b>					
Minimum Speed (km/hr)	90	90	90	89.1	80.4
Maximum Volume/Capacity Ratio	0.28	0.44	0.64	0.87	1.00
Maximum Service Flow Rate (passenger car/hr/lane)	630	990	1,440	1,955	2,250

Source: World Bank Paper for NTDP on Cost Effective Standards for Different Types of Roads by Kumares C. Sinha et al, USA (June 2011).

### CONCEPT OF 2+1 ROAD SECTIONS

Several European countries have published standards on the design of 2+1 roads. A 2+1 road consists of two lanes dedicated to travel in opposite directions and a lane in the middle with alternating travel directions for the purpose of passing or turning. These roads involve either the new construction or the conversion of a two-lane facility (single lane in each direction) to three lane facility to defer expansion to a four-lane facility. Table 2.18 shows the longitudinal and transverse design standards implemented by Germany, Sweden, Ireland, Finland and South Korea.

The stated values for length of the passing section provide motorists a more generous opportunity for overtaking than passing sections available for US two-lane highways<sup>9</sup>. Such an opportunity causes

drivers to execute the passing manoeuvre with a more relaxed approach and consequently reduces crash frequency.

Main lessons emerging from these standards are:

- i. The above capacity standards may not apply in India since there is a considerable mix of motorised and non-motorised traffic on roads in India both in urban areas and on inter-city highways. There is urgent need for development of a Highway Capacity Manual specific to India. It is understood that some research work has started in this direction by the Central Road Research Institute. This needs to be expedited and overseen by the Ministry of Road Transport and Highways.
- ii. The capacity standards specified by the IRC

9. Lee et al. (2012); FHWA (2005).

Table 2.18  
**Design Standards for 2+1 Road Sections in Selected Countries**

	SWEDEN	GERMANY	FINLAND	IRELAND	SOUTH KOREA
Diverging Area Length: L <sub>nc</sub> (m)	100	30	50	50	90
Junction Length: L <sub>c</sub> (m)	300	180	500	300	280
Length Of Passing Section: L <sub>p</sub> (km)	1.00 to 1.25	1.00 to 1.40	1.50	1.00 to 2.00	1.00 to 1.50
Total Length: L (km)	1.40 to 1.65	1.21 to 1.61	2.05	1.35 to 2.35	1.37 to 1.87
Lane Width (m)					
First Traveled Lane	3.75	3.50-4.25	3.75	3.50	
Second Traveled Lane	3.25	3.25-3.50	3.50	3.50	
Passing/Turning Lane	3.25	3.25	3.25	3.50	
Shoulder Width (m)	1.00	0.25	1.25	0.50-1.00	

Source: World Bank Paper for NTDP on Cost Effective Standards for Different Types of Roads by Kumares C. Sinha et al., USA (June 2011).

need immediate review particularly in respect of multilane highways. From Tables 2.15 to 2.17, it is observed that there is no perceptible decrease in operating speed under LOS C compared to that under LOS B and yet 40 per cent more traffic can be carried. The current Indian practice of designing roads for LOS B could be reviewed if studies in India show similar results. Adopting LOS C for design will imply more intensive use of the highway and it will also enable postponement of avoidable investment in capacity augmentation without any significant decrease in operational speeds.

- iii. The 2+1 road section should not be considered at the current stage of road development in India until we have experimented with such designs and evolved specifications suitable for Indian traffic conditions on intercity roads.

### ROAD ASSETS: PRESERVATION AND MANAGEMENT

In the 1980s, the growing perception of widespread failures in road maintenance led to a series of World Bank studies and these studies culminated in the publication in 1988 of Road Deterioration in Developing Countries (RDDC). The report asserted that sound road asset development and maintenance required that:

- A coalition of private and public stakeholders asserts 'ownership' of the road asset development functions.
- Road user costs and life-cycle analysis of road agency costs are both taken into account in

public policy decisions concerning road development and management.

- Owners of the road network set up adequate funding mechanisms to sustain maintenance and capital renewal.
- Road maintenance and renewal works are carried out by bodies separate from the public road planning and administration bodies, contracted out in competitively tendered contracts.
- The more broadly engaged owners of the road network establish strong accountability and incentives aligned with the public interest among road administration, funding sources, planners, executing agencies and contractors. Quantitative performance measures are set and monitored regularly to support accountability.

Table 2.19 summarises the extent to which the above prescriptions have been applied in selected countries.

Main lessons emerging from these practices are:

- i. Long-term (five years or more) performance-based maintenance contracts have encouraged contractors to invest in economically efficient maintenance actions and purchase of proper maintenance equipment. While PPP approaches have in-built provisions for long-term maintenance for projects undertaken through EPC mode, it is inevitable to move towards outsourcing of maintenance on a long term basis.
- ii. Success of outsourcing depends upon proper

Table 2.19

## Cross-Country Comparison of Adherence by Successful Countries to Key Recommendations of 'Road Deterioration in Developing Countries'

COUNTRY	COALITION OF DIVERSE STAKEHOLDERS FOR GOOD ROADS	PLANNING BASED ON HOLISTIC COST ANALYSIS	SUSTAINED FUNDING MECHANISM	OUTSOURCING		QUANTITATIVE PERFORMANCE MONITORING
				WORKS DESIGN & SUPERVISION OUTSOURCED TO 'ENGINEER'	EXECUTION OUTSOURCED TO 'CONTRACTOR'	
South Africa	Yes, sustained, but has evolved from broad stakeholder representation to more specialised board of professionals	Yes, sustained application of HDM-4	Yes, adequate funding sustained by taxes, tolls, and toll-backed borrowing, but earmarking discontinued	Yes, the engineer functions were corporatized in SANRAL, providing Full management flexibility as owner of National Roads	Yes, sustained	Yes, with sustained annual measurements of national roads condition
Rest of Sub-Saharan Africa	Extensive experimentation, with widely varying results	At least one strategic application in most countries, but mostly ad hoc, not sustained	Much improved across the region, but still major problem due to low population and low GDP per road-km	In some cases	In many cases	Extensive experimentation, but generally not well sustained
Argentina	No specific coalition, but concessionaires and contractors well incentivised for high road quality	Yes, sustained application of HDM-4	Yes, long-term contract funding sustained even through major fiscal crisis	No, the engineer functions have been retained in the government highways authority	Yes, sustained with major innovations in contracts to offset risks and incentivise contractors	Yes, sustained

Source: World Bank paper for NTDP on Road Asset Management by Clell Harral, et al. (May 2011).

contractual framework, risk allocation mechanism and governance environment covering financial management, effective internal and external audits, accountability and responsiveness of road agencies to the needs/expectations of road users.

- iii. Application of ICT measures offers promise to enhance performance. Quality of road agencies in planning, contract procurement and administration is the prime determinant of success in providing a good road infrastructure to society.

### DIRECT CHARGING FOR HIGHWAY USE

Direct charging mechanisms to transfer the costs of construction, maintenance and operations to users is widely practiced in several countries. These include user fees paid to the road agency that reflects the amount of time or extent of highway use. Table 2.20 provides a summary of direct charge pricing schemes in Europe and Singapore. It would be seen that some of the general contexts of direct charging

include levy of toll, congestion pricing, cordon fee, distance/weight based fees.

In some European countries (Box 2.6) such as Switzerland, Austria, Germany, Czech Republic, Slovak Republic, heavy goods vehicles (HGV) or commercial vehicles are required to pay tolls proportional to distance travelled on some, or all, major roads. None of these schemes is designed for congestion pricing although Austrian and German technologies permit some differentiation of tolls by time and location.

Several countries have studied distance-based charges for passenger vehicles (Box 2.7). Depending on the technology, the fee could be varied by time, distance, and location to price based on congestion. In the UK and the Netherlands, such schemes have not yet been implemented due to political opposition. In the United States, the use of a Vehicle Miles Travelled (VMT) fee as a long-run alternative to fuel taxes as the primary funding mechanism for roads is being considered, although the current political climate does not

Table 2.20  
**Summary of Direct Charge Pricing Schemes in Europe and Singapore**

	SYSTEM	PURPOSE/OBJECTIVE	TYPE OF PRICING	MILESTONE DATES	TECHNOLOGY	MEASURED IMPACTS	ANNUAL REVENUES AND COST (IN USD)	DISTRIBUTION OF NET REVENUES
Demand Management	<b>Stockholm, Sweden:</b> Congestion Tax	Manage Congestion (primary)  Promote Transit and protect Environment (secondary)	Cordon pricing in city center by time of day at SEK10 to SEK20 (about US\$1.50 to US\$3) per crossing of cordon line into and out of city center	Trial: January–July 2006  Referendum: September 2006  Permanently reinstated: August 2007	Automated number plate recognition (ANPR) to assess tax to vehicle owner	20 per cent reduction in traffic congestion in the city center  10-14 per cent decrease in emissions	Gross revenues (2009): SEK850 million (US\$118.5 million)  Net revenues (2009): SEK530 million (US\$74 million)  Overhead costs: SEK320 million (US\$44.5 million), about 37 per cent of revenues	Collected by national government and transferred to the city of Stockholm  Net revenues used to invest in transit and new roads
	<b>London, United Kingdom:</b> Congestion Charge	Manage Congestion (primary)  Promote Transit and Protect Environment (secondary)	Area pricing in central London and its Western extension  Flat daily rate of £8 (US\$13)	Started in Central London: February 2003  Price increased from £5 to £8 (60 per cent increase) in July 2005  Western extension: February 2007  Repeal of western extension: planned in 2010	ANPR to track compulsory payment compliance and identify violators	Initial traffic reductions of 25 per cent and 19 per cent (central London and western extension, respectively)	Gross revenues (2008): £268 million (US\$435 million)  Net revenues: £137 million (US\$222 million)  Overhead costs: £131 million (US\$212 million), about 50 per cent of Revenues  Capital costs for central London zone: £130 million (US\$211 million)	Net revenues used for transit (80 per cent) and other transport (20 per cent) Improvements within greater London
Revenue Generation	<b>Singapore:</b> Electronic Road Pricing (ERP)	Manage congestion (primary)  Promote transit (secondary)	Cordon and expressway pricing by time of day and vehicle class	Cordon pricing via manually enforced paper permit system in 1975  Transition to ERP in 1998, followed by expressway pricing	Dedicated short Range Communication (DSRC) in-vehicle units with removable stored-value smart card for payment  ANPR for enforcement	Achieves free flow road speed targets of 45–65 km/h on expressways and 20–30 km/h on arterials.	Gross revenues (2008): SG\$125 million (US\$90 millions)  Net revenues: SG\$100 million (US\$72 million)  Overhead costs: SG\$25 million (US\$18 million), 20 per cent of gross revenues	Net revenues returned to vehicle owners through tax rebates – heavy investment from general fund in transit and highway systems

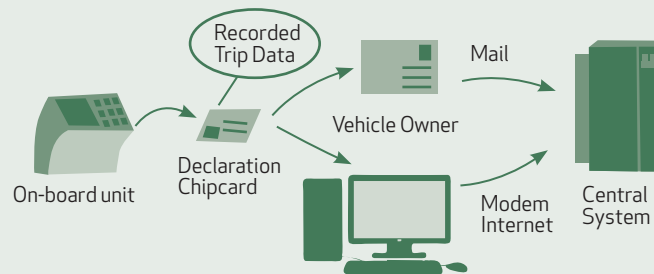
	SYSTEM	PURPOSE/OBJECTIVE	TYPE OF PRICING	MILESTONE DATES	TECHNOLOGY	MEASURED IMPACTS	ANNUAL REVENUES AND COST (IN USD)	DISTRIBUTION OF NET REVENUES
Revenue Generation	<b>Germany:</b> Heavy Goods Vehicle (HGV) Charging on Highways	Generate revenue and promote user pays principle (primary)  Protect environment and encourage mode shift to rail and water (secondary)	Truck tolls for HGVs greater than 12 metric tons on the autobahn and limited portions of other National Highways based on distance traveled, number of axles, and emissions class	Opened in January 2005	Global Positioning System (GPS) for vehicle location  Global System for Mobile Communications (GSM) for data Transmission  DSRC and ANPR for Enforcement  Manual booking system via kiosk terminals and Internet for those without on-board units	Violations less than 2 per cent  Empty truck trips declined by 7 per cent  58 Per cent shift from dirtier truck models (Euro class 1, 2, 3) to cleaner trucks (Euro class 4, 5)	Gross revenue (2008): €3 to 5 billion (US\$5 billion)  Overhead costs: 15–20 per cent of gross revenues  Average toll rate: €0.163 per km (US\$0.378 per mi)	Net revenues for roads (50 per cent), rail (38 per cent), and Waterways (12 per cent)  €560 million (US\$815 million) per year for Truckers 'harmonization' programme
	Czech Republic: Truck Charging on Highways	Generate revenue and promote user pays principle (primary)  Advance environmental objectives (secondary)	Truck charges on selected National Highways based on distance traveled, number of axles, and emissions class	Opening: January 2007  Originally for HGVs >12 metric tons  Expansion to include trucks >3.5 metric tons in January 2010	Transponder-based DSRC system with gantries on mainline highways  ANPR for enforcement	Average toll rate of US\$0.35 per mi on freeways	Gross revenue (2008): CZK6 billion (US\$340 millions)  Overhead costs: 30 per cent of gross revenues  Average toll rate: CZK4.05 per km (US\$0.36 per mi) for highways; CZK1.90 per km (US\$0.17 per mi) for first-class roads	Net revenues for roads and highways, railway lines, and inland transport routes
Demand Planning	<b>The Netherlands:</b> National Distance Based Tax (The plan has been dropped in 2010 due to political inaction)	Manage congestion, replace vehicle tax revenue, and promote user-pays principle (primary)  Promote transit and protect environment (secondary)	National distance based road pricing of all vehicles (commercial trucks and private cars) on all roadways	Phased implementation was originally planned to begin in 2011, with all trucks covered by 2012 and all vehicles by 2018  Implementation is on hold	Under development, likely GPS for vehicle location, GSM-based data communication, and DSRC interrogation with ANPR for enforcement	2020 forecasted results: 5-10 per cent reduction in vehicle-miles traveled  40–60 per cent reduction in delays  10 per cent reduction in CO <sub>2</sub>  6 per cent increase in public transit use	Gross revenues (2019 forecasted): €9 billion ((US\$13.1 billion)  Overhead costs: to be determined (capped in law at 5 per cent of gross revenues)  Capital costs (estimated): €5.7 Billion (US\$8.3 Billion)	Revenues intended to replace existing vehicle ownership taxes

Source: World Bank Paper for NTDP on Direct Charging Mechanisms for Highway Use by Kumares C. Sinha et al. (July 2011). (Adapted from FHWA 2010).

## Box 2.6

### Distance-based Heavy Goods Vehicle Schemes in Europe

The **Swiss** toll applies to HGVs over 3.5 metric tonnes gross vehicle weight and is paid on the entire 71,000 km national road network. It is differentiated by emissions class but not by type of road or time of day. Distance is recorded using a digital tachograph and a smart card. The unit is activated by roadside dedicated short-range communication device (DSRC) transponders when a vehicle enters the country, and it is deactivated when the vehicle exits. Charges are paid by inserting the smart card into a roadside terminal.



Billing procedure of Swiss HGV distance-based pricing scheme

In contrast to the Swiss system, HGV tolls in **Austria** are only charged on the 2,060 km primary road network and are not differentiated by emissions class. An on-board unit called a “Go Box” is used for communications. It uses DSRC microwave technology, is attached to the windscreen, and can be easily set to register the number of axles on the truck and trailer. Such pricing schemes in European countries offer interoperability or seamless travel. For instance, the Swiss on-board unit (OBU) can be used in Austria as an alternative to the “Go Box”.

**Germany’s** HGV scheme “Toll Collect” applies to federal motorways and some secondary roads (12,000 km in total). Toll differentiation is similar to Switzerland, but the technology is more advanced, using GPS to measure distance. DSRC beacons are used for backup location information. The system is scalable in that more roads can be added, and the technology allows tolls to be differentiated by road type and time of day.

Source: World Bank Paper for NTDP on Direct Charging Mechanisms for Highway Use, Kumares C. Sinha et al. (July 2011).

favour such a scheme. Several US experiments with regional distance-based pricing have been conducted that provide evidence on the technological possibilities and challenges.

Main lessons emerging from these practices are:

- i. Road toll is a good mechanism for direct charging for road use and to generate additional revenues. The current practice of levy of tolls for use of multi-lane highways in India should continue.
- ii. For collection of tolls, manual toll booths are prone to revenue leakage. It is, therefore, preferable to switch over to electronic toll collection. A transparent system improves confidence of the general public. There is need to display toll collected upto date at each toll plaza.
- iii. Toll charges may be dynamic, different for peak and non-peak periods.

- iv. The policy of weight-distance charges being implemented for heavy goods vehicles in Europe should be introduced in India to generate additional revenues.
- v. Linking the rates/charges to the benefits received by the users contributes to public acceptance. There is a strong case, therefore, for a detailed highway allocation study that should capture the costs occasioned by different class of vehicles on road construction and maintenance. Evidence-based research in this direction is of paramount importance. This would help the government in facing the occasional threats/concerns by the transporters and truckers as they do believe/perceive that benefits received by them are not commensurate with the taxes and toll charges being recovered.

## Box 2.7

### Experimental Distance-based Passenger Vehicle Schemes

- Oregon VMT Pricing Pilot Project (2004–06)
  - Assessed viability of distance-based charges as a replacement for fuel taxes.
  - Charges defined by zone and peak/non-peak periods
  - Test vehicles equipped with GPS devices that recorded mileage
  - Individual vehicle movements cannot be tracked
  - Distance-based charge paid automatically when vehicles refuel at participating gasoline stations
  - State fuel tax was deducted from the bill
  - Conclusion: GPS technology is reliable; privacy protection can be assured.
- Puget Sound Regional Council assessed the merits of several road-pricing schemes (2002–2008)
  - Examined driver responses to network-wide facility based tolls
  - Tolls were varied by road class, peak/non-peak period
  - Unlike Oregon, GIS used with GPS; distances travelled on freeways and arterials recorded separately
- University of Iowa Study (2005)
  - Assessed feasibility of GPS-based tolling technology, gauged driver response and public attitudes
  - GIS is used in combination with GPS to record distances within the region, to compute charges on the vehicle, and to download updates to the database
  - Only aggregate charging data is transmitted from the vehicle
  - Unlike in the Oregon and Puget Sound studies, tolls are flat

Source: World Bank Paper for NTDP on Direct Charging Mechanisms for Highway Use, Kumares C. Sinha et al. (July 2011).

### USE OF INTELLIGENT TRANSPORT SYSTEMS

ITS has been deployed by several countries to provide a number of services to enhance the operational performance of highway networks by increasing user awareness of traffic conditions and alternative routing opportunities. The deployment status of ITS services and application areas in different countries is presented in Table 2.21.

Main lessons emerging from this are:

- i. The ongoing advances in information and communication continue to lower the cost of ITS deployment.
- ii. ITS can be installed at the time of development of road infrastructure (to save on additional retrofitting cost later on).
- iii. Low cost incident management systems (highway service patrols, call centres) are most cost-effective ITS.
- iv. Electronic Toll Collection has helped reduce congestion at toll booths besides ensuring transaction security and reducing revenue leakage.
- v. ITS application in Commercial Vehicle Operations is critical to the productivity and effi-

ciency of trucking and interstate bus operations. Such applications are designed to enhance commercial vehicle safety, communication between carriers and consignors/consignees, fleet management and facilitate regulatory processes. They help in seamless movements across states.

- vi. To start with, a simple ITS architecture and gradual phasing-in of ITS components is preferable.

### ROAD SAFETY

Road safety is a matter of grave concern in India. Box 2.8 gives a glimpse of some of the best international practices.

A Report of the Sundar Committee on Road Safety and Traffic Management was submitted to the MoRTH in February 2007. Based on this report, the National Road Safety and Traffic Management Board Bill, 2010, was submitted to the Lok Sabha in 2010 and considered by the Standing Committee On Transport, Tourism & Culture. The Bill was referred back to the MoRTH for reconsideration and it has not yet been resubmitted to the Parliament. The

Table 2. 21

## Deployment Status of Selected ITS Application Areas in Different Countries

APPLICATION AREAS OF FOCUS	SUB-AREAS I	SUB-AREAS II	SELECTED COUNTRIES WITH EXPERIENCE
Advanced Traffic Management Systems	Incident Management	Service Patrols and Call Centres	US, Europe
		Automated Systems	US, Europe, China, Malaysia, South Korea, South Africa
	Electronic Toll Collection (ETC)	ETC Systems	US, Europe, China, Malaysia, South Korea, South Africa, India, Singapore
	Arterial Management	Adaptive Traffic Control Systems	US, Europe, China, India, Thailand, South Korea, Brazil
		Automated Enforcement (red light, speed limit)	US, Europe, South Africa
	Demand Management	Ramp Metering	US, Europe, South Africa
		Managed Lanes	US, Europe
Advanced Traveller Information Systems		Variable Message Signs	US, Europe, China, Malaysia, Thailand, South Korea
		Internet/Mobile Applications	US, Europe, Malaysia, Thailand, South Korea
		Call Centres	US, Europe
Commercial Vehicle Operations		Credentials Administration	US, Europe
		Safety Assurance	US, Europe
		Electronic Screening	US, Europe
		Carrier Operations and Fleet Management	US, Europe, Brazil
		Security Operations	US, Europe

Source: Resource Paper by World Bank for NTDP.

main recommendations of the Sundar Committee report are:

- The National Road Safety and Traffic Management Board should be established through an Act of the Parliament called the National Road Safety and Traffic Management Act.
- It should address road safety issues in respect of the National Highways and Mechanically Propelled Vehicles and make recommendations and set guidelines on road safety on other roads. It should contain enabling provisions to set up Road Safety and Traffic Management Boards in the states. It should also encompass the provisions related to road safety contained in the other relevant Acts like the Motor Vehicles Act. The Parliament is competent to legislate on Road Safety and Traffic Management in respect of National Highways and Mechanically Propelled Vehicles as they fall in List II of Schedule VII of the Constitution. This Act should be administered by the Ministry of Road Transport and Highways.
- The primary objective of this Board would be to promote road safety and improve traffic management in India. It would be responsible for the following functions:
  - Road related measures: designing, setting standards and conducting audits
  - Vehicle related measures: prescribing safety features and setting standards
  - Road safety research: institutional linkages and training
  - Traffic laws, operations and management
  - Capacity building
  - Medical care and rehabilitation: Lay down

## Box 2.8

### Best Practices: Systematic Road Safety

#### SWEDEN

In 1997, the Swedish Parliament adopted the Vision Zero, a bold new road safety policy based on four principles:

- i. Ethics: Human life and health are paramount; they take priority over mobility and other objectives of the road transport system;
- ii. Responsibility chain: The providers, professional organisations and professional users are responsible for the safety of the system. The users have the responsibility to follow rules and regulations. If the road users fail to follow rules and regulations, the responsibility falls back on the providers of the system;
- iii. Safety philosophy: Humans make errors; road transport systems should minimise the opportunity for error and the harm done when errors occur;
- iv. Driving mechanisms for change: Providers and enforcers of the road transport system must do their utmost to guarantee the safety of all citizens and each of the participants should be ready to change to achieve safety.

#### Who is involved?

The Swedish Road Administration (SRA) has the overall responsibility for road safety within the road transport system. According to the principles of Vision Zero, all other stakeholders in the field of road transport also have responsibilities for ensuring and improving road safety.

#### How effective and costly is it?

Vision Zero is estimated to achieve a possible reduction in the number of deaths by a quarter to one third over a 10-year period. The adoption of Vision Zero in Sweden helped in developing further research and implementing a new system design. It helped in the implementation of the upgrading of single carriageways to 2+1 lanes roads with central cable barriers to shield drivers from opposite traffic.

#### THE NETHERLANDS

A Sustainable Safe road system aims to prevent crashes and if they still occur, to minimise their consequences. It is based on the idea that people make mistakes and are physically vulnerable. There are five main principles: functionality, homogeneity, predictability, forgivingness, and state awareness. The Sustainable Safety vision has a large influence on road safety work in practice, and has led and still leads to the implementation of effective and sustainable road safety measures. For example, one of the consequences of the principle of homogeneity is that motorised traffic and vulnerable road users (pedestrians, cyclists) can only interact if speeds of motorised traffic are low. If speeds cannot be kept low, separate facilities for vulnerable road users are required.

#### Who is involved?

Sustainable Safety has been the leading vision in the road safety policy of the Netherlands since the early nineties. The road authorities at the different levels (national, regional and local) actually implement the Sustainable Safety measures.

#### How effective and costly is it?

It has been estimated that the infrastructure measures of the sustainable safety approach reduced the number of fatalities and in-patients by 6 per cent nationwide. Costs, in particular those related

to reconstruction of roads are high, but can largely be combined in the budget for regular maintenance work.

### AUSTRALIA AND NEW ZEALAND

Road authorities in Australia and New Zealand have committed to the Safe System approach as a conceptual framework which guides all activities relating to the provision and operation of roads. In managing road safety, the safe system approach implies:

- Designing, constructing and maintaining a road system to reduce fatal or debilitating injury accidents.
- Improving roads and roadsides to reduce the risk of crashes and minimise harm.
- Regulating or encouraging high quality active and passive safety systems in vehicles to reduce impact forces on occupants and on struck pedestrians and cyclists.
- Managing speeds, taking into account the risks on different parts of the road system. Advising, educating and encouraging road users to obey road rules and to be unimpaired, alert and responsive to potentially high-risk situations.
- Using enforcement and penalties to deter road users from breaking the rules, including removing the privilege of road use from those who do not comply.
- Program research to identify the most cost-effective interventions for particular situations. Promoting public understanding and endorsement of the safe system approach, and public participation in achieving a safer road system.

Source: Europa Road Safety Handbook, 2009

guidelines for establishing and upgrading trauma care systems at all levels

- The Committee noted that the Committee on Infrastructure decided that one per cent of the cess accruing to the National Highways should be employed to create a National Road Safety Fund. The Committee was of the considered view that a minimum of one per cent of the total proceeds of the cess on diesel and petrol should be available to the Road Safety Fund of Centre and the states, as road safety is a matter of concern not only on National Highways but also on the state roads, village roads and railway level crossings.
- The legislation should also contain an enabling chapter for the states to set up Road Safety and Traffic Management Boards, which the states could adopt.
- The proposed structure of the Board is given as follows.

### RECOMMENDATIONS IN THE 12<sup>TH</sup> FIVE YEAR PLAN

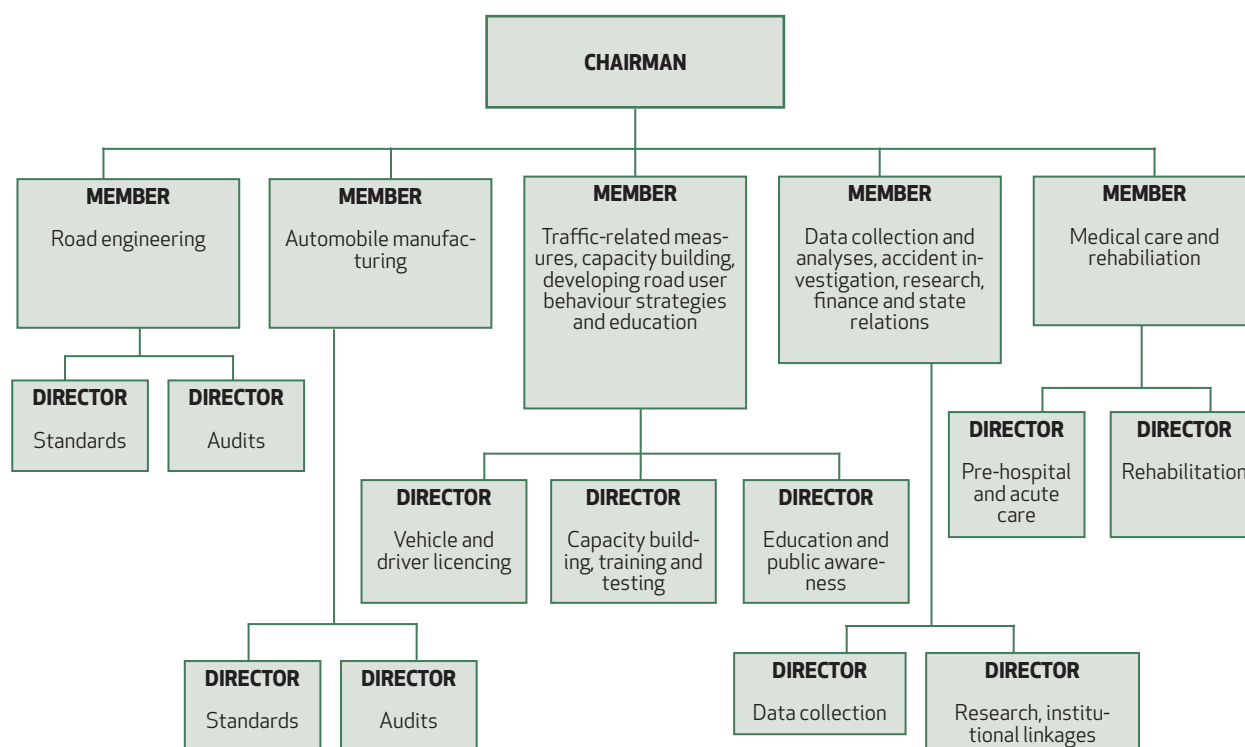
Annually, 150,000 people die in road accidents in India. To strengthen the data, there is need to set minimal road death and injury data reporting requirements in accordance with standards set by the International Accident Database Group (IRTAD) for national level data. Web-based data systems should be established and be made operational in the

12<sup>th</sup> Plan period. There is need to implement on an urgent basis the key recommendation of the Sundar Committee Report regarding the creation of National Road Safety and Traffic Management Board.

High level of awareness is required so that systemic problems get rectified. Awareness should be spread using all modes of communication: TV, newspapers and radio. ITIs need to be involved in driver training. MoRTH provides a scheme for setting up IDTR/DTI at state level. Before they start imparting driving training in driving schools, they should attend 'Trainers Training' in IDTRs/RSIs. To ensure that the needs are met, driver training schools should be encouraged to come up in the PPP mode.

At present, the introduction of new safety standards is dependent on testing facilities available in the country including those at NATRIP. Since the vehicles produced in the next few years will be present on the road for about two decades, it is essential that the provision of testing facilities and introduction of new standards should be expedited. Impact standards for vehicles should be implemented on an early basis. Since a vast majority of those injured and killed in road accidents comprise pedestrians, bicyclists, and motorcyclists, India should take the lead in introduction of pedestrian impact standards for all vehicles. India should set up an NCAP India

Figure 2.3  
**Road Safety and Traffic Management Board: Proposed Structure**



Box 2.9  
**Capacity and Performance Indicator Framework for Road Agencies**

**Mandate, Policy and Legal Framework:** The indicators under this category are intended to capture the vision/mission statement of the highways agency and to find out if a formal road policy, backed by a legal and regulatory framework, has been laid down covering development, asset management and safety.

**Planning:** Indicators in this category are expected to inform planning capabilities of the highway agency by assessing the existence of long- and short-term investment plans for both development and maintenance of their road network and asset management system.

**Capacity:** Under this category, indicators are intended to capture the highway agency's strength to deliver its mandate by knowing outputs of the budget, expenditure, projects delivery, skill development strategies, and human resource management.

**Efficiency:** The indicators under this category would capture the agency's ability to evolve cost effective strategies in developing the road programs and efficient contract administration to contain time and cost overruns during the implementation. Monitoring the 'asset value' of the network is one such indicator.

**Quality of Road Network:** The indicators under this category are intended to assess the agency's ability to provide a safer, greener, reliable and more comfortable road network. The indicators suggest the shifting of focus from a traditional input- and process-based one to outcome- and user-oriented measures, for example, capturing the degree of congestion, network quality index, and accident hazards.

**Private Sector Participation:** The indicators under this category intend to assess the road agency's effort to attract and promote private sector financing of the road sector.

**Governance:** The indicators under this category are intended to capture initiatives such as right to/freedom of information, e-procurement, website, publishing of annual reports, road user satisfaction surveys, and grievance redressal mechanisms.

Source: A Review of Highway Agencies in the South Asia Region by Rajesh Rohatgi et al. World Bank and DFID, 2011

Programme. In the first phase, cities with significant transport vehicles (Metros) should introduce a modern inspection and certification regime.

## CAPACITY AND PERFORMANCE INDICATOR FRAMEWORK FOR ROAD AGENCIES

A study of road agencies in the South Asia region including India was undertaken by the World Bank with the objective to help governments and policy makers in identifying reforms required to strengthen the capacity and performance of their agencies to deliver large investment programmes. The study utilised the systems prevalent in Australia, South Africa, New Zealand and Sweden. It recognised that each country and within each country, each road agency has to identify its own capacity and performance indicator framework based on its specific mandate and vision. Keeping in view the functions required to be performed by the road agencies, the Bank has proposed a seven-category framework. These are indicated in Box 2.9.

The benefits of adopting such a framework are:

- i. The agency is able to improve its performance and pride itself in doing so as the performance of its roads become verifiable.
- ii. The accountability of the agency improves as it becomes easier to assign responsibilities to specific departments and engineers/managers.
- iii. It brings transparency to the agency's decision-making process.
- iv. It supports highway agencies in improving its efficiency and effectiveness in delivery of road programmes.

The road agencies need to move steadily and gradually to modern organisation. The basic requirement is to establish a regular data and information collection strategy in the highway agency and instituting a system of annual performance targets, capacity building and enhancing competence of staff in business practices in programme delivery and bringing in a culture of road asset management and focusing on responsiveness to needs of users. The MoRTH already has a system of RFD (Result Framework Document) for functions within its mandate. This can be reviewed to capture outcome based indicators suggested earlier.

## POLICIES TO ENCOURAGE ENERGY EFFICIENT VEHICLES

Policies for enhancing energy efficiency of vehicles may be intended to improve operational efficiency of existing vehicles or to encourage purchase of fuel efficient vehicles. Fuel efficiency also leads to reduction in CO<sub>2</sub> emissions. There are five core areas

where international experience provides examples that might be helpful to consider: financial measures; regulatory standards; inspection and maintenance programme; public outreach; and traffic management. They have been applied in various forms, in a number of countries, including the US, UK, Canada, Australia, Japan, China, Singapore, Hong Kong, and South Korea<sup>10</sup>. Box 2.10 gives broad details

## SUMMARY AND CONCLUSIONS

- i. The capacity standards adopted in USA, China, etc. may not apply in India since there is considerable mix of motorised and non-motorised traffic on roads in India both in urban areas and on inter-city highways. Some research work for development of a Highway Capacity Manual specific to India is in progress by the Central Road Research Institute. This needs to be expedited and overseen by the Ministry of Road Transport and Highways.
- ii. The current Indian practice of designing roads for LOS B could be reviewed if studies show that there is no perceptible decrease in operating speed under LOS C compared to that under LOS B. Adopting LOS C for design will imply more intensive use of the highway and it will also enable postponement of avoidable investment in capacity augmentation without any significant decrease in operational speeds.
- iii. Experience from countries like South Africa and Argentina, which succeeded in improved delivery of road maintenance has revealed that long term (five years or more) performance-based maintenance contracts have encouraged contractors to invest in economically efficient maintenance actions and purchase of proper maintenance equipment. While PPP approaches in India have in-built provision for long-term maintenance, for projects being undertaken through EPC mode, it is inevitable to move towards outsourcing of maintenance on long term basis. Further, success of outsourcing depends upon proper contractual framework, risk allocation mechanism and governance environment covering financial management, effective internal and external audits, accountability and responsiveness of road agencies to the needs and expectations of road users.

For projects undertaken through the EPC mode, it is inevitable to move towards outsourcing of maintenance on long-term basis

10. Onoda (2008); APEC (2009); IEA (2009); Kojima and Ryan (2010).

## Summary of Core Areas to Achieve Energy Efficiency of Vehicles

### Financial Incentives and Disincentives

Initiatives involving financial measures can be grouped under the following mechanisms:

- Differential taxes and charges based on fuel efficiency or greenhouse gas emissions (or proxies such as engine size or vehicle weight).
- 'Feebates': a set of fees (surcharges) for fuel-inefficient old vehicles and rebates for the purchase of new fuel efficient vehicles, based on fuel-efficiency, GHG emission (CO<sub>2</sub>) performance of the vehicle.
- Internalisation of the external costs of highway energy consumption by increasing fuel taxes.
- Subsidies for purchasing alternative fuel vehicles or for converting traditional fuel vehicles to alternative fuel vehicles.
- Support to manufacturers to develop vehicles that use alternative fuels.
- Support for research and development into existing fuel enhancement and new fuel technologies.
- Mandate government agencies to purchase hybrid, alternative fuel, or efficient vehicles for agency fleets

### Regulatory Standards for Vehicle Fuel Efficiency

In countries where regulatory standards for vehicle fuel efficiency have been used, it has been in the form of one or more of the following specific mechanisms:

- Foster mandatory vehicle fuel efficiency or CO<sub>2</sub> emission standards.
- Establishing automotive industry agreements on fuel efficiency and adaptation of efficient and innovative vehicle technology.
- Improve on-road fuel efficiency of vehicles by focusing on energy efficiency of non-engine components (generally not considered in official fuel efficiency tests), including tyres, cooling technologies, and lighting systems.
- Developing and enforcing standards on imported or used vehicles.
- Vehicle efficiency labels/ratings at point of sale/purchase.
- Implement fuel efficiency standards for heavy duty vehicles
- Provide a mandate that two- and three-wheeled vehicles, a large source of petroleum fuel consumption and air pollution, should be retrofitted with modern engine improvements and alternative fuels that enhance energy efficiency and reduce emissions.

### Inspection and Maintenance Programmes

Inspection and maintenance (I/M) programmes are a common initiative in many countries to promote greater fuel efficiency and ensure that vehicles meet emissions standards. I/M programmes have been implemented through a variety of specific mechanisms such as:

- Enforcing operational efficiency of used vehicles through periodic inspection and maintenance programme.
- Mandatory vehicle emissions inspection, targeted primarily to local air quality.
- Encouraging the retirement of old vehicles through both mandatory and voluntary programme.

The enforcement of periodic inspection and maintenance requirements has been accomplished as a part of annual registration process or the use of windshield decals indicating compliance. In the US, universal I/M programs were discontinued after public complaints and are currently administered only in metropolitan areas that are not in compliance with EPA air quality standards. Some countries have experienced that I/M programs can become burdensome requirements for vehicle owners and thus can lead to evasion and attendant corruption.

### Public Outreach and Awareness Programs

The mechanisms of public awareness campaigns, through billboards, television, print media, radio, and in-vehicle systems, have included the following:

- Provision of information to car purchasers on vehicle performance, e.g., fuel consumption

- labelling on vehicles, including fuel consumption data in vehicle advertisements.
- Standards/labelling requirements for non-engine components, such as tyres, cooling units and lighting, etc., which impact on fuel consumption.
- Communicating the range of operational efficiency of vehicles and its monetary significance to consumers/drivers, such as in-car feedback instruments for eco-driving.
- Heavy vehicle environmental rating scheme.

### Highway Traffic Management

Policy initiatives in this area are directed at minimising stop-and-go operations and frequent speed changes. Fuel efficiency can be improved if a relatively smooth traffic flow can be maintained. Many countries are in the process of pursuing the following:

- Implement intelligent transportation systems in order to minimise delay and idling.
- Rapid incident detection and clearance at low capacity highways
- Improve highway, street, and intersection design standards that foster smooth flow of traffic.
- Adopt demand management programs.
- Add physical capacity by adding lanes, bypasses, or other improvements.

Source: World Bank Paper for NTDP on Government policies to encourage energy efficient vehicles on roads by Kumares C. Sinha et al. June 2011.

- iv. Direct charging mechanism for road development practiced in Europe, Singapore, etc. provide evidence that road toll is a good instrument for direct charging of road use and to generate additional revenues. The current practice of levy of tolls for use of multi-lane highways in India should continue. For collection of tolls, it is preferable to switch over to electronic toll collection. A transparent system improves confidence of the general public. There is need to display toll collected upto date at each toll plaza. Toll charges may be dynamic, different for peak and non-peak periods.
- v. The policy of weight-distance charges being implemented for heavy goods vehicles in Europe should be introduced in India to generate additional revenues.
- vi. Linking the rates/charges to the benefits received by the users contributes to public acceptance. There is a strong case, therefore, for a detailed highway allocation study that should capture the costs occasioned by different class of vehicles on road construction and maintenance. Evidence-based research in this direction is of paramount importance. This would help the government in facing the occasional threats/concerns by the transporters and truckers as they do believe/perceive that benefits received by them are not commensurate with the taxes and toll charges being recovered.
- vii. Intelligent transport systems have been deployed by several countries to enhance the operational performance of highway networks. The ongoing advances in information

and communication technology continue to lower the cost of ITS deployment. ITS application in Commercial Vehicle Operations is critical to the productivity and efficiency of trucking and interstate bus operations. Such applications are designed to enhance commercial vehicle safety, communication between carriers and consignors/consignees, fleet management and facilitate regulatory processes. They help in seamless movements across states.

## INDIA'S ROAD NETWORK OVER THE NEXT 20 YEARS

### A VISION STATEMENT FOR INDIA'S ROAD NETWORK

There is value in constructing a normative vision statement for India's desired road network. It can help to ensure that the various institutions responsible for planning, providing and commissioning road infrastructure agree on the ends that the network must serve. A shared vision together with derived qualitative and quantitative goals is more likely to result in a coherent, comprehensive network that best addresses India's socio-economic needs and wants. It can serve as a valuable communication device in selling infrastructure policy and decisions to the populace. Equally, it can serve to hold to account the public and private institutions that are responsible for designing, planning, commissioning, building, operating, managing and maintaining India's road network.

By 2032, the end of the 15<sup>th</sup> Five Year Plan period, India's road network should:

Table 2.22  
**GDP Estimates for 12<sup>TH</sup>, 13<sup>TH</sup>, 14<sup>TH</sup> and 15<sup>TH</sup> Plans**

YEARS	GDP ESTIMATES (PER CENT)
2012-17 (12 <sup>TH</sup> PLAN)	6.6
2017-22 (13 <sup>TH</sup> PLAN)	8.0
2022-27 (14 <sup>TH</sup> PLAN)	8.5
2027-32 (15 <sup>TH</sup> PLAN)	9.0

Source: NTDP Research (Chapter 3, Volume II).

- Be of an extent and quality that is commensurate with supporting the desired pace of India's economic transition;
- Facilitate export and import trade movements;
- Provide reliable all-weather road connectivity between every village and settlement to an arterial road that in turn connects with market towns;
- Help in achieving enhanced road safety as also smooth and efficient movement of people and goods;
- Mitigate the adverse environmental costs of road transport to the furthest extent;
- Meet India's strategic and defence needs as also national and energy security goals;
- Be the product of a sensitive approach to social considerations, including through fairly compensated land acquisition, and proper resettlement and rehabilitation of affected people;
- Be sustainable, well managed and preserved commensurate with investments being made in the sector;
- Promote the integration of scheduled castes and tribes, and national integration more generally;
- Assist in providing equitable access to economic, educational and healthcare facilities for all citizens.

### ESTIMATED DEMAND

The demand for both freight and passenger traffic has been growing rapidly over the years. The modal split between rail and road transport in both freight and passenger traffic is heavily inclined towards road transport. As of 2011-12, road transport is estimated to hold 69 and 90 per cent share in case of freight and passenger traffic respectively<sup>11</sup>.

The NTDP has estimated the growth in road freight and passenger traffic over the next 20 years

(Table 2.23). The forecasts are made using the elasticity of traffic demand with respect to GDP as the underlying approach. Table 2.22 presents the GDP growth projections.

As far as freight traffic is concerned, it is estimated on the basis of historical data that the total freight traffic (rail+road) holds an elasticity of 1.2 with respect to GDP<sup>12</sup>. In addition, it is estimated that the share of road in total freight traffic would decline from 69 per cent in 2011-12 to 65 per cent in 2016-17 to 55 per cent in 2021-22 to 50 per cent in 2031-32.

In case of passenger traffic, the elasticity of road passenger traffic has been estimated 1.9 with respect to GDP, keeping the GDP estimates same as above, which appears reasonable given the historical trend.

Road freight traffic is estimated to grow at about 9 per cent per annum and the road passenger traffic at about 17 per cent over the next 20 years. Throughout, the growth elasticity of freight transport is held, conservatively, at 1.2 and of passenger transport at 1.9. There is substantial international evidence that as countries enter phases of sustained high growth, growth elasticities—which, like all elasticities, are linear estimates valid only at defined points—become increasingly unrepresentative. If India sustains growth rates in excess of 7 per cent, implying a doubling in the size of the economy every 10 years, the GDP-elasticities for transport demand will almost certainly be different.

### POLICY AND PLANNING

#### TRAFFIC SURVEYS

Transport operations in the road sector being basically in private hands, there is high level of customer focus. However, at the same time, this mode is much less energy efficient and environment friendly besides being more unsafe. As such, road development should not be seen in isolation but as part of

11. NTDP Research.

12. For more details, refer Chapter on Trends in Growth and Development of Transport (Chapter 2, Volume II).

Table 2.23  
**Projected Road Freight and Passenger Traffic**

YEAR	TRAFFIC	
	FREIGHT BTKM	PASSENGER BPKM
2011-12	1,385*	9,329
2016-17	1,987	17,272
2021-22	2,949	35,043
2026-27	4,321	74,079
2031-32	6,559	163,109

\* Estimated  
 Source: NTDP Research

an integrated modal system of transport. For facilitating such a process, it is necessary to undertake regional traffic and transport surveys on regular basis—preferably every five years (to provide inputs to formulation of Five-Year Plans and mid-course correction of policy prescriptions formulated for long-term development goals)—of freight and passenger flows, transport pricing, resource costs and identify existence of distortions in the movement from point of view of a desirable/optimal inter-modal mix and investment policy for different modes of transport.

To this end, a Total Transport System Study encompassing the five modes of transport in the country—railways, roads, coastal shipping, inland waterways and airways—should be mandated, covering the following main objectives:

- a. To generate and analyse inter-modal transport resource costs and traffic flows
- b. To identify the factors leading to the current distribution of passengers and freight traffic and reasons for distortions observed from the perspective of national resource costs
- c. To determine an optimal inter-modal mix and allocation of transport investment to assist the planners in designing a transport vision for the immediate term of five years and direction for the long-term

The exercise indicated above should be carried out under the umbrella of Office of Transport Strategy.

#### ROAD DATA CENTRE

Database in the road sector is virtually absent. This needs serious attention. Setting up of a dedicated road data centre managed through a high level institution does not admit of any delay. This would help

in reducing the current ad hoc decision-making in the road development planning process.

#### CAPACITY AUGMENTATION

The entire transport system, including roads, is facing capacity constraints. The economic and environmental costs of a saturated transport system are high. Strangulation of railway capacity is unduly burdening the road sector. Railways need to regain their share. This cannot happen until their capacity is enhanced and they learn from road transporters to provide a better customer focus. It is also to be realised that the congested roads lead to lower transport productivity, increased energy consumption and pollution. Lack of road and vehicle maintenance adds to the undesirable industry competitiveness in the international market besides resulting in high inventory costs. Once the role for roads and road transport is identified within the overall transport system, it is necessary to identify and carve out road development and maintenance programmes which not only meet the expected traffic demand and improve transport productivity but also ensure that such programmes reduce in their wake the negative externalities of energy inefficiency, environment pollution and accident hazards.

#### RURAL CONNECTIVITY

Integrated rural development has been another area of focus by the government for considerations of social justice, national integration, economic uplift and overall higher productivity in rural areas. For this, there is all-round recognition of rural roads serving as one of the key infrastructures as they help in increasing accessibility to schools, health centres and in creating more employment opportunities. Rural roads serve as an entry point for poverty alleviation. These roads also provide

The primary roads should have uniform design standards for a given volume of traffic and service level desired, irrespective of whether they are National Highways or State Highways.

physical mobility of raw materials, farm produce, promote specialisation and increased size of market. Further, these roads influence the process of growth by facilitating dispersal of knowledge and reduction of inequalities. The states have already prepared district level Core Road Network master plans in due consultation with the Panchayati Raj institutions and local MLAs and MPs. These plans could be reviewed every five years to account for both agricultural and industrial growth in each district. The current programme of PMGSY needs to be expanded to achieve universal connectivity to all habitations on a time-bound basis and upgradation of existing roads based on traffic and condition assessment. In remote hill areas, provision of ropeway bridges across streams/rivulets need also to be considered to enhance access. Priority for upgradation of existing roads would need to be given to roads linking rural growth centres.

#### SOCIAL ASPECTS

Another area of concern is finding ways and means of reducing the burden of land acquisition where it affects the communities. Road design standards should account for this social factor as well. The rehabilitation and resettlement (R&R) of persons whose livelihoods or habitations are affected by road development projects varies widely, depending on whether projects are implemented through external aid or loan assistance, or through publicly funded projects or PPP projects. It is also dependent on the nature of the project and the area through which it passes. There is further variance in R&R policies between state and central governments who are each responsible for constructing, improving and maintaining different kinds of roads. A uniform R&R policy is desirable to ensure that compensations are equitably rationalised for similar kinds of utility losses across state and central government projects.

#### REVISITING THE ROAD HIERARCHY

The current system of road hierarchy and classification dates back to 1943 when the Indian Roads Congress formulated the first Long Term Road Development Plan. The road network is divided into five classes—National Highways, State Highways, Major District Roads, Other District Roads and Village Roads. Many countries classify their road network into three broad groups—primary, secondary and tertiary. Primary roads offer a high degree of mobility at the cost of reduced accessibility in the sense that longer distances must be travelled to access the primary network. In direct contrast,

tertiary roads feature high levels of accessibility together with low mobility that is characterised by local rural traffic, lower speeds and shorter trips. Bridging the gap, secondary roads have medium mobility and medium accessibility, and they basically serve as the collection and distribution system, providing links with higher and lower order roads in the total journey.

A simplification of the five-step Indian road hierarchy into a tripartite system of primary, secondary and tertiary roads would serve to bring greater strategic clarity to the goals of road investment planning and the resulting outcomes. It is recommended that an independent Road Classification Commission (RCC) comprising of administrators, economists, geographers and road engineers under the umbrella of the Office of Transport Strategy proposed by the NTDPCC should be set up for this purpose. This Commission should set down clear, objective criteria keeping in view holistic network planning perspective that maximizes the efficiency of each class. There is also a need to introduce systematic numbering of different classes of roads as per international practice.

Under a reworked hierarchy, both national and state highways could be classified as part of the primary network. For declaration of any road as a primary road, there should be well laid down criteria, for example connectivity to state capitals, district headquarters, ports, important industrial hubs and tourist destinations and linkages with highways in neighbouring countries. Road alignments that provide direct connection between important origin/destination points and result in cutting down journey distance could also be considered good candidates.

The primary roads should have uniform design standards for a given volume of traffic irrespective of whether they are National Highways or State Highways. Their development should be undertaken commensurate with the level of traffic and level of service desired and be independent of the actual designation. State Highways are a state subject and their financing is the responsibility of the concerned state government. The nomenclature National Highways and State Highways may therefore continue but the latter should be treated as part of primary road network. It may be added that, the Central Government provides financial support by way of certain component of CRF for state roads and roads/ bridges of interstate and economic importance. In addition, central funds are also provided towards viability gap funding for PPP road projects being undertaken by the states. States should formulate programmes of development of state highways on the lines of NHDP. This programme could be labelled SHDP and projects undertaken through various phases on the lines of NHDP.

## Financing Expressways Around the World

Expressways are access-controlled roads with grade-separated intersections that are limited to motorised traffic that is capable of travelling above a certain minimum speed. These are known by different names around the world: interstates in the US, motorways in the UK and in New Zealand, autoroutes in France, autobahns in Germany, autostrades in Italy, or simply as highways. Mechanisms that have been used to finance these are equally varied.

- In the US, the interstate highway system is funded through the Highway Trust Fund, which is sourced from a tax on fuel and tyres. These tax rates have varied over time, and state governments levy their own taxes. There is very limited tolling, only a few roads and bridges.
- Motorways in the UK are developed through taxes on fuel and on vehicles. There is no direct tolling. Shadow tolling is adopted for some stretches of motorways that are built or upgraded under the scheme of Private Financing Initiative. A shadow toll is paid directly by the government to the entrepreneur, without a direct user charge.
- Australian and New Zealand expressways are generally free of tolls, though for certain bypasses and bridges, nominal user fees are levied.
- In Japan, all expressways were constructed through government funding and investments recovered through tolls. Toll rates are amongst the highest in the world. It is only lately that the government has awarded some operational and maintenance contracts to private agencies.
- The French autoroute system was built by several public and private companies. A length of around 1,500 to 2,500 km was entrusted to each agency. These agencies were permitted to recover costs by levying tolls governed by an agreed schedule.
- Over the past 15 years, China has developed a huge network of expressways through the state enterprise system. Though users pay tolls, initial funding is through several sources of taxes and user fees at the district level.
- Malaysia constructed about 250 km of expressway to partially link Kuala Lumpur to Singapore from its own budgetary resources. Thereafter, tolling rights were offered to private entrepreneurs who also had to build the remaining length (about 500 km). The government guaranteed a minimum level of traffic, and the project was successfully completed by the entrepreneur.
- In India, the Government of Uttar Pradesh commissioned the Yamuna Expressway linking Greater Noida with Agra through a private agency. Apart from tolls from users, the private agency has been given real estate rights (capturing incremental land values).
- In India, the Government of Maharashtra built an expressway between Mumbai and Pune by setting up a public sector road corporation and raising bank loans. After a few years of operation, the project was offered to a private concessionaire for operations and management, for the consideration of a lump-sum rights payment to the corporation. The concessionaire has right to retain toll collected from users.

Source: NTDP Research and World Bank Papers for NTDP

Expressways need not be a separate class; they may be considered as part of primary road network since they are highways with features of access control and limited to movement of fast motorised traffic.

Similarly, Major District Roads may be classified as the secondary network with concomitant changes to design standards. And finally, Other District Roads and the Village Roads could be grouped as Rural Roads, as they already are informally.

### EXPRESSWAYS

Access-controlled expressways feature heavily in plans for future highway development. The other defining features of these roads are grade-separated interchanges and divided carriageways. They are

typically intended for use by fast-moving motorised traffic. However, investments in expressways are of an order of magnitude much higher than those in four- and six-lane highways that are not access-controlled, and should therefore be based on well-defined economic criteria for resource allocation. Further, all access-controlled roads foster faster traffic and divide villages and other communities. This makes local transit more difficult and longer, especially for non-motorised vehicles and pedestrians, and for livestock and agricultural produce. Alternative routes and crossings should be made available in conjunction with access-controlled roads. Wherever expressways provide the sole route within a defined area with no viable alternatives for slow-moving, non-motorised, or

For capacity augmentation of National Highways, the current programme of NHDP in seven phases is well conceived and its implementation may continue in the immediate term, i.e., the 12<sup>th</sup> Five Year Plan.

local traffic, it is essential that they are augmented with service lanes.

Expressways are likely to form the backbone of India's land transport network along with railways insofar as they will swiftly carry the large volumes of traffic along busy corridors. Box 2.11 gives a glimpse of financing modalities for provision of expressways around the world. Given that expressways are often greenfield developments that duplicate existing routes, they may not be straightaway attractive to private investors and developers.

It may be noted that most expressways in the world have been constructed by the government or public sector undertakings/authorities. There is mixed experience in the use of tolls to help recover costs. The use of fuel and vehicle taxes is common.

Based on international practices and experience, there appears to be a number of different options that could be considered for development of an expressway network in the country:

- a. The government could choose to develop these expressways from its own budget, albeit seek to recover costs through user charges and tolls. In doing so, it may also explore the feasibility of obtaining external loan assistance including technology transfer. Private entrepreneurs could be involved after initial construction of say 2,000 to 3,000 km of expressways by the government. These stretches could be handed over to private entrepreneurs for their O&M and leveraging the revenue earned to expand the network of expressways in a phased manner.
- b. The entire expressway network be divided into eight to 10 packages of 1,500-2,000 km each on the lines of French autoroute development strategy. Each package could be entrusted to major private developers. For this purpose, a dialogue with industry leaders is critical to formulate a strategy for their financing, construction and operation. Some seed money can be infused by the government as a start-up. Costs are to be recovered through user charges and tolls. Each package could be bid out to private developers for financing, construction and operations, if feasible and found to be economic. In the light of international experience, to accomplish this, it will be necessary to make a clear assessment of the private sector to undertake projects of this magnitude

A target of 18,637 km of expressways has been approved in principle by the Government of India, and is intended to be achieved by 2031. However, there is inadequate information on characteristics of road links, traffic volumes and traffic patterns. This network should be subjected to a consultation process with the states. Ideally, industry should also be taken into confidence in freezing the broad contours of such a network. There should be a minimum threshold traffic to consider provision of an expressway, say 40,000 PCUs per day. Access control highways effectively divide the countryside, necessitating provision of flyovers and interchanges to permit cross movement. This involves high capital investments. Priorities should be determined based on the needs of economy and progress of railway network capacity augmentation. Some of the existing four- and six-lane roads under the NHDP may be considered for converting them into access control facilities by providing service lanes all through for local and non-motorised traffic as an immediate step.

## STRATEGIES FOR DEVELOPMENT OF PRIMARY ROADS (NATIONAL HIGHWAYS AND STATE HIGHWAYS)

### NATIONAL HIGHWAYS

A strategic plan (1981-2001) for India's roads envisaged that India's national and state highways should together connect all towns with population greater than 5,000. The Road Development Plan: Vision 2021 pegged the length of National Highways to 80,000 km and of State Highways to 160,000 km. MoRTH's preferred strategy for identifying desired lengths is to partition the country into a square grid, with each gridline representing a road of a designated standard. For NHs, a grid size of 60 km has been suggested for being achieved by 2031. Of course, the practical realities of geography, topography and demographics will guide deviation from this ideal. The 60 km grid size is a rough average of several considerations: states with high traffic densities and throughput require more immediate access to the NH network, and topography in hill states and demography in sparsely populated states motivate a much larger grid size in these regions. With this reasoning, 80,000 km of National Highway are proposed by 2021, with an increase to 100,000 km by 2031. A large share of this will be accomplished by promoting existing state highways to NH status, and by upgrading these to the required standards.

Since the main function of the primary system is mobility and enhanced productivity of transport, stress should be laid on consolidation of National Highways in terms of capacity augmentation through multi-laning of existing highways and provision of access controlled expressway facilities.

Within these phases, the programme relating to widening of single lane roads to two lanes deserve to

be accelerated for reasons of enhancing safety and energy efficiency. Six-laning of existing roads without access control has the potential of being more accident prone. As such, the programme relating to six-laning of existing four-lane stretches needs to be stopped and where traffic volumes are beyond four-lane capacity, consideration given to provision of expressway network. In order to improve transport efficiency and enhance safety, all existing four-lane and six-lane roads need to have service lanes to cater to the requirements of local (both motorised and non-motorised) traffic so as to bring in an element of partial access control on such facilities. Provision of wayside amenities along the highways is becoming an integral part of the road projects. Such facilities should be provided by the private sector.

### STATE HIGHWAYS

At 166,000 km, the state highway network is already more extensive than was envisaged in the Road Development Plan: Vision 2021. For NH and SH put together, an average grid size of 20 km is reckoned adequate for network purposes. This will imply that the length of the national and state highways together may be about 300,000 km. Since 100,000 of these kilometres are already intended as NHs, the required extent of the SH network is 200,000 km. For these roads also, the focus should be on consolidating the existing network, with minimal expansion as needed, due to economic and geographic considerations.

When developing state highways, priority ought to be given to:

- Providing links to minor ports, special economic zones, industrial towns, and pilgrimage and tourist centres
- Connecting remaining towns with population exceeding 5,000
- Connecting remaining district headquarters with state capitals
- Construction of missing bridges and reconstruction/widening of existing weak and narrow bridges and replacement of semi-permanent timber bridges with regular bridges in the North-East region.

Under the present system, state governments lobby the Central Government to declare certain SHs as NHs, thereby removing the SH from its administrative purview. About 64,000 km of SH are reported to be candidates for reclassification as NH. The present arrangements are inefficient in that they create incentives for state governments to delay maintenance and upgrades of key SHs. These sub-standard roads have ramifications for the entire primary network, and the Central Government becomes more amenable to reclassify these as NHs. States that ensure on their own that the SH network is upgraded and maintained may stand to get penalised for their diligence since MoRTH could be reluctant to reclassify such good SHs which require little rehabilitation as it places pressure on exhausting the budget allocation. It is important to recon-

Provision of wayside amenities along the highways is an integral part of road projects, and should be provided by the private sector

sider the institutional, policy and budgetary mechanisms that encourage this unhelpful lobbying and punish diligence. As mentioned earlier, there is need for setting down objective criteria for classification of roads.

For capacity augmentation of state highways, every state should formulate programmes on the lines of NHDP and undertake implementation as per priorities identified through traffic surveys, economic and financial analysis of individual project stretches on the SH network. Each state should formulate its own State Highway Development Project (SHDP). The SHDP may comprise schemes of capacity augmentation by two laning, four laning, construction and rehabilitation of bridges, bypasses, replacement of railway crossings and works of riding quality improvements and safety engineering measures. Constitutionally, these roads are to be funded by the states. Central assistance is currently made available from the viability gap funding for projects being implemented under the PPP scheme and some funds for state roads out of CRF. There is a case for enhanced central assistance to make up for the past neglect.

### OTHER ASPECTS

**Financing of Primary Roads:** Financing of the primary roads should continue with the existing Central Road Fund through additional levies on petrol and diesel. The accruals to the CRF may be enhanced by making levy of cess on fuel on ad valorem basis rather than the current system of a fixed amount of Rs 2 per litre, which was fixed in 2005. At that time, the price for petrol was around Rs 40 per litre and diesel was around Rs 30 per litre. The existing policy of levy of toll on two lane roads needs to be done away with. A two-lane highway on the primary network should be viewed as a basic minimum facility and provided through government budget including CRF. For four-lane highways and expressways, the user charge principle should be relied on. The levy of appropriate tolls would help in cost recovery.

**Bypasses:** While preparing projects for capacity augmentation, the need arises for planning of bypasses around towns to ensure smooth movement of through traffic. In most cases, these bypasses also serve as vehicle for development of the town along or on the other side of the bypass. Therefore, the alignment for such bypasses should be planned jointly by the road agency and the urban development agency. Further, these bypasses should be planned and provided as access-controlled expressway type facilities with entry/exit at predetermined locations. For large size cities (population above one million), bypasses could also be provided in the form of peripheral

The efficacy of airports, and especially ports, is greatly diminished when the quality of the connecting road network is poor. Special needs of connectivity to ports, airports, mining areas and development of power plants should be factored in when planning road programmes

expressways. The intersection points of bypasses with main highways may also serve as freight logistics parks on case to case basis. The bypasses may preferably be elevated.

**Dilapidated and Weak Bridges:** Another critical requirement for development of national highways and state highways relates to the strengthening and widening or reconstruction of several existing bridges that are showing signs of distress. As per the Report of the Working Group on Roads, there are as many as 1,650 bridges on national highways which are in dilapidated condition which require reconstruction. Similarly, there would be several weak bridges on state highways and major district roads crying for replacement especially semi-permanent timber bridges in the North East region. It is to be recognised that a weak bridge on the section of the corridor can become the bottleneck for efficient movement of heavy loads thus impairing the transport efficiency. It is necessary to put in place a system of regular inspection of all bridge structures, diagnosis of their ill-health and formulation of remedial measures and strategies required for implementation on a defined time-frame. A system of maintaining and updating database on bridge inventory and their condition surveys need to be instituted to enable decision-making regarding their maintenance. For the purposes of expeditious reconstruction of these bridges, consideration may be given to initiating a special plan scheme with associated earmarked funding. There are also missing bridges on several large rivers flowing across different areas. It is necessary to identify critical locations that are posing an impediment in opening up of the area. A phased programme of construction of missing bridges should also be undertaken.

**Tunnels:** In the recent past, tunnel technology has been promoted for both rail and road network. In hill areas, provision of tunnels on selected alignments can help in cutting down not only the distance of travel but also the potential for landslides in cases of hairpin bends requirements as an alternative. Another advantage can be that the road facility is available to the users for a much longer period during winter months.

**Special Areas:** Besides the programmes noted above, various ministries undertake road construction and development with a mandate to ensure more equitable access to economic opportunities for areas

and peoples that have been historically under-served by prior road-building efforts. This may have come about for any number of reasons such as exceptionally difficult terrain, distance or disconnect from the broader Indian economy, historic marginalisation and so on. These special programmes can include road development of all standards from National Highway to village road. Under these programmes, funds are made available for widening and strengthening roads, constructing missing links, building and rehabilitating bridges, culverts and bypasses, and other measures aimed at improving ride quality.

**North East:** Under Phase A of the Special Accelerated Road Development Programme for North-East region (SARDP-NE) and Special Arunachal Pradesh packages, about 6,400 km of roads will be improved in the North-East states by the end of the 12<sup>th</sup> Plan period. Projects have been and will be commissioned with private participation when possible.

**Tribal and Left Wing Extremism Areas:** The Government has also taken up a programme for the development of about 1,120 km of NH and 4,352 km of state roads in Left Wing Extremism (LWE) affected areas as a special project, with the aim of completing all works by March 2015. Some relaxations are also accorded in guidelines for PMGSY roads in such areas by including all habitations with population exceeding 250. On similar grounds, a special programme for funding road development in Jammu and Kashmir has also been approved.

**Industrial Corridors:** Several investment regions and areas are proposed along the new Delhi-Mumbai Industrial Corridor, and along future such industrial corridors. These regions and areas will require road connectivity both within the various lands they are developed over, and also to the rail and road network more generally. These greenfield roads must necessarily be built well in advance of actual demand.

**Connectivity to ports, airports, power plants, etc.:** The efficacy of airports, and especially of ports, is greatly diminished when the quality of the connecting road network is poor. Development programmes exist to address this need. The aim is to ensure that each major port has at least four-lane road connectivity. Further, roads to non-major ports can now also be designated as National Highways on a case-by-case basis. Special needs of connectivity to ports, airports, mining areas and development of power plants should be factored in development of the road programmes. In certain cases of power plants, movement of Over Dimensioned Cargos (ODCs) will be involved and this will require advance planning particularly for strengthening of bridges involved and improvement of curves in hilly areas.

**Container Freight Stations and Railway Stations:** Similarly, there is a need to ensure good connectivity by road to railway stations and container

Table 2.24  
**Investment Requirements for Expressways (at 2011-12 prices)**

PARTICULARS	PERIOD				TOTAL
	2012-17	2017-22	2022-27	2027-32	2012-32
Physical Targets (km)	500	2,000	4,000	6,000	12,500
Total Investments (Rs billion) including land acquisition	200	600	1,200	1,800	3,800
Of which Private Investment	NIL	100	300	1,000	1,400

freight stations while formulating plans for development of road network in cities and towns.

**Inland Waterways and Water Fronts:** Another area that requires attention would be the road connectivity to identified water fronts on the inland waterway network to facilitate smooth cargo entry to and evacuation from the IWT terminal stations.

**Highway Facilities:** A well-developed road network is also one that is easy and comfortable to use. Depending on traffic volumes, roads should variously offer opportunities for rest breaks, refuelling and meal purchase. Each of these can also be expected to contribute to the overall safety of the network by preventing driver fatigue and timely assistance to vehicle breakdowns. Facilities like parking lots, drinking water stations, snack bars and restaurants, rest rooms, kiosks, information facilities, petrol pumps with service and repair facilities and communication systems should be developed. As several of these facilities are revenue generating enterprises, the private sector may be encouraged and supported to provide for such amenities. The provision of these amenities must form an integral element of the design for both new projects as well as for major widening and upgrading of roads. Provision must be made for concomitant land acquisition. For PPP projects, the construction and operation of a specified list of amenities and other project facilities can be attached to the concession agreement. On road stretches constructed directly by the government, wayside amenities should be set up and managed by private enterprises on commercial terms. The provision of such facilities must be commensurate with the buying power of truck and bus drivers along with passengers. (In recent times, some of the facilities built are not affordable for the common trucker.)

#### INVESTMENT REQUIREMENTS

It is difficult to hazard a precise estimation of physical and financial requirements for development of primary roads without a detailed study of

traffic forecasts. However, a broad assessment is presented based on the exercise undertaken by the NTDP Working Group on Roads and taking into consideration the likely lower levels of private sector financing expected in future and constraints of budgetary support. An investment of Rs 21,400 billion for National Highways and Rs 11,600 billion for state highways at 2011-12 prices, spread over 20 years upto the year 2032 could be required. See Tables 2.24 to 2.29 for National Highways (including special programmes and expressways) and Table 2.30 for state highways. Targets for private sector financing are also indicated.

#### STRATEGIES FOR DEVELOPMENT OF MAJOR DISTRICT ROADS

These roads run within the districts connecting areas of production with markets and serve as connecting links between rural roads and the primary road network and are thus equally vital for agricultural and industrial development of the landscape. However, these roads have not received the desired level of attention and investments in the past. This gap has to be filled to ensure balanced development of all classes of roads and in all regions of the country. An overall length of 400,000 km as proposed by the Working Group on Roads is recommended as a target network of MDRs. Here too, the strategy should be on consolidation of the road network. Currently, these roads are mostly single-lane with weak road pavement and bridges that are in need of immediate strengthening. A large percentage of these roads are reported to be in bad shape. This is posing a threat to even optimal use of PMGSY roads which are in much better condition. The situation is further aggravated due to movement of overloaded vehicles. Presence of railway level crossings causes undue delay to traffic movement on one side and lowering of speeds to the rail movement on the other. Therefore, the stress should be to accelerate the programme of widening of these roads to regular two lanes, including bridges, and provision of rail over/under bridges on heavily trafficked stretches. Priorities

Table 2.25  
**NHDP Proposed Expansion/Improvement: 12<sup>th</sup> Plan and Beyond (2012-32)**

PHASES	TOTAL LENGTH (KM)	LENGTH COMPLETED (KM) END MARCH 2012	LENGTH TO BE COMPLETED (KM) BEYOND MARCH 2012
NHDP-I GQ,EW-NS corridors, Port connectivity, etc.	7,522	7,484	38
NHDP-II 4/6-laning N-S,E-W corridors etc	6,647	5,499	1,148
NHDP-III Upgradation, 4/6-laning	12,109	3,643	8,466
NHDP-IV 2- laning with paved shoulders	20,000	0	20,000
NHDP-V 6-laning of GQ and High density corridor	6,500	913	5,587
NHDP-VI Expressways	1,000	0	1,400
NHDP-VII Ring roads, bypasses, flyovers, etc.	700 km of ring roads / bypasses + flyovers	11	689

Source: NTDP (2012).

Table 2.26  
**Investment Requirements for NHDP**  
 (Rs billion)

MODE OF INVESTMENT	2012-17	2017-22	2022-27	2027-32	TOTAL (2012-32)
Public Sector	1,100	1,650	2,000	2,750	<b>7,500</b>
Private Sector	550	700	1,000	1,250	<b>3,500</b>
Total	1,650	2,350	3,000	4,000	<b>11,000</b>

Source: NTDP (2012).

Table 2.27  
**Investment Required for Special Schemes**  
 (Rs billion)

SCHEME	2012-17	2017-22	2022-27	2027-32	TOTAL (2012-32)
SARDP-NE including Arunachal Pradesh	250	400	500	600	<b>1,750</b>
Of which Private Sector	NIL	NIL	50	50	<b>100</b>
Left wing extremism tribal special package for J&K connectivity to ports, airports, E&I	100	150	200	200	<b>650</b>
Of which Private Sector	NIL	NIL	NIL	NIL	<b>NIL</b>
Total	350	550	700	800	<b>2,400</b>
Of which Private Sector	NIL	NIL	50	50	<b>100</b>

Source: NTDP (2012).

Table 2. 28  
**Investments Required for Non-NHDP National Highways**  
 (Rs billion)

SCHEME	2012-17	2017-22	2022-27	2027-32	TOTAL (2012-32)
Four-Laning	30	100	300	600	<b>1,030</b>
Two-Laning with Paved Shoulders	270	450	600	700	<b>2,020</b>
Strengthening Weak Pavements	40	50	50	100	<b>240</b>
Reconstruction of Weak Bridges	80	100	100	100	<b>380</b>
Safety Engineering Works	40	50	100	100	<b>290</b>
Miscellaneous Works (bypasses, railway overbridges, etc.)	40	50	50	100	<b>240</b>
<b>Total</b>	<b>500</b>	<b>800</b>	<b>1,200</b>	<b>1,700</b>	<b>4,200</b>
Of which budgetary support including toll and external assistance	450	700	1,050	1,500	<b>3,700</b>
Private Sector	50	100	150	200	<b>500</b>

Source: NTDPC (2012).

Table 2. 29  
**Abstract of Projected Investments for Central Sector National Highways including Expressways and Special Programmes**  
 (Rs billion)

SCHEME	2012-17		2017-22		2022-27		2027-32		2012-32	
	TOTAL	PRIVATE SECTOR	TOTAL	PRIVATE SECTOR	TOTAL	PRIVATE SECTOR	TOTAL	PRIVATE SECTOR	TOTAL	PRIVATE SECTOR
NHDP (NHs)	1,650	550	2,350	700	3,000	1,000	4,000	1,250	11,000	<b>3,500</b>
Non-NHDP (NHs)	500	50	800	100	1,200	150	1,700	200	4,200	<b>500</b>
SARDP-NE	250	NIL	400	NIL	500	50	600	50	1,750	<b>100</b>
Other Special Schemes	100	NIL	150	NIL	200	NIL	200	NIL	650	<b>NIL</b>
Expressways	200	NIL	600	100	1,200	300	1,800	1,000	3,800	<b>1,000</b>
<b>Total</b>	<b>2,700</b>	<b>600</b>	<b>4,300</b>	<b>900</b>	<b>6,100</b>	<b>1,500</b>	<b>8,300</b>	<b>2,500</b>	<b>21,400</b>	<b>5,500</b>

Source: NTDPC (2012).

Table 2.30  
**Proposed Investment for State Highways in the State Sector**  
 (Rs billion)

SCHEME	2012-17		2017-22		2022-27		2027-32		2012-32	
	TOTAL	PRIVATE SECTOR	TOTAL	PRIVATE SECTOR	TOTAL	PRIVATE SECTOR	TOTAL	PRIVATE SECTOR	TOTAL	PRIVATE SECTOR
SHDP for State Highways	1,500	100	2,000	200	2,300	250	2,600	300	<b>8,400</b>	<b>850</b>
Reconstruction of Weak and Narrow Bridges	400	50	500	50	700	100	800	100	<b>2,400</b>	<b>300</b>
Safety Engineering Works	100	NIL	100	NIL	100	NIL	100	NIL	<b>400</b>	<b>NIL</b>
Additions to The SH Network	100	NIL	100	NIL	100	NIL	100	NIL	<b>400</b>	<b>NIL</b>
Total	2,100	150	2,700	250	3,200	350	3,600	400	<b>11,600</b>	<b>1,150</b>

Source: NTDPCC (2012).

Table 2.31  
**Proposed Investments for Major District Roads in the State Sector**  
 (Rs billion)

SCHEME	2012-17		2017-22		2022-27		2027-32		2012-32	
	TOTAL	PRIVATE SECTOR	TOTAL	PRIVATE SECTOR	TOTAL	PRIVATE SECTOR	TOTAL	PRIVATE SECTOR	TOTAL	PRIVATE SECTOR
SHDP for Major District Roads	800	NIL	1,000	NIL	1,200	NIL	1,700	NIL	<b>4,700</b>	<b>NIL</b>
Reconstruction of Weak and Narrow Bridges	100	NIL	200	NIL	300	NIL	300	NIL	<b>900</b>	<b>NIL</b>
Safety Engineering Works	50	NIL	50	NIL	50	NIL	50	NIL	<b>200</b>	<b>NIL</b>
Additions to The MDR Network	50	NIL	50	NIL	50	NIL	50	NIL	<b>200</b>	<b>NIL</b>
Total	1,000	NIL	1,300	NIL	1,600	NIL	2,100	NIL	<b>6,000</b>	<b>NIL</b>

Source: NTDPCC (2012).

Table 2.32  
**Funding Requirement for Completion of PMGSY**  
 (Rs billion)

Funds Required for Completion of Works Already Sanctioned	342
Funds Required for Works Not Yet Sanctioned	1,814
Total Funds Needed	2,157
Funds Available in 2011-12	200
Net Funding Requirement in the 12 <sup>th</sup> Plan and Beyond	1,957
	(rounded off) 1,960

Source: NTDPC (2012).

may be governed by the traffic—current and projected. Some limited stretches may require four-laning also in later years depending upon the traffic growth witnessed.

Besides two-laning, attention would also be required for strengthening of pavement of existing single lane and provision of hard shoulders to enable safe movement of vehicles and preventing such stretches from getting damaged beyond repair and rehabilitation. Programmes of improvement in riding quality with partial strengthening need to be planned and implemented. Several isolated bridges on the MDR network which show signs of distress would also require reconstruction as standalone works.

An investment of Rs 6,000 billion, at 2011-12 prices, spread over the next 20 years is envisaged. See Table 2.31 for broad details.

Currently, the Central Government is providing some funds for these roads out of the CRF but funding needs a quantum increase in order to make up for the continued neglect by the states.

### DEVELOPMENT OF RURAL ROADS

The design of rural roads must begin by acknowledging the all-or-nothing nature of the village road, and the attendant harsh realities of construction and maintenance. For the vast majority of Indian villages, the village road is the only avenue in and out for people, animals and goods. Contrast this with cities connected together with urban roads or with towns linked by highways, where there are not just alternative roads for transport between points A and B, but also alternatives offered by rail and possibly air. By connecting the village with a district road or highway, the rural road provides faster and better access to markets for the agricultural output of the hinterland, and provides access to social infra-

structure including a wider array of education, employment and healthcare opportunities. Often, the absence of a road can mean miles spent traipsing across muddy fields and gullies, enormously raising the costs of engagement with the rest of the world. Indeed, as far as re-distributive policies go, the village road may well offer better value-for-money than any other alternative.

The challenges associated with delivering safe and reliable all-weather rural roads are manifold. First, construction must often take place in remote locales over unyielding terrain. Road design must safely accommodate pedestrians, cyclists, animals, carts, small vehicular traffic, large trucks, and perhaps even heavy machinery (such as for mining) on relatively narrow roads. The opportunity cost of appropriating farmland for wider roads in the face of limited traffic may be prohibitive. However, the relatively lower traffic carried does not justify lethargic maintenance. Where roads are not sealed, they are prone to being washed away in the annual monsoon. All roads contend with the potholes and obstructions wrought by floods and landslides. If routine maintenance like the upkeep of drainage, clearance of vegetation, and repair of potholes is neglected, it is much more likely that major, more expensive, rehabilitation work will be required sooner than otherwise necessary.

Considerable progress has been made and is continuing under the current PMGSY. The National Rural Roads Development Agency (NRRDA) has developed a common set of engineering standards, contract documents and operating and financing procedures that are applied in respect of rural roads nationwide through the state implementing agencies. For the first time, well-engineered roads are being provided in rural areas. Funding for construction is provided 100 per cent by the Centre, while states are responsible for subsequent maintenance. The programme covers rural roads required for new connectivity

Table 2.33  
**Cost estimates for Universal Connectivity**

1. LEFT-WING EXTREMISM/INTEGRATED ACTION PLAN DISTRICTS (LWE/IAP)*	NUMBER	LENGTH (KM)	AMOUNT (RS BILLION)
i. Habitations with Population Above 250	800	3,200	160
ii. Habitations with Population Between 100 and 249	9,000	38,680	193
iii. Additional Funds for Bridges and Drainage			149
<b>Total for LWE/IAP districts</b>			<b>502</b>
2. OTHER HABITATIONS			
Total Unconnected Habitations**	120,000	250,000	1,250
<b>Total for Universal Connectivity</b>			<b>1,752</b>

Estimates by MORD \*\* Quick estimates based on MORD-Rural Road Development Plan: Vision 2025

(one basic access to unconnected habitation) and upgradation of existing roads (requiring improvement to provide all-weather access). Some dispensations have been given to accelerate the pace of implementation of PMGSY roads in Left Wing Extremism (LWE) affected areas and Integrated Action Plan (IAP) districts and in NE states. This programme is being implemented for the last over 10 years. Investments over Rs 100 billion have been made. This programme is well conceived and its implementation may continue. Main areas of concern emerging relate to assured maintenance, safety and upgradation in areas that have witnessed high agricultural and other economic growth. These aspects need special attention.

The Central Government has recently approved a scheme of PMGSY-II which envisages consolidation of the existing rural road network and cost sharing by the states. The selection of roads would be with the objective of identification of rural growth centres and other critical rural hubs.

The state governments have also been undertaking their own investments in provision of rural roads to connect other villages/habitations not eligible under the PMGSY or Bharat Nirman. This has helped in accelerated development of rural areas. The implementation needs to continue as per the district level core road network plans of the state governments. There is a need for expansion of the current mandate of PMGSY to achieve universal connectivity as these roads serve as entry point for poverty alleviation and provision of access to social infrastructure such as education and health, besides market. In order to estimate the overall requirements of rural connectivity, proper GIS maps should be generated

covering habitations of various population sizes in terms of new road links and those requiring upgradation.

These roads can stay as single-lane roads in view of low volume of traffic likely to prevail. However, some roads under this category could witness volumes that may justify widening to intermediate or two lanes. Some states like Punjab and Haryana are providing such facilities. Provision should be made accordingly in other states as well.

Fiscal federalism would suggest that since rural roads serve as a prime redistributive tool in the government's armoury, they should continue to be funded by grants from the Centre. It is proposed that for financing of these roads, the current CRF accruals and RIDF window of NABARD may need to be augmented. The strategy of some states to raise funds through market committee fees on agricultural produce is commended for being emulated by other states as well. Some funds for earth work for example may be leveraged from MGNREGA schemes.

For completion of the PMGSY programme remaining at the end of 11<sup>th</sup> Five Year Plan, an investment of Rs 1,957 billion is estimated to be required (see Table 2.32). An amount of Rs 1,265 billion has been allocated for the 12<sup>th</sup> Plan (2012-17). Obviously, the programme would spill over to the 13<sup>th</sup> Plan.

As mentioned earlier, the programme needs to be extended to cover LWE/IAP districts and universal connectivity to habitations above population 100. This would require investments to the tune of another Rs 1,752 billion (Table 2.33).

Table 2.34

## Investments Requirements for Rural Roads (2012-32) (Budgetary Allocations) (Rs billion)

PROGRAMME/PROJECT	2012-17	2017-22	2022-27	2027-32	TOTAL
Balance of PMGSY	1,090	860	--	--	<b>1,950</b>
LWE/IAP Districts	175	200	125	--	<b>500</b>
Other Lower Size Habitations	185	290	675	100	<b>1,250</b>
Upgradation	--	500	500	1,000	<b>2,000</b>
Total	1,450	1,850	1,300	1,100	<b>5,700</b>

In addition, need will arise for upgradation of the core road network which is not covered under the PMGSY and strengthening of pavement of PMGSY roads at the end of their design life. As per District Rural Roads Plans finalised by the states, the length of core network of rural roads is 1,134,114 km. Of this, a length of 374,844 km is covered under PMGSY. This leaves a length of about 750,000 km that is not covered under the PMGSY scheme. The estimated cost of upgrading and strengthening of pavement would be Rs 2,000 billion.

From the above, it will be seen that an investment of Rs 5,700 billion, at 2011-12 prices would be required over the next 20 years for development of rural roads. Table 2.34 gives the broad phasing. These are to be budgetary allocations only as no private sector financing is envisaged.

### OVERALL INVESTMENTS REQUIRED

An abstract of the overall investments required for the road infrastructure in the next 20 years is provided in Table 2.35. Broad assessment of private sector financing is also shown. Annual investments of the order of Rs 1,450 billion in the 12<sup>th</sup> Five Year Plan to increase to Rs 3,000 billion in the 15<sup>th</sup> Five Year Plan are envisaged. Of these, private sector financing may be of the order of 10 to 15 per cent as only part of the road network can be taken up on PPP basis.

### MANAGEMENT AND PRESERVATION OF ROAD ASSETS

The absolute and opportunity costs of providing and maintaining roads for society at an acceptable ser-

viceability level is high: for every km of district road we might instead choose to provide primary education for several children; for every km of expressway we may instead bring power to several villages. It is therefore essential to ensure that road assets do indeed supply a quality of transportation that is commensurate with the funds applied, and that this is not compromised over time for want of maintenance and repair.

The current replacement value of the existing road network defies precise estimation, given that there is no sustainable system of updating inventory and condition assessment of roads and bridges at present. A ballpark figure of Rs 10,300 billion is claimed by some experts as a broad asset base of the road network. Even if such an assessment would be and could be debatable, for a policy dialogue, there can be no two opinions that to ensure continuity of benefits of the road infrastructure being developed at huge cost to the economy, the road agencies must preserve, operate and maintain the assets.

The vicious cycle of build, neglect and rebuild has to be broken. While PPP approaches have helped in taking care of operation and maintenance needs of roads built during the concession period which extends to 15-20 years, this addresses the issue for only part of the overall road network.

Timely and adequate maintenance of the existing road network does not admit of any laxity. It is an economic necessity as otherwise, erosion of asset base will get accelerated. Challenges will grow as the road network ages and traffic increases occur. Box 2.12 provides an example of Asset Management core

Table 2.35  
**Projected Investments for Road Infrastructure**  
 (Rs billion)

SCHEME	2012-17		2017-22		2022-27		2027-32		2012-32	
	TOTAL	PRIVATE SECTOR	TOTAL	PRIVATE SECTOR	TOTAL	PRIVATE SECTOR	TOTAL	PRIVATE SECTOR	TOTAL	PRIVATE SECTOR
Expressways	200	NIL	600	100	1,200	300	1,800	1,000	<b>3,800</b>	<b>1,400</b>
National Highways	2,150	600	3,150	800	4,200	1,150	5,700	1,450	<b>15,200</b>	<b>4,000</b>
Special Schemes SARDP-NE+ Arunachal Package (Central Sector)	250	NIL	400	NIL	500	50	600	50	<b>1,750</b>	<b>100</b>
Other special schemes (Central sector)	100	NIL	150	NIL	200	NIL	200	NIL	<b>650</b>	<b>NIL</b>
State Highways	2,100	150	2,700	250	3,200	350	3,600	400	<b>11,600</b>	<b>1,150</b>
Major District Roads	1,000	NIL	1,300	NIL	1,600	NIL	2,100	NIL	<b>6,000</b>	<b>NIL</b>
Rural Roads including PMGSY	1,450	NIL	1,850	NIL	1,300	NIL	1,100	NIL	<b>5,700</b>	<b>NIL</b>
<b>Total</b>	<b>7,250</b>	<b>750</b>	<b>10,150</b>	<b>1,150</b>	<b>12,200</b>	<b>1,850</b>	<b>15,100</b>	<b>2,900</b>	<b>44,700</b>	<b>6,650</b>

principles of national highway network in South Africa.

It will be advisable for the road agencies to institute road network asset management systems. This will involve specifying asset performance indicators for each road class, scientific condition assessment and determination of priorities for maintenance interventions on rational basis.

Information pertaining to the consolidated inventory of road assets needs to be maintained and updated at regular intervals. At present, very limited information is available regarding the road inventory, available Right of Way (ROW), etc. A proper system shall have to be developed for creating the database based on actual ownership details supported by legally acceptable documentation and with support for periodic updating of the database. Formats should be developed to compile the information starting from Panchayat and block levels, and compiled for each

state on GIS platform. The data should be available in electronic form with facility for real-time updating as and when land is acquired to augment the existing ROW. Further, there should be facility to add to the inventory in case of newly declared NH or Expressways, etc.

Various Finance Commissions also laid stress on maintenance management of the road network and recommended central grants for state roads besides budgetary allocations by the state governments under the Non-Plan Head.

The road agencies are not the users of the road network. That might partially explain why there is weak planning and implementation of road maintenance operations. It is necessary to change this laissez faire attitude. Every road agency should prepare an Annual Asset Management Plan for roads within its jurisdiction, which as a minimum should include:

## Box 2.12

### Commercial Management of a National Road Network: The Case of South Africa

Management of South Africa's national road network exemplifies successful implementation of asset management core prescriptions.

Ownership of all national roads is vested in a commercial company, SANRAL, which is wholly state-owned and accountable to the national government for the satisfactory performance of the assets (provincial and municipal roads are managed separately). The agency is governed by an 8-member board that comprises 2 government officials appointed by the Minister of Finance and Minister of Transport, 5 private members appointed by the Minister of Transport, and SANRAL's chief executive.

Spending is prioritised and justified by holistic economic life-cycle costing, using the HDM-4 model. Management of assets is financed by a blend of the national budget (13,050 km of network), and user toll revenues and borrowing (3,120 km of network), mostly secured by road assets and sovereign guarantees.

SANRAL is run as a semi-private company, operating under a shareholder agreement and a performance agreement to manage the national roads. It must adhere to the Public Financial Management Act (PFMA) because it is executing public funds, and must follow financial reporting requirements under the Companies Act. However, as a company it may operate with its own procurement rules that comply with PFMA, and human resource policies which permit performance incentives and market-based remuneration.

Government requires all agencies—SANRAL, provinces and municipalities—to prepare a multi-year business plan as the basis of their multi-year budget submission, and to manage their roads under a network management system, which includes regular monitoring and reporting of road conditions. SANRAL, with its clear business model and a comprehensive asset management system, has been consistently successful in achieving its performance targets.

Developed over twelve years, this institutional model has reached a maturity that enables it now not only to fund and manage existing national road assets, but also to sustainably finance major investment in expansion of the network to meet surging economic growth in the country. The South Africa National Road Agency Limited (SANRAL) was established in 1998 as a limited liability company, wholly owned by the government. This board reports to the Government through the Minister of Transport. SANRAL's functions and operations were defined in an act of parliament, which provides some protection from political pressures.

Source: World Bank paper for NTDP on Road Asset Management by Clell Harral et al. (May, 2011).

- Inventory of assets (pavements, bridges, safety appurtenances, etc.)
  - Network condition, pavement serviceability index, bridge structural index
  - Assessment of maintenance treatment required for each road link based on condition, traffic, importance of road
  - Annual maintenance plan based on available/allocated budget
  - Impact on deterioration and performance of the road network for which funds are not allocated.
- patrol are other activities that should become integral part of O&M provisions. The Control of NHs (Land & Traffic) Act, 2002 was promulgated giving quasi-judiciary powers to Highway Administrations. The provisions under this Act inter-alia delegates authority to remove encroachments, prevent occupation of or damage to NH land and control access on NH land. The Act stipulates punitive measures for the offences committed (which are deemed as cognizable) in violation of its stipulations. However, there is lack of enforcement of the provisions of the Act, partly due to want of appropriate management and monitoring systems. Adequate support from state governments and law enforcement agencies is critical. It is of paramount importance that proactive support and assistance is available to the Highway Administrations from the District Administrations so that the provisions of these legislations can be effectively

For primary roads, there is need for non-engineering aspects as well. This would include land management by way of prevention of encroachment, control on ribbon development, regulation of access on existing highways and use of ROW by utility agencies. Incident management and highway police

## Box 2.13

### **Performance-Based Contracts for Road Rehabilitation and Maintenance: Argentina's Experience**

At the start of the 1990s, Argentina had the lowest share of roads in good condition among upper-middle-income countries. Due to previous neglect and mismanagement, more than a third of the national paved network was in poor or even critical condition. Today, informed observers consider Argentina one of the best performers in Latin America in implementing sustainable maintenance and rehabilitation of a large part of the national road network.

To achieve this transformation, over the past 15 years, the national roads department has put in place several effective policies aimed at this goal. A central instrument is the award of long-term contracts for rehabilitation and maintenance of main roads, with maintenance being paid for on the basis of performance standards met, rather than on the basis of inputs employed. Argentina's experience with this innovative approach, known as a 'rehabilitation and maintenance concession' (in Spanish 'concesión de rehabilitación y mantenimiento' or CREMA) has been very successful. It illustrates the following core prescriptions:

- Expenditure priorities determined by life-cycle analysis of road agency costs
- Sustained funding
- Outsourcing the execution of works to access the flexibility and incentives for efficiency of the private sector under contractual structures that closely align incentives with the public interest
- Clear accountability supported by quantitative performance measurements.

The concept underpinning CREMA was to contract out packages consisting of road rehabilitation followed by routine maintenance over a period of five years, to be paid for on a lump-sum basis against indicators of road condition. This concept was generated locally, from within the national roads department (known in Spanish as 'Vialidad'). This packaging of routine maintenance with rehabilitation followed a trial period, starting in 1994, of contracting out only routine maintenance. It embodied three principles: (i) long-term contract for routine maintenance; (ii) pay against results; and (iii) the basis for paying would reflect the road users' view of road condition.

The contracts specify several indicators, with penalties for non-performance. After the first three years, 600 certificates for non-compliance had been issued over the 60 contracts awarded, and penalties amounting to 1 per cent of the total amount of the contracts had been withheld from payments.

CREMA contracts now cover over 90 per cent of the whole national paved network, about 19,000 km, at a rate of about \$20,000 per km, for a total of about \$380 million per year. The total budget allocation for national roads in 2006 was about \$1.0 billion (0.5 per cent of GDP).

Source: World Bank paper for NTDP on Road Asset Management by Clell Harral et al. (May, 2011)

implemented. Similar frameworks may be evolved for all categories of roads on the lines of the Control of NHs (Land & Traffic) Act, 2002.

The government may also consider not to treat maintenance of roads as a non-Plan activity so that it does not suffer ad-hoc cuts as is the current experience. Plan funds should be used for maintenance of existing road assets to the extent necessary to bridge the gap between maintenance requirements and allocation.

The states have been steadily reducing their gang labour and increasing maintenance works through private contractors. This has been the right approach. While existence of some gang labour may be useful particularly for emergency situations and disaster management under conditions of earthquakes, landslides, cyclones, etc., there is a need to move to standalone long-term performance-based main-

tenance contracts where capacity augmentation may not be required in immediate future. Box 2.13 gives an example of Argentina's experience on such contracts.

Currently, there is weak enforcement of maintenance performance standards on the roads particularly the primary road network being managed by the concessionaires. Enforcement of performance standards by the government through a well laid down mechanism is essential and road agencies responsible for execution of maintenance works made accountable. The road agencies need to borrow a leaf out of the railway book with responsibility assigned to an Executive/Assistant Engineer for the upkeep of the road segment assigned to him. For enabling him to do so, sufficient funds should be made available to him together with supervision facilities.

## Maintaining Rural Roads: Lessons from Around The World

### Rural Road Co-operatives for Maintenance: The Finnish Experience

The Government of Finland has promoted rural road maintenance using road co-operatives. A road-co-operative is a rural road maintenance organisation whereby people living along a road accept responsibility for its maintenance. The Finnish Government has provided a legal framework which stipulates the right-of-way, cooperative ownership, and the formula for distribution of maintenance costs amongst the road users and property holders along the road. Participation in the road co-operative is compulsory for property owners who use the road. The cost of road maintenance is shared amongst the members of the co-operative depending on the benefits to each member in the form of the size of the holding and the created traffic. Each co-operative holds an annual general meeting to decide the fees, to accept new members and to audit the previous year's accounts.

### Routine maintenance by Community Based Micro-enterprises in Peru

In Peru, the Rural Roads Project (RRP) has set up a cost-effective routine maintenance system based on contracting out labour-intensive maintenance works to micro-enterprises, local co-operatives and other community based organisations. The composition of these entities varies according to the size of the road. Their average size is about 13 people and the average length of the road covered is about 36 km. Priority is given to unemployed people with prior experience in construction works.

The micro-enterprises are engaged through performance based contracts with the Peru Roads Department and paid on a monthly basis. The micro-enterprises are self-governing, and determine how the monthly payment is allocated to the various uses: wages, tools, rentals, transportation, savings and other investments.

Micro-enterprises carry out simple works continuously throughout the year, to clean the ditches and culverts, control vegetation, fill potholes and ruts, maintain the surface camber, remove small landslides, and undertake other emergency works. They have also demonstrated capacity to build retaining walls and small bridges and handle El Nino emergency works under the guidance of the highway authority.

Source: IDFC Infrastructure Report 2007

The states should encourage citizen and user oversight through undertaking road user satisfaction surveys. To start with, structured questionnaire and analysis of response can bring out road user satisfaction index on various stretches of the primary road network. This should include the projects awarded to BOT concessionaires as well. This will strengthen the government oversight on enforcing performance standards from the private sector.

There is a case for a dialogue with the contracting industry to support them in creating a dedicated band of contractors who specialise in undertaking O&M works on the road network. This will improve maintenance delivery on the ground and also act as a good resource partner of the BOT concessionaires during the operation period. For rural roads, local small contractors may be utilised in area-based contracts and gradually involve local community with technical support

from road agencies. Box 2.14 gives examples from Finland and Peru.

### SUMMARY AND CONCLUSIONS

- i. Road development should not be seen in isolation but as part of an integrated modal system of transport. For facilitating such a process, it is necessary to undertake regional traffic and transport surveys on regular basis—preferably every five years (to provide inputs to formulation of Five Year Plans and mid-course correction of policy prescriptions formulated for long-term development goals) of the freight and passenger flows, transport pricing, resource costs and identify existence of distortions in the movement from point of view of a desirable/optimal intermodal mix and investment policy for different modes of transport. Database in the road sector is virtually

The existing policy of levy on two-lane roads needs to be done away with. A two-lane highway on the primary network should be viewed as a basic minimum facility and provided through the government budget.

absent. This needs serious attention. Setting up of a dedicated road data centre managed through a high level institution does not admit of any delay. This would help in reducing the current ad hoc decision-making in the road development planning process.

- ii. Current system of road hierarchy and classification dates back to 1943 when the Indian Roads Congress formulated the first Long Term Road Development Plan. The road network is divided into five classes—National Highways, State Highways, Major District Roads, Other District Roads and Village Roads. It is recommended that the division of the network may be confined to three categories—primary, secondary and tertiary. Primary roads may encompass both national and state highways. Secondary roads may include current major district roads. Tertiary roads could be termed rural roads and comprise of both other district roads and village roads. Expressways need not be a separate class but these may be considered as part of primary road network since they are highways with features of full access control and limited to movement of motorised traffic. An independent road classification commission comprising of administrators, economists, geographers and road engineers under the umbrella of proposed Office of Transport Strategy should be set up. It should lay down clear, objective criteria for which authority holds the administrative mandate over a particular class of road. It should do so from a holistic network planning perspective that maximises the efficiency of each class. There is also need for introducing systematic numbering of different classes of roads as per international practice. For each class of road and traffic groupings, the standards should be uniform both in design and translation on ground.
- iii. The existing network of national highways and state highways may be expanded in tune with the economic growth and development of industrial hubs, special economic zones, ports, tourist centres and connectivity to international routes—linkage with Asian Highways and European Road Network. At the same time, since the main function of the primary system is mobility and enhanced productivity of road transport, stress should be laid on consolidation of this network in terms of capacity augmentation through multi-laning of existing highways and provision of access controlled expressway facilities. An overall length of 100,000 km of NHs and 200,000 km of SHs should be largely adequate for the country. This may also include about 20,000 km of access controlled expressways.
- iv. For capacity augmentation of national highways, the current programme of NHDP in seven phases is well conceived and its implementation may continue in the immediate term, i.e., the 12<sup>th</sup> Five Year Plan. Within these phases, the programme relating to widening of single lane roads to two lanes deserves to be accelerated for reasons of enhancing safety and energy efficiency. Six-laning of existing roads without access control has potential of being more accident prone. As such, the programme relating to six-laning of existing four-lane stretches needs to be stopped and where traffic volumes are beyond four-lane capacity, consideration given to provision of expressway network. In order to improve transport efficiency and enhance safety, all four-lane and six-lane existing roads need to have service lanes to cater to the requirements of local (both motorised and non-motorised) traffic so as to bring in an element of partial access control on such facilities. Provision of wayside amenities along the highways is becoming an integral part of the road projects. Such facilities should be provided by the private sector.
- v. For capacity augmentation of state highways, every state should formulate programmes on the lines of NHDP and undertake implementation as per priorities identified through traffic surveys, economic and financial analysis of individual project stretches on the SH network.
- vi. Financing of these roads should rely on user charge principle in the form of tolls as direct beneficiaries and continuing with the existing Central Road Fund through additional levies on petrol and diesel. The existing policy of levy of toll on two-lane roads needs to be done away with. A two lane highway on the primary network should be viewed as a basic minimum facility and provided through government budget including CRF. The accruals to the CRF may be enhanced by making levy of cess on fuel on ad valorem basis rather than the current system of a fixed amount of Rs 2.0 per litre, which was fixed in the year 2005. This may be enhanced to Rs 4 per litre to enhance the accruals to meet the project investment requirements. Some states have constituted

state road funds to provide assured funding for the state sector road projects. This is a good strategy and worthy of upscale by other states as well.

- vii. While preparing projects for capacity augmentation, the need arises for planning of bypasses around towns to ensure smooth movement of through traffic. In most cases, these bypasses also serve as a vehicle for development of the town along or on the other side of the bypass. Therefore, the alignment for such bypasses should be planned jointly by the road agency and the urban development agency. Further, these bypasses should be planned and provided as access controlled expressway type facilities with entry/exit at predetermined locations. For large size cities (population above one million), bypasses could also be provided in the form of peripheral expressways. The intersection points of bypasses with main highways may also serve as freight logistics parks on case to case basis.
- viii. Another requirement relates to reconstruction of dilapidated and weak bridges which are showing signs of distress and crying for replacement. There are also missing bridges on large rivers needed for opening of the area.
- ix. Special needs of connectivity to ports, airports, mining areas and development of power plants should be factored in development of the road programmes. In certain cases of power plants, movement of ODCs (Over Dimensioned Cargo) will be involved and this will require advance planning particularly for strengthening of bridges involved and improvement of curves in hilly areas.
- x. It is difficult to hazard a precise estimation of physical and financial requirements for development of primary roads without a detailed study of traffic forecasts and inventory of existing road network. However, a broad assessment is presented based on projections by the Working Group on Roads and deliberations within the Committee.
- xi. The Major District Roads run within the districts connecting areas of production with markets and serve as connecting link between the rural roads and the primary road network and are thus equally vital for agricultural and industrial development of the landscape. Somehow, these roads have not been receiving the desired level of attention and investments in the past. This gap has to be filled to ensure balanced development of all classes of roads and in all regions of the country. An overall length of 400,000 km as proposed by the Working Group on Roads is recommended as

The cess on fuel should be on ad valorem basis rather than the current system of Rs 2 per litre, which was fixed in the year 2005.

- a target network of MDRs. The stress should be to accelerate the programme of widening of these roads to regular two lanes including bridges and provision of rail over/under bridges on heavy trafficked stretches. Priorities may be governed by the traffic—current and projected. Some limited stretches may require four-laning also in later years depending upon the traffic growth witnessed.
- xii. Considerable progress has been made and is continuing under the current Pradhan Mantri Gram Sadak Yojana for providing connectivity to villages with all-weather roads. This programme is being implemented by the states with good managerial and technical support by the Centre. For the first time, well-engineered roads are being provided in rural areas. Hundred per cent fund for construction is by the Centre. The states are responsible for subsequent maintenance. The programme covers rural roads required for new connectivity (one basic access to unconnected habitation) and upgradation of existing roads (requiring improvement to provide all-weather access). This programme is well-conceived and its implementation may continue. The main areas of concern emerging relate to assured maintenance and upgradation in areas that have witnessed high agricultural and other economic growth. These aspects need special attention. The Government of India has recently approved a scheme of PMGSY-II which envisages upgradation of existing major rural links to rural growth centres where cost of upgradation will be shared by states also. There is a need for expansion of the current mandate of PMGSY to achieve universal connectivity as these roads serve as entry point for poverty alleviation and provision of access to social infrastructure such as education and health besides market.
- xiii. The overall investments required for the road infrastructure in the next 20 years is given in Table 2.35. Broad assessment of private sector financing is also shown. Annual investments of the order of Rs 1,450 billion in the 12<sup>th</sup> Five Year Plan to increase to Rs 3,000 billion in the 15<sup>th</sup> Five Year Plan are envisaged. Of these, private sector financing may be of the order of 10 to 15 per cent as only part of the road network can be taken up on PPP basis.
- xiv. The road agencies are not the users of the road network. That might partially explain why there is weak planning and implementation of

States should encourage citizen and user oversight through undertaking road user satisfaction surveys. This should include the projects awarded to BOT concessionaires as well. This will strengthen government oversight on enforcing performance standards from the private sector.

road maintenance operations. It is necessary to change this *laissez faire* attitude. Both the Central and state governments should declare as a policy that the roads would receive dependable and adequate allocation of funds on a continuous basis. A system of working out the replacement value of the road assets at the end of each financial year should be established by every road agency for roads under its jurisdiction. The information relating to road asset value should be put on a website in public domain. The government may also consider not to treat maintenance of roads as a non-Plan activity so that it does not suffer ad hoc cuts as is the current experience.

- xv. There is need to move to long-term performance-based maintenance contracts where capacity augmentation may not be immediately required. Projects under the PPP mode have in-built provision for maintenance and operation during the concession period. Enforcement of performance standards by the road agencies through a well laid down mechanism is essential and field engineers responsible for execution of maintenance works made accountable.
- xvi. The states should encourage citizen and user oversight through undertaking road user satisfaction surveys. This should include the projects awarded to BOT concessionaires as well. This will strengthen the government oversight on enforcing performance standards from the private sector.
- xvii. There is a case for a dialogue with the contracting industry to support them in creating a dedicated band of contractors who specialises in undertaking O&M works on the road network. This will improve maintenance delivery on the ground and also act as a good resource partner of the BOT concessionaires during the operation period.
- xviii. Technology for maintenance also needs a quantum jump particularly in respect of primary and secondary roads.
- xix. For primary roads, non-engineering aspects should include land management by way of

prevention of encroachment, control on ribbon development, regulation of access on existing highways and use of ROW by utility agencies. Incident management and highway police patrol are other activities that should become integral part of O&M provisions.

- xx. The state transport authorities also need to support the road agencies in enforcing axle load limits of vehicles particularly trucks as overloading is seen to damage the roads prematurely.
- xxi. Annual allocations required for maintenance should be worked out by each road agency for the roads under its jurisdiction based on asset management principles and traffic and road condition observed on the system. This should be a first charge on the available resources.

## IMPLEMENTATION CHALLENGE

In evaluating the desired contours of India's road network, there are two basic questions that demand answers. First, is it possible to transport oneself or one's goods from points A and B within India? For the most part, the answer to this is, undoubtedly, yes. There will invariably be the extremely remote villages and settlements where the local terrain make it difficult for such habitations to be formally connected with the road network. Leaving these special cases aside, it does seem that India's road network in 20 years time will allow seamless transit between any two given points on the map. A more pertinent question that arises is how to enhance cost effectiveness and efficiency of delivery of the road development programmes without compromise on safety, quality and sustainability of assets. This would call for capacity building of the road agencies and the private sector, revisiting of road standards and sensitising road engineers so that road safety and environment mitigation measures become integral part of road design.

## REVISITING THE MoRTH

Currently, the Ministry of Road Transport and Highways is responsible for development and maintenance of National Highways on behalf of the central government. For implementation of works on the ground, there are three agencies: National Highways Authority of India (NHAI), Border Roads Organisation (BRO) and state Public Works departments (PWDS).

The NHAI is the arm of the MoRTH for execution of NHDP. Works on National Highway stretches in the border areas of the country are entrusted to the BRO. The works on all other National Highways are executed by the Public Works departments in the states for the stretches within their respective juris-

diction. The designs and preparation of projects is handled by the state PWDs and their technical and financial sanction as per plan programmes and budget earmarked are issued by the MoRTH. Thereafter, awarding of contracts and implementation are undertaken by the state PWDs on agency basis.

With the NHAI having become operational through successful implementation of the NHDP, there is need to review the current structure of the MoRTH and expand the mandate of the NHAI. The objective should be for the MoRTH to entrust all National Highways and National Expressways to NHAI with proper restructuring of NHAI and only planning, policy and budget functions should remain with the MoRTH.

## HUMAN RESOURCE DEVELOPMENT

At present, there is an acute shortage of skills at all levels and in all spheres of activity related to road infrastructure development. Indeed, this paucity of skilled manpower is emerging as the weakest link in ensuring that India can efficiently deliver on the road network it needs. It is imperative that central and state governments attach high priority to building capacity in the highways sector.

### TRAINING NEEDS ASSESSMENT

As a first step, a comprehensive survey of the training needs of all road agencies responsible for the delivery of various programmes is required. While undertaking this exercise, attention should also be focused on training of supervisors and junior engineers who have so far largely been neglected by formal skills enhancement programmes. Associations and federations of contractors also need to provide a similar assessment of the skills gaps extant in their areas of operation. The assessments should be undertaken both in headcount as well as in qualitative terms.

### PLANNING FOR EDUCATION AND TRAINING

On induction to an organisation, every new staff member should be given a comprehensive orientation course on various responsibilities and duties expected. A specified proportion of mid level officers (at least 5-10 per cent every year) in road agencies of the states and the central governments should be encouraged to go in for M.Tech/Ph.D courses in various disciplines of highway engineering and construction management. We must target that at least 3,000 engineers belonging to road agencies in the Centre and the states have a minimum of M.Tech/Ph.D. qualifications. In order to utilize their talents, new positions will have to be created in the various departments which allow them to use their knowledge.

The Indian Academy of Highway Engineers (formerly known as the National Institute for the Training

of Highway Engineers) is currently the apex institution for training of highway engineers, functioning under the aegis of the Ministry of Road Transport and Highways. Besides providing training to engineers of central and state governments, it imparts training to engineers of consultants and contractors (see Box 2.15). It also organises site visits to marquee construction sites and built projects. There is need for considerable investment in IAHE for enabling them to effectively discharge its mandate. A minimum of 20 to 30 full time faculty and commensurate support technical and secretariat staff should be in place. The faculty should comprise both educationists and practising engineers. IAHE should also tie-up with business schools in the country and abroad so that our engineers may also be exposed to tailor-made management courses. The state governments should also strengthen their state level training centres with support of local academic institutions.

Attention should be paid to training needs of supervisors and junior engineers who have so far been neglected by skills programmes.

To prevent ossification of skills in the face of continuously changing technologies and design principles, continuing education must form an essential part of every highway engineer's career. The requirement for specialisation and skill development of officers of the road agencies in core processes of planning, design, preparation of sound feasibility reports and detailed project reports, project development and financial appraisal for BOT projects, social and environment concerns, traffic studies, contract management, etc., should receive regular attention. The training plans should also include study tours of projects in India and abroad by a group of officers from different states and the central government; and post-graduation in various disciplines of highways from prestigious universities in the UK, US, Australia, etc.

It is very important that all road agencies of the states and the central governments make provision for lateral entry of professionals mid-career and senior levels through open competition. Relevant rules and procedures will have to be devised for this. In addition officers may be admitted on deputation from industry and academic institutions for periods of one to three years. It is possible that some of these professionals may opt for lateral entry into these departments eventually if they find the work more rewarding than at their parent institution. Similarly, officers from state and central road agencies should be encouraged to take up short-term deputations in academic institutions and the private sector.

## Box 2.15 Indian Academy of Highway Engineers (IAHE)

An apex institution of excellence for training of highway engineers in road sector—both at entry level and during the service.

Mission: Bring in efficiency and value for money in planning, design, construction and maintenance of roads in the country and inculcate leadership quality, professionalism and commitment to excellence among the highway engineers.

Initiative of Ministry of Road Transport and Highways. Established in 1983. Campus in NOIDA. Collaborative institute of the Central and State Governments. Organises training for government, contractors and consultants at both national and state levels, also conducts programmes in various states (inset). Also imparts training to highway engineers from SAARC and African countries. Has an excellent infrastructure: lecture halls, seminar halls, auditorium, hostel, Board room, office block, canteen, recreation facilities, library, computer lab, soil testing lab, staff quarters (spread over an area of around 10 acres)

### Types of Training Courses

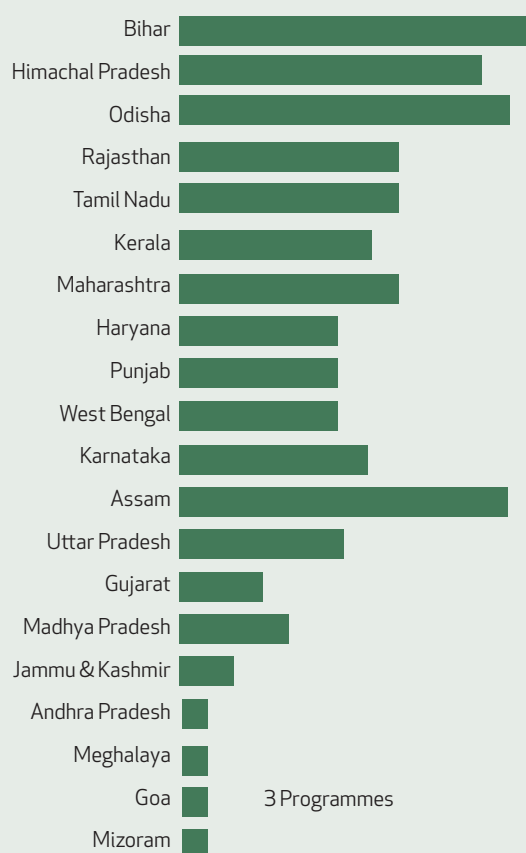
- Foundation Courses (for newly recruited Engineers)
- Refresher Courses
- Orientation Courses
- Specialised Areas of Highway Engineering
- Contract Management
- Highway Management and Administration Programmes
- Management Development Programmes

### Mode of Training

- Lectures
- Case Studies
- Group Discussions
- Multimedia Presentations
- Site Visits & Field Attachments
- Laboratory Practice
- Software Packages
- Video Films



### Programmes conducted in various states



Source: Indian Academy of Highway Engineers, [www.nithe.org](http://www.nithe.org) (accessed 1 July 2013).

## Box 2.16

### **National Academy of Construction (Hyderabad)**

(A Model Agency for Training in Construction)

**Initiative:** Government of Andhra Pradesh set up the Academy in 1998 as a Society; managed by Board of Governors chaired by the Chief Minister, Andhra Pradesh.

**Mission:** Improving efficiency and productivity of the Indian Construction Industry

**Core Activity:** Training of workmen, supervisors, managers, contractors and engineers in the field of construction.

**Funding:** 0.25 per cent (recently reduced to 0.10 percent) deduction from the bill payments of contractors in the state.

**Objectives:**

- i. Basic skill training for general/specialized construction trades
- ii. Upgradation of skills in contract management practices of government, corporate and contractors managers.
- iii. Quality supervision, stores management and surveying.
- iv. Training of Trainers

**Methodology:**

- i. Structured courses for training (theory and practice)
- ii. Group discussions
- iii. Workshops, seminars, conferences, symposia
- iv. On-job experience, visit to project-sites

**Faculty:** Both core and guest faculty

**Infrastructure:** Spread over an area of 167 acres (land allotted by the state government), the campus has a very good infrastructure consisting of classrooms, workshops, auditorium, seminar halls, office block, board room, hostel, canteen, recreation facilities, shopping centre, exhibition halls, etc.

#### **Example of competencies provided to works supervisors**

Surveying; marking out; estimating; costing and quantity surveying, roads and cross drainage works with quality control as per IRC/MORTH/MORD specifications, on-job experience with leading construction companies.

Certificate of Competency is awarded by NAC under authorisation by the Ministry of Labour & Employment, Government of India

Training efforts directed at contractors' staff must be an essential part of the agreement signed between the contractor/concessionaire and commissioning agency. The government should support the construction industry in strengthening existing training centres and ITIs. For skill upgradation of construction workers, equipment operators and supervisors, an initiative was taken by the state government of Andhra Pradesh to set up National Academy of Construction in Hyderabad. Box 2.16 gives a snapshot of its activities. Such an example needs to be replicated in each state.

Some of the leading construction contractors like Larsen & Toubro have set up their own institutes and centres throughout the country (Box 2.17).

Once a critical mass of skilled engineers, construction workers, and equipment operators is assured,

the construction industry should be encouraged to adopt a formal system of apprenticing to provide a practical supplement to more academic training efforts. Box 2.18 brings out the skills development strategy for construction workers in the road sector that can be adopted.

#### **FUNDING OF TRAINING PROGRAMMES**

Sufficient funds must be budgeted by the various stakeholders—government, contractors and consultants—for training. Government road agencies should make a provision of 0.25 per cent of the project cost in each estimate towards staff training to cover course fees, travel to training centres, per diem allowances, and expenses of institutions in imparting training. In consultation with the Ministries of Finance and Labour & Employment, 0.25 per cent of the cess collected under the Construction Workers Welfare Cess Act, 1996, should be earmarked for training of construction workers.

## Box 2.17

### L&T Construction Skills Training Institute

**Mission:** Empowering and building careers for rural youth through skill training.  
Enhance productivity of men and machines in construction projects.

**Objectives:**

1. Train construction workforce to meet demand for construction skills in terms of safety and quality of workmanship.
2. Identify training needs and set standards for occupational competencies.
3. Testing and certification to validate competency levels.
4. Facilitate training by setting up modular training schools.
5. Serve social objective of channelising the potential and strength of rural youth for producing employable construction workforce.

**Courses offered:** Formwork, carpentry, bar bending, masonry, electrical, scaffolding, pre-stressing

**Training period:** 200 hours to 600 hours (one month to three months)

**Methodology:**

1. Preparation of skill standards, training modules
2. Trade Testing
3. Three distinct levels (level III basic, level II intermediate and level I high)
4. Coverage is 80 per cent practical and 20 per cent classroom

**Mainstreaming:** Via certification through approved National Certifying Authorities

**Spread:** Chennai, Mumbai, Ahmedabad, Bengaluru, Delhi, Kolkata, Hyderabad and Cuttack

Source: L&T Limited, ECC Division

This will usefully benefit other construction-reliant industries as well.

#### SKILLS INVENTORY

There are several areas for training in the highway sector to which the stakeholders in the road sector should be exposed. An indicative list of possible areas for skill enhancement in the highway sector is given in Box 2.19.

#### TRAINING STRATEGY

MoRTH in consultation with the Ministry of Rural Development and state governments may take the lead in formulating a training strategy for the road sector in India. Such a strategy may cover:

- All stakeholders: Road agencies, contractors, consultants.
- Different aspects: Project management, quality assurance, legal, contract administration, dispute resolution, public private partnership approaches, social and environment aspects, safety.
- System of incentives: Weightage in construction contracts to workers and site engineers who hold competency certificate from accredited training institutions.
- Financing strategies: Both government budg-

et and private sector.

- Institutional framework: Strengthening and networking of existing training and academic institutions, collaboration with international agencies.

#### INDIAN ROADS CONGRESS

Currently, the IRC mandate is to evolve standards, specifications, manuals, guidelines for planning, design, construction and maintenance of different categories of roads. There are several similar professional bodies across the world like American Association of State Highway and Transportation Officials in the US; Permanent International Association of Road Congresses in Paris; National Association of State Roads in Australia; Japan Roads Association in Tokyo; International Road Federation in Geneva, etc., which are engaged in various activities connected with planning, design, construction, maintenance and operation of highways and development of codes, standards and specification. The Indian Roads Congress is already in touch with some of these organisations. The IRC should take advantage of such agencies in continuously keeping abreast of latest practices. There is a need to review design standards on a regular basis so that these are in line with international practices duly taking into account our own milieu.

## Skills Development Strategy

For the 12<sup>th</sup> Plan (2012-17), preliminary exercises suggest an investment level of Rs 45,000 billion in infrastructure. As a modest estimate, about 40 per cent of these investments would directly contribute to construction activities. This includes a significant component of roads. For construction workers in the road sector, there is huge demand for trades like surveyor, excavator operator, grader operator, stone crusher operator, laboratory technician, road roller operator, skilled, semi-skilled and unskilled workers. Very few opportunities for skill development are currently available for these trades as most ITIs and polytechnics have bypassed them. There are hardly any organised training providers to train the construction equipment operators or quality assurance technicians. The Government of Andhra Pradesh took the initiative of setting up National Academy of Construction in Hyderabad for training of construction workers a few years back. This is a joint effort of the state government and contractors associations. This is an excellent example for being replicated in several regions of the country with due focus on road sector demands.

The framework for skill development of workers of workers in the road sector should include the following key features:

- Demand driven short-term training courses based on modular employable skills to be decided in consultation with the construction industry, viz., contractors and consultants;
- Testing and certification of prior learning (skills of persons acquired informally);
- Flexible delivery mechanism (part time, weekends and full time);
- Different levels of programmes (foundation level as well as skill upgradation) to meet demands of various target groups;
- Optimum utilization and enhancement of existing training infrastructure to make training cost effective and purposeful;
- Testing of skills of trainees by independent assessing bodies who would not be involved in delivery of the training programmes.

Source: Road Sector: Skills Development Strategy by Mukesh C. Gupta, International Labour Organisation, New Delhi. IRC Discussion Paper No. 565, October 2010.

The current system of formulating design codes and manuals needs a total overhaul.

Eventually the standards should have statutory standing and become the responsibility of the Standards Departments of the proposed Indian Institute for Intercity Road Transport, Indian Institute for Urban Transport, and National Road Safety and Traffic Management Board (see chapters on Safety and Research and Human Resource Development). The Standards Departments in these institutions will have the authority to propose, evaluate and establish relevant standards that will have statutory status. The procedure followed will have to be similar to those established by Bureau of Standards in India and abroad with domain experts in charge of specific standards.

### ROAD DESIGN INSTITUTE

Except for a few technical officers in the road agencies who staff design cells in the states and the Centre, there is no dedicated institute for undertaking designs for the various components of the road projects. There is a compelling need for a dedicated Indian Institute for Intercity Road Transport and Indian Institute for Urban Transport for the road

sector that should function under the umbrella of MoRTH. It should have around 400 to 500 professionals at various levels covering various disciplines such as transport planning, traffic and safety engineering, transport economics, pavement design, bridge structure design, maintenance technology, geo-technical engineering, material engineering, IT related interventions, tunnel engineering, social and environment engineering, etc. Similar institutes should be set up in each state PWD and Rural Roads Agencies. Every state should have at least 40 to 50 professionals covering various disciplines.

### RESEARCH, DEVELOPMENT AND TECHNOLOGY INITIATIVES

The basic purpose of research in the highway sector is incorporation of technology innovations for:

- Achieving cost efficiencies, speed in construction, increased durability and performance,
- Providing technical underpinning to evolving standards, and
- Developing a pool of scientists and engineers having knowledge of latest developments around the globe.

## Box 2.19

### Highways-Related Skills Inventory

- **Introductory issues**
  1. Current issues in highway development, financing and administration
- **Project design and evaluation**
  1. Undertaking best-practice feasibility and detailed project reports
  2. Cost-benefit and commercial analysis of highway projects; quantifying project benefit; selecting between construction alternatives
  3. Traffic forecasting
  4. Financing methods: standard PPP models, road user charges, Road Funds, tolls and tolling methodology
  5. Environment management plans
  6. Land law and acquisition schemes; resettlement and rehabilitation policy
  7. Highway legislation including NH Act, NHAI Act, Control of National Highways (Land & Traffic) Act, CRF Act, States Highways Act, Motor Vehicles Act
  8. World Bank and ADB guidelines for construction projects
- **Project management**
  1. Procurement planning and preparing bid documents
  2. Contract management
  3. Tailoring MCAs and drafting standard bidding documents
  4. Evaluating bid proposals and awarding tenders
  5. Liaising with supervising and monitoring concessionaires
  6. Managing construction consortia
  7. Managing construction site safety
  8. Dispute resolution and negotiation
- **Highway design and regulations**
  1. Road safety measures including use of signs, markings, crash barriers
  2. Pavement design: flexible and rigid pavement; international practice
  3. Geotechnical investigations and landslide protection measures
  4. Road geometry and alignments
  5. Bridge design
  6. Hill road design—special considerations
- **Highway construction and engineering**
  1. Pavement construction
  2. Design and construction of high embankments, ground improvement methods, soil reinforcement structures
  3. Bridge construction including foundations, sub-structures, superstructures, aesthetics
  4. Construction of flyovers and interchanges
- **Maintenance**
  1. Designing and monitoring road performance measures; pavement evaluation techniques; road maintenance management systems
  2. Planning, norms, financial and institutional issues
  3. Maintenance of road asset inventory and condition history
  4. Bridge inspection and distress diagnosis; bridge management system
- **Expressways**
  1. Planning and alignment
  2. Design of pavement, bridges and interchanges
  3. Construction and operations and management
- **Highway management**
  1. Monitoring axle weights, traffic data, origin-destination surveys, traffic forecasting
  2. New materials and construction technologies

## Central Road Research Institute, New Delhi: A Snapshot

**Established:** 1952 as National Laboratory under CSIR

**Mandate:** Explore emerging areas in road sector, provide guidance to highway profession, support development of cost effective standards and specifications of roads of various categories

### Research Areas

- Road Development Planning and Management
- Traffic Engineering Safety and Environment
- Pavement Engineering and Materials
- Geotechnical and Natural Hazards
- Bridge Engineering and Management
- Instrumentation

### Beneficiaries

- Government Road Organisations
- Indian Roads Congress (IRC)
- Contracting and Consultancy Sector
- Oil Companies, Cement Manufacturers
- Testing Equipment Manufacturers

### Landmark Achievements

- Road user cost study (input to World Bank HDM-III, HDM-4)
- Landslide mitigation strategies (hill regions)
- Consolidation of marine clay (coastal belts)
- Soil stabilisation techniques
- Pavement deterioration prediction models
- Use of flash and other industrial waste in roads
- Road Safety Audits, Traffic Management Measures
- Non-destructive testing of bridges
- Road Condition Evaluation Devices, Bump Integrator
- CC block pavement in deserts and mountains
- Training Highway Engineers (10,000 so far)

### Current Activities

- Road Information System
- Slope protection strategies in hills
- Maximising use of marginal/waste material
- Engineering safety measures
- Highway Capacity Manual for Indian Conditions
- Refining pavement condition prediction models
- Diagnostics of distressed bridges
- Pilot testing of innovative materials
- Skill enhancement of highway professionals

### Spectrum of Activities

- Basic Research
- Applied Research
  - Sponsored
  - Collaborative
- Technical Services
- Principal Technical Agency, PMGSY
- Testing, Calibration
- Skill Enhancement
- Think Tank of IRC

### International Collaboration

- Transportation Research Board, USA
- Transport Research Laboratory, UK
- Australian Road Research Board, Australia
- LCPC, France
- PIARC (World Roads Congress), Paris
- International Road Federation (IRF), Geneva
- CSIR, South Africa

### Support Infrastructure

- Good Size Campus
- Wide pool of talented Scientists and Engineers
- Support Staff
- World Class Testing Equipment and Labs
- Test Tracks
- Library
- Computer/Data Centre
- Software Packages (in-house and international)
- Seminar Halls
- Hostel

## Box 2.21

### Thrust Areas for Research, Development and Technology Innovations

#### A. Areas relevant to PPP and government funded projects on main highways

1. Blending/stabilisation techniques to maximise use of locally available and marginal materials. (Pilot projects be undertaken throughout the country).
2. Determining design service volumes at various levels of service for 2-lane, 4-lane and 6-lane roads.
  - with/without paved shoulders
  - with/without service roads in both urban and non-urban areas.
3. Accelerated bridge construction technologies to achieve faster construction (precasting techniques, concrete-steel superstructures, etc.). Also evolve standard designs.
4. Condition assessment of existing bridges and distress diagnostics of superstructures, substructures and foundations of bridges
5. Evolving pavement performance predication models for determining rate of deterioration of road pavements and riding quality with time, traffic and weather (including rural roads). Develop non-destructive evaluation and inspection techniques (quick results possible as CRRI has acquired an APT facility)
6. Evolving bio-engineering and other measures for improving slope stability in hills (including rural roads)
7. Recycling techniques (hot/cold) of bituminous pavements. Evolve guidelines for promoting their use as it would ease the burden on use of aggregates and reduce carbon footprint

#### B. Areas relevant to rural roads

1. Identification of locally available materials at district level and determining their strength characteristics and promoting stabilisation techniques
2. Use of soil cement, cement blended granular material, brick ballast and other marginal materials
3. Use of bituminous emulsions, chip sealing and surface dressing
4. Evolve low cost water crossing structure designs
5. Evolve low cost drainage and erosion control measures
6. Evolve designs for fabricating low-end technology equipment for construction and maintenance

Source: Report of the Working Group on Roads for the NTDPCC – May 2012.

The early development planners of the country had clearly recognised the need for national research and development in all branches of science and technology. The establishment of the chain of National Laboratories under the Council of Scientific and Industrial Research (CSIR) was a major step in this direction. The Central Road Research Institute (CRRI) was one such Laboratory set up for the road sector in the early 1950s in New Delhi. The CRRI has been doing pioneering service to the highway engineering profession (Box 2.20).

The MoRTH and IRC have created a mechanism for accreditation of innovative materials and technologies for the road sector to promote their utilisation on ground. However, despite these measures, there is a time lag between research findings and application on ground. Moreover, the level of R&D in the highway sector is currently low in relation to the investments on road development

being made by the Central and state governments. We need to provide opportunities to the road construction industry to introduce cost effective materials, specifications and technologies to satisfy requirements of performance and durability and achieve fast construction and reduced carbon footprint.

Thrust areas for knowledge development are given in Box 2.21.

In order to give further push to the technology initiatives, centres of excellence should be set up in the existing IITs, IIMs, NITs and other academic institutions on various topics related to road sector viz. PPP, safety, highway administration and management, trucking operations, construction management, pavement design, environment concerns, energy conservation, urban transport, bridges, tunnels, disaster management, expressways, low volume roads.

## Technology Initiatives under PMGSY: Lab to Land

### 1. Main Drivers of Technology

- Political: Awareness and commitment
- Bureaucracy: Appreciation and encouragement to scientists
- Scientists/professionals: Innovation effort
- Practitioners: Pilot/experiments on ground

### 2. Advantages

- Enhanced durability and performance
- Reduced initial or life cycle cost
- Reduced environment degradation

### 3. Strategies Adopted

- All India Workshop of Stakeholders
- Group of scientists, academia, technocrats constituted by Ministry
- Guidelines proposed by Group deliberated among SRRDAs, STAs, PTAs
- Guidelines considered and approved by Ministry
- Guidelines issued to state governments for implementation
- Oversight on implementation through regional reviews

### 4. Salient Features of Guidelines

#### A. For proven technologies

- Field officers, academic institutions capacity building
- Contractors to be guided during execution
- CRRRI + IITs + NITs to map the availability of marginal materials and their strength characteristics
- Minimum 15 per cent projects to use these technologies
- No sub-contracting till critical mass of contractors created in execution of such technologies
- Defects Liability Period: Six months, thereafter employer, contractor not held responsible. Checks and balance with respect to strict quality control during execution.

#### B. For potential technologies

- Pilot projects on ground
- Obtain warranty for performance and cost-containment from Technology Provider
- MoU with Technology Provider for providing material and technology guidance and support during execution
- On successful performance, treat them as Proven Technology

### Focus

- Marginal Materials
- Industrial Wastes
- New Materials
- Green Technologies

Source: Prepared from the Ministry of Rural Development, National Rural Roads Development Agency Guidelines on Technology Initiatives issued to States in May, 2013.

The government should promote transfer of proven R&D technologies from lab to land through well considered pilots for implementation by BRO, NHAI, NRRDA, state PWDs and SRRDAs, etc. At pilot stage of testing performance, a liberal view would need to be taken of some unintended non-performance or failure of such pilots, with of course a laid down mechanism for supervision and monitoring during execution. See Box 2.22 for the recent initiative taken by the Ministry of Rural Development in mainstreaming technology initiatives under PMGSY.

### QUALITY AUDIT

The National Rural Roads Development Agency, an arm of the Ministry of Rural Development, has instituted a three-tier quality monitoring system for construction of PMGSY rural roads. The first tier is at the Project Implementation Unit level where the Junior Engineer, Assistant Engineer and Executive Engineer have been made responsible for

exercising quality control checks during execution and before authorising payments to contractors for the work carried out. Second tier is the system of State Quality Monitor (SQM). At the state head-quarter level, one Chief Engineer or Superintending Engineer is designated to exercise sample checks and oversight on the quality at various predefined stages. At the third tier is the system of National Quality Monitors (NQM) whereby the retired CE/SE with high credentials, based on recommendation of the state government are empanelled by the NRRDA (Ministry of Rural Development, Government of India). These NQMs visit the states as per the direction of the NRRDA and provide independent report on quality of construction of PMGSY road to both NRRDA and the State Implementing Agencies.

The NHAI and some of the state PWDs also undertake third party independent technical audit of their projects through reputed private sector and academ-

The MoRTH should entrust all National Highways and Expressways to the NHAI and only planning, policy and budget functions should remain with the ministry.

ic/research agencies. However, there is no well laid down system in place except for the quality control checks exercised by the 'Engineer' of road agencies or of the Construction Supervision Consultant engaged for contract administration. Road agencies need to institute a credible system of third party audit to enhance quality in execution of projects in the road sector on the lines of NRRDA.

## SUMMARY AND CONCLUSIONS

- i. The current system of formulating design codes and manuals by the Indian Roads Congress needs an overhaul. There is need to reduce the delays currently experienced in finalisation and updating of design codes, etc. Funds for such purposes should be provided by the government out of R&D budget. Eventually, the standards should have statutory standing and become the responsibility of the Standards Departments of the proposed institute for Intercity Road Transport, Institute for Urban Transport and Traffic Management Board.
- ii. Except for a few technical officers in the road agencies who are manning design cells in the states and the Centre, there is no dedicated institute for undertaking designs for the various components of the road projects. There is compelling need for a dedicated institute for the road sector that should function under the umbrella of MoRTH. It should have around 400 to 500 professionals. Similar institutes should be set in each state PWD and Rural Roads Agencies. Every state should have at least 40 to 50 professionals covering various disciplines.
- iii. With the NHAI having become operational through successful implementation of the NHDP, there is need to review the current structure of MoRTH and expand the mandate of the NHAI. The objective should be for the MoRTH to entrust all National Highways and National Expressways to NHAI with proper restructuring of NHAI and only planning, policy and budget functions should remain with the MoRTH.
- iv. The existing road agencies in the Centre and the states are gearing themselves to the needs of accelerated road sector programmes. However, capacity and performance of these agencies need further enhancement depending upon the current weaknesses in each agency. The Government of India has instituted a system of Results Framework Document for various sectoral ministries and are also encouraging the state governments for similar initiatives. The road agencies may consider self-evaluation or undertake capacity analysis through domain management expert agencies to identify enhancement measures required to improve their capacity and performance.
- v. Staff at various levels should receive regular training in various aspects of the road projects. Each road agency should have its training plan and calendar for both short-term and long-term. Such a plan should cover sponsoring officers for undertaking M.Tech. programmes in various branches of highways, bridges and tunnels.
- vi. There is a huge backlog of training at the cutting edge level of supervisors, junior engineers and assistant engineers for which special programmes need to be evolved and provided. A few states have set up their own training institutes for this purpose. These institutions need strengthening and provision of state-of-art training infrastructure. Such training institutions should come up in all states.
- vii. The government also needs to support Indian Academy of Highway Engineers (IAHE), other training institutes at state level and academic institutions to improve their infrastructure for training of road agencies.
- viii. Consultancy in the road sector has played a significant role in supporting the road agencies. However, due to quantum jump in the volume of work, weaknesses in their output become evident in some cases. There is need for a system of internal quality audit by the consulting firms before they submit their outputs to the road agencies. The government should also tighten the current performance evaluation system to bring in more accountability of the consultants.
- ix. With the push given by the World Bank and the Asian Development Bank since the mid 1980s, the contracting industry in the road sector has come up reasonably well in terms of mechanisation and acquisition of professional site engineers and project managers. However, the sheer increase in volume and size of projects bring offered by the government in the road sector has created several challenges and constraints in this industry. Major constraints relate to poor productivity and substandard quality due to non-availability of skilled construction workers, and equipment

operators and site supervisors. Both the government and the construction industry need to address this concern. Advantage should be taken of the skill development initiatives being launched by the Government of India to assess the magnitude of requirements of the road sector and consider a three pronged strategy, viz. at the vocational level through industrial training institutes, at the diploma level through polytechnics and at the state level through setting up construction academies.

- x. There is an urgent need for quantum jump in the R&D and technology upgradation effort in the road sector covering pavements, bridges, tunnels, safety and traffic management for knowledge acquisition and knowledge development in our own context and situation.
- xi. The R&D schemes having immediate practical relevance in the context of the initiatives of the government to develop the road sector in the country needs to be taken up on priority. In this context, consideration needs to be given to evolving country specific highway capacity manual, models for prediction of pavement performance with traffic, distress diagnostics of bridges and strategies for maximising use of locally available marginal materials including recycling of existing pavements and promoting use of industrial waste materials and by-products where found useful.
- xii. Centres of Excellence should be created on different aspects of roads and road transport including safety in IITs, NITs, other engineering institutes and IIMs to accelerate the research and capacity building activities.
- xiii. The government should promote transfer of proven R&D technologies from lab to land through well considered pilots for implementation by BRO, NHAI, NRRDA, State PWDs and SRRDAs, etc. At pilot stage of testing performance, liberal view would need to be taken of some unintended non-performance or failure of such pilots, with of course a laid down mechanism for supervision and monitoring during execution.
- xiv. A provision of one per cent of the total road investments should be earmarked for capacity building of the stakeholders involved and technology innovations in the road sector.

## ROAD TRANSPORT

### NEED FOR TRANSHIPMENT FACILITIES

Freight transport is the backbone of the economy. For reoptimisation of modal mix, a critical infra-

structure need is transshipment facilities, both rail and road transshipment and the use of 'transport nagars'. Such nagars can be positioned on suitable locations on the periphery of large cities and pick-up and delivery services on the hub-and-spoke model.

Other integration that is needed is synchronisation of short haul movement by road and long haul movement by rail for both export/import cargo through containers and long haul freight movement to/from destinations in remote areas not connected with rail network.

### MODERNISING THE TRUCKING INDUSTRY

The trucking industry can be broadly characterised as being highly fragmented and unorganised. According to statistics provided by Transport Corporation of India, 90 per cent of the industry consists of entities that have less than five trucks, contributing 80 per cent of gross revenues. The remaining 10 per cent that comprises the organised sector, consists of small numbers of fleet operators who have the flexibility to operate trucks of varying payloads over a distributed network, and are primarily employed in supply chain management and for other formal logistics purposes. However, the bulk of the unorganised fleet is used for general goods transportation with operators working on a 'hub and spoke' model. With transportation companies that run big fleets gradually moving from asset-based to contractual models, it is widely recognised that the dependence of small fleet operators and small operators on brokers will continue to have impact on the physical as well as the financial performance of the sector. There is a case for regulating trucking firms for suitable incentive structures (Box 2.23).

One per cent of the of the total road investments should be earmarked for capacity building and technology innovations.

The approach of government departments to the trucking industry has been to regard it as a source of revenue at every stage: excise duties; sales tax on purchase of vehicles; road tax on owning and using; licence fees and permits for operating; octroi or entry tax by local authorities; not to speak of taxes and duties on petrol, lubricants and spares. As a result, over 30 per cent of the initial cost and about 50 per cent of the operating costs are due to these multiple burdens<sup>13</sup>. So there is little incentive to invest in better vehicles, improved maintenance or well-trained and well-paid operating crew. The industry is characterised by very low levels of technology. The main reason for this situation is market failure—the market is not transmitting the signals required for technology upgradation. There is a multiplicity of taxes, variations both in the basis and

13. Asian Institute of Transport Development: Journal on Trucking Industry, 2000.

## Box 2.23

### Regulating for Suitable Incentive Structures

Single truck owners make up as much as 50 per cent of the trucking firms; economists will consider the prevailing situation as one which comes close to perfect competition. That is, there is a large number of producers of trucking services and none of them is big enough to influence the price line. As a result, the industry today is essentially controlled by intermediaries, because a large number of truck owners themselves are too small as firms to acquire critical market information.

The inability of poorly capitalised firms to gather information about cargo has resulted in the growing domination of brokers who need to be brought under the purview of regulation keeping in mind the fact that while trucking firms will have to pay for information about consignments, this asymmetry must not be allowed to become the fulcrum around which the industry revolves.

Usually, it is possible to strike a balance between the demand and the supply side of any activity. But in trucking, the fiduciary nature of the activity has to be kept in mind. This suggests an important approach to regulating trucking, namely, that the thrust of regulation has to be on the seller of trucking services.

The creation of an efficient marketplace, similar to a stock exchange or a commodity exchange, to bring together customers and transport vendors in this largely unorganised sector could bring about the desired change in the trucking landscape.

Source: Asian Institute of Transport Development: Journal on Trucking Industry, 2000.

rates at which these are levied, high incidence of these taxes and the absence of guidelines for the tax authorities. An ideal tax system is one which is neutral, efficient in allocation of resources, administratively expedient and avoids cascading effect in the economy.

There is a relatively high percentage of light trucks on Indian roads when compared internationally. Indian trucks largely consist of a chassis that is supplied by a truck manufacturer. Specialist after-market 'body' carpenters and other constructors then build a complementary cab and a tray or hold according to the purpose for which the truck will be used. There is considerable variation in the final versions of the trucks and buses turned out by these constructors, guided as they are by regional preferences and individual idiosyncrasies. Unlike elsewhere, there is comparatively little use of the tractor-trailer model wherein a tractor may be hitched to various trailers as dictated by demand. This means that Indian trucks often carry goods in generic trays and boxes which may not be expressly suited to the job at hand. This jerry-built nature of Indian trucks is perhaps understandable given that road surface conditions mandate robust, easy-to-fix trucks. Lately, however, multi-axle vehicles have grown in significant numbers on the back of growth in NHDP-funded highways that encourage their use.

The Indian trucking industry is characterised by low levels of technology<sup>14</sup>. This is in spite of the fact that both truck manufacturers and trucking firms are in the private sector. This suggests that the main reason for the low level of technology is market failure: the market is not transmitting the signals required for technology upgradation. The duopoly on the supply side and the peculiarities of the cost structure on the demand side seem responsible for this. Unless these distortions are rectified, it may not be possible to speedily raise the level of technology in this industry. Overall, it will be necessary for policy-makers to forge a stronger link between profitability and technology because at present this link is quite weak. The thrust of the policy should be to alter the structure of costs so that fixed costs play a less important role in determining the profitability of trucking operations. This can be done by making available finance more liberally.

The profitability of truck operations depends on the following factors: capacity utilisation; freight trips; fuel prices and fuel efficiencies; and other operating costs. In order to maximise profitability from their inefficient vehicle fleet, truck operators will increase revenue by overloading vehicles, resulting in excessive road wear and tear, a reduction in the economic life of the vehicle itself, and a higher propensity for road accidents.

14. Asian Institute of Transport Development: Journal on Trucking Industry, 2000.

Table 2.36

**Role of CVO in Seamless Interstate Freight Movement in the United States**

CVISN	APPLICATION	IMPACTS CAPABILITY
Safety Assurance	Safety Information Exchange	Has provided inspectors with electronic access to carrier and vehicle safety information from previous inspections.
	Automated Inspection	Identifying of faulty equipment on carriers facilitated by remote testing.
Electronic Screening	Safety Screening	In-vehicle transponders are used to facilitate communications with inspection stations to pre-screen trucks for safety records.
	Border Clearance	By applying in-vehicle transponders, truckers are able to communicate with customs checkpoints to pre-screen their trucks for safety records, border clearance and proper credentials.
	Weight Screening	Weigh stations and in-vehicle transponders are able to communicate to pre-screen trucks for compliance with weight regulations. Weigh-in-motion (WIM) scales and Automatic Vehicle Classification (AVC) systems have reduced delay at checkpoints by allowing carriers to pass inspection without stopping.
	Credential Checking	Weigh stations and customs check-points are able to communicate with in-vehicle transponders, to pre-screen trucks for proper administrative credentials.
Credentials Administration	Electronic Payments	Facilitates electronic business and transfer of registration fees between carriers and the revenue collection agency.
	Electronic Registration/Permitting	The internet applications and other electronic means facilitate the exchange of credential data between licensing/permitting agencies and the carriers. This reduces time taken for permit approval.
Security Operations	Asset Tracking	The location and condition of fleets can be monitored for security purposes by using surveillance and detection technologies.
	Remote Disabling Systems	Theft and unauthorised use of commercial vehicles can be prevented by employing ITS technologies.

Source: World Bank Paper for NTDP on Institutional and Regulatory Frameworks for Free Movement of Commercial Highway Vehicles Across States/Provinces by Kumares C. Sinha et al. (June, 2011)

The major policy issues with respect to modernising the trucking industry then have to do with industrial organisation and market consolidation; modernising the trucking fleet by encouraging the use of modern tractor-trailers; encouraging fuel efficiencies through the supply of cleaner fuels and advanced engine technologies. The first of these depends as much on labour laws, increasing educational standards, emergence of alternative investments and on labour and capital market deepening as anything else. It will also depend on increasing levels of supply chain sophistication, such as the requirement for specialist automobile delivery lorries and refrigerated trucks. These must also function alongside rail haulage facilities and ser-

vices. These advanced logistics will naturally become the preserve of more complex entities that are capable of managing larger, more technologically advanced fleets. (See Chapter 4, Volume II on Integrated Transport: Strategy and Logistics)

### ENHANCING PRODUCTIVITY OF COMMERCIAL VEHICLES

Cumbersome documentation, detention at check posts and bureaucratic hassles have adversely affected the productivity of the trucking industry. As a result, a truck on a highway is able to clock only 300 to 500 km per day. Trucks in the developed countries are able to cover double this distance.

Due to cumbersome documentation, detention at check posts and bureaucratic hassles, a truck on an Indian highway clocks only 300-500 km per day. Trucks in developed countries cover double this distance.

Commercial vehicles should be treated as rolling stock of the road transport infrastructure as they are carrying the economy on wheels. All efforts must therefore be made to improve productivity of precious assets. The use of intelligent transportation systems (ITS) in commercial vehicle operations can significantly enhance regulatory processes and this can make interstate truck movement seamless. Electronic registration and issue of permits by state agencies allows carriers to register online, decreasing the turnaround time associated with permit approval. Electronic processing of driver and vehicle safety information can eliminate or minimise inspection and enforcement requests at state borders. At check stations, enforcement personnel can use the national database clearing houses to confirm carrier regulatory compliance data and cross check safety assurance information. A commercial vehicle can thus travel seamlessly through state boundaries, once it is inspected and cleared at the origin state and the information is electronically transmitted to other states along the proposed trip. In this context, reference is invited to the Commercial Vehicle Information System And Networks (CVISN) as a component of the Commercial Vehicle Operations (CVO), designed by the US Federal Motor Carrier Safety Administration. Table 2.36 captures the role of CVO in seamless interstate freight movement.

The following measures need to be introduced to achieve seamless movement of commercial vehicles in the country:

- i. Promote use of ITS in commercial vehicle operations to enhance regulating processes making interstate truck/bus movement seamless. Electronic screening promotes safety and efficiency since trucks or buses equipped with low-cost in-vehicle transponders can communicate with check stations. Communication equipment at the roadside can automatically query regulatory data as they approach these stations and issue a red or green light on in-vehicle transponders, so drivers know whether to continue or report to the check stations for inspection.
- ii. Electronic processing of driver and vehicle safety information can eliminate or minimise inspection and enforcement requests at state borders. Once a vehicle is inspected and cleared at the origin state and the information

is electronically transmitted to other states along the intended trip, the travel can be seamless. The US Federal Motor Carrier Safety Administration have designed the commercial vehicle information system and networks (CVISN) as a component of the commercial vehicle operation. The information systems, therein, are owned and operated by the state governments, motor carriers and other parties. Similar system can be easily evolved and adopted in the country.

- iii. Apart from cooperation of respective state governments, it will be advisable for the MoRTH to undertake outreach programmes and facilitate development of such ITS backed commercial vehicle operations and information networks to enable full advantage of NHDP being reaped by the industry.

## INSPECTION AND MAINTENANCE OF VEHICLES

Even though the new technology vehicles meet the emission and safety standards, there are a lot of old vehicles (cars, buses and trucks) operating on the roads. The MV Act obligates the motor vehicle users to carry out periodic checks and maintenance to ensure that they are both road worthy and non-polluting. Presently, only commercial vehicles are required to undergo fitness test for road worthiness. Private vehicles are required to undergo pollution under control checks at periodic intervals. For ensuring safety, road worthiness and emission performance, all motor vehicles should be covered. The inspection and certification regime practised by the State Transport Departments need to be modernised and strengthened with automated test equipments as per international practices. These aspects have been elaborated in Chapter 7, Volume II, on Energy and Environment.

## BUS TRANSPORT SERVICES IN RURAL AREAS

The share of passenger traffic by road continues to be high. However, despite that rural areas are still poorly served by bus transport. As per an assessment by the MoRTH, about 70 per cent of villages are not connected by organised public transport. These villages are currently served by autos, jeeps, jugads and private buses which may not be reliable and affordable. The government is likely to undertake a pilot project where buses will be owned and operated by private enterprises with predefined service levels and government financial support will be provided as Viability Gap Funding (VGF). The bidding parameter is proposed to be net cost VGF. The outcome of this pilot needs to be watched.

## END OF LIFE VEHICLES (ELV)

End of Life Motor Vehicles (ELV) are a significant contributor to waste volumes. The number of

ELVs arising each year is likely to increase with the expanding automobile sector. The recycling of recoverable materials at end-of-life of vehicles would lead to considerable energy savings. It will be necessary to establish collection centres so that the last owner of the end-of-life vehicle hands it over to the centre. The issue is discussed in more detail in the Chapter 7, Volume III on Energy and Environment.

## ICT FOR ROAD TRANSPORT

ICT in road transport will help in:

- Increasing safety
  - Enhancing uniformity and interoperability
  - Improving operational performance
  - Enhancing mobility
  - Delivering environmental benefits
  - Boosting productivity and economic growth
- In order to ensure uniformity and interoperability throughout the country, the Government has sanctioned a project for creation of National Register and State Registers of Driving Licences (DL) of Drivers and Registration Certificates (RC) of Motor Vehicles. The objective is to capture the functionalities as mandated by Central Motor Vehicles Act, 1988 as well as state motor vehicle rules. Along with the National Register, a National Transport Portal has also been launched. This is a very good initiative as this would help not only in interoperability between states but will also improve enforcement and instant verification of Driving Licences and Registration Certificates.

The Regional Transport Officer is the 'aam aadmi's' interface with the road transport administration. Sharing of data by the RTOs with each other, traffic police and insurance agencies would help in dealing with defaulting drivers. Further, computerisation of check posts would help in cutting down delays and revenue leakage.

Other areas for ITS applications proposed are:

- i. Advanced Traffic Management Centres
- ii. Electronic toll collection along with Central Toll Clearing House
- iii. Advanced Public Transport System
- iv. Fully integrated vehicle to infrastructure and vehicle to vehicle communication, vehicle tracking mechanism, commercial vehicle operations
- v. Weigh-in-motion systems for control on overloading

## ENHANCING FUEL EFFICIENCY AND FUEL QUALITY

Policies for energy efficiency in road transport should be targeted to both new vehicles and in-use

The recycling of recoverable materials at the end of life of motor vehicles would lead to considerable energy savings.

on-road vehicles. Based on current national practices and international experience (refer Box 2.10), there are five core policy areas where practicable strategies need to be evolved. The following measures merit consideration:

- i. Financial Measures
  - Differential taxes and charges based on fuel efficiency and greenhouse gas emissions
  - Internalisation of external costs of highway energy consumption by increasing fuel taxes
  - Support to automotive industry for development of vehicles that use alternative fuels
  - Support for Research and Development for fuel technologies
- ii. Fuel Efficiency Standards
  - Foster mandatory vehicle fuel efficiency and CO<sub>2</sub> emission standards
  - Establish automotive industry agreements on fuel efficiency and emission norms
  - Fuel efficiency labels/ratings at point of sale/purchase
- iii. Inspection and Maintenance Programmes
  - Enforce operational efficiency of on-road vehicles through periodic inspection and maintenance programmes
  - Encourage retirement of old vehicles and establish age limits for retirement
- iv. Enhancing Awareness
  - Fuel consumption labelling and data in vehicle advertisements
  - Communicating range of operational efficiency of vehicles
- v. Traffic Management
  - Advanced Traffic Management Centres on high traffic corridors
  - Adopt demand management strategies and programmes
  - Provide minimum two lanes to reduce use of earth shoulders for passing and overtaking
  - Encourage highway and intersection designs that foster smooth flow of traffic

## OPTIMISATION OF AXLE LOADS OF COMMERCIAL VEHICLES

There has been demand from the trucking industry to permit higher axle loads to increase their productivity and earning capacity. This would, however, result in accelerated deterioration of road pavement and require heavy investments in road infrastructure for construction, maintenance and rehabilitation. A study on optimum axle loads for commercial vehicles was undertaken by the Asian Institute of Trans-

## Box 2.24

### Optimisation of Axle Loads of Commercial Vehicles

- There is a strong correlation between pavement design standards and carrying capacity of vehicles due to static and dynamic forces generated in the course of the movement of the vehicles. It is because of this correlation that countries prescribe maximum permissible gross vehicle weight and maximum allowable axle loads.
- The notified axle loads in India are: front single axle load of 6 tonnes with single tyres and a rear single axle load of 10.2 tonnes with twin-mounted tyres, although most roads have been designed for an axle load of 8.16 tonnes. Tandem and multiple axles fitted with additional tyres are allowed higher tonnage. Restrictions on the front axle load apply primarily because the vehicle has to meet the requirements of steering torque.
- The Indian standards do not differentiate between a driven and non-driven or steered axle. European standards, however, make such a distinction. Thus, in their case, the permissible axle load is 11.5 tonnes for single-driven axle and 10 tonnes for single non-driven axle, irrespective of the number of tyres. An additional tonne per axle is permitted if the same is fitted with pneumatic or equivalent suspension.
- The total transport costs (road user costs plus the road agency costs of construction, maintenance and rehabilitation) are minimised at an axle load of 11 tonnes, as against the prescribed limit of 10.2 tonnes. This limit of 11 tonnes may be taken as the optimal axle weight for purposes of pavement design.
- Higher dynamic loads cause higher rates of pavement deterioration. For example, increase in designed axle load of 8.16 tonnes to 12 tonnes for a two-axle truck results in a four-fold increase in the vehicle damage factor (VDF). In the case of a multi-axle truck, the increase in VDF is much less for the same tonnage.
- Reduced rates of pavement deterioration lead to significant reductions in total costs, arising mainly from vehicle operating costs, while increased rates of deterioration lead to significantly increased costs, arising from the same source.
- The road network suffers from a host of deficiencies in terms of pavement thickness, distressed bridges, etc. Approximately 80-90 per cent of the national and state highways are not suitable for the permissible axle loads of 10.2 tonnes.
- Massive investments are needed to strengthen the network for the currently prescribed axle loads. It is, therefore, premature to revise upwards the axle load limit for commercial vehicles. However, after the network is strengthened, consideration should be given to increasing the axle load limits to 11 tonnes.
- The use of improved vehicle technology offers great potential for reducing pavements costs. It is well known that Indian trucks are a product of an outdated technology—two-axle rigid trucks fitted with steel leaf-spring suspension. There is need for research in various aspects of interaction between vehicle design and road surface, an area that has so far been neglected.

Source: Optimisation of Axle Loads of Commercial Vehicles, World Bank sponsored study conducted by the Asian Institute of Transport Development, New Delhi, 2004.

port Development sometime back. The study concluded (Box 2.24) that the total transport costs—road user costs plus road agency costs of construction, maintenance and rehabilitation are minimised at an axle load of 11 tonnes. However, about 90 per cent of the road network is not suitable for the permissible axle load of 10.2 tonnes and massive investments are needed to strengthen the network for even the currently prescribed loads. It is, therefore, premature to revise upwards the axle load limits for commercial vehicles.

## CONTROL ON OVERLOADING

Various studies conducted on the effect of axle loads on road pavements have established that damage to road pavement occurs in proportion to the fourth power law; e.g., an axle load of 16.32 tonnes (which is two times the equivalent standard axle load of 8.16 tonnes) causes 2<sup>4</sup>, i.e., 16, times more damage to a road. Axle load surveys are conducted for assessing vehicle damage factors (VDF) when designing a new pavement<sup>15</sup>. As an alternative to axle load surveys, indicative values are available from IRC guidelines, though these should be updated to reflect changes in trucking technology and the business environment<sup>16</sup>.

Axle load surveys conducted on various stretches of National Highways have revealed that a VDF in the range as high as 10-15 for multi-axle vehicles is not uncommon. This implies that there are rampant violations of the legally permissible axle and gross vehicle weight limits by the commercial carriers of goods.

Thus, overloading of trucks is causing premature death of roads resulting in loss of investments and undue burden on rehabilitation of roads. Besides, overloading is resulting in deaths of vulnerable road users—pedestrians and cyclists as they share the same carriageway. The wilful overloading observed on roads suggests that the imposed fine does not discourage owners and operators. Both the private sector and public sector agencies as consignors indulge in pushing the transporters in overloading of trucks. It will require strong political and bureaucratic will for enforcement.

Buses and light vans frequently carry passengers in greater numbers than they are designed to safely accommodate. It is a matter of some concern that many of these vehicles are either owned by or ply on behalf of the state transportation authorities.

A far stricter regime needs to be put in place for control on overloading. The following measures need to be adopted to exercise control on overloading:

- a. The main road corridors should be dotted with

Weigh-In-Motion (WIN) stations along with static weigh stations and space for off-loading of excess cargo. Excess load must necessarily be offloaded before allowing the vehicle to proceed further. The infrastructure—WIM stations, static weigh scales, hardware, software, etc.—can be provided even under public-private partnership mode and legal procedures of weight check, penalties and off-loading taken care of by the enforcement staff.

- b. The consigner should be held guilty of violation.
- c. Awareness campaigns be held to improve self-discipline by the truck owners and drivers. They should themselves decline (refuse) to drive the vehicle in case it is overloaded.
- d. The policy of weight-distance charges being implemented for HGVs in Europe should be introduced in the country (see Box 2.6).
- e. In respect of buses and light vans, the state transport authorities must exercise due care and concern on their own part, and greater vigilance over contracted firms.

## MOTOR VEHICLE WORKSHOPS

For ensuring effective maintenance of vehicles, motor vehicle repair workshops must have trained mechanics, proper equipment and procedure, and quality assurance checks. Therefore, there is an urgent need for the upgradation of workshops. The authorised agents of dealers of vehicles—cars, buses and trucks—should set up workshops and also be responsible for certification of workshops. The certification will enable individual vehicle owners and vehicle fleet owners to make informed choices in engaging workshops for the maintenance of their vehicles to ensure vehicles working in good condition with respect to emission and safety.

## DRIVING TRAINING INSTITUTIONS

It has been estimated that about 500,000 commercial vehicles are being added every year, resulting in an annual requirement of the same number of commercial vehicle drivers. Assuming that one training establishment can turn out 25 trainees every month, 1,660 drivers' training schools are needed for commercial vehicles alone. Meeting this requirement will be quite a challenge. While the licensing of training institutions for driving may continue to be with the state governments, the law may be amended to require them compulsorily to adhere to an accreditation and quality assurance system. An important element in the strengthened regulation of training institutions for transport vehicle drivers will be to ensure that these institutions have adequately trained staff. For this purpose adequate facilities need to exist for training of trainers. MoRTH should

15 VDF multipliers convert the number of commercial vehicles of different axle loads and axle configuration to the number of equivalent standard axle load repetitions.

16. A capacity constrained business environment is likely to see more trucks taking to the roads with heavier loads than normal.

Road signs have to be legible and understood in time to permit a proper response. The current situation in India on this is dismal.

carry forward the scheme for establishing model driver training institutes across the country for addressing the training needs of driving motor vehicles. The central task of these institutes should be to produce training instructors.

## HUMAN DIMENSION

The employment generated by the trucking industry is quite substantial—4,500,000 or so in direct operation and many times more in all the up-and-downstream activities. Yet, the human element in the industry is often overlooked. Take the case of a truck driver, who is perhaps the most critical link in the road transport chain. But in terms of infrastructural support, social status and compensation package, he is way behind his counterparts in other modes of transport. Overall, his quality of life is poor. A survey conducted some time ago showed<sup>17</sup> that more than 25 per cent of the drivers could return to their base only after eight days of duty. About 40 per cent of the drivers returned to base between five and eight days, 20 per cent between three and four days, while only 10 per cent returned in less than two days. The incidence of HIV and other such diseases is known to be high among professional truckers. Clearly, the most effective way to make the job more attractive is to reduce the length of trips to 400-500 km so that drivers can spend more time with their families. There is a need to set up terminals at these distances so that he can hand over to another driver, Pony Express style. Containerisation of goods will facilitate this much desired operational practice.

## STANDARD ROAD SIGNS

The basic requirement for road signs is that they are legible and understood in time to permit a proper response. The current situation in the country is dismal in the matter of road signs on the road network. Apart from being inadequate, the existing signs are not in conformity with the existing Code of Practice. It hardly needs emphasis that uniformity of application is as important as standardisation with respect to design and placement of road signs. The decision to use a particular sign at a particular location should be based on proper traffic engineering study by knowledgeable professionals.

A standard signage system should be introduced across all highways in the country for intercity roads, roads in urban areas and for rural roads serving the villages and connecting markets, agriculture mandis, etc. The Indian Roads Congress is

understood to have recently updated its old Code of Practice on road signs and revised it in line with international standards and in conformance with the Vienna Convention on international signs. As recommended by the Sundar Committee on amendments of Motor Vehicles Act, 1988, this Code should be regularly updated by the IRC so that it is kept in line with developments taking place round the globe. Side by side, a mechanism for enforcement needs to be in place. This is a serious gap at present.

## SUMMARY AND CONCLUSIONS

- i. The Motor Vehicles Act is in need of amendment to respond to the demand of road transport for the current century. The Sundar Committee has suggested the needed amendments. These need to be carried out.
- ii. Freight transport being the backbone of the economy, apart from reoptimisation of the modal mix between road and rail, transshipment facilities by way of transport nagars and synchronisation of short haul movement by road and long haul movement by rail for both import and export cargo through containers would be required.
- iii. For modernisation of trucking industry, continued emphasis is needed for higher energy efficiency and lower emission levels with suitable incentive structure for multi-axle vehicles. Further, the industry is controlled heavily by intermediaries who need to be brought under the purview of regulation. The thrust has to be on the seller of services. The trucking industry is also characterised by low levels of technology. A strong link needs to be forged between profitability and technology. Financing for acquisition of modern trucks should be more liberal.
- iv. Use of Intelligent Transport Systems can significantly enhance regulatory processes and streamline seamless movement in inter-state movement of commercial vehicles. Advantage should therefore be taken of such technologies so that once a vehicle is inspected and cleared at the origin state and the information is electronically transmitted to other states along the proposed trip, there is seamless travel. The commercial vehicle should be treated as mobile infrastructure since they are carrying the economy on wheels. All efforts should be made to improve the productivity of these precious assets.
- v. The Inspection and Certification regime practised by the State Transport Departments should be modernised to reduce human inter-

17. Asian Institute of Transport Development: Journal on Trucking Industry, 2000.

vention and it should gradually cover all motorised vehicles, not just commercial vehicles alone.

- vi. There is need to establish collection centres for end-of-life vehicles to retrieve scrappage material as this would ultimately help in considerable energy savings.
- vii. Passenger transport services in rural areas are still lacking and this requires a special focus of the state transport departments. Possibility of public-private partnership needs to be explored by providing viability gap funding to the private operators for such services.
- viii. Information and communication technology needs to be used to improve operational performance of road transport including traffic management, electronic toll collection, vehicle tracking, overloading control and 'aam aadmi' interface with the transport administration.
- ix. Policies for energy efficiency in road transport should be targeted for both new and in-use on-road vehicles. There are five core policy areas—financial measures, fuel efficiency standards, inspection and maintenance regime, awareness raising and traffic management—for which practicable strategies need to be evolved and implemented.
- x. There is need for uniform applicability of road signs as per international standards across highways throughout the country.

## SUSTAINABILITY

A well-designed road network must convey goods and passengers in reasonable time between desired locations. However, it must also ensure that transportation is safe, mitigates environmental harm, socially responsible, and minimises other externalities. All of these considerations may be broadly captured under measures that promote the 'sustainability' of the network. In turn, 'sustainability' can be taken to mean a composite of:

- Buy-in from citizens, both those directly affected by road construction and improvement, those who will benefit from the eventuating infrastructure, and those who pay direct and indirect costs;
- Putting in place processes and procedures that address the issues arising from land acquisition, utility shifting/relocation, adverse environment impact, risks of accidents, etc.

Road alignments need to be finalised early from environmental and social perspectives to avoid land acquisition problems.

## LAND ACQUISITION

A major reason for delays in executing projects is the time taken to ensure that the necessary land is acquired and made free from encumbrances. For PPP projects, the current practice that 80 per cent of the required land should be available at the time of award of the projects should continue. Further, it should also be ensured that the remaining 20 per cent is made available to the concessionaire within a period reasonable enough so as not to delay the implementation of the projects as per the stipulations of the contract and concession agreements.

It is necessary to go in for land acquisition proceedings well in advance. For this, the first requisite is the finalisation of the road alignment for each project from technical, environment and social perspectives. Whenever the road alignment happens to pass through protected forests, it is essential for the road agencies to interact with the concerned environment authorities for jointly finalising the road alignment.

The Government has taken up the initiative for amendment of the Land Acquisition Act, 1894, and this is in advanced stages of finalisation. It needs to be ensured that the land acquisition clauses as per the provisions of the NH Act, 1956 are also amended accordingly. There may be need to move towards acquiring land for roads through the system of negotiated rates to accelerate the process. Further, the concept of land bank may also be explored.

The given land resources of the country have to meet myriad requirements of its large population. Ever-increasing economic activities are putting greater pressure on this scarce resource. Hence, there is an imperative need to have a closer look at the requirements of land for transport projects. Expressways, particularly greenfield projects, consume large swathes of land. Rail corridors use much less land and provide much greater capacity. Intermodal choices need to factor in this also, besides inherent characteristics of each mode.

In the foreseeable future, the acquisition of land would become a difficult and time consuming process. It would therefore be prudent to build land banks. Time lags can thus be minimised.

Utility agencies are not the owners of Right of Way. For any operation, they should enter into an agreement with the concerned road agency for use of the stretch of road in question, and pay a reasonable rent for this.

## REHABILITATION AND RESETTLEMENT

The rehabilitation and resettlement (R&R) of persons whose livelihoods or habitations are affected by road development projects varies widely, depending on whether projects are implemented through external aid or loan assistance, or whether they are publicly funded or PPP projects. It is also dependent on the nature of the project and the area through which it passes.

There is further variance in R&R policies between state and Central governments, who are each responsible for constructing, improving and maintaining different kinds of roads. A uniform R&R policy is desirable to ensure that compensations for project affected persons (or families) are equitably rationalised.

## UTILITY SHIFTING

It is often the case that various utility networks piggyback on existing road networks. This includes electric and telephonic cables, water mains, gas and other pipelines. The rationale is obvious. There is an existing right of way, the localised terrain is already made manageable by the road, and there are no costs associated with further land acquisition. Further, the roads themselves provide easy access to the utility agencies for construction, repair and maintenance. On the whole, this piggybacking is desirable as it can help manage construction costs of both road and utility, and also does not require duplication in land that is reserved as right of way. However, these utility networks that skirt the margins of the roads are problematic when roads need to be widened or improved. A complex set of permissions and sign-offs are needed from any number of concerned authorities. Further, specialist technicians must undertake the work of relocating the utility network along the margins of the new, wider, road. Overall, seeking the necessary permissions and arranging for temporary alternatives during the construction period and then for permanent realignments once works are complete is a slow and onerous task, and one that often contributes to delayed road infrastructure projects.

There is a more general argument to be made with respect to roads and utilities. Land acquisition and creating usable rights of way is a central issue

to the planning of any kind of network, though is undoubtedly most crucial for road infrastructure.

Utility agencies need to recognise that they are not the owners of the Right of Way. As such, for any operation, they need to seek prior permission of the road agency within whose jurisdiction the particular stretch lies. They should enter into an agreement with the concerned road agency for use of the ROW of the road stretch in question. Where such utilities need to cross the road, this should be at mutually agreed locations. For use of the right of way, a reasonable rent should be payable by the utility agency to the road agency to compensate the latter for the cost incurred in acquiring the ROW. The agreement should also stipulate obligations on the part of the utility agencies for laying and thereafter restoring the road embankment, etc., in its original condition and with least delay. The entire cost of relocation of existing utilities should be borne by the utility agency irrespective of whether this is due to road upgradation or due to requirement of utility agency itself. For any new locations, the utility agencies should acquire their own right of way.

## ROAD SAFETY

It is essential that a new paradigm for road safety is adopted in India wherein all stakeholders and participants, from legislators through to regulators, administrators, engineers, contractors, constructors and ultimately, road users acknowledge the role that they must play in ensuring road safety, and execute actions to achieve this. Based on the report of the Sundar Committee on Road Safety, the MoRTH has already introduced a Bill in Parliament to create a Road Safety and Traffic Management Board as an umbrella agency in this regard. The major areas of attention can be grouped into: engineering measures on roads and vehicle design incorporating safety features; education and awareness; enforcement; and emergency medical care. There are several financing options for funding road safety such as the road fund; surcharges on fuel or vehicle licences; corporate social responsibility initiatives on the part of public and private agencies; and automobile industry contributions.

## SUNDAR COMMITTEE ON ROAD SAFETY AND TRAFFIC MANAGEMENT

The wide-ranging recommendations of the Sundar Committee on Road Safety and Traffic Management should be adopted. The centrepiece of the Committee's recommendations was to set up a Road Safety and Traffic Management Board together with a National Road Safety Fund. In consultation with the government, which will also retain powers to issue directions, the Board will have wide-ranging powers to promote road safety and improve traffic management in India. The Board should consist of a chairperson and three to five experts in road engi-

neering, traffic engineering, vehicle engineering, traffic laws and enforcement, and accident-related healthcare. A summary of the functions of the Board is provided in Box 2.25.

#### POST-ACCIDENT EMERGENCY MEDICAL CARE

An area of critical concern is the post-accident emergency medical care. A new safety initiative (post-accident initiative) called 'Golden Care' is recommended to reduce fatalities in the event of an accident on National or State Highways. The golden hour is a term used in emergency medicine and refers to the time immediately following a traumatic injury, when prompt medical attention is most likely to prevent death. Under the Golden Care Initiative, when an accident occurs, medical care should be provided to the victims within the golden hour. Administrators should ensure that whenever an emergency situation occurs in the highways, the victims are rushed to a nearby medical centre within 10 minutes of accident (Figure 2.3).

The administrators can get the relevant details of the vehicle and driver through an online database (blood group, medical history if needed etc.). Meanwhile nearby ambulances (using GPS technology etc) can be called to transport victims to the nearby medical centre. Automation technologies and communication technologies can be used to provide right-of-way to ambulances while transporting passengers during emergency situations. This can be linked with the existing system that uses the phone number 108 for emergencies.

#### ROADS AND THE ENVIRONMENT

As described on several occasions in this report, trucks on roads account for the vast bulk of freight carted across India. Rising mode-share for road, vis-à-vis rail-based freight transport, is undesirable on several counts and a central theme of this report has been to argue in favour of reversing this trend. Be that as it may, road transport will remain a central element of both freight and passenger transportation for the period under consideration, and it remains essential that its environmental impact is evaluated and mitigated to the furthest possible extent.

#### ENERGY USE

The transport sector derives nearly all of its energy requirements from petroleum products, using about 27 per cent of total oil and oil products available in India in 2006-07. Of the total energy employed by transport, roads account for the lion's share at 78 per cent, a figure which is only projected to increase over the next 20 years (see Figure 2.4). With India importing most of its petroleum products, any efficiencies in energy use that may be wrung from the road transport sector will be enormously beneficial.

The single most influential measure to constrain energy use is to maintain or even increase the share of public transportation.

Given the relative efficiencies of public over private transportation modes for passenger traffic (Table 2.37), the single most influential measure at constraining the road transport sector's energy use is to ensure that public transportation shares are maintained or even increased.

For each mode, proper economic incentives should price passenger-kilometres at the true inherent marginal social costs. The implications of this are profound, including an unravelling of fuel subsidies, at least on the basis of their justification today. Better quality fuels are usually more expensive to refine but offer better energy efficiencies in turn.

Newer engines offer technologies such as variable valve timing, variable compression ratios, friction reductions etc that improve fuel economies. Appropriate incentives should be in place to encourage faster migration to the use of these engines. The quality of road pavement and the generally free-flow of traffic—which can be aided by two-laning and the provision of earth shoulders—also impact fuel efficiencies. In summary, better fuels, better engines, and better roads can all contribute to dampening the incessant increase in demand for energy from the road transport sector.

#### EMISSIONS

Emissions of greenhouse gases are directly related to the quality and quantity of petroleum products used in the sector. These gases contribute to the warming of the climate. The important gases in this regard are carbon monoxide, nitrogen oxide, nitrogen dioxide, and sulphur dioxide and methane. Emissions also take the form of unburned hydrocarbons, which are collectively called PM10 (particulate matter that is less than 10 microns in diameter). This particulate matter greatly affects the air quality and, at excessive levels, poses severe health complications.

The quantity of emissions drastically increases with reductions in motor speeds, therefore measures aimed at easing congestion will not only result in reduced journey time but also in reduced emission of pollutants into the atmosphere.

The standard methodology for managing emissions is through the use of vehicle emissions standards. Implemented with varying stringencies worldwide, these standards have become progressively tighter over time as technologies and fuel qualities have improved. The standards relate to both the quality of fuels and vehicles made available for sale in relevant jurisdictions. Once, Indian standards were

## Functions of Road Safety and Traffic Management Board

### Road-related measures

- Set safety standards in conjunction with the IRC for the design, construction and operation of National Highways
- Conduct or commission road safety audits of National Highway projects through all phases to monitor adherence to prescribed standards and issue directions, and where necessary, to take corrective action
- Recommend minimum safety standards for the design, construction and operation for roads other than National Highways
- Recommend traffic calming and other similar measures

### Vehicle-related measures

- Set standards for safety features for all mechanically propelled vehicles
- Conduct or commission audits to monitor adherence to standards
- Set minimum conditions for the safe usage of mechanically propelled vehicles and safety standards for vehicular traffic on various types of roads
- Recommend minimum safety features for non-mechanically propelled vehicles and promote safe carriageways for such transport and vulnerable road users

### Road safety research

- Identify subjects and institutions for research in different areas of road safety
- Establish centres of excellence in road safety research and education
- Create links between research centres at central, state and local levels
- Maintain a comprehensive database on safety-related matters
- Establish a procedure and methodology for data collection, storage and dissemination

### Traffic law

- Recommend guidelines to state governments for computerizing information regarding vehicle and driver licensing
- Recommend guidelines for training, testing and licensing of drivers

### Public awareness

- Promote best practices in road safety and traffic management
- Identify and recognise NGOs working towards road safety and assist where possible

### Medical care

- Lay down guidelines for establishing and upgrading trauma care systems
- Create a grid of medical, allied medical and rehabilitation facilities to provide first aid, care during transportation, emergency care

### Other functions

- Advise the central government on administration of provisions under Central Motor Vehicles Act, 1988
- Provide technical assistance to state boards and other agencies engaged in road safety
- Liaise with international agencies and organisations
- Liaise with other agencies like education and health boards, healthcare providers

Source: Report of the Sundar Committee on Road Safety and Traffic Management – February, 2007.

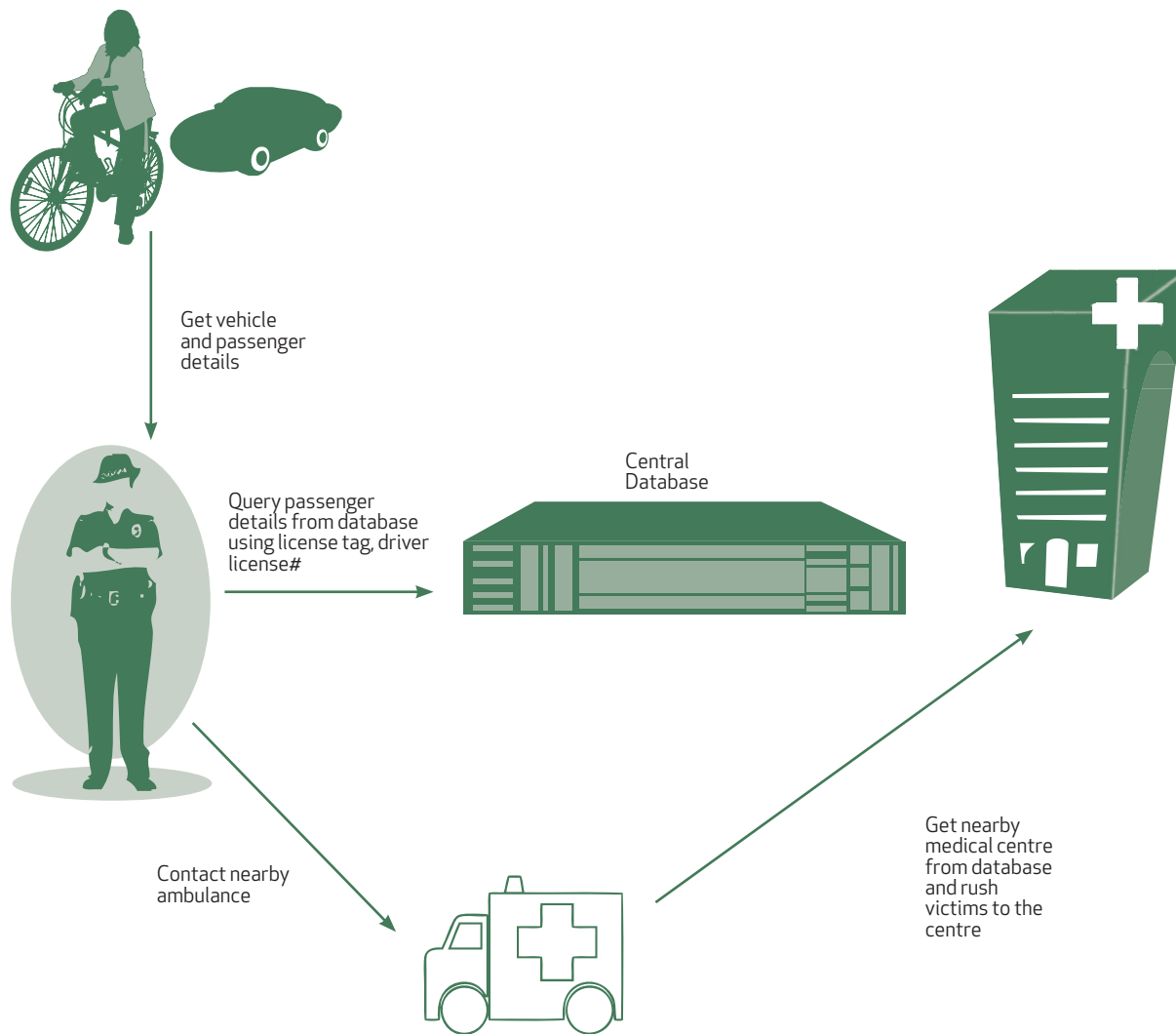
nearly 15 years behind emissions norms in Europe; today, much progress has been made and this lag is now only five years. However, there is some disparity in that different norms apply in metropolitan urban areas and in the rest of the country. This is at least partially connected with the difficulties of ensuring adequate quantities of better quality fuels, e.g., low-sulphur diesel. Over the next five years, India must introduce uniform fuel quality and emissions standards throughout the country and make emissions monitoring a key component of the vehicle inspection and certification process.

This issue has been dealt with in detail in Chapter 7, Volume II, on Energy and Environment.

### INTER-AGENCY COORDINATION

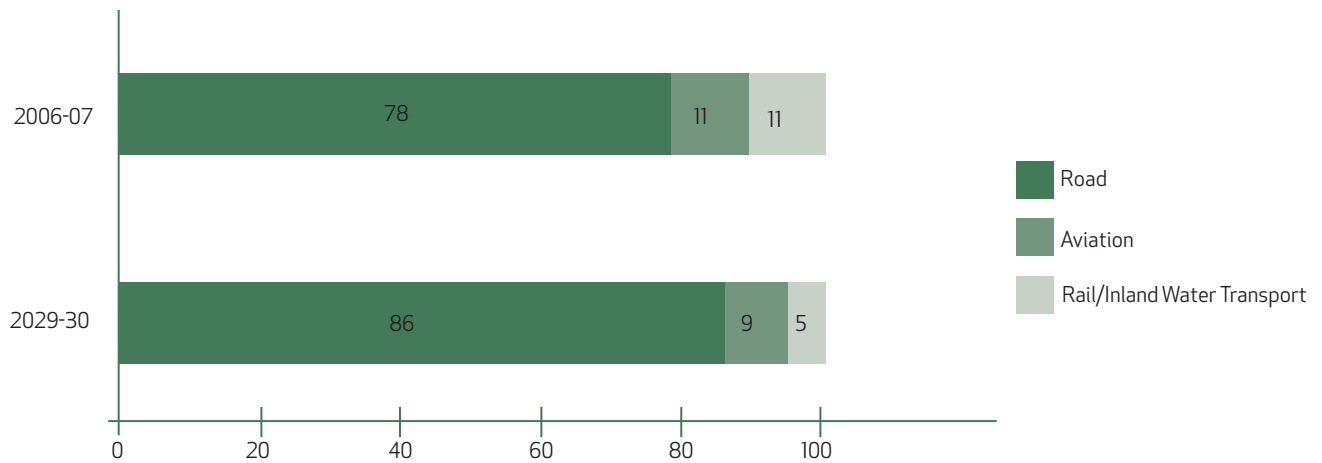
There are multiple agencies both in the Centre and the states for the development of the road transport sector. In such a situation, more often than not, each agency formulates and implements its own plan for development without any regard to the plans of other agencies. This leads to sub-optimal network development and results in higher resource cost of transportation. In Chapter 5, Volume II, Institutions for Transport System Governance, setting up of the Office of Transport Strategy (OTS) has been recommended. This organisation would develop a larger coordinated plan for all modes of trans-

Figure 2.3  
**Golden Care**



Source: Infosys Research

Figure 2.4  
**Mode-Wise Energy Shares in the Transport Sector**  
[Per cent]



Source: Report of the Working Group on Roads for NTDP, May 2012

Table 2.37  
**Relative Fuel Efficiencies of Various Road Transport Modes**

MODE	FUEL TYPE	FUEL EFFICIENCY (KM/L)	ENERGY INTENSITY (L/PKM)	RELATIVE ENERGY INTENSITY
Bus	Diesel	4.3	0.006	1.0
Two-wheeler	Petrol	44.0	0.015	2.5
Three-wheeler	Petrol	20.0	0.028	4.7
Car	Petrol	10.9	0.038	6.3

Note: pkm = passenger kilometre, l = litre  
 Source: Report of the Working Group on Roads for NTDP, May 2012

portation including road transport. Within the framework of this plan, each organisation may formulate plans and policies. If necessary, OTS may issue suitable guidelines and assist the agencies in this regard.

### SUMMARY AND CONCLUSIONS

- i. Delays in land acquisition affect the implementation of road projects. It is necessary to go in for land acquisition proceedings well in advance. There may be need to move towards acquiring land for roads through the system of negotiated rates to accelerate the process.
- ii. Ever-increasing economic activities are putting greater pressure on the scarce resource of land. Hence, there is an imperative need to have a closer look at the requirements of land for transport projects. Expressways, particularly greenfield projects, consume large swathes of land. Rail corridors use much less land and provide much greater capacity. Intermodal choices need to factor this in also, besides inherent characteristics of each mode.
- iii. A uniform policy for rehabilitation and resettlement of project affected persons is desirable so as to ensure equitable compensation across state and Central government agencies.
- iv. Utility agencies need to seek prior permission of the road agencies for their operations and should be required to pay a reasonable rent for use of the right of way. The entire cost of relocation of existing utilities should be borne by the utility agency irrespective of whether this is due to road upgradation or due to requirement of the utility agency itself.

- v. The wide-ranging recommendations of the Sundar Committee on Road Safety and Traffic Management should be adopted. A Road Safety and Traffic Management Board should be set up, together with a National Road Safety Fund. In consultation with the government, which will also retain powers to issue directions, the Board will have wide-ranging powers to promote road safety and improve traffic management in India. The Board should consist of a chairperson and three to five experts in road engineering, traffic engineering, vehicle engineering, traffic laws and enforcement, and accident-related healthcare.
- vi. Given the relative energy efficiencies of personalised vehicles and public transport, it is necessary to enhance the share for the latter. Apart from this, better fuels, better engines and better roads would also help contain the incessant increase in demand for energy for road transport. This would also help in containing the emission levels to acceptable norms.

### FINANCING ROADS

As seen earlier, the projected investments for roads in the next 20 years covering the 12<sup>th</sup>, 13<sup>th</sup>, 14<sup>th</sup> and 15<sup>th</sup> Five Year Plans are huge. To recapitulate, Table 2.38 shows the requirements of funds to respond to the traffic demand and providing universal connectivity to our villages.

### FINANCING STRATEGIES

It is not too far into the past, when the sole method available for financing road infrastructure was the government budgetary allocation of each year, made according to a five-year investment plan. Some of

the budgetary allocation would be directly funnelled from revenue sources such as fuel taxes, vehicle and passenger taxes, other road taxes, and named cesses. Recent attempts at private sector involvement in provision of road infrastructure have brought enormous changes, and made possible greater quantities of better new roads available faster than they otherwise might have. However, these partnerships between the public and private sectors have not proved to be uniformly successful. Even so, there can be no escaping the conclusion that private sector involvement is essential over the next 20 years. Hence, government focus must also be on lessons learnt from the current concession projects and incorporate the same in designing mode of delivery of road infrastructure so as to ensure value for money invested.

## ROAD TAX AND FUEL CESS REFORM

Taxes on petroleum and high speed diesel oil are earmarked for road construction programmes. For the Central Road Fund, the current policy is to charge a fixed cess of Rs 2 per litre. In an environment of rapidly increasing oil prices (which it must be recalled, immediately influence road construction costs), these cesses comprise decreasingly lower shares of fuel retail prices. This policy should be replaced with fuel taxation on an ad valorem basis. As noted earlier, the cess was fixed at Rs 2 per litre on petrol and diesel in 2005. At that time, the price of petrol was around Rs 40/per litre and that of diesel around Rs 30/per litre. Current prices are Rs 70 and around Rs 50 (highly subsidised). The cess can be enhanced to Rs 4 per litre now and be increased with time. The CRF accruals would get enhanced to about Rs 400 billion a year. Apart from this fund, several states have created state road funds for development and maintenance of state roads. Such initiatives can be adopted by other states as well.

Furthermore, road taxes are inconsistent and seemingly disconnected from the desired economic outcomes they ought to relate to. Myriad taxes at varying rates on varying tax bases apply on vehicle purchase, on the operation of motor vehicles, and on parts and tyres. There are fees associated with registration and transfer and on permits for commercial vehicles to ply on interstate routes. Finally, there are periodic vehicle taxes, and operational fees payable, such as lease taxes, and passenger and goods taxes. The idiosyncrasies of the taxation regimes across the states mean that it is difficult to account for how these revenues are actually used. There is need for rationalisation of road taxes on motor vehicles (Chapter 9, Volume II on Fiscal Issues, for details).

These differing taxation regimes also act as a deterrent to the free movement of freight, hampering economic productivity and growth. The uncertainty and confusion caused by the taxation policies of the states must be rationalised with the guiding prin-

A uniform policy for rehabilitation and resettlement of project-affected persons is desirable so as to ensure equitable compensation.

ciple being a clear mapping between the economic rationale for the tax, the tax itself, and how the resulting revenues are deployed.

There is a case for significant increase in taxes on personalised vehicles so that they can be ploughed back to generate resources for strengthening public transport.

In addition to road taxes and tolls, some states have also been generating financial resources through market committee fees on agriculture produce and share out of royalties from mining.

## PPP IMPLEMENTATION

With limited public funds and a pressing need to rapidly develop India's infrastructure, the government has, in recent years, sought private participation in major infrastructure projects. Typically, the government (at the central or state or joint levels) negotiates terms with a consortium of private enterprises under which each contributes a certain amount towards the construction of the project. The terms also govern how the project is to be operated and maintained over a defined period, how risks and revenues are shared, what guarantees are supplied by both parties to each other, and what happens to the asset at the end of the defined period.

The current policy framework for undertaking road infrastructure projects through the PPP mode has been well laid down and needs to continue. The standard documents prepared by the Planning Commission and the Indian Roads Congress are world class. While implementing projects through the PPP, a few problems have, however, arisen. Box 2.26 brings out issues and experiences in implementation of three projects as case examples.

The initial exuberance that private enterprise would prove to be a bedrock on which the road network of the future could be built seems to have dampened to some extent in recent months. Much of the low-hanging fruit in the form of the most profitable, i.e., highly trafficked, highways has been picked. Projects that are less attractive to the private sector, but no less important for the nation, have struggled to find suitors. Several PPP-funded projects have suffered from want of pre-construction preparation in the form of securing land, permissions, and adequate provisions for resettlement and rehabilitation. More generally, the balancing of risks between government and private enterprise remains desirous of a consistent framework that is fair, rational, and sustainable.

Table 2.38  
**Projected Investments for Road Infrastructure**  
 (Rs billion)

SCHEME	2012-17	2017-22	2022-27	2027-32	2012-32
Expressways	200	600	1,200	1,800	3,800
National Highways	2,150	3,150	4,200	5,700	15,200
Special Schemes SARDP-NE + Arunachal Package (Central Sector)	250	400	500	600	1,750
Other Special Schemes (Central Sector)	100	150	200	200	650
State Highways	2,100	2,700	3,200	3,600	11,600
Major District Roads	1,000	1,300	1,600	2,100	6,000
Rural Roads Including PMGSY	1,450	1,850	1,300	1,100	5,700
Total	7,250	10,150	12,200	15,100	44,700

While it is necessary to design agreements that are flexible enough to accommodate the concerns of the entrepreneurs, it is equally incumbent on the road agencies to exercise due diligence in conceptualising the scope of work for the PPP projects. See Box 2.27.

The following suggestions merit consideration for provision of road infrastructure through PPP.

- i. Undertake studies of several PPP road projects with a view to distilling good practices and problems faced and how they were resolved. The reports based on such studies should be put on the web and discussed with road agencies to improve delivery of future projects.
- ii. Continue with the current strategy of phased development for capacity augmentation—neither too much too early nor too little too late. Provide capacity for a minimum of 10-12 years initially. Land width should of course be planned and provided initially itself. It is necessary to ensure that land acquisition con-

forms to the letter of the law and institutional arrangements are made to address grievances and adequate provisions are made for rehabilitation and resettlement of project affected persons.

- iii. The road agency must provide a value-for-money analysis for each project not only at the time of procurement but also post construction. The post construction value-for-money analysis should also capture time and cost overruns, variations in revenue realised compared to initial forecasts and quality of service achieved.
- iv. It is also to be appreciated that PPP projects are vulnerable to both the financial and the real impact of the economic downturn. Drop in GDP growth rate in the recent past has directly affected the traffic growth rate and thereby revenue potential of road projects. Due to the lower revenue potential, viability of highway projects took a hit. The lenders found that the original revenue projections

given by the project developers were not being met and debt servicing was not upto the levels originally projected. Due to this, lenders reduced their interest and exposure towards road sector projects. Effects of down turn on PPP projects are evident. There is need for the government to invest in knowledge acquisition, especially in respect of traffic forecasting, pavement performance and deterioration prediction and highway capacity norms. This would help both the government and the concessionaire in more informed financial appraisal, transparency in PPP finances and reduced risks arising from uncertain outcomes. Even the current risk sharing mechanism may need review to provide reasonable comfort to the concessionaire and the lender.

- v. The Annuity Model is nothing but a deferred budget form of delivery and has the potential of casting a heavy burden on contingent liability of the government. It is clearly unsustainable in the long run as the entire traffic risk is transferred to the government. The government would do well to stop this mode of delivery in its present form. Where this mode of delivery is proposed, there should be a cap, say no more than 15 per cent of the annual road budget to defray year-by-year contingent liability by way of annuity payments. Further, such projects, being prohibitively expensive, should be subjected to a more rigorous value-for-money analysis and compared with the public sector delivery option. Another modification that has potential to soothen contingent liability in the future would be for the government to provide 40 per cent of the construction cost upfront and the balance cost of construction plus maintenance to be paid back through annuity payments. There is also need for stricter scrutiny of annuity payments demanded by the bidders on the parameter of reasonableness of demand. Otherwise, it would be more cost-effective to undertake projects instead as EPC contracts.
- vi. Given that for some projects in the past, the concessionaires did not evince interest in BOT (Toll) and preferred BOT (Annuity), it is evident that there is less appetite for bearing full traffic risk by private players. It would be advisable to revisit the strategy for traffic risk sharing in BOT (Toll) model. The government needs to share both the upside and downside of a predecided/predetermined traffic band and address the concern of competing facility so as to provide the requisite comfort to the private sector.
- vii. The government is already aware of the problems arising due to lack of progress on pre-

construction activities covering land acquisition, shifting of utilities and environmental clearances. Arrangements should be made for bringing these activities under control before project award and streamlining the system of various clearances and State support in facilitation of these clearances as also in law and order and toll operations.

- viii. The level of service and riding quality are seen to be poor on several projects. There is need for a stricter regime for enforcement of performance standards during operation and management of projects by the concessionaires. The agencies should be held accountable for any deficiency in performance of the concessionaires.
- ix. PPP projects necessarily involve a user-pays element. In several parts of the country, the local population has balked at the idea of paying to use a road that is constructed on land that is considered their own. Occasionally, it has proved sound politics to stoke this civil disobedience. Wider acceptance of this model is required to reduce the social and political risks associated with PPP-funded projects. This can be done by ensuring that land acquisition conforms to the letter of the law, setting up institutions to address grievances, providing for adequate resettlement and rehabilitation efforts, and by demonstrating direct benefit and value for money. This last factor depends on timely construction, assured maintenance, smooth toll collection, and predictable toll escalation.

#### THE WAY FORWARD

PPP has introduced much-needed private funding for provision of public infrastructure. Amongst the various sectors, the influence of PPP on roads has been especially strong. This can be attributed to strong political leadership for promoting user charge principle, a supportive institutional environment and sound legal framework with fair risk sharing mechanisms, a clear mandate, a capable champion and enabler in the road agencies, and an incentive structure that welcomes private investment. However, for PPP funding to continue to contribute to the development of the Indian road network, there is a strong case for learning from the achievements made so far and undertake further reforms to enhance the level of private financing.

#### REVIEW OF TOLL POLICY

There is need for review of the current policy of user fees (tolls) on National Highways. A two-lane road should be considered a minimum facility to be provided out of government budget in respect of primary roads (National Highways and State High-

## Issues and Experiences in Implementation of PPP Road Projects

### Delhi-Gurgaon Project on Golden Quadrilateral: Better Project Preparation

The project was conceptualised in 1999 as a part of the Golden Quadrilateral project. It was awarded to the consortium of Jaypee Industries and DS Constructions Ltd in 2002. It was also the first project to be awarded on negative grant basis. The project could be opened to traffic only in 2007 after five years of its award.

In between, following issues were observed:

1. NHAI relied on old traffic data which resulted in a situation with high traffic levels causing heavy queuing at the toll plaza.
2. The project required various approvals from 15 government/civic bodies, which was a complex and time consuming process. Such delays can be avoided through a single window clearance mechanism or a clearer approval process that should be standardised across states and agencies.
3. The original project cost envisaged was Rs 548 crore. However, actual cost to the concessionaire turned out to be more than Rs 1,000 crore. There were substantial changes in the original design to provide for future requirements and the convenience of commuters. Out of a total of 11 structures, nine had significant design modifications. Also, various government agencies demanded changes in the project alignment and design resulting in change in scope, project cost and consequent delay.
4. The project also faced issues in land acquisition. There were certain small parcels of land which were difficult to acquire.

Experience in this project highlights the importance of reliable and up to date traffic data, single window clearance for large projects, deeper stakeholder consultations for design finalisation during project preparation, especially in urban areas, and the need to closely monitor project performance as well as to ensure that audited results reflect the true performance of the project.

### Ahmedabad-Vadodara (NH-8) 6-laning project combined with Ahmedabad-Vadodara Expressway: Innovative Structuring

Ahmedabad-Vadodara Expressway (NE-1) was constructed by NHAI and was operated under an SPV owned by NHAI. Recently, when the need for six-laning of the Ahmedabad-Vadodara NH-8 section was realised, its project structuring faced issues relating to a competing facility in the form of the existing Expressway. Also, there was an issue of correct estimation of traffic on the NH-8 section and thus there was risk of developers allocating high risk premium in their bids.

Consequently, the Expressway and the NH-8 sections were clubbed under one project for bidding out. This reduced the risk perception and also improved viability of the project.

This experience highlights the importance of innovative project structuring leading to win-win situations.

### Mumbai-Pune Expressway: Importance of Establishing Revenue Streams for PPP Projects on Toll Basis

This project, developed by the Government of Maharashtra, involved a full new alignment with attendant traffic risk and significant uncertainty in initial years. The Government of Maharashtra allowed the project to first establish a definite revenue stream over a few years and then awarded the project on operations and maintenance contract with tolling rights. This experience highlights the need of a reliable and established revenue stream for PPP projects to be successful on toll basis.

Source: Report of the Working Group on Roads for NTDP-2012.

## Sub-Prime Highways

- Banks have been lending far in excess of the duly approved TPC (Total Project Cost) in case of several PPP highway projects under the NHDP, leading to a situation where the concessionaire may not only spend beyond reasonable costs, but also siphon out funds at public expense. A question arises as to whether these are in the nature of sub-prime loans that can expose public finances to undue risk.
- Disproportionate grants by the government for construction of PPP road projects combined with permitting the concessionaire to sell its equity and exit from the project after two years of completing the construction reduces its incentive to build a project that would last longer and can leave government with low-quality assets. Need to identify and eliminate potential risks to public interest.
- Bids received for some of the annuity projects also seem to be very high and unjustified. This arrangement does not seem to represent value for money from the perspective of the exchequer.
- There seems inadequate appreciation of the fact that annuity payments are essentially a form of deferred budgetary payments which will pre-empt future development by committing the expected cess revenues for 15 to 18 years. This is not only unprecedented but also unsustainable.
- The standards laid down in the IRC Manuals are being routinely exceeded and excessive costs continue to be incurred by adding elements that lack justification.

Source: Sub-prime Highways: An Issues Paper by Gajendra Haldea, June 2010.

ways) with no direct user charge. Toll should be levied on multi-lane highways, both access-controlled and non-access controlled, as also spot improvement projects such as bridges, tunnels, flyovers, bypasses.

The government is already considering reduction in user fees after recovery of capital costs and dispense with charging of toll when the project is under construction. This would be a step in the right direction. In addition, the government may also consider incentivising toll rates for multi-axle vehicles as they carry more tonne km per litre of fuel.

Due to multiplicity of vehicle taxes being paid by the commercial vehicles (buses and trucks), there have been occasional threats and concerns expressed in the past by the road transport industry for linking the rates of tolls with the savings in time, fuel consumption and vehicle operating costs. It is necessary to immediately launch a highway allocation study to decipher the costs occasioned by cars, buses and trucks in use of roads covering both construction and maintenance costs and benefits occurring due to capacity augmentation in terms of savings in road user costs. This

will provide the much-needed rationale for review of the current toll rates.

While the open system of toll collection needs to continue in respect of non-access controlled multi-lane roads, there is need to move to closed system of toll collection on expressways so that users are charged based on the length of road utilised for the journey. In the open system also, there have been cases where the users have been required to pay much heavier toll amount in relation to the use of the highway because of irrational location of toll plazas. This requires a more reasonable approach in deciding location of toll plazas.

There is need to adopt the electronic toll collection system as per recommendations of the Nandan Nilekani Committee. To enhance transparency, each toll plaza should display cost of project, and amount of toll collected up-to-date.

### PUBLIC SECTOR FINANCING

Private sector financing in the highways would remain confined to the commercially viable and high traffic density stretches. Rural roads are being built with the government financing utilising the CRF and

The government is considering reduction in user fees after recovery of capital costs and dispense with tolls when the project is under construction. In addition, it should also consider incentivising toll rates for multi-axle vehicles as they carry more tonne-km per litre of fuel.

RIDF window of the NABARD funding. While the private sector would continue to serve an important segment of the road network, sizeable investments in the road sector are required to develop the balance road network of even primary and secondary roads. It will be prudent, therefore, to enhance the availability of public sector funding sources to bridge the current gap between the availability of funds and the road development requirements. Further, public sector delivery also is in need of enhanced efficiency and value engineering.

## SUMMARY AND CONCLUSIONS

- i. The current policy framework for public-private partnership in roads has been well laid down and should continue. However, the government must focus on lessons learnt from the current concession projects and ensure value for money invested.
- ii. Recently, there has been somewhat poor response from the private sector. There is need for the government to invest in knowledge acquisition, especially in respect of traffic forecasting, pavement performance and deterioration prediction and highway capacity norms. This would help both the government and the concessionaire in more informed financial appraisal and reduced risks arising from uncertain outcomes. Even the current risk sharing mechanism may need review to provide reasonable comfort to the concessionaire and the lender.
- iii. The Annuity Model is nothing but a deferred budget form of delivery and has potential of casting a heavy burden on contingent liability of the government. It is clearly unsustainable in the long run as the entire traffic risk is transferred to the government. The government would do well to stop this mode of delivery in its present form. Where this mode is proposed, there should be a cap, say no more than 15 per cent of the annual road budget to defray year-by-year contingent liability by way of annuity payments. Further, such projects should be subjected to a more rigorous value-for-money analysis and compared with the public sector delivery option. Another modification that has potential to soothen contingent liability in future would be for the government to provide, 40 per cent of the construction cost upfront and the balance cost of construction plus maintenance to be paid back through annuity payments. There is also need for stricter scrutiny of annuity payments demanded by the bidders on the parameter of reasonableness of demand. Otherwise, it would be more cost-effective to undertake projects instead as EPC contracts.
- iv. Given that for some projects in the past, the concessionaires did not evince interest in BOT (Toll) and preferred BOT (Annuity), it is evident that there is less appetite for bearing full traffic risk by private players. It would be advisable to revisit the strategy for traffic risk sharing in BOT (Toll) model. The government needs to share both the upside and downside of a predecided/predetermined traffic band and address the concern of competing facility so as to provide the requisite comfort to the private sector.
- v. The government is already aware of the problems arising due to lack of progress on pre-construction activities covering land acquisition, shifting of utilities and environmental clearances. Arrangements should be made for bringing these activities under control before project award and streamlining the system of various clearances.
- vi. The level of service and riding quality are seen to be poor on several projects. There is need for a stricter regime for enforcement of performance standards during operation and management of projects by the concessionaires. The road agencies should be held accountable for any deficiency in performance of the concessionaires.
- vii. PPP projects necessarily involve a user-pays element. In several parts of the country, the local population has balked at the idea of paying to use a road that is constructed on land that is considered their own. Occasionally, it has proved sound politics to stoke this civil disobedience. Wider acceptance of this model is required to reduce the social and political risks associated with PPP-funded projects. This can be done by ensuring that land acquisition conforms to the letter of the law, setting up institutions to address grievances, providing for adequate resettlement and rehabilitation efforts, and by demonstrating direct benefit and value for money. This last factor depends on timely construction, assured maintenance, smooth toll collection, and predictable toll escalation.

- viii. It is to be realised that the private sector financing in the highways would remain confined to the commercially viable and high traffic density stretches. Rural roads are being built with the government financing utilising the CRF and RIDF window of the NABARD funding. While the private sector would continue to serve an important segment of the road network, sizeable investments in the road sector are required to develop the balance network of even primary and secondary roads. It will be prudent, therefore, to enhance the availability of public sector funding sources to bridge the current gap between the availability of funds and the road development requirements. Further, public sector delivery also is in need of enhanced efficiency and value engineering.

## DATA AND INFORMATION TECHNOLOGY

Better decisions on road infrastructure can only stem from better understanding of the underlying structure of current and expected traffic on our roads. This understanding, which in turn is dependent on better data, can help ensure that outlays deliver infrastructure that actually addresses the core concerns of mobility and accessibility, while not being wasteful. As a simple example, consider a situation where the citizens of a medium-sized town report an access road to be perpetually congested. Solutions to this problem can range from widening the access road, constructing a bypass around the town, boosting rail capacity into the town, constructing a transport nagar on the outskirts, amending city bylaws, and many others. The point is that the most efficient and cost-effective solution hinges crucially on an in-depth understanding of why the road is congested and the pattern and characteristics of the types of traffic plying on the road. Such evidence-based decision-making and monitoring of resulting outcomes is reliant on extensive, relevant and robust data.

### EXISTING DATA COLLECTION AND DISSEMINATION

The existing system of planning and management of various categories of roads involves some level of judgment and empiricism due to the lack of a fit-for-purpose database on existing condition of roads, traffic data, vehicle fleets, level of service, accidents and so on. Even for National Highways, only limited data is available on the inventory of bridges and overpasses. Traffic censuses are based only on seven-day counts carried out twice a year, falling well short of delivering a complete picture of year-round use. Much useful data collected by both Central and state governments stay unused for want of being accessible from a centralised system in a standardised format.

The government needs to share both upside and downside risks so as to provide the requisite comfort to the private sector.

### PHYSICAL INFRASTRUCTURE

Data on physical infrastructure at the Central and state level is collected in Basic Road Statistics, a publication issued by MoRTH. All classes of roads are covered, though with a substantial time lag. With ambitious targets for road building that are often expressed in terms of km per day, it would be immensely useful for performance monitoring purposes if data were published regularly and frequently. This will require overhauling and streamlining of the data collection system that relies on a multiplicity of agencies and often features incomplete and inconsistent data that frustrate timely publication.

### VEHICLE FLEET STATISTICS

The Road Transport Yearbook collates data on India's vehicle fleet from the governments of states and union territories. Disaggregated data is also available for many of the largest cities. The headline data item is the total of the registered motor vehicle fleet in each jurisdiction, though this is more finely distinguished by: vehicle classification, passenger load for public transport vehicles, engine size, public and private ownership of buses, and so on. However, with road transport primarily under state purview, the quality and coverage of this data is largely dependent on state-level funding and effort. A major limitation of this data is that registered vehicles are a superset of vehicles actually in use. Thus, there is considerable overestimate of the number of vehicles that are on the road. Other missing features of this data concern the vehicle km travelled by both private and public transport vehicles, the degree to which they conform to design rules and pollution controls, and whether or not they are fit for use on the road network.

### OTHER STATISTICS ON ROAD TRANSPORT

The Road Transport Yearbook also includes other important data such as the applicable rates of registration fees and tax on different types of vehicles, the rates of tax on goods and passenger transport, revenues realised from motor vehicle taxes, physical and financial performance of state road transport undertakings, some road accident data and Plan outlays and expenditure in the road sector.

Other sources such as the Reserve Bank of India, and Central Excise and Customs also publish data pertaining to the roads sector. For example, in its survey of state finances, the RBI provides data of revenue raised from motor vehicles, passenger and freight taxes. Meanwhile, Customs publishes excise data on motor vehicles and parts. The

Performance and outcome-based indicators are not being captured for roads, leading to an incomplete picture of the impact of new or better roads on traffic carried, congestion alleviation, environmental effects, and quality of life. Collection of this data is essential.

Planning Commission is the central repository of data on Plan allocation and expenditure on roads under the various central and state schemes. It also brings together some data on how the road sector interacts with other transport modes, though this data is neither periodic nor standardised.

## DATA REQUIREMENTS

Indicators for the road transport sector need to be identified so that data on these is compiled and analysed for benchmarking, performance monitoring within the sector, and for intermodal comparison. Good progress is being made in compiling data on physical achievements. However, performance and outcome-based indicators are not captured, leading to an incomplete picture of the impact of new or better roads on traffic carried, congestion alleviation, environmental effects, and quality of life. Data on these outcomes-focussed measures are equally essential for all categories of roads.

As noted earlier, a major limitation of the data on vehicle fleets is that it focuses on the registration rather than on vehicles actually in use. This can be addressed through a specially created Motor Insurance Database wherein all insurance companies provide details of the first insurance policy as well as for renewals for each vehicle covered.

Road accident data has already been addressed, but it is worth reiterating that more extensive data on the circumstances peculiar to each accident can help identify long-term trends and patterns which can be used to inform safer road design, improved laws and regulations, and more stringent enforcement where necessary.

Maintenance work on roads is especially hampered by lack of knowledge on the real-time condition of a road in terms of the level of service it is capable of providing. Data is needed on the pavement quality as measured by rut depth, the extent of road cracks, number of potholes, bridge condition and so on. Maintenance treatments can be prioritised by combining this information with other data that compares observed average traffic speeds with design speeds and accident histories amongst others.

There is no organised data on non-motorised transport modes, although it is known that they serve an

important need in both urban and non-urban areas by catering to short trips and providing access to public transport catering to long trips.

With respect to passenger bus services in the public sector, much useful information is available on fleet utilisation, vehicle productivity, staff productivity, staff bus ratio, fuel consumption for state-owned transport companies. But there is virtually no data available on private bus operators even though they constitute a major share of total public transport. This information should be collected and should be made available in electronic form for public use.

There is no mechanism for undertaking systematic origin-destination studies for freight moved by road. It is widely acknowledged that goods vehicles face substantial delays at state borders and other check posts, and at inter-modal junctions. However, there is little data that can be used to substantiate and then address this phenomenon. In order to collect data on the movement of freight, a random survey should be conducted every five years. Figure 2.5 shows the kind of data on freight that will be required. This method can be used to track industries that contribute significantly to freight movement such as manufacturing, retail, mining, fuel, electronic shopping, etc. We expect the following industries to be included in the survey: food; petroleum products; coal; chemicals; primary metal manufacturing; machinery; wholesale dealers in fuels; and warehousing and storage.

Figure 2.6 shows the process to be used for obtaining the data. It shows the various groups of participants which should be included in the survey. After obtaining data from the surveys, a database needs to be built. Various analytical studies can then be carried out and the results shared with users to get their feedback. If there seem to be major discrepancies or gaps in the data based on the feedback, then design of the freight database will need to be modified.

In order to ensure that all the necessary data is accurately represented in the database and to facilitate data entry for the surveyors, it will be important to develop standards for the format of the various kinds of data. Figure 2.7 shows the categories of data that will be included in the database and for which data standards and formats will need to be agreed upon, and developed if not already available. There will be a wide variety of data that will need to be collected and a great deal of work will need to be done before the surveys are started to arrive at a consensus on the data formats and standards. Recent traffic surveys carried out by RITES for total transport system studies would give the basic framework for data formats which would also help in analysis of intermodal choices and needed policy corrections.

The existing programme of traffic census that is carried out to support certain studies must be urgently

supplemented by permanent traffic count stations at several hundred important locations on the network. These counts can be used to monitor the overall health of the network, to identify choke points and to direct new infrastructure spending to where it may be most beneficial. With an increasing number of projects funded through PPP arrangements, these counts would also enable more reliable traffic growth forecasts, besides helping in proper planning, design, construction and operational phases of the contract. More accurate traffic counts lead to better estimates of future road use, project revenues, and required government subsidies.

## MANAGING DATA

Notwithstanding the data collection gaps identified above, an equally pressing problem is the management and dissemination of the data that is already being collected. At substantial cost to both government and private agencies, a large number of traffic censuses, feasibility studies, detailed project reports and the like have been carried out to support the construction of new road infrastructure. These reports normally include much useful information such as assessment of localised network features, soil conditions, unit costs, manpower, machinery and material requirements, traffic volumes, and the impact of a project on the network and local catchment area. However, there is currently no organised system to access the data generated from these efforts.

MORTH has financed several studies and research and development with a view to improving the strategy and management of all categories of roads. It would be expedient to establish a Road Data Centre for the collection of data from various sources, its storage, retrieval and analysis for the use of other interested agencies. The Data Centre should ensure that the data collected and distributed conforms to standard measures of data integrity: timeliness, accuracy and coverage. Data should be periodically updated, and stored in a format that permits easy electronic access. The Data Centre should make available both raw data at the highest level of granularity possible, and also seek to construct meta-measures such as quality-adjusted or hedonic cost indices. Table 2.39 provides a listing of important statistics that should be collected, constructed and disseminated and put on the web so that it is in public domain.

## PAVEMENT AND TRAFFIC MANAGEMENT SYSTEMS

A pavement preservation strategy must be devised based on statistically valid data on the performance of various types of pavement compositions under varying traffic, geographic and climatic conditions. Special care must be taken to ensure that this data

accounts for the stresses that the Indian climate and topography places on road pavement.

A Pavement and Bridge Management System (PBMS) needs to be developed so that the pavement preservation strategies may be optimally implemented. This system will record detailed current inventories of road assets, thereby ensuring that road maintenance and overhaul programmes can be tailored for maximal efficiency. The PBMS ought to be part of a wider, more comprehensive database called a Road Information System that will effectively provide details not just on the 'quality' of the road at a given point in time but also on its extent, reach and possibly traffic flows (if permitted by technology).

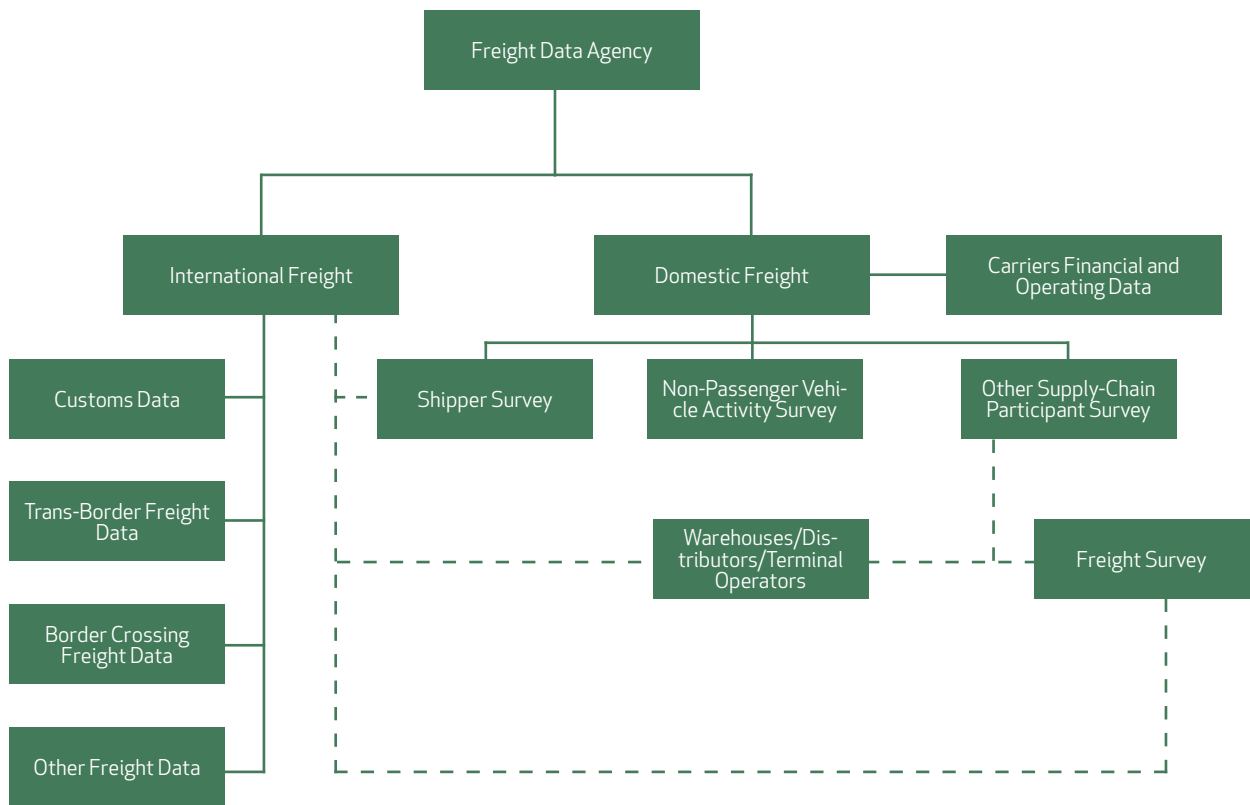
An Advanced Traffic Management System (ATMS) should be progressively introduced especially on National Expressways and four-lane NHs. The ATMS is a broad collection of technologies that work together to ensure a better and safer traffic flow. Such systems include facility and traffic control centres, emergency call boxes, variable message signs, video surveillance and incident detection, and meteorological sensors. They may also lend support to commercial mobile communication systems. Finally, automatic traffic counting and classifying systems can aid greatly in managing traffic, and in providing ready data for several purposes such as identifying bottlenecks and future road design.

## ELECTRONIC TOLLING

The integration and standardisation of toll collections across the country will greatly aid faster and smoother traffic flows. Collecting tolls electronically from freely moving traffic has seen good international success. The Nilekani Committee on this subject has recommended Radio Frequency Identification (RFID) technology for this purpose on the grounds that it is cheap, robust, easy to use, maintenance-free, scalable and reliable. The case is convincing. The system consists of cheap tags that, affixed to a windscreen, uniquely identify a vehicle. The tags are readable by special sensors located at toll plazas. Tolls may be pre-paid and appropriate amounts are deducted whenever the vehicle passes a toll plaza. In order to manage the financial transactions relating to toll collection, the Nilekani Committee recommends a central clearing house. Because a tag uniquely identifies a vehicle, the RFID system has additional advantages in the sense that it can be

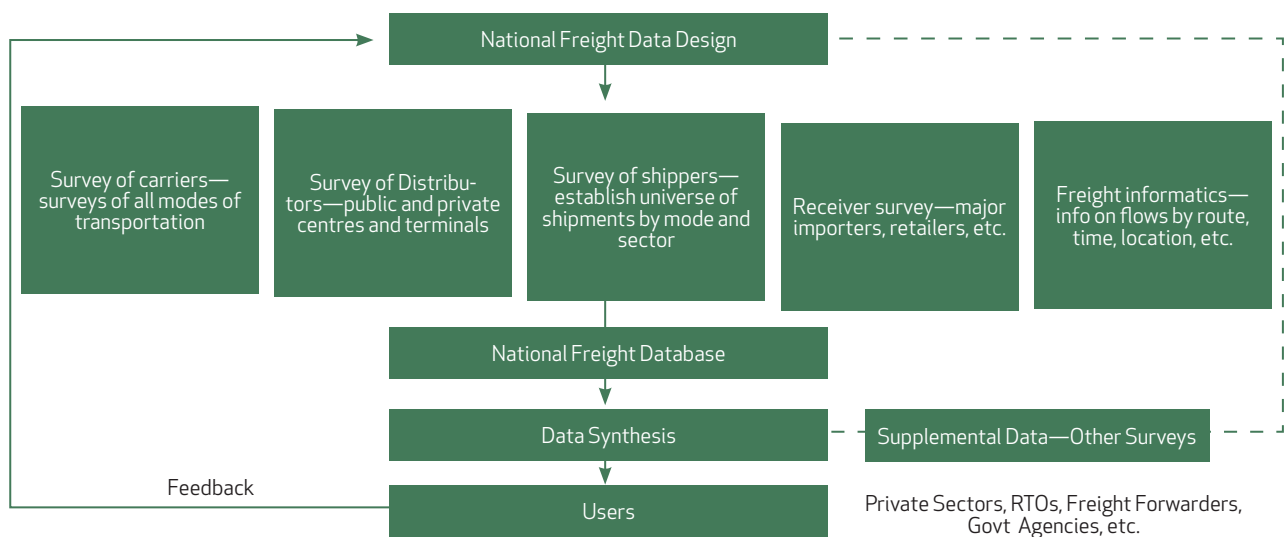
The current programme of traffic census must be urgently supplemented by permanent traffic count stations at several hundred important locations on the network.

Figure 2.5  
**Data Requirements on Freight Movement**



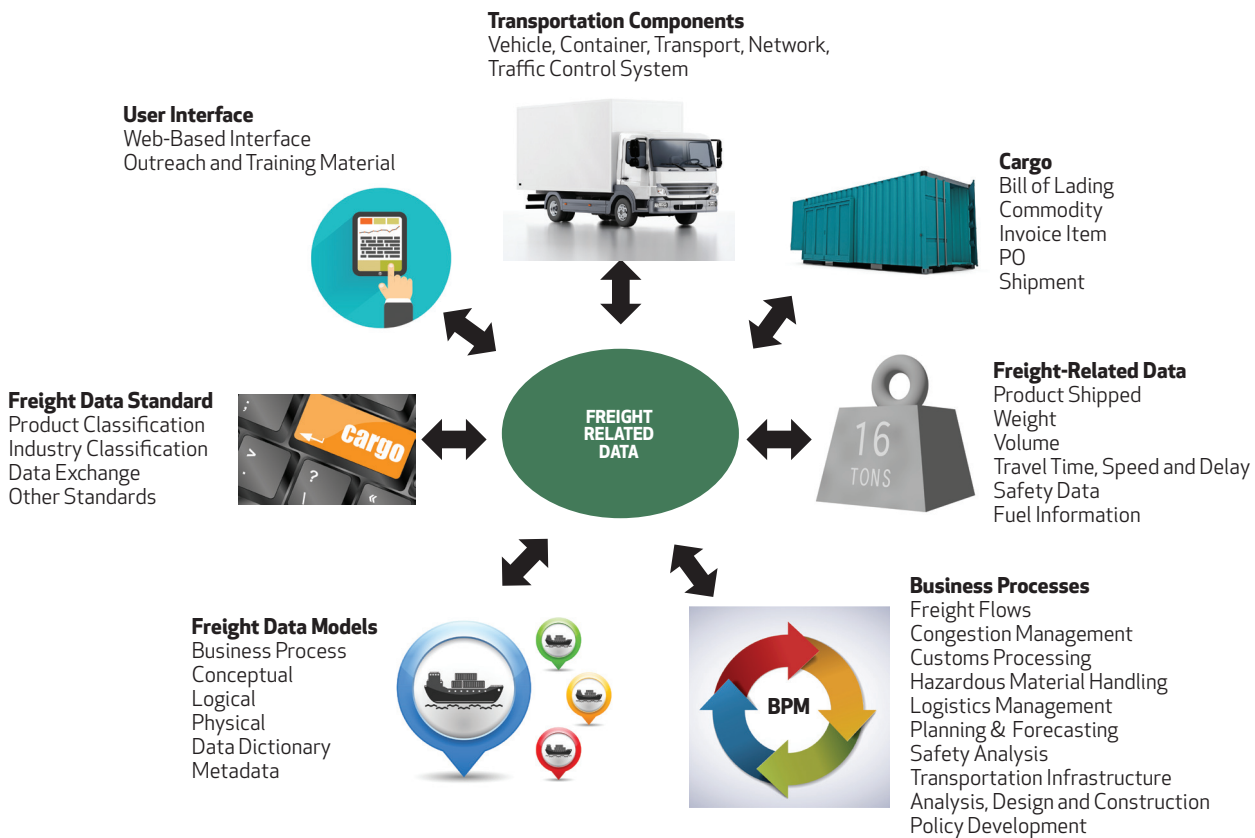
Source: Infosys Research (adapted from BTS)

Figure 2.6  
**Process for Developing Database**



Source: Infosys Research (adapted from BTS).

Figure 2.7  
**Required Data Formats and Standards**



Source: Infosys Research (adapted from BTS).

easily used for vehicle tracking, parking and traffic enforcement, etc. Box 2.28 gives the implementation strategy proposed by the Apex Committee constituted by the MoRTH.

## GOVERNANCE

Regulation of the road sector in India, as in other countries, has been largely through contracts. The Concession Agreements that are entered into with BoT concessionaires or the EPC contracts awarded to the construction contractors spell out the rights and obligations of the two parties involved, the concessionaires and the governments/road agencies. Such contracts attempt an equitable allocation of risks. A well drafted concession agreement together with adequate contract management skills in the government/road agencies would constitute a satisfactory mechanism for regulating road development

either through contract or concession agreement. In fact, as stated earlier, in most countries of the world, road development is regulated through contracts and not through a commission or a regulatory authority. There is no example of a road regulator anywhere in the world.

At best, the argument of a road regulator rests on the premise that concession agreements are for lengthy periods of time, say 20-30 years, and it is not possible to predict events that might occur and impact the project during that period; a road regulator could help in addressing such events. However, even such a contingency can be duly provided for in a binding agreement. It is essential to improve governance whereby the road agency enforces performance of the contractor/concessionaire as per the obligations set out in the contract agreement. The road agency is also to perform its own obligations set out in such agreements.

Table 2.39  
**Data: Metrics and Sources**

CATEGORY	PARTICULARS	POSSIBLE AGENCIES
Network	<ol style="list-style-type: none"> <li>1. Total length</li> <li>2. Length by classification</li> <li>3. Width of carriageway</li> <li>4. Ownership</li> </ol>	<ul style="list-style-type: none"> <li>• Road agencies at central and state level</li> </ul>
Inventory and Condition	<ol style="list-style-type: none"> <li>1. Width of right of way</li> <li>2. Width of road formation, carriageway</li> <li>3. Location and span of culverts, bridges, rail overpasses and crossings</li> <li>4. Roughness</li> <li>5. Rut depth</li> <li>6. Area of cracks</li> <li>7. Subgrade strength of soil</li> <li>8. Bridge conditions and distress</li> </ol>	<ul style="list-style-type: none"> <li>• Road agencies at the central and state level</li> <li>• Private O&amp;M agencies</li> <li>• Privately commissioned surveyors</li> </ul>
Traffic	<ol style="list-style-type: none"> <li>1. Classified traffic counts—motorised and non-motorised—by section</li> <li>2. Axle load spectrum</li> <li>3. Permanent traffic counts</li> <li>4. Speed surveys</li> <li>5. Origin-destination surveys at selected points</li> </ol>	<ul style="list-style-type: none"> <li>• Road agencies at the central and state level</li> <li>• Academic institutions may be funded to undertake certain delegated surveys</li> </ul>
Vehicle Fleet	<ol style="list-style-type: none"> <li>1. Number of motorised vehicles of various categories registered state-wise</li> <li>2. Vehicle age and usage status</li> </ol>	<ul style="list-style-type: none"> <li>• State-level transport departments</li> </ul>
Passenger Movement	<ol style="list-style-type: none"> <li>1. Frequency</li> <li>2. Purpose</li> <li>3. Fare per km</li> <li>4. Km per journey</li> <li>5. Km per mode</li> <li>6. Fleet utilisation</li> <li>7. Vehicle productivity</li> <li>8. Staff productivity</li> <li>9. Staff-vehicle ratio</li> <li>10. Fuel consumption</li> </ol>	<ul style="list-style-type: none"> <li>• ASRTU</li> <li>• AIMTC</li> <li>• Federation of Bus Owners' Associations</li> </ul>
Freight Movement	<ol style="list-style-type: none"> <li>1. Commodity-wise tonne-km</li> <li>2. Freight movement by vehicle class, including non-motorised transport</li> </ol>	<ul style="list-style-type: none"> <li>• AIMTC</li> <li>• Federation of Truck Owners' Associations</li> <li>• Sample surveys through agencies like RITES, CRR</li> </ul>
Accidents	<ol style="list-style-type: none"> <li>1. Fatalities</li> <li>2. Injuries: grievous, minor</li> <li>3. Property damage</li> <li>4. Location of accidents</li> </ol>	<ul style="list-style-type: none"> <li>• Traffic police and state departments</li> <li>• Academic institutions</li> </ul>

CATEGORY	PARTICULARS	POSSIBLE AGENCIES
Revenue: Taxes and Tolls	<ol style="list-style-type: none"> <li>1. Statewise taxes on various categories of passenger and freight vehicles</li> <li>2. Number of toll plazas and booths</li> <li>3. Collection of tolls from each plaza</li> </ol>	<ul style="list-style-type: none"> <li>• Transport departments</li> <li>• Regional Transport Authorities at state levels</li> <li>• Road agencies in the centre and states</li> <li>• Concessionaires</li> </ul>
Financial	<ol style="list-style-type: none"> <li>1. Investments in various categories of roads with public-private sector breakdowns, and disaggregation by schemes: capacity augmentation, bypasses, bridges, etc.</li> <li>2. Expenditure on maintenance of various categories of roads</li> <li>3. Unit construction and maintenance costs</li> <li>4. Cost indices</li> </ol>	<ul style="list-style-type: none"> <li>• Road agencies in the Centre and the states</li> </ul>
Connectivity	<ol style="list-style-type: none"> <li>1. Number of habitations connected by all-weather roads</li> <li>2. Number that remain to be connected</li> </ol>	<ul style="list-style-type: none"> <li>• NRRDA</li> <li>• SRRDAs</li> </ul>
Material	<ol style="list-style-type: none"> <li>1. Bitumen use per km</li> <li>2. Steel use per km</li> <li>3. Aggregates use per km</li> <li>4. Cement use per km (Disaggregated for various construction categories and maintenance)</li> </ol>	<ul style="list-style-type: none"> <li>• Contractors</li> <li>• Consultants</li> <li>• Road agencies at central and state levels</li> </ul>
Manpower	<ol style="list-style-type: none"> <li>1. Technical staff by level and agency</li> <li>2. Non-technical staff by level and agency</li> <li>3. Educational qualifications of staff</li> </ol>	<ul style="list-style-type: none"> <li>• Road agencies at central and state levels</li> </ul>

Recent experience in respect of PPP projects in the road sector by the NHAI has shown that contract negotiations become necessary not only since eventualities occur after a long period of time but because of lack of clarity on the rights and obligations of the parties in the concession agreements. A number of disputes appears to have arisen between road concessionaires and NHAI because of unsatisfactory contract or poor contract management. The clamour for the road regulator seems to have arisen because of these disputes. It now appears that government is now considering a mechanism to resolve contractual disputes in PPP project across all sectors. Once this mechanism is established and PPP disputes are addressed, there would be no need for the road regulator to resolve disputes between PPP developers in the road sector. The Model Concession Agreements, standard construction bidding and EPC contracts

should be live documents, amenable of being modified based on feedback or learnings from projects being implemented.

Ultimately, drafting appropriate contract agreements, managing contracts, resolving disputes, etc., are all part of good governance. There is considerable scope for improving governance in the road sector and good governance is possible only when there is adequate capacity to provide the necessary support. Road engineers, as a tribe, are not thorough with contractual terms, negotiations and management. Capacity building amongst road engineers should be given high priority. There is also a tendency in the NHAI/government to be more concerned and focused on awarding contracts without bringing under control preconstruction activities such as acquisition of land, resettlement and rehabilitation of project

## Electronic Toll Collection: Implementation Strategy

- The Committee headed by Nandan Nilekani recommended adoption of passive RFID technology for electronic toll collection (ETC) at toll plazas in India, considering user convenience, rate of acceptance and ease of implementation. The system involves a self adhesive tag on the wind-shield of the vehicle which is read by transreceivers installed at the toll plaza.
- A key component for implementation of nationwide RFID based ETC is interoperability, which requires that the tag on the vehicle can be read by all the transreceivers and at the same time all tags can be read by a particular transreceiver. This implies that both the tags and the transreceivers together with Automatic Vehicle Identification should have certain common specifications. This has to be a mandatory requirement of the ETC system.
- The main functions of the ETC system are:
  - Tag distribution
  - Toll road user registration and recharge
  - Toll transaction

For managing these functions, a virtual hub called the Central ETC system (CES) is proposed to be created.

- ETC being a relatively new concept in the country, at least for the initial phase, services of domain expertise would need to be procured from the international market.
- Simultaneously, it will be essential to identify possible violations and enforcement elements against the same. Some countries use a video system to track violations.

Source: Report by Apex Committee for ETC Implementation, Government of India, September 2011.

affected persons, shifting of utilities, tree cutting and other environmental clearance. Government should consider taking a more market-oriented approach both in awarding contracts and resolving disputes so that road construction and development can take place rapidly without getting caught in a quagmire of disputes and time/cost overruns. Periodic user surveys should be carried out on the NH and SH corridors to capture the concerns of users, which should be duly considered for corrective measures and an instrument of feedback on road agency performance.

mulated for long-term development goals) of freight and passenger flows, transport pricing, resource costs and to identify existence of distortions in the movement from point of view of a desirable/optimal intermodal mix and investment policy for different modes of transport. Database for the road sector is virtually absent. This needs serious attention. Setting up of a dedicated Road Data Centre managed through a high level institution does not admit of any delay. This will help in reducing the current ad-hoc decision making in the road development planning process.

## RECOMMENDATIONS

### POLICY AND PLANNING

#### TRAFFIC SURVEYS AND DATA CENTRE

Transport operations in the road sector being basically in private hands, there is a high level of customer focus. However, at the same time, this mode is much less energy efficient and environment friendly besides being more unsafe and requiring more land. As such, road development should not be seen in isolation but as part of an integrated modal system of transport. For facilitating such a process, it is necessary to undertake regional traffic and transport surveys on regular basis—preferably every five years (to provide inputs to formulation of Five-Year Plans and mid-course correction of policy prescriptions for-

#### CAPACITY AUGMENTATION

The entire transport system, including roads, is facing capacity constraints. The economic and environmental costs of a saturated transport system are high. Strangulation of railway capacity is unduly burdening the road sector. Railways need to regain their share. This cannot happen until their capacity is enhanced and they learn from road transporters to provide a better customer focus. It is to be realised that congested roads lead to lower transport productivity, increased energy consumption and pollution. Lack of road and vehicle maintenance adds to undesirable industry competitiveness in the international market besides resulting in high inventory costs. Once the role for roads and road transport is identified within the overall transport system, it is nec-

essary to identify and carve out road development and maintenance programmes which not only meet the expected traffic demand and improve transport productivity but also ensure that such programmes reduce in their wake the negative externalities of energy inefficiency, environment pollution and accident hazards.

### RURAL CONNECTIVITY

Integrated rural development has been another area of focus by the Government for considerations of social justice, national integration and economic uplift. For this, there is all-round recognition of rural roads serving as one of the key elements of rural infrastructure as they help in increasing accessibility to schools, health centres and in creating more employment opportunities. Rural roads serve as an entry point for poverty alleviation. These roads also provide physical mobility of raw materials, farm produce, promote specialisation and increased size of market. Further, these roads influence the process of growth by facilitating dispersal of knowledge and reduction of inequalities. The states have already prepared district level Core Road Network master plans in due consultation with the Panchayati Raj Institutions and local MLAs and MPs. These plans could be reviewed every five years to account for both agricultural and industrial growth in each district. The current programme of PMGSY needs to be expanded to achieve universal connectivity to all habitations on a time-bound basis.

### SOCIAL ASPECTS

Another area of concern is finding ways and means of reducing the burden of land acquisition where it affects the communities. Ever increasing economic activities are putting greater pressure on the scarce land resources. There is an imperative need to have a closer look at the requirements of land for transport projects including roads. Road design standards should account for this social factor as well.

### ROAD CLASSIFICATION

Current system of road hierarchy and classification dates back to 1943 when the Indian Roads Congress formulated the first Long Term Road Development Plan. The road network is divided into five classes—National Highways, State Highways, Major District Roads, Other District Roads and Village Roads. It is recommended that the division of the network may be confined to three categories—primary, secondary and tertiary. Primary roads may encompass both national and state highways. Secondary roads may include current major district roads. Tertiary roads could be termed rural roads and comprise both other district roads and village roads. Expressways need not be a separate class but these may be considered as part of primary road network since they are highways with features of full access control and limited to movement of motorised traffic. An inde-

Government should take a more market-oriented approach, both in awarding contracts and resolving disputes so that road development does not get caught in a quagmire of time/cost overruns.

pendent road classification commission comprising administrators, economists, geographers and road engineers under the umbrella of proposed Office of Transport Strategy should be set up. It should lay down clear, objective criteria for which authority holds the administrative mandate over a particular class of road. It should do so from a holistic network planning perspective that maximises the efficiency of each class. There is also need to introduce systematic numbering of different classes of roads as per international practice. For each class of road and traffic groupings, the standards should be uniform both in design and translation on ground.

### EXPRESSWAYS

Facilities like expressways are highly capital intensive and need a long lead time for planning of alignment, acquisition of land, rehabilitation and resettlement of people affected and other pre-construction activities including environment clearances. The Central Government has identified a network of about 18,000 km. However, there is inadequate information on characteristics of road links, traffic volumes and traffic patterns. This network should be subjected to a consultation process with the states as well. There should be a minimum threshold traffic to consider provision of an expressway: 40,000 PCUs per day is recommended. Access-controlled highways effectively divide the countryside, necessitating provision of flyovers and interchanges to permit cross movement. This involves high capital investments. Priorities should be determined based on the needs of the economy and progress of railway network capacity augmentation. Some of the existing four-lane roads under the NHDP may be considered for conversion into access control facilities by providing service lanes all through for local and non-motorised traffic as an immediate step. User charge principle would be amply justified in provision of such facilities. Strategy of constructing 2,000 to 3,000 km initially through the government budget and borrowings, and thereafter handing over such stretches to the private sector for its O&M and leveraging the revenue earned to expand the network could be another promising option.

### SPECIAL NEEDS OF NE REGION

The government has been focusing special attention to the transport development needs of the North-East Region and other isolated areas. It is necessary to formulate and implement a comprehensive master plan for the NE region covering all modes of

Access-controlled highways involve high capital investments. Therefore, priorities for these should be determined based on the needs of the economy and progress of railway network capacity augmentation.

transport including roads. Chapter 6, Volume III is devoted to this issue.

#### AUTO INDUSTRY

The vehicle-manufacturing sector has shown some improvement in technology upgradation to bring in efficiency in fuel consumption and reduction in environment pollution. There is steady increase in production and operation of multi-axle vehicles for movement of freight. Such developments do help in increasing tonne-km per litre of fuel. Bus design is in need of overhaul to improve boarding and riding comfort. There is need for continuous upgradation of technology in the auto industry, especially the commercial vehicle sector, to meet the objectives of better comfort, productivity, energy efficiency, safety and emission standards in line with international practices and standards.

#### ROAD DEVELOPMENT

##### CURRENT INITIATIVES

The two decades covering the period 8<sup>th</sup> to 11<sup>th</sup> Five Year Plans (1992-2012) proved momentous for the road sector as it was marked by a heavy dose of road investments by the government and its strategy of promoting PPP in development of National Highways, state highways and revamping of road fund through additional excise duty to serve as a window for viability gap funding. International agencies like the World Bank and the Asian Development Bank also supplemented the resources. A part of the Central Road Fund and NABARD ensured availability of dedicated funds for rural roads under the PMGSY. The entry of international lending agencies helped in enhancing the capacity of contractors and consultants in the delivery of the development programmes and road projects. Private sector entry in financing got facilitated through introduction of direct user charge in the form of tolls, liberalised economic policies, increased transparency, open competition and reasonable apportionment of risks between the various stakeholders—government, concessionaire and lenders. It will be advisable to continue multiple strategies for development of the road network during the next two decades upto 2032, building on the current focus during the 12<sup>th</sup> Five Year Plan (2012-17). Private sector financing in the highways would remain confined to the commercially viable and high traffic density stretches. It will be prudent, therefore, to enhance the availability of public sector funding.

#### STRATEGIES FOR PRIMARY ROADS (NATIONAL HIGHWAYS AND STATE HIGHWAYS)

- i. The existing network of National Highways and state highways may be expanded in tune with the economic growth and development of industrial hubs, special economic zones, ports, tourist centres and connectivity to international routes—Asian Highways and the European Road Network. At the same time, since the main function of the primary system is mobility and enhanced productivity of road transport, stress should be laid on consolidation of this network in terms of capacity augmentation through multi-laning of existing highways and provision of access-controlled expressway facilities. For projects of four-laning through PPP mode, a phased development approach can be adopted by initially reserving the full land width for 20 to 25 years' traffic needs, but providing number of lanes to meet demand for 10 years in the first instance and further widening in the second phase. An overall length of 100,000 km of NHs and 200,000 km of SHs should be largely adequate for the country. This may also include about 20,000 km of access-controlled expressways.
- ii. For capacity augmentation of National Highways, the current programme of NHDP in seven phases is well-conceived and its implementation may continue in the immediate term, i.e., the 12<sup>th</sup> Five Year Plan. Within these phases, the programme relating to widening of single lane roads to two lanes deserve to be accelerated for reasons of enhancing safety and energy efficiency. Six-laning of existing roads without access control has potential to be more accident-prone. As such, the programme relating to six-laning of existing four-lane stretches needs to be stopped and where traffic volumes are beyond four-lane capacity, consideration given to provision of expressway network. In order to improve transport efficiency and enhance safety, all existing four-lane and six-lane roads need to have service lanes to cater to the requirements of local (both motorised and non-motorised) traffic so as to bring in an element of partial access control on such facilities. Provision of wayside amenities along the highways is becoming an integral part of the road projects. Such facilities should be provided by the private sector.
- iii. For capacity augmentation of state highways, every state should formulate programmes on the lines of NHDP and undertake implementation as per priorities identified through traffic surveys, and economic and financial analysis of individual project stretches on the SH

network.

- iv Financing of these roads should rely on the user charge principle in the form of tolls as direct beneficiaries and continuing with the existing Central Road Fund through additional levies on petrol and diesel. The existing policy of levy of toll on two-lane roads needs to be done away with. A two-lane highway on the primary network should be viewed as a basic minimum facility and provided through government budget including CRF. The accruals to the CRF may be enhanced by making levy of cess on fuel on *ad valorem* basis rather than the current system of a fixed amount of Rs 2 per litre., which was fixed in the year 2005. This may be enhanced to Rs 4 per litre to enhance the accruals to meet project investment requirements. Some states have constituted state road funds to provide assured funding for the state sector road projects. This is a good strategy and worthy of upscale by other states as well.
- v. While preparing projects for capacity augmentation, the need arises for planning of bypasses around towns to ensure smooth movement of through traffic. In most cases, these bypasses also serve as a vehicle for development of the town along or on the other side of the bypass. Therefore, the alignment for such bypasses should be planned jointly by the road agency and the urban development agency. Further, these bypasses should be planned and provided as access-controlled expressway type facilities with entry/exit at predetermined locations. For large-sized cities (population above one million), bypasses could also be provided in the form of peripheral expressways. The intersection points of bypasses with main highways may also serve as freight logistics parks on case to case basis.
- vi. Another requirement relates to reconstruction of dilapidated and weak bridges which are showing signs of distress and crying for replacement. There are also missing bridges on large rivers needed for opening up of the area.
- vii. Special needs of connectivity to ports, airports, mining areas and development of power plants should be factored in development of the road programmes. In certain cases of power plants, movement of Over Dimensioned Cargo (ODCs) will be involved and this will require advance planning, particularly for strengthening of bridges involved and improvement of curves in hilly areas.
- viii. It is difficult to hazard a precise estimation

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of physical and financial requirements for development of primary roads without a detailed study of traffic forecasts and inventory of existing road network. However, a broad assessment is presented based on projections by the Working Group on Roads and deliberations within the Committee. An investment of Rs 21,400 billion for National Highways and Rs 11,600 billion for state highways, at current prices, spread over 20 years upto the year 2032 could be required. Targets for private sector financing are also proposed.

#### STRATEGIES FOR SECONDARY ROADS (MAJOR DISTRICT ROADS)

- i. These roads run within the districts connecting areas of production with markets and serve as a connecting link between the rural roads and the primary road network and are thus equally vital for agricultural and industrial development of the landscape. These roads have not been receiving the desired level of attention and investments. This gap has to be filled to ensure balanced development of all classes of roads and in all regions of the country. An overall length of 400,000 km as proposed by the Working Group on Roads is recommended as a target network of MDRs. Currently, these roads are mostly single-lane with weak road pavement and bridges in need of immediate strengthening. A large percentage of these roads is reported to be in bad shape. This is posing a threat to even optimal use of PMGSY roads which are often in much better condition. The situation is further aggravated due to movement of overloaded vehicles. Presence of railway level crossings causes undue delay to traffic movement on one side and lowering of speeds to the rail movement on the other. Therefore, the stress should be to accelerate the programme of widening of these roads to regular two lanes including bridges and provision of rail over/under bridges on heavy trafficked stretches. Priorities may be governed by the traffic—current and projected. Some limited stretches may require four-laning also in later years depending upon the traffic growth witnessed.
- ii. Besides two-laning, attention would also be required for strengthening of pavement of existing single-lane roads and provision of

Attention must be paid to strengthening of pavement and provision of hard shoulders to enable safe movement and preventing road damage beyond repair and rehabilitation.

hard shoulders to enable safe movement of vehicles and preventing such stretches from getting damaged beyond repair and rehabilitation. Programmes of improvement in riding quality with partial strengthening need to be planned and implemented.

- iii. Some isolated bridges on the MDR network which show signs of distress would also require reconstruction as standalone works.
- iv. As per a broad assessment, an investment of Rs 6,000 billion, at current prices, spread over the next 20 years, is envisaged.
- v. Currently, the Central Government is providing some funds for these roads out of the CRF but it needs a quantum increase in order to make up for the continued neglect by the states.

#### STRATEGIES FOR RURAL ROADS (OTHER DISTRICT ROADS AND VILLAGE ROADS)

- i. Considerable progress has been made and is continuing under the current PMGSY. This programme is being implemented by the states with good managerial and technical support from the Centre. For the first time, well engineered roads are being provided in rural areas. The entire funds for construction come from the Centre. The states are responsible for subsequent maintenance. The programme covers rural roads required for new connectivity (one basic access to unconnected habitation) and upgradation of existing roads (requiring improvement to provide all-weather access). The programme being implemented for the last over 10 years, is well conceived and its implementation may continue. The main areas of concern emerging relate to assured maintenance and upgradation in areas that have witnessed high agricultural and other economic growth. These aspects need special attention. The Government of India has recently approved a scheme of PMGSY-II which envisages upgradation of existing major rural links to rural growth centres where cost of upgradation will be shared by states also.
- ii. The state governments have also been making their own investments in provision of rural roads to connect other villages/habitations not eligible under the PMGSY or Bharat Nirman. This has helped in accelerated develop-

ment of rural areas served by such roads. The implementation of rural roads programmes need to continue as per the district level core road network plans of the state governments. The current mandate of PMGSY should be expanded to achieve universal connectivity as these roads serve as the entry point for poverty alleviation and provision of access to social infrastructure such as education and health besides market.

- iii. Basically, these roads can stay as single-lane roads in view of the low volume of traffic likely to prevail. However, some roads under this category could witness traffic volumes that may justify widening to intermediate or two-lane. Provisions should be made accordingly.
- iv. Fiscal federalism theory would suggest that since rural roads serve as a prime redistributive tool in the government's armoury, they should continue to be funded by grants from the Centre. It is proposed that for financing of these roads, the current CRF accruals and RIDF window of NABARD may need to be augmented. The strategy of some states to raise funds through market committee fees on agricultural produce is commended for being emulated by other states as well. Some funds for earth work for example can be leveraged from MGNREGA schemes.
- v. An investment of Rs 5,700 billion, at current prices, spread over the next 20 years, is envisaged.

#### MAINTENANCE AND ASSET MANAGEMENT

The current replacement value of the existing road network defies precise estimation, given that there is no sustainable system of condition assessment of roads and bridges at present. A ballpark figure of Rs 10,300 billion is claimed by some experts as a broad asset base of the road network. Even if such an assessment would be and could be debatable, for a policy dialogue, there can be no two opinions that the current assets are huge and justify both preservation and maintenance.

The vicious cycle of build, neglect and rebuild has to be broken. While PPP approaches have helped in taking care of operation and maintenance needs during the concession period which extends to 15 to 20 years, this addresses the issue for only part of the road network. The various finance commissions have also laid stress on maintenance management of the road network and recommended central grants for state roads besides budgetary allocations by the state governments under the non-Plan head. Timely and adequate maintenance of the existing road network does not admit of any laxity. It is an economic

necessity as otherwise, erosion of asset base will get accelerated. It will be advisable for the states to institute road network asset management systems so that there is scientific condition assessment and priorities for maintenance interventions are fixed on a rational basis.

Both the Central and state governments should declare as a policy that roads would receive dependable and adequate allocation of funds on a continuous basis. A system of working out the replacement value of the road assets at the end of each financial year should be established by every agency for roads under its jurisdiction. The information relating to road asset value should be put on the web in public domain.

The government may also consider not to treat maintenance of roads as a non-Plan activity so that it does not suffer ad hoc cuts as is the current experience.

The states have been steadily reducing their gang labour and increasing maintenance works through private contractors. This has been the right approach. While existence of some gang labour may be useful, particularly for emergency situations and disaster management under conditions of earthquakes, landslides, cyclones, etc., there is a need to move to standalone long-term performance-based maintenance contracts where capacity augmentation may not be required in the immediate future. Enforcement of performance standards by the government through a well laid down mechanism is essential and field engineers responsible for execution of maintenance works made accountable.

States should encourage citizen and user oversight through undertaking road user satisfaction surveys. To start with, structured questionnaires and analyses of response can bring out road user satisfaction index on various stretches of the primary road network. This should include the projects awarded to BOT concessionaires as well. This will strengthen the government oversight on enforcing performance standards from the private sector.

There is a case for a dialogue with the contracting industry to support them in creating a dedicated band of contractors that specialises in undertaking O&M works on the road network. This will improve maintenance delivery on the ground and also act as a good resource partner of the BOT concessionaires during the operation period. For rural roads, local small contractors may be utilised in area-based contracts and gradually involve the local community with technical support from road agencies.

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Technology for maintenance also needs a quantum jump, particularly in respect of primary and secondary roads. There is a need to evolve long-lasting pavements which can help in increasing the current four-five year renewal cycle to a 12-15 year cycle. Mobile maintenance units need to become a normal practice.

Non-engineering aspects need to be focused on as well. This would include land management by way of prevention of encroachment, control on ribbon development, regulation of access on existing highways and use of ROW by utility agencies. Incident management and highway police patrol are other activities that should become integral part of O&M provisions.

The state transport authorities also need to support the road agencies in enforcing axle load limits of vehicles, particularly trucks, as overloading is seen to damage the roads prematurely.

Annual allocations required for maintenance should be worked out by each road agency for the roads under its jurisdiction based on asset management principles and traffic and road condition observed on the system. This should be a first charge on the available resources.

## CAPACITY BUILDING FOR ENHANCING DELIVERY EFFICIENCY

### INDIAN ROADS CONGRESS

- i. Currently, the IRC mandate is to evolve standards, specifications, manuals, guidelines for planning, design, construction and maintenance of different categories of roads. Many of the standards are outdated. Design standards need to be reviewed on a regular basis so that these are in line with international practices duly taking into account our own milieu.
- ii. The current system of formulating design codes and manuals needs an overhaul. Base papers for each topic need to be prepared through identified academic, research or professional agencies or even international domain experts. These outputs should then be subjected to peer review by domain experts and thereafter by the members of the committee. This would considerably reduce the delays currently experienced in finalisation

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and updating of design codes, etc. Funds for such purposes should be provided by the government out of R&D budget. Eventually, the standards should have statutory standing and become the responsibility of the Standards Departments of the proposed institute for Intercity Road Transport, Institute for Urban Transport and Traffic Management Board.

- iii. The IRC needs to expand its mandate to cover a systematic assessment of road transport operations and their impact on the road network with a view to reviewing the existing standards and guidelines so that the roads serve the intended purpose.
- iv. The IRC can draw lessons from international bodies like American Association of State Highway and Transportation Officials (AASHTO), Permanent International Association of Road Congresses (PIARC), National Association of State Roads of Australia (NASRA), Japanese Road Association (JRA), International Road Federation (IRF) to further enhance its capacity.

#### ROAD DESIGN INSTITUTE

Except for a few technical officers in the road agencies who are manning design cells in the states and at the Centre, there is no dedicated institute for undertaking designs for the various components of the road projects. While some capability is available in the academic institutions and the private consulting firms, there is no system of adequate oversight on their output. The current experience of time and cost overruns on major road projects is indicative of the weaknesses in the preparation of DPRs and lack of proper design focus in the first instance. There is a compelling need for a dedicated road design institute for the road sector that should function under the umbrella of MoRTH. It should have around 400 to 500 professionals at various levels covering various disciplines such as transport planning, traffic and safety engineering, transport economics, pavement design, bridge structure design, maintenance technology, geotechnical engineering, material engineering, IT-related interventions, tunnel engineering, social and environment engineering, etc. Similar institutes should be set in each state PWD and Rural Roads Agency. Every state should have at least 40 to 50 professionals covering various disciplines.

#### ROAD AGENCIES

- i. With the NHAI having become operational through successful implementation of the NHDP, there is need to review the current structure of MoRTH and expand the mandate of the NHAI. The objective should be for the MoRTH to entrust all National Highways and National Expressways to NHAI with proper restructuring of NHAI and only planning, policy and budget functions should remain with the MoRTH.
- ii. The existing road agencies in the Centre and the states are gearing themselves to the needs of accelerated road sector programmes. However, capacity and performance of these agencies need further enhancement. The Government of India has instituted a system of Results Framework Document for various sectoral ministries and is also encouraging state governments for similar initiatives. The road agencies may consider self-evaluation or undertake capacity analysis through domain management expert agencies to identify enhancement measures required to improve their capacity and performance. A set of suggestive indicators have been given in the Report based on a recent study of the highway agencies in the South Asia Region by the World Bank. At a minimum, the road agencies must have core competence in monitoring output of consultants, public private partnership models, contract procurement and administration, quality control and monitoring, adherence to design standards, safety engineering, maintenance planning, social and environment impact assessment, etc. Some selected officers need be encouraged to go in for graduate programmes in various disciplines of highway engineering.
- iii. Staff at various levels should receive regular training in different aspects of road projects. Each road agency should have its training plan and calendar for both short-term and long-term. Such a plan should cover sponsoring officers for undertaking M.Tech. programmes in various branches of highways, bridges and tunnels.
- iv. There is a huge backlog of training at the cutting edge level of supervisors, junior engineers and assistant engineers for which special programmes need to be evolved and provided. A few states have set up their own training institutes for this purpose. These institutions need strengthening and provision of state of art training infrastructure. Such training institutions should come up in all states.

- v. The government also needs to support the Indian Academy of Highway Engineers (IAHE), other training institutes at state level, and academic institutions to improve their infrastructure for training of road agencies.
- vi. Study tours should be undertaken both within the country and abroad for raising awareness among road agencies staff about good national/international practices in implementation of road projects.

#### CONSULTANTS

- i. Consultancy in the road sector has played a significant role in supporting the road agencies in various stages of road development projects and programmes—be it feasibility studies, preparation of DPRs, bidding documents for procurement of construction contracts and BOT projects, supervision of works during construction or review of designs or quality audits as third party. With the entry of multinational firms and their setting up India-specific subsidiaries, domestic firms have also graduated to international stature. Larger firms have not only experienced professionals on their roster but also they are equipped with state-of-art instruments and software. However, due to the quantum jump in the volume of work, weaknesses in their output become evident in some cases. One area of deep concern is the poor quality of DPR and bid documents being prepared by the firms. This results not only in avoidable variations in design and scope-of-work changes during execution but also in time and cost overruns. A number of disputes raised by the contractors also emanate from poor bid documentation. There is a need for a system of internal quality audit by the consulting firms before they submit their outputs to the road agencies. The government should also tighten the current performance evaluation system to bring in more accountability of the consultants.
- ii. The personnel of the consulting firms can also avail of the training facilities and infrastructure available in the IAHE, CRRI and other engineering and management institutes in the country for keeping abreast of the latest national/international practices.
- iii. For complex projects, the current practice of third party review of consultants' design may continue, but such a role should ideally be performed by the Road Design Institute referred to earlier. We should also utilise the academic institutions depending upon the special expertise residing therein. For this, the government may permit entrustment of such assignments on negotiated basis.

#### CONTRACTORS AND CONCESSIONAIRES

- i. Thanks to the push given by the World Bank and the Asian Development Bank since the mid-1980s, the contracting industry in the road sector has responded reasonably well in terms of mechanisation and acquisition of professional site engineers and project managers. However, the sheer increase in volume and size of projects being offered by the government in the road sector has created several challenges and constraints in this industry. Major constraints relate to poor productivity and substandard quality due to non-availability of skilled construction workers, and equipment operators and site supervisors. Both the government and the construction industry need to address this concern. Advantage should be taken of the skill development initiatives being launched by the Government of India to assess the magnitude of requirements of the road sector and consider a three-pronged strategy—at the vocational level through industrial training institutes, at the diploma level through polytechnics, and at the state level through setting up construction academies. For the latter, an excellent initiative has been taken by the government of Andhra Pradesh. The National Academy of Construction set up in Hyderabad is a joint effort of the state government and the contractors' association. For financing the academy, an amount of 0.25 per cent is deducted from the bill of every contractor in the state and earmarked for the functioning of the academy. The contractors' association has developed the campus and road agencies depute their senior level officers in managing the affairs of the academy. Such an example needs to be multiplied in other states.
- ii. Another area that holds promise is promoting the concept of equipment bank. Private entrepreneurs could venture into this arena and provide equipment to small and medium-sized contractors on lease/hire.
- iii. There is need to recognise that contractors and concessionaires are partners in progress. The road agencies also need to provide proper environment for their performance. Various approvals/decisions are required at various stages of the project. A healthy deci-

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sion support system and dispute resolution mechanism would contribute a great deal in improving the performance of the contractors and the concessionaires.

- iv. The senior and middle level staff of the contractors should also avail of the training facilities of the central and state government for enhancing their capacity and capability.

#### FINANCING FOR CAPACITY BUILDING

A provision of one per cent of the total road investments should be earmarked for capacity building of the stakeholders involved and technology innovations in the road sector.

#### RESEARCH, DEVELOPMENT AND TECHNOLOGY INITIATIVES

There is an urgent need for a quantum jump in the R&D and technology upgradation effort in the road sector covering pavements, bridges, tunnels, safety and traffic management for knowledge acquisition and knowledge development in our own context and situation. R&D vision and strategy need to be developed for the next 20 years by the Highway Research Board with support of MoRTH, MoRD, MoUD, CRRI, NHAI, NRRDA, BRO, state governments, academia and regional research centres.

The R&D schemes having immediate practical relevance in the context of the initiatives of the government to develop the road sector in the country needs to be taken up on priority. In this context, consideration needs to be given to evolving country-specific highway capacity manual, models for prediction of pavement performance with traffic, distress diagnostics of bridges and strategies for maximising use of locally available marginal materials including recycling of existing pavements and promoting use of industrial waste materials and by-products where found useful.

The equipment industry should sponsor and support research in development of technologies for accelerated construction of bridges, tunnels, flyovers, etc., and increased mechanisation in maintenance operations.

Centres of Excellence should be created on different aspects of roads and road transport including safety in IITs, NITs, other engineering institutes

and IIMs to accelerate the research and capacity building activities.

The government should promote transfer of proven R&D technologies from lab to land through well-considered pilot projects for implementation by BRO, NHAI, NRRDA, state PWDs and SRRDAs, etc. At pilot stage of testing performance, a liberal view would need to be taken of some unintended non-performance or failure of such pilots, with of course a laid down mechanism for supervision and monitoring during execution.

#### PRIVATE FINANCING INITIATIVES

The Government has put in place a sound policy, institutional and legal framework to deliver the NHDP and state highways upgradation projects. This includes a menu of fiscal and financial incentives to enhance commercial viability of road projects. However, it is time to undertake case studies of a few PPP projects on a random sample basis to draw lessons for future projects. Such a study should include dialogue with the concessionaires, contractors, consultants, financing institutions and road agencies.

The government would do well to stop the policy of undertaking projects through BOT (Annuity) Model as it is not a sustainable option. Where this mode of delivery is proposed, these should be a cap say 15 per cent of the annual budget to defray contingent liability year by year. Further, such projects should be subjected to rigorous value-for-money analysis and compared with public sector delivery option.

One area of concern that the Committee noted relates to the undue haste in award of such projects without bringing under control the pre-construction activities covering land acquisition, rehabilitation and resettlement of people affected, environment clearances, shifting of utilities.

Support of state governments would be needed for effective control on ribbon development along the high-density corridors.

#### ROAD TRANSPORT

The Motor Vehicles Act is in need of amendment to respond to the demand of road transport for the current century. The Sundar Committee has suggested the needed amendments. These need to be carried out.

Freight transport being the backbone of the economy, apart from reoptimisation of the modal mix between road and rail, transshipment facilities by way of transport nagars and synchronisation of short haul movement by road and long haul movement by rail for both import and export cargo through containers would be required.

For modernisation of trucking industry, continued emphasis is needed for higher energy efficiency and lower emission levels with suitable incentive structure for multi-axle vehicles. Further, the industry is controlled heavily by intermediaries who need to be brought under the purview of regulation. The thrust has to be on the seller of services. The trucking industry is also characterised by low levels of technology. A strong link needs to be forged between profitability and technology. Financing for acquisition of modern trucks should be more liberal.

Use of Intelligent Transport Systems can significantly enhance regulatory processes and streamline seamless movement in inter-state movement of commercial vehicles. Advantage should therefore be taken of such technologies so that once a vehicle is inspected and cleared at the origin state and the information is electronically transmitted to other states along the proposed trip, there is seamless travel. The commercial vehicle should be treated as mobile infrastructure since they are carrying the economy on wheels. All efforts should be made to improve the productivity of these precious assets.

The Inspection and Certification regime practised by the State Transport Departments should be modernised to reduce human intervention and it should gradually cover all motorised vehicles, not just commercial vehicles.

There is need to establish collection centres for end-of-life vehicles to retrieve scrappage material as this would ultimately help in considerable energy savings.

Passenger transport services in rural areas are still lacking and this requires a special focus of the State Transport Departments. Possibility of PPP needs to be explored by providing viability gap funding to the private operators for such services.

The Motor Vehicles Act is in urgent need of amendment to respond to demands of road transport for the 21st century. The suggested amendments are with the Government.

Information and communication technology needs to be used to improve operational performance of road transport including traffic management, electronic toll collection, vehicle tracking, overloading control and 'aam aadmi' interface with the transport administration.

## ROAD SAFETY

It is essential that a new paradigm for road safety is adopted wherein all stakeholders—legislators, administrators, engineers, contractors, police, transport department, road users acknowledge the role they must play in ensuring road safety. Safety engineering measures should become an integral part of road design and construction.

The wide-ranging recommendations of the Sundar Committee on road safety and traffic management should be implemented by the government on a priority basis to contain the accident situation which is going from bad to worse.

## GOVERNANCE

There is need for enhanced governance to improve quality of contract agreements and contract administration to achieve higher performance levels in delivery of road programmes and projects rather than a separate regulatory body. Nowhere in the world is there a regulator for the road sector. However, the Model Concession Agreement, construction and EPC contracts should not be static documents. Rather, they should be live documents, being modified based on feedback or learnings from projects being implemented.

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