PART TWO: LAND TRANSPORT: URBAN TRANSPORT, RAILWAYS, ROADS AND ROAD TRANSPORT
Photos on previous page: (top left) bridge over the Meghna River, Bangladesh; (top right) Asian Highway in Tashkent; (middle left) Trans-Asian Railway in the Republic of Korea (middle right) Trans-Asian Railway in the Russian Federation; (bottom left) “Skytrain” in Bangkok, Thailand; (bottom right) traffic jam in Bangkok, Thailand;
IV. URBAN TRANSPORTATION

A. Introduction

Over the last two decades, rapid population growth and spatial expansion has led to a sharp increase in demand for urban transport facilities and services in many cities in the ESCAP region. However, several factors have hindered the adequate provision of services to match the ever-increasing demand. In many cities, densification and spatial expansion have occurred with little or no development planning, while in some cases the failure of the instruments of governance has resulted in a significant wastage of resources or substandard quality of infrastructure. Furthermore, the huge capital costs and time required to develop high capacity transit systems have prevented the timely implementation of such systems in rapidly growing urban areas. As a result, many cities have relied on road-based systems which have serious capacity constraints, negative environmental consequences and other limitations.

Consequently, many cities in the region are facing serious problems, including serious congestion, air pollution from transport sources, high rates of traffic accidents and inadequate access to transport facilities by poor and vulnerable groups, such as people with disabilities. The deteriorating urban environment threatens the “liveability” and productivity of many cities. In some of the major capitals, such as Bangkok, Dhaka, Manila and New Delhi, the situation is so severe that the efficiency of their urban economy is negatively affected, as is the health and welfare of the people living in them.

B. Current challenges in urban transportation

1. Growing motorization

While the level of motorization in Asian cities is still much lower than levels in European cities, a trend of rapid motorization is evident in almost all of them. Apart from a few cities in Central Asia, there has been a considerable increase in the motor vehicle populations of all major cities. However, there are significant variations in the level and rate of motorization between cities, due partly to differences in income levels and government policy.

For example, the number of road vehicles in Bangkok grew more than sevenfold between 1970 and 1990. The vehicle population of Beijing grew about threefold between 1991 and 2000, from 540,000 to 1,570,000. Similar trends in growth occurred in Jakarta and Kuala Lumpur. Since the late 1990s, Indian cities have also experienced rapid growth rates of their vehicular population, following the introduction of economic reforms that lowered costs and increased the affordability of passenger cars. For example, Mumbai has registered an annual growth of motorized vehicles of about 10 per cent in recent years, while between 1995 and 2000, Delhi’s total motor vehicle population grew from 2.4 to 3.3 million, of which the car population increased from 576,000 to 837,000.19

The exponential growth of motorized two- and three-wheelers is another visible trend in Asian cities. In many countries, such as Thailand, Malaysia, and Indonesia, two- and three-wheelers make up over half of all motor vehicles. Bangkok currently has an estimated 2 million motorcycles. Ho Chi Minh City in Viet Nam and Penang in Malaysia have about 300 motorcycles per 1000 persons. The number of these vehicles is expected to grow very

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1 N.V. Iyer, Measures to control vehicle population: The Delhi experience, paper presented at the workshop on Fighting Urban Air Pollution: From Plan to Action, held at Bangkok from 12 to 14 February 2001.
rapidly in China, Viet Nam, India and other low-income countries; for example, it is projected that there will be 70 million motorcycles in China by 2015.20

It is expected that cities in the region will continue to experience high rates of vehicle population growth, particularly for private vehicles, for many years to come. This is partly due to government policy, which has significantly influenced the growth of motor vehicles in many countries. For example, despite their comparatively lower average income levels, car ownership rates in Bangkok and Jakarta are much higher than in Singapore; Hong Kong, China; and Seoul.

2. Financial burden on the public exchequer

The growth in motor vehicles has led to increased demand for new and improved road infrastructure and services, which require massive investments of financial and other resources. For various reasons, many governments have found that it is difficult to fund transport infrastructure projects by charging the users directly. Consequently, transport infrastructure development has remained mainly the responsibility of the public sector, putting an enormous financial burden on national and urban local governments. For example, during the Seventh Plan period of Thailand between 1992 and 1996, the total investment for road infrastructure projects in Bangkok alone amounted to a staggering 142 billion baht, or about US$ 5.7 billion. The private sector contribution made up 20.5 per cent of the total.21

3. Public transport

Public transportation has a very important role in urban transportation. Many cities such as Hong Kong, China; Singapore; and Tokyo, where the modal share of public transport is 70 per cent or more of total person trips, are deemed to be public-transportation oriented. In Bangkok, Jakarta, and Manila, the modal share of public transport varies between 40 and 60 per cent of total person trips. In most cities of the region, the majority of the common people, the poor and other disadvantaged groups are very heavily dependent on public transportation. Compared with private cars, public transportation is more sustainable on economic, financial, social and environmental grounds. However, the failings of public transportation have become one of the major challenges faced by many cities. Dissatisfaction with the level and quality of public transportation services leads those people who can afford it to turn to private modes of transport. Another common problem in many cities is that women, people with disabilities and other disadvantaged groups have poor access to public transport services and that it is found difficult to meet their basic mobility needs.

4. Congestion

Congestion is a common mark of motorization in most growing cities of the region. The central parts of many capitals, such as Bangkok, Delhi, Dhaka, Jakarta, Metro Manila, and Seoul, are particularly congested, with weekday peak-hour traffic speeds reported to average 10 km per hour or less. One estimate put the average travel time for work trips in Asia at 42 minutes.22 In large cities this number can be much higher, as in the case of Bangkok, where the average is estimated to be about 60 minutes. Delays due to congestion account for a significant proportion of the total trip time.

The estimated social cost of congestion could be enormous. A study in 1995 estimated the direct economic costs of congestion in Bangkok at 163 billion baht annually. The total cost represented 27 billion for the additional costs of vehicle operation, 20 billion for additional labour costs, and 116 billion for passengers’ lost time.\textsuperscript{23} The total cost, however, did not include the cost of damage to the environment or human health. In many cities the level of congestion is so high that even a moderate reduction could provide significant benefits. A recent World Bank study estimated that a 10 per cent reduction in peak-hour trips in Bangkok would provide benefits of about US$ 400 million annually.\textsuperscript{24}

\textbf{Figure IV.1 Road length per capita in selected Asian cities in 1990 and 2000}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{road_length.png}
\caption{Road length per capita in selected Asian cities in 1990 and 2000}
\end{figure}

Sources: Barter, Paul, An international comparative perspective on urban transport and urban form in Pacific Asia: The challenge of rapid motorization in dense cities, PhD thesis, Murdoch University, Perth, 1999; and various other sources.

\section*{5. Air pollution}

Vehicular emissions have become a major source of air pollution in many cities. In Bangkok, Beijing, Delhi, Dhaka, Karachi, Jakarta, Manila, Mumbai, Seoul, and Tehran, suspended particulate matter (SPM) exceeds the World Health Organization guidelines by more than a factor of two.\textsuperscript{25} The conditions are no different with respect to the levels of other pollutants such as carbon monoxide, sulphur oxides, lead and nitrogen dioxide. These poor air quality conditions prevail despite relatively low levels of motorization and vehicle use per person, by global standards. The existence of a large number of vehicles with poor emission control standards and the low quality of available fuel are the two primary reasons for this situation.

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\end{thebibliography}
In some cities, the prevalence of three-wheelers with two-stroke engines has further aggravated the situation. For instance, Dhaka has an estimated population of 70,000 bajaj three-wheelers. These three-wheelers emit 30 times more pollutants than a normal car. The cost of pollution in some cities is colossal: the World Bank, for example, estimates that the public health cost from air pollution in Jakarta alone will cost Indonesia US$ 220 million a year. In Bangkok, Jakarta and Kuala Lumpur, the annual costs from dust and lead pollution are estimated at US$ 5 billion, or about 10 per cent of combined city income.

C. Trends in urban transport development

1. Initiatives for rail-based systems

A notable trend in urban transport development is the growing interest in rail-based public transport systems. Governments in many countries have begun studying or implementing projects to develop rail-based transit systems in response to the shortcomings of road-based transport systems to meet growing demand in very large cities. Bangkok (Thailand), Busan, Incheon and Seoul (Republic of Korea), Kolkata (India), Kuala Lumpur (Malaysia), Manila, Beijing, Guangzhou, Shanghai, Shenzen, Daegu and Tianjin (China) have implemented new projects or are undertaking major extensions for their existing systems, while cities such as Bangalore, Dhaka, Hyderabad, Karachi, Mumbai, and about 10 cities in China are understood to be actively considering rail-based systems.

2. The improvement of public transport

Another notable trend is the increased attention being given to raising the quality of bus transport services, through the improvement of existing services and the introduction of new services. Premium (air-conditioned) bus services are now available in a large number of cities in the region. Cities with relatively higher incomes such as Bangkok, Kuala Lumpur, Shanghai, and Shenzhen have introduced higher-quality buses on their roads. Advanced-technology, low-floor kneeling buses have been introduced in Hong Kong, China; Singapore; and many Japanese cities to facilitate the embarking and disembarking of passengers, particularly for elderly passengers or passengers with disabilities.

Another major direction of development is the integration of public transport services. Cities with more advanced forms of transportation such as Singapore and Hong Kong, China have successfully integrated their various public transport services provided by multiple operators, such as the underground and bus systems. Seoul and Metro Manila, meanwhile, have been less successful in modal integration. Bangkok has prepared a plan to integrate the city’s bus services with the rail transit systems, such as the underground system currently under construction.

3. The improvement in air quality

The present levels of air pollution have prompted many cities to undertake measures to improve air quality. These measures include the introduction of lead-free petrol and low-sulphur diesel; the introduction of vehicle emission control standards and a mandatory regular vehicle inspection system; the promotion of cleaner fuels like liquefied petroleum gas

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(LPG) and compressed natural gas (CNG) for commercial vehicles; the banning and phasing out of certain types of vehicles; restrictions on diesel vehicles; and transport demand management.

For example, Bangkok is implementing an air quality management project; Manila has an anti-smoke-belching programme; Jakarta has introduced an inspection and maintenance programme for private cars; Delhi has banned the operation of all diesel-powered buses and trucks; and Dhaka has undertaken a programme to phase out two-stroke engine three-wheelers by 2003. Most of the cities with air quality management programmes have identified priority areas for improvement. For instance, Bangkok and Delhi have identified SPM as the main target for improvement of air quality, and are therefore concentrating on interventions to target diesel-powered buses and trucks, since they are the major sources of SPM. Unleaded petrol is now available in most of the countries, but is not necessarily priced in such a way as to attract more customers. As a result, the market share of unleaded petrol varies widely across the region. While it is 100 per cent in Bangladesh, Japan, Korea, Malaysia, Singapore, and Thailand (due to the banning of leaded petrol), the market share of unleaded petrol is only about 50 per cent in Cambodia, China and the Philippines, and about 10 per cent in India and Indonesia.29

4. Private sector participation

The increased participation of the private sector in providing urban transport infrastructure and services is an encouraging feature of transport development in many Asian cities. Major toll roads and rail transit systems have been developed in Bangkok, Kuala Lumpur and Manila with private sector participation. The private sector is also assuming a greater role in providing transport services. The number of standard (non-airconditioned) buses operated by private operators in Bangkok has increased from 1,474 in 1996 to 1,993 in 2001. The deregulation of bus fares has encouraged private operators in Dhaka to introduce a large number of buses. As a result of a new franchising scheme in Pakistan, the private corporate sector has introduced large fleets of buses in Lahore and Rawalpindi/Islamabad.

5. The applications of Intelligent Transport Systems Technology

The application of Intelligent Transport Systems (ITS) technology is an important mark of transport development in cities with relatively advanced systems of transportation. The major application areas of ITS technology include electronic road pricing, traffic management, integrated ticketing systems for different public transport modes, and traveller information. Typical applications like en-route traffic information systems using Variable Message Sign (VMS), traffic surveillance and incidence management are quite common, especially for the management of expressways. Electronic Toll Collection (ETC) is in use in many developing countries such as China, Malaysia, Philippines, and Thailand. Hong Kong, China and Singapore have introduced more comprehensive electronic toll and parking fee management systems. The introduction of smart card integrated ticketing systems for public transport systems is another significant development, with the first large-scale smart card integrated ticketing system introduced in Hong Kong, China in 1997. The contactless cards offer a common ticketing system for more than 30 transit operators providing bus, ferry and rail services. There are now 7.2 million cards in active use, with 6.2 million journeys occurring daily.30 A similar system is currently under trial in Singapore.

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D. Innovative approaches

1. Public-private partnership in providing bus services in cities of Punjab, Pakistan

In 1998 the Government of Punjab in Pakistan decided to wind up the public sector bus service agency, which was on the verge of collapse due to heavy financial losses and a drastic fall in fleet size from 1,000 to a mere 49 buses. The regulatory environment, high capital cost, undue interference by law-enforcement agencies and other conditions prevented any private corporate sector initiative from providing comprehensive urban bus services. The cities in Punjab were virtually left with only paratransit services provided by a large number of small operators using old and unstable 15 to 20 seater vehicles. These disorganised services not only failed to meet demand, but were also creating serious air pollution and congestion problems in Lahore and other cities in Punjab.

Faced with this situation, the Government decided to organize initiatives to promote private sector participation in urban bus services. A new franchising scheme was devised and piloted by the Government to attract the private corporate sector. Measures included: (a) a new form of franchise agreement to protect the commercial interests of the private operators and to ensure quality service to users; (b) the creation of a conducive environment for the operation of bus services; (c) new regulatory regimes to administer the franchising scheme and safeguard the operators’ rights; and (d) providing fiscal incentives to enable large investments by operators, such as a reduction in taxes and duties to import buses, and preferential interest rates (4 per cent lower) to borrow capital from banks. Franchises were awarded after a competitive bidding process. Selection criteria included the bidder’s capability to provide bus services and proposed fare levels. A minimum fleet size of 50 buses was a requirement for any bidder to compete. The initial award could be between 6 and 10 years depending on the size of the investment to be made. The Government made necessary amendments to the existing law to provide exclusive operational rights by an operator within a franchised zone and set up a regulatory framework. The Government also persuaded the paratransit operators to shift their services to unfranchised routes or areas, or to form a cooperative society to join the new scheme as bus operators.

The scheme was initially launched in Lahore and Rawalpindi/Islamabad. Under this new scheme, two franchisees have already introduced 300 new buses in Lahore and plan to introduce another 500 within three years. A second project, for the operation of 300 buses in Rawalpindi/Islamabad, has also been launched.

2. Participatory approaches to integrated comprehensive urban transport planning

Inclusive “bottom-up” participatory approaches that incorporate community consultation and wide participation by all social groups including women and other disadvantaged groups can greatly enhance sustainable urban transport development. They are also more likely to win public support, especially when questions of difficult policy choices and public actions arise, for example in the case of urban transport demand management. These principles have been guiding the implementation of a pilot project in the Rattanokosin area of Bangkok, which is being jointly implemented by ESCAP and the Bangkok Metropolitan Administration in close collaboration with the Government of the Netherlands. The approach adopted in the pilot project essentially inverts the traditional approach, going first to the principal stakeholders and asking them for their views on the problems, the causes of the problems and strategic transport sector goals. The results of these interviews are then used to develop problem-and-cause relationships, which, after further consultation with the stakeholders and analysis by experts, are used to develop draft action plans. In contrast to
top-down approaches, integrated approaches are based on methodologies that develop a broad-based consensus on an achievable vision of the future and clearly articulate the means by which the visions can be realized.

E. Examples: transportation in Dhaka, Bangkok and Singapore

Case studies on urban transport development in Dhaka, Bangkok and Singapore are presented in this section. These three cities represent cities at different stages of development (low, medium and advanced) and reflect the diversity in the form of and approaches to urban transport development. However, the three cities are not representative of the whole range of urban transportation situations in the ESCAP region; their selection was rather determined by data and information availability.

1. Dhaka

Dhaka is a densely populated city of an estimated 12.3 million people. The historical urban development pattern of the city has led to a mixed type of high-density land use with multiple major centres of activities. The city has primarily a road-based transportation system served by a network of 199 km of primary roads, 109 km of secondary roads, 152 km of collector roads, and about 2,540 km of access and other roads. Except in the case of some primary roads, all other roads are single carriageway. In most parts of the city, the road network has emerged with relatively wide primary and secondary roads, but narrow local and access roads. With the exception of a few planned residential areas, the road network in most of the city is narrow and alignment poor in accommodating motorized vehicles, especially public transport modes. All the intersections are at grade. The major ones are signal controlled, while some intersections are of rotary type. There are few pedestrian overpasses and facilities for pedestrians in general are grossly inadequate and poorly managed.

Dhaka has a low level of motorization. About 60 per cent of all trips are made on foot. Almost half of the remaining trips are made by rickshaw. Out of total vehicular person-trips, the share of public transportation is less than 25 per cent, of which the bus is the most popular mode. About 2,000 buses are operated, most of which are old and small. In the past few years, private sector operators have introduced about 200 air-conditioned buses. Bangladesh Road Transport Corporation, a public sector agency, owns a limited number of single and double-decker buses. These buses are operated by private operators under a lease agreement with the agency and operate in competition with the private sector along the high-demand corridors.

The number of motorized and non-motorized three-wheelers has grown quickly as a substitute for buses, although they are expensive and costs are higher than for a feasible premium bus service. The non-motorized transport (NMT) modes, especially the rickshaws (the estimated number of which is more than 300,000), play a significant role. They effectively operate on almost all the roads of the city, except a few major roads. There are about 70,000 two-stroke engine three-wheelers and 3,000 taxis. These three-wheelers are the major sources air pollution in Dhaka. Due to poor traffic management, lack of enforcement of traffic rules, and operation of a diverse mix of modes sharing the same right, the city experiences chronic traffic congestion and other related problems on all major roads.

Recently, initiatives have been taken to improve the transportation system of the city under a World Bank-financed project. Some of the measures include building new roads and improving existing road infrastructure, improving bus services, providing pedestrian facilities, creating non-motorized vehicle facilities, phasing out two-stroke three wheelers, and promoting CNG-operated vehicles.
2. Bangkok

Bangkok has an estimated population of 7.3 million spread over an area of 1,568 sq km. The city is primarily served by a road-based car-dominated transport system. Currently, a road network comprising elevated expressways (toll roads) (148 km), primary arterials (990 km), outer ring road (part) (115 km) and lanes or sois (2,825 km) serve the city. In recent years impressive road infrastructure development has taken place, with the involvement of both the public and private sector, to alleviate the city’s traffic congestion problem. The private sector had a major role in developing the city’s elevated toll roads, under several BOT projects. A total of about 700 km of expressways and ring roads (existing and proposed) is planned to serve the city in the future.

A large number of government departments, urban local governments, agencies and state-owned enterprises under different ministries are involved in planning, regulating, developing or operating parts of the urban transport system. The city does not have any single agency responsible for the overall planning and development of the transport system. However, the Office of the Commission for the Management of Land Transport, a national land transport planning body under the Office of the Prime Minister, serves as a coordinating agency for major mass rapid transit and toll road projects.

Bangkok is heavily dependent on private cars. Compared with other Asian cities in the region, both the level of passenger car ownership and car use are significantly higher, and are still increasing at a rapid rate. A large number of road infrastructure projects of all descriptions and sizes was implemented in the 1980s and 1990s to meet the increasing demand of car traffic. This has led to some improvement in the overall traffic situation. Despite commendable efforts in road building, Bangkok still enjoys much less road space in terms of the road-to-total-area ratio and network density compared with Tokyo, London, Singapore, or New York. Roads cover an estimated 11 per cent of the urbanized area in Bangkok.

A wide variety of public and private transport modes provided by the formal and informal sector serve the transportation needs of Bangkok. The public transport modes include buses of various types, rail transit, boats and ferries, and a wide range of paratransit modes and informal transport including taxis, samlors (3-wheelers), silors (4-wheelers), vans, and hired motorcycles. Buses carried 41 per cent of total passengers (about 5.2 million bus passengers a day) in 1995 compared with 23 per cent by car, 14 per cent by motorcycle, 5 per cent by taxi, and about 15 per cent by walking and other modes. The combined share of trips by railway and ferry was only about 2 per cent.

Bangkok Mass Transit Authority (BMTA), the lone public sector operator, and other private sector operators provide the bus services. In 2000, they operated about 7,200 regular buses (of various sizes) on 302 routes, and 3,200 air-conditioned buses and minibuses on 134 routes. With about 3,800 standard buses, BMTA currently carries about 2.7 million passengers a day. BMTA also functions as the regulatory authority for bus services and franchises bus routes to private operators. The recent trend is of a greater involvement of the private sector and a declining role for BMTA in providing services.

Measures have been taken to improve passenger comfort by introducing new buses. There has been a substantial increase in the number of air-conditioned buses with some decline in the number of non-air conditioned buses in the recent years. To minimize poor air quality problems, BMTA has been operating natural gas buses (NGV) on an experimental basis since 1992. By 1999, 82 NGV buses were operating along three different routes. BMTA also operates 797 rented Euro II buses with higher emission control standards. Some of these buses have arrangements for wheelchair lifting to provide easy access for people with disabilities.
Bangkok has a large paratransit fleet of 49,000 licensed taxis; 7,400 3-wheeler tuk-tuks; 8,400 silor-leks (small 4-wheelers), and about 40,000 hired motorcycles (which provide services in the lanes). The majority of taxis and all tuk-tuks are LPG-powered. A recent innovation was the introduction of mini vans by the informal sector. About 3,500 14-seater minibuses serve the commuters on 82 routes, mainly between suburban locations and the central areas. They were recently legalized.

The first rail transit system in Bangkok has been in operation since 1999. Known as the “Skytrain”, it is a 23 km elevated heavy rail transit system. The system has 23 stations and serves the inner areas of Bangkok. It has a maximum capacity of 25,000 passengers per hour per direction, with a 3-car train configuration at present. The capacity can be doubled in the future with 6-car trains. A private sector operator has built the US$ 1.22 billion mass transit system as a BOT project under a 30-year concession. An extension of the system with some support from the public sector is now under consideration. An underground rail transit system of similar capacity is under construction. This 20 km long underground system, with 20 stations, is scheduled to go into operation in 2002. It is being built by a state agency, but will be operated by a private operator under a 25-year concession agreement. When completed, the two rail mass transit systems together would form a loop around the central area of the city. Bangkok also has a plan for light rail systems to serve the city’s suburban areas in the future.

Plans are under consideration for system integration of different transit modes in Bangkok. Studies have been undertaken for the reorganization of existing bus routes to complement newly introduced and future rail transit services, and for a common ticketing system for all the systems. A proposal has been developed by the Bangkok Metropolitan Authority to reorganize bus routes based on their reclassification as trunk and feeder routes.

3. Singapore

Singapore, a city of 3.2 million people, has developed an advanced urban transport system with a variety of high quality transit and paratransit services. The important features of the city’s transport system include an integrated public transport system, electronic road pricing, wide applications of ITS, and an emphasis on private car restraint policies and management measures. All land transport development in Singapore is overseen by a central agency, the Land Transport Authority, which is a statutory board under the Ministry of Communications and Information Technology. It has the overall responsibility for the planning, development and management of Singapore’s land transport system.

The city has a network of 4,000 km of roads, which includes 150 km of expressways, 571 km of major arterials, 375 km of collector roads, and 2,004 km of local and access roads. Roads share about 21 per cent of urbanized areas, one of the highest rates in Asia. It also has a (heavy rail) metro network of 83 km and has recently introduced another 8 km of light rail transit.

Singapore has an efficient and reliable integrated public transport system comprising bus, metro and light rail services. Three private operators run the bus services. Together they operate 261 routes (175 trunk and 86 feeder) with a fleet of about 3,500 buses. The average daily number of passengers is about 3 million. The metro rail system was introduced in 1987 and has two main lines with 49 stations. It has an average daily ridership of about 1.1 million passengers. The system is now being extended to connect to the airport and this extension is expected to be in operation by 2002. Another feeder light rail system was introduced in 1999, mainly to complement the metro rail. A separate service company has been set up by the bus and metro operators to develop an integrated public transport system. Central planning and coordination of the bus network taking into consideration the metro and light rail systems has reduced wasteful duplication and improved transit services. The transit modes have
a common ticketing system with a cashless mode of payment by stored-value magnetic cards. The ticketing system would be further improved by introducing a contactless smart card system, which is now under trial.

An electronic road pricing system was introduced in 1998. It replaced the famous Area Licensing Scheme and the Road Pricing Scheme. There are gantries at the entrances of the central area restricted zone, expressways and other main roads. The system automatically deducts charges from a stored-value magnetic card inserted into the in-vehicle unit when motorists drive pass an electronic road pricing gantry during operational hours. The city has also introduced other ITS systems to improve traffic circulation, which include the Road Information Management System, the Expressway Monitoring and Advisory System, Green Link Determining, J-Eyes (to monitor real-time traffic conditions), and the Bus Lane Enforcement Camera System. Singapore also uses the Internet to provide real-time travel information to the public through a system called Traffic Scan. Introduced in 1999, Traffic Scan is linked to the systems mentioned above and gathers information on travel speeds by probing into the Global Positioning System (GPS) technology currently used by taxi companies. It may be mentioned here that the city has 17,863 taxis, which are operated by four major companies and many of which are equipped with GPS receivers. The information provided by Traffic Scan is updated every five minutes or can be manually updated by a user at any time.

Singapore has a vehicle quota system to manage long-term vehicle population growth at a sustainable rate. Every year, only a moderate increase in number is allowed through this system. Over a period of ten years between 1990 and 2000, the city’s car population increased from 272,475 to 392,961 representing an annual growth of 3.72 per cent. Over the same period, the number of buses increased from 9,298 to 12,300 (2.84 per cent annually), and the number of taxis from 12,239 to 18,327 (4.12 per cent annually).

F. Selected challenges in urban transport development

1. Lack of participation by stakeholders in the planning process

A common deficiency in the past practices of urban transport development has been that not all stakeholders have been involved in the decision-making process. Although changes have started to take place slowly or have been initiated in some countries, by and large institutional mechanisms to ensure the participation of all social groups including women, the poor and other marginal groups in the development process are still non-existent. Here participation means contributing to development, benefiting from development and taking part in decision-making about development. A fundamental institutional change in the planning process is required to incorporate participatory approaches in decision-making and to seek inter-disciplinary solutions to urban transportation problems. While the ways in which the involvement of all social groups is organized may be open to debate, its justification cannot be undermined.

2. Managing the growth of vehicle populations

Unmanaged growth of motorization is the root cause of many of today’s urban transport problems. Due to imperfect systems of transport pricing, prices do not reflect the true cost of the provision of the transport services and facilities. Consequently, this has led to a waste of resources, insufficient funds to develop and maintain infrastructure, distortions in modal choice and the generation of externalities (pollution and congestion). Ideally, an efficient pricing system should be in place to realize the full cost of travel from the motorists to rectify the current situation. Alternatively, serious consideration needs to be
given to the introduction of measures which include, *inter alia*, restraint and demand management measures to control the growth and usage of motor vehicles, particularly the usage of private cars.

3. **Improving of public transport and meeting the travel needs of the poor**

Public transport represents an important physical asset in the livelihood of poor people and other disadvantaged groups. They are highly dependent on public transport services for their physical access to jobs, facilities and services. However, there are not many cities in the region where the services are provided and organized to serve the needs of the poor and other groups with special needs. Improving these services, particularly bus services, to allow these groups to better meet their basic mobility needs at an affordable level would enhance their potential access to social and economic opportunities and thereby increase their welfare.

4. **The issue of non-motorized transport**

Non-Motorized Transport (NMT), including walking, remains a viable option to meet the basic mobility needs of all groups in a sustainable way. Unfortunately, NMT has received the least attention in traditional urban transport planning. Consequently, it has been either overlooked or totally neglected. Public policy towards NMT has not always been favourable and there is a need to revise public policies to promote the safe operation of NMT in Asian cities. Public policies and investments should be directed to enable greater use of NMT by providing suitable rights-of-way (shared or exclusive) and pedestrian facilities, and by giving attention to safety issues.

5. **Institutional weakness and capacity-building**

Urban local governments in most cities have serious capacity constraints on planning, developing and managing efficient transport systems. In many cities, transport development is poorly linked to the overall development process owing to shortcomings of the instruments of governance. A common problem is fragmented responsibility for transportation between many agencies. This tends to encourage a sectoral approach to planning. Plans are prepared with different financing and implementation arrangements and lack effective institutional mechanisms to examine their mutual compatibility or interrelationships. Because of this unarticulated approach, urban transport development in many cities confronts serious difficulties, including delays in project implementation, wasteful investment, and so on, and in many cases transport interventions do not produce the desired effect. Local governments also face serious legal and capacity constraints on forming partnerships with the private sector. Addressing the issues of institutional weakness and the capacity constraints of urban local governments needs more serious attention from policy-makers.
V. ROADS AND ROAD TRANSPORT

A. Introduction

The present section provides an analysis of trends in the growth of road infrastructure and motor vehicle fleets, as well as information on major road investment projects either completed within the past five years, in progress, or planned for commencement within the coming five years. The final section examines a number of institutional and policy issues relating to the roads and highways sector.

For the purposes of this review, a “road” is defined as a formed path suitable for use by all forms of non-guided vehicular transport. It can vary from the most fundamental of formed tracks through remote territory to multi-lane, high-speed motorways through, or linking, cities. It is probable that differing definitions result in inconsistencies of scope among the statistics published by individual countries; what may be defined as a road in one country may not necessarily be defined as such in another. Also, in some countries, a responsibility for the construction and maintenance of roads is dispersed among two or more different organizations, not all of which will be comprehensively reporting data on the road system(s) under their control.

These factors, among others, make it difficult to measure and compare statistics between countries. Nevertheless, it can be seen that growth of the road sector has been positive in almost all countries of the region.

An appeal is made to the responsible agencies to allocate resources for the improvement of their road sector databases. Well maintained databases will greatly help in planning the assistance programmes for the road and road transport administrations of the region.

B. Growth and development of the region’s road infrastructure

While it is difficult to provide a reliable estimate of the total length of roads in the ESCAP region, an estimate based on data assembled for 18 countries (including the largest in geographical terms – Australia, China, India and the Russian Federation) and one special administrative zone of the region is likely to be in excess of 9 million km. The 18 countries or zones for which data were assembled account for a consolidated road length of about 8.7 million km. The trends in the growth of the road networks of individual countries or zones are given in Figure V.1 and Table V.2.

In absolute terms, China, with more than 230,000 km of new road constructed in the five-year period 1994-1999, experienced by far the highest road network growth of any country in the region. Much of this growth was concentrated in the development of the long distance arterial road system linking the northern, southern, eastern and western extremities of the country. It is hardly surprising that the bulk of the region’s road building activity should be occurring in China, given its flourishing economic growth and rapidly rising income levels, coupled with its vast geography and the fact that its hinterland, which has so far been deficient in transport infrastructure, supplies most of its natural resources.

In percentage terms, China’s road growth was surpassed by that of Bangladesh, Brunei Darussalam, the Islamic Republic of Iran and Nepal, but these countries appear to have collectively accounted for only about 27,000 km of new road construction (or 11.5 per cent of China’s total) over the past five years.
The road construction programmes of Bangladesh and Nepal have been heavily supported by funding from the international development aid agencies, a large portion of which has been allocated to the construction of fair weather and local community roads. Although this funding appears not to have been matched with the absolute growth in vehicle populations or by increasing motorization (both are relatively low in Bangladesh and Nepal\(^{31}\)), it has to be remembered that rural road development in these countries is required to support more than just motorized vehicle traffic. As is suggested by Nepal’s 30 per cent share of paved roads in the total in 1998 (down from 36 per cent in 1990), the majority of funds have been allocated for the construction of gravel and earthen roads to provide access to the district headquarters located in the northern hills of the country.

In the case of the Islamic Republic of Iran, which releases a breakdown of road statistics by type of road, the expansion of the rural road network has occurred at a significantly faster pace than the growth in the overall road network. From 1993 to 1997, the rural road length of that country was reported to have grown from 73,101 to 86,209 km, an effective increase of nearly 6 per cent per year, as compared with the 4 per cent per year growth in the overall road network over the same period.

**Figure V.1 Road network growth in selected countries of the ESCAP region, 1993-1999**

![Graph showing average annual growth rate of national road network (%) for various countries](image)

**Sources:** United Nations and ESCAP Statistical Yearbooks, which have used data from Country Statistical Yearbooks. For the Russian Federation, these sources were supplemented by the Europa Yearbook and World Highways, September 1998 and for India by the India Statistical Abstract 1999. Data for the Republic of Korea were supplied by the Ministry of Construction and Transportation, Republic of Korea.

At the other end of the scale, the expansion of several road networks has been characterized by slow growth. The road networks of nearly half the 18 countries surveyed grew at rates averaging less than one per cent per year over the past five years, and of these countries, one (Georgia) actually appears to have experienced a contraction in its road network, which could be due to deterioration in the condition of road networks.

\(^{31}\) In the latest year for which data were available, vehicle densities and motorization rates for Bangladesh stood at just 10.1 vehicles per road route-km and 0.4 cars per thousand persons respectively. The corresponding figures for Nepal were 17.2 vehicles per road route-km and 2.1 cars per thousand persons.
While most of the national road networks of the region appeared to have grown at low to moderate rates over the past five years, their quality, as measured by the percentage of paved road kilometres to total road kilometres, appeared to show little improvement. Of the 14 countries for which reliable data on paved road length was available, 9 already had a paved road share of greater than 60 per cent (see Figure V.2), but only three, Bangladesh, Brunei Darussalam and the Islamic Republic of Iran, reported a growth in their paved road length of greater than 3 per cent per year. The Islamic Republic of Iran experienced the fastest growth, with an average of 12.1 per cent per year over the three-year period 1994-1997, and, significantly, most of this growth was concentrated in the rural road network.

Figure V.2 Proportion of paved road in selected countries of the ESCAP region in 1997, 1998 or 1999

Sources: United Nations and ESCAP Statistical Yearbooks which have used data from Country Statistical Yearbooks. For the Russian Federation these sources were supplemented by the Europa Yearbook and World Highways, September 1998 and for India by the India Statistical Abstract 1999.

C. Growth in road vehicle fleets and motorization trends in the region

Reliable information on the size of road vehicle fleets could be obtained for only 21 countries and two special administrative zones of the region, and the data reference years for individual countries varied considerably. All types of vehicles on national motor vehicle registers have been included within road vehicle fleets (ranging from motorcycles to heavy articulated trucks).

Of the 21 countries and two special administrative zones for which data were obtained, all but 6 recorded growth in road vehicle fleets averaging greater than 6 per cent per year over the most recent five-year period for which data were available (see Figure V.3 and Table V.3). As might reasonably be expected, fleet growth was lowest among the relatively prosperous countries or zones of the region, such as Australia; Brunei Darussalam; Hong Kong, China; Japan and Singapore, and highest among the developing countries of the region, such as Bangladesh, China, India, Nepal and Tonga. Curious exceptions were
Malaysia and the Republic of Korea, which, although enjoying relatively high levels of income and motorization (private cars per thousand persons), nevertheless experienced vehicle population growth averaging roughly 8 per cent per year.

**Figure V.3** Average annual growth in road vehicle fleets in selected countries and zones of the ESCAP region, 1991-1999

<table>
<thead>
<tr>
<th>Country</th>
<th>Average annual growth of vehicle fleets [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tonga (1992-1997)</td>
<td>19.6</td>
</tr>
<tr>
<td>China (1992-1997)</td>
<td>12.1</td>
</tr>
<tr>
<td>Nepal (1990-1998)</td>
<td>10.6</td>
</tr>
<tr>
<td>Malaysia (1994-1999)</td>
<td>8.7</td>
</tr>
<tr>
<td>Bangladesh (1993-1998)</td>
<td>8.0</td>
</tr>
<tr>
<td>Republic of Korea (1994-1999)</td>
<td>8.0</td>
</tr>
<tr>
<td>India (1992-1997)</td>
<td>8.0</td>
</tr>
<tr>
<td>Turkey (1994-1999)</td>
<td>7.3</td>
</tr>
<tr>
<td>Indonesia (1993-1998)</td>
<td>7.3</td>
</tr>
<tr>
<td>Philippines (1993-1998)</td>
<td>7.3</td>
</tr>
<tr>
<td>Pakistan (1994-1999)</td>
<td>6.9</td>
</tr>
<tr>
<td>Thailand (1994-1999)</td>
<td>6.9</td>
</tr>
<tr>
<td>Maldives (1992-1999)</td>
<td>6.8</td>
</tr>
<tr>
<td>Myanmar (1993-1998)</td>
<td>6.8</td>
</tr>
<tr>
<td>Sri Lanka (1993-1998)</td>
<td>6.4</td>
</tr>
<tr>
<td>Macau, China (1993-1998)</td>
<td>6.2</td>
</tr>
<tr>
<td>Brunei Darussalam (1993-1998)</td>
<td>3.4</td>
</tr>
<tr>
<td>Australia (1993-1998)</td>
<td>3.1</td>
</tr>
<tr>
<td>Singapore (1994-1999)</td>
<td>3.0</td>
</tr>
<tr>
<td>Japan (1994-1999)</td>
<td>1.8</td>
</tr>
<tr>
<td>Hong Kong, China (1994-1999)</td>
<td>1.8</td>
</tr>
<tr>
<td>Kazakhstan (1992-1997)</td>
<td>-1.3</td>
</tr>
</tbody>
</table>

Sources: United Nations and ESCAP Statistical Yearbooks which have used data from Country Statistical Yearbooks. For the Russian Federation these sources were supplemented by the Europa Yearbook and World Highways, September 1998 and for India by the India Statistical Abstract 1999. Commercial vehicle numbers for Singapore and Turkey for the year 1999: ESCAP estimates. The growth rate for road vehicle population in the Republic of Korea was supplied by the Ministry of Construction and Transportation, Republic of Korea.

The fastest-growing road vehicle population was that of Tonga, with a growth rate averaging nearly 20 per cent per year over five years, but the number of vehicles recorded in the base year was only 7,000. At the other end of the range, the road vehicle fleet of Kazakhstan actually contracted by 1.3 per cent per year over five years.

The strong growth registered by road vehicle populations of some countries or zones of the region, as compared with their moderate road network growth, is reflected in rising vehicle density (vehicles/road length) ratios. This provides a broad indication of the increasing pressure being placed on some of the region’s networks to accommodate the exponential growth in road traffic growth often associated with sharply rising vehicle density. Figure V.4 shows the most recent vehicle density ratios for a selection of countries and zones.
Of the countries or zones appearing in this figure, those with the fastest growth in vehicle density are:

- Malaysia with 70.5 vehicles per km of road in 1999 (up from 46.1 in 1994)
- Nepal with 17.2 vehicles per km of road in 1998 (up from 9.6 in 1990)
- Russian Federation with 11.5 vehicles per km of road in 1996 (up from 8.0 in 1991)
- Indonesia with 15.2 vehicles per km of road in 1998 (up from 11.0 in 1993)
- India with 4.0 vehicles per km of road in 1997 (up from 2.9 in 1992)
- Thailand with 111.6 vehicles per km of road in 1999 (up from 81.8 in 1994)
- Pakistan with 14.6 vehicles per km of road in 1999 (up from 11.3 in 1994)

At the other end of the scale are the wealthier countries and zones, such as Australia; Brunei Darussalam; Hong Kong, China; Japan and Singapore, whose vehicle densities either declined or registered very modest rates of growth over five years. It should be noted, however, that these countries already have high vehicle densities. The highest density, for example, is in Hong Kong, China, at 283 vehicles per road-km. Significantly, the group of countries and zones registering only modest growth in vehicle density includes Bangladesh, where the vehicle population appears not to have grown at a much faster rate than the road network.
A final measure of road vehicle growth assessed for this review is the change in levels of motorization of the region’s member countries. Motorization, which is expressed in terms of the number of private cars per thousand persons, is also used by international aid agencies as an indicator of development or income levels. A factor limiting the value of any analysis of motorization rates, however, is that individual countries differ in their road vehicle classifications: in some cases, utilities, pick-ups and light vans are included with private cars under a “non-commercial vehicle” heading. Figure V.5 shows the most recent motorization data for a selection of countries and zones. Data limitations would suggest that these figures should be regarded as indicative only.

Figure V.5 Motorization rates in selected countries of the ESCAP region in 1997 to 1999

Sources: United Nations and ESCAP Statistical Yearbooks which have used data from Country Statistical Yearbooks. For the Russian Federation these sources were supplemented by the Europa Yearbook and World Highways, September 1998 and for India by the India Statistical Abstract 1999. Commercial vehicle numbers for Singapore and Turkey for the year 1999: ESCAP estimates. The growth rate for road vehicle population in the Republic of Korea was supplied by the Ministry of Construction and Transportation, Republic of Korea.

Not surprisingly, the three wealthiest countries within the group shown in the figure (Australia, Brunei Darussalam and Japan) achieved the highest motorization rates, with greater than 400 private cars per thousand persons. Similarly, five of the developing countries of the group (Bangladesh, China, India, Myanmar, and Nepal) achieved the lowest motorization rates, with less than 5 private cars for every thousand persons in the population. In between, there is a group of 15 countries or zones with motorization rates ranging from 7.2 private cars per thousand persons in Pakistan to 169.6 private cars per thousand persons in Malaysia. At the lower end of the scale, the motorization rate of Bangladesh (the lowest of the group, at only 0.5 private cars per thousand persons) was lower than the next lowest rate (2.1 private cars per thousand persons for Nepal) by a factor of 4.

Of the countries or zones appearing in the figure, those with the fastest growth in the level of motorization are:

- Tonga with 85.6 private cars per thousand persons in 1997 (up from 33.9 in 1992)
China with 4.7 private cars per thousand persons in 1997 (up from 1.9 in 1992)

Russian Federation with 104.9 private cars per thousand persons in 1996 (up from 65.5 in 1991)

Indonesia with 14.4 private cars per thousand persons in 1998 (up from 9.9 in 1993)

Republic of Korea with 167.3 private cars per thousand persons in 1999 (up from 115.3 in 1994)

Malaysia with 169.6 private cars per thousand persons in 1999 (up from 116.9 in 1994)

Thailand with 43.0 private cars per thousand persons in 1999 (up from 30.6 in 1994)

Myanmar with 3.7 cars per thousand persons in 1998 (up from 2.6 in 1993)

D. Selected road and highway investment projects

Table V.1 summarizes selected road and highway investment projects in the ESCAP region. Completed during the past five years, at currently committed to or in progress, or planned for commencement within the next five years. The list is not intended to be, nor can it be, comprehensive. Rather, the projects described are examples of some of the more significant construction undertakings in the region.

Table V.1 Selected road and highway investment projects in the ESCAP region (status as of 2001)

<table>
<thead>
<tr>
<th>Country</th>
<th>Selected road and highway investment projects</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armenia</td>
<td><em>Upgrading links with Georgia and the Islamic Republic of Iran:</em> A current World Bank loan of US$ 40 million covers road and railway upgrading, with a specific emphasis on improving transport links with Georgia and the Islamic Republic of Iran.</td>
<td>In progress</td>
</tr>
<tr>
<td>Bangladesh</td>
<td><strong>Construction of the Jamuna River Bridge:</strong> The country’s single biggest transport infrastructure project to date, involving construction of the 4.8 km long Jamuna River Bridge at a cost of US$ 800 million, was completed in 1998. However, while road traffic is now flowing across this fixed link between the western and eastern zones of the country, construction of railway lines connecting to the bridge is still under way. <strong>Third Road Rehabilitation and Maintenance Project (US$ 529 million):</strong> Road projects soon to commence are a number being funded by the World Bank and the Governments of Bangladesh and the United Kingdom of Great Britain and Northern Ireland under the third Road Rehabilitation and Maintenance Project, for a total cost estimated at US$ 529 million. They include the construction of a new highway linking Nalka, Hatikamrul and Bonpara as well as 500 km of type A feeder roads, rehabilitation of the Dhaka-Sylhet highway, and the repair and overlaying of 1,000 km of national and provincial highways.</td>
<td>Completed</td>
</tr>
</tbody>
</table>
Construction of Padma River Bridge at Paksey:
Another major bridge is to be built over the Padma River at Paksey with financial assistance from the Government of Japan. This bridge, which will connect the northern and south-western zones of Bangladesh, will be 1.8 km long and carries a cost estimate of US$ 121 million.

The national road construction programme for China focuses on improvement of the rural road network and the expansion and upgrading of the national trunk highway system.

17,736 km of new highways from 1998-2002:
During the period 1998-2002, the national government is partly financing the construction of 17,736 km of new highways, including 9,709 km of upper-grade highways and 2,620 km of grade I-II highways.

New national trunk highways to begin “in the near future”:
In addition, it is expected that construction of the following new national trunk highways will commence “in the near future”, for a total cost estimated at US$ 60 billion:
- the Tongjiang-Sanya expressway of 5,200 km, with an estimated cost of US$ 18.8 billion;
- the Beijing-Zuhai expressway of 2,400 km, with an estimated cost of US$ 9.0 billion;
- the east-west Lianyungang-Huoerguosi expressway/upper grade highway of 4,400 km with a cost estimated at US$ 13.2 billion;
- the Shanghai-Chengdu expressway of 2,500 km with an estimated cost of US$ 9.0 billion;
- the Beijing-Shenyang expressway of 750 km, with a cost estimated at US$ 1.9 billion;
- the Beijing-Shanghai expressway of 1,300 km, with an estimated cost of US$ 4.8 billion;
- the Chongqing-Beihai expressway/upper grade highway of 1,270 km, likely to cost US$ 4.6 billion.

Hong Kong, China:
Motorway and Bridge linking new airport with Kowloon:
The US$ 925 million, 2.2 km long Tsing Ma Bridge and the associated motorway linking the new Chek Lap Kok airport with Kowloon was completed in 1997.

Tunnel in hard rock, high-level bridges and Stonecutters Bridge:
Design and supervision contracts have been signed for two large-scale transport infrastructure projects. One is the US$ 897 million Tsing Lung Tau to So Kwun Wat section of Highway Route 10, which includes a 1.75 km dual three-lane tunnel in hard rock, two high-level bridges and more than 4 km of dual three-lane highway. The other is the US$ 650 million, 1.8 km long Stonecutters Bridge spanning Hong Kong’s Rambler Channel and the entrance to the Kwai Chung container port. This bridge will itself be part of the US$ 2 billion Route 9 linking Tsing Yi, Cheung Sha Wan and Sha Tin and when complete will be the world’s longest cable-stayed bridge.
### Part Two ---- V. Roads and Road Transport

#### Road Rehabilitation (US$ 95 million):
Some 900 km of road will be rehabilitated within the next five years at a cost of approximately US$ 95 million, co-financed by the Government of Georgia and the World Bank.

#### The World Bank has estimated that India’s annual capital expenditure on highway development will soon quadruple, to US$ 4 billion.

2,520 km highways in Madya Pradesh by 2002:
India, with less than 500 km of four-lane roads for a country of nearly one billion persons, has immediate priorities to develop its road system to support economic growth in several key states, including Madya Pradesh, where the state government has plans to construct 15 highways with a total length of 2,520 km by 2002.

*Mumbai-Pune expressway and 50 flyovers in Mumbai:*
The Maharashtra State Road Development Corporation has commenced construction of the US$ 395 million Mumbai-Pune expressway and the US$ 447 million project to construct 50 flyovers in Mumbai, both projects being financed with public BOT borrowings.

3,000 km to be widened widened to four-lane highways:
At the federal level, some 3,000 km of roads (including the 1,447 km long highway linking Calcutta with Delhi) will be widened to four-lane highways as part of a US$ 12 billion national highway plan.

*Master Plan for rural roads:*
In addition, the Government of India is considering a master plan for the improvement of 40,000 km of rural roads over the next five years at a cost estimated at US$ 750 million.

#### Indonesia

*Road and bridge rehabilitation in the poorer areas (2000-2004):*
The Asian Development Bank has approved a US$ 190 million loan for road and bridge rehabilitation in the poorer areas of Java, Kalimantan, Sulawesi and Sumatra during a four-year period ending in 2004. This project will also assist the formulation and implementation of road sector policies related to road user charges, cost recovery, the earmarking of funds for maintenance, vehicle overloading and road safety.

*Sumatra East Coast Highway:*
Elsewhere, contracts have been signed for the design and construction supervision of a 165 km long section of the proposed Sumatra East Coast Highway. Financed by the Overseas Economic Cooperation Fund (OECF), this US$ 50 million project will form part of a second strategic north-south route for Sumatra, and will provide a more direct link between Central Sumatra and the Java-Sumatra ferry terminal at Bakuheni in South Sumatra. Construction of this 165 km section was scheduled to begin in late 2000 and is expected to be completed by 2003.

#### Kazakhstan

*Rehabilitation of road network:*
The Japanese Bank for International Cooperation will lend the Government of Kazakhstan US$ 147 million for a 30-year period to rehabilitate the road network in the west of the country.

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Table V.1 (continued)

<table>
<thead>
<tr>
<th>Country</th>
<th>Selected road and highway investment projects</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Georgia</td>
<td><em>Road Rehabilitation (US$ 95 million):</em> Some 900 km of road will be rehabilitated within the next five years at a cost of approximately US$ 95 million, co-financed by the Government of Georgia and the World Bank.</td>
<td>Planned</td>
</tr>
</tbody>
</table>
| India       | The World Bank has estimated that India’s *annual capital expenditure on highway development will soon quadruple, to US$ 4 billion.*  
2,520 km highways in Madya Pradesh by 2002:  
India, with less than 500 km of four-lane roads for a country of nearly one billion persons, has immediate priorities to develop its road system to support economic growth in several key states, including Madya Pradesh, where the state government has plans to construct 15 highways with a total length of 2,520 km by 2002.  
*Mumbai-Pune expressway and 50 flyovers in Mumbai:*  
The Maharashtra State Road Development Corporation has commenced construction of the US$ 395 million Mumbai-Pune expressway and the US$ 447 million project to construct 50 flyovers in Mumbai, both projects being financed with public BOT borrowings.  
3,000 km to be widened widened to four-lane highways:  
At the federal level, some 3,000 km of roads (including the 1,447 km long highway linking Calcutta with Delhi) will be widened to four-lane highways as part of a US$ 12 billion national highway plan.  
*Master Plan for rural roads:*  
In addition, the Government of India is considering a master plan for the improvement of 40,000 km of rural roads over the next five years at a cost estimated at US$ 750 million. | Planned |
| Indonesia   | *Road and bridge rehabilitation in the poorer areas (2000-2004):* The Asian Development Bank has approved a US$ 190 million loan for road and bridge rehabilitation in the poorer areas of Java, Kalimantan, Sulawesi and Sumatra during a four-year period ending in 2004. This project will also assist the formulation and implementation of road sector policies related to road user charges, cost recovery, the earmarking of funds for maintenance, vehicle overloading and road safety.  
*Sumatra East Coast Highway:* Elsewhere, contracts have been signed for the design and construction supervision of a 165 km long section of the proposed Sumatra East Coast Highway. Financed by the Overseas Economic Cooperation Fund (OECF), this US$ 50 million project will form part of a second strategic north-south route for Sumatra, and will provide a more direct link between Central Sumatra and the Java-Sumatra ferry terminal at Bakuheni in South Sumatra. Construction of this 165 km section was scheduled to begin in late 2000 and is expected to be completed by 2003. | In progress |
| Kazakhstan  | *Rehabilitation of road network:* The Japanese Bank for International Cooperation will lend the Government of Kazakhstan US$ 147 million for a 30-year period to rehabilitate the road network in the west of the country. | Planned |
New Mukdahan-Savanakhet Bridge over the Mekong: In August 2000, the new Mukdahan-Savanakhet Bridge over the Mekong River at Pakse was officially opened. This 1.4 km-long suspension bridge was built with a grant from the Government of Japan and it is expected that it will encourage increased trade and tourism between the Lao People’s Democratic Republic, Thailand, Cambodia and Viet Nam. The Asian Development Bank is funding the construction of roads connecting the bridge with the borders of Cambodia and Viet Nam, while the Government of Japan is funding the reconstruction of Route 13 north of Pakse.

In Nepal, the road system has been developed predominantly on an east-west axis linking the whole of the southern part of the country. North-south connections to this primary axis are relatively few (owing to the mountainous terrain) and some 33 per cent of the population who live in these mountainous areas are denied access to roads of any description.

6,000 km of new roads for districts not yet connected by road: Accordingly, the equivalent of US$ 387 million has been allocated within the tenure of the Ninth National Development Plan (1997-2002) towards the construction of more than 6,000 km of new roads in various districts to provide road links to the district headquarters not yet connected with road. The majority of these are fair weather roads with gravelled or earthen surfaces.

Construction of Lahore-Islamabad M2 Motorway: In September 1997, the 334-km Lahore-Islamabad M2 Motorway, constructed for a cost equivalent to US$ 1 billion, was opened to traffic. This was followed by the commencement of work in late 1997 on construction of the 154 km, six-lane M1 Motorway from Peshawar to Islamabad. The cost of the latter project, which was completed in late 2000, was estimated at US$ 430 million, with funding supplied under a Finance-Own-Operate-Transfer concession.

In September 2000, the National Highway Authority of Pakistan invited bids to design, build, operate, maintain and transfer a bridge over the River Chenab on the N-70 highway at Shershah, Punjab in Pakistan’s northeast. The bridge would be 3 km long and would be accessed by four-lane approach roads.

<table>
<thead>
<tr>
<th>Country</th>
<th>Selected road and highway investment projects</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lao People’s Democratic Republic</td>
<td><strong>New Mukdahan-Savanakhet Bridge over the Mekong:</strong> In August 2000, the new Mukdahan-Savanakhet Bridge over the Mekong River at Pakse was officially opened. This 1.4 km-long suspension bridge was built with a grant from the Government of Japan and it is expected that it will encourage increased trade and tourism between the Lao People’s Democratic Republic, Thailand, Cambodia and Viet Nam. The Asian Development Bank is funding the construction of roads connecting the bridge with the borders of Cambodia and Viet Nam, while the Government of Japan is funding the reconstruction of Route 13 north of Pakse.</td>
<td>Completed</td>
</tr>
<tr>
<td>Nepal</td>
<td>In Nepal, the road system has been developed <em>predominantly on an east-west axis</em> linking the whole of the southern part of the country. North-south connections to this primary axis are relatively few (owing to the mountainous terrain) and some 33 per cent of the population who live in these mountainous areas are denied access to roads of any description. <em>6,000 km of new roads for districts not yet connected by road:</em> Accordingly, the equivalent of US$ 387 million has been allocated within the tenure of the Ninth National Development Plan (1997-2002) towards the construction of more than 6,000 km of new roads in various districts to provide road links to the district headquarters not yet connected with road. The majority of these are fair weather roads with gravelled or earthen surfaces.</td>
<td>In progress</td>
</tr>
<tr>
<td>Pakistan</td>
<td><strong>Construction of Lahore-Islamabad M2 Motorway:</strong> In September 1997, the 334-km Lahore-Islamabad M2 Motorway, constructed for a cost equivalent to US$ 1 billion, was opened to traffic. This was followed by the commencement of work in late 1997 on construction of the 154 km, six-lane M1 Motorway from Peshawar to Islamabad. The cost of the latter project, which was completed in late 2000, was estimated at US$ 430 million, with funding supplied under a Finance-Own-Operate-Transfer concession. In September 2000, the National Highway Authority of Pakistan invited bids to design, build, operate, maintain and transfer a bridge over the River Chenab on the N-70 highway at Shershah, Punjab in Pakistan’s northeast. The bridge would be 3 km long and would be accessed by four-lane approach roads.</td>
<td>Completed</td>
</tr>
</tbody>
</table>

Table V.1 (continued)
Finally, in July 2000, work started on the first phase of construction of the 650 km-long Makran Coastal Road. This road will connect Karachi with Gwadar on the border between Pakistan and the Islamic Republic of Iran. The first phase of 247 km, passing through the mountainous region between Liari (near Karachi) and Ormara, is expected to be completed in three years at a cost of about US$ 77 million. The second phase, from Ormara to Gwadar will cost about US$ 135 million and will be constructed over a four-year period. This new highway has been justified in terms of providing access to ports (such as Gwadar) and cities not linked to the national highway system, as well as boosting the prosperity of the region by ensuring an inflow of domestic and foreign investment. However, it also has to be noted that it will compete directly with the existing rail link between Pakistan and the Islamic Republic of Iran, which has thus far been denied the funds necessary to upgrade it to the standard of an international rail link.

A major plan of assistance under the Technical Assistance for the Commonwealth of Independent States (TACIS) project has identified priorities for the rehabilitation and maintenance of the road network of the Arkhangelsk-Oblast region in north-western Russia. A budget of US$ 45 million is being allocated for rehabilitation of sections of the main road system, comprising 330 km of federal and 560 km of territorial roads.

In Siberia, highways are being built to link Tyumen with Salekhard (1,971 km) and Tomsk with Perm (2,857 km). These highways will then be linked by the recently completed cable-stayed bridge across the Ob River at Surgut.

Finalization of a loan of US$ 22 million from the Islamic Development Bank permitted a start in March 2000 on construction of a highway link between Tajikistan and China. It was expected that construction of the Murghab-Qulma highway through the mountainous terrain of the Badakshon autonomous region could be completed by the end of 2000 and the remainder of the project by early 2001.

Between 1993 and 1997, approximately 41,000 km of new roads were built in Thailand, of which about 33,000 km (or 80 per cent) were rural roads. In 1998, approximately 330 km of expressways and ring roads in the vicinity of Bangkok were under construction at a cost estimated at about US$ 3.6 billion. Most of these projects were expected to have been completed by 2000.

Also in 1998, plans were being finalized for the construction of 150 km of new elevated expressways (at an estimated cost of US$ 5.4 billion); 2,519 km of new highways (at an estimated cost of US$ 5.3 billion); 8,797 km of road widening and other improvement projects (costing an estimated US$ 4.3 billion); and 4,450 km of rural and community roads (for which costs were not provided).

A major project under construction at the time of writing is the new Rama VIII Bridge across the Chao Phraya River in Bangkok, being built under a design and construct contract at an estimated cost of US$ 32.5 million.

<table>
<thead>
<tr>
<th>Country</th>
<th>Selected road and highway investment projects</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pakistan (continued)</td>
<td>Finally, in July 2000, work started on the first phase of construction of the 650 km-long Makran Coastal Road. This road will connect Karachi with Gwadar on the border between Pakistan and the Islamic Republic of Iran. The first phase of 247 km, passing through the mountainous region between Liari (near Karachi) and Ormara, is expected to be completed in three years at a cost of about US$ 77 million. The second phase, from Ormara to Gwadar will cost about US$ 135 million and will be constructed over a four-year period. This new highway has been justified in terms of providing access to ports (such as Gwadar) and cities not linked to the national highway system, as well as boosting the prosperity of the region by ensuring an inflow of domestic and foreign investment. However, it also has to be noted that it will compete directly with the existing rail link between Pakistan and the Islamic Republic of Iran, which has thus far been denied the funds necessary to upgrade it to the standard of an international rail link.</td>
<td>In progress</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>A major plan of assistance under the Technical Assistance for the Commonwealth of Independent States (TACIS) project has identified priorities for the rehabilitation and maintenance of the road network of the Arkhangelsk-Oblast region in north-western Russia. A budget of US$ 45 million is being allocated for rehabilitation of sections of the main road system, comprising 330 km of federal and 560 km of territorial roads. In Siberia, highways are being built to link Tyumen with Salekhard (1,971 km) and Tomsk with Perm (2,857 km). These highways will then be linked by the recently completed cable-stayed bridge across the Ob River at Surgut.</td>
<td>Planned</td>
</tr>
<tr>
<td>Tajikistan</td>
<td>Finalization of a loan of US$ 22 million from the Islamic Development Bank permitted a start in March 2000 on construction of a highway link between Tajikistan and China. It was expected that construction of the Murghab-Qulma highway through the mountainous terrain of the Badakshon autonomous region could be completed by the end of 2000 and the remainder of the project by early 2001.</td>
<td>In progress/ completed</td>
</tr>
<tr>
<td>Thailand</td>
<td>Between 1993 and 1997, approximately 41,000 km of new roads were built in Thailand, of which about 33,000 km (or 80 per cent) were rural roads. In 1998, approximately 330 km of expressways and ring roads in the vicinity of Bangkok were under construction at a cost estimated at about US$ 3.6 billion. Most of these projects were expected to have been completed by 2000. Also in 1998, plans were being finalized for the construction of 150 km of new elevated expressways (at an estimated cost of US$ 5.4 billion); 2,519 km of new highways (at an estimated cost of US$ 5.3 billion); 8,797 km of road widening and other improvement projects (costing an estimated US$ 4.3 billion); and 4,450 km of rural and community roads (for which costs were not provided). A major project under construction at the time of writing is the new Rama VIII Bridge across the Chao Phraya River in Bangkok, being built under a design and construct contract at an estimated cost of US$ 32.5 million.</td>
<td>Completed</td>
</tr>
</tbody>
</table>
E. Institutional and policy aspects

The main institutional and policy aspects of significance to the roads and highways sector include those related to the financing of major road infrastructure development projects, creating road safety awareness, initiating road maintenance policy reforms by establishing sustainable road funds, and policy measures to safeguard the environment.

a) Road infrastructure financing

Throughout the region, considerable progress has been made in applying new approaches to the financing of large road infrastructure development projects. For example, China which first applied BOT and other forms of concession funding to localized road construction projects in the early 1990s, is now extending this concept to the construction of major new long-distance trunk highways. The use of tolls is now a widely accepted and practised method of highway revenue collection in China. Additionally, in December 2000, the Government of China announced plans to levy a 10 per cent sales tax on motor vehicle purchases, to be used to fund road projects (especially those in the west of the country) which cannot be expected to show a financial rate of return.
Within the past five years, India applied its first private-financing initiatives to large road projects, such as the Udaipur Bypass (for which a BOT funding concession was granted in order to raise the required capital of US$ 6 million). However, conventional BOT funding has limited potential in India, which lacks a long-term debt market and has not yet embraced the concept of toll collection. It was decided that BOT concessions, if they were to succeed in India, would have to involve some risk assumption by the government. This was done through the application of a modified approach to BOT funding, known as the Public BOT, in which the concessionaire is not a consortium of private sector organizations, but a single public sector enterprise wholly dedicated to the road sector. This new form of BOT was first applied in the case of two huge road projects, one involving construction of the US$ 395 million Mumbai-Pune expressway, and the other construction of 50 flyovers in Mumbai at a cost of about US$ 447 million. In this case, the BOT concessionaire was the Maharashtra State Road Development Corporation, which raised capital through a debenture issue. The success of this venture was demonstrated by the fact that the initial debenture offering of US$ 131.6 million was over-subscribed to the extent of US$ 308 million.32

In the past 3-4 years, Pakistan has also adopted BOT funding for major road construction projects, specifically for the Lahore-Islamabad (M2) and Peshawar-Islamabad (M1) motorways.

In South-east Asia (most notably in Malaysia and Thailand), private financing of large expressway and highway construction projects, which had already become a well-established practice by 1995, continued to provide the major source of funds for these projects, despite some setbacks following the Asian monetary crisis of 1997-1998.

Although BOT can provide an alternative means for governments to construct and manage road infrastructure, it is not an easy option and involvement of the private sector requires a well-thought-out strategy and policies, as well as a considerable amount of commitment from governments. The involvement of the private sector in the road sector might not be attractive in all countries owing to their low volume of traffic and differing priorities.

b) Road safety

Recognizing the urgency of the problem and the need for road safety improvements, a number of countries in the Asia and Pacific region have taken initiatives to improve road safety measures. About 400,000 people are killed annually and many more thousands injured in the Asia and Pacific region alone. A series of road safety awareness workshops and seminars have been organized at the national and regional levels. Various seminars, publicity and education programmes and road safety campaigns along highways and on television and radio programmes have been launched in India; the Lao People’s Democratic Republic; Myanmar; Nepal; and Hong Kong, China. National road safety committees or councils have been established in all of these countries, as well as in the Islamic Republic of Iran, to address the road safety issue more effectively and comprehensively.

Hong Kong, China is considering amending or introducing legislation related to road safety issues such as the prohibition of drink-driving, the use of mobile phones while driving, and the use of seat belts. India, Malaysia, and Hong Kong, China are developing methodologies and introducing road safety audit systems. Hong Kong, China has recently introduced taxi drop-off points in busy streets, yellow road markings for expressway exits and time limits for no-stopping zones. Driver’s training programmes have been introduced in India, Lao People’s Democratic Republic, and Malaysia. India is also introducing a refresher-training course for heavy-vehicle drivers. In Japan, drivers of commercial trucks,
buses and taxis are required to take a special driving aptitude test and counselling, if they are beginners, above a certain age, or are very likely to cause accidents. Many countries have begun taking measures for improving the reporting of road accidents and maintaining a road accident database for analysis.

(c) **Road maintenance initiatives**

The concept of commercially managed roads emerged during the 1990s. In this regard, regional and national seminars and workshops have been organized to introduce the concept of sustainable road maintenance in the Asia and Pacific region. So far, 10 national workshops have been organized in various countries, with other countries attending as observers. As a result, a number of countries are taking policy initiatives to establish self-sustained autonomous road funds, which will be funded through road tolls, vehicle taxes, fuel levies, overloading charges, transit charges and other funds provided by government. In Nepal, the legislation to establish such a fund has been submitted to the parliament after cabinet approval; Lao People’s Democratic Republic has started a dialogue with donors for establishing a road fund; and in Cambodia, a dialogue with various stakeholders is ongoing. A national workshop has been held in Indonesia to create awareness among government officials, and a series of public awareness campaigns are planned on road maintenance initiatives. In Pakistan, a series of workshops have been held in four cities to stress the need for proper maintenance of roads. Turkey has recognized the importance of maintenance and put great effort into the development of a highway maintenance system. Additional sources from levies on petrol and high-speed diesel have strengthened the Central Road Fund in India. Although a seminar on private sector participation in road management and financing was organized in Dhaka in 1998, there has been no further progress towards creating a road fund.

(d) **Road and environment**

A number of countries in the Asia and Pacific region have taken measures to safeguard the environment from road-related adverse impacts. China, India, the Islamic Republic of Iran, Kazakhstan, Malaysia, the Philippines, the Republic of Korea, Thailand, Turkey, Uzbekistan, and Viet Nam had introduced environmental legislation by 1995. New environmental legislation and rules have been introduced in Bangladesh, Indonesia, Nepal, and Pakistan in the last five years, which makes the Environmental Impact Assessment (EIA) or Initial Environmental Examination (IEE) process mandatory for any road projects, including maintenance, depending on the scale of impacts. Public consultation is mandatory for any new road construction project as part of the EIA process after enactment of environmental laws and regulations in Nepal. In Nepal, vehicle emission standards have been introduced and monitored, and the Government has relocated diesel-operated three-wheelers (tempo) out of the Kathmandu valley and encouraged the use of battery-operated three-wheelers to curb air pollution.
### Table V.2 Length of road networks and proportion of paved road in selected ESCAP countries, 1993-1999

<table>
<thead>
<tr>
<th>Country or region</th>
<th>Year “i”</th>
<th>Year “n”</th>
<th>Length of paved road (1,000 km)</th>
<th>Proportion of paved road in road network</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia (1993-1999)</td>
<td>801</td>
<td>814</td>
<td>0.3%</td>
<td>37%</td>
</tr>
<tr>
<td>Azerbaijan (1994-1999)</td>
<td>24</td>
<td>25</td>
<td>0.6%</td>
<td>62%</td>
</tr>
<tr>
<td>Bangladesh (1994-1999)</td>
<td>16</td>
<td>21</td>
<td>6.0%</td>
<td>75%</td>
</tr>
<tr>
<td>Brunei Darussalam (1994-1999)</td>
<td>2</td>
<td>3</td>
<td>4.9%</td>
<td>59%</td>
</tr>
<tr>
<td>China (1994-1999)</td>
<td>1,118</td>
<td>1,352</td>
<td>3.9%</td>
<td>40%</td>
</tr>
<tr>
<td>Hong Kong, China (1994-1999)</td>
<td>2</td>
<td>2</td>
<td>2.6%</td>
<td>100%</td>
</tr>
<tr>
<td>Georgia (1993-1997)</td>
<td>21</td>
<td>20</td>
<td>2.5%</td>
<td>50%</td>
</tr>
<tr>
<td>India (1993-1998)**</td>
<td>2</td>
<td>700</td>
<td>3.9%</td>
<td>234</td>
</tr>
<tr>
<td>Indonesia (1993-1998)</td>
<td>345</td>
<td>355</td>
<td>0.6%</td>
<td>11</td>
</tr>
<tr>
<td>Islamic Republic of Iran (1994-1997)</td>
<td>147</td>
<td>166</td>
<td>4.0%</td>
<td>20</td>
</tr>
<tr>
<td>Japan (1993-1997)</td>
<td>136</td>
<td>156</td>
<td>1.4%</td>
<td>15</td>
</tr>
<tr>
<td>Malaysia (1994-1999)</td>
<td>60</td>
<td>65</td>
<td>1.4%</td>
<td>20</td>
</tr>
<tr>
<td>Nepal (1993-1998)</td>
<td>10</td>
<td>12</td>
<td>4.6%</td>
<td>10</td>
</tr>
<tr>
<td>Pakistan (1993-1998)</td>
<td>87</td>
<td>94</td>
<td>1.6%</td>
<td>20</td>
</tr>
<tr>
<td>Republic of Korea (1994-1999)</td>
<td>74</td>
<td>88</td>
<td>3.6%</td>
<td>10</td>
</tr>
<tr>
<td>Russian Federation (1995-1998)*</td>
<td>1,180</td>
<td>1,300</td>
<td>0.5%</td>
<td>15</td>
</tr>
<tr>
<td>Thailand (1994-1999)</td>
<td>51</td>
<td>57</td>
<td>4.4%</td>
<td>20</td>
</tr>
<tr>
<td>Singapore (1994-1999)</td>
<td>3</td>
<td>3</td>
<td>0.8%</td>
<td>90</td>
</tr>
<tr>
<td>Total</td>
<td>8,160</td>
<td>8,727</td>
<td>567</td>
<td>4,024</td>
</tr>
</tbody>
</table>

**Sources:** United Nations and ESCAP Statistical Yearbooks, which have used data from Country Statistical Yearbooks. For the Russian Federation, these sources were supplemented by the Europa Yearbook and World Highways, September 1998 and for India by the India Statistical Abstract 1999. The growth rate for road length in the Republic of Korea was supplied by the Ministry of Construction and Transportation, Republic of Korea.

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### Table V.3 Motor vehicle populations and level of motorization in selected ESCAP countries, 1993-1999

<table>
<thead>
<tr>
<th>Country or region</th>
<th>Total MV population [thousands]</th>
<th>Private car population [thousands of vehicles]</th>
<th>Population [millions of persons]</th>
<th>Motorization [cars per 1,000 persons]</th>
<th>Vehicle density [veh. per km of road]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia (1993-1998)</td>
<td>10,093</td>
<td>9,561</td>
<td>17.7</td>
<td>455.6</td>
<td></td>
</tr>
<tr>
<td>Bangladesh (1993-1998)</td>
<td>139</td>
<td>65</td>
<td>115.2</td>
<td>55.7</td>
<td></td>
</tr>
<tr>
<td>Brunei Darussalam (1993-1998)</td>
<td>145</td>
<td>171</td>
<td>20.1</td>
<td>14.6</td>
<td></td>
</tr>
<tr>
<td>China (1992-1997)</td>
<td>6,677</td>
<td>2,506</td>
<td>125.2</td>
<td>65.5</td>
<td></td>
</tr>
<tr>
<td>Kazakhstan (1992-1997)</td>
<td>1,373</td>
<td>973</td>
<td>16.4</td>
<td>55.7</td>
<td></td>
</tr>
<tr>
<td>Hong Kong, China (1994-1999)</td>
<td>484</td>
<td>384</td>
<td>6.0</td>
<td>54.6</td>
<td></td>
</tr>
<tr>
<td>Indonesia (1993-1998)</td>
<td>3,994</td>
<td>1,799</td>
<td>10.0</td>
<td>20.3</td>
<td></td>
</tr>
<tr>
<td>Japan (1994-1999)</td>
<td>63,955</td>
<td>51,165</td>
<td>125.2</td>
<td>340.9</td>
<td></td>
</tr>
<tr>
<td>Macau, China (1993-1998)</td>
<td>39</td>
<td>6</td>
<td>3.0</td>
<td>85.8</td>
<td></td>
</tr>
<tr>
<td>Malaysia (1994-1999)</td>
<td>2,778</td>
<td>1,799</td>
<td>20.1</td>
<td>116.3</td>
<td></td>
</tr>
<tr>
<td>Maldives (1993-1998)</td>
<td>183</td>
<td>117</td>
<td>18.9</td>
<td>24.4</td>
<td></td>
</tr>
<tr>
<td>Myanmar (1998)</td>
<td>90</td>
<td>50</td>
<td>11.0</td>
<td>18.0</td>
<td></td>
</tr>
<tr>
<td>Nepal (1990-1998)</td>
<td>12,992</td>
<td>7,145</td>
<td>11.0</td>
<td>17.0</td>
<td></td>
</tr>
<tr>
<td>Pakistan (1994-1999)</td>
<td>977</td>
<td>707</td>
<td>119.4</td>
<td>27.0</td>
<td></td>
</tr>
<tr>
<td>Philippines (1995-1998)</td>
<td>1,551</td>
<td>970</td>
<td>127.0</td>
<td>23.7</td>
<td></td>
</tr>
<tr>
<td>Republic of Korea (1994-1999)</td>
<td>7,375</td>
<td>8,388</td>
<td>115.3</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Russian Federation (1991-1996)</td>
<td>12,492</td>
<td>12,492</td>
<td>184.2</td>
<td>65.5</td>
<td></td>
</tr>
<tr>
<td>Singapore (1994-1999)</td>
<td>475</td>
<td>430</td>
<td>3.4</td>
<td>10.1</td>
<td></td>
</tr>
<tr>
<td>Sri Lanka (1993-1998)</td>
<td>364</td>
<td>278</td>
<td>17.7</td>
<td>11.2</td>
<td></td>
</tr>
<tr>
<td>Thailand (1994-1999)</td>
<td>4,183</td>
<td>1,799</td>
<td>10.0</td>
<td>115.3</td>
<td></td>
</tr>
<tr>
<td>Tonga (1992-1997)</td>
<td>7</td>
<td>7</td>
<td>0.0</td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td>Turkey (1994-1999)</td>
<td>3,392</td>
<td>4,862</td>
<td>5.9</td>
<td>47.9</td>
<td></td>
</tr>
</tbody>
</table>

**Source:** United Nations and ESCAP Statistical Yearbooks, which have used data from Country Statistical Yearbooks. For the Russian Federation, these sources were supplemented by the Europa Yearbook and World Highways, September 1998 and for India by the India Statistical Abstract 1999. The growth rate for road length in the Republic of Korea was supplied by the Ministry of Construction and Transportation, Republic of Korea.
VI. RAILWAY TRANSPORT

A. Introduction

There are 42 railway networks and 47 railway operating organizations in the ESCAP region. These networks and organizations are located in 30 countries and one special administrative zone within the region. Newly included are the railways of Georgia and Turkey which have been accepted as members of ESCAP since the Ministerial Conference on Infrastructure, held in New Delhi in 1996.

B. Network growth trends

Two growth indicators are of relevance when measuring network development: the growth in the overall route length of individual railway networks and the growth in the electrified route length within individual networks.

1. Growth in overall route length

A railway network’s route length is defined as the sum of the distances (in kilometres) between the mid-points of all stations on the network.

The total route length of all 42 railway networks in the ESCAP region was estimated at about 350,000 kilometres in 2000. Just 5 out of the 30 countries with railways in the region (Australia, China, India, Japan and the Russian Federation) account for 75 per cent of this route length.

The overall railway route length for the ESCAP region is estimated to have increased only marginally (by 1.5 per cent) over the five-year period 1994-1999, as may be observed in Figure VI.1. However, this marginal growth at the level of the region masks some very rapid growth (and some almost as rapid contraction) in the railway route lengths of some individual countries and subregions.

By subregion, the fastest railway network growth occurred in East and North-east Asia, where overall route length grew by 4,660 km, or 7.2 per cent, over five years. All of this growth was concentrated in China, whose railway network expanded by 8.6 per cent over the same period. Relatively strong network growth (4.5 per cent over the five-year period) was recorded for South-east Asia, where over the past five years, Myanmar Railways is understood to have completed the construction of nearly 800 km of new railway lines, expanding its network by 20 per cent. In the remaining subregions, railway network growth was either marginally positive (South and South-west Asia, Japan) or negative (North and Central Asia, Australia and New Zealand). Significantly, the largest network contraction in absolute terms occurred in the Russian Federation, where network route length appears to have decreased by 809 km (from 87,469 km to 86,660 km) over five years. It is likely that this contraction can be explained mainly by the closure of some uneconomic branchlines, as can the reduction in the consolidated network in Australia of 703 km over the same period.
2. Growth in electrified route length

The adoption of electric traction by the railway organizations of the region is a measure of their preparedness to accept cost-saving advanced technology, and also an indication of their preference for environmentally-friendly methods of operation.

No fewer than 26 railway networks in 19 countries and one special administrative zone throughout the region are, at least in part, electrified. However, in 1999, only 27.3 per cent of the overall railway route length of the region was electrified (up slightly from 25.7 per
cent in 1994), as shown in Figure VI.2. By subregion, Japan and North and Central Asia, have achieved by far the highest rates of electrification in the region, with 59.6 and 43 per cent of their railway networks electrified respectively. However, in absolute terms, the fastest growth in electrified route length was achieved in East and North-east Asia, where China expanded its electrified route by more than 3,000 km (or 34 per cent) in five years, and in South and South-west Asia, where India added nearly 1,500 km (or 12 per cent) to its electrified route over the same period. On the other hand, South-east Asia has the lowest percentage of its route electrified of any subregion (1.4 per cent), with electrified railway routes confined to the Jakarta and Kuala Lumpur suburban networks.

Significantly, China appears to have been investing both in network expansion and electrification, while India appears to have been diverting its resources from network expansion to electrification and gauge conversion.

3. Railway employment

Railways are still among the region’s largest employers, with a total workforce estimated at more than 6.8 million persons in 1999. However, the region’s railway employment has shrunk considerably (by nearly 11 per cent) since 1994. The annual trend in railway employment for each subregion and selected countries is summarized in Figure VI.3.

Figure VI.3 Average rates of change in railway employee numbers in the ESCAP region, 1994-1999

Significant staff attrition took place in North and Central Asia, where the workforces of the railways of Azerbaijan and the Russian Federation were cut by an average of 8.1 and 5.8 per cent per year respectively during the five-year period 1995-2000. Large reductions were also realized recently in Australia, where three of the six former government-owned railway organizations were transferred to private ownership and operation. By contrast, the slowest workforce reductions occurred in South and South-west Asia, especially in India, where the railway workforce barely declined (-0.3 per cent per year) over five years.
In only five cases are railway staff numbers reported to have risen: in Georgia, by 2.1 per cent per year; in Hong Kong, China by 5.6 per cent per year; in Myanmar by 0.7 per cent per year; and in Mongolia by 0.7 per cent per year.

In 1999, just three railway organizations within three countries, China, India and the Russian Federation, accounted for nearly 90 per cent of all railway employment within the region. It is to be noted, however, that the railway workforces of these countries include substantial numbers of employees who are engaged in essentially non-railway activities, such as the operation of railway-owned hospitals, schools, and community facilities.

### 4. Locomotive fleets

The locomotive fleets considered here include all types of locomotives (main line and shunting, electric, diesel-electric, diesel-hydraulic and in a small number of cases, steam) in the serviceable fleets of all 47 railway operating organizations of the region. The trend in the size of locomotive fleets, by subregion, may be observed in Figure VI.4.

**Figure VI.4 Trend in the size of locomotive fleets in the ESCAP region, 1994-1999**

![Graph showing the trend in the size of locomotive fleets in the ESCAP region, 1994-1999](image)


During the five-year period 1994-1999, the overall number of locomotives in the fleets of the region grew by about 2 per cent (from 40,300 to 40,900 units). However, the only substantial increase in fleet size occurred in East and North-east Asia, where 1,093 locomotives were added to the fleet of Chinese Railways, representing a fleet expansion of nearly 8 per cent. The expansion of the route network in China during the same period is likely to have been the main factor explaining this increase in locomotive numbers.

For most of the remainder of the region, locomotive fleets contracted, possibly as a result of improved utilization, which may have allowed the accelerated retirement of life-expired locomotives. The largest fleet reduction appears to have occurred in India, where the fleet at the end of 1999/2000 was smaller by 414 units than it was in 1994/1995. This reduction appears to have coincided with the withdrawal of the last remaining steam locomotives (in all, about 350 units) from operation on the Indian system. In Australia, overall locomotive fleet size seems to have decreased by about 280 units (or 18 per cent), but this may reflect the closure of branchlines as well as improved fleet utilization.
5. Freight wagon fleets

The size of the consolidated wagon fleets of the region fell by nearly 15 per cent (from 1.88 million to 1.61 million units) over the five-year period 1994-1999 (Figure VI.5). In only one subregion, East and North-east Asia, did the wagon fleet expand, owing to the significant growth in China, where wagon numbers grew by 17 per cent from 373,233 to 437,686 units. This growth was possibly also a reflection of the substantial route expansion which has occurred in that country.

![Figure VI.5 Trend in the size of freight wagon fleets in the ESCAP region, 1994-1999](image)

This reduction seems to indicate that the enforcement of operational improvements such as time-tabling improvements, faster maintenance turnarounds or increased block train running, has resulted in improved freight rolling-stock fleet utilization, with a related effect on wagon fleet sizes. It seems that further improvement could still take place.

6. Passenger coach fleets

The passenger coaching stock of the region comprises powered and unpowered diesel multiple unit and electric multiple unit vehicles, in addition to locomotive-hauled carriages. In assessing the fleet sizes of passenger coaches, an effort was made to exclude coaching stock used exclusively on suburban rail services, as these should typically be considered to belong to urban transport activities. However, it has not always been possible to extract all data accurately, as it is possible that the data for some fleets may still include such vehicles.

Between 1994 and 1999, the overall size of the passenger coach fleets of the region fell by 5 per cent, from 149,000 to 141,000 units (Figure VI.6). Notable exceptions to this negative trend were:

- East and North-east Asia (where the fleet of Chinese Railways increased by 5,900 units, or 20 per cent);
- South-east Asia (where the fleets of Myanmar and Thailand grew by 12 to 13 per cent);
Japan (where 632 units were added to the fleet, for an overall increase of 5 per cent);

- New Zealand (where the coaching stock grew by 40 units, or 34 per cent).

By contrast, large fleet reductions were achieved in Australia, where new private operators are understood to have cut some long-distance passenger services, and in North and Central Asia, where there is no obvious explanation for the apparent substantial contraction of passenger fleets.

Figure VI.6 Trend in the size of passenger coach fleets in the ESCAP region, 1994-1999


C. Railway traffic trends

This section contains an assessment of the trends in the freight tonnage, ton-km, and average freight haul as well as the passenger numbers and passenger-km for 46 of the region’s 47 railway operating organizations or systems.

1. Railway freight traffic: net tons

An estimated 3.6 billion tons of freight traffic was carried by the region’s railways in 1999. This was almost unchanged from the tonnage carried in 1994 (Figure VI.7). Declining freight tonnages in the Russian Federation, as well as stagnant rail freight demand in China appear to have contributed most to this result.

By contrast, Georgia (+28.6 per cent per year), Kyrgyzstan (+25.3 per cent per year), Armenia (+10.2 per cent per year), New Zealand (+9.6 per cent per year), and Australia (+5.2 per cent per year) all appear to have registered significant increases in their rail freight tonnages over the five-year period from 1994 to 1999. In addition, Indonesia recorded an average annual increase of 3.7 per cent in its railway freight volume, despite the adverse effects of the Asian economic crisis, but it is likely that this result was mostly due to the movement of export coal on the South Sumatra railway system.

In 1999, just three countries, China, India and the Russian Federation, accounted for about 80 per cent of the region’s overall rail freight tonnage.
2. Railway freight traffic: net ton-kilometres

A net ton-kilometre (ton-km) represents one net ton of freight transported for one kilometre. A “net-ton”, as distinct from a “gross ton” includes the weight of the freight consignment and its packaging, but excludes the weight of the railway wagon. When aggregated across a railway system, the statistics “net ton-kilometre” provides a measure of the work done by the system, or the task of the railway system, in moving freight traffic.

Details of the freight traffic task, expressed in net ton-km, of all railway systems in the region were obtained, except for those of Australia and the Democratic People’s Republic of Korea. Between 1994 and 1999, the overall railway freight traffic task of the region is estimated to have declined at a rate averaging 1.5 per cent per year, from 2.98 to 2.76 trillion net ton-km. It should be borne in mind that these figures exclude the rail freight traffic task of Australia, which, owing to its growing freight tonnage and long freight hauls, could possibly be expected to add significantly to the regional estimate.

The trend in the freight traffic task by subregion is given in Figure VI.8. The fastest decline (-3.9 per cent per year) was registered in North and Central Asia, where the freight traffic task of the Russian Federation alone declined at an average rate of 3.4 per cent per year. As is the case with freight tonnage, the freight ton-km for East and North-east Asia (and for China in particular) showed little change over the five-year period of the review, suggesting that both the tonnage and the average length of haul remained constant between the beginning and the end reference years of the review. The freight tasks of South and South-west Asia and of South-east Asia appear to have grown at moderate rates (2.3 and 1.6 per cent per year respectively), but in the case of these subregions, the rate of growth in their freight traffic tasks was exceeded by that of their freight tonnages. This is reflected in a declining average haul distance over the period.

Figure VI.7 Trend in railway freight tonnages in the ESCAP region, 1994-1999

3. Railway freight traffic: average freight haul distances

The average distance over which rail freight traffic moves is one of the indicators of the financial viability of the rail freight business. It is widely accepted that average freight hauls of less than about 300 km are unlikely to generate sufficient net revenue to be able to offset fixed costs, unless they involve regular high tonnage shipments (of the type which can be generated in the region by container feeder train movement between ports and inland terminals).

Railway freight haul distances are getting shorter, as may be seen by subregion and country. Figure VI.9 shows the trends in average freight haul distances over the five year period 1994-1999. Within the region, rail freight was hauled an average distance of 758 km in 1999 (down from 818 km in 1994). In the East and North-east Asia subregion, average freight haul distances appeared to be little changed (at about 785 km) between 1994 and 1999, but in the case of every other subregion they appear to have declined. In the case of South-east Asia and New Zealand, average freight hauls appear to be less than 300 km.

4. Railway passenger traffic: number of passengers

The basic passenger traffic indicator is the number of passengers or passenger trips handled in any given period. The data presented here were intended to cover only trips on medium- to long-distance services, but the practical difficulties of excluding commuter trips, when many of the region’s railway organizations are providing integrated services, proved insurmountable. As a result, the data for many countries are known to encompass all passenger trips, irrespective of distance. The rail passenger growth trends are given by country in Figure VI.10.

Figure VI.10 Trend in passenger numbers in the ESCAP region, 1994-1999

For the region, the total number of rail passengers per year is estimated at about 17.9 billion. Between 1995 and 2000, the annual number of passengers appeared to grow marginally (by only 0.1 per cent per year). Subregions and countries which registered moderate to high passenger growth throughout this period were:

- South and South-west Asia, where the number of rail passengers grew by 2.2 per cent per year, with India alone registering growth of 2.4 per cent per year);
- New Zealand, where the private rail operator, Tranzrail, appears to have succeeded in boosting the use of its passenger services by about 5 per cent per year, although it is likely that much of this growth was focused on commuter services in Auckland and Wellington.

In East and North-east Asia, South-east Asia, North and Central Asia, and Japan, the number of rail passengers grew either at marginally positive or marginally negative rates. In
Australia, however, passenger trip growth was clearly negative, due to some extent to network contraction and almost certainly also to intensive modal competition.

In the case of South-east Asia, only Indonesia registered strongly positive growth in passenger numbers, at 6.5 per cent per year; this was possibly the result of maintenance of the Indonesian Government’s cheap fare policy for economy class rail travel. Cambodia and Thailand, on the other hand, appear not to have fared as well during the Asian economic crisis, with passenger numbers dropping at the rate of 16 and 6 per cent per year respectively.

5. Railway passenger traffic: passenger-kilometres

Details of the passenger-kilometres (pax-km) of all railway systems in the region were obtained, except for those of Australia, the Democratic People’s Republic of Korea, and New Zealand. Excluding these three systems, the total pax-km task of the region was estimated at 1.31 trillion in 1999/2000, up from 1.29 million in 1994/1995 (a marginal increase of 0.3 per cent per year). Throughout much of the region, the rail passenger task is declining, especially in North and Central Asia, where over the five-year period reviewed, it appears to have contracted at the rate of 6.7 per cent per year. The task of Russian Railways alone dropped by about 6 per cent per year over this period.

The only subregions to have registered increases in their rail passenger tasks were South and South-west Asia (+4.3 per cent per year) and East and North-east Asia (+0.4 per cent per year). However, in the case of South and South-west Asia, only India (+4.8 per cent per year) and Pakistan (+1.6 per cent per year) registered positive rates of growth in their rail passenger tasks. The relevant growth rates, by subregion, are shown in Figure VI.11.

**Figure VI.11 Trend in passenger-kilometres in the ESCAP region, 1994-1999**

![Graph showing average annual change in passenger-km [%] for different subregions of the ESCAP region.](image)

D. Railway productivity trends

Unlike previous reviews when detailed information on the utilization and productivity of railway assets was obtained by means of mailed questionnaires, for this review published information had to be used in order to construct only two crude productivity indicators. These indicators were:

- Traffic units per route-kilometre; and
- Traffic units per employee

“Traffic units” (TU) are the summation of net-ton km and passenger-km for each railway system or operating organization. They provide a measure of the total traffic task (freight and passenger combined) for each system.

In combination with the data relating to common railway resources (that is, route, staff and locomotives), they provide indicators of the productivity of those resources.

While locomotive productivity can also theoretically be related to the total traffic task of individual systems, the fact that a significant part of the passenger traffic task of the region is likely to be handled by diesel or electric multiple units, made it difficult to identify the proportion of the passenger task which is locomotive-hauled. Thus, it was not possible to estimate locomotive productivity for this review.

Two important features of railway productivity indicators are that: (a) the size of any given indicator will vary within a wide range from the most productive to the least productive railway system, and (b) route productivity can vary considerably from one year to the next, simply because the rail route utilized may not be varied in line with traffic growth or decline (unlike railway staff and, to a lesser extent, locomotives). It must also be borne in mind that absolute route productivity levels are much influenced by system characteristics, such as the proportion of double-tracked route within the total route length.

1. Trend in railway route productivity

Railway route productivity declined considerably throughout the region during the five-year interval 1994-1999, as may be observed in Figure VI.12. For the region as a whole, route productivity declined by 1.3 per cent per year, from 12.4 to 11.7 million TU per route-km. Only South and South-west Asia were able to improve their route productivity over the period reviewed, with India contributing the fastest rate of improvement (by 3.8 per cent per year, from 9.1 to 10.9 million TU), as a result of little network expansion and moderate traffic growth over this period. China, on the other hand, did not attract significant traffic volumes on par with its high rate of network expansion during the past five years, although Chinese Railways nevertheless achieved by far the highest route productivity of any country in the region (25 million TU per route-km).
2. Trend in railway employee productivity

The railways of the region have considerable scope to achieve improved employee productivity. On the whole, employee productivity is low compared to that of European and North American railways but this is explained by the fact that, as indicated earlier (Section VI.B.3), some railways still employ substantial numbers of employees in non-railway activities. Nevertheless, railway employment in the region is in a state of readjustment, and over the past five years it is apparent that for most of the region’s railways which have experienced a shrinking traffic task, the decline in their staff numbers has exceeded that of the traffic task.

For the region as a whole, employee productivity grew from 0.557 million TU per employee in 1994 to 0.595 million TU per employee (an increase of 1.4 per cent per year), as may be observed in Figure VI.13. Again, the fastest productivity growth occurred in South and South-west Asia (+4.2 per cent per year), where most countries achieved healthy rates of growth. The lowest rate of employee productivity growth occurred in Japan (+0.7 per cent per year) which already achieves by far the highest labour productivity of any country or subregion.

In 1999, railway employee productivity ranged from a low of 0.326 million TU per employee (in South-east Asia) to a high of 1.480 million TU per employee (in Japan).
The value of selected development projects identified either as currently in progress or planned for commencement in the region during the period 2001-2006 is about US$ 73 billion, of which China alone accounts for US$ 45 billion (62 per cent). The following section provide details, by country, of the major railway infrastructure projects identified in the course of preparation of this review document. The list (Table VI.1) is far from being exhaustive, but does provide some indication of the sheer magnitude of the investment required for some projects. The large number of projects aimed at railway infrastructure development across the region shows that many governments are aware of the inherent strength of the railways as a safe, environmentally-friendly and technologically innovative mode of transport.

**E. Selected railway infrastructure development projects**

The value of selected development projects identified either as currently in progress or planned for commencement in the region during the period 2001-2006 is about US$ 73 billion, of which China alone accounts for US$ 45 billion (62 per cent). The following section provide details, by country, of the major railway infrastructure projects identified in the course of preparation of this review document. The list (Table VI.1) is far from being exhaustive, but does provide some indication of the sheer magnitude of the investment required for some projects. The large number of projects aimed at railway infrastructure development across the region shows that many governments are aware of the inherent strength of the railways as a safe, environmentally-friendly and technologically innovative mode of transport.
Table VI.1  Selected railway infrastructure development projects in the ESCAP region (status as of 2001)

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<tr>
<th>Country/Region</th>
<th>Selected railway investment projects</th>
<th>Status</th>
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<tr>
<td>Australia</td>
<td>Railway route upgrading and electrification works in progress:</td>
<td>In progress</td>
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<td>In the Australian network these have a combined value of about US$ 400 million. The largest single project currently under way is the track upgrading and resignalling of part of the North Queensland trunk line between Rockhampton and Townsville, at a cost of $A 240 million, or US$ 122.4 million. Only one non-urban electrification project, involving wiring of the 25 km Kiama-Dapto line in New South Wales (at a total cost of US$ 11 million) is included among the projects in progress, most of which are scheduled for completion by 2002. All of these projects are being funded internally by the responsible railway systems or infrastructure owning or management organizations.</td>
<td>Planned</td>
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<td>Construction of two major new line projects (to begin before 2005):</td>
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<td>■ The 1,420 km Darwin-Alice Springs Railway, construction of which is finally to get under way in the second quarter of 2001, after more than 20 years in planning. This project, with a cost estimated at $A 1.24 billion, or about US$ 632 million, is being built under a 50 year BOOT (Build-Own-Operate-Transfer) concession. The concessionaire, Asia Pacific Transportation Consortium (composed of Australian and foreign investors) will raise debt and equity of $A 750 million, which will be supplemented by grants from the Federal, South Australian and Northern Territory governments, totalling A$ 485 million. At the end of the concession period, ownership of the line will revert to the AustralAsia Railway Corporation, established jointly by the Northern Territory and South Australian Governments. When completed in early 2004, the line is expected to be used by double-stack container trains with an axle loading of up to 23 tons and average speeds of about 90 km per hour.</td>
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<td>■ An 82 km line between Perth and Mandurah to serve industrial areas in the southwest of Western Australia, including the Kwinana oil refinery. Construction of this line, which is expected to cost about A$ 940 million, or US$ 479 million, is likely to proceed before 2005, once financing issues have been decided.</td>
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<td>A third large investment project, involving the construction of a 300 km very high-speed train route between Sydney and Canberra, at a cost of about US$ 1.79 billion, recently appears to have been abandoned.</td>
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Based on an estimate, within the ninth five-year plan (1996-2000), of 330 billion yuan renminbi (US$ 39.76 billion) for construction of 8,100 route-km of new lines.

### Table VI.1 (continued)

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<tr>
<th>Country/Region</th>
<th>Selected railway investment projects</th>
<th>Status</th>
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</table>
| Bangladesh     | Jamuna River Bridge Railway Link Project:  
|                 | The primary focus of railway network development in Bangladesh is on the connection of the recently completed Bangabandhu Bridge across the Jamuna River to the existing network, at a total cost estimated at US$ 245 million. This project, known as the Jamuna River Bridge Railway Link Project, is being co-financed by the Asian Development Bank, the organization of the petroleum Exporting Countries, and the Governments of Bangladesh, Canada, France and Spain. The project has two components:  
|                 | Construction, at an estimated cost of US$ 151.2 million, of a new dual gauge (1,000/1,676 mm) line between Joydebpur and Jamtoil to link the east and west zones of the Bangladesh Railway across the Bangabandhu Bridge;  
|                 | Conversion of existing broad gauge lines between Jamtoil and Ishurdi (66 km) and between Ishurdi and Parbatipur (174 km) to dual gauge, at an estimated cost of US$ 93.3 million.  
|                 | Construction work on these components is well advanced, and is expected to be completed before the end of 2001.  
|                 | Extension of broad gauge to Chittagong:  
|                 | There is a longer-term proposal for the extension of the broad gauge to Chittagong, by dual-gauging one existing metre-gauge running line and adding a broad gauge line to existing single line sections between Tongi and Chittagong. This proposal is still under consideration by the Government of Bangladesh. | Completed/In progress |
| China           | Projects in progress estimated at US$ 14.9 billion:  
|                 | As indicated earlier, nearly 5,000 route-kilometres were added to the Chinese railway network between 1994 and 1999. In 1999, a further 3,035 route-km of new railway lines were under construction, not including the significant 970 km Korla-Kashi line in Western China, which was completed in May 1999. The total cost of the new line construction in progress is estimated at about US$ 14.9 billion, the majority of which (about 75 per cent) will be funded by the central government and the remainder by provincial governments.  
|                 | Projects to commence by 2002, estimated at US$ 16.4 billion:  
|                 | New line construction projects expected to commence by 2002 amount to another 3,350 route-km, at an estimated cost of about US$ 16.4 billion.  
|                 | Additional “Jinghu” high speed line Beijing-Shanghai at US$ 12 billion:  
|                 | Not included among these projects is the proposed 1,307 km “Jinghu” high speed passenger line between Beijing and Shanghai. | Completed/In progress |

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33 Based on an estimate, within the ninth five-year plan (1996-2000), of 330 billion yuan renminbi (US$ 39.76 billion) for construction of 8,100 route-km of new lines.
**Excluding the proposed high speed line, new line construction projects fall into three broad categories: (a) new lines in high-density corridors, primarily intended for passenger traffic at the higher end of the speed range; (b) new lines intended to augment capacity in corridors, which have a vital role in supporting economic development; and (c) new lines intended to provide future international connections.**

The overall construction programme therefore has as its main objectives the relief of capacity shortages in the densely trafficked trunk-line network in the eastern part of the country and the further extension of the railway network into the western and south-western provinces, which are currently under-provided with railway infrastructure.

**Electrification and track duplication:**
The other major thrusts of railway infrastructure development in China are electrification to increase speeds, reduce operating costs and expand the capacity of the trunk-line network, as well as track duplication works to increase line capacity in critical areas. In many cases, these developments are undertaken conjointly.

Electrification at 25 kV 50 Hz is currently proceeding on about 5,300 route km, including on a number of important lines in the southwest, such as Chengdu-Kunming and Chengdu-Yangpingguan. These works follow on from the 3,000 route-km electrified during the five-year period 1994-1999.

Track duplication works are in progress on about 3,000 route km, including the 498km Lanzhou-Baoji line, which hitherto has been a bottleneck for traffic feeding onto or off the international route from Lianyungang to Alashenko (on the border with Kazakhstan). This project alone carries a cost estimated at 11.5 billion yuan or US$ 1.38 billion (US$ 2.77 million per km).

**Hong Kong, China:**
**West Rail project (US$ 6.2 billion):**
The Kowloon-Canton Railway (KCR) has embarked on a mega project designed to expand its coverage of the commuter population. This is the West Rail project, which with an estimated cost of HK$ 57.1 billion or US$ 6.62 billion, is currently Hong Kong’s largest civil engineering undertaking. It involves construction of a new commuter rail link of 30.5 km between Nam Cheong in West Kowloon and Tuen Mun in the New Territories. Only 5.6 km of the route will be on the surface with 13.4 km elevated and 11.5 km in tunnel (of which 5.5 km will constitute Hong Kong’s longest transport tunnel). Construction of the West Rail route began in September 1998 and will be completed in December 2003.

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**Table VI.1 (continued)**

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<th>Country/Region</th>
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<tr>
<td>China (continued)</td>
<td>Detailed design work on this project has been completed, but a start on construction of this line, estimated to cost US$ 12 billion, is believed to have been postponed to around 2006, pending decisions to be made about the technology to be employed and the securing by the Government of China of the necessary foreign funding support. The proposed line is designed for operation at a top-speed of 350 km per hour.</td>
<td>Planned</td>
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<td>Excluding the proposed high speed line, new line construction projects fall into three broad categories: (a) new lines in high-density corridors, primarily intended for passenger traffic at the higher end of the speed range; (b) new lines intended to augment capacity in corridors, which have a vital role in supporting economic development; and (c) new lines intended to provide future international connections.</td>
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<td>The overall construction programme therefore has as its main objectives the relief of capacity shortages in the densely trafficked trunk-line network in the eastern part of the country and the further extension of the railway network into the western and south-western provinces, which are currently under-provided with railway infrastructure.</td>
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<td><strong>Electrification and track duplication:</strong> The other major thrusts of railway infrastructure development in China are electrification to increase speeds, reduce operating costs and expand the capacity of the trunk-line network, as well as track duplication works to increase line capacity in critical areas. In many cases, these developments are undertaken conjointly.</td>
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<td><strong>Hong Kong, China:</strong> The Kowloon-Canton Railway (KCR) has embarked on a mega project designed to expand its coverage of the commuter population. This is the West Rail project, which with an estimated cost of HK$ 57.1 billion or US$ 6.62 billion, is currently Hong Kong’s largest civil engineering undertaking. It involves construction of a new commuter rail link of 30.5 km between Nam Cheong in West Kowloon and Tuen Mun in the New Territories. Only 5.6 km of the route will be on the surface with 13.4 km elevated and 11.5 km in tunnel (of which 5.5 km will constitute Hong Kong’s longest transport tunnel). Construction of the West Rail route began in September 1998 and will be completed in December 2003.</td>
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<tr>
<td>China (continued)</td>
<td>Extensions to the existing East Line:</td>
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<td>In addition, KCR is building three short extensions to its existing East Line, in order to provide direct connections with the East Tsim Sha Tsui ferry terminal (at the southern end of the line) as well as to Lok Ma Chau on the Shenzhen border (at the northern end). These extensions will be brought into service in 2004.</td>
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<td>India</td>
<td>Network development priorities of the Indian Railways include:</td>
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<td>- Electrification of the remaining high density routes still operated with diesel traction. During the eighth plan, which ended in 1997, a total of 2,708 route-km was electrified. Against a target established for the ninth plan (1997-2002) of 2,300 route-km, by March 2001 approximately 1,800 route-km of new electrification had been completed, leaving 500 km remaining for completion within a budget of Rs. 3.255 billion, or US$ 69 million. If electrification continues at the rate of about 500 km per year, an investment of US$ 345 million would be required over the next five years.</td>
<td>Completed</td>
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<td>- Track doubling: Especially within the heavily congested northern part of the network. This work is proceeding at the rate of about 300 km per year at a cost of about US$ 2.34 million per km. Track doubling of 1,500 km would require an investment outlay over the next five years of about US$ 3.5 billion.</td>
<td>Planned</td>
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<td>- Gauge conversion: Between 1992 and 1997, a route-length of 6,900 km was converted from metre gauge to broad gauge (1.676 mm) against a target for the 8th Five Year Plan of 6,000 km. Within the current 9th plan (1997-2002), a length of 2,080 km has thus far been gauge converted and within the current financial year a sum of Rs. 6 billion (US$ 128 million) has been allocated for the conversion of about 690 route-km (or about US$ 186,000 per km). Gauge conversion of about 3,450 km over the next 5 years would therefore require a total investment of about US$ 642 million.</td>
<td>Planned</td>
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<td>- New line construction. It is understood that new line projects either under construction or planned for construction within the next five years will require an investment of about US$ 4.3 billion.</td>
<td>In progress</td>
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<td>All of the above projects are being financed by IR from internally generated funds.</td>
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<td>Korean Peninsular</td>
<td>Border rail link between Munsan and Jangdan:</td>
<td>In progress</td>
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<td>During 2000, following an historic summit meeting between the leaders of the Democratic People’s Republic of Korea and the Republic of Korea, a start was made on restoration of the 24 km cross border rail link between Munsan and Jangdan. This project, with a cost of 28.08 billion Won (about US$ 22 million), is to be the first phase of a programme which will also involve rehabilitation, double-tracking and electrification of the 411 km Gaesun-Shineuizou line in the Democratic People’s Republic.</td>
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<tr>
<td>Korean Peninsular</td>
<td>The first phase is being financed from the South and North Economic Cooperation Fund, while it is planned to seek international consortium funding for the cost of the second phase (rehabilitation of the Gaesun-Shineuzou line), estimated at US$ 4 billion.</td>
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<tr>
<td>Kyrgyzstan</td>
<td>Railway links between Uzbekistan, Kazakhstan, Kyrgyzstan and China:</td>
<td>Planned</td>
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<td></td>
<td>An international railway connection is being planned to link Uzbekistan and Kazakhstan with China, via the territory of Kyrgyzstan. The European Union is financing feasibility studies of two lines. One of these would proceed from the Kyrgyzstan/Uzbekistan border at Jalal-Abad, through Kazarman and the Kyrgyzstan/China border post at Torugart, to connect with the recently constructed Korla-Kashi line through the Xinjiang Autonomous Region of China. The second line would provide a connection from the Kazakhstan/Kyrgyzstan border, through the Kyrgyzstan capital, Bishkek, to join the line to China via Torugart, at Kazarman. The total route length of these connections would be 535 km and construction of the single track line would have to proceed through mountainous terrain, imposing a cost initially estimated in the range of US$ 1.5-2.0 billion (i.e. US$ 2.8-3.7 million per kilometre). Since the connection with Kazakhstan would also serve coal reserves to be mined at Kara-Keche in northeastern Kyrgyzstan, the government of Kyrgyzstan is hopeful of attracting private finance to the extent of US$ 650 million for the project.</td>
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<tr>
<td>Malaysia</td>
<td>Upgrading the Kuala Lumpur-Butterworth mainline (Rawang-Ipoh section):</td>
<td>In progress</td>
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<td>In December 2000, work commenced on the double-tracking, electrification and re-signalling of the 175 km Rawang-Ipoh section of the Kuala Lumpur-Butterworth mainline. This project has an estimated cost of US$ 947 million (US$ 526 for civil and trackworks and US$ 421 for electrification and re-signalling). It is being funded by the government of Japan under the Miyazawa Initiative, intended to assist the countries of South-east Asia affected by the Asian economic crisis of 1997/98. The objectives of the project are to provide for extension of electric commuter train services to Tanjung Malim and to permit introduction of rapid (160km/hour) electric passenger train services between Kuala Lumpur and Ipoh. Railway link between port at Tanjung Pelepas with Pelabauhan: Another significant railway development project currently being undertaken by the government of Malaysia involves construction of a 31.5 km single track line linking the new private sector-managed port at Tanjung Pelepas with Pelabauhan, near Johor Bharu. This project, which is being funded by the government of Malaysia under the seventh Malaysia Plan, commenced in July 1999 and is scheduled for completion in January 2002.</td>
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<th>Country/Region</th>
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<tr>
<td>Myanmar</td>
<td>Network expanded by 40 per cent since 1989: Prior to 1989, the network of Myanma Railways consisted of only 3,180 route kilometres. Since 1989, the network has been expanded by 40 per cent, with nearly 1,300 km of new line being opened for traffic, some 800 km of which appears to have been built within the last five years (most of it presumably before the onset of the Asian economic crisis in 1997/98). The use of less restrictive gradient (2 per cent) and curvature specifications, and of low cost construction techniques, has to some extent minimized the cost of this network expansion. Even so, it is estimated that the equivalent of US$ 540 million must have been committed to the 1,300 km of new line built since 1989. Completing connections to the borders with India and China: Since Myanma Railways appears to have ambitious plans to commence construction of another 1,375 km in the near future, a requirement for an internally generated investment fund of about US$ 570 million might be envisaged to support construction over the next 10 years. It is expected that much of the planned construction will be aimed at completing connections to the borders with India (at Tamu) and China (at Mu-se).</td>
<td>Completed</td>
</tr>
<tr>
<td>Republic of Korea</td>
<td>The largest single transport infrastructure project undertaken to date in the Republic of Korea involves construction of the Seoul-Busan High Speed Railway. The project, with a total cost estimated at 18.44 trillion won (US$ 1.43 billion), is proceeding in two phases. The first phase, involving the construction of a 292 km high speed line between Seoul and Daegu, upgrading and electrification of the Daegu-Busan line, and improvement of stations at Taejon, Daegu and Busan, is scheduled for completion in April 2004, at a cost of 12.74 trillion won (US$ 989.0 million). It will be followed by a second phase, involving construction of a 118 km high speed line from Daegu to Busan, via Kyungju at a cost estimated at 5.70 trillion won (US$ 442.4 million), which is scheduled to commence in 2004 for completion in 2010. Funding for this project is split between the Government – 45 per cent – and the Korea High Speed Rail Construction Authority (KHRCA) – 55 per cent – with the government portion being used to finance civil works and the KHRCA portion to finance trackwork, signalling and rolling stock. The government contribution is being provided through subsidies and loans, while local currency bonds, offshore finance and domestic private capital sources will make up the KHRCA contribution. The exposure of offshore finance is limited to just 24 per cent of the project’s total capital. The high speed rolling stock for the new railway is based on TGV/Eurostar technology, is designed for a maximum speed of 300 km per hour, and will allow travel times between Seoul and Busan of 2 hours 40 minutes after completion of phase one and 1 hour 56 minutes after completion of phase 2.</td>
<td>In progress</td>
</tr>
</tbody>
</table>
Currently underway is the relaying of track in 100 lb rail and concrete sleepers on 148 km of track between Lop Buri and Chumsaeng on the main northern line, and on 141 km of track between Hua Hin and Ban Krut on the main south line, for a total cost estimated at US$ 108 million. This work, being jointly funded respectively by the Japanese OECF – 67 per cent – and the Thai government – 33 per cent – is expected to be complete within 2001. It will be followed by rehabilitation of a further 502 km of mainline track between now and 2005 for a cost of about US$ 224 million.

Prior to the economic crisis, the Thai government had been committed undertaking track duplication (and in the case of two lines, triplication) works on about 234 route-km, mostly within a 100 km radius of Bangkok, with a cost initially estimated at US$ 769.2 million. Work on an initial tranche of 204 route-km is continuing with completion expected within 2001. Work on the remaining 34 km, involving triplication between Hua Mark and Chachoengsao, has been suspended pending completion of a “Track Duplication Masterplan” commissioned by the State Railway of Thailand amid concern that track duplication on some lines might not be justified in view of the relatively high construction cost and low percentage rates of existing capacity utilization.

Among other railway development projects being proposed for Thailand before the economic crisis were a number of new line construction projects, including the routes Denchai-Chiang Rai, Phuket extension off the southern line, Map Ta Phut-Rayong and Bua Yai – Roi Et – Mukdahan – Nakhon Phanom. These projects have been placed in suspension pending a review by the new Thai government of its capital expenditure priorities.

Construction of a new 530 km line to link the capital, Ashgabat, with Tashauz near the border with Uzbekistan was started in April 2000. This project, with an estimated cost of US$ 1.5 billion (or US$ 2.8 million per km), is scheduled for completion by 2005.