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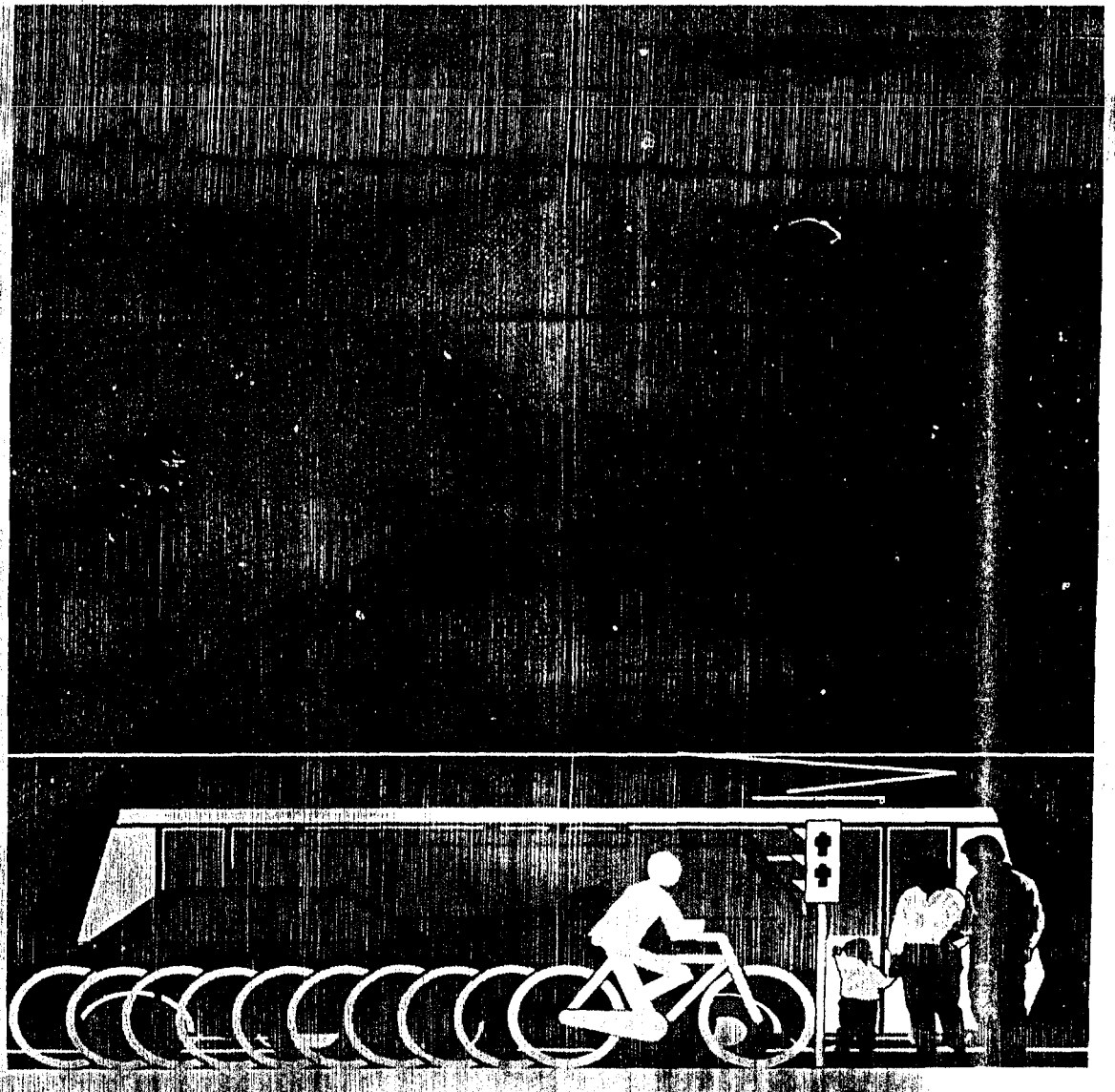
Urban Transport in Asia

An Operational Agenda for the 1990s

Peter Midgley



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Peter Midgley

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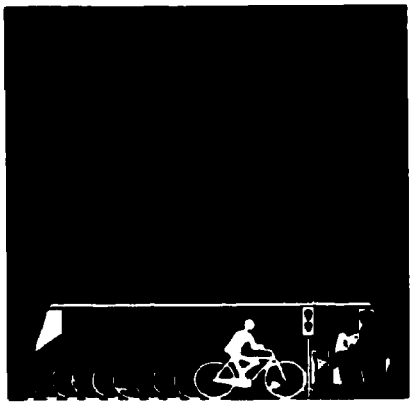

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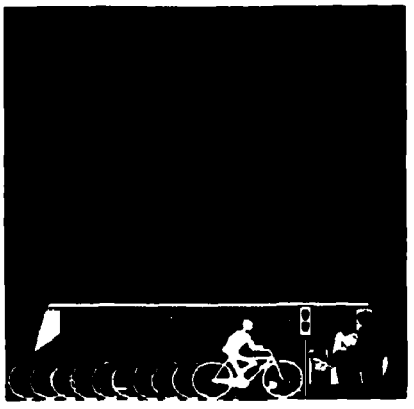

Foreword

This report, prepared by the Asia Technical Department, diagnoses Asia's urban transport problems and outlines a corresponding agenda for Bank lending and technical assistance activities. This work should be placed in the wider perspective of the Bank's 20 year involvement with urban transport projects in developing countries. It is of particular importance to relate it to the Bank's 1986 *Urban Transport Policy Study*, the most recent statement of basic principles which underlie Bank interventions in this field. The current paper can be seen as a continent-specific application of those principles, enriched and modified by the subsequent internal and external research. If the Asian example is followed by other regional departments in the Bank, one could expect in the second half of the decade anew statement of Bank urban transport policies.

The Asian continent provides a perfect place to test urban transport policies and strategies. It contains 3 billion people, more than half of the world's population. It is urbanizing at startling rates with much of the urban growth taking place in already large cities. By the turn of the century, the continent will have 13 megacities and 160 cities with populations above one million; nearly half of the continent's population. Poverty remains a problem. Asia has 700 million people living at annual incomes under $370 per capita which represents nearly three quarters of the world's poor. However, absolute poverty in East Asia has decreased form 400 million in 1970 to 180 million in 1990, a decrease of over 50%. In addition, the continent has experienced in the past decade economic growth rates far above anywhere else in the world (6.3% in East Asia and 3.1% in South Asia), with several countries achieving double-digit rates.

Like the 1986 Policy Study, this report strongly focusses on efficiency. Urban areas are conceived primarily as economic mechanisms, responsible for and increasing share of the countries' national product. It is therefore of utmost importance to ensure efficiency in both traffic flow and the provision of public transport services. The report goes beyond the Policy Study in urging the introduction of urban road user charges to achieve short-term traffic efficiency and generate funds for expansion of capacity. Similarly, the current report retains, strengthens and extends the case for private sector involvement in urban transport in speaking of ownership of bus operations or the build-operate-transfer approach to major urban roads and mass transit systems.

This report explores new areas that the Policy Study did not examine. First, cities are seen in explicit environmental terms, where transport problems strongly impact on air and water quality, noise and other aspects of the living ambient. Second, the poverty aspect of urban transport is explicitly discussed in the walking and non-motorized transport modes. The report calls for a sharper focus of the Bank's research and project work on these modes.

Finally, large-scale urban public transport systems constitute an area where this report diverges from the Policy Study. Without abandoning the efficiency objective, the report has a more positive attitude towards such modes as urban rail rapid transit (metros) and the light-rail systems. This is due to a better understanding of advantages enjoyed by pub-

lic transport modes which operate on separate or protected rights-of way, whatever the guidance and propulsion technology of vehicles. It has been recognized that an urban transport strategy based on a combination of traffic management methods and public transport modes operating in mixed traffic cannot be expected to cope alone with problems on a scale experienced today in many cities. This paper sees these modes as high potential candidates for investment agendas in very large and highly congested cities in Asia. The testing ground of ideas expressed in this report will be the World Bank lending program in this sector

Daniel Ritchie
Director
Asia Technical Department
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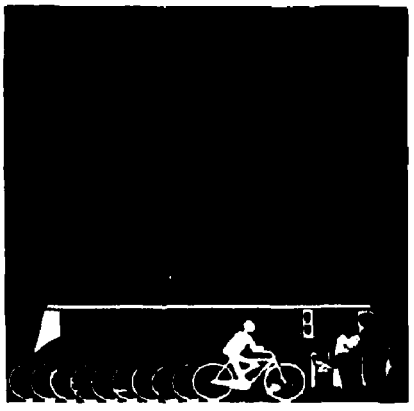
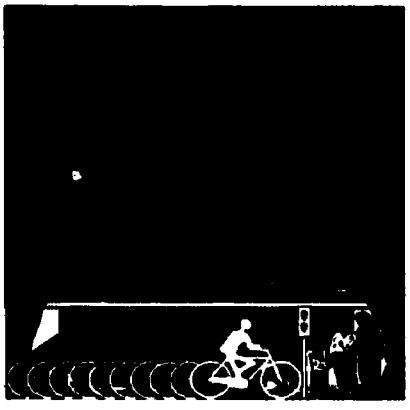


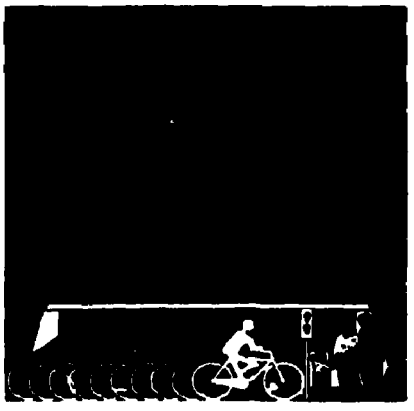
Acronyms and abbreviations

ADB	Asian Development Bank
AGT	Automated Guided Transit
ALS	Area Licensing Scheme
ARF	Additional Registration Fee (in Singapore)
ASTIN	Asia Technical Department Infrastructure Division (of the World Bank)
ATC	Area Traffic Control
AVI	Automatic Vehicle Detection
BECL	Bangkok Expressway Company Ltd.
BOT	Build, Operate and Transfer
CDB	Central Business District
CMB	China Motor Bus (in Hong Kong)
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO2	Carbon Dioxide
Db	Decibel
DOH	Department of Highways (Thailand)
EPA	Environmental Protection Agency (of the US Government)
ERP	Electronic Road Pricing
ESCAP	Economic and Social Commission for Asia and the Pacific
ETA	Expressway and Rapid Transit Authority of Thailand
FES	First Stage Expressway (Bangkok)
GDP	Gross Domestic Product
GNP	Gross National Product
GRP	Gross Regional Product
GRT	Guided Rapid Transit
HC	Hydrocarbons
IFC	International Finance Corporation (of the World Bank)
INUTD	Infrastructure and Urban Development Department Transport Division (of the World Bank)
JICA	Japan International Cooperation Agency
KCR	Kowloon Canton Railway (Hong Kong)
KMB	Kowloon Motor Bus (in Hong Kong)
LRT	Light Rail Transit
mpg	miles per gallon
MRR	Middle Ring Road (in Kuala Lumpur)
MRT	Mass Rapid Transit
MTR	Mass Transit Railway (Hong Kong)
NMV	Non-motorized vehicle
NOx	Nitrogen Oxides
ODA	Official Development Assistance
OECD	Organization for Economic Cooperation and Development
OECF	Overseas Economic Cooperation Fund (of Japan)
Pb	Lead
PM	Particulate Matter
PRE	Policy, Research and External Affairs department (of the World Bank)
SEATAC	Southeast Asian Agency for Regional Transport and Communications Development
SBS	Singapore Bus Services
SPURT	Seventh Plan Urban and Regional Transport study (in Thailand)
TIBS	Trans-Island Bus Services (in Singapore)
TRB	Transportation Research Board
TRRL	Transport and Road Research Laboratory
UNDP	United Nations Development Program
WDR	World Development Report



Abstract

The extent to which Asian cities meet the challenges of urbanization and contribute to macroeconomic performance will, to a large extent, depend on how efficiently they can transport the goods, services, information and people upon which their economic activities depend. The intrinsic development of the urban transport sector and its response to the pace, scale and nature of urbanization and economic development in the 1990s will determine to a large extent the nature and form of Asian cities in the early twenty first century. The performance of the urban transport sector in Asia in the 1980's has been mixed. It is clear that the demands on the sector will be even greater in the 1990s and that new approaches are needed to rectify the issues inherited from the past and meet the following challenges of the future. These challenges are unique in their scope, scale and pace of change and require a response which is tailor made to the region. The paper presents new approaches for the transport sector, the implications of these actions for World Bank operation and the role of agencies in ensuring the availability of adequate and timely external aid.



Executive Summary

Part One: Introduction

In terms of economic growth, Asia is undoubtedly the most dynamic region in the world today. The impressive performance of Asia in terms of economic development and the growth in population is causing the region to grapple with extremely rapid rates of urbanization. The extent to which Asian cities meet the challenges of urbanization and contribute to macroeconomic performance will, to a large extent, depend on how efficiently they can transport the goods, services, information and people upon which their economic activities depend.

Currently, walking and cycling are often the sole means of gaining access to employment and social services for the urban poor who cannot afford public transport services. Vehicle emissions are increasingly being recognized as the dominant cause of localized air pollution and health problems. And the pressing demands for motorized forms of personal mobility are generating pressures on the road network and resulting in congestion which threatens the sustainability of socio-economic progress.

The intrinsic development of the urban transport sector and its response to the pace, scale and nature of urbanization and economic development in the 1990s will determine to a large extent the nature and form of Asian cities in the early twenty first century.

Part Two: Sector background

In the process of analyzing the urban transport situation in Asia, we were struck by the diversity as well as by the wide range of performance between individual city systems.

Non-motorized transport: Asia has the widest variety of non-motorized forms of transport in the world. They form the backbone of the transport system for the poor in many cities for both personal and goods movements. Bicycles are by far the most numerous. Exact numbers are hard to come by, but it is estimated that there are some 300 million bicycles in China, 66 million in Japan, 45 million in India and six million in Korea. These four countries alone account for more than half of the world's estimated total bicycle population of 800 million.

Motorization: Asia accounts for just over ten percent of the world's automobile population and over 25 percent of the global truck and bus fleet. Within Asia, the majority of these vehicles are in Japan which accounts for 70 percent of the region's automobiles and 62 percent of trucks and buses. Motor cycles are increasing in numbers throughout the region as people strive for cheaper and more usable alternatives to the motor car for urban personal mobility. For some, the motorcycle is a logical progression from the bicycle and for others it offers a faster alternative to slow and crowded buses.

Vehicle ownership restraints: Most developing countries in Asia have some form of deterrent to vehicle ownership. High import duties, registration fees, excise taxes and road user charges are the main forms currently in use. Such restraints also form a ready source of tax revenue and are relatively easy to impose. This was the reason for their introduction. Few Governments have attempted to use control mechanisms to "clamp down" on vehicle ownership. Restricting car ownership is unpopular in any soci-

ety, but in the developing economies of Asia it is seen by politicians as going against the aspirations of the rising middle class and depriving them of one of the most important benefits of development—personal mobility. How to manage rising vehicle ownership and use in urban areas and avoid congestion is a major challenge for Asia in the 1990s.

Traffic congestion: The substantial growth in vehicle fleets is clearly evident in the urban areas throughout the region in the form of increasing traffic congestion. Not only does such congestion promote greater fuel consumption, and the resulting increase in air pollution, but the severe increase in transit times can have substantial impact on economic productivity. Few countries in the region have made a serious effort to reduce congestion and even fewer have succeeded. There is an argument that all major cities suffer from traffic congestion and that traffic will always grow to the same level of congestion independently of the network improvements introduced. It is often said that as no city has found a solution, congestion is a way of life that has to be accepted.

Travel speeds: Peak hour travel speeds average about 16 kilometers per hour in the center of most large cities in the world. Singapore is one of the few large cities in Asia where inner city travel speeds exceed this average and this is because a conscious decision has been taken to manage congestion for the well being of citizens and for the well being of the economy at large.

Environmental impacts: Increasingly, the urban transport sector is generating adverse environmental conditions in many countries in the region. Vehicle emissions are polluting the atmosphere, motorized vehicles are generating intolerable noise levels, traffic accidents are claiming more lives and the road infrastructure being built to accommodate urban traffic is often visually intrusive and blocks access from one community to another. In the battle to combat congestion and increase personal mobility, the environment of Asian cities is paying an increasingly heavy price.

Facilities for road users: Cities in Asia lack adequate road space to accommodate the ever increasing demands for mobility of people and goods. In attempting to provide sufficient capacity for motor vehicles, most cities have sacrificed the needs of pedestrians. Outside of Japan and China, there is no evidence of special facilities for non-motorized vehicles in urban areas in Asia. This is especially surprising given the high concentration of such vehicles in the region. Street lighting, bus stops, bus shelters and bus bays are rarely adequate in low- and middle-income country cities. Often located near junctions and where the sidewalks either no longer exist or are too narrow, bus stops often cannot accommodate the crowds of people waiting for buses. Shelters, when provided, are rudimentary and usually damaged. No provision is made for seating or for the aged and infirm. Rarely are bus stops provided with lighting, timetables or route information.

Expressways and mass transit: In order to overcome the inadequacy of the street network in meeting motorized vehicle demands, seven cities have developed expressway networks (Bangkok, Jakarta, Osaka, Pusan, Seoul, Singapore and Tokyo) and five cities have urban toll road systems (Bangkok, Hong Kong, Jakarta, Osaka and Tokyo). There are 37 mass transit systems carrying 17 million passengers per day in 26 cities in Asia. Over two thirds of these systems are in high-income countries and, somewhat surprisingly given their high capital and operating costs, the bulk of the remainder are in low income countries. Developing countries in Asia are unique in the development of private sector financing of urban transit systems. As many as six mass transit schemes with varying levels of private sector financing and operation are under active consideration in the region (two in Bangkok, one in Manila, one in Karachi and two in Taipei). Although much interest has been expressed in private sector participation, to date no privately financed urban mass transit system is yet operational in Asian developing country cities.

Traffic management and traffic restraint: As an alternative to creating more physical capacity through major investment in urban transport infrastructure, many cities have attempted to make more effective use of existing road space by traffic engineering techniques. Some have attempted to translate these techniques into effective traffic management schemes to reduce demand and/or give priority to moving people rather than vehicles—by providing facilities for high occupancy vehicles such as buses. Unlike traffic management measures, which seek to manage existing traffic flows more effectively, traffic restraint measures seek to discourage the use of cars in order that other road users, especially public transport, pedestrians and goods vehicles may benefit. The main restraint measures in use in Asia are parking controls and area licensing.

Parking and restraint measures: Most cities in Asia control on-street parking with varying degrees of success depending on the level and extent of enforcement applied. Singapore is the only city, probably in the world, with effective traffic restraint measures centered on its famous Area Licensing Scheme (ALS) which was inaugurated in 1975. It is accompanied by strict controls on the amount of parking which business and public agencies may provide there. These measures, coupled with the development of effective bus and mass transit public transport systems, have cut the number of cars entering the restricted zone in the rush hour by three quarters and as a result Singapore is relatively unjammed.

Area licensing: Experience with area licensing, although effective in Singapore, has revealed the need for political consensus and commitment to enforcement which other countries in Asia have found hard to achieve. Attempts to institute area licensing in World Bank projects in the late 1970s in Bangkok and in Kuala Lumpur failed in part due to resistance from the car owning lobby and central area business interests.

Bus operations: Buses form the backbone of urban public transport services throughout Asia with the notable exception of Japan and Australia (where in both countries extensive use is made of rail based urban public transport). Most cities have bus systems which are owned and operated by the public sector but many cities have private sector operations and informal "paratransit" systems operate extensively in most cities in South East Asia.

Bus companies and paratransit: In all cities in China, in the People's Democratic Republic of Korea and in Australia ownership is public. In Hong Kong, Korea, in Malaysia and in Singapore ownership is private. In all other cities ownership is mixed. Data on paratransit operations is incomplete but where it exists it suggests that paratransit is the predominant form of urban public transit in Bangladesh, in Indonesia, in Pakistan, in the Philippines and in Thailand.

Bus services: Throughout the region, the level of service provided by bus operators in developing country cities has continued to deteriorate over time. In the case of public sector operations, companies are frequently observed to be saddled with poor management, operated by labor regulated by restrictive practices, constrained by inadequate financing policies, affected by poor maintenance of vehicles, and unable to provide adequate service frequencies and route networks. Not surprisingly, urban bus services are perceived by most people in Asian cities as being inadequate, overcrowded and unresponsive to demand.

Urban travel patterns: In low-income countries, public transport is the predominant modes of motorized travel in most cities. Buses account for over 60 percent of motorized trips in Bangladesh, China, India and Pakistan. In middle-income countries it would appear that walking and non-motorized modes are less significant than in low-income countries. In most middle-income cities bus use predominates but in some cities such as Seoul, and more recently, Manila and Pusan, rail systems are beginning to take a share of public transport trips. The travel characteristics of large cities in high-income countries are differentiated from such cities in low-and middle-income countries by the use of mass rapid transit and commuter rail systems. Over two-thirds of motorized trips in Osaka and Tokyo are by rail based public transport.

Urban freight: In trying to cope with congestion caused by freight traffic, many cities in the region have instituted "truck bans" which operate by time of day and/or along certain roads or within certain areas of the city. Distribution centers and freight terminals have been built and proposed in many cities to resolve the problem of truck parking.

Traffic laws and enforcement: Traffic laws are rarely enforced in developing country cities in the region. In many cases the laws themselves date back to legislation drawn up in colonial times or are derived from traffic codes in North America, Europe or Japan. Whatever the reason, the laws often do not reflect conditions in developing country cities. Since traffic regulations can only be effective when pedestrians and drivers observe them, they depend on the extent to which the vast majority of people understand them and acknowledge their reasonableness. Their effectiveness also depends on the extent to which they are enforced.

Administration and regulation: Providing for the many and expanding needs of the urban transport is often frustrated by institutional weakness. There are considerable problems involved in managing urban transport services and in coordinating urban transport plans and the provision of urban transport infrastructure. A characteristic of most cities is the very large number of different agencies responsible for the various modes of transport and infrastructure requirements as well as the overall planning and development of the urban transport system. This has

often led to overlapping responsibilities with a resultant lack of clarity as to who does what. There is also evidence of insufficient numbers of trained staff and this has been perceived as a major factor inhibiting the sector's development over the past decade.

Equipment and consultancy services: Outside Europe and North America, the market for urban transport equipment and services in Asia must be one of the largest in the world. From available data it has been possible to tabulate a total of 120,000 vehicles in the bus fleets of 48 of the 101 cities with populations in excess of one million. To this must be added the 1,900 Light Rail Transit (LRT) units and 6,500 Main Rapid Transit (MRT) units identified in the larger cities of the region all of which run on some 1,300 kilometers of electrified double track. Japan alone has 120,000 traffic signals; the total for the region is probably well over one million. The volume and value of trade in the manufacture and supply of equipment and in the provision of consultancy services is, however, not in any way fully documented. It is therefore impossible to assess its extent; it is undoubtedly significant.

Financing: Over the past decade, the growth in traffic has outpaced the rate of investment in urban transport infrastructure and services in most cities throughout the Region. In many cases, both national governments and city authorities have been unable or unwilling to address these needs by mobilizing additional revenues from the sector, either by increasing prices or by reducing subsidies.

Expenditure: Typically, the public sector is involved in financing some or all of the following: urban transport infrastructure, urban public transport equipment and operations, maintenance of urban roads, traffic management and traffic enforcement. In most countries the scale of funding in the sector is quite large. In many countries the distribution of funding is skewed over time, geographically, by city size and/or importance and by sub-sectoral preferences or demands.

Sources of funds: As in most parts of the world, in Asia urban transport investments and operations are financed from taxation, user charges (such as fares), borrowing and private investment. Certain countries in Asia, however, make also make extensive use of the private sector in the provision of urban transport services.

Fare revenues: In most low-income countries public sector bus operations do not recover their expenditures from fares. A major cause of inadequate fare revenue is "leakage," either through passengers simply not paying the fare or through ticket collectors pocketing a proportion of fare revenues. The extent of such fare "leakage" is rarely known, admitted or documented.

Cost recovery: In Korea and in high-income countries such as Hong Kong and Singapore, road based urban public transport is provided by the private sector and fare revenues cover expenditures. Unlike most cities in Asian middle-income developing countries, Korean cities have been able to maintain investment in infrastructure and municipal services at high levels. Much of this due to a strong municipal financial base and effective management of municipal finances and services.

Private sector participation: Cost sharing schemes with participation from the public sector and private developers or the community are being used more and more in some Asian cities to finance urgently needed urban transport infrastructure. The concession arrangements which provided the bulk of urban public transport in developing countries and in developed countries in the past are being revitalized and refurbished in Asia in the form of Build-Operate-Transfer (BOT) schemes as a way of attracting private sector capital, entrepreneurship, management skills and efficiencies into a sector which is unable to develop, modernize and expand under public sector tutelage.

External aid: External aid flowing into the urban transport sector in Asia amounted to some US$ 1.9 billion between 1980 and 1989. Just over two-thirds of this amount was allocated to what are currently defined as low-income countries and the bulk of the remainder to middle-income countries (0.1 percent was allocated to two high income countries—Brunei and Singapore).

Sources of aid: Japan was the main source of development assistance financing in the urban transport sector in Asia between 1980 and 1989 with US$1.1 billion, which represents 59 percent of total aid and 91 percent of all bilateral aid. Other bilateral resources amounting to US$108 million or six percent of the total were provided by Australia, France, Germany and the United Kingdom during the period.

Funding from multilateral agencies in urban transport in Asia amounted to US$657 million or 35 percent of the total for the period 1980 to 1989. The main source of funds was the World Bank Group which provided US$ 603.1 million which represents 32 percent of the total and 92 percent of all multilateral aid.

Aid allocation by sub-sector: The primary allocation of external aid (47 percent of the total) was to urban road infrastructure (for urban road construction, improvement and maintenance). Urban rail investments take second place (accounting for 33 percent). Traffic management (a modest eight percent), technical assistance (seven percent) and bus related activities (a very modest five percent) account for the remainder.

Impact and benefits of aid: Judging by the severe congestion to be found currently in most cities which have benefited from external aid in the 1980s, the first reaction would be to say that the impact has been minimal! However, the total volume of external aid has been very small and the scope of interventions has been very discrete. The total volume of external aid in the sector for the whole of Asia for the ten years between 1980 and 1989 is less than half of total urban transport expenditure of Hong Kong in the ten year period between 1976 and 1985, and a quarter of proposed expenditures on BOT schemes in Bangkok. Rarely has external aid been directed at solving problems throughout the urban transport system in a given city or country. Usually such aid is directed at one or more critical, but nevertheless discrete, components of the system and/or at specific geographic locations within the city. Hence problems not addressed in one part of the system often engulf solutions addressed in another part of the system.

Part Three: Prospects for the 1990s

The performance of the urban transport sector in Asia in the 1980s has been mixed. In city states such as Singapore and Hong Kong it has performed remarkably well in keeping pace with the growth in demand of people and goods. Elsewhere, in low- and middle-income countries alike, conditions have deteriorated. It is clear that the demands on the sector will be even greater in the 1990s and that new approaches are needed to rectify the issues inherited from the past and meet the following challenges of the future:

- enhancing economic productivity: through serving the transport needs of urban business and industry;
- increasing personal mobility: through improving access by all elements of the population to urban services and jobs;
- improving the urban environment: through the provision of environmentally friendly urban transport services and infrastructure which are beneficial to the form of urban growth; and
- ensuring financial viability: through the financing of urban transport services and infrastructure in a way which is affordable to local governments and to all users of the urban transport system.

Economic productivity

Economic productivity is being constrained by congestion and to reduce it will require managing vehicular travel demand (which requires action on vehicle ownership and traffic restraint), increasing passenger carrying capacity (which requires action on public transport and mass transit) and giving greater priority to freight movements.

Vehicular travel demand is a product of motorization and the use of motorized vehicles for trip making. A clearer understanding of motorization trends in Asia and possible control measures is an essential ingredient to managing motorized vehicle use in Asian cities. Managing the use of motorized vehicles and the capacity of the road network within cities can be achieved through traffic management measures. Reducing vehicle demand within congested urban areas involves demand management. With congestion levels so high that they are beginning to impact directly on city productivity, demand management is no longer a theoretical option. It is central to relieving congestion now and in the future and must be firmly placed on the urban transport agenda for cities throughout the region.

Increasing passenger carrying capacity is the realm of public transport and mass transit systems. Improvements in bus operations and the provision of bus priority facilities in the road network can achieve higher passenger carrying capacities in public transport systems. In large cities, where passenger demand is concentrated along corridors serving city centers increased capacity can also be achieved through mass transit systems.

Freight movements are of equal importance as passenger movements to city productivity but the needs of freight are often overlooked in dealing with traffic congestion. Measures to streamline freight transport in cities will need to be considered in the urban transport agenda for Asian cities to serve the goods transport needs of commerce and industry.

Personal mobility

Personal mobility in cities is especially problematic for low-income groups who tend to suffer from poor location and poor access in most countries in the region. The poor are tending to live more and more on the periphery of cities with often tenuous transport links to employment opportunities. Even when such links exist, low-income groups are obliged to walk long distances to reach affordable public transport services which do not penetrate low-income neighborhoods.

Non-motorized vehicles offer a low-cost alternative to low-income groups for personal mobility in many cities in Asia and yet it is clear that the use of non-motorized vehicles is being increasingly marginalized by a variety of factors. How to incorporate non-motorized vehicles as an integral part of the urban transport system is a major challenge in the region in the 1990s. A start is being made in the Bank by undertaking a detailed inventory of NMV needs and opportunities for their development, developing technical guidelines for the management of NMVs in mixed traffic and in urban environments; and undertaking pilot schemes in selected cities to manage NMV movements more effectively and to encourage and expand their use.

Walking is an important mode of transport in all cities and the only form of personal mobility for many of the poor and underprivileged. Few facilities exist for pedestrians and walking space is being progressively eroded by motorized vehicles. This trend needs to be reversed in the 1990s in an effort to substantially improve walking conditions in cities. Pedestrian improvements are needed in large and small cities. In larger cities, such programs need to address the deficiencies of the past as well as plan for the future. In smaller cities, there is greater scope for introducing the foundations for adequate attention (and funding) to the needs of pedestrians now and in the future.

The urban environment

Urban transport has contributed significantly to the deterioration of the urban environment in Asia in most countries throughout the region. Unless measures are taken in the 1990s to redress the degradation which has already occurred and to design urban transport infrastructure and services to be environmentally friendly, the cities of Asia will pay a heavy price in terms of the health and well-being of their citizens.

A World Bank agenda for environmental action in the urban transport sector in Asia is already long overdue. All urban transport projects without exception should be designed to explicitly address environmental issues. In all cities subject to lending operations in the urban transport sector, an environmental stock-taking is needed to assess the extent of adverse environmental impacts resulting from the urban transport sector or prospective actions in it. Cost-effective environmental action plans and improvement programs specifically related to the needs of the sector need to be drawn up and agreed with local authorities.

Within this general framework, actions are needed with regard to the nature and extent of vehicle emissions, to safety and accidents and to community severance, visual intrusion and the need for environmental management.

Financial viability

The magnitude of financial requirements for developing the urban transport sector in low- and middle-income countries in Asia has not been estimated. It undoubtedly exceeds available resources and with central and local governments already strapped for revenues, the search for urban transport financing will not be easy in the 1990s.

Constraints on public sector financing have resulted in innovative approaches to urban transport finance in several countries in the region. These will need to be developed further in the 1990s and will involve making more efficient use of more traditional financing mechanisms such as fares, local taxation, user charges, domestic borrowing and external borrowing as well as exploring further the potential for private investment.

Part Four: Conclusion

The urban transport challenges in Asia are unique in their scope, scale and pace of change. They require a response which is tailor made to the distinctiveness of the region and which recognizes its inherent diversity. This is in itself is a major challenge.

There are three main groups of recommendations which emerge from this analysis which provide a basis for the development of a strategic response to these challenges in the 1990s.

1. the first concerns new approaches which need to be taken in the sector;
2. the second concerns the implications of these actions for World Bank operations; and
3. the third concerns the role of the World Bank and other development agencies in ensuring the

availability of adequate and timely external aid for the development of the sector.

New approaches

In terms of enhancing economic productivity:

Motorization: As vehicle ownership is the driving force in urban areas for stimulating demand and causing congestion, a clearer understanding of trends and possible control measures is essential.

Congestion: Strategies and action plans need to be prepared for each major city to deal with congestion and differentiated according to current and potential levels of congestion.

Mass transit: A clearer understanding of the role of mass transit within the overall transport system is needed along with an assessment of the potential for mass transit to influence urban development. Mass transit technology requires incremental development and more work is needed on how to achieve reductions in capital and operating costs:

Urban freight: In improving goods movements in Asian cities, a comprehensive approach is necessary which recognizes that urban freight handling is first and foremost an inherently private sector activity composed of many closely inter-related elements and that freight movements are just as important as passenger movements.

In terms of increasing personal mobility:

Non-motorized vehicles: (NMVs) are an attractive form of personal mobility in an increasingly environmentally conscious world but their future is dependent on their being treated as an integral part of urban transport systems and on understanding the conditions under which they can be cost-effective relative to (and complimentary to) other modes of transport.

Walking: is an important mode of transport in all cities and the benefits of pedestrian improvement programs accrue to all sections of urban society but especially to low income groups; pedestrian improvements will not alleviate poverty, but they will save lives and reduce the risk of injury and will improve walking conditions for the poor and underprivileged who are too often neglected and treated as second class citizens in urban transport programs.

In terms of improving the urban environment:

Vehicle emissions can be reduced by promoting greater fuel economy, the use of unleaded petrol, cleaner diesel fuel and alternative fuels as well as the introduction of closed loop three-way catalysts and inspection and maintenance programs to ensure that the anticipated benefits of emission control strategies are not lost through poor maintenance or tampering with emission control devices.

Road safety has to be brought to the forefront of the minds of planners and engineers along with the important details of design affecting road safety that might otherwise be overlooked or considered insignificant.

Environmental standards need to be established within cities concerning the scale and type of infrastructure and vehicles and the associated levels of air pollution, noise and speed which can be tolerated within each neighborhood.

In terms of ensuring financial viability:

Traditional financing mechanisms: such as fares, local taxation, user charges, domestic borrowing and external borrowing will need to be used more efficiently.

Private sector financing: efficient mechanisms need to be designed to attract private sector finance to the sector including the use of bond issues, cost sharing schemes, cross subsidy of capital investment from the sale of property development rights, joint venture schemes and build-operate-transfer (BOT) schemes.

World Bank operations

The recommendations concerning actions which need to be taken for the sector to adjust and respond to the challenges of development and growth in the 1990s have several important implications for the nature and composition of the World Banks lending operations.

Urban development context: First, urban transport lending should subscribe to overall urban development objectives and fit with urban development policies within the region and member countries.

Role of urban transport: Second, the role of urban transport in meeting urban development objectives needs to be clearly articulated.

System performance: Third, although lending operations may not finance investments throughout the urban transport system, they need to take account of the performance of the system as a whole in the assessment of costs and benefits. Actions in one part of the urban transport system effect all parts of the system to some extent. A comprehensive view is therefore needed.

A holistic approach: Fourth, a holistic approach is needed in lending operations. Given the issues confronting the urban transport sector in Asia in the 1990s, two approaches are possible. One would center lending operations around the theme of demand management which brings into focus the role of congestion pricing, mass transit and environmental management in relieving congestion, curbing the unrestrained use of motor vehicles and improving personal mobility for the urban poor. The other would center lending operations around the theme of environmental management which brings into focus the role of all elements of the urban transport system in respecting the urban environment in its human, ecological and physical dimensions and in promoting more environmentally appropriate forms of urban growth. Both approaches are interrelated and the emphasis toward one or the other or both would depend on the situation in a given city or country.

Timing: Fifth, urban transport lending must be more responsive in terms of timing. The pace of change in Asia is speeding up and delays in decision making and project execution are proving to be more and more costly in terms of system performance and in terms of the measures needed to rectify problems not dealt with in a timely fashion.

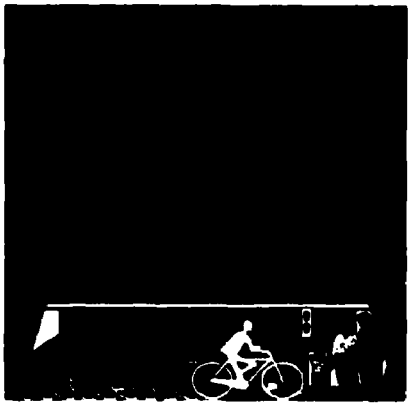
Lending instruments: Finally, new urban transport lending instruments will need to be explored to achieve faster response times and sustainability in the sector. In the past, the World Bank has relied exclusively on project lending to finance investments in the sector. Policy based lending making use of procedures used successfully in sector loans needs to be explored and adapted to the needs for investment in the sector and to the requirements of individual member countries in the regions. A programmatic approach will also need to be developed with regard to lending operations to ensure their sustainability over time in a sector where the real developmental impacts are measured in decades rather than in years. This implies making a long term commitment to the sector and long range programming of staff and resources with expertise in the sector.

The role of the World Bank and development agencies

Although the World Bank has an important role to play in the sector in the 1990s, it can no longer operate alone. Nor should it. The World Bank is in no position to monopolize the development of urban transport in Asia. Its staff resources in the sector are limited in quantity and its range of operations are also limited by the nature of its lending instruments and by competing priorities from other sectors.

Other multilateral agencies such as the ADB, UNDP and ESCAP can be more responsive and more effective in addressing technical assistance, training, institutional development and demonstration projects in the sector than the World Bank. Bi-lateral agencies can often mobilize resources more rapidly and arrange for technology transfer more efficiently than multilateral agencies including the World Bank.

Already the World Bank has taken part in several regional initiatives involving collaboration with external aid agencies. These initiatives now need to be expanded and developed further. The challenge before us is to ensure that the combined resources of the development community and the private sector can, with the assistance of the World Bank, respond appropriately to the needs of individual cities and governments in such a way that by the year 2000 Asia's urban transport systems are not unique due to congestion but are unique due to their efficiency in meeting the travel demands of all sections of urban society.



Part One: Introduction

Geo-demographic scope

The Asia Region has different coverage for different organizations. As this report draws on several collaborative studies between the World Bank, the Asian Development Bank (ADB) and the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), Asia is considered in this report to include countries within these organizations (see Table 1, Annex 1)

Asia is estimated to have a total population of 3 billion inhabitants in 1990 or 56 percent of the world's population. The vast majority are concentrated in the 16 countries classified in the 1990 World Development Report (WDR) as low-income economies with GNP per capita below $545 in 1988. This group of countries also contains the majority of the region's urban population and the majority of cities with populations in excess of one million.

The region has several distinctive characteristics. It contains some of the lowest (Bangladesh) and highest (Japan) GNPs per capita; it contains some of the lowest (Bhutan) and highest (Singapore) urbanization rates; and it has some of the smallest (Tonga, Guam) and largest (China) national population groupings. It's climate, geography and topography are as diverse as its peoples, cultures, religions and governments.

Economic development

In terms of economic growth, Asia is undoubtedly the most dynamic region in the world today. Notwithstanding the disparities in the economic performance of individual economies, the growth in GDP of the region as a whole has averaged nearly seven percent per annum during the 1980s. This compares with world economic growth of around three percent per annum and less than two percent for developing countries. Thus the record for the Asia region is impressive when compared with the world as a whole, and particularly when compared with developing countries in other regions.

The growth outlook in the 1990s is more favorable for developing countries in Asia than in other regions (see Table 1.1). According to the 1990 WDR, per capita incomes in South Asia appear to be set to continue growing at 3.2 percent per year. Per capita income in developing countries in East Asia is projected to grow at 5.1 percent leading to a 65 percent rise in average incomes by 2000.

Table 1.1 Growth prospects for the 1990s

	GDP per capita growth rates		
Country group	*1965-1980*	*1980-1989*	*1989-2000*
Industrial countries	2.8	2.5	2.6
Developing countries	3.4	2.3	3.2
East Asia[a]	4.8	6.7	5.1
South Asia	1.2	3.2	3.2
Sub-Saharan Africa	2.0	-2.2	0.5
Eastern Europe	4.5	0.8	1.5
EMENA[b]	3.9	0.8	2.1
LAC[c]	3.4	-0.6	2.3

a. including China
b. Europe, Middle East and North Africa
c. Latin America and the Caribbean
Source: World Development Report 1990

Poverty

In spite of impressive economic growth, in 1985 Asia still had the vast majority, 72 percent, of the world's poor. Some 700 million people in Asia had annual incomes below $370 per capita. The incidence of poverty is higher in South Asia (51 percent) than East Asia (20 percent).

The 1990 WDR sets out what might be achieved in reducing poverty through the expanded provision of social services for the poor coupled with growth scenarios which make productive use of labor. Under these assumptions and within the context of relatively favorable conditions for the global economy, the WDR estimates that Asia's share of the world's poor would decline from 72 percent in 1985 to 53 percent in 2000.

In South Asia, where the region's poor are concentrated, the WDR considers there is considerable potential toward reducing poverty, particularly in India. The prospects for Bangladesh are also good but are bleaker in Pakistan. Strong measures will be needed to prevent poverty from deepening over the decade.

According to the WDR, East Asia is expected to achieve the most dramatic impact on poverty reduction. The incidence of poverty is expected to fall from 20 percent in 1985 to 4 percent in 2000 with a reduction in the number of absolute poor from 280 million to 70 million. The Philippines may well be a notable exception to this trend as could be China if present social safety nets are not maintained or replaced during the current market reform process.

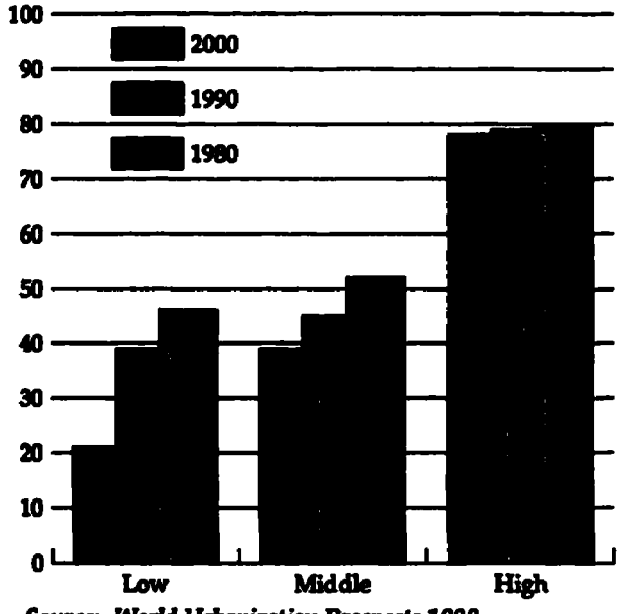
Rising incomes and strong employment growth in the middle income countries of Asia are seen by the WDR as increasingly confining poverty to those who cannot directly benefit from this process—the elderly, the infirm and children. The use of social safety nets will therefore be increasingly necessary for poverty alleviation in these countries.

Urbanization

The impressive performance of Asia in terms of economic development and the growth in population is causing the region to grapple with extremely rapid rates of urbanization. Already, more than half of the world's urban population increases occur in Asia and the majority of this growth is occurring in the region's low income countries (see Figure 1.1).

An analysis of the latest United Nations data reveals some startling statistics. It is estimated that by the turn of this century, the urban population in Asia will increase by 420 million from 1.2 to 1.6 billion. The resultant increase in the proportion of urban residents within the total population would be from 39 percent in 1990 to 46 percent by the year 2000.

Figure 1.1 Proportion of urban population in Asia by country income group (1980–2000)



Source: World Urbanization Prospects 1990.

In 1980, Asia already had 72 cities with populations of a million or more. In the past decade, 29 additional towns grew into cities with populations in excess of one million. Cities of this size are expected to reach 160 in number by the end of this century in Asia.

The number of Asian megacities (cities with a population in excess of ten million) is more than doubling every decade. Between 1980 and 1990 they increased from two (Tokyo and Shanghai) to five (with the addition of Beijing, Calcutta and Seoul).

By the year 2000, there is expected to be 13 megacities in Asia with a combined population of 179 million. Within a decade, more than half the world's 21 megacities and two thirds of the 18 megacities in the developing world would be located in Asia (see Table 1.2). And the majority of these would be in low income countries.

The implications of these statistics indicate the magnitude of the tasks facing urban managers in Asia over the decade of the 1990s and beyond. Furthermore, it is apparent that urban areas will become increasingly more important contributors to economic growth in Asia and that efficient urban areas will be increasingly viewed as catalysts for stimulating growth and development.

Table 1.2 World Megacities 2000

Region/country	No.	Megacity Name	Megacity Population
Asia	**13**		**179.4**
Bangladesh	(1)	Dhaka	12.2
China	(3)	Beijing	14.0
		Shanghai	17.0
		Tianjin	12.7
India	(3)	Bombay	15.4
		Calcutta	15.7
		Delhi	13.2
Indonesia	(1)	Jakarta	13.7
Japan	(1)	Tokyo	19.0
Korea	(1)	Seoul	12.7
Pakistan	(1)	Karachi	11.7
Philippines	(1)	Manila	11.8
Thailand	(1)	Bangkok	10.3
Africa	**1**		**12.9**
Nigeria	(1)	Lagos	12.9
EMENA	**1**		**11.8**
Egypt	(1)	Cairo	11.8
LAC	**4**		**72.1**
Argentina	(1)	Buenos Aires	12.9
Brazil	(2)	Rio de Janeiro	12.5
		Sao Paulo	22.1
Mexico	(1)	Mexico City	25.6
North America	**2**		**30.7**
USA	(2)	Los Angeles	13.9
		New York	16.8
Total	**21**		**306.9**

Source: UN World Urbanization Prospects 1990.

The ADB estimates that in 1985, urban areas in selected Asian developing countries contribute[-1] on average 55 percent of GDP and that by the end of this century urban areas would account for more than two thirds of total economic production. It should be noted, however, that these estimates may be somewhat inflated by the higher prices of goods and services in urban areas.

Until recently, little attention has been given by the international development community to the impact of the urban sector on macroeconomic performance. The 1991 World Bank Urban Policy and Economic Development (UPED) paper , sets out the broad policy framework, policy agenda and recommended strategy for improving the productivity of urban economies, alleviating urban poverty and developing effective approaches to addressing the urban environment.

As these recommendations provide a framework for the management of the urbanization process in Asia and for the role of the urban transport sector, they are summarized below.

Improving urban productivity and environment

The UPED paper begins by pointing out that to increase the productivity of the urban economy and assure its contribution to macroeconomic performance requires actions at the national and city levels. It involves shifts in the role of central governments from direct providers of urban services and infrastructure to "enablers," creating a regulatory and financial environment in which private enterprises, households, and community groups can play an increasing role in meeting their own needs. It will also require some measure of decentralization of responsibility to municipalities for urban finance and the management of infrastructure. The proposals to achieve this are presented in Box 1.1

The challenge of urban management in the economic environment of the 1990s is to improve productivity while directly alleviating the growing incidence of urban poverty, and thereby also improving equity. The proposals to achieve this are presented in Box 1.2.

The third area identified by the UPED paper as requiring attention is the emerging environmental crisis in towns and cities throughout the developing world. The UPED paper recognizes that environmental issues are poorly understood in developing countries and that a major research and development effort is necessary to identify effective approaches to their solution. The requirements for sustainable approaches to the management of the urban environment are presented in Box 1.3

Box 1.1 Improving urban productivity

(1) Strengthen the management of urban infrastructure at the city level;

(2) Improve the city-wide regulatory framework to increase market efficiency and to enhance the private sector's provision of shelter and infrastructure;

(3) Improve the financial and technical capacity of municipal institutions through more effective division of resources and responsibilities between central and local governments; and

(4) Strengthen financial services for urban development.

Source: Urban Policy and Economic Development: An Agenda for the 1990s, World Bank, 1991.

The role of urban transport

Urban transport has an important role to play in achieving the objectives outlined in the UPED paper.

The extent to which Asian cities meet the challenges of urbanization and contribute to macroeconomic performance will, to a large extent, depend on how efficiently they can transport the goods, services, information and people upon which their economic activities depend.

Walking and cycling are often the sole means of gaining access to employment and social services for the urban poor who cannot afford public transport services.

Vehicle emissions are increasingly being recognized as the dominant cause of localized air pollution and health problems in Asian cities. And the pressing demands for motorized forms of personal mobility in Asian cities are generating pressures on the road network and resulting in congestion.

The intrinsic development of the urban transport sector and its response to the pace, scale and nature of urbanization and economic development in the 1990s will determine to a large extent the nature and form of Asian cities in the early twenty first century.

The nature of this process and role of international and bi-lateral development agencies are discussed in the following chapters of this report.

Box 1.2 Strategy for alleviating urban poverty

(1) Manage the economic aspects of poverty through increasing the demand for the labor of the poor, alleviating the structural constraints inhibiting the growth and productivity of the informal sector, and increasing the labor productivity of the poor;

(2) Manage the social aspects of poverty through increasing social sector expenditure for human resource development of the urban poor, increasing access of the poor to infrastructure and housing to meet their basic needs, and recognizing and supporting the efforts of the poor to meet their own needs; and

(3) Targeting "safety net" assistance to those most vulnerable to short term shocks, such as children and women who head households through direct transfers of food assistance, health care, employment and provision of other basic needs on a short term basis as well as measures to moderate the decline in private consumption.

Source: Urban Policy and Economic Development: An Agenda for the 1990s, World Bank, 1991.

Box 1.3 Improving the urban environment

(1) Raise the global awareness of the urban environmental crisis in order to develop the political support for action;

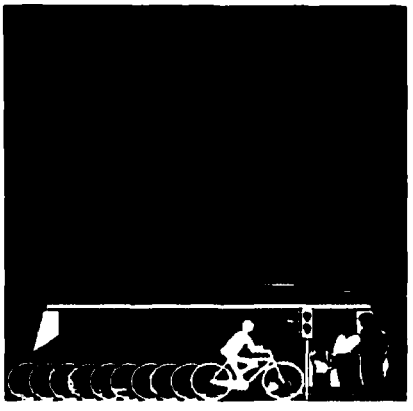
(2) Improve the information base and understanding of the dynamics of environmental deterioration in urban areas;

(3) Develop city-specific urban environmental strategies that respond to the circumstances of individual cities;

(4) Identify programs of curative action for cities to redress the most serious environmental consequences of past public policies and private behavior; and

(5) Formulate effective national and urban policies and incentives to prevent further environmental deterioration.

Source: Urban Policy and Economic Development: An Agenda for the 1990s, World Bank, 1991.



Part Two: Sector background

Urban transport characteristics of Asian cities

In the process of analyzing the urban transport situation in Asia, we were struck by the diversity as well as by the wide range of performance between individual city systems.

In Asia, Singapore presents an example of what must be one of the most efficient urban transport systems in the world and Bangkok provides an example of one of the least efficient and most congested cities in the world. Transport technology ranges from the most sophisticated in Japan (monorails, linear induction motors, automated guided transit systems, peoplemovers, etc.) to the most simple in China (walking and cycling).

Every conceivable mode of urban transport is being used, and being used extensively, somewhere in Asia—walking and cycling; pedicabs; motorcycles; guided bus systems in Japan and in Australia; metros in Australia, China, Hong Kong, India, Japan, Korea and Singapore; trams in Australia, China, Hong Kong, India, Japan and, until very recently, Vietnam; light rail and jeepneys in Manila; suburban rail in Bombay; tuk-tuks and ferries in Bangkok; monorails and guided rapid transit in Japan; rickshaws in India and becaks in Indonesia coupled with every conceivable form of bus from double-deckers in Indonesia to articulated trolley buses in China.

A greater variety of approaches are being used in Asia to manage urban traffic than in any other region of the world: area licensing and road pricing in Singapore; with-flow, counter-flow and tidal-flow bus lanes in Bangkok, toll expressways in Jakarta, area wide traffic control in Hong Kong, Tokyo and Singapore, non-motorized vehicle only routes in Shanghai, and "bike and ride" in Osaka and "park and ride" in Adelaide.

With few exceptions these measures are having little effect on the rising tide of motorization confronting all countries in the region. The high rates of urbanization, economic growth and rises in personal incomes are generating demands for personal mobility that threaten to engulf the region's cities with levels of congestion and air pollution similar to those experienced in Los Angeles and Mexico City.

Non-motorized vehicles

Asia has the widest variety of non-motorized forms of transport in the world. They form the backbone of the transport system for the poor in many cities for both personal and goods movements.

Most non-motorized vehicles (NMVs) are pedal-powered in the form of bicycles and tricycles. Many Asian cities use tricycles as taxis. Called "cycle-rickshaws" in India, "becaks" in Indonesia, "trishaws" in Malaysia, "samlors" in Thailand and "siklors" in Vietnam, these resourceful adaptations of the tricycle do much the same work as motorized taxis elsewhere.

Heavy-duty tricycles often haul up to half-ton loads and in Bangladesh, trishaws transport more tonnage than motorized forms of transport. The use of animal powered NMVs for freight haulage is common in small towns throughout the region. The most widespread is the bullock cart but other, more exotic, varieties exist: the "calesa and sled" in the Philippines, the "andong and dokar" in Indonesia and the "tonga" in India.

Bicycles are by far the most numerous and the most used mode of personal NMV transport. Exact

numbers are hard to come by, but it is estimated that there are some 300 million bicycles in China, 66 million in Japan, 45 million in India and six million in Korea. These four countries alone account for more than half of the world's estimated total bicycle population of 800 million.

It is common knowledge that China leads the world in the production and use of non-motorized vehicles as the basis for rural and urban transport needs. In 1949, China began with three factories producing 14,000 bicycles per year. By 1983, this modest beginning had grown to 115 factories producing 30 million bicycles annually. By 1987, domestic bicycle sales had reached 37 million, surpassing total worldwide automobile sales.Mass production, standardization, special bicycle facilities (cycle lanes and parking) and subsidies for commuting to work by bicycle have resulted in the bicycle being the dominant form of transport in all Chinese cities. Typically, well over 50 percent of urban trips are by bicycle. The urban bicycle fleet increased annually by eight percent in the 1960s, by 13 percent in the 1970s and by 17 percent in the past decade.

Shanghai and Tianjin in China rival each other as being the bicycle capitals of the world. Both have large concentrations of bicycles; the bicycle fleet in Shanghai is the largest in the world at 6.8 million (and growing at 17 percent annually). Tianjin has a smaller fleet (around 4.5 million bicycles) but the highest rate of bicycle use in the world at 80 percent of vehicle trips (compared with 73 percent in Shanghai).

Outside of China, the trend over the past decade has been a reduction in the number and use of non-motorized vehicles. City expansion and increasing travel distances is one factor contributing to this decrease. In Delhi, city sprawl was a major factor in the reduction of cycle trips from 36 percent in 1957 to 17 percent by 1981. In other cases, Government attitudes to NMVs as being difficult to regulate, unsafe, inhumane or symbols of "backwardness" have lead to the discouragement or eradication of cycle taxis. In Jakarta, some 100,000 becaks were confiscated in the late 1980s and dumped into the sea in order to reduce traffic congestion. In Surabaya, becaks cannot use or cross main roads but are allowed to circulate within neighborhoods.

Only in Japan are NMVs coming back into vogue as an alternative mode in journey to work trips. Census figures for 1980 showed that 7.2 million commuters (15 percent of the total) rode bicycles to work or to commuter rail stations. Bicycle ownership in Japan has climbed from an average of one per household in 1970 to 1.5 today. National legislation empowers the provision of ample bicycle parking and "bike and ride" facilities in most major Japanese cities.

China and Japan provide examples of avoiding automobile dependance and reducing the impacts of excessive motorization through encouraging NMV use (and heavy investment in efficient public transport in the case of Japan). Both countries are also attempting to manage vehicle ownership, in the case of China to prevent it; and in the case of Japan, to reduce it.

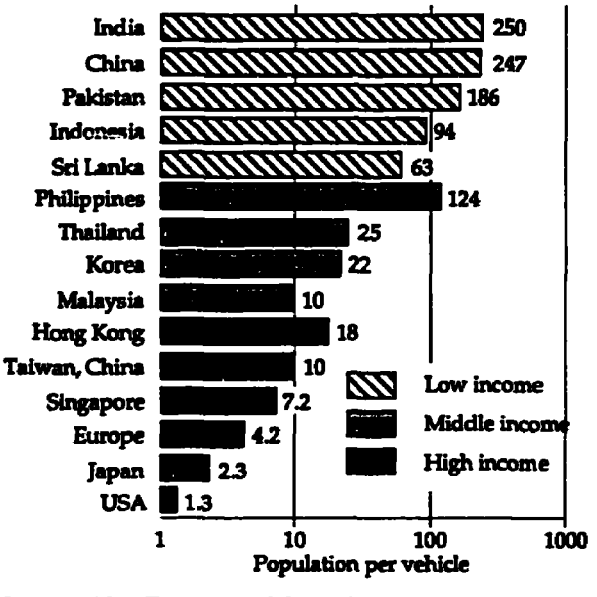
Motorization

Asia has 56 percent of the world's population and accounts for just over ten percent of the world's automobile population and over 25 percent of the global truck and bus fleet. Within Asia, the majority of these vehicles are in Japan which accounts for 70 percent of the region's automobiles and 62 percent of trucks and buses.

Some of the world's highest and lowest motorization rates are to be found within the region, as can be seen from the analysis of the most recent vehicle ownership data presented in Figure 2.1.

In low-income countries vehicle ownership rates range from as high as 63 persons per vehicle in Sri Lanka to as low as 250 in India; in middle-income countries they range from as high as 10 in Malaysia

Figure 2.1 Population per vehicle rates in selected Asian countries in 1988
(population per vehicle)



Source: Urban Transport and the Environment in the Asia-Pacific Region, M. Walsh, 1991.

to 124 in the Philippines; and in high-income countries they range from as high as 2.3 in Japan to 18 in Hong Kong.

The relation between vehicle ownership and GNP per capita is remarkably constant throughout the region. In some countries, however, annual growth rates in the vehicle fleet in the 1980s were quite dramatic and far in excess of GNP growth. For example, between 1984 and 1988 the annual growth of the motor vehicle fleet in the Republic of Korea was 30 percent, in China 14 percent, and in Pakistan and Thailand nine percent each, compared with about two percent in the United States and three percent in the United Kingdom.

Due to the inadequate data base, it is difficult to assess present and future levels of motorization within urban areas. In Thailand, it is estimated that the Greater Bangkok Metropolitan Area accounts for more than one-third of the national vehicle fleet. Between 1982 and 1988, this "urban" fleet doubled in size and between 1989 and 1990 automobile sales registered an astonishing 40 percent growth.

Large increases in the size of the urban vehicle fleet are also being observed in China, in India, in Indonesia, in Malaysia and in the Philippines. Although the growth in the urban vehicle fleet may not be as extreme as that being experienced in Bangkok, it is clear that urban vehicle growth is higher than the national average in most countries in the region.

In India, some 30 percent of vehicles are concentrated in twelve metropolitan areas which account for only six percent of the total population. In the past decade, the growth rate of vehicles in metropolitan areas has averaged 11 percent per annum and has reached as high as 17 percent in Madras.

Motorcycles

Motor cycles are increasing in numbers throughout the region as people strive for cheaper and more usable alternatives to the motor car for urban personal mobility. For some, the motorcycle is a logical progression from the bicycle and for others it offers a faster alternative to slow and crowded buses.

In Bangkok, the number of motorcycles is expected to rise from 459,000 in 1990 to over 600,000 by the turn of the century, if current trends continue. There could be as many as three million motorcycles in Bangkok within the decade if trends were to follow what is happening in Taipei where there is now more than one motorcycle per household!

India has experienced a staggering increase in the ownership and in the production of motorcycles. Ownership is increasing at 17 percent annually and production at 20 percent. The total number of motorcycles in the country has risen from 2.5 million in 1981 to 10.6 million in 1989 and motorcycles (including scooters and mopeds) account for between 40 and 85 percent of the motorized vehicle fleet in India's twelve largest cities.

Vehicle ownership restraints

Most developing countries in Asia have some form of deterrent to vehicle ownership. High import duties, registration fees, excise taxes and road user charges are the main forms currently in use. Such restraints also form a ready source of tax revenue and are relatively easy to impose. This was the reason for their introduction.

Until very recently, the use and ownership of automobiles in China was limited to official business and taxis. In Japan, car owners are charged a US$ 2,000 equivalent registration fee every two years for the life of the vehicle. In Singapore, import duties, registration fees and "registration lotteries" combine to make car ownership expensive and limited in quantity.

Few Governments have attempted to use control mechanisms to "clamp down" on vehicle ownership. Restricting car ownership is unpopular in any society, but in the developing economies of Asia it is seen by politicians as going against the aspirations of the rising middle class and depriving them of one of the most important benefits of development—personal mobility.

Within urban areas, such controls have little impact as they pay no regard to when, where or how often the vehicle is used, nor to the costs which it imposes in those places or at those times. Ownership controls may therefore be justified in "city states" such as Singapore where every vehicle is a potential contributor to congestion, but this is hardly the case in other, largely rural countries. How to manage rising vehicle ownership and use in urban areas and avoid congestion is a major challenge for Asia in the 1990s.

Traffic congestion

The substantial growth in vehicle fleets is clearly evident in the urban areas throughout the region in the form of increasing traffic congestion. What constitutes congestion in one city may not in another. An absolute definition would be all vehicles bumper to bumper at zero speed. This occurs frequently in Bangkok at approaches to intersections. Once through the intersection, vehicles travel at speeds in excess of 40 kilometers per hour until they hit the next

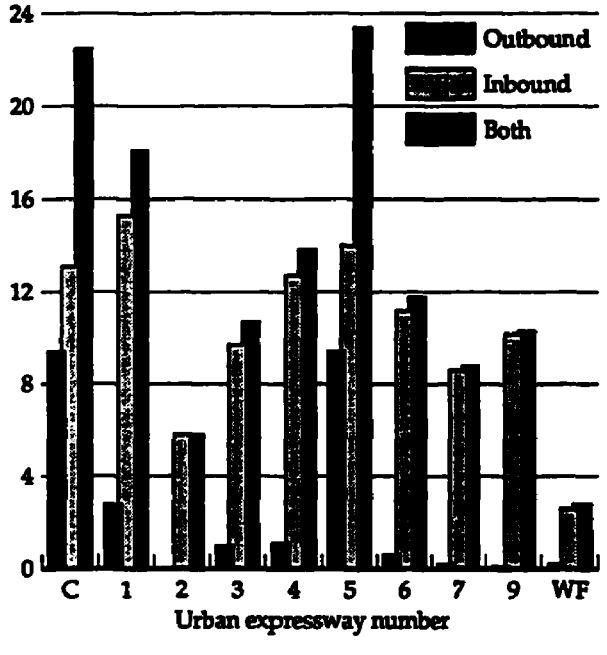
blockage, where they can be delayed for five minutes or so.

On the expressway system in Tokyo, congestion is defined as average speed (moving and stationary) below ten kilometers per hour. In the case of the Tokyo expressway network, this ranges from 2.8 hours per day on the Waterfront route to as much as 22.5 hours on the Circle route (see Figure 2.2, below). For the ten routes in the network, the average is 10.3 hours per 24 hours!

The Tokyo expressway data is collected "on-line" from detectors on a continuous basis and is used by the Expressway Authority to monitor and redirect traffic around congested sections of the network. No other city in Asia has this level of sophistication in terms of data collection and congestion management.

The congestion threshold of ten kilometers per hour used in Tokyo is a reasonable yardstick against which to assess congestion. Despite the multitude of transport studies undertaken in the region, there is little reliable data on travel speed. Data have been gleaned from a variety of sources with differing levels of reliability. In the discussion that follows, the speeds quoted present at best a crude measure of traffic conditions for comparison purposes and for attempting to define a problem which everyone recognizes but few can quantify.

Figure 2.2 Congestion on urban expressways in Tokyo
(hours per day)



Source: Investment Policies for Urban Transport, S. Morichi

The most reliable data comes from Japan, where it would appear that average travel speeds have declined significantly in most cities. Between 1980 and 1985, speeds declined from 26 kilometers per hour in Nagoya, and 22 kilometers per hour in Osaka, to 20 kilometers per hour in both cities. In Tokyo, outside the expressway network, the decline is even more dramatic as over the same five year period speeds have dropped by six kilometers per hour from 21 to 15 kilometers per hour. No data exists for speeds in the central areas of these cities but given this low city-wide speed data, it is likely that Central Business District (CBD) speeds are below ten kilometers per hour in peak periods.

In India, overall journey speeds in large cities are around 20 to 25 kilometers per hour and in smaller cities the range is larger, between 15 and 30 kilometers per hour. Within central areas of most cities, however, speeds are between five and 12 kilometers per hour and well within the congestion range irrespective of city size. In the largest cities, Bombay and Calcutta, there is data to show that speeds have been declining around three percent annually over the past decade. Time series data is not available for other cities, but a decline in speed can be assumed.

Average speeds in Chinese cities are low. This is particularly evident in large cities such as Shanghai and Tianjin where inner city traffic speeds rarely exceed 15 kilometers per hour and where the city center is congested with speeds around eight kilometers per hour in peak periods. Data from Anshan, Fushun, Shenyan and Tianjin suggests that in most cities, bicycle speeds are often higher than speeds by other modes, especially public transport.

In Indonesia, congestion is concentrated in Jakarta where peak hour traffic speeds can be as low as seven kilometers per hour on certain roads within a ten kilometer distance from the city center. Currently, traffic speeds in Jakarta average between 15 and 16 kilometers per hour during business hours and average trip speeds per 24 hours in 1990 were 9.4 kilometers per hour for buses (including transfers) and 19.3 kilometers per hour for other traffic. The situation in other cities is less critical with peak hour speeds ranging from 20 kilometers per hour to 30 kilometers per hour.

The traffic congestion in Bangkok is widely perceived to be the worst in the region due to the duration and extent of delays. On average each car is estimated to spend 44 days equivalent each year in Bangkok's ever increasing traffic jams. Peak hour traffic speeds in central Bangkok have declined by an average two kilometers per hour per year between 1985 and 1990 and are currently estimated to average nine kilometers per hour.

Not only does such congestion promote greater fuel consumption, and the resulting increase in air pollution, but the severe increase in transit times can have substantial impact on economic productivity.

A recent study by the Japan International Cooperation Agency (JICA) concluded that Bangkok currently loses about one-third of its potential gross city product due to congestion-induced travel delays and this could rise to about two-thirds if no actions are taken . Paradoxically, four years of buoyant economic growth have created such traffic congestion that many foreign investors are re-evaluating their plans to open offices in the city.

Few countries in the region have made a serious effort to reduce congestion and even fewer have succeeded. There is an argument that all major cities suffer from traffic congestion and that traffic will always grow to the same level of congestion independently of the network improvements introduced. It is often said that as no city has found a solution, congestion is a way of life that has to be accepted.

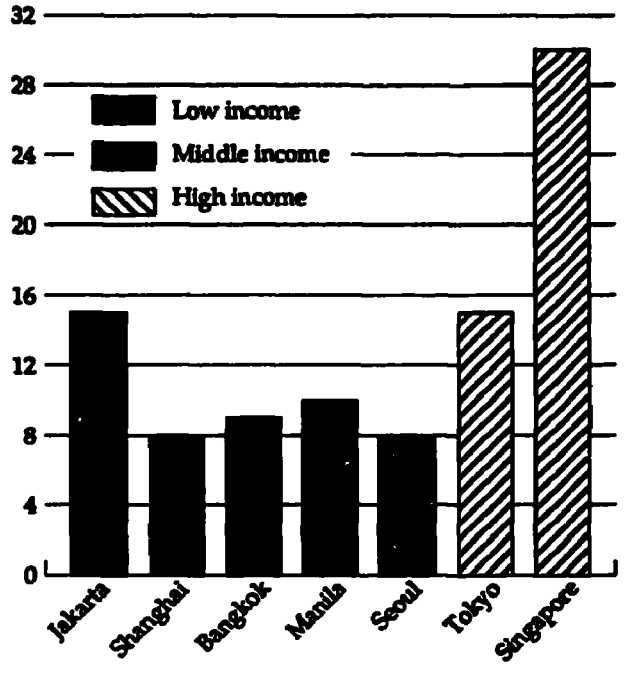
Peak hour travel speeds average about 16 kilometers per hour in the center of most large cities in the world. Singapore is one of the few large cities in Asia where inner city travel speeds exceed this average, as can be seen from Figure 2.3, and this is because a conscious decision has been taken to manage congestion for the well being of citizens and for the well being of the economy at large.

In Singapore, the combined effects of restraining motorization, restricting vehicle access to the CBD and providing efficient, affordable and high quality public transport alternatives to the commuter have resulted in average peak hour travel speeds of around 30 kilometers per hour. Even more remarkable is the stability of these speeds between 1984 and 1988.

In attempting to assess levels of congestion in Asian cities, it is worth looking at the traffic flow indicators provided in a recently published analysis of life in the world's largest metropolitan areas. These indicators are derived from personal estimates by respondents to a questionnaire concerning the time it takes by car to travel to the CBD from the airport during the morning rush hour.

Travel speeds to airports in low-income and high-income countries are on average higher than in cities in middle-income countries. Speeds in cities in middle-income countries range from around 12 kilometers per hour (in Manila) to 28 kilometers per hour (Pusan) and average 21 kilometers per hour. Speeds in cities in low- and high-income countries range from 16 kilometers per hour (in Poona) to 60 kilometers per hour (in Singapore) and average 28 and 32 kilometers per hour respectively.

Figure 2.3 Inner-city average travel speeds in selected cities in Asia (Km/h)



Source: Various study reports and seminar papers.

Clearly these data are dependent on the location of airports in relation to city centers and on the type and capacity of the airport access road. It is, however, the only data available to compare travel speeds in all cities with populations in excess of two million in the region and world wide.

An analysis of these data shows that with an average speed of around 28 kilometers per hour Asian cities rank lowest in the world (see Table 2.1, below). Even the highest average speeds in cities in high-income countries in Asia only approximate the world average of around 31 kilometers per hour.

Environmental impacts

Increasingly, the urban transport sector is generating adverse environmental conditions in many countries in the region. Vehicle emissions are polluting the atmosphere, motorized vehicles are generating intolerable noise levels, traffic accidents are claiming more lives and the road infrastructure being built to accommodate urban traffic is often visually intrusive and blocks access from one community to another. In the battle to combat congestion and increase personal mobility, the environment of Asian cities is paying an increasingly heavy price.

Table 2.1 Average peak hour travel speeds airport to CBD by region and country income group
(Kilometers per hour).

	Country income group			
Region	Low	Middle	High	Total
Asia	27.8	20.6	31.8	27.8
EMENA[a]	..	39.2	24.6	32.4
LAC	..	33.5	..	33.5
North America	..	..	35.9	35.9
Africa	29.0	..	49.7	39.3
Total	27.9	33.7	31.2	31.1

a. Includes USSR

Vehicle emissions and air pollution

As can be seen in Figure 2.4, the Asia region is responsible for around 20 percent of global vehicle emissions of carbon monoxide (CO), hydrocarbons (HC) and the oxides of nitrogen (NOx) and the region is responsible for about 10.5 percent of global vehicle emissions of carbon dioxide (CO_2).

Asia based companies are rapidly becoming major producers of motor vehicles and increasingly these vehicles are staying in the region. Many have no pollution controls.

Many motorcycles in Asia are powered by two-stroke engines (which have been largely phased out of most other areas of the world) which emit as much as ten times more hydrocarbons and smoke per kilometer than four-stroke motorcycles and even cars.

In Asia, diesel vehicles (trucks, buses and, in some cases, taxis) represent a higher proportion of the vehicle fleet and of total kilometers driven than in most highly industrialized countries. The pollution from these vehicles is exacerbated by generally poor (and, in some cases, exceedingly poor) vehicle maintenance characteristics.

Many of the fuels used in the region are among the dirtiest in the world, especially with regard to sulfur in diesel fuel and lead in petrol, and in many Asian countries today, it is not yet possible to purchase unleaded petrol.

As a result of the large and growing population of poorly maintained vehicles with minimal, if any, pollution controls, powered by unusually dirty fuels, most major cities of Asia are already experiencing serious motor vehicle related air pollution, frequently on top of other serious environmental problems.

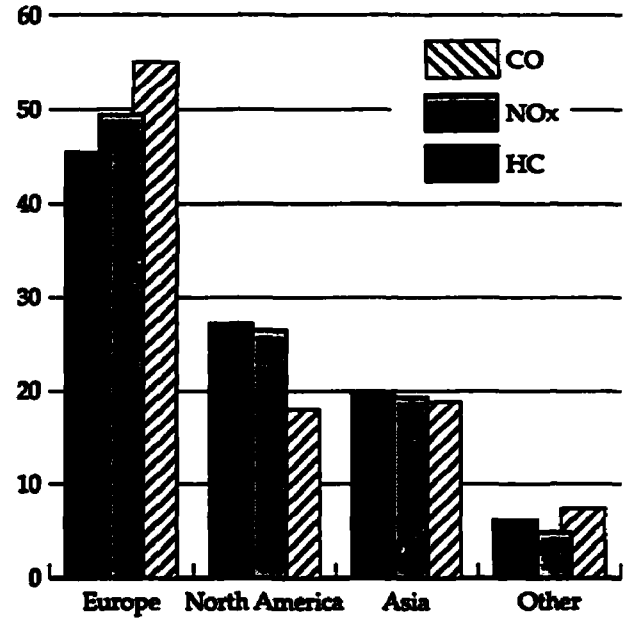
In virtually every city for which data is available, carbon monoxide, lead and particulate levels are the primary source of the emissions causing these problems. Further, vehicles contribute significant amounts of hydrocarbon and oxides of nitrogen emissions which are frequently toxic as well as contributing to photochemical smog in cities with the appropriate meteorological conditions.

Some 70 percent of carbon monoxide and 46 percent of hydrocarbons in Bombay are reportedly due to vehicle emissions. Similar conditions exist in Calcutta. In Thailand the Office of the National Environment Board has monitored levels of carbon monoxide, particulate matter and lead near major roads in Bangkok since 1984. According to their latest annual report, in certain areas of the city where traffic is high:

> particulate matter's concentrations far exceed the daily ambient air quality standards of 330 microgram/cubic meter on any day, and are as high as 2-3 times standard values on some days.

A study of blood-lead levels of policemen in Bangkok who had been subjected to three different rates of exposure to vehicular traffic, found a statistically significant link between traffic exposure and blood-lead levels. Other air pollutants, such as nitrogen and ozone from photochemical oxidant reactions, are currently at relatively low levels in the city due to favorable meteorological conditions (prevailing seasonal monsoon winds and sea breezes).

Figure 2.4 Global vehicle emissions
(Percent)



Source: Urban Transport and the Environment in the Asia-Pacific Region, M. Walsh, 1991.

In 1989, the Environmental Protection Agency of Hong Kong issued a White Paper on pollution in the city which reported that:

> approximately 1.5 to 2 million people are exposed to unacceptable levels of sulfur dioxide and nitrogen dioxide and about three million people are exposed to high particulate levels. Many people are exposed to unacceptable levels of all three pollutants.

The air pollution problem in many urban areas is compounded by the life style and climate in many of the warmer Asian cities. Much of the region is located in a tropical zone with an outdoor lifestyle. As a result there is much greater public exposure to vehicle emissions than in more temperate climates.

In a recent study conducted by the East West Center, an individual in Bangkok carried a personal exposure monitor throughout the day. Carbon monoxide levels were found to increase dramatically during a vehicle trip compared to levels in a house, even when a charcoal stove was in use (see Figure 2.5).

Quantifying the health impacts and costs of vehicle emissions is very difficult. No data is available for Asia but a recent study carried out for the American Lung Association concluded that

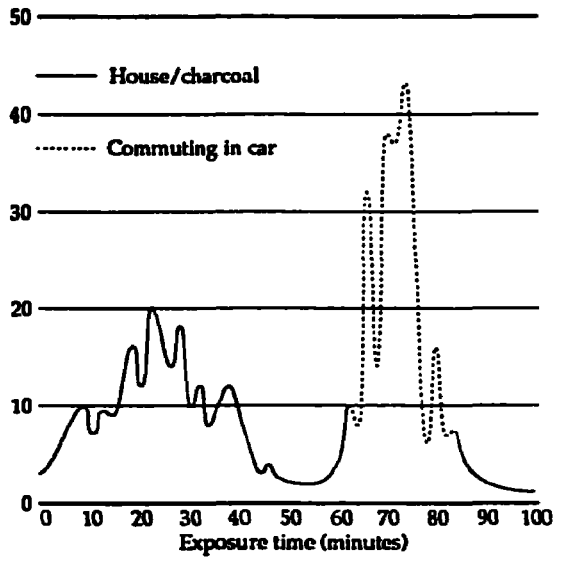
> National health costs worth between $4.43 billion and $93.49 billion per year due to automotive and truck exhaust pollution could be avoided.

In spite of the technological advances which are now readily available, countries in Asia have made limited progress in reducing vehicle emissions.

Prospects are not entirely bleak. The wealthiest country in the region and the one with the largest vehicle population, Japan, has traditionally been one of the world leaders in motor vehicle pollution control and has one of the cleanest fleets in the world, at least for petrol powered vehicles. In 1990, Japan started to introduce particulate controls on diesel vehicles, boding well for future control of this especially hazardous pollutant in other countries in the Region.

Rapidly industrializing areas such as Taipei and Seoul have recently introduced state-of- the-art controls on new petrol cars and are rapidly putting comprehensive vehicle control programs in place. Decisions have been made to do the same in Hong Kong and in Singapore. In Thailand, the government has announced that all new cars produced by September 1993 would need to be equipped with catalytic converters and it is estimated that 87 percent of passenger cars sold in Thailand over the past decade could immediately switch to unleaded petrol.

Figure 2.5 Carbon monoxide exposure levels in Bangkok
(CO levels in ppm)



Source: Urban Transport and the Environment in the Asia-Pacific Region, M. Walsh, 1991.

Unleaded petrol and low-leaded petrol, which has been relatively rare in much of the region, is starting to spread rapidly and either already exists or is likely to soon exist in Japan, Taipei, Korea, Hong Kong, Singapore, Malaysia, Indonesia and Thailand. Thailand announced the introduction of unleaded petrol in May 1991 "to combat worsening air pollution."

In 1992, motorcycles in Taipei will be subject to the most stringent motorcycle standards in the world which may assist other cities in the region with similar two-stroke motorcycle problems.

Noise pollution

Traffic noise is becoming an increasingly worrying irritant in most cities in Asia. Little data exist on noise levels but buses and trucks are major culprits, as is evidenced by data from Bangkok (one of the few cities where noise measurements have been undertaken).

Data collected alongside densely travelled roads in Bangkok revealed daily noise levels between 75 decibels (Db) and 80 dB, much higher than the 70 dB standard recommended by the United States Environmental Protection Agency (USEPA) for long term hearing protection. More than 75 percent of buses, 60 percent of trucks and 25 percent of mini-buses emit-

ted noise levels in excess of 100 dB at a distance of 0.5 meters.

Accidents

Traffic accidents are one of the major causes of mortality and hospitalization in developing countries in Asia. Traffic growth, undisciplined road user behavior, poorly maintained vehicles and inadequate traffic control and engineering all contribute to increases in the incidence of traffic accidents.

The statistical base for accidents and accident rates for developing countries in the region is rather fragmented and unreliable. Under-reporting of traffic accidents and incomplete collection of accident data are common. What is certain, however, is that the situation is much worse than reported. For example, in Dhaka, Bangladesh, it is estimated that the number of road fatalities reported in the police statistics represents at best only 50 percent of the number of such fatalities recorded in the hospitals.

Figures that are available suggest that accident rates are well in excess of those recorded in developed countries and that there are higher accident rates in urban areas than elsewhere, even in countries with low motorization rates. For example, the metropolitan area of Dhaka accounts for 40 percent of motorized vehicles in Bangladesh but the city accounts for over 50 percent of all traffic accidents.

Some 3,400 fatalities were registered on Shanghai's road network during the five year period 1984-1988. The incidence of traffic fatalities in Shanghai is ten times that of Tokyo and is due to the high proportion of pedestrians and cyclists "at risk" in the traffic network and delays in providing first aid to accident victims.

In India, over 40,000 people are reported to lose their lives annually in motor vehicle accidents. Over 11 percent of fatal accidents and 29 percent of total accidents take place in the 12 largest cities and one third of fatalities in urban areas are pedestrians. Fatal accident rates in metropolitan cities range from 13.7 to 28.7 per 10,000 vehicles, compared with 2.1 in Japan and 3.8 in Australia.

In many cities traffic accidents are increasing at an alarming rate. For example, the number of road accidents in Bangkok is reported to have doubled in three years from 14,000 in 1985 to 31,000 in 1988 and in Delhi, the number of fatal accidents increased from 700 in 1977 to 1,270 in 1985. In Shanghai, traffic accidents increased by 12.5 percent annually between 1985 and 1987 and fatal accidents have increased at a rate of nearly nine percent per annum over the past five years.

Accidents have important adverse socio-economic impacts. Various research studies have assessed the economic losses associated with traffic accidents to ar ınt to as much as one percent of GNP in developing countries. Between 1985 and 1987, the material loss caused by traffic accidents in Shanghai increased by 33 percent per annum, totalling US$ 2.6 million in 1987.

Visual intrusion

In any city, traffic reduces the visual quality of streetscape and of the city in general. The visual quality of most Asian cities has deteriorated, and much of it is due to traffic related visual intrusion. In road widening schemes, trees and green verges have been removed; where they remain, they can hardly be seen or appreciated among the traffic and air pollution. Increasing use is being made of elevated roads, flyovers and pedestrian overpasses which obstruct views and dwarf adjacent buildings.

In most cities, the streetscape is cluttered with poorly designed, located and maintained signs, poles, wires and railings which obscure each other and the street in general. Only in Singapore and parts of some Japanese cities, such as Kobe and Nagoya, have attempts been made to locate structures and street furniture to be as unobtrusive as possible; and to design them well when they have to be obtrusive!

Community severance

It is common knowledge that roads perform two contradictory functions in cities: they provide the essential links by which people and goods can move but they also separate people and communities from one another (except at specific crossing points).

In many Asian cities, roads are beginning to separate people more than link them. Impassable barriers are being created by increasing conversion of four lane roads into one-way high-volume, high-speed roads. The addition of median barriers, protective fencing, flyover approach ramps and limited access expressways and toll roads are forcing pedestrians to walk further and further to "cross the road'. In some cities, the technical term "traffic cell" is becoming a physical reality!

Few cities have attempted to provide pedestrian links, spaces or infrastructure to facilitate movement within, and between, Central Business Districts, resi-

dential communities and shopping or market areas. In many cities, railway tracks (once physical barriers, have become the only way for pedestrians to get from one part of the city to another in relative safety.

Urban transport infrastructure and facilities

Urban transport infrastructure comprises not only the space allocated to the movement of vehicles but also pedestrian facilities, non-motorized vehicle facilities, street lighting, public transport facilities and mass rapid transit infrastructure. Although the road space between building facades is the domain of urban transport, it serves a multiplicity of uses, many of which do not enter into the traditional area of concern of the traffic engineer or the transport planner. In most cities in Asia it is the "high street" of England or the "main street" of the USA; it is the space for shopping, for social contact, for markets and trade. Since time immemorial it has been a place of conflict between vehicles and people. And rarely has it been organized to cater for both.

Roadspace

Cities in Asia lack adequate road space to accommodate the ever increasing demands for mobility of people and goods. This can be best illustrated by comparing the length of road network per capita in selected cities. Most cities have road network densities per thousand inhabitants in the 400 meters (Jakarta) to 600 meters (Manila) range. The exceptions are Singapore, with as much as 2.7 kilometers per thousand, and Hong Kong with as little as 230 meters per thousand.

Most urban roads in Asia were designed and laid out before the advent of the massive levels of motorization and demands on personal mobility experienced throughout the region in the past decade. With few exceptions, the majority of the roads in urban areas are two lanes wide and the majority of arterial streets are four lanes wide.

Junctions are frequent and ill-designed for turning movements. Few cities have a road hierarchy based on functional criteria; most are based on road width. Although most roads within the city center are paved, roads in the fast developing suburbs are often unpaved, depending on the profit margin of the developer.

Where the poor live, roads are usually non-existent. In most cases "roads" are narrow alleys which cannot accommodate motorized vehicles such as cars, vans or buses. In many cities the road network is incomplete, especially within low income neighborhoods. Bangkok and Jakarta have "coarse grained" networks which divide each city into "super-blocks" through which it is impossible to pass by motor vehicle.

Pedestrian facilities

In attempting to provide sufficient capacity for motor vehicles, most cities have sacrificed the needs of pedestrians. Road widening schemes have reduced sidewalks to less than one meter in width in many cities. Where sidewalks exist, they are poorly maintained with broken paving slabs and broken curbstones. In many cases, open drains force pedestrians to walk on the road which in turn reduces the capacity of the road widening scheme.

Pedestrian crossings are usually provided in city centers and high-income areas only. They are impressive design features which are never respected by motorists or enforced by the police except in high-income countries such as Singapore, Japan and Australia.

As pedestrians, who are by and large the poor, have no right to disturb motorists, who are by and large rich, by crossing the road on pedestrian crossings, pedestrian bridges are provided where space permits. These bridges are often located without regard for pedestrian flows or needs. In some absurd cases, bridges have been located in such a way that they force pedestrians to walk into the road (and the traffic).

Median strips and barriers are used in many countries to "protect" pedestrians from traffic. In reality such devices protect "traffic" from "pedestrians" who are forced to walk long distances before finding a pedestrian bridge, which, if they are not old or infirm, they can use to cross the road.

With the exception of high-income countries such as Australia and Japan, there are no specifically designed pedestrian streets in Asian cities. Most cities in low-income countries have market "streets" where the concentration of stall holders and pedestrians is such that no motorist would attempt to enter. But the notion of closing streets to traffic for the benefit of the walking public has not permeated municipal thinking in most cities.

The lack of attention to pedestrian needs in most countries in Asia can be illustrated by a simple fact—with the exception of Japan there is no data on such facilities. The Japanese, on the other hand, are proud to publish the fact that the total number of pedestrian crossings has increased from 77,643 in 1967 to 698,991 by 1985; and, that over the same period, the total length of sidewalks has increased from 5,590 kilome-

ters to 72,824 kilometers; the number of pedestrian bridges has increased from 737 to 10,088 and the number of pedestrian underpasses has grown from 101 to 2,140.

Non-motorized vehicle facilities

Outside of Japan and China, there is no evidence of special facilities for non-motorized vehicles in urban areas in Asia. This is especially surprising given the high concentration of such vehicles in the region.

Japan had some 45,000 kilometers of bicycle paths in 1985 (compared with 10,558 kilometers in 1975). Most major cities have "bike and ride" parking facilities and bicycle lanes are common in CBDs.

China must have the most extensive bicycle priority facilities in the Region (and in the world) although there are no data on the quantity or lengths. Bicycle lanes are demarcated by moveable barriers at the approaches to junctions in most cities. A special bicycle underpass has been built in Shanghai and a special bicycle "level" has been incorporated in multi-level interchanges in Beijing and Tianjin. An exclusive non-motorized vehicle network is planned for Shanghai which has already begun the implementation of the first phase of a 20 kilometer network in and around the CBD.

Elsewhere, non-motorized vehicles are forced to compete with motorized vehicles on the roads and with pedestrians on the sidewalks. With few exceptions, there is little evidence to suggest that facilities have even been planned in Asian cities.

Street lighting

Street lighting is generally inadequate in Asian cities outside of Australia, Hong Kong, Singapore and Japan (where the number of street lights has increased from 190,150 in 1967 to 1.6 million by 1985!).

In most cities in low-income countries the quantity of street lights is insufficient. In both low- and middle income countries there is no differentiation of street light intensity (or color) by road hierarchy. Most major arteries, expressways, city centers and high-income neighborhoods have some form of continuous lighting but rarely is it designed or located in response to driving, non-motorized vehicle or pedestrian needs.

The worst conditions are in China where the lights are so dim as to be almost useless. The best conditions are in Singapore where "yellow" lights demarcate arterial routes and expressways from other "white" light roads; and where all pedestrian crossings are clearly lighted to reveal pedestrians to approaching motorists.

Public transport facilities

Bus stops, bus shelters and bus bays are rarely adequate in low- and middle-income country cities. Often located near junctions and where the sidewalks either no longer exist or are too narrow, bus stops often cannot accommodate the crowds of people waiting for buses. Shelters, when provided, are rudimentary and usually damaged. No provision is made for seating or for the aged and infirm. Rarely are bus stops provided with lighting, timetables or route information.

Bus stations vary from being well designed sophisticated terminals (in India) to overcrowded "parking lots" (in Jakarta). Located more for the convenience of the bus operator than the public, they are often difficult to access, impossible to move around in, and centers of chaos and frustration for passengers and bus drivers alike.

In many cities, bus terminals are defined by parked buses on the street. In the case of paratransit, rarely are bus stops or bus terminals/stations available due to the quasi-legal or outrightly illegal nature of these services.

Urban expressways

In order to overcome the inadequacy of the street network in meeting motorized vehicle demands, seven cities have developed expressway networks: Seoul (731 kilometers), Tokyo (200 kilometers with 110 kilometers under construction), Osaka (238 kilometers), Pusan (145 kilometers), Singapore (96 kilometers), Jakarta (46 kilometers) and Bangkok (24 kilometers).

Five cities in the region have urban toll road systems: Bangkok, Hong Kong, Jakarta, Osaka and Tokyo. Of these, Hong Kong and Jakarta have privately financed urban toll roads (two in Hong Kong and one in Jakarta); two more are under construction (one in Hong Kong and one in Bangkok); and several under consideration (in Bangkok, Hong Kong, Jakarta, and Kuala Lumpur).

Indonesia has the most extensive government owned toll road system in Asia. There are some nine toll roads with a total length of 273 km and four toll bridges with a further three toll roads under construction that will add 58 kilometers to the network in 1991.

In Indonesia, the capital and operating costs of these schemes (whether public or private sector) are

meant to be recovered from the road user through toll payments. The toll rates are based on benefits to toll road users, derived from estimates of vehicle operating cost and time savings, and the need for the construction, operation and maintenance of the toll road system to be self-financing. The government normally contributes an equity participation to cover the share of costs that could not be self financing.

Mass transit systems

There are 37 mass transit systems carrying 17 million passengers per day in 26 cities in Asia. Over two thirds of these systems are in high-income countries and, somewhat surprisingly given their high capital and operating costs, the bulk of the remainder are in low income countries (see Table 2.2 below).

Mass transit modes can be distinguished from other forms of public transport by their need for specific infrastructure to operate. This infrastructure can be above ground, below ground or at grade; but wherever it is located it usually needs to be separated from other traffic or pedestrians.

It is useful to distinguish three modes:

RAPID TRANSIT (MRT) systems, often called "metros", are rail based and fully grade separated (either above or below ground or physically protected when at grade), with the highest available capacity and travel speed performance characteristics;

LIGHT RAIL TRANSIT (LRT) systems, often called "trams" or "streetcars," are rail based and capable of operating at grade (within road rights-of-way) or grade separated, with higher capacities and higher speed performances than buses; and

GUIDED RAPID TRANSIT (GRT) systems are non-rail based and fully grade separated systems which make use of special guidance mechanisms and track; included within this category are the "new technology systems" such as "Guided Bus," "Monorails" and "Automated Guided Transit" (AGT) systems.

Mass Rapid Transit (MRT)

Of the cities in the region with populations exceeding one million, thirteen have operating MRT systems (see Table 2.3) and three more (Bangkok, Shanghai and Taipei) are planning or building them. The most extensive systems are found in Japan (in Tokyo) and the simplest systems in China (in Tianjin).

MRT systems have demonstrated a capacity to carry between 50,000 and 75,000 passengers per hour in one direction (pass/h/d). Some 81,000 pass/h/d were counted on one section of the Hong Kong MRT in 1987.

Tokyo has the most extensive urban mass transit system in the region with a municipal subway network and a rapid transit authority metro network. The Tokyo system also comprises "private railways" and commuter rail and carries over two million passengers per day.

Although efficient, the system is operating at "bodies touch, feel quite strong pressure, yet somehow magazines can be read" levels of 200 percent nominal capacity, an improvement over conditions

Table 2.2 Urban mass transit systems in Asia

Country	*City*	*MRT*	*LRT*	*GRT*	*Total*
Low income	**6**	**4**	**3**	**0**	**7**
China	Anshan	..	1	..	1
	Beijing	1	..	..	1
	Dalian	..	1	..	1
	Tianjin	1	..	..	1
India	Calcutta	1	1	..	2
Korea (DPR)	Pyongyang	1	..	..	1
Middle income	**3**	**2**	**1**	**0**	**3**
Korea	Pusan	1	..	..	1
	Seoul	1	..	..	1
Philippines	Manila	..	1	..	1
High income	**17**	**9**	**8**	**10**	**27**
Australia	Adelaide	..	..	1	1
	Melbourne	..	1	..	1
	Sydney	..	..	1	1
Hong Kong	Hong Kong	1	2	..	3
Japan	Chiba	..	..	1	1
	Ina	..	..	1	1
	Kitakyushu	..	1	1	2
	Kobe	1	..	1	2
	Kyoto	1	1	..	2
	Nagoya	1	..	..	1
	Osaka	1	..	1	2
	Sapporo	1	1	..	2
	Tokyo	2	2	1	5
	Yokohama	..	..	1	1
	Yukarigaoka	..	..	1	1
Singapore	Singapore	1	..	..	1
Total	**26**	**15**	**12**	**10**	**37**

Source: Annex Tables 8, 9, and 10.

in the late 1960s when the system was operating at "bodies affected by jolts of train and cannot move, even hands" levels of 250 percent nominal capacity.

Light Rail Transit (LRT)

Eleven cities have LRT systems (see Table 2.4, below). The majority are conventional "tram" systems which have been in existence since the 1930s; the Manila, Kitakyushu and Tuen Mun systems are more recently constructed LRT systems; and the Manila system is the only grade separated light rail system operating in the region.

Manila is extending its light rail system, and ongoing studies in Jakarta are examining the feasibility for guided bus transit and light rail.

Karachi is considering the development of a 90 kilometer partially elevated bus/light rail "transitway" system. The first section is expected to be light rail with remaining sections developed initially as busways, but designed for convertibility to light rail in the future.

Table 2.3 Mass rapid transit systems in Asian cities

Country/city	*Network (kms)*	*Lines (no.)*	*Stations (no.)*	*Pass/day (000)*
Low income	**80.5**	**6**	**65**	**705.1**
China:				
Beijing	40.0	2	29	500.0
Tianjin	8.0	1	8	30.0
India:				
Calcutta	10.0	1	11	60.0
Korea (DPR):				
Pyongyang	22.5	2	17	115.1
Middle income	**137.8**	**5**	**122**	**2,553.2**
Korea:				
Pusan	21.3	1	20	334.0
Seoul	116.5	4	102	2,219.2
High income	**484.5**	**29**	**443**	**12,569.2**
Hong Kong	39.0	3	37	1,624.7
Japan:				
Kyoto	6.9	1	8	130.0
Nagoya	60.2	4	61	926.6
Osaka	99.1	6	79	2,525.7
Sapporo	40.5	3	38	550.4
Tokyo[a]	205.8	10	197	6,591.8
Singapore	33.0	2	23	220.0
Total	**702.8**	**40**	**593**	**15,827.5**

a. excluding commuter rail
Sources: Annex Table 9.

Table 2.4 Light rail transit systems in Asian cities

Country /city	*Network (kms)*	*Lines (no.)*	*Stations (no.)*	*Pass/day (000)*
Low income	**106.6**	**33**	**598**	**1,344.0**
China:				
Anshan[a] 12.9	1	19	270.0	
Dalian[a]	14.7	3	29	600.0
India:				
Calcutta[a]	79.0	29	550	474.0
Middle income	**15.0**	**1**	**18**	**278.0**
Philippines:				
Manila	15.0	1	18	278.0
High income	**125.1**	**19**	**262**	**845.1**
Hong Kong				
Hong Kong[a]	16.9	6	97	352.6
Tuen Mun	23.3	5	41	150.0
Japan:				
Kitakyushu	15.4	1	..	46.6
Kyoto	25.2	2	32	98.6
Osaka	18.7	2	40	53.2
Sapporo[a]	8.4	1	23	28.0
Tokyo[a]	17.2	2	29	116.1
Total	**246.7**	**53**	**878**	**2,467.1**

a. conventional tram systems
Sources: Annex Table 8.

Guided Rapid Transit (GRT)

Ten cities in the region have "hi-tech" GRT systems operating, of which six are in cities below one million; all GRT systems, with the exception of those in Adelaide and Sydney, are in Japan (see Table 2.5).

The simplest technology used is the guided bus system in Adelaide, but it requires extensive precision in the design and construction of the "track;" the systems in Japan use advanced technology for automated guidance and/or operation to save on what are perceived as rising staff costs.

Most GRT systems have been built as alternatives to LRT systems and are designed to meet the transport needs of an intermediate volume of passengers between MRT systems and buses. In several cases, AGTs and monorails have been adopted to reduce the cost of land acquisition as the track takes less width than a conventional roadway or LRT system. Most link a specific community to the city center; and the monorail in Tokyo serves Haneda airport.

AGT systems are under construction in Nagoya and Taipei. Osaka is developing a linear motor system. Trials are underway for guided bus systems in

Japan and a guided bus system, similar to the Adelaide system, is under consideration in Jakarta. A Brazilian air-powered system is also undergoing trials in an amusement park in Jakarta.

Financing mass transit: BOT

Developing countries in Asia are unique in the development of private sector financing of urban transit systems. As many as six mass transit schemes with varying levels of private sector financing and operation are under active consideration in the region (two in Bangkok, one in Manila, one in Karachi and two in Taipei).

Private sector interest not withstanding, to date no privately financed urban mass transit system is yet operational in Asian developing country cities. The Calcutta metro was funded by the central government with a contribution from Japan, the Manila LRT was a turnkey contract financed by loans from the Belgium government and foreign banks with about 30 percent central government equity.

Thailand is the pacesetter in attracting private sector finance for urban mass transit with a growing list of Build-Operate-Transfer (BOT) projects in and around Bangkok. It would seem that the levels of congestion are so high in Bangkok that private investors feel that such schemes can be financially viable.

Table 2.5 Guided rapid transit systems in Asian cities

Country/city	*System*	*Network (kms)*	*Stations (no.)*	*Pass/day (000)*
Australia:				
Adelaide	Guided Bus	12.0	3	22.8
Sydney	Monorail	3.6	..	..
Japan:				
Chiba	Monorail	15.3	18	..
Ina	AGT[a]	12.7	13	19.5
Kitakyushu	Monorail	8.4	12	26.3
Kobe	AGT[a]	6.4	9	41.4
Osaka	AGT[a]	6.6	8	55.1
Tokyo	Monorail	13.2	5	85.7
Yokohama	AGT[a]	11.0	14	..
Yukarigaoka	Monorail	3.6	6	0.9
Total		92.8	88	251.6

a. AGT=automated guided transit
Sources: Annex Table 10.

Two schemes are under consideration: the Hopewell scheme which is a US$3.1 billion project to build a combined 60 kilometer elevated rail and 57 kilometer elevated expressway (with Hopewell Holdings of Hong Kong) and the US$2.1 billion "Skytrain" scheme to build a 34 kilometer elevated mass transit system (with Lavalin of Canada).

The World Bank is involved in the preparatory stages of the Karachi scheme where potential exists for private sector participation in the first section of the proposed transitway system.

Some systems in other cities are associated with property development schemes which are attractive to the prospective developers and are intended to contribute to the financing of the mass transit infrastructure.

Experience with this approach in Asia, outside of Japan, is limited to Hong Kong where it is estimated that development profits will have funded about 15 percent of the HK$38.6 billion capital cost of the MRT. Consideration is being given to this approach in Bangkok, where the Hopewell mass transit scheme is linked to substantial land development rights; and in Taipei, where an innovative approach is being taken to station developments for the MRT in which equity stakes are held by the transit company, the land owners and the private developer.

Traffic engineering and traffic management

As a complement to creating more physical capacity through major investment in urban transport infrastructure, many cities have attempted to make more effective use of existing road space by traffic engineering techniques. Some have attempted to translate these techniques into effective traffic management schemes to reduce demand and/or give priority to moving people rather than vehicles—by providing facilities for high occupancy vehicles such as buses.

Traffic engineering makes use of simple techniques such as lane markings, channelization (traffic islands, median strips, etc), traffic signs and traffic signals to improve the flow and safety of traffic. Often these simple measures are combined with slightly more sophisticated techniques such as computerized "area traffic control" (ATC) systems, one way street networks, bus lanes and bus priority measures to manage the traffic system of a whole city center more efficiently.

In very rare cases in the region, traffic management is used as part of a package of policy and regulatory measures designed to reduce non-esser:-

tial vehicle usage, protect the environment, reduce fuel consumption and reduce accidents. Box 2.1 provides an example of such use of traffic management measures in Singapore.

In Singapore, these techniques have proven effective not only in reducing congestion but also in improving public transport speeds, reducing accidents and saving fuel. In other cities, they have proven difficult to sustain without complementary measures to reduce car usage as can be seen by comparing the early results of such a scheme in Bangkok in 1982 (see Box 2.2) with the congested conditions in the city today (as described earlier in this report).

Area traffic control

Area Traffic Control systems provide for the central computerized management of traffic signal controlled junctions along traffic corridors and/or within specific areas with complex or intense traffic flows (such as Central Business Districts).

Box 2.1 A summary of the traffic management systems that have been implemented in Singapore

(a)Street usage strategies
- One-way schemes
- Bus bays
- Bus lanes

(b)Signalized traffic control
- Area traffic control (ATC)
- Green link determining system (Glide)

(c)Road pricing and car pools
- Area licensing scheme (ALS)
- Car pools
- Park-and-ride

(d)Car parking and vehicle inspection
- Parking space control
- Adjustment of parking fees
- Compulsory vehicle inspection system
- Incentives for the replacement of old cars with new ones

(e)Public transport management
- Encouraging the use of public transport system
- Discouraging car ownership through various fiscal measures

(f)Other systems
- Construction of overhead pedestrian crossings
- Imposition of speed limits
- Driver information

Source: Traffic Management Systems and Energy Savings: The Case of Singapore, B. W. Ang, 1989.

Box 2.2 Traffic engineering in Bangkok

Bangkok's bus lanes initially reduced car travel times by up to 29 percent over the roads concerned while its first ATC scheme increased total flows between seven and eight percent, reduced travel times by 27 percent and, through reducing the number of stops, achieved fuel savings of as much as 18 percent within the ATC area which was only three kilometers across.

Source: The effects of urban traffic control in Bangkok, J. H. Jones, N. W. Marler and A. J. Downing, TRRL, 1982.

The most sophisticated systems in the region are to be found in Japan and Australia. In Tokyo and Osaka traffic flows are monitored continuously and signal timings can be adjusted "on-line" to divert traffic to less congested sections of the network. The city of Sydney has pioneered and developed a traffic responsive control system called SCATS (Sydney Co-ordinated Adaptive Traffic System) which is also being used in Shanghai (an example of intra-regional technology transfer).

Japan has the highest density of ATC systems in the region with a total of 34,500 intersections under area traffic control in 74 cities. Bangkok, Bombay, Hong Kong, Jakarta, Kuala Lumpur, Manila, Pusan, Seoul, Shanghai, Singapore and Taipei have all, to some degree, developed ATC systems. ATC is the most technology-intensive traffic management measure and the one which relies most on imported hardware and software. ATC is being introduced in Beijing and more extensive ATC systems are being considered in Bangkok, Jakarta and Shanghai.

When used appropriately, ATC systems can not only reduce congestion but also impact on fuel efficiency and fuel savings as is evidenced from recent research in Singapore. Average morning peak hour speeds increased by 16 percent from 25.7 kilometers per hour before the ATC scheme was introduced to 31.7 kilometers per hour under ATC operation.

In Singapore, the ATC scheme is estimated to have reduced average fuel consumption per passenger in the morning peak hour by 18 percent from 8.3 kilometers per liter to 12 kilometers per liter. Aggregate fuel savings (gasoline and diesel) are estimated to have risen annually from 8.5 million liters in 1982 (six months after the scheme was introduced) to 9.8 million liters by 1986.

On the basis of these estimates, the capital cost of the ATC scheme was "recovered" on fuel savings alone within its first two years of operation.

Bus lanes

Bus lanes (devel ·ped initially in France in the early 1960s) and busways (developed initially in the USA in the 1970s) are used widely in Europe and North America for giving priority to buses (and other high occupancy vehicles such as taxis and car pools) in congested city centers and/or along congested commuter routes. Busways are used extensively in Brazil where, in Sao Paulo, they have been found to carry up to 20,000 passengers per hour—equivalent to rail based mass transit systems.

Many cities in Asia have introduced bus lanes but reliable data is only available for facilities in fourteen cities (see Table 2.6).

The most extensive bus lane networks are to be found in Tokyo and Bangkok. The Tokyo network comprises "with flow" bus lanes which provide priority only during the peak hour for peak direction bus flows. The Bangkok network is more sophisticated and comprises 24 hour bus lanes many of which are "contra-flow" (operate in the opposite direction to traffic flows along a one-way street) and provide "short-cuts" for buses through the one-way street network.

Japan is the only country in Asia which has made use of busways. They are found in two cities, Kitakyushu and Nagoya. The Nagoya system is the most extensive but is only partially physically segregated from other traffic.

A 13.7 kilometer bus lane has been recently established in Jakarta and a further 18 kilometers of bus lanes are scheduled to be opened by the end of 1991. A system of busways is being considered (along with LRT) to meet the mass transit needs of Jakarta and Karachi, and busways have been proposed in Bangkok.

Table 2.6 Bus priority facilities in Asian cities

	Bus lanes		*Busways*	
Country /city	*Length (kms)*	*Speed (km/h)*	*Length (kms)*	*Speed (km/h)*
Low income	13.7	..	..	..
Indonesia:				
Jakarta	13.7			
Middle income	221.7	..	0.0	..
Philippines:				
Manila	21.7	20.0	0.0	..
Thailand:				
Bangkok	200.0	35.0	0.0	..
High income	459.7	..	25.0	..
Australia:				
Brisbane	3.0	..	..	..
Melbourne	1.3	17.0	..	..
Perth	3.8	..	..	..
Sydney				
Hong Kong:				
Hong Kong				
Japan:				
Kitakyushu	..	..	4.0	..
Kyoto	93.0	17.0	..	..
Nagoya	59.0	..	21.0	25.0
Osaka	11.6	..	..	..
Tokyo	238.0	14.0	..	..
Singapore:				
Singapore	68.0	..	..	..
Total	695.1	..	25.0	..

Sources: Jane's Urban Transport Systems 1989; and study reports.

Traffic restraint measures

Unlike traffic management measures, which seek to manage existing traffic flows more effectively, traffic restraint measures seek to discourage the use of cars in order that other road users, especially public transport, pedestrians and goods vehicles may benefit. The main restraint measures in use in Asia are parking controls and area licensing.

Most cities in Asia control on-street parking with varying degrees of success depending on the level and extent of enforcement applied. Singapore is the only city, probably in the world, with effective traffic restraint measures centered on its famous Area Licensing Scheme (ALS) which was inaugurated in 1975. It is accompanied by strict controls on the amount of parking which business and public agencies may provide there. These measures, coupled with the development of effective bus and mass transit public transport systems, have cut the number of cars entering the restricted zone in the rush hour by three quarters and as a result Singapore is relatively unjammed.

A recent survey found that in 1989 the number of vehicles entering the restricted zone during the morning peak period (7.30 am to 10.15 am) was 51,000 compared with 74,000 in 1975, before the ALS scheme was implemented. This is even more impressive when seen in the context of Singapore's development. In the 14 years of ALS operation, the restricted zone has grown by a third in terms of employment, a tenth in size, and the vehicle population in Singapore has increased by 68 percent!

This scheme is now being upgraded to full road pricing that will, over time, be extended to the whole island. Various other measures (import duties, addi-

tional registration fees (ARFs), "bonuses" for scrapping old cars, annual road tax increases and a quota system for the maximum numbers of new vehicles that can be registered) are being also used effectively in Singapore to curb the growth in vehicle ownership.

Experience with area licensing, although effective in Singapore, has revealed the need for political consensus and commitment to enforcement which other countries in Asia have found hard to achieve. Attempts to institute area licensing in World Bank projects in the late 1970s in Bangkok and in Kuala Lumpur failed in part due to resistance from the car owning lobby and central area business interests.

In 1983, Hong Kong was the first city in the world to test the technical, economic and administrative viability of electronic road pricing (ERP) to curtail traffic as an alternative to parking controls, area licensing and physical restraint measures. ERP was found to be effective in reducing congestion by time-of-day and location but it was abandoned in 1985 because (a) car drivers felt singled out and discriminated against (taxis were seen to create more congestion but were exempted from ERP charges); (b) ERP was considered an invasion of privacy (and the installation of closed circuit television cameras to catch defaulters did not help); (c) the Government did not succeed in effectively explaining the purpose and benefits of the system; and (d) it was perceived by the public as yet another ploy by Government to raise revenues (as vehicle taxation had recently been increased substantially and had already resulted in a reduced vehicle use and growth in the fleet).

Despite the apparent unpopularity of traffic restraint measures, further consideration needs to be given to them in Asia in the future if central business districts are to survive. Current developments in electronic road pricing (ERP) technology may provide a more palatable way for restraining peak hour demand for travel by car.

Urban bus services

Buses form the backbone of urban public transport services throughout Asia with the notable exception of Japan and Australia (where in both countries extensive use is made of rail based urban public transport). Most cities have bus systems which are owned and operated by the public sector but many cities have private sector operations and informal "paratransit" systems operate extensively in most cities in South East Asia.

In all cities in China, in the People's Democratic Republic of Korea and in Australia ownership is public. In Hong Kong, Korea, in Malaysia and in Singapore ownership is private. In all other cities ownership is mixed. Data on paratransit operations is incomplete but where it exists it suggests that paratransit is the predominant form of urban public transit in Bangladesh, in Indonesia, in Pakistan, in the Philippines and in Thailand.

As can be seen from Table 2.7, it would appear that in terms of vehicle fleets paratransit and public sector bus companies predominate in low income countries; paratransit and private bus operations predominate in middle income countries; and private and public sector operations predominate in high income countries.

Throughout the region, the level of service provided by bus operators in developing country cities has continued to deteriorate over time. In the case of public sector operations, companies are frequently observed to be saddled with poor management, operated by labor regulated by restrictive practices, constrained by inadequate financing policies, affected by poor maintenance of vehicles, and

Table 2.7 Percentage distribution of vehicles by urban public and private bus companies and paratransit in selected Asian countries

	Bus companies		%
Country /city	*% Public*	*% Private*	*Para transit*
Low income	22.8	8.3	68.9
Bangladesh	4.3	..	95.7
China	100.0	..	..
India	70.6	29.4	..
Indonesia	2.3	6.4	91.3
Korea (PDR)	100.0	..	..
Myanmar	50.0	50.0	..
Pakistan	24.3	18.9	56.8
Middle income	7.9	20.1	72.0
Korea	..	100.0	..
Malaysia	..	100.0	..
Philippines	1.8	8.0	90.1
Thailand	15.1	5.4	79.5
High income	43.1	36.8	20.1
Australia	100.0	..	..
Hong Kong	..	47.0	53.0
Japan	89.6	10.4	..
Singapore	..	100.0	..
Total	19.9	14.0	66.1

Source: Jane's Urban Transport Systems 1989 and various study reports and seminar papers.

unable to provide adequate service frequencies and route networks.

Many publicly owned bus operations are highly subsidized, subject to revenue leakage and overstaffed (see the staff per bus ratios presented in Figure 2.6).

Even where services are provided by the private sector, in many cases deterioration of services and frequencies has also occurred due to restrictive policies and regulations by public authorities.

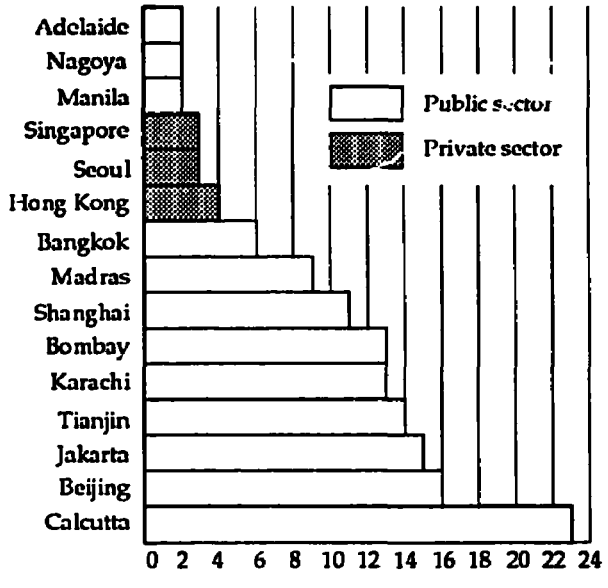
Restrictive fare policies and licensing controls have often inadvertently accelerated the deterioration of service as well as the condition of the vehicles. This in turn has aggravated overcrowding, increased the incidence of breakdowns and added to poor service frequency and stimulated the continued decline and deterioration in general levels of service and comfort.

Not surprisingly, urban bus services are perceived by most people in Asian cities as being inadequate, overcrowded and unresponsive to demand.

Public sector bus companies

The public sector has been traditionally responsible for the provision of public transport services in most Asian cities. In countries such as China, India and Australia ownership is vested with the public sector; in others, such as Indonesia and Thailand, the public sector is both "owner" and "operator" of bus companies and regulator of competing private sector services.

Figure 2.6 Staff per bus ratios in selected Asian city bus companies



Source: World Bank, *Urban Transport Data Book: 1987*

Public sector bus operations are generally inefficient and subsidized. In Indonesia, where large public bus companies were created in the early 1980s to serve Jakarta and eight regional cities, central government expenditures on these companies between 1979 and 1984 amounted to 15 percent of total spending on urban services by all levels of government.

China has the most extensive network of public sector bus companies in the region with an annual ridership of 26 billion passengers and with 45,000 buses distributed over a total route length of 106,000 kilometers in 310 cities. China is one of the few countries in the region to make extensive use of trolley buses. Ten cities have trolley bus networks; the most extensive are in Shanghai and Shenyan where trolley buses account for one third and one half respectively of total ridership in each city.

Fares have been kept at artificially low levels for several decades in China as public transport was considered part of public welfare. In recent years, the operating costs of public transport have been increasing substantially and operators have been incurring increasing losses which are met by subsidies from local governments.

In India, urban bus services are usually provided by State Road Transport Corporations or by city corporations and the private sector is effectively banned. In 1988, the Association of State Road Transport Undertakings comprised 66 members which owned 90,000 buses with an annual ridership of 18.6 billion passengers. Most of these bus companies are providing inadequate urban services and are operating them at a loss.

Public sector bus operators typically operate under the dual burden of politically restrained fares and strong labor union pressure requiring excessive staffing. For example the Calcutta State Road Corporation currently employs 17.5 workers per bus compared with three in Singapore and two in Adelaide. The result is typically loss-making operations which provide neither a quality or quantity of service that meets demand (see Box 2.3, below).

Employers in some cities in India provide their own bus services rather than rely on the public bus company. Exacerbating the problem is the very large size of some bus companies in an industry where economies of scale are known not to exist after an operation reaches between 300 and 400 buses. For example the Maharashtra State Road Corporation with over 100,000 employees and nearly 14,000 buses is among the largest bus companies in the world.

Overall, these state run bus companies have losses that are estimated to have reached US$ 100 million in 1985 and are a major drain on government resources.

Private sector bus companies

In Asia, with the exception of Hong Kong and Singapore, private sector bus operations are predominantly run by small operators.

Seoul has a fleet of 8,000 buses operated quite efficiently and without subsidy by some 90 private groups or companies operating as a cooperative under franchises issued by the municipal transport board.

In Pusan, bus services are provided by 65 private companies which operate as an Association with some 2,300 buses on a route-franchise basis. Each company typically operates between one and five routes and the frequencies and fares are set by government agencies.

In Kuala Lumpur, conventional bus services are provided by eight area-franchised private companies with a combined fleet of around 1,000 buses and by many route-franchised owner-operators with a combined fleet of around 500 minibuses.

Private bus companies are found in Hong Kong and Singapore. In Hong Kong the financial objectives of public transport operations are, reportedly, to make a profit out of the system. The two major bus companies, Kowloon Motor Bus (KMB) and China Motor Bus (CMB), are franchised by government and receive no subsidies.

Box 2.3 Public transport in Indian cities

Urban transport in India today presents a depressing and bewildering picture. The scene is marked by the preponderance of over-aged vehicles of out-moded designs and obsolete technologies, invariably overloaded beyond permissible limits, plying on poor road surfaces under hazardous traffic conditions. Passengers are called upon to endure excessive journey times and to tolerate long periods of waiting, not to speak of accident hazards. Increasing congestion, noise and air pollution, growth of travel demand in geometric progression, stagnant public transport supply capacity and ever increasing gap between earnings and expenditure of public transport organizations are some of the more conspicuous features of urban travel that cause concern. If the situation is already bad enough, the future trends project a much more explosive situation by the turn of the century.

Source: Public Transport: The Indian Scene, V. Nagaraja.

Arrangements are made about levels of service and route structure based on five year plans. Grants are provided by government for student travel concessions and these, in the case of KMB, amounted to 5.5 percent of operating costs in 1988.

In Singapore, government involvement in public transport did not result in a loss of private ownership or subsidies. Improvements were achieved over several years by reorganizing 11 bus companies into four, then three, and ultimately one, and through the infusion of management skills and better enforcement of regulations. This approach, although slower than a government take-over, brought steady improvements yet preserved the financial viability of public transport operations.

Singapore currently has two privately owned bus companies, Singapore Bus Services (SBS) established in 1978 and Trans-Island Bus Services (TIBS) established in 1982 to introduce competition with SBS. In 1988, SBS had a fleet of 3,000 buses operating on 220 routes and TIBS had a fleet of 340 buses operating on 24 routes.

Paratransit services

Paratransit services are mostly provided by the informal sector. Rarely encouraged officially, paratransit operations provide an important service in cities throughout the region with the notable exceptions of China and high income countries such as Australia, Japan and Singapore.

Reliable data on paratransit is unavailable due to the informal, and sometimes illegal, nature of the services. From the findings of a study undertaken in 1981 of paratransit use in selected Asian cities it is evident that paratransit use is widespread and predominant in secondary cities in low-income countries.

Manila is famous throughout the world for its "jeepneys" which have progressed from being an informal "pirate taxi" system (developed using US Army surplus jeeps after the Second World War) into a major public transport business with an officially estimated fleet of 28,000 owner-driver vehicles (unofficial estimates put the fleet as high as 60,000 vehicles) carrying 2.3 million passengers daily.

Present day jeepneys are assembled locally by a thriving industry. With flamboyant and brightly painted coachwork, adorned with slogans and chrome plated accessories, and with cassette players pumping out the latest disco music, the present Jeepney has been described as a mobile celebration experience. All this is in the interests of marketing and attracting patronage in a highly competitive market.

Paratransit vehicles in Bangkok carry 1.3 million passengers per day which represents 15 percent of the 8.1 million public transport related trips made by bus, minibus, taxi, rail and boat in the city in 1989.

Paratransit services comprise some 7,900 "silors" (light trucks converted into six-seat vehicles), 7,400 "samlors" (three-wheeled vehicles, also known as "tuk-tuks" because of their engine noise, which carry up to three passengers) and 16,600 hired motorcycles which ply the narrow "sois" or alleys which make up the secondary road network in Bangkok. Hired motorcycles, although increasingly popular, are considered relatively unsafe given the probability of being involved in an accident in one year is greater than 50 percent.

Revenues exceed expenses for all modes, with the excess of revenues over expenses ranging from 41 percent in the case of silors to 181 percent in the case of hired motorcycles (see Table 2.8, below).

A recent study of paratransit in Southeast Asia concludes that while it is well known that paratransit provides low performance services tailored to what people can pay, an often overlooked benefit is that paratransit also compensates for the inadequacies of the road network in many Asian cities.

Using data for eight cities in Southeast Asia (Bandung, Bangkok, Jakarta, Kuala Lumpur, Manila, Medan, Singapore and Surabaya) the study found that the greatest variety of paratransit modes, both in terms of vehicle types and seating capacities, generally exists in places with the least amount of road capacity per capita and a poor road hierarchy. This is certainly the case in Bangkok. Where unhampered by strict entry and service regulations, it would appear that the urban transport market can respond to the inadequacies of the physical road network.

A dilemma in the field of paratransit is that although such services provide an affordable public transport service at no cost to governments, they are seen as inefficient users of road space.

This is illustrated well in the case of Manila. Although jeepneys provide extensive coverage, high frequency, almost door-to-door service which is affordable to the majority of the population, they are considered by Government to be inefficient users of road space.

Table 2.8 Operating characteristics of paratransit services in Bangkok (1989)

Average per vehicle	*Samlor*	*Silor*	*Motorcycle*
Trips per day	20.6	16.0	28.3
Passengers per day	42.0	26.1	34.3
Working days per week	6.6	6.7	6.7
Working hours per day	10.2	11.7	12.1
Revenue per day (US$)	$ 17.70	$ 12.75	$ 9.33
Expenses per day (US$)	$ 12.53	$ 6.51	$ 3.32
Revenue/Expenses	1.41	1.96	2.81
Income per day (US$)	$ 5.17	$ 6.24	$ 6.01
Monthly income (US$)	$150.97	$181.73	$174.80

Source: The Study on Medium to Long Term Improvement/Management Plan of Road and Road Transport in Bangkok, JICA, 1990.

Urban travel by mode

Comprehensive data on urban travel patterns in Asia does not exist. The reliability, nature and timing of the data that is available is so variable that statistical comparisons are impossible. In attempting to assess travel characteristics in Asian cities, we are obliged, therefore, to use what little data exists as being representative of conditions in the region as a whole.

Data from Bangladesh, China, India and Indonesia provide glimpses of typical conditions in low-income developing countries; data from Korea, Malaysia, the Philippines and Thailand present the picture in middle-income countries; and data from Hong Kong, Japan and Singapore provide an indication of conditions in high-income countries.

Low-income countries

An analysis of urban travel characteristics by all modes in low-income countries are presented in Annex 1 Table 11. Walking and non-motorized vehicles are the predominant travel modes in most cities. This is still likely to be the case despite the increase in vehicle ownership (especially motorcycles) which has occurrred since the survey data was collected.

Not surprisingly, public transport is the predominant modes of motorized travel in most cities (see Table 2.7 and Annex 1 Table). Buses account for over 60 percent of motorized trips in Bangladesh, China, India (except for Kanpur where buses account for 11 percent of trips) and Pakistan. In Indonesia, however, buses are not the predominant mode. In Jakarta, they account for 42 percent of motorized trips and, in Surabaya, they account for only 24 percent of motorized trips due to the intense use of motorcycles (which accounted for 46 percent of motorized trips in 1984).

BANGLADESH. Dhaka, Bangladesh is one of the poorest cities in the region and, not surprisingly, the majority of trips are either on foot or non-motorized modes of transport. The only data available dates back to 1980, at which time 21 percent of trips were on foot, 35 percent by rickshaw, 34 percent by bus, four percent by auto-rickshaw and only six percent by car.

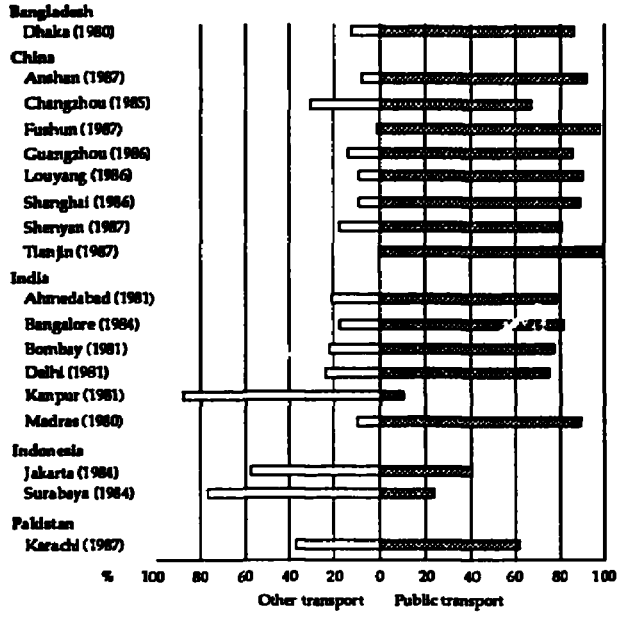
CHINA. Walking and cycling are the predominant modes of travel in all Chinese cities and bicycles play an important role in personal mobility due to Government policies to promote their use over the past 40 years as an alternative to motorization.

In 1986, average travel distances for bicycle trips were around five kilometers in most cities (ranging from 4.6 kilometers in Anshan and to 5.5 kilometers in Fushun) with travel times less than 30 minutes.

Bus trips are slightly longer, ranging from five kilometers in Tianjin to 8.7 kilometers in Fushun but bus travel times are almost double those of bicycles in all cities.

INDIA. In India, the travel characteristics of urban households fall into three broad categories:

Figure 2.7 Percentage of trips by public transport and by other transport modes in selected cities in low-income Asian countries



Source: Annex Table 12.

- motorized households which make up ten percent of the urban population;
- public transport orientated households which represent 60 percent of the urban population; and
- walking and/or NMV dependant households which account for the remaining 30 percent.

Public transport is the dominant form of urban motorized travel, especially in large cities such as Bombay, Delhi and Madras, accounting for about 80 percent of all motorized trips.

Walking and cycling trips are less common in large cities, such as Bombay (where they account for 15 percent and 10 percent respectively of total trips) than in smaller cities such as Kanpur (where walking accounts for 72 percent of all trips) and Lucknow (where NMVs account for 53 percent of all trips).

Trip lengths vary considerably by city size in India averaging around five kilometers in cities with populations below 100,000 to around 11 kilometers in cities with populations above 200,000.

INDONESIA. Motorized forms of transport are used more in Indonesian cities than in Bangladesh, China and India. Some 60 percent of trips in Jakarta and 55 percent of trips in Surabaya are motorized. Motorcycles are becoming important urban modes of travel in both cities where they account for between 13 and 26 percent of all trips.

In 1985, the trip rate for low income residents of Jakarta was two-thirds that of high income groups and the average trip distance of low income groups was about half that of high income groups.

The differential in trip making between rich and poor can be seen with some clarity in Jakarta where 60 percent of low income trips are on foot and 63 percent of high income trips are by car. Undoubtedly similar disparities exist in other low-income countries, with the notable exception of China.

Middle-income countries

Urban travel characteristics of middle-income countries are presented in Annex 1 Tables and and are summarized in Figure 2.8.

Data on all modes are only available for cities in Korea and Malaysia where it would appear that walking and non-motorized modes are less significant than in low-income countries. In most middle-income cities bus use predominates but in some cities such as Seoul, and more recently, Manila and Pusan, rail systems are beginning to take a share of public transport trips.

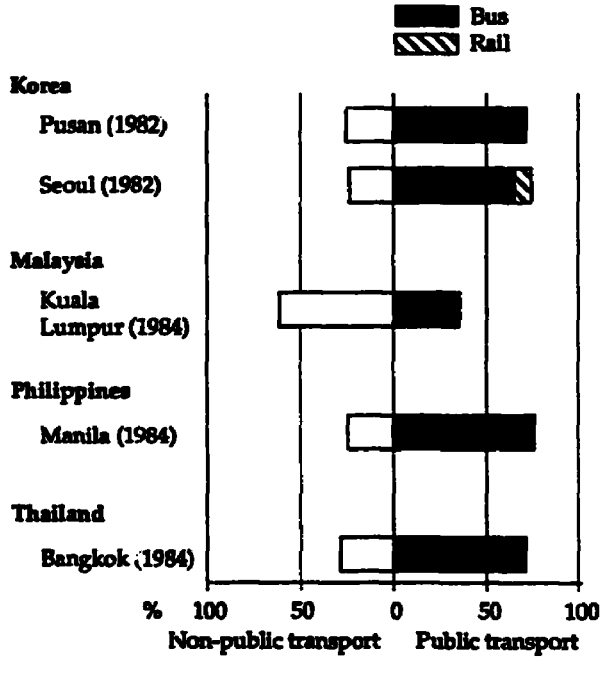
KOREA. Data for Korea are derived from comprehensive urban transport studies undertaken in 1982. Since then, Pusan has put into service a 32 kilometer subway line and the metro system in Seoul has expanded from one line, 7.8 kilometers in length to eight lines, 117 kilometers in length.

The vast majority of trips in both cities were by bus in 1982, with cars accounting for less than ten percent of all trips. Since then, the rise in car ownership and the rapid increase in motorcycle use (estimated to have grown at 15 percent annually since 1983) will have lead to more trips being made by these modes.

This can be seen in the case of Seoul where, in the six years between 1982 and 1986, car trips increased from nine percent to 16.6 percent. During the same period, the subway increased its share from 7.4 percent to 16.8 percent and the proportion of trips by bus decreased from 66.6 percent to 50.6 percent.

Although comparative data are not available for Pusan, it would appear that a similar phenomenon has occurred there as it is reported that since the opening of the subway, one third of bus passengers have diverted to the subway along the mass transit corridor.

Figure 2.8 Percentage of trips by public transport and by non-public transport modes in selected cities in middle-income A: 'an countries



Source: Annex Table 11.

MALAYSIA. In 1984, around one third of trips were made by car and one third by bus. Motorcycles and walking accounted each for ten percent of trips with non-motorized vehicles (two percent) and taxis (eight percent) making up the remainder.

THE PHILIPPINES. In Metro Manila, there were an estimated 16.3 million person trips per day in 1989 and the majority are by public transport. Jeepneys account for 75 percent of public transport trips while the LRT system accounts for only a modest three percent. Within the LRT corridor, the system is reported to carry 35 percent of public transport demand and has led to a 15 to 20 percent reduction in vehicle flow (principally jeepneys).

Car usage has increased from 26 percent of motorized trips 1980 to 35 percent in 1989 despite recent years of slow economic growth.

THAILAND. The majority of trips in Bangkok are by bus and by car but an increasing proportion of trips are being made by motorcycle as people search for ways to cut through traffic jams.

The average trip length in Bangkok is currently estimated to be 6.6 kilometers and is forecast to reach over ten kilometers within the next fifteen years due to the continued expansion of the city.

Despite the plethora of studies on Bangkok's urban transport system, data on travel time is illusive. Journey times are nevertheless considered "excessive" and, worst of all, "unpredictable" during the working day for all modes of transport.

Speed data indicate that buses (which have the advantage of using bus lanes) actually travel at speeds faster than cars during peak hours, indicating that the door-to-door time advantages of cars over buses may be very little in the city.

High-income countries

The travel characteristics of large cities in high-income countries are differentiated from such cities in low- and middle-income countries by the relatively higher use of mass rapid transit and commuter rail systems. Over two-thirds of motorized trips in Osaka and Tokyo are by rail based public transport.

Figure 2.9 presents the breakdown of public transport and non-public transport motorized trips in selected high income countries. The lack of data on walking and the use of non-motorized vehicles in transport studies in high-income countries probably means the use of these modes is both insignificant and not problematic to the performance of the transport system.

HONG KONG. Around 90 percent of trips in Hong Kong are made by public transport and a quarter of these were by MRT in 1988. As can be seen from Figure 2.22, below, the proportion of trips by the MRT has more than doubled between 1980 and 1988.

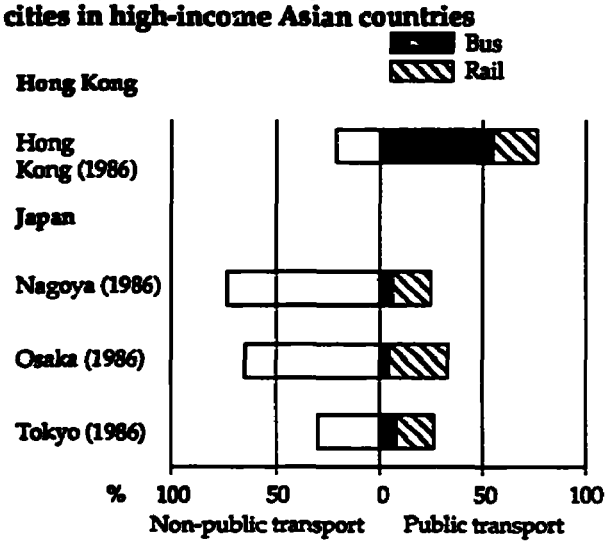
The shift to rail mass transit in Hong Kong has been at the expense of ferry services (which saw their share of trips decline from nine percent in 1976 to three percent by 1988) and minibuses. The quantity of minibuses has been held constant by Government since 1976, resulting in a decline in their share of trips from 28 percent in 1976 to 17 percent by 1988.

Bus services maintained their 46 percent share of public transport trips from 1976 (before the introduction of the MRT) to 1980 (after the MRT went into service) after which there was a minor decline to 43 percent by 1988.

It is reported that by 1988, car ownership fell sharply as a result of restraint taxes but bus flows increased and congestion remains as severe as ever. Average journey times are reportedly around 30 minutes for all modes.

SINGAPORE. The majority of trips in Singapore are by bus but the MRT system, which began operations in 1987, had already accounted for 14 percent of daily public transport trips by 1989.

Figure 2.9 Percentage of trips by public transport and by non-public transport modes in selected cities in high-income Asian countries



Source: Annex Table 12.

JAPAN. The proportion of bus trips in Japanese cities is very low (accounting, in 1985, for 3.6 percent, 6.4 percent and 8.4 percent of motorized trips in Osaka, Tokyo and Nagoya respectively) compared with other cities in high-income countries in the region.

In Osaka and Tokyo the majority of trips are by rail (subway and commuter rail) reaching as high in 1985 as 73 percent of motorized trips in Tokyo and 65 percent in Osaka. In Nagoya, which is representative of smaller cities, the majority (around 60 percent) of motorized trips in 1985 were by car. Rail trips accounted for 28 percent of the total which is still a higher proportion than in any other city in the region outside of Japan.

The only comprehensive data available concerning the proportion of walking and bicycle/motorcycle trips is for Tokyo. Walking accounts for 13 percent of total commuting trips in central Tokyo, higher than the Metropolitan Region average of seven percent. Bicycles and motorcycles are used more for commuting (presumably to rail stations) in the outer suburbs of Tokyo, where they account for between ten and 25 percent of trips, than in the center (where they account for 11 percent of trips).

Urban freight transport

Cities throughout the world are centers of consumption and production. It is not surprising, therefore, that inbound freight usually exceeds outbound or "back haul" freight in terms of volume.

This is the case with most cities in Asia and this directional imbalance in road-based freight volumes often causes outbound trucks to be empty and inbound trucks to be overloaded in an effort to recover the costs of the round trip journey on the inbound trip.

Overloading is also caused by seasonal peak demands exceeding the capacity of the trucking fleet. Often truck fleets do not expand to meet peak demands because competition for available "back haul" is already severe. The impact of such overloading in Bangkok is illustrated in Box 2.4.

The directional imbalance of freight also causes congestion due to outbound trucks queuing for hours and sometimes days to pick up "back-haul" cargo. The nature of this problem can be observed in Bangkok, where in 1988, the annual tonnage of inbound cargo (41.4 million tons) was nearly four times higher than outbound cargo (11.1 million tons) and where inbound laden trips (3.7 million) were three times higher than outbound laden trips (1.1 million).

Trucks are estimated to represent 20 percent of total vehicle flow (excluding motorcycles) in Bangkok and the truck fleet has been increasing at 12.5 percent annually between 1982 and 1988.

In Pusan, between 1973 and 1983, daily urban freight volumes increased from 75,000 tons to 295,000 tons; a fourfold increase in ten years. The majority of freight in Pusan is moving within the city accounting for 50 percent of daily volumes in 1983 (compared with 46 percent of inbound/outbound volumes and four percent of "through" volumes). Trucks and vans accounted for around 20 percent of traffic volumes in 1983.

In trying to cope with congestion caused by freight traffic, many cities in the region have instituted "truck bans" which operate by time of day and/or along certain roads or within certain areas of the city. Distribution centers and freight terminals have been built and proposed in many cities to resolve the problem of truck parking.

Truck bans

A number of large cities in developing countries have imposed truck bans of various forms. They fall into two categories: area-wide bans and route limitations. Bangkok and Jakarta use the first type of restriction, while Manila the second.

The following detailed descriptions provide an example of truck ban operations in these cities:

BANGKOK. Four and six-wheeled trucks are restricted in the Greater Bangkok Area during peak hours (06h00-09h00 and 16h00-20h00) every day except official and school holidays. Ten wheelers and larger trucks are restricted in the morning between 06h00 and 10h00 and in the afternoon/evening between 15h00 and 21h00 every day except official holidays. Small cargo vehicles whose tare weight is less than 1600 kg are exempt from these restrictions.

These restrictions apply to moving vehicles. Therefore, when the restricted period begins, trucks must stop wherever they are inside the city and as a result many trucks end up parked on inner-city streets for many hours.

There are several designated truck routes which allows premises along these routes to be serviced at all times.

JAKARTA. Trucks whose gross vehicle weight is heavier than 3.5 tons are not allowed to enter the downtown area of Jakarta in the morning between 07h00 and 09:00 and in the afternoon between 15h00 and 17h00 on weekdays and between 07h00 and 09h00 and between 13h00 and 15h00 on Saturdays. These restrictions do not apply to trucks owned by the Government and the Army, nor to trucks used for the transportation of fuel, food and cement.

Articulated trucks are not allowed into the city between 06h00 and 18h00; tractors with 20 foot container are banned from the city between 06h00 and 22h00; and tractors with 40 foot containers are banned from the city at all times. These vehicles are allowed on the toll roads, ring roads and harbor roads at all times.

MANILA. The passage of trucks is banned on eleven specific routes in Metro-Manila between 07h00 and 09h00 and between 16h00 and 19h00, Monday through Friday.

Where these measures have been introduced they have contributed to the alleviation of traffic congestion, but they have caused other problems.

Congestion has been shifted to the periphery of cities where long lines of trucks are observed waiting for the end of restricted time period for entering the city.

Large trucks are forced to limit their operation to only off-peak hours or during nighttime, which significantly reduces truck utilization rates and users of trucking services suffer from inconveniences due to shortened service times and also from higher freight charges.

Freight terminals

Few freight terminals have been built in the region outside of Japan. Most truck operators do not understand the benefits of using truck terminals. In most developing countries the majority of truck operators

Box 2.4 Truck overloading in Bangkok

The loading of trucks beyond the legal limit is commonplace. Even government trucks are consciously overloaded. It is not uncommon for a 10-wheel truck (tare weight 8 tonnes, legal payload 13 tonnes) to be 60 percent overloaded (ie. a gross weight of nearly 29 tonnes instead of 21 tonnes). Such a heavy load concentrated in a single 10-wheel truck causes as much damage to the highway pavement as five vehicles loaded to the legal limit.

Source: Seventh Plan Urban and Regional Transport, Working Paper No. 2: Freight, Halcrow Fox, 1990 (May).

are "owner-drivers" or small family-owned companies. They try hard to minimize out-of-pocket cash expenditures and, so long as the use of truck terminals incurs what are perceived as "extra" costs, they will not use them (see Box 2.5, below).

Truck parks

Truck parks are designated areas where trucks can park for short periods of time, awaiting prearranged time for collection or delivery, instructions regarding next assignments, or permitted time to enter the city. Some of the truck parks are just fenced rough grounds, while others are leveled parking areas with proper entrance/exit arrangements and eating/resting facilities.

Currently, there do not seem to be any truck parks in use in the Region. The main reason for this is that, as long as there is a charge for the use of these facilities, truckers tend not to use them (see Box 2.6).

Traffic laws and enforcement

Traffic laws are rarely enforced in developing country cities in the region. In many cases the laws themselves date back to legislation drawn up in colonial times or are derived from traffic codes in the North America, Europe or Japan. Whatever the reason, the laws often do not reflect conditions in developing country cities. Since traffic regulations can only be effective when pedestrians and drivers observe them, they depend on the extent to which the vast majority of people understand them and acknowledge their reasonableness. Their effectiveness also depends on the extent to which they are enforced.

Box 2.5 Truck terminal use in Surabaya

The Sidotopo Terminal was built in Surabaya in 1975. It is now jointly operated by a private sector and city government. It offers parking and warehousing facilities, along with canteen and hostel. All trucks are required to pass through the terminal and make payments. For many of the users, it represents only a toll collection point and not a facility for cargo handling. It is understood that many trucks pass straight through, paying their due, only to get a receipt which, if they are subsequently stopped by the police, provide an evidence of compliance with the regulation."

Source: Road Freight Transport in Urban Areas, Halcrow Fox and Associates with BIEC International Inc, 1986.

Box 2.6 Truck park use in Jakarta

The Bekasi Truck Park is comprised of a fenced-in site lying at the north of Jakarta with access from the main road through gate-house. The site offers no facilities other than partially paved land. The site is no longer in use because truckers were unwilling to pay a premium for use of a site offering no improvements over the existing roadside. Outside the site, for some distance, on both sides of the road, trucks and trailers were parked on the edges of the road, either awaiting the time of day when they could legally enter Jakarta, or transshipping loads from trailers. Street vendors, tire repair agencies and other small traders were very much in evidence.

Source: Road Freight Transport in Urban Areas, Halcrow Fox and Associates with BIEC International Inc, 1986.

Enforcement is the responsibility of the police and the courts. In many developing countries in the Region, the police force allocated to traffic duties is usually understaffed and inadequately trained to manage the traffic flow let alone enforce the law. And the courts are too overwhelmed to prosecute adequately the cases brought before them. The result, in too many cities, is an unhealthy disrespect of traffic regulations.

In Japan, the development of traffic laws and regulations has kept pace with the growth in motorization and mobility. Efforts have also been made to reinforce and expand the number and quality of traffic police.

Generally speaking Japanese traffic police are committed and enthusiastic about their work. Furthermore, since there is a comparison of the incidence of traffic fatalities and accidents occurring within all prefectures in Japan is conducted annually, there is a certain degree of competitiveness among different areas in their efforts to reduce the number of traffic accidents.

In many cities in the region, pedestrians and drivers alike are unfamiliar with traffic regulations. In surveys undertaken by the Central Road Research Institute of India it was found that 50 percent of driving license holders had no knowledge of traffic rules and that 63 percent admitted they did not observe the rules of the road.

In trying to grapple with congestion, traffic police often ignore traffic regulations and overrule traffic

engineering devices that appear to get in the way of keeping the traffic moving.

In Manila, it is reported that the operation of the computer controlled ATC system was greatly hampered by the tendency of the police on point duty to request that the traffic signals be placed under manual control during peak periods. The independent manual operation of signalized junctions negated the very advantages of the ATC system which are to link signal timings between junctions. Similar problems exist in Bangkok.

Traffic police are usually underpaid and overworked with few incentives to improve their performance when confronting thousands of irate commuters during congested peak hours. In Manila, an experimental scheme was introduced in 1989 at 60 intersections to improve the enforcement of traffic laws and minimize the manual control of traffic signals.

Under this scheme, local companies sponsored particular intersections and were allowed free publicity in the form of dedicated signs. In return the companies paid allowances to the traffic police including meals, uniforms, etc. The scheme is reported to have had some measure of success but detailed "before-and-after" study results are as yet unavailable.

Often the traffic police become de facto traffic engineers and traffic planners either because of their inherent legal powers or due to the lack of such professional staff in the city.

Urban transport administration and regulation

Providing for the many and expanding needs of the urban transport sector in the Region is often frustrated by institutional weakness. There are considerable problems involved in managing urban transport services and in coordinating urban transport plans and the provision of urban transport infrastructure.

A characteristic of most cities is the very large number of different agencies responsible for the various modes of transport and infrastructure requirements as well as the overall planning and development of the urban transport system. This has often led to overlapping responsibilities with a resultant lack of clarity as to who does what.

There is also evidence of insufficient numbers of trained staff and this has been perceived as a major factor inhibiting the sector's development over the past decade.

The most frequently regulated urban transport service is public transport. Bus operations are regulated with varying degrees of intensity in every city in the Region. As a general rule, the greater is the degree of regulation the less efficient is the service and the greater is the need for subsidy. In some countries, public transport operations are highly regulated as they are perceived as social services. In others, regulations are designed to protect the consumer from unsafe or unreliable operators. In some, regulations are designed to attract potential car users to public transport and/or bus users to mass rapid transit.

The most frequently regulated aspects of public transport operations are the fares. Often such regulations inhibit the development of the very service they are designed to protect by not allowing operators to raise fares to meet rising costs or vary fare structures according to different levels of service. In some cases fares are regulated in such a way as to allow public sector operations to cover costs but also provide a bench mark above which private operators would not hike fares unreasonably.

The growth of informal paratransit operations is often a market response to an over-regulated public transport system. Paratransit services are also regulated in many countries by route or area franchising systems. In others, the development of paratransit is limited by regulations on vehicle imports or registrations. In this way, Hong Kong allowed the bus companies to flourish while ridership was eroded from minibus operators whose vehicle fleet and competitiveness was "stabilized" during the growth of the MRT.

Restrictions on the supply of buses in the public and private sectors in Jakarta have contributed, along with inefficiencies in service operation, to peak hour bus passenger transport volumes remaining static between 1985 and 1990. It is estimated that if the supply of buses had been allowed to increase, there would have been a 21 percent growth in passenger volumes over the same five year period.

For the public sector to provide sufficient bus capacity would cost an estimated US$28.0 million; an alternative would be for the public sector to concentrate its funding on the provision of bus priority infrastructure and allow new private operators to take care of bus fleet expansion which is currently restricted below requirements by regulation.

Despite the proliferation of public transport regulations in Asia, the region is relatively well endowed with public transport services compared with developing countries in other regions of the world. This does not mean there is not room for improvement in Asia: bus companies in China, India, Indonesia and Pakistan provide less than adequate services at enormous cost to the national and municipal budgets. The

private sector, both formal and informal, is alive and well in the provision of road based public transport services in most countries in the region (with the notable exception of China). Expansion of services is more often hampered by regulation than by capital or entrepreneurship.

Fortunately, the region provides sufficient examples and varieties of "regulations that work" in Hong Kong, Korea and Singapore to serve as models for improving the regulation of public transport elsewhere.

Urban transport equipment and consultancy services

Outside Europe and North America, the market for urban transport equipment and services in Asia must be one of the largest in the world. From available data it has been possible to tabulate a total of 120,000 vehicles in the bus fleets of 48 of the 101 cities with populations in excess of one million. To this must be added the 1,900 LRT units and 6,500 MRT units identified in the larger cities of the region all of which run on some 1,300 kilometers of electrified double track. Japan alone has 120,000 traffic signals; the total for the region is probably well over one million.

Consultancy services have been used extensively throughout the region. Every major city and many secondary cities have had at least one "urban transportation study" undertaken by consultants; several capital cities have had many such studies. Major studies using extensive consultant assistance are on-going in many cities in China, India, Indonesia, Korea, Malaysia, Pakistan, the Philippines and Thailand.

The volume and value of trade in the manufacture and supply of equipment and in the provision of consultancy services is, however, not in any way fully documented. It is therefore impossible to assess its extent; it is undoubtedly significant.

Urban transport equipment

It would appear that there has been a considerable growth in the production of urban transport equipment in Asia in the past decade. Whereas in the 1970s, most equipment was imported into the region from Europe and North America, the 1980s saw the beginning of local production of equipment such as traffic signals and Japan has become a major supplier of road and rail based public transport vehicles and associated equipment.

A complete inventory of manufacturers and suppliers is not available but an indication of the extent of local production of urban transport equipment is presented in Table 2.9 below.

Urban transport consultancy

Consultant firms with specialized urban transport services have developed in the Region over the past decade in Australia, Hong Kong, India, Indonesia, Japan, Korea, Taiwan (China) and Thailand.

Many urban transport studies are, nevertheless, still being undertaken by European and North American consultancy firms. But, in more and more countries, these non-regional firms are associating with local firms and/or regionally based firms.

Financing of the urban transport sector

Over the past decade, the growth in traffic has outpaced the rate of investment in urban transport infrastructure and services in most cities throughout the Region. In many cases, both national governments and city authorities have been unable or unwilling to address these needs by mobilizing additional revenues from the sector, either by increasing prices or by reducing subsidies.

Expenditure

Typically, the public sector is involved in financing some or all of the following: urban transport infrastructure, urban public transport equipment and operations, maintenance of urban roads, traffic management and traffic enforcement. In most countries the scale of funding in the sector is quite large.

Table 2.9 Urban transport equipment production in selected Asian countries

	Transit systems		
Country	*Rail*	*Bus*	*Traffic signals*
Low income			
China	λ	μ	λ
India	λ	μ	λ
Indonesia	λ	λ	λ
Middle income			
Korea	μ	μ	μ
Philippines	..	μ	λ
High income			
Australia	μ	μ	μ
Japan	μ	μ	μ

μ = more; λ = less; .. = unknown.
Source: Janes Urban Transport Systems, 1989.

In many countries the distribution of funding is skewed over time, geographically, by city size and/or importance and by sub-sectoral preferences or demands.

In Indonesia, it is estimated that between 1984 and 1989 nearly 50 percent of all public sector urban infrastructure expenditure was allocated to the urban transport sector. Urban road expenditures (funded equally by central and local government resources) accounted for only 16 percent of the total. The remaining 34 percent was for public transport investments principally in rail investments, rehabilitation and operations in Jakarta. Around 80 percent of the costs of these urban bus and rail services were being met entirely by central government resources.

With the exception of Beijing and Tianjin, urban transport expenditure in China has been negligible until relatively recently. For example, annual investments in urban transport infrastructure in Shanghai quadrupled between 1983 and 1985 from US$20 million to US$80 million and have averaged US$115 million in 1986 and 1987 (which, in 1987, represented about six percent of municipal tax receipts after deducting transfers to central government).

Currently, Shanghai is planning to spend in excess of US$380 million annually on urban transport infrastructure which represents around three percent of Gross Regional Product (GRP) and is the upper limit of affordability in the sector when one considers that typical levels of transport investment in developing countries are close to five percent of GDP. Although high compared to historical levels, this investment is still below the expenditure required to finance the needs evidenced by Shanghai's present transport situation, which is near crisis.

In Hong Kong, government expenditure on transport by 1988 had largely been devoted to new highway projects. Large sums had been spent on building the MRT and improving rail facilities. Smaller amounts had been spent on improving the airport, port facilities and public transport. All public transport modes in Hong Kong are operated either by private companies or by independent government corporations. The only public transport costs incurred by government concern the provision of bus terminals and ferry piers. Private investments by the bus, tramway and ferry companies are excluded from the government's expenditure accounts, as is the investment by the Mass Transit Railway Corporation (MTRC), which amounted to nearly US$3.2 billion between 1975 and 1988 (and includes US$0.9 billion as equity contribution from government and US$2.3 billion provided by commercial loans).

Total expenditure on transport between 1976 and 1985 amounted to US$4.9 billion of which the private sector provided 71 percent of funds. As a percentage of public expenditure and of GDP, government investment in transport peaked at 6.6 percent and 1.3 percent in 1982-83, but decreased to 2.5 percent and 0.4 percent in 1986-87. However, when government equity contributions to the MTRC are included in 1981, peak transport investments reach 13.5 percent of total public sector expenditure and 2.6 percent of GDP.

In Thailand, annual capital expenditure on transport in the Bangkok Metropolitan Region accounted for around 20 percent of government budget between 1985 and 1988 increasing to 25 percent in 1990. While the public sector was responsible for all capital expenditure until 1988, since then, there has been a conscious decision on the part of the government to reduce its share to around 40 percent by the end of the current national plan in 1992. The remaining 60 percent is to be funded by the private sector.

Sources of revenue

As in most parts of the world, in Asia urban transport investments and operations are financed from taxation, user charges (such as fares), borrowing and private investment. Certain countries in Asia, however, make also make extensive use of the private sector in the provision of urban transport services.

In Shanghai, taxes on vehicles and transport which could be considered as user fees are estimated to generate around two-thirds of the funds for urban transport investment expenditure (at three percent of GRP). These comprise a Highway Maintenance Fee (a tax on vehicle use), a bicycle tax and vehicle utilization taxes. By international standards, road transport users in Shanghai pay a high percentage of transport costs.

In Hong Kong, where the majority of expenditure in urban transport sector is by the private sector, public sector urban transport revenues make a significant net contribution to the government's finances. In fiscal 1987/88, transport expenditures were 56 percent of land transport revenue. Fuel taxes (31 percent), vehicle registration taxes (31 percent) and vehicle licenses (22 percent) generated over 80 percent of revenue in the sector.

In India, urban road infrastructure is financed from general local government revenues (property taxes and "octroi"—a tax on merchandise entering municipal jurisdictions) and from state budget allocations (in the form of grants to local governments

and/or in the form of allocations to state agencies which provide infrastructure within urban areas). The central government also provides funds to the states for road construction, some of which are used in urban areas.

Central and state government road transport revenues are derived from fuel taxes, vehicle registration and licensing fees, and tariffs and taxes on the purchase of motor vehicles and parts. Between 1974 and 1981, it is estimated that nationally road transport expenditures were around 40 percent of revenues. City corporations and municipalities tax road transport through the "octroi". These revenues and property taxes (which are usually assessed on rental values and are kept artificially low because of rent control) provide insufficient funds for urban services let alone major urban road investments with the result that state agencies are assuming an ever increasing share of total road expenditures.

Public transport revenues do not meet expenditures in public sector bus operations in India. Low fares, delays in fare increases and the non-reimbursement by state governments of concessions to student bus riders coupled with inefficient operations and high staff per bus ratios are the main causes of public sector bus company deficits. State run bus companies generated losses of US$100 million in 1985 which were met by subsidies from state and central government general revenues.

In most low-income countries public sector bus operations do not recover their expenditures from fares. A major cause of inadequate fare revenue is "leakage", either through passengers simply not paying the fare or through ticket collectors pocketing a proportion of fare revenues. The extent of such fare "leakage" is rarely known, admitted or documented.

A study of fare leakage in Karachi provides some interesting insights into the extent of losses which can occur through this practice. In a survey of 25,000 passengers and 170 trips, it was discovered that tickets were not issued to 46 percent of passengers. Given that some passengers without tickets travel free legally (police, bus company staff, etc), the actual non-ticketed passengers are estimated to be 40 percent. In a floating survey it was found that leakage occurred through evasion by passengers (nine percent of the surveyors were not asked to pay) and diversion by ticket collectors (16 percent of surveyors paid the fare but received no ticket).

The results of the two surveys indicate that leakage from passenger evasion probably accounts for between 15 and 20 percent of potential fare revenue and that fare diversion accounts for an additional 20 to 25 percent. In one case, the ticket collector noticed he was being watched and threw his ticket book out of the bus window which suggests that he had even printed his own forged tickets and these were being issued to passengers in lieu of the real ones!

In Korea and in high-income countries such as Hong Kong and Singapore, road based urban public transport is provided by the private sector and fare revenues cover expenditures. Unlike most cities in Asian middle-income developing countries, Korean cities have been able to maintain investment in infrastructure and municipal services at high levels. Much of this due to a strong municipal financial base and effective management of municipal finances and services.

In the case of Taegu (the third largest city in Korea), the municipality has historically allocated about half of its general account to capital expenditures and in most years has recorded a surplus cash balance of around ten percent of revenues. In 1985, urban transport investments were estimated to represent 40 percent of capital expenditures. Local taxes provide the majority of revenues and these are based on land prices which have risen continuously in the past and which reflect, albeit indirectly, investment and/or improvement in the urban road system. In addition, the city issues "highway bonds" to finance urban transport infrastructure. These bonds are a form of earmarked revenue and compulsory savings since their purchase is mandatory for residents registering vehicles in the city .

Bond issues are also being used in Bombay by the city development corporation to finance a new rail link between the city and New Bombay. The bonds are to be serviced from revenues from property development along the rail corridor and at rail stations.

In searching for sources of revenue to finance urban transport infrastructure, local governments in Japan are using taxation instruments which are targeted to those who benefit most from the proposed investment. For instance, in 1980 the Sendai Municipal Government established a Special Railway Fund to finance metro construction costs. The resources of this fund are provided by earmarking the incremental revenue derived from a 14.5 percent increase in local corporation and business establishment taxes. Similar schemes operate in Sapporo, Fukuoka and Kitakyushu .

Cost sharing schemes

Cost sharing schemes with participation from the public sector and private developers or the commu-

nity are being used more and more in some Asian cities to finance urgently needed urban transport infrastructure.

In Japan, the government has issued guidelines on ways to share the cost of transport infrastructure between public transport operators (both public and private sector) and land developers for the construction of extensions to mass transit systems to serve new town development projects in Chiba and Senpoku. Key features of these cost sharing schemes are presented in Box 2.7.

Another cost sharing procedure used in Japan for commercially less attractive, but publicly desirable, projects such as community transit services is the "Third Sector Scheme." Under this scheme, joint venture companies can be set up by municipal governments with equity contributions from the municipality, industries and major leading companies such as banks and power companies.

The Kobe New Transit System company was set up in this way to build and operate an AGT system to link Kobe Port Island with the CBD. The shares of this joint venture company are owned by the Kobe City Municipality (55 %), commercial banks (22%), leading companies in the city (13%) and companies involved in the project itself (3%).

For smaller urban transport investments, voluntary cost sharing schemes are common in Japan. Local communities often share the construction costs of stations, in order to persuade transport operators to build an additional station for their needs.

Cost sharing is sometimes used for local road improvements where property owners contribute land for urban transport needs. In one scheme in Medan, Indonesia, private landowners contributed land for road widening (one private property owner donated land eight meters wide and 1.8 kilometers in length) and for new road construction. Private landowners have also contribution funds for small road construction projects and footpaths (as well as various public and religious buildings).

Land and property development schemes on a larger scale used to be linked to the development and extension of urban rail systems in Europe and North America at the turn of the century. Private railway builder-cum-operators became skilled property developers at the time and the profits from land and property development contributed significantly to the investment cost of the rail operation.

These processes are still alive and well in Japan where the Tokyu Corporation (which is one of the leading urban rail companies in Japan) undertook an integrated 20 kilometer long urban rail and 3,000 hectare land development project over a period of some 25 years (1960 to 1984). The site has grown from being a vast and hilly area, scarcely inhabited and underdeveloped, to a city of 440,000 people with an extended rail and bus service network.

As is the case with most major private rail lines in Japan, the rail construction and operation costs are fully recovered by the farebox. Land and property development gains do not need to be, and legally cannot be, earmarked to recover the costs of rail construction and operations. However, the land and property development profits have contributed to the financial success of the Tokyu Corporation Group in such a way that any credit the group needed to finance urban rail expenditure would have been readily available at very favorable terms (and probably from within the Tokyu Group of Companies itself if needed).

Box 2.7 Cost sharing guidelines for mass transit links to new towns in Japan

(a) the developer pays to the operator half of the construction costs of ground-level urban rail infrastructure;

(b) within the new town area, the developer sells the land for the urban rail system to the operator at a market price which reflects its undeveloped value;

(c) outside the new town area, the developer pays the operator the difference in price for land at its historic undeveloped value and its actual value (which will have risen due to the proximity of the new town development); and

(d) on the basis of the above contributions by the developer, central and local governments will each provide grant funding up to 18 percent of the construction cost of the urban rail system.

Source: Private Financing of Urban Transport Infrastructure in Asia, Technical Note Series for Urban Transport in Asia: An Operational Strategy for the 1990s (draft), ASTIN, March 1991.

Concessions and BOT

In many cases the private sector is not willing to wholly finance urban transport infrastructure due to the risks involved in recovering the high start up costs of construction and provision of equipment and/or rolling stock. An incentive which has been traditionally used to mitigate these risks is the granting of an exclusive operating franchise to the private investor to operate the service without fear of com-

petition for a sufficient time to enable him to recuperate his investment and make a profit.

The concession arrangements which provided the bulk of urban public transport in developing countries and in developed countries in the past are being revitalized and refurbished in Asia in the form of Build-Operate-Transfer (BOT) schemes as a way of attracting private sector capital, entrepreneurship, management skills and efficiencies into a sector which is unable to develop, modernize and expand under public sector tutelage.

The nature and potential of BOT schemes in the provision of urban transport infrastructure services are summarized in later sections of this report. The experience with the few BOT schemes which have been implemented in the region is discussed below as part of the alternative sources of urban transport infrastructure financing which are being tried in the region.

BOT has been used in Hong Kong and Indonesia to finance toll facilities; attempts are being made to begin BOT schemes in Thailand. These three countries, therefore, provide the state of the art in terms of BOT practical experience in the region.

HONG KONG. In Hong Kong, the government rationale for supporting BOT operations is that they believe the private sector is more efficient. By using the private sector and BOT it reduces the need for more government borrowing, it avoids expansion of the civil service and avoids raising more tax revenue. All of these are beneficial to government.

Furthermore, the Hong Kong government has a conviction that the private sector is more efficient and responsive to demand than government itself thus the completion times of BOT projects are extraordinarily rapid, and far more so than government could realize.

Government experiences to date with BOT have involved the following projects:

Cross Harbor Tunnel (1960s): a single-source award in which government was forced to contribute 25 percent of the equity owing to unfortunate timing;

Eastern Harbor Crossing (1984): attempted preemptive bids were rejected and were followed by a competitive bidding process after extensive financial analysis by government had defined the viability of the project; and

Tate's Cairn Tunnel (1988): where a very substantial amount of preliminary work was undertaken by government and followed by competitive bidding.

In Hong Kong the government has learnt by experience that it is preferable to be the instigator rather than the receiver of BOT proposals. Hong Kong has also learnt that considerable emphasis needs to be placed on the complementary costs to be borne by government as a result of the BOT scheme or as a result of the BOT scheme being operational ahead of government's expenditure plans. BOT bridges, tunnels and elevated expressways need access roads, major utility diversions, etc and the opportunity cost to the public sector in providing these can be high.

In the case of both the Tate's Cairn Tunnel and the Eastern Harbour Crossing, the Hong Kong government was obliged to commit expenditure to provide feeder roads.

The procedures adopted in Hong Kong for processing BOT projects are summarized in Box 2.8.

INDONESIA. The Government of Indonesia has been a proponent of privately financed urban and inter-urban toll roads for many years and has invited private sector interest in 17 projects nationwide and established guidelines for private capital investment in toll roads. These guidelines are summarized in Box 2.9.

The sole BOT project to date is the North-South Link expressway, in Jakarta. This is an elevated dual-carriageway toll road which opened recently after being constructed on a tight time schedule. The private sector interests are all domestic and funding is understood to be from a combination of sources including loans from state banks.

Box 2.8 BOT procedures in Hong Kong

During the initial stages of the BOT process, the Government undertakes the following analyses of the proposed project:

(a) an economic appraisal to ensure it is of real benefit to the community;

(b) an evaluation of the cost to government;

(c) a financial appraisal to determine likely returns and cash flow characteristics;

(d) an establishment of acceptable tariffs; and

(e) a risk analysis and contingency plan if things go wrong.

Before bidding, the following steps are taken:

(a) the government estimates of capital cost, operating costs, traffic and revenue, and financing costs are put in a sealed envelope which is opened after bids are received; and

(b) the government defines in detail its strategy for negotiations, the timetable and organization.

The competitive bidding process is a two stage procedure with bidders shortlisted to around three followed by parallel competitive negotiations until the selection of a single bidder.

Source: Private Funding of Transport Infrastructure in Asia, Allport R. J., 1990.

Box 2.9 BOT procedures in Indonesia

BOT procedures are processed by PT Jasa Marga, the government corporation charged with developing and operating toll roads in Indonesia. Two private consortia are shortlisted for each toll road and required to submit preliminary feasibility studies. The selected consortium is then granted the right to negotiate the concession within the following framework:

(a) the successful bidder should form a joint venture with Jasa Marga. The toll road and all land associated with it is owned by the state and the joint venture company builds it and operates it for a concession period;

(b) the toll road should be an alternative to an existing road and be at least four lanes wide;

(c) the government is responsible for the assembly and acquisition of all land for the toll road and for expropriation procedures; and

(d) the toll level is determined by Presidential Executive Order and is set such that about half the reduction in vehicle operating cost and time resulting from use of the toll road accrues to the users and half accrues as tolls to the joint venture company.

Source: Private Financing of Urban Transport Infrastructure in Asia, Technical Note Series for Urban Transport in Asia: An Operational Strategy for the 1990s (draft), ASTIN, March 1991.

1989 by questionnaire from donor countries (excluding the USA which did not respond) and from the ADB and UNDP. Data concerning the World Bank was collected from Staff Appraisal Reports and Loan Documents.

Data is available from all responding agencies, except Japan for 1990. The analysis is, therefore, limited to the period 1980–1989 given the distortions which would have occurred in 1990 without data from Japan (which is a major source of external aid in the sector). Where appropriate, data for 1990 is commented on separately.

External aid flowing into the urban transport sector in Asia amounted to some US$ 1.9 billion between 1980 and 1989. Just over two-thirds of this amount was allocated to what are currently defined as low-income countries and the bulk of the remainder to middle-income countries.

The annual flows of total external aid in the sector are uneven over the period but show a steady increase between 1984 and 1988. Somewhat surprisingly, middle-income countries have seen their share of aid increase from less than ten percent in 1980 to 32 percent by 1989.

Table 2.10 Transport concessions in Bangkok

Project	*Status of contract*	*Civil works*	*Length (kms)*	*Cost US$ (billion)*
Expressways			173	3.70
Don Muang	(S) 1989	imminent	16	0.33
Second Stage Exp.	(S) 1988	underway	32	1.38
Khlong San Saep	stalled	none	22	0.29
Rangsit Saraburi	rejected*	underway	73	0.21
Third Stage Exp.	awarded	none	30	0.79
Mass Transit/ Rail			94	5.05
Skytrain	imminent	none	34	2.13
Hopewell[a]	imminent	none	60	2.92
Total			267	8.05

* *under construction by government*
a. including expressway scheme
(S) contract signed
Source: Seventh Plan Urban and Regional Transport Study, Executive Report, 1991.

Distribution of aid by country

Only ten low- and middle-income countries have benefitted from external aid in urban transport between 1980 and 1989. Of those countries with significant urban populations and/or major cities, Bangladesh, Korea (DPR), Lao PDR, Mongolia, Vietnam and, since 1985, Malaysia would appear from

Box 2.10 Experience with BOT proposals in Bangkok

Most projects are not financially viable without public subsidy.

There is no effective system of project development.

Government has been reactive and sometimes pre-empted by events. The result is a multitude of competing projects producing bad transport planning, severe environmental impacts and construction difficulties.

The government has incurred unexpected costs and risks. In certain cases the government may be liable for large compensation claims.

Finally, there may be macroeconomic impacts which were not foreseen.

Source: Seventh Plan Urban and Regional Transport Study, Executive Report, 1991.

the data collected to have not been recipients of external aid in the sector.

The geographic distribution of urban transport aid varies considerably by country income group and by geographic location. With the low-income group of countries, Indonesia was the major recipient country for all urban transport aid in the region, receiving more than four times the amount allocated to India. Other low-income countries (Sri Lanka, China and Pakistan) received only small amounts (see Figure 2.10)

The distribution among middle-income countries is more balanced with Thailand, the Philippines and Korea accounting for around one third each and with Malaysia accounting for the remaining two percent (see Figure 2.10).

The geographic distribution of aid to the sector during the period 1980 to 1989 confirms the shift detected during the past decade in global bilateral and multilateral aid from South Asia to South East Asia. South Asian countries received only 18 per cent of urban transport aid even though these countries accounted for 39 percent of the total population of Asia in 1990 and 24 per cent of the region's urban population.

External aid in the sector has also been quite unevenly distributed in terms of dollars per urban inhabitant. The ratio varies from US$0.10 in the case of China to US$21.9 in the case of Sri Lanka, a two hundred fold difference.

Sources of aid

Japan was the main source of bilateral financing in the urban transport sector in Asia between 1980 and 1989 with US$1.1 billion, which represents 59 percent of total aid (see Figure 2.11) and 91 percent of all bilateral aid. Other bilateral resources amounting to US$108 million or six percent of the total were provided by Australia, France, Germany and the United Kingdom during the period.

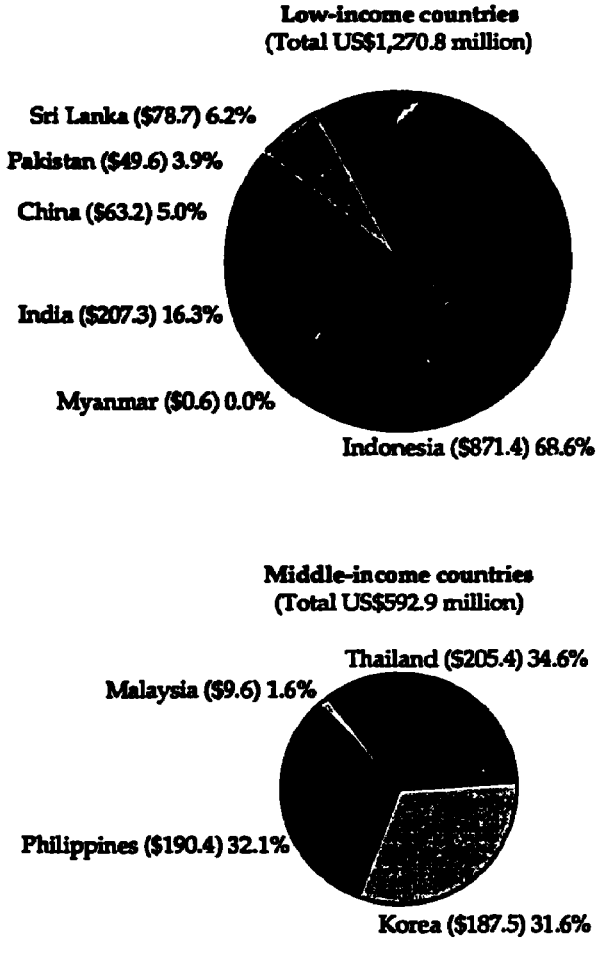
Funding from multilateral agencies in urban transport in Asia amounted to US$657 million or 35 percent of the total for the period 1980 to 1989. The main source of funds was the World Bank Group which provided US$ 603.1 million which represents 32 percent of the total and 92 percent of all multilateral aid.

The Asian Development Bank and Fund (for non-concessional and concessional aid, respectively) began to allocate resources totalling US$53 million to the sector in 1988 and 1989. A further US$132.6 million has been allocated by the ADB in 1990 and 1991 of which US$120 million was in the form of loans, US$10 million was in the form of equity investment and US$2.6 million was in the form of technical assistance grants.

The United Nations Development Program (UNDP) and the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) has provided a total of US$1.2 million for technical assistance programs in 1987 and 1989.

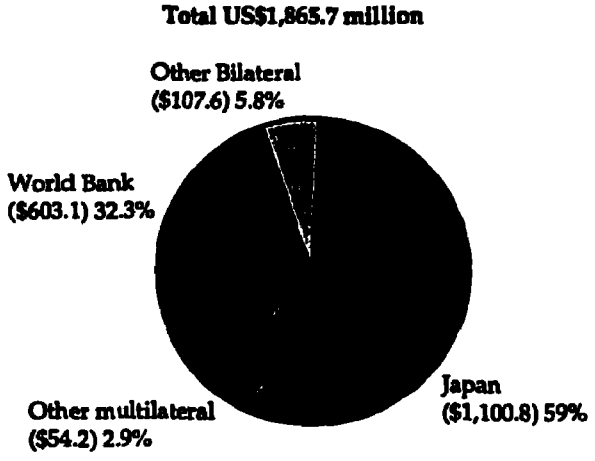
Clearly, Japan and the World Bank provide the vast majority of resources to both low- and middle-income countries with Japan providing a greater share to middle income countries. Apart from Japan and Australia, other bilateral funding, although small, has been made exclusively to low-income countries. UNDP assistance has been concentrated in middle-income countries and (until 1990) ADB funding has been directed at low-income countries.

Figure 2.10 Geographic distribution of external aid in the urban transport sector in Asia by low-income country group (1980–1989)



Source: External Financing and Urban Transport in Asia, C. Diou, ASTIN, 1991 (unpublished draft).

Figure 2.11 Sources of external aid in the urban transport sector in Asia (1980–1989)



Source: External Financing and Urban Transport in Asia, C. Diou, ASTIN, 1991 (unpublished draft).

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Japan and the World Bank

The share of World Bank resources has been overshadowed considerably over the period by the growth of resources from Japan. Between 1980 and 1989, the Overseas Economic Cooperation Fund (OECF) has provided loans totalling US$ 1.054 billion equivalent for 34 urban transport projects and the Japan International Cooperation Agency (JICA) has provided grants totalling US$46.7 million equivalent for 33 technical assistance projects.

Even before 1980, the World Bank and Japan dominated the urban transport sector in Asia. Lending began in 1972 for the World Bank (with a US$16 million urban transport loan in Kuala Lumpur) and for OECF (with a US$90 million loan for metro construction in Seoul). The scope of these projects (road in the case of the World Bank and rail in the case of OECF) was to dominate and differentiate each agency's approach to the sector for many years in the region. JICA began providing technical assistance in 1971/72 with an urban transport study in Manila.

Since 1972, Japan has consistently provided more resources (US$1.3 billion or US$74 million per year) to the sector in Asia than the World Bank (US$0.7 billion or US$41 million per year). The increase in resources from Japan and the World Bank was almost identical (a 4.3 to 4.8 increase) between the decade of the 1970s and the decade of the 1980s.

Since 1972, Japan has consistently focussed aid in the sector in South East Asia. Indonesia has been the largest recipient country, accounting for 47 percent of total Japanese aid in the sector. Thailand and the Philippines follow with 21 percent and 14 percent

respectively. In comparison, the assistance provided by Japan in the sector to India, China and other countries has been low.

In the 1970's, the World Bank focussed more aid in the sector toward South Asia; the latter accounted for around 81 percent of lending (India and Pakistan accounted for 60 percent and 20 percent of loans respectively). In the 1980's, Bank lending shifted toward South East Asian countries which accounted for 75 percent of loans (Indonesia and Korea accounted for 44 percent and 29 percent of loans respectively). India, in particular saw its share of World Bank urban transport lending fall from 60.7 percent in the 1970s to 20.4 percent by the 1980s.

Since 1972, Bank urban transport lending occurred in eight countries (plus China in 1991): India (12 loans), Indonesia (three loans), Korea (six loans), Malaysia (two loans), Pakistan (one loan), Philippines (four loans), Sri Lanka (one loan) and Thailand (two loans).

In some cases, especially in the earlier years, "repeater" projects were undertaken by the Bank: in Kuala Lumpur (in 1972 and 1976), in Bombay (in 1977 and 1985), in Calcutta (in 1978, 1980, and 1983) and in Madras (in 1978, 1980 and 1988).

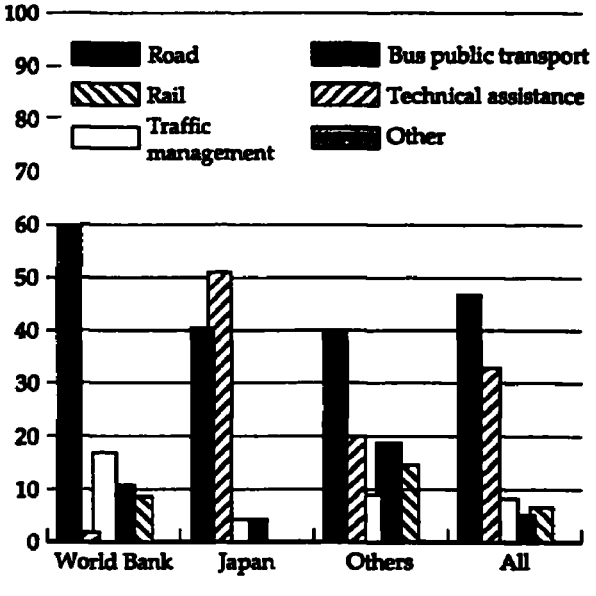
World Bank urban transport lending in Asia was driven by the twin objectives of World Bank urban policy: poverty alleviation and improved city efficiency (with greater emphasis on the former in the 1970s and on the latter in the 1980s). Bank lending was provided either in the form of free-standing urban transport projects (of which there were nine) or as components within urban development projects (of which there were 22).

Components included investments in road construction, street improvement, road maintenance, traffic management, bus rehabilitation and acquisition, bus facilities (depots, maintenance, terminals, etc.) and bus priority schemes, pedestrian facilities and technical assistance and training. Emphasis was given to short-to-medium term investments in road-related infrastructure and services, the low cost options which make the best use of existing facilities.

The Bank has to date not allocated resources to the urban rail sector (with the exception of trams in Calcutta, which represent 3.7 percent of the Asia lending program because it was judged that the proposed projects did not meet economic and financial criteria.

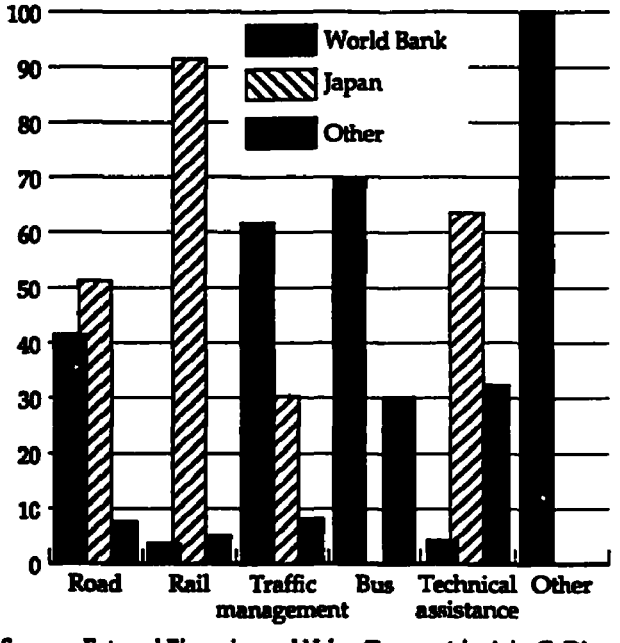
By contrast, Japan has allocated 52 percent of its resources to urban rail (mass rapid transit in Calcutta, Seoul and Beijing and commuter rail in Indonesia, Korea and the Philippines) and 40 percent of its resources to urban roads (principally urban toll roads in Jakarta and major highways elsewhere).

Figure 2.12 Sectoral focus of external aid to the urban transport sector in Asia (1980–1989)



Source: External Financing and Urban Transport in Asia, C. Diou, ASTIN, 1991 (unpublished draft).

Figure 2.13 Sources of aid in Asia by sector (1980–1989)



Source: External Financing and Urban Transport in Asia, C. Diou, ASTIN, 1991 (unpublished draft).

The fundamentally different approaches taken by the major sources of external aid to the sector in Asia has been the cause of friction in some cases in the past. The Japanese approach to urban transport is based on the long term development of urban rail systems without which most cities in Japan would have been engulfed in car induced traffic chaos. This approach has in the past been sometimes perceived by the Bank as promoting large scale, costly projects which only solve part of the problem and which are inefficient compared with alternative uses for the often massive resources involved.

The World Bank approach has been seen by Japan as being wider in scope and more closely related to other sectoral needs. It has also been seen as leading to piece meal solutions which although less costly initially, increase reliance on road based transport systems, especially buses, which cannot cope with the increasing demands for mobility and mass transit in major cities in the region.

Since 1989, the Asia Technical Department of the World Bank and the Ministry of Transport in Japan have had two informal discussions on the different approaches taken in the past and are beginning to learn from each other's experiences in a sector where there are no straightforward solutions. These discussions are on-going and it is hoped that the pooling of experience between Japan, the World Bank and other bilateral and multilateral agencies will lead to a more comprehensive and collaborative approach to the allocation of external aid to the sector in the 1990s.

Sectoral focus of external aid

When the analysis of the sectoral focus of urban transport aid is expanded to include all donors, it can be seen tht each donor has a specific approach to recipient requests. The breakdown of aid by sector and donor is presented by donor in Figure 2.12 and by sector in Figure 2.13.

A major share of external aid (US$0.9 billion or 47 percent of the total) was allocated to the urban road infrastructure sector (for urban road construction, improvement and maintenance). Japan in fact contributed the most to the road sector (US$445.7 million or 51 percent) although it only represented 40 percent of total Japanese aid and this sector was always thought of as dominated by the World Bank.

Urban rail investments take second place in terms of sectoral focus accounting for US$613.9 million or 33 percent of all aid. Over 90 percent of urban rail related aid was provided by Japan which also allocated the majority (51 percent) of its aid to this sector. Although their overall share was very modest, other bilateral donors allocated 19 percent of their aid to the rail sector.

Traffic management (US$156.3 million) represented a modest 8.4 percent of all external aid. The majority of aid (62 percent) to this sector was allocated by the World Bank with Japan providing 30 percent and other donors the remaining eight percent.

Technical assistance and bus-related activities account for seven and five percent respectively of total aid. The majority of technical assistance funds (43 percent) were provided by the World Bank; Japan and other donors provided the remaining 38 and 19 percent respectively. The vast majority of assistance to bus public transport was provided by the World Bank which accounted for 70 percent of the total. Japan provided no assistance to the bus sector and for other donors it represented 18 percent of their total allocations.

Since 1989, there has been a noticeable increase of around US$370 million in the resources of bilateral donors other than Japan targeted at the urban rail sector. In 1990, the United Kingdom allocated resources (US$52.6 million) to the Beijing Subway, France provided funds (US$18 million) to supervise the construction of the Jabotabek (Jakarta Region) railway and in 1991, Germany provided financing (US$300 million) for the first stage of the Shanghai metro.

In addition 1990 witnessed the addition of two new donor countries to the sector in Asia: Spain (with US$19.6 million allocated for traffic management in Indonesia) and Canada (with US$0.7 million allocated to technical assistance in the sector in China).

Impact and benefits of aid

Judging by the severe congestion to be found currently in most cities which have benefitted from external aid in the 1980s, the first reaction would be to say that the impact has been minimal! However, the total volume of external aid has been very small and the scope of interventions has been very discrete.

The total volume of external aid in the sector for the whole of Asia for the ten years between 1980 and 1989 is less than half of total urban transport expenditure of Hong Kong in the ten year period between 1976 and 1985, and a quarter of proposed expenditures on BOT schemes in Bangkok.

Rarely has external aid been directed at solving problems throughout the urban transport system in a given city or country. Usually such aid is directed at one or more critical, but nevertheless discrete, components of the system and/or at specific geog-

raphic locations within the city. Hence problems not addressed in one part of the system often engulf solutions addressed in another part of the system.

In assessing the impact of aid, there is little quantifiable data on results outside of the World Bank. Most external aid projects have been built and most technical assistance studies and training have taken place. Change has occurred as a result of external aid; in assessing the impact of this change it is worth looking at the positive and negative results in so far as these can be assessed.

On the positive side:

- most projects and technical assistance programs have met their objectives;
- most projects have been economically viable (with rates of return in the 25 to 35 percent range in the case of World Bank projects) including those in the rail sector (the Seoul metro is estimated to have an economic rate of return of around 17 percent);
- World Bank projects have been by and large cost effective in their use of scarce resources;
- traffic management projects and technical assistance have changed attitudes in many cities in favor of using low-cost traffic engineering techniques to make full use of existing facilities and manage traffic more efficiently;
- bus companies in several cities, especially in India, have benefitted from more efficient operations as a result of World Bank projects;
- the focus of lending toward alleviating poverty by the World Bank in the 1970s and early 1980s has benefitted low income residents of many cities by ensuring their concerns were not ignored in transport planning and by improving their access to affordable urban transport services;
- replicability (extension of project concepts beyond the scope of the original project) has been achieved in several cases (the expansion of the bus lane network in Bangkok, privatization of bus services in Kuala Lumpur; traffic management in Korea); and
- technical assistance, in the form of studies and training, has introduced innovative thinking and greater self reliance for those responsible for managing the sector in many cities.

On the negative side:

- in many cases, interventions were too limited in scope with the result that benefits achieved by specific projects have been negated by disbenefits elsewhere in the system (for example, the provision of bus lanes without the provision of adequate bus services);
- lack of continuity (due to shifts in funding priorities, staffing, or administrative responsibilities) has left many cities without the means to build on the experiences of what are often innovative and new approaches to problems in the sector;
- the time taken to prepare, approve and execute projects and programs is too long and the procedures involved in obtaining assistance are seen as over complicated and cumbersome (especially in the case of the World Bank);
- in some cases donor over-enthusiasm with particular approaches or modes of transport have caused rejection or failure of projects (in the mid-1970s the World Bank stance on rail resulted in the Bank being excluded from Singapore and the Bank's enthusiasm with Area Licensing was rejected in Bangkok and Kuala Lumpur, and Bank projects have not materialized in either city ever since);
- in other cases, bilateral agency enthusiasm with the scope for exporting a particular technology has resulted in a less than cost effective use of resources (such cases range from over sophisticated traffic signal technology to costly urban rail systems);
- in many cases, there has been an over-emphasis on the provision of civil works and equipment at the expense of policy development, institutional development, deregulation and issues concerning fares;
- although often cited as the raison d'etre of intervention in the sector, little attempt has been made to use urban transport assistance to reshape or improve inefficient urban development patterns; and
- throughout the region, external aid has had little effect on the rising tide of motorization (urban rail schemes which were designed to reduce car use have in fact only reduced bus ridership).

Appropriateness of aid

Several issues in the sector have not been addressed by external aid; some of these have only emerged recently but many have been there for a long time.

The environment, the use of non-motorized vehicles, the needs of pedestrians, paratransit, safety, urban freight and the movement of goods, the private sector provision of infrastructure and the interrelationship of urban transport infrastructure and

urban development are some of the important aspects of the sector which have not been addressed in external aid programs and projects in the 1980s.

In addition, at least with regard to World Bank projects, less emphasis seems to have been given to urban poverty in recent urban transport projects: two projects in Indonesia in 1988 estimated that only six percent and twelve percent of project investments would benefit the poor and, in the case of one project in Korea in 1988, urban poverty is not mentioned.

The lack of attention to the environment is of particular concern. This is probably due to the environment not being given sufficient attention by the world community until relatively recently, to there not being any appropriate and affordable solutions available and to the issue being seen as of national rather than urban importance in terms of dealing with vehicle emissions (through changing gasoline and retrofitting vehicles).

Only very recently and in China, has any real attention been given by external aid agencies to the needs of non-motorized vehicles in the region. Several initiatives of a research nature have been undertaken by the United Kingdom through its Transport and Road Research Laboratory but little has been achieved on the ground to facilitate the use of this important mode of transport. Pedestrians have been short-changed by external aid agencies. World Bank projects have financed pedestrian facilities as a consequence of traffic management schemes (pedestrian overpasses, pedestrian crossings, etc) but little has been done to study the needs of pedestrians, the majority of whom are poor, or finance meaningful facilities for them.

The lack of attention to non-motorized vehicles and pedestrians is partly explained by the lack of export potential on the part of bilateral donors and partly by not knowing what could be done until traffic issues were brought under control (apart from providing bicycle lanes and sidewalks when opportunities arose) on the part of multilateral agencies, in particular the World Bank.

Given the scale of paratransit operations throughout the region, it is surprising that little attention has been given to this fundamental means of transport for the poor. Apart from studies of public transport operations undertaken by research institutions in the UK, France and the USA, little has been done even in World Bank projects to assist paratransit in the 1980s.

Road safety has been the concern of several bilateral donors in the transport sector but little has percolated through to the urban transport sector in a meaningful way. Clearly, traffic engineering schemes improve safety but specific accident prevention schemes have not been an important part of external aid focus. Given the scale of traffic accidents in developing countries generally and in Asian cities in particular, this is somewhat surprising.

Urban freight forms the life blood of many Asian cities, especially port cities which are numerous in the region. Little attention has been given to freight movements apart from several studies financed by:

- JICA in Indonesia (Jakarta Harbour Road Project in 1980-82) and Thailand (Bangkok Urban Truck Terminals Construction Project in 1978–80);
- ADAB in the Philippines (Metro Manila Urban Transportation Strategy Planning Project: Truck Operations in 1984);
- the World Bank in Indonesia as part of a highways project (Land Transport Development Plan: Road Freight Transport in Urban Areas in 1986); and
- UNDP in Bangkok (Seventh Plan Urban and Regional Transport study in 1990-91).

The role of the private sector in the provision of urban transport services has always been of concern to the World Bank which has consistently advocated the privatization of bus services as being a more efficient way of improving productivity, accountability and performance while ensuring affordability to the users, especially the poor.

The Bank has noted with interest the move toward privatization of infrastructure through BOT operations but has only very recently begun to intervene in the process (in a possible project in Karachi, through technical assistance in Manila and through possible IFC participation in Bangkok). The ADB has recently provided equity in one scheme in Bangkok and UNDP has financed a study in Bangkok which looked into transport concessions in depth as well as other transport issues in the city.

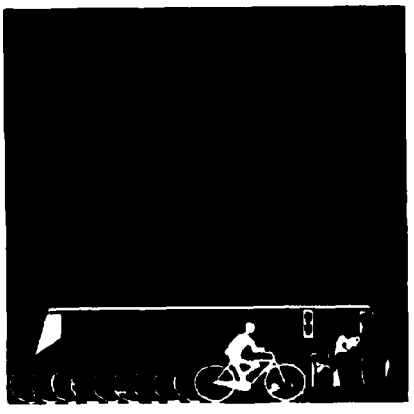
The interrelationship between urban transport infrastructure and urban development has escaped the attention of all donors in the sector including Japan which has the most experience, albeit in the private sector, of integrated mass transit and urban development schemes.

Apart from two abortive attempts to introduce traffic restraint in the late 1970s by the World Bank, measures to deal with motorization have also eluded the attention of external aid in the region. The growing tide of motorcycles has not been addressed in any projects or technical assistance programs.

While external donors have not addressed these issues, several countries in the region have. Hong Kong was the first country to integrate mass transit and urban development through the leasing of air

rights above MRT stations. Hong Kong and Singapore have taken steps to manage demand and, in the case of Singapore, to deal realistically with car ownership, improve the environment and provide facilities for pedestrians. Both cities/countries have urban transport systems which most other cities in the world would be proud of. Sadly, neither Hong Kong nor Singapore provide external aid ... yet!

To sum up, the benefits of external aid in the sector have been visible, albeit marginal. For external aid to be more meaningful it needs to adapt to the changing issues of the sector in the region. This is the subject of the next part of this report.



Part Three: Prospects for the 1990s

Introduction

The performance of the urban transport sector in Asia in the 1980s has been mixed. In city states such as Singapore and Hong Kong it has performed remarkably well in keeping pace with the growth in demand of people and goods. Elsewhere, in low- and middle-income countries alike, conditions have deteriorated and as the decade of the 1990s unfolds, the predominant legacies of the 1980s in the region are:

- increasing motorization and use of motor vehicles in cities;
- chronic traffic congestion coupled with increased air pollution, fuel consumption, travel costs and journey times; and
- need for the systematic accomodation of the separate needs of motorists, public transport, freight vehicles, non-motorized vehicles and pedestrians.

It is clear that the demands on the sector will be even greater throughout the region in the 1990s and that new approaches are needed to rectify the issues inherited from the past and meet the following challenges of the future:

- enhancing economic productivity: through serving the transport needs of urban business and industry;
- increasing personal mobility: through improving access by all elements of the population to urban services and jobs;
- improving the urban environment: through the provision of environmentally friendly urban transport services and infrastructure which are beneficial to the form of urban growth; and
- ensuring financial viability: through the financing of urban transport services and infrastructure in a way which is affordable to local governments and to all users of the urban transport system.

In meeting these challenges, the region has established an impressive record in the development of the following, at times innovative, responses which are proving to be successful in improving the performance of individual parts of the system:

enhancing economic productivity:

- Singapore has demonstrated that the combined effects of restraining motorization, restricting vehicle use and providing efficient, affordable and attractive public transport services can avoid congestion; and
- toll expressways are being introduced in Indonesia and Thailand as differentially priced alternatives for the motorist to the congested road network.

increasing personal mobility:

- paratransit services have survived initial attempts to restrict them and now provide the backbone of services for the poor (especially in smaller cities); and

- Hong Kong and Manila have introduced the first LRT systems into the region outside of Australia and Japan.

improving the urban environment:

- China and Japan have demonstrated that the bicycle can be a low-cost, environmentally friendly and energy efficient alternative to motorized travel for short trips;
- vehicle emission controls and unleaded fuel are being introduced in several countries in South East Asia as a first step in mitigating the detrimental environmental effects of motorization; and
- area traffic control has been used effectively in Singapore to reduce fuel consumption.

ensuring financial viability:

- efficient road based public transport services have been developed in Hong Kong, Korea, Malaysia and Singapore as a result of private sector initiative;
- Thailand is expanding the urban transport network in Bangkok through the private sector provision of rail based urban mass transit systems and toll expressways;
- bond issues are being used in Korea and in Bombay as a supplement to tax revenues for financing urban transport infrastructure; and
- development agencies have made significant contributions to the sector in the form of technical assistance, project funding and the supply of equipment which have helped sustain its development in recipient countries throughout the 1980s.

It is now time to capitalize on the initiatives and experiences of Asian countries and development agencies alike in the 1980s to meet the challenges of the 1990s. In this endeavor, the World Bank has the opportunity to play an important role in the development of the sector and in the role of the sector in the development process.

Economic productivity

As a result of the review of the performance of the urban transport sector in Asia presented in Part Two of this report, it is clear that the economic productivity of most cities in the region is being constrained by congestion. In Bangkok, people conduct business with cellular car phones in air conditioned limousines while spending hours in Bangkok's traffic jams. There are basically two actions with regard to moving people which can be taken within the urban transport system to reduce congestion:

- reducing vehicular travel demand; and
- increasing passenger carrying capacity.

Vehicular travel demand is a product of motorization and the use of motorized vehicles for trip making. A clearer understanding of motorization trends in Asia and possible control measures is an essential ingredient to managing motorized vehicle use in Asian cities. Managing the use of motorized vehicles and the capacity of the road network within cities can be achieved through traffic management measures. Reducing vehicle demand within congested urban areas involves demand management.

In smaller cities and in cities where congestion is widely dispersed, traffic management measures can increase capacity and channel more effectively demand. In the highly congested centers of most large cities in the region, however, little more capacity can be derived from traffic management schemes and there are not enough resources, time or space to provide sufficient road infrastructure to meet current or expected demand. With congestion levels so high that they are beginning to impact directly on city productivity, demand management is no longer a theoretical option. It is central to relieving congestion now and in the future and must be firmly placed on the urban transport agenda for cities throughout the region.

Increasing passenger carrying capacity is the realm of public transport systems. Improvements in bus operations and the provision of bus priority facilities in the road network can achieve higher passenger carrying capacities in public transport systems. In large cities, where passenger demand is concentrated along corridors serving city centers increased capacity can also be achieved through mass transit systems.

Given that in most cities in the region with populations in excess of five million, conventional bus systems can no longer cope with city center induced public transport travel demands, increasing passenger carrying capacity with mass transit is an agenda item for the 1990s in many cities in the region.

Freight movements are of equal importance to city productivity as passenger movements, but the needs of freight are often overlooked in dealing with traffic congestion. Measures to streamline freight transport in cities will need to be considered in the urban transport agenda for Asian cities to serve the goods transport needs of commerce and industry.

An agenda for managing congestion requires action in the following four areas:

- motorization;
- demand management;
- mass transit; and
- urban freight.

Motorization

While motorized vehicle ownership levels in Asia are still well below those of industrialized countries, motorization is on the rise in the majority of cities. At the beginning of the 1980s, there was a large diversity in vehicle ownership levels in developing countries in the region. The range is now narrowing upward in South East Asia with the dramatic rise in motorcycle ownership. It will narrow further in the 1990s and the rate of increase will undoubtedly exceed expectations (just as it has historically). The reasons for this are well known:

- historically car ownership increases rapidly with rises in income and can double or triple within a decade; the same probably holds true for motorcycles;
- cars and motorcycles have a personal mobility value as well as a status value with the result that rises in vehicle ownership have proved very difficult to contain; and
- several countries in the region consider the car (and motorcycle) industry as of strategic importance for industrial development and encourage the development of domestic markets which further stimulates vehicle ownership.

As vehicle ownership is the driving force in urban areas for stimulating demand and causing congestion, a clearer understanding of trends and possible control measures is essential. The World Bank has an opportunity to initiate and support research into motorization in Asia in three important areas (Box 3.1):

- suppressed demand;
- motorcycles; and
- control measures.

Demand management

The region has a rich experience in trying to avoid congestion in city centers by modulating the demand for urban motorized car trips through traffic restraint measures and pricing mechanisms. In Singapore, the experience has been successful but elsewhere there has been failure (with area licensing promoted by the World Bank, in the case of Bangkok and Kuala Lumpur,).

Success and failure seem to depend on several factors:

- success is clearly linked to the availability of alternative forms of public transport which are attractive to the motorist; but
- failure is caused by inadequate planning and marketing of the concept and its benefits for all users, particularly the motorist; and
- failure is also associated with pricing mechanisms being perceived as sources of extra revenue for government rather than sources of funding to improve the urban transport system for all users.

Without some form of restraint, the future of Asian cities in rapidly developing low- and middle-

Box 3.1 A research agenda motorization

Topic 1: Suppressed demand

Scope:	trends in motorization given present suppressed demand and prospective growth in incomes and liberalization policies.
Output:	directed at providing governments with realistic and practical options for regulating both demand and supply to avoid congestion in urban areas.
Countries:	China, Vietnam

Topic 2: Motorcycles

Scope:	analysis of factors which promote motorcycle ownership in low- and middle income countries in Asia.
Output:	trends in ownership and options for regulation of demand and supply in urban areas.
Countries:	India, Indonesia, Thailand

Topic 3: Control measures

Scope:	analysis of measures adopted in Asia to control vehicle ownership and their impacts, successes and failures.
Output:	recommendations concerning the use and potential impact of control measures on motorization growth rates in low- and middle-income Asian countries.
Countries:	Hong Kong, Japan, Singapore

income countries in Asia looks bleak - even for those countries which think they can afford the massive resources necessary for the scale of infrastructure to meet anticipated demand.

The more cor ,elling argument in favor of restraint is that not only does congestion become manageable but also the scale of investment in road infrastructure is less. This should allow for investment in public transport which should be more cost effective in moving people than cars.

This approach was taken initially with area licensing, traffic management and bus based public transport in Singapore and congestion was kept under control. However more recently, Singapore has made major investments in rail mass transit and urban expressways. Hence, even with demand management there is a need for additional urban transport infrastructure.

The linkage of demand management (through licensing or congestion pricing) with mass transit is being seen by many as the way to overcome political and popular opposition to what are perceived as unacceptable restrictions on personal mobility.

It is clear that mass transit itself is no cure for congestion and that many of the benefits expected from mass transit could be achieved in a more cost-effective way with restraint measures.

It can be argued that in major cities, with high levels of motorization, traffic restraint is unachievable today without upper-scale mass transit to provide motorists with an acceptable alternative. It can also be argued that proper road transport pricing has been shown to be an irreducible requisite to mass transit as a form of traffic restraint, unless physical restraint of road transport is possible.

This dual approach is being recommended in Bangkok where the development of a mass transit system is seen as providing a high quality alternative means of transport to the private car or motorcycle and therefore an opportunity for the progressive introduction of area road pricing. This could well be the way through the demand management dilemma which has plagued Bangkok for nearly a decade.

Developments in technology may soon enable road pricing to be more applicable, with electronic road vehicle licenses or number plates being charged in relation to vehicle use as routinely as using and paying for telephone calls (by distance, duration, time of day and equipment features). This technology has been available since 1983 (Box 3.2).

Electronic road pricing requires substantial initial investment costs (estimated to have been in the order of US$30 million for a full system in Hong Kong in 1985) and not insignificant recurrent costs (estimated at around US$2.5 million annually in Hong Kong) but experience in Hong Kong suggests that with benefit-cost ratios in the order of 14 to 1, these costs are more than recovered by the benefits that would accrue.

Box 3.2 Electronic road pricing in Hong Kong (1983–1985)

"The 21-month pilot stage of Hong Kong's Electronic Road Pricing (ERP) Scheme, lasting from July 1983 to March 1985, demonstrated the technical feasibility of ERP.

ERP is a form of automatic vehicle identification (AVI), in which each vehicle has an electronic number plate—the size of a video-cassette tape—mounted underneath the vehicle.

Whenever a vehicle passes over a toll site, an interrogator power loop embedded beneath the road surface sends out electronic signals to the moving vehicle's number plate and relays the vehicle's identification code to a roadside computer.

The data is transmitted to the control centre via dedicated lines. The system sends a monthly bill to the motorist giving a breakdown of the toll sites crossed, similar to a long distance telephone bill.

In addition, roadside closed-circuit television cameras automatically shoot pictures of vehicles with faulty or tampered number plates.

The technical and economic feasibility of the ERP system based on a true subset of the full system was found to be above the performance equirement, exceeding well over 99% effectiveness and reliability"

Source: Road Pricing: A Proposal for Hong Kong, T. D. Hau, 1989

In most congested city centers in major cities in Asia, little more capacity can be derived from traffic management schemes and there are not enough resources, time or space to provide sufficient road infrastructure to meet current or expected demand.

With congestion levels so high that they are beginning to impact directly on city productivity, demand management is no longer a theoretical option. It is central to relieving congestion now and in the future and must be firmly placed on the urban transport agenda for cities throughout the region.

Strategies and action plans need to be prepared for each major city and differentiated according to current and potential levels of congestion:

- curative strategies: to relieve high levels of congestion and avoid it increasing; and
- preventive strategies: to avoid severe congestion beginning.

Curative strategies for highly congested cities will embrace the dual approach being advocated for Bangkok. This is clearly appropriate in cities that have or are planning mass transit facilities (such as Calcutta, Delhi, Jakarta, Karachi, Manila, Pusan and Seoul) but demand pricing mechanisms will require considerable marketing to overcome the resistance of motorists.

Preventive strategies for smaller, less congested cities and for larger cities with low motorization rates (such as can be found in Bangladesh and China currently) will initially make use of traditional methods (such as traffic management, parking controls and charges, and bus priority measures) to pave the way for the progressive introduction of pricing mechanisms as congestion builds up.

Research is needed into demand management measures for controlling motorcycle use in cities. Physical measures may prove more difficult to enforce than pricing mechanisms given the ability of motorcycles to cut through or across physical barriers.

It will be important for the World Bank and other development agencies active in the region to take a leadership role in demand management.

The agenda for the World Bank with regard to demand management provides the opportunity for incorporating appropriate curative and preventive congestion strategies in current and prospective lending operations (Box 3.3) and monitoring developments in technology through:

- monitoring the introduction of Electronic Road Pricing technology and tariff structures in high-income countries in the region (Singapore and Hong Kong);
- promoting pilot schemes to test the appropriateness of such technology in low- and middle-income countries; and
- developing measures for controlling the use of all vehicles in the context of rapidly rising motorcycle ownership.

In addition, the agenda would need to take into account the real problems involved in persuading motorists to pay for commuting by car or give up using the car for commuting. The Bank, in collaboration with other development agencies, has an opportunity to assist governments in anticipating the resistance of motorists to demand management and in preparing appropriate marketing strategies to overcome such resistance.

Mass transit

In the past the Bank has taken the position that borrowers should be encouraged to compare capital-intensive mass transit systems with other less expensive systems and to carefully appraise the implications of such major investments in the context of the priorities of the city's or country's overall public investment program. In many cases, the Bank's assessment of mass transit systems revealed

Box 3.3 Demand management strategies

	Preventive congestion strategies	*Curative congestion strategies*
Objective:	avoid congestion developing in the future	reduce existing congestion
Approach:	progressive restriction on car use in CBD	restriction on car use in CBD, sub centers, and major transit corridors
Methods:	physical, pricing, and planning mechanisms	traffic control, transit, pricing, and urban renewal mechanisms
Scope:	traffic management, pedestrian streets, bus lanes, parking restrictions, localized (CBD) area licensing, traffic calming	mass transit, car pooling, area licensing, electyronic road pricing, area wide traffic control, designation of environmental areas/standards
Countries:	Bangladesh, China, India, Indonesia, Pakistan, Philippines	Indonesia, Korea, Phillippines, Thailand
Cities:	Small to medium-sized	Large

that it would have been better to have increased the capacity of existing bus services through bus priority measures, such as exclusive busways and better road access.

In Asia, most cities in predominantly low-income countries could not afford to even consider mass-transit. Several cities in middle-income countries could afford mass transit and did not follow this advice. Metros have been constructed in Pusan and Seoul in Korea, an elevated light rail system is operating in Manila and contracts are being negotiated for several rail-based systems in Bangkok. Busways have not been built in Asian cities and Bangkok is the only city in the region to have made extensive use of bus lanes to improve the performance of the bus system.

The argument for less costly busway systems is persuasive. Brazil has developed an extensive and often high capacity system of busways in nearly all metropolitan areas. But in many cases in Brazil, busways were not considered as the alternative to mass transit; they were and are considered as a first stage in moving toward rail-based mass transit. The most sophisticated busway system in the world in the city of Curitiba was designed over a decade ago with gradients and curves to permit a later conversion to light rail.

The lack of enthusiasm with busways in Asia can be partly explained by the lack of roadspace to devote to the exclusive use of buses. But several initiatives are being taken in Asia to develop elevated "transitways" which allow for conversion from exclusive bus use to light rail (see Box 3.4).

Box 3.4 Transitway proposals in Karachi

"The convertible transitway is seen as a fortuitously flexible approach to mass transit improvement. Implementation as busways avoids commitment of impractical investment levels, per kilometer, and permits effective use of much shorter and non-contiguous transitway segments.

The network itself, as busways, allows immediate and extensive integration of routes and is far more flexible in the way it is initially used than is possible with a rail network. Because of low cost, the prospects for early completion of a citywide network are far greater than would be the case for a rail system.

Private bus operators using the convertible busway can profitably own, maintain, and operate the required bus fleet, and pay a toll sufficient to meet the transitway operating and maintenance costs.

The availability to convert transitways from bus to rail use allows the investment in busways not to be wasted when later circumstances encourage or require conversion to rail."

Source: Reinvesting Mass Transit—A Solution for Karachi, M. Tahir Soomro and David B. McBrayer, TRB Annual Meeting, 1991

Bank support for the progressive and incremental development of mass transit systems is warranted in large cities in low-income countries and in smaller but fast growing cities in middle-income countries in the region as corridor flows are increasing and cannot realistically be handled by bus lanes ad infinitum.

This involves recognizing the longevity of mass transit systems and viewing their performance within a long term context when comparing their costs and benefits with other more expedient alternatives. It also involves designing infrastructure to be compatible with changes in technology such that increases in system capacity can be achieved cost-effectively at later dates without disruption to operations. The proposals under consideration in Karachi and Jakarta and the development of "pre-metro" (LRT deigned to be upgraded to MRT) systems in Germany provide useful examples of how this can be done.

Studies of the performance of mass transit systems, usually rail-based, in developing countries show that no system has been able to pay its way, except for those in very high income cities (Hong Kong and Singapore). Even those that carry very high passenger volumes (such as in Mexico City) with apparently very good urban structure impacts, still impose burdensome and unsustainable subsidy payments on government.

This presents a dilemma for governments and development agencies such as the World Bank when considering mass transit systems since they may have the capacity to satisfy increasingly high corridor travel demands but are usually not designed to be financially self-supporting and, although economically viable in their own right, they usually turn out to be not economically attractive when compared with less costly, but often less efficient, alternatives.

Two complementray options which have been used in Asia point the way through this dilemma. One is to develop lower-cost, high-capacity mass transit systems (Manila); the other is to share the cost burden more widely among the beneficiaries (Japan). A third, which has yet to be developed anywhere, is to offset a proportion of the costs of mass transit against the marginal benefits (and revenues) that accrue from its role in achieving more effective demand management. A fourth, which has often been mentioned by suppliers and manufacturers of rail based systems but which has yet to be seriously assessed, is the value of their contribution to air

quality and energy conservation when compared with other modes.

Light rail systems offer the potential for high capacity transit at lower costs than full-scale rail rapid transit systems. Recent developments in LRT technology (especially acceleration) suggest that capacities of 50,000 passengers per hour per direction are possible with four-car units operating at frequencies of one train per minute with running speeds of 60 kilometers per hour and 20 second dwell times at stations.

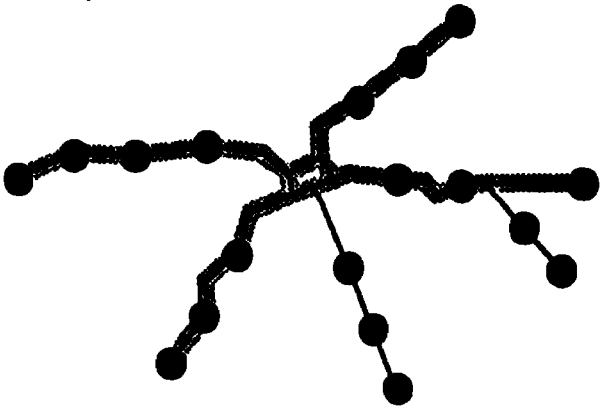
The Manila LRT was reportedly carrying 16,500 passengers per hour per direction with two-car units operating at two and a half minute headways in 1986. The construction costs of the Manila system were relatively low at US$ 17.9 million per kilometer (despite the system being elevated and made earthquake resistent). The domestic nominal cost has since more than doubled due to dramatic currency depreciations. This would have occured with any imported technology and reveals the need for cushions to absorb foreign exchange risks in volatile economies.

Subsidies from the sale of property development rights associated with mass transit schemes can be an effective method of sharing the cost burden of such systems more widely and providing a cushion against foreign exchange risks. Development profits contributed around 15 percent of the capital cost of the Hong Kong MRT system.

When planned correctly, there is evidence to show that mass transit systems can open up areas for development (see Box 3.5) and lead to increased development densities along mass transit corridors (see Figures 3.1 and 3.2). High density corridors with high capacity transport services are more efficient forms of urban development than urban sprawl, especially in cities where the majority of the population rely on public transport.

Land management and taxation policies, when prepared in conjunction with mass transit proposals, can ensure over time that a proportion of the development gains (see Box 3.6) derived from this process passes to society. This can help offset the additional investments made by society in a mass transit system (as against street-based public transport) to secure high density corridor growth.

Figure 3.1 Mass transit corridors in Curitiba, Brazil



Box 3.5 Mass transit and land development in Japan

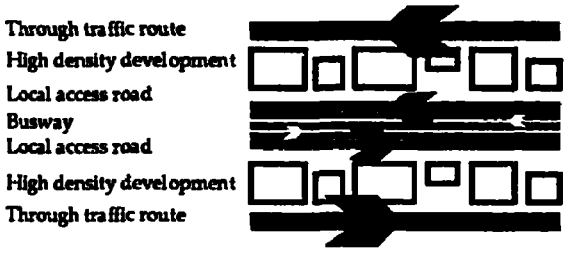
The Tokyu Corporation, which is one of the leading urban rail companies in Japan, has undertaken an interesting integrated urban rail and land development project consisting of 20.1 kilometers of mass transit and more than 3,000 hectares of land development.

The area was formerly a vast and hilly area, scarcely inhabited and underdeveloped. It has become a community of 440,000 people, centered around the mass transit system and feeder bus network.

Like most major private rail lines in Japan, the rail construction and operation costs have been wholly covered by the farebox from users. Although, in this current financial situation and under the existing government regulation on rail fares, development gains do not need to be, and cannot be, earmarked to recover the costs of rail construction and operations, the development gains have accrued to the Tokyu Corporation group which is the parent company of the Tokyu mass transit company.

Source: Private Financing of Urban Transport Infrastructure in Asia, Shunso Tsukada and Roger Allport, ASTIN, 1991.

Figure 3.2 Mass transit corridor (detail)



Box 3.6 Land value increases and mass transit

In Santiago there have been big developments at metro terminals, Escuela Militar and Lo Ovalle; the upper class suburb of Provincia, served by line 1, has boomed and there has been enormous commercial development on that side of the city centre. In Seo 1, pedestrian shopping centres have been integrated with the metro. Land prices are said to have doubled in two years alongside the light rail in Tunis, and the Porto Alegre system has also seen land prices growing strongly near its stations, where some business development has already taken place.

Source: Transport and Development in Asia, Roger Allport, ASTIN, 1990.

Box 3.8 Threshold for conventional bus services

"It is obviously difficult to assess theoretically how large a city might grow before its city center outstripped the capacity of a road-based transport system. But one can see when the bus system reaches its full potential, i.e. when it is carrying about 16,000 passengers per hour per direction in the main corridors, and demand is still growing. This is the point when rational people begin to say the buses cannot cope. It is not in itself a justification for a metro, but it is a sign that urban development may have reached an important threshold."

Source: Transport and Development in Asia, Roger Allport, ASTIN, 1990.

In the review of mass transit experience in developing countries published by the TRRL, there is evidence to show that although these systems do not in themselves cause city centers to grow, cities such as Sao Paulo, Seoul and Mexico City would have had their growth severely constrained without the capacity of mass transit systems (see Box 3.7).

The review considers that cities with populations in excess of five million such as Bangkok, Bombay, Delhi, Jakarta, Karachi, Manila and Shanghai have probably already reached the threshold wherein conventional bus systems can no longer cope with city center induced public transport travel demands (Box 3.8).

The review concludes by stating that without some form of high capacity transport system, central city activities will be forced to non-central locations, average journey distances will increase and there will be a growth in inter-district traffic. The demands for personal mobility will rise and congestion will increase in the city center.

Box 3.7 Mass transit and city center growth in Mexico City

In Mexico City, lines 1–3 constitute 6 routes into the city centre, averaging 10 kilometers each. They carry 1,800,000 two-way trips each working day of which 900,000 could be work trips and a high proportion would be located in or just outside the central area. One does not have to look any further to realise that the development of the centre during the last 20 years must have been profoundly dependent on the metro system.

Source: Transport and Development in Asia, Roger Allport, ASTIN, 1990.

Although these changes take place over long time periods, it is important to assess these impacts, their value to society and how and when society should pay for them.

The role of mass transit and demand restraint measures in curative congestion management strategies has already been discussed in earlier sections of this report. Suffice it here to say that the extent to which the cost of mass transit should or could be cross subsidized from road pricing revenues, needs to be assessed as an integral part of the process of developing and implementing such strategies.

Finally, the environmental benefits of electrically propelled mass transit systems have rarely been seriously evaluated in comparison to other modes. The investment costs of rail-based mass transit systems are difficult to justify on the basis of air pollution control alone. What proportion of these costs could be justified needs to be assessed so that the environmental benefits of such systems can be really understood and taken account of in assessing mass transit performance.

The challenge for the World Bank in the 1990s is to take a balanced view in assisting governments in trying to resolve some of the following issues with regard to mass transit:

- how to take an incremental approach to the development of a strategic mass transit network which takes account of present needs and constraints but allows for physical, operational, and technical evolution (such as transitways);
- finding ways to reduce the capital and operating costs of mass transit systems (through LRT for example) and in seeking ways to pay for them which

reflect their benefits to users, developers and society at large (which avoid or at least minimize outright subsidies);

- defining pragmatically the role of mass transit within the urban transport system in terms of demand management and relative to other modes of public transport (including non-motorized vehicles); and
- assessing the potential inter-relationships between mass transit and urban development in managing more effectively urban growth and productivity.

Several steps have already been taken within lending operations (in Jakarta), preparatory studies (in Karachi) and technical studies executed by the World Bank on behalf of UNDP (in Bangkok) to begin to try and address some of these issues (such as light rail technology, value capture, incremental development and demand management).

The Asia Technical Department has initiated reviews of mass transit and land development (with special emphasis on experience in Japan), mass transit and urban development and the private sector financing of urban transport infrastructure (with special reference to mass transit systems).

More needs to be done. The economics of mass transit need to be revisited by the World Bank to take into account the environmental, demand management and urban structure implications of such systems relative to the priorities of a city's overall public investment program.

It has often been said with regard to capital intensive mass transit systems that "they will only become viable when the private sector considers them to be a good investment without government subsidies". The point of the statement being that this would of course never happen.

The private sector is investing in these systems in Asia without, to date, subsidy requirements. This must now be recognized in the approach to the urban transport sector taken by development agencies such as the World Bank in the case of the Asia region in the 1990s.

The time for debate is past; this is the decade for action in the fast growing cities of Asia. The Bank can be part of that action by being balanced, objective but above all realistic in its assessments of mass transit options and their potential contribution to the development process.

Urban freight

Urban freight plays a critical role in the productivity of cities and in the provision of essential supplies for urban residents. In spite of the importance of urban freight, urban transport related requirements received little attention in the past by governments or development agencies.

One reason for this neglect is the assumption that adequate provision of urban transport infrastructure and facilities for the movement of people implicitly provides for the movement of goods as well. Another is the assumption that freight is so related to other transport modes, especially ports, rail and shipping, that the specialists and agencies in these areas will resolve any problems occurring with goods movements within city boundaries. But this is not the case.

Urban freight is also at the bottom of the pecking order when it comes to solving congestion. Trucks are seen as taking away valuable road space from commuters and should therefore be banned from city streets during peak hours or throughout the day. The consequences of these action on the trucking industry, prices of goods and delays in transhipment are rarely considered.

In attempting to improve goods movements in Asian cities, a comprehensive approach is necessary which recognizes that urban freight handling is foremost an inherently private sector activity which is flexible and responsive to demand; and secondly, that the freight handling system is composed of many closely inter-related elements; and finally that freight movements are of equal importance to city productivity as are passenger movements and therefore deserve a comparable share of attention and resources.

In preparing an agenda for urban freight, the World Bank has an opportunity to assist governments improve the performance of the urban freight sector by:

- assisting governments in creating regulatory frameworks which allow for greater freedom of choice and greater efficiency on the part of the private sector.
- developing urban freight management programs within lending operations in major cities in the region; and
- making use of the experience and expertise in freight handling from within the region;

Personal mobility

Personal mobility in cities is especially problematic for low-income groups who tend to suffer from poor location and poor access in most countries in the region. As pointed out by Professor Gakenheimer in a recent EDI Seminar on Transport Policies in Megacities:

"The potential payoff from incorporating the poor in the public transportation system is very high in social, political and economic terms for everyone".

The poor are tending to live more and more on the periphery of cities with often tenuous transport links to employment opportunities. Even when such links exist, low-income groups are obliged to walk long distances to reach affordable public transport services which do not penetrate low-income neighborhoods.

Non-motorized vehicles offer a low-cost alternative to low-income groups for personal mobility in many cities in Asia and yet it is clear that the use of non-motorized vehicles is being increasingly marginalized by a variety of factors. How to incorporate non-motorized vehicles as an integral part of the urban transport system is a major challenge in the region in the 1990s.

Walking is an important mode of transport in all cities and the only form of personal mobility for many of the poor and underprivileged. Few facilities exist for pedestrians and walking space is being progressively eroded by motorized vehicles. This trend needs to be reversed in the 1990s in an effort to substantially improve walking conditions in cities.

Although improving access to urban services and employment involves motorized travel modes, the marginalization of non-motorized vehicles and the neglect of pedestrians warrants special attention in the World Bank agenda for the sector in Asia in the 1990s.

Non-motorized vehicles

Non-motorized vehicles (NMVs) are an attractive form of transport in an increasingly environmentally conscious world. They offer low-cost personal mobility, are non-polluting, use renewable energy, and are well suited for short trips in most cities in the region regardless of culture, income, location or size.

For these reasons, NMVs can be appropriate modes of transport in programs designed to address poverty alleviation, air pollution, congestion management and motorization.

NMVs play a unique and vital role in urban transport in much of Asia and account for between 25 and 80 percent of vehicle trips in many Asian cities, more than in any other region in the world. However, the future of NMVs in Asia appears to be threatened by several factors:

- increasing motorization and use of motorcycles;
- reduction in street space for safe NMV use;
- longer trip distances prompted by urban sprawl;
- exclusion of NMV needs in urban transport planning and investment programs;
- affordability of NMVs for low-income groups;
- social and political attitudes towards NMVs as being "backward;" and
- excessive and often inappropriate regulation of NMV use.

The future for NMVs is dependent on their being treated as an integral part of urban transport systems and on understanding the conditions under which they can be cost-effective relative to other modes of transport (see Box 3.9)

The actual and potential use of NMVs varies considerably in relation to city size. In smaller cities where distances are relatively short, NMVs are used, and could be used more extensively, for work, shopping, and school trips. In larger cities, where average trips lengths are longer, NMVs can play more of a complementary role in providing access to public transport stops or mass transit stations for work trips as well as being used for shorter-distance shopping and other trips within neighborhoods. NMVs can also play a very important role in person and goods transport in industrial areas and central business districts.

Extensive use of NMVs in mixed traffic can provoke congestion and accidents unless provisions are made within the road network to segregate NMVs from traffic. Several simple low-cost physical measures can be taken to make NMV use safer and competitive with motorized transport.

Many cities have extensive networks of narrow lanes or alleys which are unsuitable for motor vehicle use but which are sufficiently wide for bicycle use. The designation of NMV routes using such alleys and combined with appropriate facilities where NMV routes cross traffic streets can be a simple and practical way of developing safe and appropriate networks for segregated NMV use at little cost (see Box 3.10 and Figure 3.3). In other cases, NMV routes can be established parallel to railway lines (as the gradients are ideal for NMV use) or underneath elevated expressways.

NMVs can be provided with segregated lanes on existing streets and techniques exist to separate NMV turning movements and/or provide priority for them at junctions.

Bicycle parking facilities are required at mass transit stations, within central areas and shopping complexes to encourage their use and avoid encroachment and the risk of theft.

Provision of small scale credit systems can play an important role in making non-motorized vehicles affordable to low-income groups, where the price of

Box 3.9 Potential roles for non-motorized vehicles

A Bicycles can be competitive and complementary with other modes in meeting personal mobility needs:

1. for short trips between 0.6 and seven kilometers in length (on flat or undulating terrain) where bicycles would be faster than walking and more energy efficient than motorized transport;
2. for commuting trips to public transport facilities (bike-and-ride) as alternatives to walking or motorized "park-and-ride;"
3. for trips within neighborhoods (or residential environmental areas) where extraneous motorized traffic is incompatible with the local environment; and
4. for trip making by low-income residents as a faster alternative to walking and/or cheaper alternative to public transport.

B. Cycle-rickshaws can play a useful role within the passenger transport system:

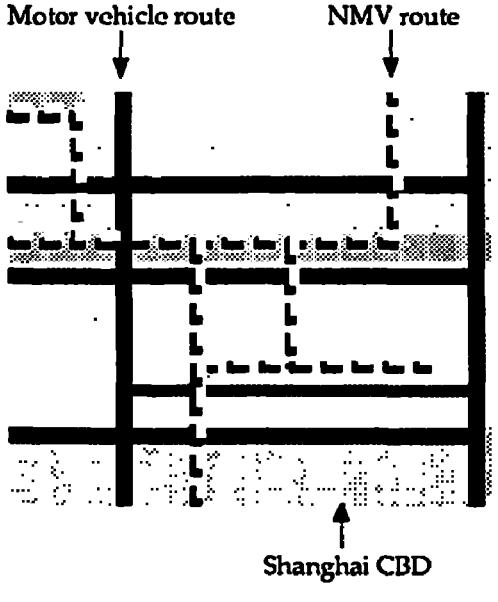
1. for local non-motorized paratransit services in cities where wages are low and where there is substantial surplus labor; and
2. for taxi, ambulance and "school bus" services in low-income areas which are inaccessible to motorized vehicles and/or which cannot afford their services.

C. Cycle-rickshaws can also be effective in freight transport:

1. for small scale delivery services within central business districts and residential neighborhoods; and
2. for small freight haulage for micro-enterprises and within wholesale market areas.

a bicycle in terms of their local wages can be equivalent in scale to the price of a motor car for a European or North American. The Grameen Bank in Bangladesh provides an example of such micro-lending, using pooling of borrowers in small groups to secure loan repayments on such mobile assets as NMVs.

Figure 3.3 A World Bank financed NMV network in Shanghai



Other employer credit systems allow workers to pay back the purchase of bicycles over a year or so at a cost equivalent to commuter bus fares. Lines of credit can be established for bicycle purchase with incentives built-in to the terms of the loan for adequate maintenance.

Even with credit schemes of this type, bicycles can often be unaffordable due to artificially high purchase costs due to taxation. More affordable prices for low-income groups can be achieved by reducing or eliminating import duties, purchase taxes, registration and licensing fees on basic models.

The influence of NMV use on motorization is debatable. There is no doubt that promoting NMV use for bike-and-ride as an alternative to park-and-ride for middle- and high-income car owners reduces car usage in Japan. It is, however, unlikely that potential car owners would purchase bicycles instead of cars in low- and middle-income countries in Asia.

In terms of motorization, the greatest threat to NMV use comes from motorcycles which provide an attractive progression for NMV users and a cheaper alternative for prospective car buyers.

Climatic factors also effect NMV use in many Asian countries. Climate mitigates against NMV use by the rising middle-class who aspire for air-conditioned comfort. But for low-income groups, who make up the bulk of urban populations, climatic factors can favor NMVs which provide cooler alternatives to overcrowded and non-air conditioned buses.

Box 3.10 A World Bank financed NMV program in Shanghai

The Non-Motor Vehicle (NMV) action program (estimated to cost US$7.8 million or US$0.4 million per kilometer) would increase capacity for bicycles (and other non-motor vehicles) by the provision of 19.4 kilometers of exclusive NMV routes each 2 x 4 lanes wide (thereby providing a total of 77.6 kilometers of bicycle lane in each direction) through:

(a) the establishment of a network of ten routes serving the CBD from the conversion of 17.8 kilometers of existing, but little used, secondary roads for exclusive NMV use; and

(b) the construction of 1.6 kilometers of missing links (including the construction of an exclusive NMV bridge across the Suzhou Creek at Puji) at six strategic points in the proposed exclusive NMV network.

Source: Staff Appraisal Report, Shanghai Metropolitan Transport Project, World Bank, 1991.

NMVs can also be used effectively to substitute for inefficient motorized transport in delivery services for goods (see Box 3.11) and messages or small packets (as many cities in Europe and North America are discovering with the explosion of pedal-powered courier services).

Many factors influence modal choice with regard to NMVs and clearly their use can be beneficial in a variety of conditions. The attitudes and actions taken by the World Bank, multi-lateral and bi-lateral development agencies, non-governmental organizations, governments and the private sector influence the direction and nature of change in NMV use in urban areas in Asia.

Box 3.11 An example of complementary NMV delivery services in Bogota, Colombia

"In the 1970s, the Ramo bakery delivered products direct from the factory to 60,000 small shops in Bogota using 135 trucks, which often operated with partial loads and had trouble parking near their deliveries.

The bakery changed its distribution system so that a much smaller fleet of trucks were used to haul products to satellite warehouses, where a fleet of 900 cargo-tricycles picked up the baked goods for final delivery. Total costs of the delivery system dropped by two-thirds from their previous level through this intermodal integration and differentiation, while expanding employment."

Source: SustainableTtransportation Planning and Development: Lessons from Megacities, Michael Replogle, May 1991.

In the past, the World Bank has been noticeably neutral with regard to NMV use. It has been criticized for implicitly benefitting motorized transport in lending operations and for only occasionally paying attention to the needs of NMVs. In China (where the needs of NMVs are overwhelming), the World Bank is addressing non-motorized travel in a significant way (as can be seen from Box 2.10 above). A more concerted effort is needed now and in the future throughout Asia toward encouraging NMV use where it is appropriate within urban transport systems.

Setting an agenda for the Bank with regard to NMVs in Asia would initially involve subscribing to their importance within urban transport systems and would comprise:

- undertaking a detailed inventory of NMV needs and opportunities for their development (a beginning has been made in this process by the Asia Technical Department in the Urban Transport Technical Note "Non-motorized vehicles in Asia: issues and strategies" by Michael Replogle);
- developing technical guidelines for the management of NMVs in mixed traffic and in urban environments (using experience in such measures from the Netherlands and China); and
- undertaking pilot schemes in selected cities to manage NMV movements more effectively and to encourage and expand their use.

The possible steps and elements of this agenda are presented in Box 3.12 and are designed to identify which measures would be appropriate for inclusion within lending operations. This agenda would not only serve the needs of the Asia region but also other regions in the Bank which are considering encouraging the use of NMVs as integral parts of developing the urban transport sector and/or alleviating poverty (such as Africa and Eastern Europe).

As a result of this approach, the Bank would be in a better position to advise governments as to what can and needs to be done to assist NMVs, and what are the costs and benefits of actions to promote their use. Given the experience and interest of bi-lateral development agencies and non-governmental organizations in the development of NMVs, opportunities exist for the Bank to take the lead in a collaborative effort in the region to pool resources in undertaking each of the steps outlined in Box 2.12. A seminar on the issue of NMVs in Asian cities would provide a useful forum to initiate this type of approach.

Box 3.12 An agenda for NMV use in Asian cities

Step 1: Inventory of NMV needs and opportunities:

vehicles:	typology and use/cost and affordability/manufacture/assembly/maintenance costs
use:	volumes/capacities/speed and distance/geometric standards/safety and accidents
integration:	with pedestrians, public transit, freight transport, in neighborhoods, in commercial areas
facilities:	networks and routes/priority/segregation/parking/storage
regulations:	registration/licensing/use of roads/sidewalks/dimensions/weights/inspection procedures

Step 2: Development of technical guidelines for NMVs:

routes:	surface/gradients/drainage; lane dimensions/width; signs/markings/lighting
lanes:	warrants; safety and separrators
signals:	warrants/height/type/NMV actuated/ATC
parking:	location/type/theft prevention/charges
facilities:	bridges/underpasses/barriers to other vehicles

Step 3: Pilot NMV improvement schemes:

Objective:	determine effectiveness of NMV measures and their costs and benefits in large and medium-sized cities.
Scope:	physical measures to develop routes, small networks, priority facilities in mixed traffic; monitoring and evaluation.
Locations:	within low-income neighborhoods and along travel corridors serving CBDs, industrial and commercial areas.
Countries:	Bangladesh, China, India, Indonesia, Laos, Nepal, Vietnam

Pedestrians

Walking is an important mode of transport in all cities and yet in low- and middle-income countries in Asia few facilities exist for pedestrians and pedestrian space is being progressively eroded by motorized and non-motorized vehicles.

In terms of accidents, pedestrians are the most vulnerable group of road users and they not only lack adequate space for walking but also rarely have facilities that are safe, especially for the young, elderly and infirm.

Often, pedestrian facilities are regarded as luxuries which cannot be afforded or are simply overlooked in road improvement plans. In cases where pedestrian facilities are provided, they are often poorly designed, badly located or not respected by drivers and shop-keepers, or enforced by the police.

Examples of techniques for improving pedestrian safety and providing pedestrian facilities abound in the high-income countries in the region (Australia, Japan, Hong Kong and Singapore) and in traffic management literature.

The World Bank and other development agencies have an opportunity to assist governments in low- and middle-income countries in giving priority to developing and financing the types of action programs presented in Box 3.13 specifically designed to meet pedestrian needs in cities.

An important constraint to the development of pedestrian facilities in the past has been lack of funds. Municipal governments in particular need to be encouraged to investigate the possibility of funding pedestrian improvements from such sources as parking fees, area licensing fees, electronic road pricing

Box 3.13 Typical pedestrian improvement programs

Central Area Programs:
pedestrian streets, precincts, networks
sidewalk widening and management

Low-income residential neighborhood programs:
pedestrian networks, paved footpaths (and staircases), footbridges (over canals and waterways), paved bus stop areas (and shelters), street lighting

Other residential/neighborhood programs:
sidewalk paving, street lighting, environmental management (chicanes, road narrowing and other traffic and speed reduction programs)

Traffic/transport corridor programs:
pedestrian refuges, footbridges, underpasses, barriers/fences, signalized crossings, sidewalk paving.

charges and betterment taxes/surcharges (in central business districts and middle- to high-income residential areas).

Other possibilities such as the allocation of say ten percent of all major road related civil works contracts to pedestrian improvements also need to be explored along with sustained funding arrangements for the maintenance and repair of such facilities.

In many crowded cities, improvements of pedestrian facilities can increase pedestrian travel speed and safety, depressed because of sidewalk space. The benefits of pedestrian improvement programs accrue to all sections of urban society but especially to low income groups. Pedestrian improvements will not alleviate poverty; but they will save lives and reduce the risk of injury. They will also improve walking conditions for the poor and underprivileged who are too often neglected and treated as second class citizens in urban transport programs.

Pedestrian improvements are needed in large and small cities. In larger cities, such programs need to address the deficiencies of the past as well as plan for the future. In smaller cities, there is greater scope for introducing the foundations for adequate attention (and funding) to the needs of pedestrians now and in the future.

Environment

Urban transport has contributed significantly to the deterioration of the urban environment in Asia in most countries throughout the region. Unless measures are taken in the 1990s to redress the degradation which has already occurred and to design urban transport infrastructure and services to be environmentally friendly, the cities of Asia will pay a heavy price in terms of the health and well-being of their citizens.

Urban transport infrastructure divides communities, is visually oppressive and a source of air and noise pollution from vehicle emissions. Motor vehicles by their very nature are environmentally unfriendly: they kill and maim and pollute. Measures can be taken to avoid these negative effects of the urban transport sector which is in all other respects of benefit to urban society. The techniques exist, the knowledge is available and the resources can be found; what is lacking is a willingness on the part of many governments to face the inevitable and deal with it before it engulfs them.

The World Bank, along with many development agencies active in the region, has made the improvement of the environment a central theme in the development process. A World Bank agenda for environmental action in the urban transport sector in Asia is already long overdue. Considerable urgency is now required on all fronts and in all countries on the following:

- all urban transport projects without exception should be designed to explicitly address environmental issues;
- in all cities subject to lending operations in the urban transport sector, an environmental stock-taking is needed to assess the extent of adverse environmental impacts resulting from the urban transport sector or prospective actions in it;
- cost-effective environmental action plans and improvement programs specifically related to the needs of the sector need to be drawn up and agreed with local authorities; and
- the Bank has the opportunity to provide a catalytic role for ensuring the availability of resources from its own sources and those of other development agencies.

Within this general framework, actions are needed with regard to specific environmental impacts of the urban transport sector:

- the nature and extent of vehicle emissions;
- safety and accidents; and
- community severance, visual intrusion and the need for environmental management.

Vehicle emissions

A major factor contributing to the quantity of vehicle emissions in urban areas is the fuel economy of vehicles. There is considerable scope for improved fuel economy in certain parts of the region. The typical domestically manufactured car in India and China (17-20 mpg) are half as fuel efficient as "best practice" in OECD countries (42 mpg). Fuel economy standards, differential vehicle taxes and "bonuses" for scrapping less fuel efficient vehicles are some of the measures which should be adopted to promote greater fuel efficiency.

Unleaded petrol must be a key element of vehicle emission control programs throughout the region, both to reduce its direct health effects and to allow for the introduction of advanced pollution control technologies. For an equivalent octane rating, the production cost of reducing the lead content of petrol from 1.1 to 0.1 grams per gallon is estimated to be between US$0.02–04 per gallon depending on the reformulation/blending process used. Differential

fuel taxation should be used to promote the use of unleaded fuel and leaded fuel should be progressively but rapidly phased out.

The sulfur and aromatic content of diesel fuel must be decreased to achieve reductions in particulate emissions. The cost of a tenfold reduction in sulfur content from 0.5 percent to 0.05 percent is estimated to be US$0.04 per gallon. Fuel price surcharges based on the sulfur/heavy oil content of diesel should be introduced to promote the availability and use of cleaner fuel in trucks and buses.

Alternative fuels such as compressed natural gas, liquefied petroleum gas or alcohol fuels have the potential to reduce urban carbon monoxide and ozone levels, to solve the diesel particulate problem in city buses and supplement advanced emission control technology. Alternative fuels are particularly appropriate for use in captive vehicle fleets such as taxis, buses, delivery vans and trucks. Incentives to switch to cleaner alternative fuels can be provided through differential fuel taxation.

The use of unleaded fuel allows for the introduction of closed loop three-way catalysts which have demonstrated the potential to substantially reduce petrol car emissions in a cost effective manner. These devices are estimated to cost between US$500 and US$600 (in 1989 prices) per vehicle. Oxidation catalysts (estimated to cost US$400 per vehicle in 1989 prices) would be similarly attractive to reduce motorcycle emissions. The introduction of these technologies can also improve vehicle performance and driveability, reduce maintenance and lead to improved fuel economy.

Regular and effective vehicle inspection and maintenance programs are essential to ensure that the anticipated benefits of emission control strategies are not lost through poor maintenance or tampering with emission control devices. Given that in many low-income countries the standards of vehicle maintenance are very low, such programs can significantly reduce emissions from vehicles with no pollution controls, making this a very high priority strategy throughout the region. An example of the ingredients of an effective inspection and maintenance program is presented in Box 3.14.

Although the need for action on vehicle emissions is urgent, remedial measures cannot be introduced all at once. A phased approach, supported by Bank lending, is necessary.

One such approach is to devote the early stages of the action program to laying a firm foundation for further action. Primary steps should include:

Box 3.14 An example of an effective vehicle inspection and maintenance program

A suitable test procedure, supplemented by inspection of emission control systems where necessary.

Effective enforcement of vehicle compliance, through the vehicle registration process.

Adequate attention to repair procedures and mechanic training (mechanics must be able to diagnose and fix vehicle after it fails the inspection).

Enforcement of program requirementsfor inspectors and mechanics (by using undercover vehicles with known defects).

Periodic evaluation and review, to identify problem areas and develop solutions.

Vehicle model year coveragethat includes older vehicles.

Minimization of repair cost waivers and other waivers and exemptions.

Source: Automotive Air Pollution Control: Strategic Options for Developing Countries, Asif Faiz and Jose Carbajo, INUTD, May 1991.

- air pollution monitoring;
- the adoption of necessary and feasible vehicle emission standards;
- the widespread distribution of environmentally friendly fuels;
- the introduction of restrictions on the import or assembly of vehicles which do not meet vehicle emission standards;
- the introduction of voluntary inspection and maintenance programs (which means every vehicle must be inspected but repair and retest is not yet mandatory); and
- the design and construction of necessary government testing facilities for future programs.

In the second phase, the vehicle emission requirements should be gradually tightened:

- inspection and maintenance becomes mandatory and becomes progressively more stringent;
- the importation or assembly of non-certified cars is severely restricted; and
- selective testing is used to verify vehicle certification and institute necessary recalls.

Finally, as the fundamental administrative monitoring and control structure becomes consolidated, standards can be gradually and routinely tightened:

- standards can be made more stringent as technology advances;

• recall liability and warranty protection can be extended to the actual vehicle lifetime, and allowable maintenance requirements can be reduced;

• the environmental friendliness of fuels can also continue to be improved;

• the requirement for on-board diagnostics can be systematically introduced in all new cars; and

• inspection and maintenance programs can be decentralized as technical competence increases and expands.

Safety and accidents

Traffic accidents in urban areas are increasing at alarming rates throughout low- and middle-income Asian countries. There are several reasons for this:

• urbanization brings with it many new urban residents from rural areas who are unfamiliar with urban driving conditions and levels of traffic;

• congestion causes impatience and a deterioration in driver discipline and driving conditions;

• road networks in many cities were never designed for the volumes and speeds of traffic in the 1990s; and

• the drive to provide more roadspace for motorized vehicles has resulted in inadequate facilities for pedestrians and slow moving vehicles.

In the competition for road space and getting through congestion, the life and limbs of the disadvantaged are being put increasingly at risk.

In recent years, the World Bank and other aid agencies have recognized the need to reduce road accidents which are currently estimated to claim the lives of 300,000 people every year and injure another ten to 15 million throughout the world. They have assisted governments in the development of comprehensive national road safety improvement programs which are beginning to address the problem.

However, further efforts are now needed in Asian cities to prevent and reduce increases in traffic accidents becoming yet another environmentally damaging byproduct of increased urban mobility in the 1990s.

Solutions are possible. Between 1968 and 1985 the number of traffic accident related deaths increased in developing countries in Asia by 170 percent; during the same period the number of deaths in developed countries declined by 25 percent. Many simple, straightforward and low-cost solutions are available and being used in many countries throughout the world as can be seen from the recently published TRRL report "Towards Safer Roads in Developing Countries."

What is now needed and what this report admirably achieves is:

• to bring safety to the forefront of the minds of planners and engineers in developing countries and to bring to their attention important details of design affecting road safety that they might otherwise overlook or consider insignificant;

• to introduce policy-makers in developing countries and aid agencies to the wide range of issues in highway planning and design that can affect road accident rates and the mitigating actions which can be taken to reduce the number and severity of road accidents;

• to bring together developing country experience in road safety together with material from the standards, guidelines and design guides of developed countries and make this information available to professionals in developing countries;

• to provide a source of ideas for new designs and countermeasures so that hazardous locations in developing countries can be made safer; and

• to stimulate evaluation of and research into road safety countermeasures in developing countries so that the most effective can be identified.

The first step in an urban road safety agenda for the World Bank in Asia is to subscribe to these aims, endorse the TRRL report and make sure it is distributed and available in all major cities throughout the region (it is freely available from the UK Transport and Road Research Laboratory).

The second step is to encourage member governments to develop urban road safety and accident prevention programs which make use of the ideas presented in the TRRL report and which have proven to work in other situations. In preparing such programs, the Bank should also encourage member governments to adopt the institutional arrangements recommended in the TRRL report and bring together the "safety professionals" in each city:

• the police, to influence driver behavior through the enforcement of regulations;

• the engineers, to design safer roads and countermeasures; and

• the educationalists, to train and inform road users about dangers and how to avoid them.

The third step is to recognize the importance given in the TRRL report to the success of such programs as a result of the provision of adequate funds and of ensuring the establishment of organizational arrangements for carrying out and coordinating safety

Box 3.15 The components of an urban road safety program

1. Accident data collection and analysis.
2. Traffic engineering and control improvements at accident locations.
3. Vehicle testing and inspection.
4. Driver training and testing.
5. Traffic education for children.
6. Publicity and marketing.
7. Traffic police enforcement.
8. Road safety monitoring and research.
9. Traffic and urban road safety design standards.
10. Emergency services and first-aid.
11. Road safety legislation and penalties.

Source: Towards Safer Roads in Developing Countries: A Guide for Planners and Engineers, Alan Ross et al., Transport and Road Research Laboratory, 1991.

activities. Here, the World Bank and other development agencies have an especially important role to play in securing adequate funding and in promoting institutional development.

In the case of urban road safety in Asia, there are considerable challenges to be met in the 1990s. But the basis for action exists; the TRRL report provides working examples and blueprints (see Box 3.15); and several countries in the region (Australia, Hong Kong, Japan and Singapore) have hands-on experience and expertise in developing successful operational programs. With the support of and collaboration between member governments, the World Bank and other development agencies, action plans can become reality, the challenges can be met and less lives would be sacrificed to the cause of urban mobility.

Environmental management

Community severance, noise and visual intrusion are the byproducts of subordinating the quality of life in cities to the demands of traffic. This has occurred in many cities of the region and will continue unabated unless new approaches are developed to protecting city environments. New approaches are needed in Asia; in developing them it is worth recalling approaches to this problem which were devised more than twenty five years ago in the United Kingdom and incorporated in the report Traffic in Towns by Colin Buchanan.

The essence of this approach is the need to respect the nature of city environments—termed environmental areas and protect them from extraneous traffic (see Box 3.16)

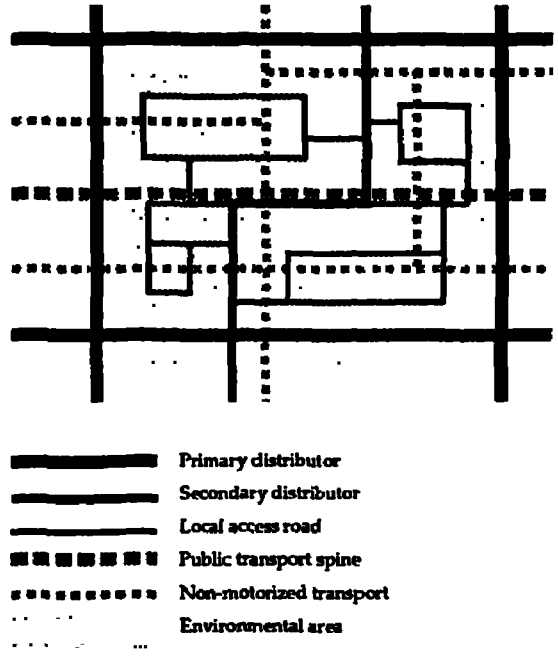
Box 3.16 The environmental area concept

"There must be areas of good environment, urban rooms—where people can live, work, shop, look about, and move around on foot in reasonable freedom from the hazards of motor traffic, and there must be a complementary network of roads - urban corridors - for effecting the primary distribution of traffic to the environmental areas. These areas are not free of traffic - they cannot be if they are to function - but the design would ensure that their traffic is related in character and volume to the environmental conditions being sought. It is a simple concept, but without it the whole subject of urban traffic remains confused, vague, and without comprehensive objectives."

Source: Traffic in Towns. Colin Buchanan, 1963.

Environmental areas are homogeneous areas within which considerations of environment predominate over the use and scale of motorized vehicles. Such areas should not be disrupted or severed by extraneous traffic (Figure 3.4) which should be channeled around them and controlled within them.

Figure 3.4 The environmental area principle



Environmentally friendly public transport and non-motorized modes would normally predominate within these areas (Figure 3.4). The neighborhood and traffic cell planning concepts and the Area Licensing demand management concept are based on similar principles.

Within environmental areas, traffic management techniques are used to deter through traffic, reduce speeds and provide priorities for pedestrians, non-motorized vehicles and public transport.

Adopting the principles embodied in the environmental concept enables cities to modulate transport infrastructure and services according to the environmental capacity and scale of its component areas. Environmental areas exist in all cities; they are not, however, usually recognized or treated as such. They can be residential neighborhoods, central business districts, industrial or commercial centers, port areas, warehouse or wholesale districts, parks, historic or religious areas. They can also be corridors with mixtures of these activities. What distinguishes and defines each area is its inherent character, scale and function.

Local low-cost improvements can be undertaken within areas to protect communities (in the case of predominantly residential areas) and activities (in the case of commercial areas) from the effects of extraneous traffic. Where traffic or infrastructure "cuts through" or is out of scale with an environmental area, special counter-measures (landscaping, noise barriers, safe crossing points, etc) are necessary to maintain the homogeneity and scale of the area.

Environmental standards need to be established for each environmental area and with the community concerning (a) the scale and type of infrastructure and vehicles; and (b) the levels of air pollution, noise and speed which can be tolerated within each area or type of area. For example, noise level tolerances in residential areas would be lower than in commercial areas. Non-motorized vehicles and pedestrians would be non-intrusive in low-income residential areas whereas commercial vehicles and trucks would be non-intrusive in wholesale market areas.

Environmental area management takes time and costs money. However, the World Bank and other development agencies concerned with the environment, have an important role to play in assisting governments to recognize the environmental costs involved in not paying attention to city environments in urban transport planning and management.

And more importantly, the World Bank in collaboration with other development agencies can assist governments in developing, and in allocating funding for, cost-effective environmental management techniques which protect and enhance city environments (be they termed environmental areas or neighborhoods).

An agenda which would provide an opportunity for the World Bank to address environmental management issues and reduce unnecessary community severance and visual intrusion would involve:

- targeting lending operations in the sector toward the definition of environmental areas and the establishment of environmental capacities and standards;
- seeking the collaboration of other development agencies in the promotion of pilot projects to assess the costs and benefits of local improvement techniques and counter-measures;
- developing technical guidelines for cost-effective urban transport related environmental management programs; and
- establishing procedures for financing such programs within lending operations in the sector.

Financial viability

The magnitude of financial requirements for developing the urban transport sector in low- and middle income countries in Asia has not been estimated. It undoubtedly exceeds available resources and with central and local governments already strapped for revenues, the search for urban transport financing will not be easy in the 1990s.

Revenue mobilization is a national and local government issue and is constrained by many factors, including the following:

- concentrated low income populations in urban areas and, as a result in many cases, a limited municipal tax base;
- restricted public sector budgets with little room to manoeuvre in the reallocation or expansion of resources from one sector to another;
- competing transport needs between inter-urban and urban systems;
- transport revenues being increasingly used for general fiscal purposes which implies that increases in revenue from the sector may not result in increases in resources being allocated to the sector; and
- debt limitations which imply that the contracting of external debt in one sector may limit the availability of debt financing in another sector.

These constraints on public sector financing have resulted in innovative approaches to urban transport finance in several countries in the region. These will need to be developed further in the 1990s and will

involve making more efficient use of more traditional financing mechanisms such as fares, local taxation, user charges, domestic borrowing and external borrowing as well as exploring further the potential for private investment.

A brief summary of the potential for more efficient use of traditional financing mechanisms is provided below and a more complete discussion is provided for the potential for private sector financing in the sector given its particular relevance in many Asian countries.

FARES in bus operations. Measures should be taken with regard to fares to ensure affordability for users and to ensure that farebox revenues are adequate to cover operating costs and finance capital expenditures;

LOCAL TAXATION for municipal road construction and maintenance. Local taxes on property are likely to remain the major source of finance, but attention needs to be given to the use of earmarked betterment charges for access road improvements;

USER TAXES. Fuel taxes, vehicle registration and license fees will also remain a principal source of revenue finance in most countries, but efforts will need to be made to improve collection efficiency, to reflect the externalities of vehicle use in urban areas (through urban congestion and pollution charges) and to improve accountability and institutional performance;

DEBT FINANCING. Local debt financing has traditionally been limited to bus and other vehicle purchases; bond issues offer attractive possibilities for more substantial items (such as major highways) but require a well developed bond market and assigning tax revenues as guarantees; and

EXTERNAL BORROWING will continue to be a major source of financing for the substantial import requirements of urban transport investments. In the case of suppliers credits, the availability of financing should not be allowed to distort investment choices.

Private sector financing

Considerable experience exists in Asia in private sector financing of urban transport infrastructure and services. In discussing private sector financing, however, it is sometimes understood very narrowly and sometimes very broadly. Within this report private sector financing is considered to occur under the following conditions:

- when investments are made by the private sector;
- when funds are raised from the private sector; and
- when facilities are provided and/or operated by the private sector.

Thus, value capture and the private provision of transport services under concession arrangements would both be considered as private financing mechanisms. General taxation and user charges would not.

Within Asia, several mechanisms are used for recuperating the transport benefits or development gains associated with the introduction of new or improved urban transport facilities; these include:

- special funds financed by earmarked taxes on local corporations and businesses (in Japan);
- bond issues financed from vehicle registration fees (in Korea) or serviced from property development (in India);
- cost sharing schemes with the participation of developers, transport operators and government (in Japan); and
- cross subsidy of capital investment from the sale of property development rights (in Hong Kong).

Several Asian countries are exploring the private provision of urban transport infrastructure through the following mechanisms:

- joint venture schemes with equity participation from the private and public sectors (in Japan and Hong Kong); and
- BOT (Build-Operate-Transfer) schemes for the private sector design, construction, operation and eventual transfer to the public sector of urban transport infrastructure (in Indonesia, Hong Kong, Malaysia and Thailand).

There are many variations of BOT schemes; these are presented in Box 3.17.

Special funds and bond issues can be successful in raising finance for urban transport infrastructure.

Cost sharing and joint venture schemes can be inefficient due to lack of competition and due to exclusive franchising arrangements. To avoid this, the selection process should be competitive and transparent and the time period of the concession should be limited with any extensions subject to competitive bidding.

The cross subsidy of capital investment outlays from the sale of property development rights can be an

Box 3.17 Variations of the BOT approach

BOO: Build-Own-Operate:
the investor retains ownership, operating in perpetuity via an open ended franchise;

DBOT: Design-Build-Operate-Transfer:
same as above plus design

BOOS: Build-Own-Operate-Sell:
at the end of the franchise period the state pays the investor a residual value;

BOOT: Build-Own-Operate-Transfer:
as above, but there is no terminal payment to the investor;

BOT: Build-Operate-Transfer:
the facility is paid for by the investor but is owned by the concessionaire; the investor maintains the facility and operates it during the concession period;

BOTT: Build-Operate-Training-Transfer:
before facilities are transferred, the investor is required to provide training; and

Source: Private Financing of Urban Transport Infrastructure in Asia, Shunso Tsukada and Roger Allport, ASTIN, 1991.

efficient and attractive mechanism in the financing of rail-based mass transit systems. It requires that:

- land ownership is vested with the system operator;
- there is a viable property market and a competitive pool of property developers; and
- the operator has adequate equity to build, operate and maintain the system without recourse to property development profits.

Property development activities must be separated from transport related activities to avoid the transport user from paying for any losses which may occur from property development. For this reason, the two activities must be legally separate in integrated urban rail and land development schemes in Japan. And in the case of Hong Kong, (see Box 2.19) the operator ensures that the property developer carries the risk by the developer paying up-front for the right to participate in any development; any subsequent downturn in the market should not therefore have a direct impact on the finances of the operator (see Box 3.18).

Of all the private financing options available to the sector, BOT has attracted the most interest and attention on the part of governments, investors, manufacturers and suppliers, and the development

Box 3.18 Property development and urban rail systems in Hong Kong

"Both the MTR and KCR have used property development to help finance the capital cost of their rail systems. Rail associated developments in Hong Kong include: major office buildings in the central business districts, major residential developments built on podium structures over the rail depots with up to 5,000 apartments in each, and other miscellaneous buildings along each line. The MTR estimates that the property profits have provided about 15% of the capital cost of their system (US$3.2 billion).

The two rail corporations have been allowed to develop sites over and adjacent to their railways, primarily over stations and above maintenance depots. Land assembly is not an issue in Hong Kong since the government has compulsory purchase powers over lands required for rail construction. However, the two rail corporations were required to pay full market price for the development rights to each site.

The developments were undertaken in partnership with professional property developers who were chosen competitively. The rail corporation provides the site. The developer finances and constructs the development. Once chosen, they were required to make a very substantial payment to the rail corporation. Down stream profits are shared, as agreed during each project negotiations. Once agreements are signed, this arrangement substantially reduces the risks for both the rail corporation and the passengers. They are protected against down-turns in the property market. The development partner bears the construction and commercial risks."

Source: Financing Transport Infrastructure and Services, R. G. Scurfield, EDI, 1991.

community at large, including the World Bank. In spite of initial enthusiasm for BOT, a more cautious attitude is now being taken as many BOT proposals have failed to materialize or have failed to meet expectations.

The reasons for failure can be summarized as follows:

- protracted negotiations concerning risk allocation and guarantees;
- aggressive marketing, lack of competition and transparency in the award process;
- inadequate preparation on the part of governments;
- dilution and confusion of the market by competing schemes and competing government agencies;
- unexpected additional costs to government; and
- accusations of corruption (which toppled at least one government in the region from office).

The decade of the 1980s was very much a learning-by-doing period in Asia with regard to BOT. Given the restraints on public sector budgets for urban transport investments, the 1990s will undoubtedly see fresh approaches being made with regard to BOT as being the most likely way to attract investment into the sector.

Although the Bank group has not yet participated in BOT schemes in the sector, it does have several key roles to play in providing professional and objective advice, in equity participation (through IFC) and in lending operations.

The Bank has accumulated sufficient experience within its central policy complex in BOT operations to be able to advise governments on the procedures to adopt with regard to BOT schemes. These need to be published and made available to member governments. They are summarized in Box 3.19.

World Bank lending operations can be designed to assist governments with technical advisory services and/or in the provision of public sector infrastructure aspects of the scheme. For example, in certain circumstances the public sector may choose to provide the infrastructure and lease it to the private operator (in the case of mass transit services this procedure is often used in Japan).

But perhaps the most valuable role that the Bank can perform with regard to BOT operations is to assist governments in ensuring the economic viability of such schemes within the overall urban transport system and the complimentary roles that the public and private sectors can most usefully play in the development and operation of the system as a whole.

Box 3.19 Procedures to adopt with regard to BOT schemes

Realism: government and the private sector need to be realistic about each others objectives and constraints:

1. governments need to understand that private investors expect to make a profit and will not take risks without adequate returns; and
2. private investors need to understand that governments must follow procedures which are designed to protect the public interest;

Rigor: governments must prepare themselves thoroughly for negotiations; the project brief should clearly establish:

1. the scope of the project;
2. its regulatory environment; and
3. the selection rules and procedures.

Competition: it is unlikely that the best deal can be obtained using the "sole tender" approach; without competition the social value of using the private sector will be reduced;

Technology: specifications need to ensure that the technology used in the scheme does not lock-in the government to a specific supplier or manufacturer for all time; and

Transparency: the award process should be transparent and open; the negotiated elements in a project should be kept to a minimum.

Source: Financing Transport Infrastructure and Services, R. G. Scurfield, EDI, 1991.

Part Four: Conclusion

Introduction

The urban transport challenges in Asia are unique in their scope, scale and pace of change. They require a response which is tailor made to the distinctiveness of the region and which recognizes its inherent diversity. This is in itself is a major challenge.

There are three main groups of recommendations which emerge from this analysis which provide a basis for the development of a strategic response to these challenges in the 1990s.

- the first concerns new approaches which need to be taken in the sector;
- the second concerns the implications of these actions for World Bank operations; and
- the third concerns the role of the World Bank and other development agencies in ensuring the availability of adequate and timely external aid for the development of the sector.

The principal new approaches which are needed in the sector can be summarized as follows:

Enhancing economic productivity

MOTORIZATION: As vehicle ownership is the driving force in urban areas for stimulating demand and causing congestion, a clarification of trends, possible control measures, and their impact is essential.

CONGESTION: Strategies and action plans need to be prepared for each major city to deal with congestion and differentiated according to current and potential levels of congestion:

- curative strategies: to relieve high levels of congestion and avoid it increasing; and
- preventive strategies: to avoid congestion beginning.

MASS TRANSIT: With regard to mass transit the following approaches are needed:

- incremental development: which takes account of present needs and constraints but allows for physical, operational, and technical evolution (such as transitways);
- reductions in capital and operating costs: (through LRT and exclusive bus ways as an alternative to MRT, for example) and cost recovery mechanisms which reflect their benefits to users, developers and society at large;
- a clearer understanding of the role of mass transit: within the urban transport system in terms of demand management and relative to other modes of public transport (including non-motorized vehicles); and
- an assessment of the potential inter-relationships between mass transit and urban development: in managing more effectively urban growth and productivity.

URBAN FREIGHT: In improving goods movements in Asian cities, a comprehensive approach is necessary which recognizes that:

- urban freight handling is first and foremost an inherently private sector activity which is flexible and responsive to demand;
- the freight handling system is composed of many closely inter-related elements; and

- freight movements are important to city productivity and therefore deserve more attention and resources than in the past.

Increasing personal mobility

NON MOTORIZED VEHICLES: (NMVs) are an attractive form of personal mobility in an increasingly environmentally conscious world and they play a unique and vital role in urban transport in much of Asia; their future is dependent on their being treated as an integral part of urban transport systems and on understanding the conditions under which they can be cost-effective relative to (and complimentary to) other modes of transport;

WALKING: is an important mode of transport in all cities and the benefits of pedestrian improvement programs accrue to all sections of urban society but especially to low income groups who are too often neglected and treated as second class citizens in urban transport programs; pedestrian improvements will not alleviate poverty, but they will save and improve lives and reduce the risk of injury.

Improving the urban environment

VEHICLE EMMISSIONS: With regard to vehicle emissions, new approaches are warranted with regard to:

- fuel economy: fuel economy standards, differential vehicle taxes and "bonuses" for scrapping less fuel efficient vehicles are some of the measures which should be adopted to promote greater fuel efficiency;
- unleaded petrol: differential fuel taxation should be used to promote the use of unleaded fuel and leaded fuel should be progressively but rapidly phased out;
- diesel fuel: fuel price surcharges based on the sulfur/heavy oil content of diesel should be introduced to promote the availability and use of cleaner fuel in trucks and buses;
- alternative fuels: incentives to switch to cleaner alternative fuels can be provided through differential fuel taxation or direct subsidy where environmental benefits would justify it;
- closed loop three-way catalysts: the introduction of these technologies can reduce emissions and also improve vehicle performance and driveability, reduce maintenance and lead to improved fuel economy; and
- inspection and maintenance programs: are essential to ensure that the anticipated benefits of emission control strategies are not lost through poor maintenance or tampering with emission control devices.

ROAD SAFETY: With regard to road safety and accidents, several approaches are warranted:

- safety has to be brought to the forefront of the minds of planners and engineers and along with the important details of design affecting road safety that might otherwise be overlooked or considered insignificant;
- mitigating actions should be incorporated in the network to reduce the number and severity of road accidents;
- developing country experience in road safety should be brought together with material from the standards, guidelines and design guides of developed countries and this information should be available to professionals in developing countries; and
- evaluations of road safety countermeasures in developing countries should be undertaken so that the most effective can be identified.

OTHER ENVIRONMENTAL IMPACTS: With regard to other environmental impacts of motorized traffic, environmental standards need to be established within cities concerning the scale and type of infrastructure and vehicles and the associated levels of air pollution, noise and speed which can be tolerated within each neighborhood. Equally important, but often overlooked, is the need to assess the impact on the use of urban land and development patterns.

Ensuring financial viability

- TRADITIONAL FINANCING MECHANISMS: more efficient use will be necessary of traditional financing mechanisms such as fares, local taxation, user charges, domestic borrowing and external borrowing; and

PRIVATE SECTOR FINANCING: mechanisms need to be designed to attract private sector finance to the sector including the use of:

- bond issues;
- cost sharing schemes;
- cross subsidy of capital investment from the sale of property development rights;
- joint venture schemes; and
- build-operate-transfer (BOT) schemes.

An integrated approach

The integration of these approaches into comprehensive programs requires considerable institutional skill. The success of programs in countries such as Hong Kong and Singapore has been possible due to a strong institutional base coupled with a political committment which has recognized the linkage and importance of efficient urban transport to economic development.

While the translation of these approaches into reality will vary from country to country and city to city, there can be no doubt that if the role of the urban transport sector in the socio-economic development of the city and the country is not understood and given importance at the highest levels of government, the development of the sector and of its performance within the economy will suffer.

The World Bank has an important role to play in ensuring that the urban transport sector is part of the country dialogue, especially in countries which are confronting urban traffic congestion.

The recommendations concerning actions which need to be taken for the sector to adjust and respond to the challenges of development and growth in the 1990s have several important implications for the nature and composition of the World Bank's lending operations.

URBAN DEVELOPMENT CONTEXT: First, urban transport lending should subscribe to overall urban development objectives and fit with urban development policies within the region and member countries.

ROLE OF URBAN TRANSPORT: Second, the role of urban transport in meeting urban development objectives needs to be clearly articulated. An approach to this has been made in this report as follows:

- through serving the transport needs of urban business and industry by relieving congestion and increasing the capacity to move people and goods, urban transport investments can be directed toward enhancing economic productivity;
- through improving access by all elements of the population, but especially the poor, to urban services and jobs through provision of affordable transport services, urban transport investments can be directed toward increasing personal mobility and thereby the alleviation of urban poverty;
- through the provision of environmentally friendly urban transport services and infrastructure which are beneficial to the nature and form ot urban growth, urban transport investments can contribute dramatically toward improving the urban environment; and
- through arranging for the financing of urban transport services and infrastructure which are affordable to local governments and to all users of the urban transport system, urban transport investments can contribute to ensuring financial viability.

SYSTEM PERFORMANCE: Third, although lending operations may not finance investments throughout the urban transport system, they need to take account of the performance of the system as a whole in the assessment of costs and benefits. Actions in one part of the urban transport system effect all parts of the system to some extent. A comprehensive view is therefore needed.

A HOLISTIC APPROACH: Fourth, a holistic approach is needed in lending operations. Given the issues confronting the urban transport sector in Asia in the 1990s, two approaches are possible. One would center lending operations around the theme of demand management; the other would center lending operations around the theme of environmental management. Both approaches are interrelated and the emphasis toward one or the other or both would depend on the situation in a given city or country.

- the theme of demand management brings into focus the role of congestion pricing, public transport and environmental management in relieving congestion, curbing the unrestrained use of motor vehicles and improving personal mobility for the urban poor; and
- the theme of environmental management brings into focus the role of all elements of the urban transport system in respecting the urban environment in its human, ecological and physical dimensions and in promoting more environmentally appropriate forms of urban growth.

TIMING: Fifth, urban transport lending must be more responsive in terms of timing. The pace of change in Asia is speeding up and delays in decision making and project execution are proving to be more and more costly in terms of system performance and in terms of the measures needed to rectify problems not dealt with in a timely fashion.

LENDING INSTRUMENTS: Finally, new urban transport lending instruments will need to be explored to achieve faster response times and sustainability in the sector. In the past, the World Bank has relied exclusively on project lending to finance investments in the sector. Policy based lending making use of procedures used successfully in sector loans needs to

be explored and adapted to the needs for investment in the sector and to the requirements of individual member countries in the regions. A programmatic approach will also need to be developed with regard to lending operations to ensure their sustainability over time in a sector where the real developmental impacts are measured in decades rather than in years. This implies making a long term commitment to the sector and long range programming of staff and resources with expertise in the sector.

Although the World Bank has an important role to play in the sector in the 1990s, it can no longer operate alone. Nor should it. The World Bank is in no position to monopolize the development of urban transport in Asia. Its staff resources in the sector are limited in quantity and its range of operations are also limited by the nature of its lending instruments and by competing priorities from other sectors.

Other multilateral agencies such as the ADB, UNDP and ESCAP can be more responsive and more effective in addressing technical assistance, training, institutional development and demonstration projects in the sector than the World Bank. Bi-lateral agencies can often mobilize resources more rapidly and arrange for technology transfer more efficiently than multilateral agencies including the World Bank.

The World Bank undertakes in-depth and comprehensive analyses of the sector's performance and its potential contribution to development. This provides the World Bank with an opportunity to play a catalytic role in the development of the sector and in the role of the sector in the development process by providing:

A FORUM FOR:

- collaboration between external aid agencies;
- co-financing among external aid agencies and the private sector; and
- exchange of information and knowledge between cities.

A FRAMEWORK FOR:

- targeting external aid within the sector more efficiently;
- using technical assistance and training more efficiently; and
- undertaking research and sector work more appropriately.

A RATIONALE FOR:

- directing external aid to the development of the sector;
- investment decisions in the sector by external aid agencies, suppliers credit agencies and the private sector; and
- the use and development of low-tech and high-tech technology within the sector

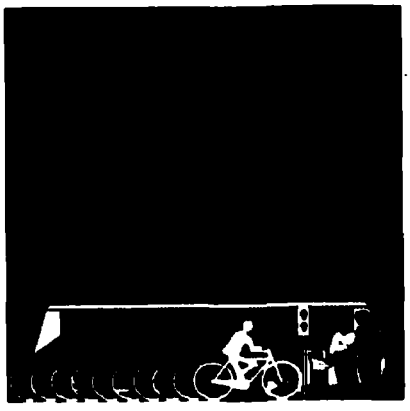
Already the World Bank has taken part in several regional initiatives involving collaboration with external aid agencies:

JAPAN: The World Bank and the Ministry of Transport in Japan have held joint seminars in 1989 and 1990 to discuss approaches to the development of the sector in Asia and the emerging issues confronting the sector in the 1990s;

ADB: The World Bank and the Asian Development have collaborated in the formulation of background papers on urban transport data, environmental issues, urban transport and urban development and the role of private sector financing which have provided useful inputs into this report; and

UN AGENCIES: The World Bank and ESCAP have submitted a joint proposal for UNDP technical cooperation funding for a regional training program in urban transport and for undertaking demonstration projects to assess the viability of technical solutions in the urban transport to promote the use of non-motorized vehicles, improve the environment and alleviate urban poverty in selected cities in the region.

These initiatives now need to be expanded and developed further. The challenge before us is to ensure that the combined resources of the development community and the private sector can, with the assistance of the World Bank, respond appropriately to the needs of individual cities and governments in such a way that by the year 2000 Asia's urban transport systems are not unique due to congestion but are unique due to their efficiency in meeting the travel demands of all sections of urban society.



References

Allport R. [1990]. *Transport and Development in Asia,* (unpublished) World Bank, Washington, D.C. (April).

Allport R.J and Thomson J.M [1990] *Study of mass transit in developing countries,* TRRL, Crowthorne.

Alluche J.F. [1990] *Revenue Leakages in Public Transport Companies: the Case of Karachi, Pakistan,* in "New Perceptions and New Policies: Urban Transport in Developing Countries, CODATU IV Jakarta", Caen.

American Lung Association [1990]. *The Health Costs of Air Pollution: A Survey of Studies Published 1984–1989,* Washington, D.C.

Ang B.W. [1989]. *Traffic Management Systems and Energy Savings: The Case of Singapore,* Paper presented in the ATAS Workshop on "New Energy Technologies: Transportation and Development" organized by the UN Centre for Science and Technology for Development, Otbwa (September).

Barrett R. [1988]. *Urban Transport in China: Current Status of Knowledge,* (Unpublished) World Bank, Washington, D.C.

Buchanan C. et alia [1963] *Traffic in Towns: a study of the long term problems of traffic in urban areas.* HMSO, London.

Bushell C. (Ed) [1989]. *Jane's Urban Transport Systems: 1989.* Coulsdon, UK

Cai J.S. [1988]. *Public Transport in China.* Paper presented at the UITP Conference "City Transport in Asia" in Singapore (October).

Cervero R [1990] *Paratransit in Southeast Asia: A Market Response to Poor Roads?,* Department of City and Regional Planning, University of California, Berkeley (July).

Cervero R. [1991] *Private Sector Participation in Financing Urban Infrastructure in Indonesia,* HIDD, Jakarta (May).

Colin Buchanan and Partners et al. [1990] *Transport Network Planning and Regulation: Transport System Proposals and Deficiencies.* Jakarta.

Colin Buchanan and Partners [1990] *Mass Transit System Options for Jabotabek* Jakarta.

Cracknell J. [1990]. *Republic of Korea: Urban Tansport Strategy: Urban Transport Sector Issues,* (Unpublished) World Bank, Washington, D.C. (September).

Dans J.P. [1988]. *The Metro Manila Light Rail Transit System: A Case for Developing Countries,* Paper presented at the Symposium on Light Rail held in Melbourne (October).

Dharmarajan K. [1990]. *Urban Transport in India,* Paper presented at the International Symposium on Urban Transport and International Cooperation jointly organized by the Ministry of Transport and the World Bank, Tokyo (October).

Dharmarajan R. [1990]. *Urban Transport in India,* Paper presented at the Ministry of Transport/World Bank Symposium on Urban Transport, Tokyo (October 2–5).

ESCAP [1990]. *Report of identification of major problems on urban transport in the ESCAP region*: Bangkok.

Esguerra G.D. [1990]. *Philippines Urban Transport Sector Issues.* (Unpublished) World Bank, Washington, D.C. (August).

Faiz A. and Carbajo J. [1991] *Automotive Air Pollution Control: Strategic Options for Developing Countries.* (Draft) INUTD, World Bank, Washington, D.C. (May)

Faiz A., Sinha R., Walsh M., and Varma A. [1990]. *Automotive Air Pollution: Issues and Options for Developing Countries,* World Bank, Washington, D.C. (August).

Government of Thailand [1991]. *Seventh Plan Urban and Regional Transport.* Final Report, Bangkok (March).

Hau T.D. [1989] *Road Pricing: A Proposal for Hong Kong,* Hong Kong (September).

Heggie I.G. [1991] *User Charging and Accountability for Roads: An Agenda for Reform.* (draft) World Bank (June).

Hong Kong EPA [1989]. *White Paper Pollution in Hong Kong—A Time To Act,* Hong Kong (June).

Hoque H.M. [1990]. *Traffic and Safety Problems in Metropolitan Dhaka*, Paper presented at the CODATU V Conference on Urban Transport in Developing Countries in Sao Paulo, Brazil (September).

International Institute for Energy Conservation (IIEC) [1990]. *Proposal for an Assessment and Conference to Address Transportation Growth in Asia and its Impact on Energy Use, the Environment. and Traffic Congestion.* Washington, D.C. (June).

Japan International Cooperation Agency (JICA) [1990]. *Seminar on Medium to Long-Term Improvement/Management Plan of Road and Road Transport in Bangkok*, Bangkok (Janu. ., .

JICA [1990]. *Seminar on Medium to Long-Term Improvement/Management Plan of Road and Road Transoort in Bangkok*, Bangkok (January)

Lowe M.D. [1989]. *The Bicycle: Vehicle for a Small Planet*, Worldwatch Paper 90, Worldwatch Institute, Washington, D.C. (September).

Melhuish C. M. [1990]. *Urban Transport Problems in Asia* Paper presented at the International Symposium on Urban Transport and International Cooperation jointly organized by the Ministry of Transport and the World Bank, Tokyo (October).

Motor Vehicle Manufacturers Associations (MVMA) [1989]. *World Motor Vehicle Data*, Washington, D.C.

Nagaraja V. [1988]. *Public Transport—Indian Scene.* Paper presented at the UN Conference "City Transport in Asia" held in Singapore (October).

National Environment Board of Thailand [1990]. *Air and Noise Pollution in Thailand 1989*, Bangkok.

NESDB [1990]. *Seventh Plan Urban and Regional Transport. Working Paper No.2 "Freight"*, Bangkok (May) and JICA. *Regional Truck Terminal Report*, Bangkok.

Office of the National Economic and Social Development Board, Government of Thailand [1991] *Seventh Plan Urban and Regional Transport study: Executive Report*, Bangkok (March).

PADECO [1990]. *The Survey of Urban Transport Costs and Fares in the SEATAC Region*, page 3–48, Endnote 24, Bangkok (December).

Population Crisis Committee [1990]. *Life in the World's 100 Largest Metropolitan Areas*, Washington, D.C.

P.T. Jasa Marga [1988]. *Investment Opportunities: Tollroads in Indonesia.* Jakarta.

Replogle M. [1990]. *Sustainability: A vital concept for transportation planning and development*, Paper presented at the Conference on the Development and Planning of Urban Transport in Developing Countries (CODATU V), Sao Paulo (September).

Ross A. et alia [1991] *Towards Safer Roads in Developing Countries: a guide for planners and engineers*, TRRL, Crowthorne.

Scurfield R.G. [1991] *Financing Transport Infrastructure and Services*, Seminar on Transport Policies in Megacities, EDI, Washington, D.C. (May).

Scurfield R.G. [19981 *Hong Kong Country Paper*, presented at the ADB Regional Seminar on Transport Policy (October).

Sompratana Raungchat [ ]. *Various Factors Associated With Blood Lead Levels Of Traffic Policemen In Bangkok Metropolis*, Unpublished Thesis, Bangkok.

The Government of Thailand [1991] *Seventh Plan for Urban Regional Transport*, Bangkok (March).

Tokyo Metropolitan Government, Bureau of City Planning [1988]. *Planning of Tokyo*, Tokyo (March).

Traffic Safety Policy Office [1986]. *Traffic Safety Policy in Japan*, Tokyo (October).

Tsuflada S. [1991]. *Urban Freight Transport: Issues and Strategies.* (Unpublished) World Bank, Washington, D.C. (April).

United Nations [1991]. *The Prospects of World Urbanization.* Unpublished Draft, New York.

Vatana Supornpaibul [19901. *The Emerging Issues in 1990s for the Country [Thailand] Measures*, Paper presented at the International Symposium on Urban Transport and International Cooperation jointly organized by the Ministry of Transport and the World Bank, Tokyo (October).

Walsh M. [1991] Personal communication with Kirk Smith, Bangkok (February 28).

World Bank [1986] *Urban Transport: A World Bank Policy Study* Washington, D.C.

World Bank [1988] *India: Tamil Nadu Urban Development Project*, Staff Appraisal Report, (May).

World Bank [1988] *Indonesia: Jabotabek Urban Development Project.* Staff Appraisal Report, (February).

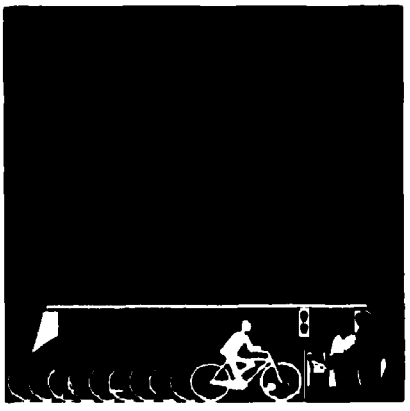
World Bank [1988] *Korea: Taegu Urban Transport Project*, Staff Appraisal Report, (January).

World Bank [1990] *China: Shanghai Metropolitan Transport Project*, draft Staff Appraisal Report, (April).

World Bank [1990] *India: Urban Transport Sector Strategy (Draft)*, Unpublished (February).

World Bank [1991]. *Urban Policy and Economic Development: An Agenda for the 1990s*, Unpublished Draft, Washington, D.C.

World Bank [1991] *Private Financing of Urban Transport Infrastructure in Asia.* ASTIN Technical Note Series (March).



Annex tables

Annex Table 1 Asia region population and urbanization data (1980–2000)

Country	GNP per capita[a]	Total population (million)[b]			Urban population (million)[c]			Proportion urban[d]		
		1980	1990	2000	1980	1990	2000	1980	1990	2000
Low income		2,150.7	2,583.2	3,037.3	454.6	1,018.1	1,403.1	21	39	46
Afghanistan	..	16.0	20.4	26.7	2.5	3.7	5.9	16	18	22
Bangladesh	170	87.5	113.1	138.7	9.9	18.6	31.8	11	16	23
Bhutan	180	1.2	1.4	1.8	0.0	0.1	0.1	4	5	8
China[e]	330	981.2	1,122.0	1,275.5	192.3	628.3	832.2	20	56	65
India	340	687.3	849.7	1,007.1	158.8	229.4	325.3	23	27	32
Indonesia	440	148.3	181.6	213.5	32.9	55.4	84.3	22	31	40
Kampuchea	..	6.4	8.2	9.9	0.7	1.0	1.4	10	12	15
Korea (DPR)	..	18.3	21.4	24.8	10.4	12.8	15.7	57	60	63
Lao PDR	180	3.2	4.2	5.5	0.4	0.8	1.4	13	19	25
Maldives	410	0.2	0.2	0.3	0.0	0.1	0.1	22	29	38
Mongolia	..	1.7	2.2	2.8	0.9	1.1	1.6	51	52	55
Myanmar	..	33.8	41.6	50.4	8.1	10.3	14.3	24	25	28
Nepal	180	14.6	19.1	24.1	0.9	1.8	3.4	6	10	14
Pakistan	350	82.6	113.7	154.3	23.2	36.4	58.5	28	32	38
Sri Lanka	420	14.7	17.0	18.9	3.2	3.6	4.6	22	21	24
Vietnam	..	53.7	67.4	83.0	10.4	14.8	22.5	19	22	27
Middle income		170.2	205.9	237.5	65.7	93.4	122.5	39	45	52
Fiji	1,520	0.6	0.8	0.8	0.2	0.3	0.4	38	39	43
Kiribati	650	0.1	0.7	0.8	0.0	0.3	0.4	32	36	43
Korea	3,600	38.1	42.8	46.7	21.7	30.8	38.0	57	72	81
Macao	..	0.3	0.5	0.5	0.3	0.5	0.5	98	99	99
Malaysia	1,940	13.8	17.8	22.0	4.8	7.6	11.2	35	43	51
Papua New Guinea	810	3.1	3.9	4.9	0.4	0.6	1.0	13	16	20
Philippines	630	49.3	62.6	74.9	18.4	26.7	36.5	37	43	49
Solomon Islands	630	0.2	0.3	0.5	0.0	0.0	0.1	9	11	14
Taiwan, China	5,640	17.6	20.3	22.1	11.6	13.8	15.4	66	68	70
Thailand	1,000	46.7	55.8	63.8	8.1	12.7	18.8	17	23	29
Tonga	830	0.1	0.1	0.1	0.0	0.0	0.0	20	21	25
Vanuatu	840	0.1	0.2	0.2	0.0	0.0	0.1	19	26	34
Western Samoa	640	0.2	0.2	0.2	0.0	0.0	0.0	21	22	26

Annex Table 1 *(continued)*

Country	GNP per capita[a]	Total population (million)[b]			Urban population (million)[c]			Proportion urban[d]		
		1980	1990	2000	1980	1990	2000	1980	1990	2000
High income		142.5	153.0	161.8	111.4	120.9	129.4	78	79	80
Australia	12,340	14.7	17.0	19.5	12.6	14.5	16.9	86	86	86
Brunei	..	0.2	0.3	0.3	0.1	0.1	0.2	60	58	59
Guam	..	0.1	0.1	0.2	0.0	0.1	0.1	40	53	63
Hong Kong	9,220	5.0	5.8	6.3	4.6	5.4	6.0	92	94	96
Japan	21,020	116.8	123.5	128.7	89.0	95.1	100.0	76	77	78
New Caledonia	..	0.1	0.2	0.2	0.1	0.1	0.1	49	36	36
New Zealand	10,000	3.1	3.4	3.6	2.6	2.9	3.1	83	84	85
Singapore	9,070	2.4	2.7	3.0	2.4	2.7	3.0	100	100	100
Total		2,463.3	2,942.0	3,436.6	631.7	1,232.5	1,654.9	26	42	48

a. *World Development Report 1990.*
b. Asia and EMENA Population Projections.
c. Derived from applying percentage urban to total population.
d. World Urbanization Prospects 1990 UN (Except for China 1990 and 2000).
e. The definition of urban areas changed 1980–90 resulting in sharp urban increases in 1990 in China and in the Totals.

Annex Table 2 Asia region population and urbanization growth (1980–2000)

Country	GNP per capita[a]	Total population		Urban population		Annual growth rate (urban population)			
		1980–90	1990–2000	1980–90	1990–2000	1980–85	1985–90	1990–95	1995–2000
Low income		**432.5**	**454.1**	**563.6**	**384.9**	**4.1**	**4.5**	**4.7**	**4.4**
Afghanistan	..	4.4	6.3	1.2	2.2	-0.5	4.2	8.5	4.8
Bangladesh	170	25.6	25.6	8.7	13.2	6.6	6.3	6.1	5.8
Bhutan	180	0.3	0.4	0.0	0.1	4.7	5.4	5.9	6.3
China	330	140.7	153.5	436.0	203.9	6.7	6.6	5.4	4.2
India	340	162.3	157.5	70.6	95.9	3.8	3.6	3.8	3.8
Indonesia	440	33.3	31.9	22.5	28.9	5.4	5.0	4.6	4.1
Kampuchea	..	1.8	1.7	0.3	0.5	3.5	4.0	4.2	4.2
Korea (DPR)	..	3.2	3.4	2.4	2.8	2.4	2.2	2.4	2.3
Lao PDR	180	1.0	1.3	0.3	0.6	5.6	6.0	6.0	5.6
Maldives	410	0.1	0.1	0.0	0.0	6.2	5.9	5.4	4.9
Mongolia	..	0.5	0.6	0.3	0.4	2.9	2.9	3.1	3.2
Myanmar	..	7.8	8.8	2.2	4.0	2.1	2.7	3.2	3.6
Nepal	180	4.5	5.0	0.9	1.6	7.2	6.9	6.5	6.1
Pakistan	350	31.1	40.6	13.2	22.1	5.0	4.9	4.5	4.5
Sri Lanka	420	2.2	1.9	0.4	0.9	1.2	1.6	2.2	2.7
Vietnam	..	13.7	15.6	4.1	7.7	3.2	3.7	4.2	4.4
Middle income		**35.7**	**31.6**	**27.7**	**29.0**	**4.5**	**4.5**	**4.6**	**4.6**
Fiji	1,520	0.1	0.1	0.1	0.1	2.4	2.2	2.2	2.4
Kiribati	650	0.6	0.1	0.2	0.1	2.3	2.5	2.6	2.7
Korea	3,600	4.7	3.9	9.1	7.2	4.0	3.1	2.3	1.8
Macao	..	0.1	0.1	0.1	0.1	4.0	4.1	3.5	2.8
Malaysia	1,940	4.0	4.2	2.9	3.6	4.9	4.7	4.1	3.5
Papua New Guinea	810	0.8	1.0	0.2	0.4	4.1	4.3	4.6	4.8
Philippines	630	13.4	12.3	8.3	9.9	4.0	3.8	3.6	3.4
Solomon Islands	630	0.1	0.1	0.0	0.0	4.8	5.0	5.4	5.7
Taiwan, China	5,640	2.7	1.8	2.2	1.6	4.8	5.0	5.4	5.7
Thailand	1,000	9.1	8.0	4.6	6.0	4.8	5.0	5.4	5.7
Tonga	830	0.0	0.0	0.0	0.0	4.8	5.0	5.4	5.7
Vanuatu	840	0.0	0.1	0.0	0.0	4.8	5.0	5.4	5.7
Western Samoa	640	0.0	0.0	0.0	0.0	4.8	5.0	5.4	5.7

Annex Table 2 *(continued)*

Country	GNP per capita[a]	Total population 1980–90	Total population 1990–2000	Urban population 1980–90	Urban population 1990–2000	Annual growth rate (urban population) 1980–85	1985–90	1990–95	1995–2000
High income		10.5	8.9	9.5	8.4	4.8	5.0	5.4	5.7
Australia	12,340	2.3	2.5	1.9	2.3	1.3	1.4	1.3	1.2
Brunei	..	0.1	0.1	0.0	0.0	3.1	3.4	2.5	2.4
Guam	..	0.0	0.0	0.0	0.0	4.5	3.5	2.7	2.1
Hong Kong	9,220	0.7	0.5	0.8	0.6	1.9	1.7	1.1	0.9
Japan	21,020	6.7	5.2	6.1	4.9	0.8	0.5	0.5	0.5
New Caledonia	..	0.0	0.0	0.0	0.0	-4.7	1.9	1.7	1.4
New Zealand	10,000	0.3	0.2	0.3	0.2	0.9	0.9	0.9	0.9
Singapore	9,070	0.3	0.3	0.3	0.3	1.2	1.3	1.1	0.8
Total		478.7	494.6	600.8	422.4	3.6	3.9	4.0	3.8

Annex Table 3 Population 1980, 1990, and 2000 of cities with 1 million or more inhabitants in 1990 (millions)[b]

Country	GNP per capita[a]	Cities	Pop: 1–5 million			Pop: 5–10 million			Pop: > 10 million			Total city population		
			1980	1990	2000	1980	1990	2000	1980	1990	2000	1980	1990	2000
Low income			**91.1**	**135.2**	**161.0**	**44.9**	**56.9**	**38.8**	**11.7**	**36.0**	**125.7**	**147.8**	**228.2**	**325.4**
Afghanistan	..	Kabul	1.0	1.6	2.6	0.0	..	..	0.0	..	..	1.0	1.6	2.6
Bangladesh	170.0	Chittagong	1.3	2.3	3.9	..	..	..	..	..	..	1.3	2.3	3.9
		Dacca	3.3	..	..	..	6.6	..	..	..	12.2	3.3	6.6	12.2
China	330.0	Anshan	1.2	1.5	2.0	..	..	..	..	..	..	1.2	1.5	2.0
		Baotou	1.0	1.3	1.7	..	..	..	..	..	..	1.0	1.3	1.7
		Beijing	..	..	..	9.0	..	..	..	10.8	14.0	9.0	10.8	14.0
		Changchun	1.7	2.2	3.1	..	..	..	..	..	..	1.7	2.2	3.1
		Changsha	1.0	1.4	1.9	..	..	..	..	..	..	1.0	1.4	1.9
		Chengdu	2.3	3.0	4.1	..	..	..	..	..	..	2.3	3.0	4.1
		Chongqing	2.6	3.2	4.2	..	..	..	..	..	..	2.6	3.2	4.2
		Dalian	1.5	2.5	4.1	..	..	..	..	..	..	1.5	2.5	4.1
		Datong	..	1.1	1.5	..	..	..	..	..	..	0.0	1.1	1.5
		Fushun	1.2	1.4	1.9	..	..	..	..	..	..	1.2	1.4	1.9
		Fuzhou	1.1	1.4	1.8	..	..	..	..	..	..	1.1	1.4	1.8
		Guangzhou	3.1	3.7	4.8	..	..	..	..	..	..	3.1	3.7	4.8
		Guiyang	1.3	1.6	2.2	..	..	..	..	..	..	1.3	1.6	2.2
		Hangzhou	1.2	1.4	1.9	..	..	..	..	..	..	1.2	1.4	1.9
		Handan	..	1.2	1.6	..	..	..	..	..	..	0.0	1.2	1.6
		Harbin	2.5	3.0	3.9	..	..	..	..	..	..	2.5	3.0	3.9
		Jilin	1.0	1.3	1.8	..	..	..	..	..	..	1.0	1.3	1.8
		Kaohsiung	1.2	1.5	2.1	..	..	..	..	..	..	1.2	1.5	2.1
		Kunming	1.4	1.7	2.3	..	..	..	..	..	..	1.4	1.7	2.3
		Lanzhou	1.3	1.6	2.1	..	..	..	..	..	..	1.3	1.6	2.1
		Luoyang	..	1.2	1.7	..	..	..	..	..	..	0.0	1.2	1.7
		Nanchang	1.0	1.4	2.0	..	..	..	..	..	..	1.0	1.4	2.0
		Nanjing	2.1	2.6	3.6	..	..	..	..	..	..	2.1	2.6	3.6
		Nanning	..	1.3	1.9	..	..	..	..	..	..	0.0	1.3	1.9
		Qingdao	1.2	1.4	1.9	..	..	..	..	..	..	1.2	1.4	1.9
		Qiqihar	1.2	1.5	2.0	..	..	..	..	..	..	1.2	1.5	2.0
		Shanghai	..	..	..	..	..	..	11.7	13.4	17.0	11.7	13.4	17.0
		Shenyang	3.9	4.8		..	..	6.3	..	..	..	3.9	4.8	6.3
		Shijiazhuang	1.0	1.4	1.9	..	..	..	..	..	..	1.0	1.4	1.9
		Taipei	2.2	3.0	4.2	..	..	..	..	..	..	2.2	3.0	4.2

Annex Table 3 *(continued)*

Country	GNP per capita[a]	Cities	Pop: 1–5 million			Pop: 5–10 million			Pop: > 10 million			Total city population		
			1980	1990	2000	1980	1990	2000	1980	1990	2000	1980	1990	2000
		Taiyuan	1.7	2.2	3.0	..	..	..	..	..	..	1.7	2.2	3.0
		Tangshan	1.3	1.6	2.1	..	..	..	..	..	..	1.3	1.6	2.1
		Tianjin	..	..	..	7.3	9.4	..	..	..	12.7	7.3	9.4	12.7
		Urumqi	..	1.4	2.1	..	..	..	..	..	..	0.0	1.4	2.1
		Wuhan	3.2	3.9	..	..	..	5.3	..	..	..	3.2	3.9	5.3
		Xian	2.1	2.9	4.0	..	..	..	..	..	..	2.1	2.9	4.0
		Zhengzhou	1.4	1.8	2.4	..	..	..	..	..	..	1.4	1.8	2.4
India	340.0	Ahmedabad	2.5	3.6	..	..	..	5.3	..	..	..	2.5	3.6	5.3
		Bangalore	2.8	5.0	..	..	..	8.2	..	..	..	2.8	5.0	8.2
		Bhopal	..	1.1	1.9	..	..	..	..	..	..	0.0	1.1	1.9
		Bombay	..	..	..	8.1	9.5	..	..	..	15.4	8.1	9.5	15.4
		Calcutta	..	..	..	9.0		..	..	11.8	15.7	9.0	11.8	15.7
		Cochin	..	1.0	1.6			..	..			0.0	1.0	1.6
		Coimbatore	..	1.1	1.5			..	..			0.0	1.1	1.5
		Delhi	..			5.6	8.8	..	..		13.2	5.6	8.8	13.2
		Dhanbad	..	1.0	1.6	..	..	..	..	..	..	0.0	1.0	1.6
		Hyderabad	2.5	3.5	5.0	..	..	..	..	..	..	2.5	3.5	5.0
		Indore	..	1.2	1.8	..	..	..	..	..	..	0.0	1.2	1.8
		Jabalpur	..	1.1	1.5	..	..	..	..	..	..	0.0	1.1	1.5
		Jaipur	..	1.6	2.4	..	..	..	..	..	..	0.0	1.6	2.4
		Kanpur	1.6	2.1	2.7	..	..	..	..	..	..	1.6	2.1	2.7
		Lucknow	..	1.2	1.6	..	..	..	..	..	..	0.0	1.2	1.6
		Madras	4.2	..	..		5.7	7.8	..	..	..	4.2	5.7	7.8
		Madurai	..	1.1	1.5	..	..	..	..	..	..	0.0	1.1	1.5
		Nagpur	1.3	1.8	2.5	..	..	..	..	..	..	1.3	1.8	2.5
		Patna	..	1.7	2.9	..	..	..	..	..	..	0.0	1.7	2.9
		Poona	1.6	2.4	3.6	..	..	..	..	..	..	1.6	2.4	3.6
		Surat	..	1.6	2.8	..	..	..	..	..	..	0.0	1.6	2.8
		Ulhasnagar	..	1.0	1.6	..	..	..	..	..	..	0.0	1.0	1.6
		Vadodara	..	1.2	1.8	..	..	..	..	..	..	0.0	1.2	1.8
		Varanasi	..	1.0	1.4	..	..	..	..	..	..	0.0	1.0	1.4
Indonesia	440.0	Bandung	1.8	2.5	3.6	..	..	..	..	..	..	1.8	2.5	3.6
		Jakarta	..	..	..	6.0	9.3	..	..	..	13.7	6.0	9.3	13.7
		Medan	1.2	1.9	2.7	..	..	..	..	..	..	1.2	1.9	2.7
		Palembang	..	1.2	1.8	..	..	..	..	..	..	0.0	1.2	1.8

Annex Table 3 *(continued)*

Country	GNP per capita[a]	Cities	Pop: 1–5 million			Pop: 5–10 million			Pop: > 10 million			Total city population		
			1980	1990	2000	1980	1990	2000	1980	1990	2000	1980	1990	2000
		Semarang	..	1.2	1.8	..	..	..	..	..	..	0.0	1.2	1.8
		Surabaya	1.7	2.4	3.4	..	..	..	..	..	..	1.7	2.4	3.4
Korea (DPR)	..	Pyongyang	1.8	2.2	2.7	..	..	..	..	..	..	1.8	2.2	2.7
Myanmar	..	Yangon	2.2	3.3	4.7	..	..	..	..	..	..	2.2	3.3	4.7
Pakistan	350.0	Faisalabad	1.1	1.5	2.2	..	..	..	..	..	..	1.1	1.5	2.2
		Hyderabad		1.0	1.5	..	..	..	..	..	..	0.0	1.0	1.5
		Karachi	4.9	..	..	..	7.7	..	..	..	11.7	4.9	7.7	11.7
		Lahore	2.9	4.1		..	..	6.0	..	..	..	2.9	4.1	6.0
		Multan	..	1.0	1.5	..	..	..	..	..	..	0.0	1.0	1.5
		Rawalpindi	..	1.1	1.6	..	..	..	..	..	..	0.0	1.1	1.6
Vietnam	..	Hanoi	..	1.1	1.5	..	..	..	..	..	..	0.0	1.1	1.5
		Ho Chi Minh	2.7	3.2	4.1	..	..	..	..	..	..	2.7	3.2	4.1
Middle income			**10.5**	**12.1**	**15.7**	**14.2**	**15.6**	**0.0**	**0.0**	**11.0**	**34.7**	**24.8**	**36.7**	**50.4**
						..	..	..	..	..	..			
Korea	3,600.0	Inchon	1.1	1.7	2.3	..	..	..	..	..	..	1.1	1.7	2.3
		Kwangchu	..	1.1	1.4	..	..	..	..	..	..	0.0	1.1	1.4
		Pusan	3.1	3.9	4.3	..	..	..	..	..	..	3.1	3.9	4.3
		Seoul	..			8.3	..	..	..	11.0	12.7	8.3	11.0	12.7
		Taegu	1.6	2.5	3.3	..	..	..	..	..	..	1.6	2.5	3.3
		Taejon	..	1.1	1.6	..	..	..	..	..	..	0.0	1.1	1.6
Malaysia	1,940.0	Kuala Lumpur		1.7	2.6		..	..	..	..	..	0.0	1.7	2.6
Philippines	630.0	Manila	..	..	..	6.0	8.5	..	..	..	11.8	6.0	8.5	11.8
Thailand	1,000.0	Bangkok	4.7	..	..		7.2	..	..	..	10.3	4.7	7.2	10.3
High income			**20.5**	**18.5**	**19.9**	**8.3**	**14.0**	**14.7**	**16.9**	**18.1**	**19.0**	**45.7**	**50.6**	**53.6**
Australia	12,340.0	Brisbane	1.0	1.2	1.4	..	..	..	..	..	..	1.0	1.2	1.4
		Melbourne	2.7	2.8	3.0	..	..	..	..	..	..	2.7	2.8	3.0
		Perth		1.1	1.2	..	..	..	..	..	..	0.0	1.1	1.2
		Sydney	3.1	3.4	3.7	..	..	..	..	..	..	3.1	3.4	3.7
Hong Kong	9,220.0	Hong Kong	4.5	..	..	..	5.4	6.1	..	..	..	4.5	5.4	6.1

Annex Table 3 *(continued)*

Country	GNP per capita[a]	Cities	Pop: 1–5 million			Pop: 5–10 million			Pop: > 10 million			Total city population		
			1980	1990	2000	1980	1990	2000	1980	1990	2000	1980	1990	2000
Japan	21,020.0	Kitakyushu	2.1	2.3	2.3	..	..	..	..	..	..	2.1	2.3	2.3
		Kyoto	1.4	1.4	1.4	..	..	..	..	..	..	1.4	1.4	1.4
		Nagoya	2.0	2.1	2.1	..	..	..	..	..	..	2.0	2.1	2.1
		Osaka	..	..	..	8.3	8.5	8.6				8.3	8.5	8.6
		Sapporo	1.3	1.5	1.8	..	..	..	..	..	..	1.3	1.5	1.8
		Tokyo	..	..	..	..	..	..	16.9	18.1	19.0	16.9	18.1	19.0
Singapore	9,070.0	Singapore	2.4	2.7	3.0	..	..	..	..	..	..	2.4	2.7	3.0
Total			**122.2**	**165.8**	**196.6**	**67.5**	**86.5**	**53.5**	**28.7**	**65.1**	**179.4**	**218.3**	**317.5**	**429.4**

a. World Development Report 1990.
b. World Urbanization Prospects 1990 (unpublished draft).

Annex Table 4 Growth in number of cities 1980–1990

Country	GNP per capita[a]	Number of cities 1980	(%)	1990	(%)	Increase 1980-90
Low income		**55**	**76.4**	**80**	**79.2**	**25**
Afghanistan	..	1	1.4	1	1.0	0
Bangladesh	170	2	2.8	2	2.0	0
China	330	32	44.4	37	36.6	5
India	340	10	13.9	24	23.8	14
Indonesia	440	4	5.6	6	5.9	2
Korea (DPR)	..	1	1.4	1	1.0	0
Myanmar	..	1	1.4	1	1.0	0
Pakistan	350	3	4.2	6	5.9	3
Vietnam	..	1	1.4	2	2.0	1
Middle income		**6**	**8.3**	**9**	**8.9**	**3**
Korea	3,600	4	5.6	6	5.9	2
Malaysia	1,940	0	0.0	1	1.0	1
Philippines	630	1	1.4	1	1.0	0
Thailand	1,000	1	1.4	1	1.0	0
High income		**11**	**15.3**	**12**	**11.9**	**1**
Australia	12,340	3	4.2	4	4.0	1
Hong Kong	9,220	1	1.4	1	1.0	0
Japan	21,020	6	8.3	6	5.9	0
Singapore	9,070	1	1.4	1	1.0	0
Total		**72**	**100.0**	**101**	**100.0**	**29**

a. *World Development Report 1990.*
b. *World Urbanization Prospects 1990* (unpublished draft).

Annex Table 5 Urban transport infrastructure in selected Asian cities

Country	City	Year	Expressway (kms.)	Expressway (%)	Primary (kms.)	Primary (%)	Secondary (kms.)	Secondary (%)	Local/access (kms.)	Local/access (%)	Mass transit (kms.)	Mass transit (%)	Total (kms.)	Total (%)
Low income														
Indonesia	Bandung	1987	0	0.0	38	6.8	160	28.5	364	64.8	0	0.0	562	100.0
	Jakarta	1988	0	0.0	1,084	30.3	1,709	47.7	790	22.0	0	0.0	3,583	100.0
	Medan	1988	0	0.0	63	10.1	252	40.0	315	50.0	0	0.0	630	100.0
	Surabaya	1988	0	0.0	112	17.0	418	63.5	128	19.5	0	0.0	658	100.0
Middle income														
Korea	Pusan	1987	145	8.0	994	54.5	663	36.4		0.0	21	1.2	1,823	100.0
	Seoul	1987	731	10.2	1,475	20.5	4,861	67.7		0.0	117	1.6	7,184	100.0
Malaysia	Kuala Lumpur	1985	89	12.6	269	38.1	203	28.8	145	20.5	0	0.0	706	100.0
Philippines	Manila	1988	0	0.0	859	29.1	945	32.0	1,134	38.4	15	0.5	2,953	100.0
Thailand	Bangkok	1988	27	1.0	390	13.9	525	18.7	1,870	66.5	0	0.0	2,812	100.0
High income														
Singapore	Singapore	1987	100	3.5	507	17.6	236	8.2	2,001	69.6	33	1.1	2,877	100.0

Annex Table 6 Asia urban public transport data: bus companies low-income countries

Country	Cities	Population 1990 (million)	Data Year	Bus company	Public/ Private	Bus fleet	Passengers per day	Passengers per day per bus	Daily vehicle kilometers	Route kilometers	No. of routes	Average Rte. length (km)
Bangladesh	Dhaka	6.6	[1988?]	BRTC	Public	450	465,753	1,035	..	1,116	..	..
China	Anshan	1.5	[1988?]	ACBC	Public	600	..	..	..	..	19	..
	Beijing	10.8	[1988?]	BCBC	Public	3,000	5,479,452	1,826	..	..	129	..
	Changchun	2.2	[1988?]	CCBC	Public	400	..	..	..	..	20	..
	Chongqing	3.2	1986	CCTD	Public	866	1,556,164	1,797	147,945	514	54	9.5
	Dalian	2.5	[1988?]	DCTC	Public	500	1,000,000	2,000	..	140	18	7.8
	Fushun	1.4	[1988?]	FCBC	Public	400	..	..	..	..	30	..
	Guangzhou	3.7	1986	1&2 BC	Public	1,800	2,164,384	1,202	..	..	269	..
	Harbin	3.0	[1988?]	HCBC	Public	600	..	..	..	..	19	..
	Jilin	1.3	[1988?]	JCTC	Public	250	..	..	..	..	20	..
	Nanjing	2.6	[1988?]	NCTC	Public	500	821,918	1,644	..	..	20	..
	Shanghai	13.4	1985	STC	Public	4,579	10,980,822	2,398	933,973	9,953	276	36.1
	Shenyang	4.8	1987	SCBC	Public	620	1,084,658	1,749	72,603	932	54	17.3
	Taipei	3.0	1987	TCB	Public	1,666	964,110	579	240,822	3,490	266	13.1
			1986	UOS (9)	Private	1,709	1,538,904	900	353,973	1,557	96	16.2
	Taiyuan	2.2	[1988?]	TCTC	Public	250	..	..	..	..	30	..
	Tangshan	1.6	[1988?]	TCBC	Public	250	..	..	..	..	15	..
	Tinjin	9.4	1984	TCTC	Public	1,439	1,627,397	1,131	243,836	..	59	..
India	Ahmedabad	3.6	1987	AMTS	Public[a]	669	667,397	998	102,712	2,368	226	10.5
	Bangalore	5.0	1982	BTS	Public[b]	937	909,589	971	146,849	..	364	..
	Bombay	9.5	1988	BEST	Public[c]	2,379	4,309,589	1,812	457,534	2,885	224	12.9
	Calcutta	11.8	[1988?]	CSTC	Public[d]	1,172	2,465,753	2,104	136,986	482	62	7.8
			[1988?]	BOUB	Private	2,200	2,739,726	1,245	342,466	1,500	101	14.9
	Delhi	8.8	1984	DTC	Public	4,135	3,772,603	912	903,562	..	689	..
	Hyderabad	3.5	1987	APSRTC	Public	1,159	1,021,918	882	233,425	5,583	389	14.4
	Kanpur	2.1	[1988?]	UPSRTC	Public	200	68,493	342	..	..	..	..
	Lucknow	1.2	[1988?]	UPSRTC	Public	300	68,493	228	..	..	..	..
	Madras	5.7	1987	PTC	Public	2,089	3,024,658	1,448	406,027	881	329	2.7
	Nagpur	1.8	1986	MSRT	Public	100	109,589	1,096	18,630	1,107	111	10.0

Annex Table 6 *(continued)*

Country	*Cities*	*Population 1990 (million)*	*Data Year*	*Bus company*	*Public/ Private*	*Bus fleet*	*Passengers per day*	*Passengers per day per bus*	*Daily vehicle kilometers*	*Route kilometers*	*No. of routes*	*Average Rte. length (km)*
Indonesia	Jakarta	9.3	[1988?]	PPD	Public	2,294	1,780,822	776	328,767	2,208	164	13.5
	Surabaya	2.4	[1988?]	DAMRI	Public	160	41,096	257	..	..	30	..
			[1988?]	URTB	Private[e]	3,200	547,945	171	..	..	..	..
Korea (DPR)	Pyongyang	2.2	[1988?]	PPATC	Public	500	410,959	822	..	..	50	..
Myanmar	Yangon	3.3	[1988?]	RTC	Public	350	273,973	783	27,397	250	11	22.7
			[1988?]	RRPBCC	Private	350	191,781	548	27,397	92	6	15.3
Pakistan	Karachi	7.7	[1988?]	KTC	Public	400	273,973	685	54,795	..	30	..
			[1988?]	KBOA	Private	1,000	547,945	548	82,192	..	30	..
			[1988?]	KMOA	Private[e]	3,000	547,945	183	136,986	..	50	..
	Lahore	4.1	1988	PRTC	Public[f]	884	258,082	292	73,973	1,891	84	22.5
Low income total		155.1		39	(Public: 36 / Private: 6)		47,357	51,715,890	1,092	5,472,849	36,949	4,344

a. no subsidy provided
b. fares cover operating costs
c. cross subsidy from electricity supply services
d. fares cover 70% of operating costs
e. paratransit operation
f. fares cover 40% of operating costs

Annex Table 7 Asia urban public transport data: bus companies middle- and high-income countries

Country	Cities	Population 1990 (million)	Data Year	Bus company	Public/ Private	Bus fleet	Passengers per day	Passengers per day per bus	Daily vehicle kilometers	Route kilometers	No. of routes	Average Rte. length (km)
Korea	Seoul	11.0	1985	SBTC	Private	8,295	7,673,973	925	..	3,620	347	10.4
Malaysia	Kuala Lumpur	1.7	1983	8	Private	969	454,795	469	159,134	3,806	174	21.9
			1983	Bas Mini	Private	490	160,000	327	112,603	..	38	..
Philippines	Metro Manila	8.5	1984	MMT	Public	560	82,192	147	..	767	16	47.9
			[1988?]	Minibuses	Private	2,500	2,054,795	822	684,932	3,000	150	20
			[1988?]	Jeepneys	Private	28,000	2,054,795	73	..	..	..	..
Thailand	Bangko[b]	7.2	1988	BMTA	Public	6,031	4,973,000	825	..	5,163	223	23.2
			1989	Minibus	Private	2,151	1,120,000	521	..	[a]	[a]	..
Middle income total		**28.3**		**8**	**(Public: 2 /Private: 6)**	**48,996**	**18,573,548**	**379**	**956,668**	**16,356**	**948**	**18.0**
Australia	Brisbane	1.2	1988	BCC	Public	589	126,027	214	74,247	734	94	7.8
	Melbourne	2.8	1988	The Met	Public	335	71,233	213	47,397	390	55	7.1
	Perth	1.1	1988	Transperth	Public	899	142,466	158	126,575	1,784	328	5.4
	Sydney	3.4	1988	STA	Public	1,461	517,808	354	162,192	978	264	3.7
Hong Kong	Hong Kong	5.4	1987	KMB	Private	2,823	2,980,822	1,056	572,603	1,500	227	6.6
			1986	CMB	Private	1,024	878,630	858	149,589	1,324	116	11.4
			1987	PLB	Private[b]	4,340	960,000	221	..	..	123	..
Japan	Kitakyushu	2.3	[1988?]	KKK	Public	144	68,493	476	27,397	..	..	..
			[1988?]	NNT	Private	700	273,973	391	82,192	..	..	..
	Kyoto	1.4	1984	KKK	Public	989	520,548	526	108,767	440	89	4.9
	Nagoya	2.1	1986	NKK	Public	1,377	605,479	440	125,479	631	111	5.7
	Osaka	8.5	1988	OKK	Public	966	317,808	329	83,836	440	105	4.2
	Sapporo	1.5	1987	SKK	Public	690	268,493	389	54,247	1,056	73	14.5
	Tokyo	18.1	1988	TKK	Public	1,867	879,452	471	186,849	1,020	113	9.0
Singapore	Singapore	2.7	1988	SBS	Private	2,921	2,473,973	847	610,959	2,924	215	13.6
			1986	TIBS	Private	369	194,521	527	94,795	..	23	..
High income total		**50.6**		**16**	**(Public: 10 / Private: 6)**	**21,494**	**11,279,726**	**525**		**13,221**	**1,936**	**7.4**
Asia total		**234.0**		**63**	**(Public: 48 / Private: 18)**	**117,847**	**81,569,164**	**692**		**66,526**	**5,335**	**12.5**

a. included in BMTA data

Annex Table 8 Asia urban public transport data: tram/lrt companies

Country	Cities	Population 1990 (million)	Data year	Tam/ LRT company	Tram/ LRT	Fleet (Units)	Passengers per day	Passengers per day/unit	Daily unit kilometers	Route kilometers	No. of routes	Average rte. length (km)
China	Anshan	1.5	[1988?]	ACET	Tram	70	270,000	3,857	..	13	1	12.9
	Changchun	2.2	[1988?]	CCETC	Tram	79	350,000	4,430	..	20	3	6.7
	Dalian	2.5	[1988?]	DCTC	Tram	100	600,000	6,000	..	15	3	5.0
India	Calcutta	11.8	1987	CTC	Tram	402	473,973	1,179	25,205	71	29	2.4
Low income total		**18.0**		**4 (Tram: 4/ LRT: 0)**		**651**	**1,693,973**	**2,602**		**119**	**36**	**3.3**
Philippines	Metro Manila	8.5	1987	LRTA	LRT	64	278,082	4,345	..	15	1	15.0
Middle income total		**8.5**		**1 (Tram: 0/ LRT: 1)**		**64**	**278,082**	**4,345**		**15**	**1**	**15.0**
Australia	Adelaide	1.0	1988	STA	Tram	21	6,301	300	2,247	11	1	11.4
	Melbourne	2.8	1988	The Met	Tram	620	309,589	499	..	342	36	9.5
Hong Kong	Hong Kong	5.4	1987	HTL	Tram	162	353,425	2,182	20,274	17	6	2.8
			1988	NWR	LRT[a]	70	270,000	3,857	..	23	5	4.6
Japan	Kitakyushu	2.3	1982	NNT	Tram	82	139,726	1,704	..	19	1	19.0
			1982	CDT	LRT	23	46,575	2,025	..	15	1	15.0
	Kyoto	1.4	1987	KDT	LRT	60	98,630	1,644	..	25	2	12.5
			1982	KDT	LRT	28	27,671	988	..	11	2	5.5
	Sapporo	1.5	1987	SKK	Tram	32	27,397	856	2,740	8	1	8.0
	Tokyo	18.1	1988	TKK	Tram	45	65,753	1,461	4,932	12	1	12.0
			1986	Tokyu	Tram	9	51,233	5,693	..	5	1	5.0
High income total		**32.6**		**11 (Tram: 7/ LRT: 4)**		**1,152**	**1,396,301**	**21,209**	**30,192**	**488**	**57**	**8.6**
Asia total		**59.1**		**16 (Tram: 11/ LRT: 5)**		**1,867**	**3,368,356**	**28,156**	**30,192**	**622**	**94**	**6.6**

Annex Table 9 Asia urban public transport data: metro/MRT companies

Country	Cities	Population 1990 (million)	Data year	Metro/ MRT company	Fleet (Units)	Passengers per day	Passengers per day/unit	Daily unit kilometers	Route kilometers	No. of routes	Average rte. length (km)
China	Beijing	10.8	1987	BMC	200	500,000	2,500	..	40	2	20.0
	Tianjin	9.4	1986	TMA	12	30,000	2,500	..	8	1	8.0
India	Calcutta	11.8	1987	MRB	144	60,000	417	25,205	10	1	10.0
Korea (DPR)	Pyongyang	2.2	1983	CMU	48	115,068	2,397	..	23	2	11.5
Low income total		**34.2**			**404**	**705,068**	**1,745**		**81**	**6**	**13.5**
Korea	Pusan	3.9	1986	PCG	186	334,000	1,796	..	21	1	21.0
	Seoul	11.0	1986	SMSC	788	2,219,178	2,816	30,137	117	4	29.3
Middle income total		**14.9**			**974**	**2,553,178**	**2,621**	**30,137**	**138**	**5**	**27.6**
Hong Kong	Hong Kong	5.4	1987	MTRC	622	1,624,658	2,612	178,082	39	3	13.0
Japan	Kyoto	1.4	1985	KKK	36	130,000	3,611	..	7	1	7.0
	Nagoya	2.1	1986	NKK	523	926,575	1,772	132,877	60	4	15.0
	Osaka	8.5	1988	OKK	936	2,525,753	2,698	245,205	99	6	16.5
	Sapporo	1.5	1987	SKK	410	550,411	1,342	77,534	41	3	13.7
	Tokyo	18.1	1988	TKK	478	1,312,329	2,745	145,753	62	3	20.7
			1986	TRTA	1,970	5,279,452	2,680	515,068	142	7	20.3
Singapore	Singapore	2.7	1988	MRTC	138	220,000	1,594	..	33	2	16.5
High income total		**39.8**			**5,113**	**12,569,178**	**19,055**	**1,294,521**	**483**	**29**	**16.7**
Asia total		**88.9**			**6,491**	**15,827,425**	**23,422**	**1,324,658**	**702**	**40**	**17.6**

Annex Table 10 Asia urban public transport data: GRT systems

Country	Cities	Population 1990 (million)	Data year	GRT company	GRT type	Fleet (Units)	Passengers per day	Passengers per day per unit	Daily unit kilometers	Route kilometers	No. of routes	Average rte. length (km)
Australia	Adelaide	1.0	1990	STA	G/Bus	92	22,800	248	..	12	1	12.0
	Sydney	3.4	[1988?]	TNT	Monorail	..	..	..	..	4	1	3.6
Japan	Chiba	..	..	..	Monorail	70	..	..	..	15	1	15.3
	Ina	..	..	..	AGT	..	19,500	..	..	13		
	Kitakyushu	2.3	1988	KKT	Monorail	9	26,301	2,922	6,849	8	1	8.4
	Kobe	1.4	1986	KSKK	AGT	72	41,370	575	..	6	1	6.4
	Osaka	8.5	1988	ICTS	AGT	64	55,068	860	10,137	7	1	6.6
	Tokyo	18.1	[1988?]	TM	Monorail	54	85,700	1,587	..	13	1	13.2
	Yokohama	3.2	[1988?]	ICTS	AGT	..	..	..	..	11	1	11.0
	Yukarigaoka	..	..	..	Monorail	..	900	..	..	4	1	3.6
Total		37.9		10 (AGT: 4 M/rail: 5)		361	251,640	6,192	16,986	93	9	10.3

Annex Table 11 Asia urban travel data (non-motorized and motorized trips)

Country	City	Year	Walk	NMV	P/transit	Bus	Rail[a]	Car	M/cycle	Other[b]	Total (%)	Motorized	Transport	Car/taxi	Sources
Low income															
Bangladesh	Dhaka	1980	21.0	35.0	4.0	34.0	..	6.0	..	..	100.0	56.0	38.0	6.0	1
China	Anshan	1987[c]	26.9	55.8	..	15.9	..	..	..	1.4	100.0	82.7	15.9	1.4	2
	Changzhou	1985	38.2	52.5	..	6.3	..	..	..	3.0	100.0	90.7	6.3	3.0	2
	Fushun	1987[c]	34.0	26.1	..	27.7	11.7	0.3	..	0.2	100.0	60.1	39.4	0.5	2
	Guangzhou	1986	38.0	30.0	..	27.4	..	1.8	..	2.8	100.0	68.0	27.4	4.6	2
	Louyang	1986	41.0	51.8	..	6.5	..	..	..	0.7	100.0	92.8	6.5	0.7	2
	Shanghai	1986	38.0	33.0	..	26.0	..	..	..	3.0	100.0	71.0	26.0	3.0	3
	Shenyan	1987[c]	29.7	55.9	..	11.7	..	..	..	2.7	100.0	85.6	11.7	2.7	2
	Tianjin	1987	50.0	41.0	..	9.0	..	..	..	..	100.0	91.0	9.0	0.0	4
India	Ahmedabad	1981	43.0	20.0	..	29.0	[d]	1.0	6.0	1.0	100.0	63.0	29.0	8.0	5
	Bangalore	1984	44.0	12.0	..	36.0	[d]	2.0	6.0	0.0	100.0	56.0	36.0	8.0	5
	Bombay	1981	15.0	11.0	..	58.0	[d]	8.0	1.0	7.0	100.0	26.0	58.0	16.0	5
	Delhi	1981	29.0	18.0	..	40.0	[d]	0.0	10.0	3.0	100.0	47.0	40.0	13.0	5
	Kanpur	1977	72.0	24.0	..	..	..	1.0	3.0	0.0	100.0	96.0	0.0	4.0	5
	Madras	1980	21.0	20.0	..	53.0	[d]	1.0	4.0	1.0	100.0	41.0	53.0	6.0	5
Indonesia	Jakarta	1984	23.0	17.0	..	25.0	..	8.0	13.0	14.0	100.0	40.0	25.0	35.0	5
	Surabaya	1984	20.0	25.0	..	13.0	..	9.0	26.0	7.0	100.0	45.0	13.0	42.0	5
Middle income															
Korea	Pusan	1982	17.9	..	..	58.4	..	5.2	..	18.5	100.0	17.9	58.4	23.7	6
	Seoul	1982	12.0	..	..	58.6	6.5	7.9	..	15.0	100.0	12.0	65.1	22.9	6
Malaysia	Kuala Lumpur	1984	10.0	2.0	..	34.0	..	34.0	12.0	8.0	100.0	12.0	34.0	54.0	7
Philippines	Manila	1984	8.0	..	55.0	14.0	..	23.0	..	[e]	100.0	8.0	69.0	23.0	8
Thailand	Bangkok	1984	16.0	..	..	58.0	..	19.0	5.0	2.0	100.0	16.0	58.0	26.0	9
High income															
Japan	Central Tokyo	1988	13.2	10.7	..	8.0	43.4	24.7	[f]	..	100.0	23.9	51.4	24.7	10
	Greater Tokyo	1988	6.8	15.7	..	8.2	15.4	53.9	[f]	..	100.0	22.5	23.6	53.9	10

a. including mass rapid transit
b. including taxi
c. morning peak hour only
d. included in bus trips
e. taxi, etc included in paratransit
f. included in NMV

Annex Table 12 Asia urban travel data (motorized trips)

Country	City	Year	P/transit	Bus	Rail[a]	Car	M/cycle	Other[b]	Total (%)	Bus	Rail	Car/taxi	Sources
Low income													
Bangladesh	Dhaka	1980	9.1	77.3	..	13.6	..	..	100.0	86.4	..	13.6	1
China	Anshan	1987[c]	..	91.9	..	..	..	8.1	100.0	91.9	..	8.1	2
	Changzhou	1985	..	67.7	..	..	..	32.3	100.0	67.7	..	32.3	2
	Fushun	1987[c]	..	69.4	29.3	0.8	..	0.5	100.0	69.4	29.3	1.3	2
	Guangzhou	1986	..	85.6	..	5.6	..	8.8	100.0	85.6	..	14.4	2
	Louyang	1986	..	90.3	..	..	..	9.7	100.0	90.3	..	9.7	2
	Shanghai	1986	..	89.7	..	..	..	10.3	100.0	89.7	..	10.3	3
	Shenyan	1987[c]	..	81.3	..	..	..	18.8	100.0	81.3	..	18.8	2
	Tianjin	1987	..	100.0	..	..	..	..	100.0	100.0	..	..	4
India	Ahmedabad	1981	..	78.4	[d]	2.7	16.2	2.7	100.0	78.4	[d]	21.6	5
	Bangalore	1984	..	81.8	[d]	4.5	13.6	0.0	100.0	81.8	[d]	18.2	5
	Bombay	1981	..	77.3	[d]	10.7	2.7	9.3	100.0	77.3	[d]	22.7	5
	Delhi	1981	..	75.5	[d]	0.0	18.9	5.7	100.0	75.5	[d]	24.5	5
	Kanpur	1981	..	11.1	[d]	55.6	0.0	33.3	100.0	11.1	[d]	88.9	5
	Madras	1980	..	89.8	[d]	1.7	6.8	1.7	100.0	89.8	[d]	10.2	5
Indonesia	Jakarta	1984	..	41.7	..	13.3	21.7	23.3	100.0	41.7	..	58.3	5
	Surabaya	1984	..	23.6	..	16.4	45.5	14.5	100.0	23.6	..	76.4	5
Pakistan	Karachi	1987	7.0	55.0	..	23.0	15.0	..	100.0	62.0	..	38.0	11
Middle income													
Korea	Pusan	1982	..	71.1	..	6.3	..	22.5	100.0	71.1	..	28.9	6
	Seoul	1982	..	66.6	7.4	9.0	..	17.0	100.0	66.6	7.4	26.0	7
Malaysia	Kuala Lumpur	1984	..	37.9	..	39.1	13.8	9.2	100.0	37.9	..	62.1	5
Philippines	Manila	1984	59.8	15.2	..	25.0	..	[e]	100.0	75.0	..	25.0	8
Thailand	Bangkok	1984	..	69.0	..	22.6	6.0	2.4	100.0	69.0	..	31.0	9

Annex Table 12 *(continued)*

Country	*City*	*Year*	*P/transit*	*Bus*	*Rail*[a]	*Car*	*M/cycle*	*Other*[b]	*Total (%)*	*Bus*	*Rail*	*Car/taxi*	*Sources*
High income													
Hong Kong	Hong Kong	1986	14.2	42.3	20.8	10.2	..	12.5	100.0	56.5	20.8	22.7	12
Japan	Nagoya	1985	..	8.4	28.3	59.2	..	4.1	100.0	8.4	28.3	63.3	13
	Osaka	1985	..	3.6	65.0	26.7	..	4.7	100.0	3.6	65.0	31.4	13
	Tokyo	1985	..	6.4	73.1	14.9	..	5.6	100.0	6.4	73.1	20.5	13
	Central Tokyo	1988	..	10.5	57.0	32.5	f	..	100.0	10.5	57.0	32.5	10
	Greater Tokyo	1988	..	10.6	19.9	69.5	f	..	100.0	10.6	19.9	69.5	10

a. including mass rapid transit
b. including taxi
c. morning peak hour only
d. included in bus trips
e. taxi, etc included in paratransit
f. included in NMV

Sources:

1. Hoque H.M. [1990]. *Traffic and Safety Problems in Metropolitan Dhaka*, CODATU V
2. Barrett R. [1988]. *Urban Transport in China: Current Status of Knowledge* (unpublished).
3. Powlis M.A. and Vance J. [1991]. *Transportation Planning for Bicycles in Shanghai*, TRB paper.
4. Thornhill W. [1991]. *Non-motorized Transport in Tianjin*, TRB paper.
5. Replogle M. [1991]. *Non-motorized Vehicles in Asia: Issues and Strategies.*
6. Korea Advanced Institute of Science and Technology [1984]. Busan Transportation Improvement Project.
7. Korea Advanced Institute of Science and Technology [1983]. Seoul Transportation Improvement Project.
8. Coloma S. [1990]. *Integration of Urban Transport*, Tokyo Symposium paper.
9. JICA [1990]. Seminar on medium to long-term improvement/management plan of road and road transport in Bangkok.
10. Morichi S. [1989]. *Investment Policies for Urban Transport*, Tokyo seminar paper.

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