Air Pollution Control in the Transportation Sector:

Third Phase Research Report of the Urban Environmental Management Project

IGES
Institute for Global Environmental Strategies

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Foreword

The focus of the Urban Environmental Management Project of the Institute for Global Environmental Strategies (UE Project) in 2005-2007 was on the opportunities and barriers for integration of global environmental concerns into local planning and management, taking greenhouse gas emission reduction as a distant but ultimate goal. Accordingly, the project builds its rationale on the common understanding that human activities in cities have profound environmental impacts far beyond city boundaries.

Looking at the reality of developing country cities in Asia, it is obvious that global concerns are not a top priority for urban environmental managers. Environmental concerns in these cities often mean more immediate and pressing local issues such as poor sanitation and health problems, air and water pollution, and improper solid waste management.

Thus, the third phase research of the UE Project aimed to explore the ways of bringing global environmental concerns into local environmental management in developing country cities in Asia. Air pollution control in the transportation sector, the title of this report, was one of the strategic targets set under this overall objective. This report is a compilation of studies conducted under this strategic target.

This report first introduces the background and objectives of the third phase research of the UE Project on the transportation sector. The second chapter provides an overview of transport and environment in Asian Cities. The third chapter illustrates the rationale of the scoping of focus policy areas and selection of case studies. The fourth chapter consists of six case studies and one comparative analysis on policies related to transport and environment in Asian cities. The last chapter summarises the findings of the studies and discusses the barriers and opportunities of the air pollution control in the transportation sector, concluding with the perspectives for future research.

We hope that the information contained in this report can provide useful analyses, information and case studies on various related practices, policies and implementation issues. It is our hope that such endeavours will assist researchers in further research as well as helping decision-makers to clarify the opportunities and barriers to address global concerns while managing transportation and local environment in Asian cities.

We would like to acknowledge the support by a number of individuals who have greatly contributed to the completion of this report. We first would like to thank the research partners who conducted case studies in Asian cities. We also would like to express our gratitude to Professor Mamoru Taniguchi, Professor Haruo Ishida, Dr. Surya Raj Acharya, and Mr. Naomi Kamioka for providing useful comments during our research meetings in July and June 2006. We are thankful to CAI-Asia for helping IGES to organise two sub-workshops based on our research results during the Better Air Quality Workshop 2006, on 13-15 December 2006. Lastly, we are grateful for Ms. Aoi Oride and Ms. Eiko Kitamura for coordinating editing and printing of this large report.

Professor Akio Morishima
Acting Project Leader
Urban Environmental Management Project

I. Introduction

With the rapid urbanisation and economic development in the Asian region, urban transportation has already become one of the prominent environmental issues that are contributing to both local and global environmental concerns. The existing information on Asian cities and various research outputs re-endorses the fact that issues in the transport sector need special attention in order for us to realise the environmental sustainability of cities.

The transportation sector presents a wide range of issues viz. air pollution, noise, congestion, accidents and increased travel time. It was evident from the existing information that air pollution controls are not only important and a current priority in the local context, but also can present a significant potential to control greenhouse gas emissions. Asian developing cities, with the expected increase in levels of industrialisation and further economic growth, would eventually have to target air pollution control and sustainable transport issues more vigorously than before in the short as well as the long term. There is a growing belief that developing countries, which may be able to afford to ignore the global concerns today, will have to take up the issue sooner or later. Indeed, air pollution and transportation may provide an easy entry point. Thus, with an ultimate goal of greenhouse gas reduction, the present study has chosen air pollution control as a strategic target from the transport sector due to its high greenhouse gas co-benefits.

The overall goal of the Third Phase of Urban Environmental Management Project (UE Project) was to contribute towards better management of the urban environment in Asian cities by developing new ideas and tools, analysing various factors that facilitate the formulation and implementation of policies, and evaluating their limitations and advantages. Many cities in Asia have not been able to solve urban environmental issues on their own due to lack of capacities, finance and technology. To fully address those issues, it is not sufficient to make these cities solely accountable. It is also necessary to involve other stakeholders such as national governments and the global community. The project's decision to focus on strategies to link local issues with global issues, specifically mitigation of greenhouse gases (GHGs) came as a breakthrough. Thus, under the theme of "integrating global concerns into urban environmental management in Asia", research was conducted on the urban transportation sector, which is thought to be the fastest growing energy consumption sector as well as the most promising sector for integrating air pollution control with greenhouse gas emissions.

The transportation studies during the Third Phase focused primarily on reduction in travel activities and promotion of modal shifts, which are the two major strategies that simultaneously have potentials to reduce local pollutants, traffic congestions and greenhouse gases. During the course of research, case studies were conducted for Mumbai (India), Bangkok (Thailand), Shanghai (China), Yokohama (Japan), Beijing (China) and Jakarta (Indonesia). In addition, one cross-city comparative analysis was carried out on the policy process to introduce Bus Rapid Transit Systems in Jakarta, Seoul and Beijing. The rationale behind selecting those priority areas and case study cities are described in Chapter Three, following an overview of the transport and environment in Asian cities in the next chapter.

Due to constraints in human resources for the UE Project, four of the above case studies (Bangkok, Shanghai, Beijing and Jakarta) were conducted by local research partners based on commission with the Project. Those researchers not only submitted their reports but also actively participated in discussions in the course of finalising the studies and provided valuable inputs to the ideas presented in the Final Chapter.[1]

1. The UE Project held two workshops to discuss the progress of the case studies and their policy implications in July and September of 2006 in Hayama. The findings of the case studies were presented and discussed at the sub-sessions of the Better Air Quality 2006 Workshop on 13-14 December in Yogyakarta.

(This section was extracted from the Third Phase Research Plan of the UE Project, approved by the Board of Directors Meeting of IGES in June 2005)

II. Overview of Transport and Environment in Asian Cities

Shobhakar Dhakal[2]

1. Environmental implications of urban transport in Asian cities

1.1 At the local level

Epidemiological studies show that air pollution costs thousands of deaths and leads to a number of health problems in cities. This results in added healthcare costs and loss of productivity. The pollutants linked to urban transport that are typically health concerns are lead (Pb), dust (due to re-suspension), particulate matter (PM), oxides of nitrogen (NO_X), and volatile organic compounds (VOC).[3] Photochemical oxidant (ozone), another important pollutant, forms from NOx and VOCs in the presence of heat and sunlight. Of course transport is only one of the contributors to urban air pollution. But household cooking is switching to modern fuels (natural gas, liquefied petroleum gas, electricity); lower-quality industrial fuels like lignite, low-grade coals and dirty heavy diesel are being replaced by cleaner coals or oils and natural gas, and industries are being moved out of cities, so the role of transport grows dramatically. One important difference is that stationary sources of air pollution are easy to spot and regulate, and they often cause annoyance to the polluters themselves, while mobile sources like vehicles are harder to spot and regulate, and are rarely a cause for direct annoyance for the polluters.

The impacts from these pollutants are very much location-specific in cities; the more dispersed impacts of carbon dioxide emissions are dealt with later on in this section. Before the phasing out of leaded gasoline, lead was a major health issue. In Bangkok, studies estimated 400 additional deaths per year due to the effects of lead (Michaelowa 1997). Several other studies have shown the costs of air pollution in cities. The UrbAir study by the World Bank, conducted in Greater Mumbai, Kathmandu Valley, Jakarta and Metro Manila, found that urban transport accounted for the majority of air pollutants, and the health impacts cost millions of dollars (Shah and Nagpal 1997). Another World Bank study, on Mumbai, Shanghai, Manila, Bangkok, Krakow and Santiago, showed that the total social cost of air pollution in these cities was as high as US$ 2.6 billion (1993) (Lvovsky et al 2000). One 1998 study of Delhi, where the transport sector accounted for over 70 percent of air pollution, suggested that 7,500 premature deaths, 4 million hospital admissions and 242 million incidences of minor sickness could be avoided if air pollution were brought within World Health Organization (WHO) suggested levels (Xie, Shah, and Brandon 1998). A recent report by the Asian Development Bank stated that in Asian cities, SPM and PM_{10} (particulate matter below 10 microns) levels in particular were higher than WHO limits and US Environmental Protection Agency (USEPA) 1997 limits respectively (1990–1999 average, citing WHO's Air Information Management Database). The report showed that SPM concentrations in Shanghai, New Delhi, Mumbai, Guangzhou, Chongquin, Calcutta, Beijing and Bangkok exceeded WHO limits

2. Executive Director, Global Carbon Project-Tsukuba International Office. Dr. Dhakal was a Senior Policy Researcher of the Urban Environmental Management Project, Institute for Global Environmental Strategies, until March 2006. The texts in this Chapter are largely extracted from two publication of the UE Project (a) Dhakal, S. and Schipper L. 2005. Urban Transport and Environment in Asian Cities. International Review for Environmental Strategies 5 (2): 399-424 (b) Dhakal, S. 2005. Urban Transport and Environment in Kathmandu Valley, Nepal: Integrating Global Carbon Concerns into Local Air Pollution Management. Institute for Global Environmental Strategies, 2006, Hayama, Japan.

3. There are a few other pollutants, such as carcinogens like poly-nuclear aromatic hydrocarbons and aldehydes.

(90 μg/m^3) by three, five, three, three, four, four, four and two times respectively (ADB 2003). It also showed that PM_{10} exceeded the USEPA limit (50 μg/m^3) by several times in a number of cities, most notably by over four times in New Delhi and Calcutta. Similarly, a benchmarking report of the Air Pollution in Mega-cities of Asia Project[4] shows that NOx and particulate matters are a serious challenge for Asian cities (Air Pollution in Mega-cities of Asia 2002). Data from Tokyo shows that SPM increased rapidly from 40 μg/m^3 in the early 1980s to over 70 μg/m^3 in the early 1990s; after that SPM has been decreasing or stagnating, but it is becoming an increasing challenge to contain SPM and NOx (Tokyo Metropolitan Government 2004).

All of the above reports show that SPM, $PM_{10,}$ and NOx are particularly problematic, and the transport sector is one of the major contributors of these pollutants. It is important to note that the health impacts are determined by dose response of the pollutant concentration to the exposed population; ironically, policies in many Asian developing countries are driven by emissions estimates that are reasonable but less efficient. Apart from local air pollution, growing motorisation takes a significant toll on traffic flow. In many cities, income is rising but the pace of improvements in efficiency of public transport, especially mass transport systems, has been slow. As a result, Asian cities such as Bangkok, Jakarta, Beijing, Manila, Delhi and Kathmandu are increasingly dominated by personal lower-occupancy vehicles, exacerbating congestion and pollutant concentrations. Such problems are further aggravated by lack of expansion and improvement of roads. The new challenges facing policymakers now demand mitigating not only air pollution but also congestion.

1.2 At the global level

Many of the issues linked to urban transport revolve around energy use. Oil supply is a major factor in world politics, while rapid motorisation threatens energy security. There is a general consensus that oil is going to remain a major transport fuel, and that the world has to confront the environmental implications of oil-based transport, for at least the next three to four decades. The latest figures indicate that oil accounts for more than 95 percent of total energy use in transport in almost all countries in the Organisation for Economic Cooperation and Development (OECD) (Fulton 2001). The situation in Asian cities is not much different. Energy use in oil-based urban transport has dramatically increased in Asian cities owing to rapid motorisation. In Ho Chi Minh City, the share of transport in total energy use stands at 20 percent. In commerce-dominated cites such as Tokyo and Seoul, the share is well over 35 percent. The rate at which the share of transport in energy use is growing has also been phenomenal. While in the rapidly growing megacities such as Beijing and Shanghai, the transport sector's share in total energy consumption stands at only seven to nine percent (Dhakal 2005), it doubled between 1990 and 2000, as did the share in Delhi. Energy use by the transport sector has even continued to increase moderately in relatively mature cities such as Tokyo (by a quarter) and Seoul (by a half).[5]

There is some speculation that vehicles powered by hydrogen fuel cells will evolve in the foreseeable future, but major questions remain over how long this will take and how the hydrogen will be obtained. Fuel-cell systems will definitely be more efficient than the internal combustion engine (ICE) but costs, energy loss and greenhouse gas emissions in production of hydrogen will determine their real benefits. Some researchers argue that even if hydrogen fuel-cell automobiles became cost-effective today (they are still in the stage of technology development), it would take 50 years before we see improvements in air quality, if we take into account the time required for design, technology refinement, cost reduction through economies of scale, development of supporting infrastructure, marketing, and penetration of the existing fleet.[6] Heywood and

4. The Air Pollution in the Megacities of Asia (APMA) project was initiated in November 2000 by the United Nations Environment Programme and WHO in collaboration with the Korea Environment Institute and the Stockholm Environment Institute.

5. Based on presentations by a number of local experts at the International Workshop on Policy Integration Towards Sustainable Urban Energy Use for Cities in Asia: Integrating Local Air Pollution and Greenhouse Gas Emissions Concerns, organised by IGES, 28–30 January 2004, Kanagawa, Japan. For details see http://www.iges.or.jp/kitakyushu/megacity_workshop /index.htm.

6. Personal communications with Prof. John Heywood, Professor of Automotive Science, Massachusetts Institute of Technology, during the OECD Ministerial Roundtable on Sustainable Mobility, September 2004.

Bandivadekar (2004) show that the new technology must account for over 35 percent of new vehicle production and over 35 percent of total mileage driven to have an impact. Penetration into the fleets of the cities of developing Asian countries will take even longer than in the developed economies of the world.

After the Rio Earth Summit, the issue of climate change has been gaining momentum in political, scientific and all other sectors. The recent ratification of the Kyoto Protocol by Russia has paved the way for the protocol to enter into force in early 2005. Now Annex-I countries[7] are obliged to fulfill Kyoto commitments, and instruments such as the Clean Development Mechanism, joint implementation and carbon trading, will be operational. The role of cities, and especially of urban transport, will be very important because they are major emitters of greenhouse gases.

In a recently published report entitled *Mobility 2030: Meeting the Challenges to Sustainability*, the World Business Council for Sustainable Development (WBCSD) estimated that worldwide transport-related greenhouse gas emissions (well-to-wheel, including air, water and road transport) would increase from slightly over six gigatons of carbon dioxide (CO_2)-equivalent in the year 2000 to over 14 gigatons by the year 2050. It also showed that light-duty vehicles were responsible for the majority of emissions, followed by freight trucks and air transport (WBCSD 2004). The International Energy Agency estimates that road transport accounts for the majority of global CO_2 emissions from the transport sector. Road transport alone contributed some 18 percent of the world's total CO_2 emissions from fuel combustion in the year 2000 (International Energy Agency 2002). In OECD countries, this share stands at 23 percent, less in developing countries. At city level, a study carried out by the Institute for Global Environmental Strategies showed that the transport sector contributed only between five and 10 percent of CO_2 emissions from fuel combustion in Beijing and Shanghai in 1985–2000, but the rate of growth was over 10 percent and was accompanied by high levels of PM_{10} and NO_x and by congestion (Dhakal 2005).

The WBCSD study also projected that CO_2 emissions from each mode of transport and each region would increase, with the majority of the additional growth coming from developing regions of the world. It showed that the volume of vehicle activity was a major problem. For example, the drop in energy consumption achieved by improving the energy efficiency of light-duty vehicles and heavy-duty trucks (by 18 and 29 percent respectively between 2000 and 2050, which is the only expected reducing factor for emissions) would not be able to offset the increase from the projected 123-percent and 241-percent growth in use of these types of vehicle.[8] Indeed, this trend explains why in some cities, for example Mexico City, dramatic improvements in new car emissions have failed to lead to a dramatic improvement in air quality—too many daily travellers are shifting from large buses to cars and minibuses (Schipper and Golub 2003).

The WBSCD report states that China and India alone surpassed the transport-related emissions from the rest of Asia due to their size and rapid rate of motorisation in the year 2000, and will continue to do so in 2050. The report assumes that the role of public transport will be undermined by private modes of transport, but it brings the following issue to the forefront: the present need to cope with growing motorisation and to find solutions to increasing CO_2 emissions through air-pollution mitigation, energy saving and congestion mitigation in dense and growing Asian metropolises.

Asian cities, unlike North American and European cities, tend to become denser and to sprawl towards their peripheries. This sprawling can lead to the creation of largely unorganised peri-urban areas that stretch the distribution and transport systems of the city. The emergence of Bangkok's peri-urban areas and Beijing's construction of 14 satellite towns outside its Fifth Ring Road may put additional burdens on these cities if urban functions are not well allocated. On the other hand, the trend of cities to become denser may be desirable

7. Developed nations listed in Annex I of the UN Framework Convention on Climate Change.
8. These are global averages. There are variations from region to region.

from a number of viewpoints, such as higher utilisation of urban infrastructure, cost-effectiveness of public transport systems, and compact distribution and supply networks for energy and other services. However, as cities become denser, management challenges increase, especially for air pollution from motor vehicles, congestion and management of other urban environmental services such as water supply, wastewater and solid waste disposal.

Recent estimates by the UN Population Division suggest that about half of the megacities (over 10 million population) and medium-sized cities (over 1 million population) worldwide will be in Asia by 2015 (UN 2002). This will certainly mean a huge rise in CO_2 emissions from Asian countries for the reasons already discussed. Sustainable mobility in Asian cities will require an appropriate balance of private and public transport (including mass transport systems) that takes into account air pollution (local and CO_2 emissions), energy saving, and congestion. Although safety, equity, financial stability and other issues are also prominent in the sustainability-mobility debate, the authors believe that congestion, emissions, and development of public transport (in particular mass transport) will pose more serious challenges than any other issues in the next 20–30 years. The WBCSD study cited above (WBSCD 2004) also supports this argument, as its modelling results indicated that transport-related conventional emissions will decline sharply in OECD countries over the next two decades. At the same time in non-OECD countries, lead, carbon monoxide (CO) and VOCs will gradually decrease during this period, but NOx and PM_{10} will not start to decline for another two decades.

2. Emerging policy issues in Asian cities: commonalities and differences

2.1 Underlying issues

Global and regional discussions of transport and environment policy are often too generalised and tend to discount the vast differences that exist amongst cities, countries and regions. While there are certainly issues that are common to many or all cities, there are also significant differences that can be presented from a number of viewpoints.

a. Motorised and non-motorised transport

One of the commonalities between cities is the diminishing role of non-motorised modes of transport. Travel patterns in the USA are dominated by automobile use, while non-motorised modes still account for the largest share of transport use in China (about 40 percent in Beijing and Shanghai). Historically, walking and bicycling have been in decline and travel demands are shifting towards faster modes. However, there have been numerous attempts to revive non-motorised modes in certain places. Contrary to the general image of North America, the city of Boulder, Colorado in the United States prides itself upon being a bicycle-friendly city in which any part can be accessed through dedicated cycle lanes. However, the example of human-powered tricycles in Dhaka shows that non-motorised modes do not always produce desirable solutions if they are not well managed. This is especially so if they are mixed with other modes of travel, only adding to congestion. Even in Shanghai, bicycles are banned on major roads to reduce congestion.

b. Infrastructure issues

Another commonality amongst Asian developing countries is the shortage of road infrastructure in relation to vehicle numbers. For example, the total road length in Beijing nearly doubled between 1979–1999, but vehicles increased by 17 times (He, Zhang and Huo 2004). The number of vehicles per kilometre of road length (note: not area) in Beijing is over 350, compared with about 200 in Tokyo and about 130 in Shanghai (all figures for the year 2000; see Dhakal 2005). There is, in most cities, a gap between travel demand and transport infrastructure, which is not only limited to normal roads but to expressways, railways and other modes of travel.

Box 2.1. Urban transport and environment in Katmandu, Nepal: Assessing synergies/conflict relation between local air pollution management and carbon concerns

Kathmandu Valley's motorised travel demand has already increased by 8.7 times in 1989-2004 and is likely to increase by three times of 2004 in 2025 with public transport catering little over fifty percent of motorised travel demand. This means the number of operating vehicles in 2025 might reach about half a million from the current one hundred and seventy thousand, resulting in a doubling of the ownership rate of cars and motorcycles and a tripling of the number of vehicles per kilometre of road length. The energy assumption by passenger transportation in the Valley has increased by about seven times in 1989-2004 and projections have shown that by 2025, it will increase to about 2.2 times the amount of 2004. Currently, private cars and motorcycles make up 71% of the operational vehicles population. They meet 41 % of travel demand. but consumed 53% of total energy. On the other hand, high occupancy public transport i.e. buses and minibuses, makes only 1.4% of vehicle population but meets 37% of travel demand while consuming only 13% of the total energy. If we compare the amount of energy consumed to travel one kilometre by a passenger travelling by bus, it is double for motorcycles, 6.5 times for private cars, double for microbuses, and 20% more for minibuses. This means that public transport is more favourable than private transportation in reducing vehicle population, saving energy and meeting large travel demands in the Valley, an area that suffers from PM10 pollution, a figure well over healthy limits.

The volume of CO_2 emissions from passenger transportation is small for the Valley compared to other cities in the developed regions of the world because of low per capita vehicle ownership rates. However, it had already increased in 2004 by 5.2 times since 1989. It is estimated that it will double by 2025 from 537 thousand tons in 2004. In particular, private cars and motorcycles' CO_2 emission in grams/pass-km is over four times that of buses and minibuses. Interestingly, such CO_2 intensity of microbuses are as bad as private cars making it evident that shifting private transport to low-occupancy public modes running on petroleum products (gasoline, diesel or LPG) does not help to reduce CO_2. On the contrary, such a shift would be able to reduce large amounts of PM_{10} emissions because high occupant modes run on diesel.

A survey of past and ongoing policy initiatives and countermeasures reveals that they are not comprehensive and mostly focused on controlling emissions from a vehicle's tail-pipe on a piece-meal basis. There is a lack of effort in developing a comprehensive policy accompanied by a set of practical countermeasures. We re-emphasise that the small pro-active and upstream countermeasures such as managing travel demand and a modal shift towards public transportation will reduce a large amount of pressure on downstream countermeasures such as emission control from vehicle tailpipes.

The five alternative scenarios over business-as-usual cases provide evidence for a much needed comprehensive policy approach. These scenarios focus on (a) reducing travel demand through dampening population influx, (b) promoting public transportation at the expense of private cars and motorcycles, (c) large scale utilisation of electric vehicles, (d) progressive tightening of emission standards, and (e) implementing a package of measures with few interventions to various components such as travel activities, modal stricture, energy intensity and fuel. Results reveal that each of the individual scenarios would have certain advantages but none of them alone would be able to meet the major objectives of the city (PM_{10} control, saving energy, using more of indigenously produce energy sources, reducing vehicle population to aid congestion mitigation, and CO_2 mitigation). It shows that a large reduction in travel demand may be able to address the entire objective. However this is a long-term measure (which will have no effect in the short-term) and its feasibility remains questionable due to the past failure of such various urban development plans. A shift of modal share to buses and minibuses by 15% from the baseline case is likely to increase PM_{10} by 23% in 2025. The introduction of electric vehicles on a large scale would have no impact on congestion reduction and will have nominal advantage for PM_{10} and CO_2 reduction. Similarly, implementing the stringent emission standards progressively to EURO 3 by 2015 will not help to reduce congestion, save energy or utilise more electricity. On the contrary, this study shows that a package of countermeasures with small improvements in various components would be the most favourable to address the multiple objectives of the city. Such a package would cut 20% of CO_2 and 47% of PM_{10}. There would be 132824 fewer cars and motorcycles, 18% less energy use, and increased electricity use by 8 million KWh from the baseline case in 2025 alone. Finally, in Kathmandu Valley, the synergy between the local and global objectives is more prominent than their conflicts. In specific countermeasures, the priority may be different and conflicts may arise, but for the overall objectives of the city (as outlined earlier), the best choice would be same scenario with and without considering CO_2 as an objective. This means consideration to local priority can equally address CO_2 mitigation.

Source: Dhakal, S. 2005. Urban Transport and Environment in Kathmandu Valley, Nepal: Integrating Global Carbon Concerns into Local Air Pollution Management. Institute for Global Environmental Strategies, 2006, Hayama, Japan.

With rising incomes and delays in development of mass transport systems, an increasing number of cars has become a major problem for cities such as Bangkok, Delhi and Beijing, while in Delhi, Kathmandu, Karachi and Dhaka, a surge in two-wheelers (motorcycles and mopeds) in addition to cars is choking road networks. To counter the growth of private modes of transport, development of mass transport is essential, but it requires long-term planning. In recent times, some cities have been planning aggressive development of rail-based mass transport systems; for example, Bangkok's expressways and its Bangkok Transit System Skytrain and subway; Delhi's subway; and Beijing's expressways and subway expansion plans to prepare for the 2008 Olympics. This has confronted them with another common challenge: procuring infrastructure financing. Bangkok's failure to build its MRTA subway planned in 1976 and subsequent failure to realise the Hopewell Project (combined MRT and expressways) is generally attributed to financing-related difficulties. In the least-developed countries especially, infrastructure financing is challenging because of cost-recovery problems. There has been a trend towards public-private partnerships in the infrastructure sector in recent years. For such mechanisms to work, a sound system needs to be in place that allows the private-sector partners to recover their investments and to reduce the investment risks. Most cities in Asia are still struggling to create appropriate environments for private-sector investment.

Per capita ownership of vehicles in developed cities such Tokyo and Seoul has already reached saturation (2.8 and 4.5 people per vehicle, respectively, in 1999). Per capita vehicle ownership, especially for cars and light-duty vehicles, in Beijing, Shanghai, Bangkok, Jakarta, Manila, Delhi and Kathmandu, is well below that in OECD countries or Tokyo (people per vehicle for Beijing was 13, for Shanghai 34 in 1999). However, the rate of increase in vehicle ownership in these cities is high (Dhakal 2005). It is also enough to sound alarms given the prevailing levels of air pollution and congestion. The rates of motorisation at prevailing household income levels in these cities are higher than at similar levels in Seoul or Tokyo in the past. Only very few cities have tried to cap vehicle numbers as a part of government policy, notably Singapore and Shanghai. Very few have tried to put any direct restrictions on vehicle use besides Singapore; Hong Kong tried in 1983–85 in a pilot scheme that was later dropped (Dhakal 2005).

c. Vehicle mix

Traditionally, analyses of urban transport have looked only at private cars; however, examining the role of two-wheelers is essential to understand motorisation in Asian developing countries. Asia accounts for 75 percent of the two-wheelers in the world. China and India alone account for 50 and 20 percent respectively in it (WBCSD 2004). Two-wheelers in Chennai, Shanghai and Wuhan account for 80 percent of those cities' total vehicle fleets. They account for 50 percent in Mumbai, over 65 percent in Kathmandu, and 40 percent in Kuala Lumpur (WBCSD 2004; Dhakal 2003a).

Two-wheelers are among the most polluting vehicles in the world. Among two-wheelers, two-stroke engines, which dominate fleets in South Asia and much of Southeast Asia, have inferior emission performance since 15 to 40 percent of the fuel-air mixture escapes from the engine through the exhaust port. Poor vehicle maintenance, misuse of lubricants, and adulteration of gasoline exacerbate emissions from two-wheelers (Kojima, Brandon and Shah 2000). In recent years, there has been an increasing trend toward banning two-stroke two-wheelers for environmental reasons from key cities in Nepal, India, Thailand and Bangladesh. Shanghai has already banned two-wheelers from major roads. Yet two-wheelers continue to make substantial contributions to air pollution and create traffic chaos in cities.

Two-wheelers skew the perception of motorisation too. The WBCSD report notes that when motorised two-wheelers are considered, Mexico City's motorisation becomes lower than Chennai's while its per capita income is 10 times higher than Chennai's. In India, two-wheelers are cheap (about US$200 for a moped or scooter), and as incomes rise, a much larger proportion of the population can own one, which drives the motorisation process (WBCSD 2004). Delhi, with US$800 per capita income, has 120 two-wheelers per thousand population, while Shanghai, with US$4,000 per capita income, has only 60 two-wheelers per thousand (WCTRS 2004). Vehicle ownership in some Indian cities, Kuala Lumpur, Hanoi, Taipei and Ho Chi Minh City leaves roughly every household with a private vehicle, most likely a two-wheeler. It should be noted that real purchasing power in Asian countries is much higher than it looks when per capita incomes are converted into other currencies. Based on purchasing power parity, the per capita GDPs of China and India are closer to four and five times respectively what they are in dollar terms (World Bank 2004). In short, the spread of two-wheelers, for better or worse, has afforded a high degree of individual mobility in urban areas, a level that may be hard to reverse with buses and rail. However, only Asia seems to be inundated by two-wheelers, which are largely absent in other developing regions of the world such as Latin America and Africa. This phenomenon can be attributed to economic protectionism, topography, security and socio-cultural factors, among others (WCTRS 2004).

Besides the prominence of two-wheelers, the modes of public transport in developing Asian countries are more diverse than in developed countries. In Tokyo and Seoul, modes of transport are largely limited to cars, taxis, buses, surface rail and subway, while in India, two-wheelers, motorised three-wheelers, bicycles, pedi-cabs and animal-pulled carts share roads with buses, taxis and cars (WCTRS 2004). This means there is a wider variety of stakeholders in urban transport bringing more complexities; poverty, equity, political and social dimensions are all mixed up with transport problems. Looking at the different travel modes and their shares, private transport's modal share in Asian cities is much smaller than it is in developed parts of the world (WCTRS 2004, chapter 2). This brings in the issue of how to avoid the mistakes of developed countries, especially those of North American cities, and how to develop congestion-free and pollution-free transport systems in Asia.

d. Technology issues

From the technology side, mitigating air pollution from vehicles does not necessarily require further innovations; existing technologies can play a substantial role in achieving this. Since the majority of Asian countries are adopting existing technology rather than creating new technology, one of the central tasks in developing urban transport is finding and utilising the right technologies to improve emission performance on the streets.

Almost all past studies in the field of vehicular pollution control in Asia have emphasised improving inspection and maintenance systems for vehicles in use (for example, ADB 2003; Faiz, Weaver and Walsh 1996; Gorham 2002; Kojima, Brandon and Shah 2002; Kojima and Lovei 2001; Schipper, Marie-Lilliu and Gorham 2000; Shah and Nagpal 1997; Xie, Shah and Brandon 1998). This requires improving enforcement mechanisms to ensure high operating fuel efficiency and meeting existing emissions standards. In some cases, such as New Delhi, a complete change in fuel choice (from diesel to compressed natural gas (CNG) for all public transport vehicles) has taken place, with one of the strongest arguments in its favour being that it requires a less stringent inspection and maintenance regime. In Mexico City, private-sector operation of inspection and maintenance systems is being tried (Kojima and Lovei 2001). In Singapore, a scheme of certifying automobile workshops is in place. In Jakarta, computerised inspection and maintenance for non-complying vehicles is being trialled. For new vehicles, at least Euro 1 (European Union Emissions Standard 1) or higher emissions standards have already become the norm in a number of Asian countries (ADB 2003). In India, higher standards for selected cities are being enforced: Delhi, Chennai, Mumbai and Kolkata introduced Euro 2 in 2001, and Euro 3 is targeted for 2005 (ADB 2003). Despite the introduction of these standards, inability to phase out decades-old vehicles and non-compliance with emissions standards among both new and old vehicles remain key barriers in many Asian cities.

Studies have reported that information technology can greatly help to reduce congestion. Computerised signal-coordination systems are in place in a number of cities, such as Tokyo, Singapore and Hong Kong.

Dhakal (2004) shows that Singapore's taxi-calling system and electronic road pricing, which use the global positioning system (GPS), have been effective in curbing congestion.

End-of-pipe technologies for gasoline and diesel vehicles, such as three-way catalytic converters and particulate traps, may help to curb local air pollution but they are not effective for reducing greenhouse gases. At vehicle level, greenhouse gas emission can be reduced through energy-efficiency improvements or fuel choice (see a series of reports published by the Pew Center between 2001 and 2003, especially Sperling and Salon 2002). If completely new vehicle technologies or fuel types are used, only lifecycle analyses can ascertain their overall greenhouse gas emissions. One such study done at the Massachusetts Institute of Technology showed that diesel could help the United States to cut greenhouse gases, but stringent diesel emissions standards for NO_X and particulate matter threaten this (Weiss et al. 2000). The WBCSD report cited above (WBCSD 2004) provides detailed analyses of various technologies and their well-to-wheel greenhouse gas emissions. It shows that propulsion systems using bio-fuels such as ethanol and bio-diesel have negative well-to-wheel emissions. Hydrogen fuel-cell vehicles have zero tank-to-wheel emissions, but total emissions depend on the source of hydrogen.

2.2 Policy and institutional issues

a. Successes, and their underlying reasons

Despite the enormous challenges to policymakers in developing environmentally sound transport sectors, there have been successes in a number of areas in Asia. One successful case is the removal of lead from gasoline, which was used as an octane enhancer. Thailand, Bangladesh, India, Nepal and other countries in Southeast and North Asia, have already phased out leaded gasoline successfully. While this process took decades in the early days, for example almost three decades in the United States, Thailand took four to five years to completely phase it out, while Bangladesh took less than a year (Kojima and Lovei 2001).

The second area where significant progress is being made these days is quality of diesel, which is usually determined by its sulphur content. In Japan, distribution of diesel containing less than 50 parts per million (PPM) of sulphur started in 2003 (Dhakal 2003). Progressively, developing Asian countries are aiming to adopt Euro 2 standards, which essentially require lower than 500 PPM sulphur in diesel. Together with diesel improvements, increasing use of CNG as a substitute for diesel is taking place in cities where CNG is available at reasonable cost. Judicial interventions in Delhi have mandated CNG substitution of diesel for public buses and taxis. A number of other cities are showing increasing interest in CNG as a substitute for diesel to reduce NOx and PM_{10} levels in the air. However, at the same time, a vigorous debate is taking place, with more people supporting not mandating specific technologies or fuels in cities and instead setting emissions standards regardless of fuel choice. Internationally, Europe is championing the use of low-sulphur diesel and views diesel as a potential fuel for CO_2 mitigation.

Small interventions can play important roles in driving policy in positive directions. There are many examples. One is the successful replacement of smoke-belching diesel three-wheelers by battery-powered electric three-wheelers in Kathmandu in the late 1990s. Kathmandu had had some of the worst air pollution in the previous few years. Since its electricity comes from hydroelectric plants (run-of-river type), the use of the new vehicles reduced local pollution as well as greenhouse gas emissions (Dhakal 2004, appendix 2). Jakarta's computerised vehicle inspection and maintenance system (which comes under its Blue Sky Program) is another successful example which closes the loopholes in the inspection and maintenance regime for potential free riders. Successes in controlling two-stroke two-wheelers in South Asian cities are also significant, as these have posed serious air pollution problems for a long time.

Singapore's success in integrating land-use and transport planning is well documented (Lye 2002; Menon 2002; Willoughby 2000). In addition, Singapore's vehicle quota system limits the stock of registered vehicles while congestion charging limits their use (Dhakal 2004 appendix 1). The current debate in Singapore is how to maintain a sound balance in restricting vehicle stocks and congestion charging, because financial resources from the auctioning of vehicle quotas and road pricing exceed what is needed for infrastructure development. There is also disagreement about whether a similar approach would work in other cities, as Singapore is in several ways a unique case. The potential reasons for Singapore's successes are described in box 2.2. In the past, governments in Thailand, Malaysia and Indonesia have rejected the results of various studies favouring road pricing as implemented in Singapore, saying that it was locally not feasible. Hong Kong implemented electronic road pricing in the early 1980s on a pilot basis and later scrapped it. However, recent experiences in London and a number of European cities have inspired renewed debate about its feasibility and utility.

Box 2.2. Singapore's success story

Integrated city planning is the keyword in Singapore's success. All the measures it has introduced are part of a comprehensive strategy and are coordinated very closely to produce a comprehensive solution. No single measure can work alone. The right to travel is a basic human right; however, government policies can offer options that encourage travellers to choose modes that are both sustainable in the long term and acceptable to residents. When electronic road pricing (ERP) was implemented in Singapore, commuters had five choices: (1) pay the charges and drive freely, (2) change the time of travel to pay lower charges, (3) use alternative roads, (4) use public transport, or (5) use other schemes, such as park-and-ride.

Singapore's success also comes in the context of favourable economic, social, and urban conditions. The small size of both the land area and the population has allowed flexible planning. As a city-state, Singapore has only a single tier of government; thus, all the complexities that can arise from multiple layers of authority and a mismatch between local and national priorities are eliminated. The economy of Singapore relies heavily on foreign investment and on transactions related to international trade, commerce and finance, for which efficient transport and communications are essential. The need to fulfill this condition for economic reasons has contributed to sustainable transport development and concern for the environment. Unlike in other countries, where economic growth is curbed by environmental countermeasures, economic growth in Singapore was actually fostered by improvements in environment and transport.

A strong government, and strong, stable regulations and institutional frameworks for enforcement are other reasons why travel-demand management has worked in Singapore. From the point of view of jurisdiction, the roles and responsibilities of authorities responsible for urban and land use planning, land transport and environment are clearly demarcated. The land reform process initiated in 1967 allowed the government to acquire most of the land and the housing estates subsequently developed on the city's periphery, and facilitated the development of infrastructure suitable for sound land-use planning. The Housing Development Board (HDB), which was set up in 1960 by the British colonial government, provided housing to just 9 percent of the population in 1960. Because the sweeping powers of the Land Acquisition Act enabled the government to acquire private land for public housing or other development activities, today 85 percent of the population lives in HDB housing complexes.

Another reason for Singapore's success is the periodic adjustment of policies using feedback from the public and other stakeholders, made possible by transparency in policy formulation. Singapore has learned by doing. It recognises that policies are never perfect and provides for periodic adjustments. For example, ERP charges are subject to review every three months, and charge structures and times change depending on traffic and economic conditions.

Another key to success has been investment in infrastructure. Demand-side management was supplemented by constructing additional road infrastructure, maintaining roads well, coordinating traffic-light systems and building expressways and MRT. The taxes and fees imposed on vehicles generated huge financial resources, which were used not only invested in demand- and supply-side management but also applied to reducing less-desirable taxes. Estimates suggest that the annual revenue from road transport in the past was at least three or four times greater than road expenditure.

Box - continued

Outside Asia, the integrated planning of land use and the bus system in Curitiba in Brazil has been successful. It uses an express-bus system with 58 km of exclusive bus lanes, coordinated with residential and commercial development, with diminishing density of settlement and well-designed road systems (Matsumoto 2003). This does not mean that bus rapid transit (BRT) systems cannot be implemented in already well built-up cities. Bogotá's BRT system is a successful experience in bus-based mass transportation (Matsumoto 2003). Introduction of BRT has become more conspicuous since 2004: a busway system called TransJakarta was started in January of that year along its 12.9 km artery road. Cities such as Seoul and Beijing also started operating BRT (See Section 4.6. and 4.7 of this report).

Box 2.2. Continued

A strong government, and strong, stable regulations and institutional frameworks for enforcement are other reasons why travel-demand management has worked in Singapore. From the point of view of jurisdiction, the roles and responsibilities of authorities responsible for urban and land use planning, land transport, and environment are clearly demarcated. The land reform process initiated in 1967 allowed the government to acquire most of the land and the housing estates subsequently developed on the city's periphery, and facilitated the development of infrastructure suitable for sound land-use planning. The Housing Development Board (HDB), which was set up in 1960 by the British colonial government, provided housing to just 9 percent of the population in 1960. Because the sweeping powers of the Land Acquisition Act enabled the government to acquire private land for public housing or other development activities, today 85 percent of the population lives in HDB housing complexes.

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Some technology factors have also played important roles in Singapore. ERP, for example, depends on sophisticated technology that allows time-of-day pricing which reflects traffic conditions. Its prototype Area Licensing System, in contrast, was a non-technology measure. A computerised traffic control system was already in place by 1986 in central business districts. It was replaced with a more advanced automated traffic signalling system called GLIDE (for "Green Link Determining System"), a traffic-adaptive signal control system monitored centrally to adjust to changing traffic conditions. Efforts are now being made now to create a Global Positioning System (GPS)-based coordinated public taxi-calling system which dispatches taxis automatically from the nearest location. Individual taxi operators are already using GPS. These high-technology measures have provided support to non-technology restrictions on car ownership and use. Some researchers, however, claim that the overall effectiveness of high-technology measures is questionable.

The last, but not the least, reason for the success of Singapore might have been the fact that it is a migrant society with citizens who originated from many countries. Since most were economic migrants in the first place, their opposition to government policies was minimal. Thus, there were no barriers in the form of an organised force of resistance.

It is difficult to say what determines the success of integrated land-use and transport planning, and of mass transport systems such as BRT and rail, as each city has unique characteristics. The case studies done at the Institute for Global Environmental Strategies for a wide range of cases dealing with urban transport and emissions suggest that major factors for success are the following:[9]

- Political will and leadership for environmentally friendlier infrastructure development;
- A sound mixture of technology, management, and investment strategies;
- Right use of economic and fiscal instruments such as single fare-pricing systems for public transport, vehicle taxation and congestion charging;
- Organisational arrangements for emissions and transport management, especially efficient division of labor and rules for operation in the organisation;

9. The detailed report and case studies are available at http://host-3.iges.or.jp/APEIS/RISPO/inventory/db/index.html.

- Stakeholder-based planning processes, and
- Capacity to enforce regulations.

b. Failures, and their underlying reasons

Unfortunately, there are far more unsuccessful cases than successes in Asian cities. The most noticeable failures have been in not controlling the numbers and use of vehicles in the majority of cities. As a city develops and its income grows, its car ownership and investment in normal roads and expressways both also increase. Often, development of expressways and normal roads is more demanded than providing solutions to congestion and emissions. Experiences in the United States show that the gains from improving fuel economy standards for individual vehicles are exceeded by increases in mileage travelled, attributed largely to needs and behavioural factors. (Fortunately, financial savings from fuel efficiency have not greatly increased travel demand, because fuel is relatively cheap in the United States (Greene and Schafer 2003)). This phenomenon is often referred to as the “rebound effect”.

Another area of failure of most cities (with Singapore a notable exception) is integrating urban and transport planning. The rates of urbanisation in Asian cities are much higher, but planning mechanisms are much weaker than in other regions of the world (World Bank 2004). Dense Asian cities had developed haphazardly without serious infrastructure planning in the past. Carrying out effective land-use planning for already built-up cities is a difficult task, especially when developing-country governments have scant financial resources and no ownership of land. For more downstream issues such as promoting public/mass transport and emissions standards, the experiences of cities are a combination of failures and successes, from case to case. Broadly, the major reasons for failure of policies in cities of developing countries can be summarised as follows:

- Policy inadequacy: over-dependency on end-of-pipe solutions and short-term measures; failure to see long-term perspective and accompanying mechanisms, and overwhelmingly negative rebound effects of poorly formulated policies;
- Weak enforcement of existing standards and regulations: weak inspection and maintenance systems for energy and emissions performance of vehicles;
- Transport and poverty: complex interrelationship between transport policies and the interests of low-income groups, and little political will to touch this sensitive area;
- Resource constraints: limited financial and technical resources, and
- Institutional failures: lack of political will and commitment; lack of management capacity; wrong market signals, and inter- and intra-institutional coordination problems, such as unclear demarcation of authority and responsibilities.

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III. Research Framework

Scoping

Schipper et al. (1997) outlined four major drivers of determining the change in CO2 emission from transport sector: (1) a growth in the overall level of travel and freight activity in each country, highly correlated with income growth; (2) shift of the mix of modes towards more energy intensive modes such as vehicles and air for travel and to trucks for freight; (3) reductions in the amount of energy consumed per passenger or ton-kilometre by a given mode; and (4) the amount of carbon released for each unit of energy consumed.

The relationship of the above four effects were formalised mathematically, as follows;

$$E = A * S_i * I_i * F_{i,j}$$

Where

E : the emissions from a particular transport mode
A : total travel volume (in passenger or ton- kilometres)
S : modal share
I : the energy intensity of each mode (in pass-km) i
F : the sum of each of the fuels j in mode i

(Schipper et al. 2000, Dhakal and Schipper 2005)

Policies to intervene the *Travel* ***A****ctivity* category include measures to reduce the travel distance of travel modes that produce more emissions, especially private vehicles. Land-use planning policies play a significant role to tackle *Travel Activities* through development of sub-centres, promoting mixed land use, and favouring concentrated development around public transport nodes (Dhakal and Schipper 2005, UNCRD 2005).

In order to shift the ***S****tructure of Modes* towards less emitting modes, it is necessary to improve the quality of public transport and non-motorised transport (NMT) while controlling the demand for private motorised travel. Policy measures for transportation demand management (TDM) include regulatory measures (manage demand for road space), fiscal policies (such as parking fees, vehicle taxes, road or congestion charging and fuel taxes etc.) and infrastructure measures (Dhakal and Schipper 2005, UNCRD 2005).

Energy ***I****ntensity* of travel mode can be improved through: (1) promoting new technology and smaller vehicles, reducing congestion, accelerating penetration of efficient vehicles in fleets, and improving inspection and maintenance systems; (2) switch to electric propulsion system such as battery, hybrid and fuel cells; (3) increasing vehicle occupancy through car sharing etc. and (4) introduction of leapfrogging technologies in niche sectors (Dhakal and Schipper 2005).

One option to improve ***F****uel quality and choice* is to improve the quality of conventional gasoline and diesel fuels. The other option is to switch to alternative fuels such as compressed natural gas (CNG) or bio-fuels (Dhakal and Schipper 2005).

Generally speaking, in Asian developing countries, there had been more focuses on the measures in the ***I*** and ***F*** categories probably because the introduction and implementation can be done in rather short term than the

AS measures. However, policies addressing the energy intensity and fuel quality cannot address the increasing numbers and use of vehicles, which is pointed out as one of "the most noticeable failures" in Asian cities in the previous chapter. Given the rapid economic growth and motorisation trend in Asia, it is not enough to address individual vehicles. There is an emergent need to address the *Activity* and *Structure* components to tackle the rapidly increasing volume of traffic, which often offsets the effects of improvements in energy intensity and fuel quality. Therefore, the Urban Environmental Management Project (UE Project) decided to focus on *Travel Activity* and *Structure of Modes* for the Third Phase research.

Common research questions

The overarching research questions of the UE Project were: "What are the opportunities created by bringing 'the global to the local' and what are the barriers (technical, financial, institutional etc.)?" and "How should we approach key policy options and make them happen?" In this report, these questions were visited repeatedly, but from different viewpoints for the two aforementioned focuses.

To answer the above questions, the project identified the "Strategic Analyses Framework" through a comprehensive literature search and expert consultations. The framework includes actors, timing, uncertainties, implementation issues and cross sectoral impacts, and is used to analyse the factors that impede and facilitate the reduction of travel demand and facilitate modal shift.

The strategic factors included in the framework include:

- Role of actors and their engagement in policy making and implementation
- Timing from the viewpoint of political developments, political cycles, short and long term impact of measures, state of the problems and others
- Air pollutant reduction potential and their uncertainties
- Level of uncertainties in basic assumptions that underpin the effectiveness of measures
- Key implementation issues such as:
    - Strategic compatibility between national and local policies, on development goals, and on other existing policies
    - Who implements (level of governance) and their authority
    - Political feasibility – Is it politically viable?
    - Administrative/institutional feasibility, can they handle it?
    - Financiability - Are they financially viable?
    - Are they compatible with prevailing local context (such as geographical, environmental, socio-economic and cultural)
- Likely cross-sectoral impacts, especially to other sectors, and social issues such as equity.

The above mentioned factors are examined in this study to find which ones affected selected measures, and how. Other factors are examined if they are found relevant in the course of the case studies.

Basically, this report addresses the "What" and "How" type of questions. Despite such questions, there are a couple of underlying hypotheses, they can be listed as:

- All possible options are often not considered
- Actors matter while their influence is often downplayed
- Timing is very important

- Underlying assumptions that are the basis for policy's effectiveness are often taken for granted
- Cross-sectoral impacts are often ignored
- Impacts to or from other polices are not thoroughly evaluated
- Local-national policy coherence is necessary
- Issues that affect implementation are not thoroughly evaluated

Discussions drawn from the case studies based on the above framework is presented in Chapter 5.

Case studies

Case studies were conducted to seek the answers to the above research questions. Five cities were chosen for city-specific case studies in the area of *Travel Activity* and *Modal Share*.

In the area of NMT, which has strong relationship with both travel activities and modal share, Mumbai was chosen due to its high potential for the introduction of NMT, since roads are generally wide and could accommodate the construction of NMT which could be an effective measure to provide access to an already well-developed public transport system.

For the researches focusing on travel activities, Shanghai, Bangkok and Yokohama were selected as they have made autonomous urban master plans and have relatively ample data on transportation, environment and urban conditions. Specific contexts of each city also have been taken into account. Bangkok was chosen because the city's auto-dependency is well-known and its development is unique in Asia. Shanghai was chosen because it has been rapidly developing and transportation planning is one of the key issues of the city. Moreover, several important urban planning policies including multi-core cities are also being realised in Shanghai. Yokohama was selected as a case of Japan because the city is systematically planned and there are many citizen-based movements in reducing travel demand by automobiles.

Regarding the modal share, case studies were conducted on both "push" and "pull" factors: promotion of public transportation and vehicle restraining policies. On the "push" side, Jakarta, the city with the first fully-fledged Bus Rapid Transit (BRT) in Asia running for 12.9 km, was chosen for an in-depth study. The system is already playing a key role in Jakarta's public transport system and drawing attention from the international community. On the "pull" side, Beijing was selected as a case where car restraining is felt to be very necessary but is facing resistance. Only indirect measures to control the use of private cars through control to parking supply and parking price have been implemented. In addition to those individual studies, comparative analysis with special emphasis on the interactions between cities and roles of actors in the process of BRT introduction was conducted on the pioneering cities of BRT systems in Asia. For this study, three cities which started the BRT around 2004, namely, Jakarta, Seoul and Beijing were selected for this study.

(This chapter was written by Naoko Matsumoto, Shobhakar Dhakal, and Noriko Kono)

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IV. Case Studies

IV.1 Non-motorized Modes of Transportation for Sustainable Mobility：Strategies for its Adaptation in Mumbai, India

Sudhakar Yedla[1]

1. Mobility in Mumbai – issues and challenges

1.1 Characteristics and transport sector profile of Mumbai

1.1.1 Geography and administration

Mumbai[2] is one of the world's largest and most crowded cities. Over the last four decades the urban sprawl has taken the toll on Mumbai and the island city is now surrounded by number of suburban cities. For administrative, planning and developmental activities Mumbai and its surrounding suburb cities are formed into Mumbai Metropolitan Region (MMR). The Mumbai Metropolitan Region (MMR) extends over an area of 4236 sq km and comprises Municipal Corporations of Greater Mumbai, Thane, Kalyan and Navi Mumbai. Its administrative limits cover Mumbai city and Suburban Districts and parts of Thane and Raigad Districts (Figure 4.1.1). For all practical purposes Mumbai represents Greater Mumbai (Figure 4.1.2) (BMRDA, 1995).

Mumbai is located on the Western edge of the region separated from the main island by Thane Creek and Vasai Creek. The city is located on Bombay Island whilst the suburbs occupy the majority of the area of Salsette Island. These two islands are separated by Mahim creek, which has largely been reclaimed at its eastern end. The Municipal Corporation of Greater Mumbai occupies about 467.8 sq km area on these two islands. Mumbai Island is about 18 km long and 4.75 km wide narrowing to little more than 1.3 km width at the southern tip of the island where one of the CBDs is located around the old Fort area (as shown in Figure 4.1.2).

1. Associate Professor, Indira Gandhi Institute of Development Research, Mumbai, India. Dr. Yedla was a Policy Researcher of the Urban Environmental Management Project, Institute for Global Environmental Strategies, until fall 2005.
2. Mumbai was earlier known as Bombay and its name has been changed for various cultural, social and political reasons. However, it is still being used in some of the reports. Thus, it may appear at places in this report as well.

Figure 4.1.1 Map of Mumbai Metropolitan Region (that includes Greater Mumbai)

Source: MMRDA

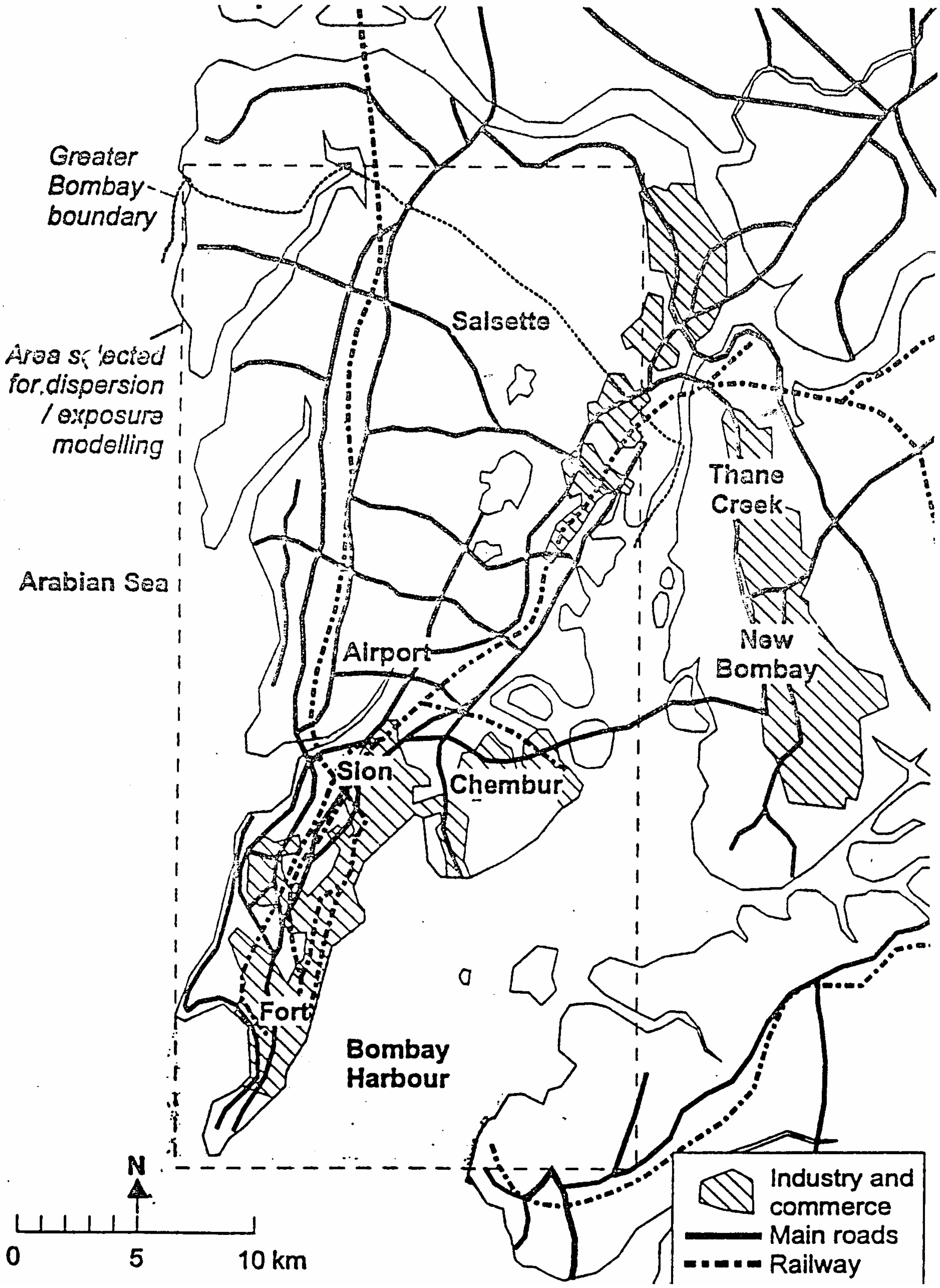

Figure 4.1.2 Map of Greater Mumbai

Source: The World Bank, 1997; IGIDR, 2004

Mumbai's peculiar geography - a narrow wedge-shaped land surrounded by waters on three sides-has for decades dictated its spatial growth. While the early growth of Mumbai took place in the south, it spread northwards along the suburban rail corridors. Till 1968, most of the Region's urban growth was confined to Greater Mumbai's municipal limits though it had began to occur in Thane, Kalyan and surrounding areas beyond Greater Mumbai. Since 1975 the Mumbai Metropolitan Region Development Authority (MMRDA) has been co-ordinating planning and development in MMR. One of the principal concerns of MMRDA is to secure an orderly decentralisation of economic growth and of development away from the MMC area and particularly away from the Island City of Mumbai. The metropolitan area development authority brings out the master plan envisaging the developmental activities in Mumbai Metropolitan Region. Its present plan covers the time period of 1996-2011.

The proposal of developing New Mumbai was a counteragent to reduce pressures in Mumbai itself. The regional plan envisaged a population of 2 million in New Mumbai by 1991. However, development of New Mumbai has been slow and the actual 1991 population was about 6 lakhs (0.6 million) only, which subsequently went up to 0.704 million in 2001.

1.1.2 Population

Mumbai is among the world's most crowded cites (WS, 1994). Table 4.1.1 presents the population growth in the Greater Mumbai over a period 1951-2001. The employment opportunity it offers has served as a major attraction for migrants from the rural hinterland. Till 1981, migration has supplemented a high rate of natural population growth. As a result, population growth was more than 3%. However, due to acute space shortage, the population of Greater Mumbai has started showing a declining growth rate during 1981-91 (Yedla, 2003). In thirty years (1961-1991) the share of population between mainland and the suburbs has reversed with suburbs accounting for almost 70% of the population in 1991. The population is expected to be 12.9 million in 2011. This takes into account of the probability that both the rate of migration and natural increase will tend to stabilize. Population density in the island city stands at 46,067 persons /sq km whilst in the suburbs the densities are 20,821 in the eastern suburbs and about 22,623 in the western suburbs (MMRDA, 2005). Population of Mumbai Metropolitan Region as a whole reads at 19.2 million and is expected to reach 23 million by 2011 and 34 million by 2031 (MMRDA, 2005). With such high population expected and considering a fact that Mumbai suffers from shortage of space, the island city is expected to experience explosion in population densities which could present severe crisis for the urban administration in providing the basic public services.

Table 4.1.1 Population dynamics in Greater Mumbai

Census Year	Population (millions)	Compound annual growth rate for the preceding decade
1951	2.99	-
1961	4.15	3.32
1971	5.97	3.70
1981	8.24	3.28
1991	9.92	1.87
2001	11.9	1.80

Source: Census India; MMRDA, 2005

1.1.3 Economic activity

Mumbai has been the country's leading port and commercial centre. It is considered as the financial capital of India. While the State's economy grew by 5.8% per annum in real terms during 1980-1989, Greater Mumbai's economy increased by about 4.7% per annum. In 1989/90, the city contributed about 22% to the State's economy. Per capita income in Mumbai has increased from Rs 4389 to Rs 5525 during 1980-90, registering a growth rate of 2.7% per annum (Table 4.1.2). Mumbai has almost double per capita income compared to the State's per capita income. This could be a major reason for increasing migration to Mumbai. Income levels and per capita incomes in Mumbai and the Maharashtra State are presented in Table 4.1.2 (CMIE, 2001).

Table 4.1.2 Income in Mumbai and Maharashtra State and income/capita (1993-94)

Year	Income (Million Rupees)		Income/per capita (Rupees)	
	Maharashtra	Mumbai	Maharashtra	Mumbai
1993-94	1,020,610	253,270 (24.8)	12,326	24,382
1994-95	1,046,549	256,557 (24.5)	12,408	24,245
1995-96	1,169,954	289,232 (24.7)	13,616	26,832
1996-97	1,226,763	300,668 (24.5)	14,046	27,441
1997-98	1,281,537	334,710 (26.1)	14,470	30,126
1998-99	1,417,239	359,112 (25.4)	15,806	31,922

Source: MMRDA (1995); Bombay First (2005); CMIE (2001)
Note: figures in parenthesis indicate the share of Mumbai in Maharashtra

However, the economic growth of Mumbai has slowed down due to certain decentralization and industrial relocation processes and now the GDP growth rate (1997-98 to 2001-02) reads barely at 2.4% compared to that of State's at 4.2% and National figure of 5.6%. This could be an indicator for the slide down of Mumbai city in the recent times.

1.1.4 Road network and transport

Fourfold growth of population since 1951 has been largely accommodated in the suburbs, while the highest concentration of jobs has remained on the Island City. As a result, out of the two million daily commuters more than half a million now commute across Mahim Creek into the Island city. Moreover, the physical characteristics of the city are such that the suburbs have been constrained to spread northwards only, and all transport facilities are concentrated within three narrow corridors. This has put tremendous stress on all modes operating in these corridors.

The urban transport network in Mumbai is linear in a north-south direction along the peninsula. Two suburban rail services and the three arterial roads are the backbones of Greater Mumbai's transport system linking it with the other components of MMR. Cross road links are less developed and mostly over crowded. The streets in most part of Mumbai city are old and narrow, and their capacity is seriously reduced by lack of appropriate management of traffic and parking. Barely inadequate pedestrian pathways are further made non-functional as the venders and parked vehicles encroach into the sideways/footpaths.

Public transport plays a dominant role in Mumbai. The urban transport in Mumbai is based on suburban railway services provided by the Western and Central Railways, Buses, taxis, three-wheelers, and personalized vehicles. Public transport accounts for more than 80% of the journeys or trips with the rail system and buses having almost equal share between them. However, in terms of passenger kms, railways carries nearly four times traffic carried by the buses because of longer average lead. It is interesting to notice that 80% of the travel demand is catered by public transport which occupies 20% of the road space where as only 20% of the travel demand is met by personal vehicles which occupy 80% of the road space in Mumbai.

Suburban rail network has served well the needs of Mumbai and ably supported by an efficient bus service under BrihanMumbai Electric Supply and Transport (BEST) Undertaking. Suburban rail services operating along a network of about 300 km of electrified broad gauge provided by two zones of the Indian Railways transports about 6 million suburban passengers per day through some 2000 daily electric motive unit (EMU) services. Despite their crucial role, public transport modes in Mumbai face formidable problems. Rail passengers suffer from some of the most severe overcrowding in the world with 9 car trains carrying over 4000 passengers at 11 persons per square meter against a normal capacity of 1,800. This is due to inadequate track capacity and trains. Table 4.1.3 presents various indicators of transport system, the present values and the standard benchmark followed among many countries. It clearly explains the status of transportation quality in Mumbai.

These problems in Mumbai are expected to be even more acute with the city's population estimated at around 22 million by the end of the decade and other mega trends in the growth of passenger and traffic within and outside its horizons (BMRDA, 1995; Yedla, 2004).

Table 4.1.3 Transportation indicators – present and the benchmark

Indicator	Current value	Benchmark
Population per rail car	570	220
Passengers per square meter (rail)	11	5
Buses per 1000 people	0.75	1
Average speed of travel Airport to CBD (kmph)	25	40
Freeway/expressways	2	8
Total public parking slots per 1000 vehicles	2	119

Source: McKinsey (2003)

Due to the linear expansion of Mumbai, the present traffic movements are concentrated in three main corridors, i.e., western, central and eastern. There are very few continuous east-west cross routes across the Island, due to the limited crossings of railway lines and density of development. As a result, there is heavy concentration of traffic along these few routes. The eastern side of the island is close to the port facilities and is congested with heavy truck traffic. The western corridor is mainly congested with private car traffic.

Table 4.1.4 presents the growth in road length in Greater Mumbai. Between 1984 and 2003, road length has increased by 541 km, averaging about 28.4 km annually. During the same period the number of vehicles added per year was 42,879. About fifteen hundred vehicles (1509) have been added for every kilometer of road laid (on an average) in the last 19 years. This clearly indicates the increasing congestion in Mumbai. Number of vehicles per km of road has increased from 278 in 1984 to 570 in 2003.

Table 4.1.4 Growth in road network in Greater Mumbai

Year	Road length (km)	Vehicles/km
1984	1431	278
1992	1584	417
1996	1738	406
1997	1752	416
2003	1972	570

Source: IGIDR (2002)

Inadequate road space, severe congestion, and lack of infrastructure for non-motorized vehicles and inefficient transportation management have been major bottle-necks in Mumbai transport system which needs immediate attention. Apart from the above measures, authorities have to concentrate on efforts to control vehicular growth in order to achieve sustainability in transportation improvements.

Table 4.1.5 shows the vehicular growth in Mumbai during 1951-2003. Vehicle growth rate has been steep over the time period with highest growth recorded during 1971-81. During this period the registered vehicles have almost doubled. Between 1980 and 2000, number of registered vehicles has increased by three times. Among the passenger vehicles, personalized vehicles (2-wheelers and cars) dominate the total vehicle population. However, while the share of cars in total vehicular stock has declined from 48% to 37%, share of two wheelers has increased from 25% to 45% during the same period (Figure 4.1.3 and 4.1.4). In absolute numbers, 2-whleers grew by more than two times in the same period, while cars grew by one and half times. Number of cars and two-wheelers per 1000 persons has grown from 21 to 25 and 15 to 30 respectively (Table 4.1.6). On the other hand, number of buses per 1000 persons increased from 0.7 to 1.2.

During the same period (1980-2000) the number of taxis has doubled while the three-wheelers have increased in number by more than 20 times. Three-wheelers serve as feeder service to the existing MRTS in Mumbai. As mentioned in the previous paragraphs, Mumbai has three major lines of metro and each station on these lines is connected to a bus network. This creates considerable amount of shorter trip in Mumbai. Three-wheelers are used as feeder services to both the metro and bus networks meeting these shorter trips. Absence of "usable" pedestrian paths and facilities for non-motorized transport (bicycles, tricycle-taxis, and pedestrian ways) could be the reason for the rise in sharp trips (about 20 times in 20 years) by three-wheelers in Mumbai. Due to lack of infrastructure, most of the shorter trips which could be met by non-motorized transportation (NMT) modes are covered by the three-wheelers, which are usually more polluting.

Table 4.1.5 Motor Vehicles Registered in Greater Mumbai during 1951-2003 (as on 31st March of each year)

Type of Vehicle	**1951***	**1961***	**1971**	**1981**	**1991**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
MotorCycle	2188	5325	24786	78474	242008	302513	328940	354799	379441	407306	440517	475352	527108
Motor Cars, Jeeps and Station Wagons	19707	36899	83360	150711	264951	252698	279613	298905	310943	329546	344870	353417	366805
Taxi Cabs	1495	5150	15951	29623	34338	44842	48646	51959	55472	58696	62447	63679	54809
Auto-Rikshaws	0	16	7	4465	24577	59222	72007	83705	91622	97565	101914	101829	98527
Stage Carriers	409	1067	1565	2133	5322	4540	4738	4949	5129	5278	5394	5258	5382
Contract Carriages	+	+	+	933	2338	5516	5788	5888	6091	6436	6710	4294	4373
Trucks and Lorries - Public	2317	4108	9817	16187	18424	44648	47058	48921	51022	53980	56626	55412	56130
Private	4555	7545	14387	22260	31236								
Ambulances	43	86	211	441	910	1151	1210	1231	1271	1318	1358	1305	1336
Schools buses	64	232	352	418	566	695	697	702	703	705	707	558	563
Private Service Vehicles	-	95	443	900	1541	1526	1588	1599	1632	1677	1713	1353	1494
Trailers	-	600	475	631	957	1143	1148	1151	1162	1158	1163	1100	1065
Tractors	-	170	396	803	998	1120	1180	1225	1270	1329	1361	1382	1392
Other	111	88	332	902	2122	3982	4302	4700	4970	4686	4783	4560	4578
Total	**30,889**	**61381**	**152082**	**308881**	**628488**	**723632**	**796915**	**859734**	**910728**	**969680**	**1029563**	**1069499**	**1123562**

Source: Transport Commissioners Office, Mumbai; MMRDA, 2005 + Included in the stage carriers; * as on 1st January

Note: Since 1993 data have been revised by the Transport Commissioner, by deleting motor vehicles which were scrapped or migrated

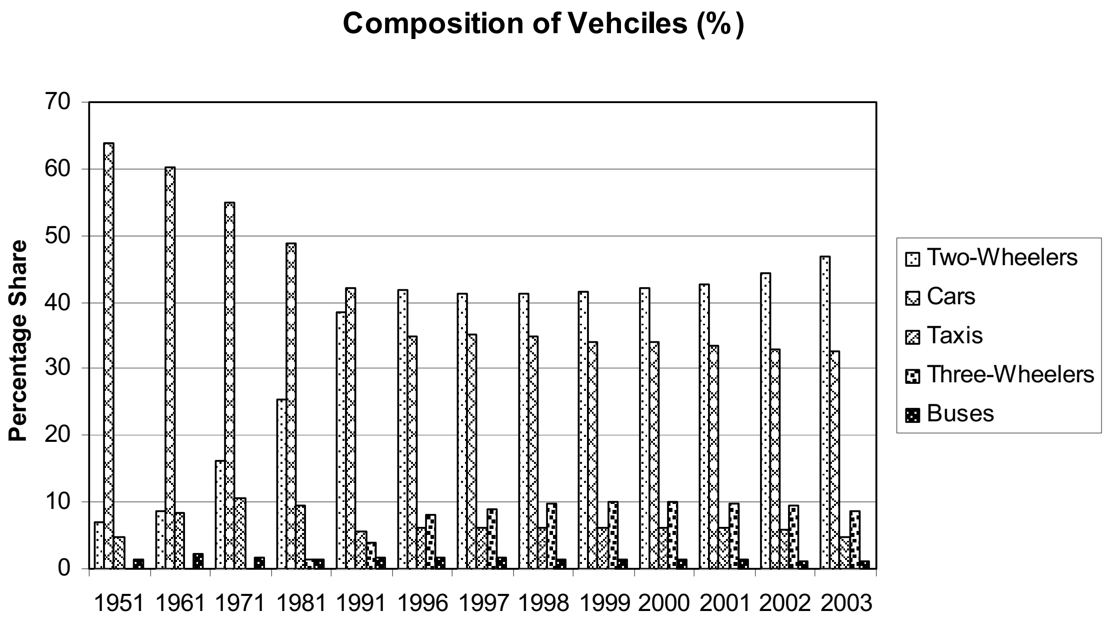

Figure 4.1.3 Composition (%) of passenger vehicles in total vehicular population

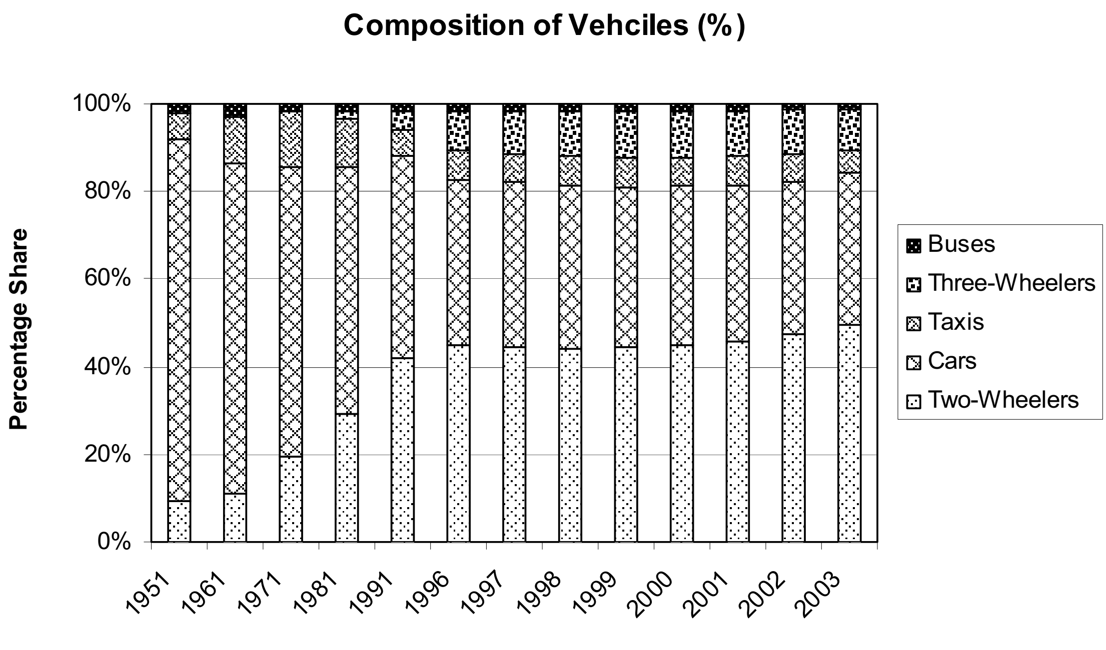

Figure 4.1.4 Percentage share of different modes of passenger transportation

Table 4.1.6 Number of vehicles per 1000 persons

Year	Car/jeeps	2- wheelers	3 wheelers	Taxis	Buses
1980	17.99	8.64	0.20	3.54	0.51
1985	21.46	15.48	2.77	3.87	0.70
1990	26.52	23.81	4.04	3.53	0.77
1998	25.15	30.02	6.57	4.44	1.20

Out of 59,000 taxis running in Mumbai in March 2000, about 11,000 operate on CNG (about 19%) and the remaining stock run on diesel. About the same year in Mumbai, out of 10599 buses 46 buses were running on CNG occupying only 0.5% of the fleet. Trends in consumption of transport fuels viz. gasoline and diesel are presented in Table 4.1.7. While, gasoline consumption increased from 0.29 mt in 1985/86 to 1 mt in 1997/98, diesel consumption grew from 0.44 mt to 2.22 mt.

Table 4.1.7 Consumption of gasoline and diesel in Mumbai (million tonnes)

Year	**Gasoline**	**Diesel**
1985/86	0.29	0.44
1990/91	0.36	0.56
1996/97	1.02	2.24
1997/98	1	2.22

Source: (WB, 1997) and TERI, 2002

1.1.5 Pollution

Municipal Corporation of Greater Bombay (MCGB) has a network of 22 measurement stations in commercial, industrial and resident areas. Levels of TSP, SO_2, NO_x, and ammonia are measured as 8-hour averages per month.

Air pollution measurement programs over the last decade show a definite increase in average suspended particles (SPM) and nitrogen oxides (NO_x) concentrations, while sulphur dioxide (SO_2) concentration have decreased (WB, 1997). SPM concentrations (annual average) are much higher than WHO air quality guidelines of 90 $\mu g/m^3$ at many measuring sites. Bombay has considerable particle pollution problem, with frequent and widespread exceeding of SPM and PM_{10} air quality guidelines (WB, 1997). According to the measurements, the SO_2 pollution problem seems less pronounced although guidelines are sometimes exceeded. NO_x concentrations are presently within WHO guidelines. Emissions from transportation are the major source of air pollution in Mumbai. Table 4.1.8 presents the share of transportation contributing to ambient air pollution in Mumbai (and Delhi). Total emissions from transport sector vis-à-vis other sectors is given in Table 4.1.9.

Table 4.1.8 Contribution of tranportation sector to the ambient air quality

Pollutant	Mumbai	Delhi
CO	Transport: 92% Industrial, Domestic and others: 8%	Transport: 76 - 90% Industrial, Domestic and others: 10 – 24%
NOx	Transport: 60% Industrial, Domestic and others: 40%	Transport: 32 - 74% Industrial, Domestic and others: 26 – 68%
SOx	Transport: 2% -4% Industrial, Domestic and others: 96 -98%	Transport: 5 - 12% Industrial, Domestic and others: 88 – 95%
TSP	Transport: Nil - 16% Industrial, Domestic and others: 84 - 96%	Transport: 3 - 22% Industrial, Domestic and others: 78 – 97%

Source: Adapted from the expert committee report on auto fuel policy, GOI, India, 2002

Note: Transport sector contributes a major share of ambient PM10 concentrations. However, apportionment of PM10 is not yet established and hence is not given here in this table.

Table 4.1.9 Vehicular emissions vis-à-vis total emissions in Greater Bombay in 1992/93 (tonnes/year)

	Vehicles	TSP	SO_2	NO_x
Gasoline	Cars	492	160	6643
	2/3 wheelers	737	250	179
Diesel	Cars	765	395	1783
	Buses	445	566	2891
	Trucks	1234	2120	8024
Transport sector		3673	3490	19520
From all sectors		22143	79264	37547
Share of transport sector (%)		16.58	4.4	51.98

Source: World Bank (1997)

Lead is a significant pollutant in the metropolitan cities of India. Annual average levels of Lead in Mumbai ranged from 0.5 µg/m^3 to 1.3 µg/m^3. This is in excess of the WHO guideline for annual average Lead concentration of 0.5-1 µg/m^3 (long term). Ambient Lead concentration in Mumbai has also exceeded Bombay guideline for ambient Lead concentration (1.0 µg/m^3, annual average and 1.5 µg/m^3 24-hour average) at all locations. From 1980 to 1987, average lead concentration in the air nearly doubled. However, the ambient Lead concentrations have come down and now read within the prescribed limit and it can be attributed to the successful implementation of unleaded gasoline programme at national level. Table 4.1.10 presents the ambient air quality in Mumbai over a period of time. The annual average SO_2 concentration in Bombay has decreased since the 1980 average of about 45 µg/m^3 to about 25 µg/m^3 in 1992/93. The summary of measurements in 1992/93 indicates that long-term average SO_2 concentrations are fairly low and less than WHO and Bombay guidelines at all sites (WB, 1997).

Table 4.1.10 Ambient air quality in Mumbai for the years 1998, 2000 and 2004

Pollutant	**Mumbai** $\mu g/m^3$		
	1998	**2000**	**2004**
NOx (60 $\mu g/m^3$)	24.9	23.3 – 34.1	18.96-21.95
SOx (60 $\mu g/m^3$)	15.9 – 16.3	9.4 – 8.4	8.17-8.62
SPM (140 $\mu g/m^3$)	211 – 264	216 – 260	208.75-218.8

Note: Figures in parenthesis indicate National ambient air quality standards in India

With transport sector posing serious challenges to the city administration in the form of congestion, reduced travel speed/increase in travel time and playing a major role in ambient air quality and greenhouse gas emissions, it is necessary to make an effort to understand various issues linked to transport sector in Mumbai. The next section presents various issues in Mumbai urban transportation vis-à-vis other Indian cities and addresses various major initiatives taken in order to improve the same.

1.2 Issues in transportation – Mumbai vis-à-vis other Indian cities

1.2.1 Introduction

The number of motorized vehicles in Indian mega cities has grown faster than the number of people which could be attributed to the higher economic growth and rapid urbanization. However, the road infrastructure that is needed to support this growing vehicular stock has not been developed at a required rate and that is leading to congestion, increased travel time, increased accident rate, decrease in fuel efficiency and increased air and noise pollution. Increased dependence on personalized motor vehicles is apparent from the rising stock in Mumbai and the other metro cities. Various policy initiative taken by the Government of India and the respective State Governments have succeeded, to some extent, in controlling urban air pollution in some cities, however, the ever rising vehicular stocks and lack of integrated clean fuel policy and lag in application of economic tools to control the traffic growth and the resulting pollution keeps the situation at the same level as before. In this context, various issues in Mumbai urban transportation are discussed in the present paper.

This part of the paper presents the trends in Mumbai urban transportation development (vis-à-vis other cities) and various policy options executed so far to control the growth in transportation and environmental emissions.

1.2.2 Issues in urban transportation

Efficient system of transportation makes key contributions to economic growth, competitiveness and cohesion. Addressing the issue of urban transportation is a complex exercise and any efforts to achieve sustainable transportation needs to go by a holistic view of diverse aspects of travel demand, vehicular growth pattern, emissions, auto technologies, traffic management & efficient land use pattern and auto fuel quality on one hand and the absorptive capacity and acceptability on the other hand. Attempting to arrive at solution from any of these dimensions in isolation or in combination would not be successful in achieving sustainability as most of them are essentially interlinked. The following sections present the trends and facts under each module of this integrated component of urban transportation.

Growth of vehicular stock

All metropolitan cities (cities with more than a million populations) including Mumbai have been facing constant rise in vehicular stock and travel demands. Rapid expansion of city boundaries and increased number of suburbs to cater the migrating populations could be the reason for such trends. Table 4.1.11 presents the growth rates of vehicular stock in major cities in India from 1985 to 2002. It is interesting to notice that Mumbai, unlike the other cities shows an increasing growth rate of vehicular stock.

Among the total vehicular stock, personalized modes of transport are dominating in almost all cities. Table 4.1.12 presents the mode wise breakup of vehicular stock in different cities for the year 2002. Unlike other cities, Mumbai has 3-wheelers having significant share in total vehicular stock. This is due to the fact that Mumbai has effective metro network in place and the three wheelers provide the feeder service. It is an interesting fact that three wheelers (auto rikshaws) from all other metropolitan cities put together (Chennai, Delhi, Kolkata) is only 75% of three wheeler population in Mumbai alone. This is a clear indication of the fact that the short trips generated by the existing MRTS are met by the three wheelers. This provides support to the argument that non-motorized transportation modes need to be promoted in Mumbai. Such an effort not only controls the congestion on roads by controlling the number of three wheelers, it can also control environmental emissions and green house gas emissions.

Table 4.1.11 Annual growth rates of motor vehicles (cars, taxis, buses, trucks, three wheelers and two wheelers) in major Indian cities from 1985 - 2002

City/District	1985-90	1990-95	1995-2002	Population (2001)
Greater Mumbai UA	**9.05**	**5.87**	**11.14**	**16,368,084**
Kolkata UA	19.44	24.89	9.53	13,216,546
Delhi state	18.93	9.71	6.57	12,791,458
Chennai UA	29.27	11.05	10.49	6,424,624
Bangalore District	17.84	9.11	14.43	5,686,844
Hyderabad	26.96	13.66	9.76	5,533,640

Source: Urban statistics, (1997); GOI, (1996); GOI (1997a)

Table 4.1.12 Total registered motor vehicles in major cities of India in the year 2002

City/ District	Two-wheelers	Autos/ Tempos	Cars/ Cabs	Buses	Good carriers	Tractors & others	Total
Bangalore District	1183,752	64,520	259,001	10,077	49,037	30,171	1596,558
Chennai UA	988,630	44,771	250,080	4,541	31,459	6,202	1325,683
Delhi state	2265,955	86,985	989,522	47,578	161,650	NA	3551,690
Greater Mumbai UA	**787,527**	**212,862**	**547,224**	**20,718**	**124,718**	**8,215**	**1701,264**
Hyderabad	1153,681	73,785	177,012	5,318	50,050	7,118	1466,964
Kolkata UA	467,756	27,003	380,079	28,923	105,687	28,003	1037,451

Source: Urban statistics, (1997)

The records of the motor vehicle registering authorities show the cumulative number of vehicles registered within their jurisdiction, right from the inception of *The Motor Vehicles Act, 1939*. Therefore, the number of registered vehicles given in the vehicle registration records is not the total number of vehicles in use, or plying on road. The number of vehicles actually plying on road is considerably lower than the numbers shown in the vehicle registration records. Considering that the on-road three wheelers over 12 years age and other vehicles over 17 years of age are negligible, the number of on-road vehicles up to 31March, 2002 are considered to be actually contributing to the problems. The estimated number of on-road vehicles is given in Table 4.1.13.

Table 4.1.13 On-road vehicle in different cities as a percentage of registered vehicles (2002)

Urban agglomeration/district	2-Wheelers	3-Wheelers	Cars/cabs	Total*
Bangalore U&R districts	83.51	90.00	77.23	82.30
Chennai UA	87.65	87.54	77.80	84.97
Delhi state	74.45	57.48	83.20	76.12
Greater Mumbai UA	**78.75**	**80.36**	**56.84**	**69.54**
Hyderabad & RR districts	86.67	90.79	79.59	85.29
Kolkata UA	65.68	73.71	5.32	58.17

* total includes the commercial and other vehicles

Mumbai clearly has fewer vehicles on road compared to its registered vehicles. And this trend is unique to Mumbai compared to the other cities, except for Kolkata. It has been a practice to consider the total registered vehicles to determine the trend of vehicular growth and the resulting emissions. However, as the above table explains, the actual vehicles contributing to the pollution generation is substantially low.

Trends in environmental emissions and ambient air quality

Growing vehicular stock results in increased environmental emission. Transport sector contributes a major share of environmental pollution (around 70%). CO is the major pollutant coming from the transport sector, contributing almost 90% of the total emission. Hydrocarbons are next to CO. It is indeed interesting to observe that the contribution of transport sector to the particulate pollution is as less as 3-5%. Most of the SPM is due to the re-suspension of dust. However, PM10 – most prominent air pollutant – is contributed mostly by transport sector. Pollutant emission levels have gone up substantially owning to the fast growth in vehicular stock. Delhi emits about 420 metric tons of CO everyday with almost 1400 metric tons of total pollution everyday. Daily emissions of various pollutants from transport sector are presented in Figure 4.1.5. Mumbai is next only to Delhi and close to Bangalore.

Growing trend of emissions is observed due to the fact that the vehicles are used for extended lifetime without proper maintenance. Ill maintained vehicles tend to emit more pollutants than others (CPCB, 2000). Improper inspection and maintenance, use of poor quality fuels, poor road conditions and increased congestion adds to the emissions. At present, due to many initiatives from various actors, most of the above mentioned factors are showing improvement and hence Delhi is experiencing an improved air quality. This has to set a trend for the other cities.

SPM is the most common air quality indicator, which exceeds the permissible level in many cities. SPM levels in different cities across the country from 1995 – 2001 are presented in Figure 4.1.6. NOx is another important air quality indicator whose dynamics are presented in Figure 4.1.7. The variation in air quality is a mixed scenario as some cities follow a rising trend with others experiencing an improvement. Kolkata, Bangalore and Pune are experiencing rise in NOx over time. Delhi showed a steady fall after initial rise.

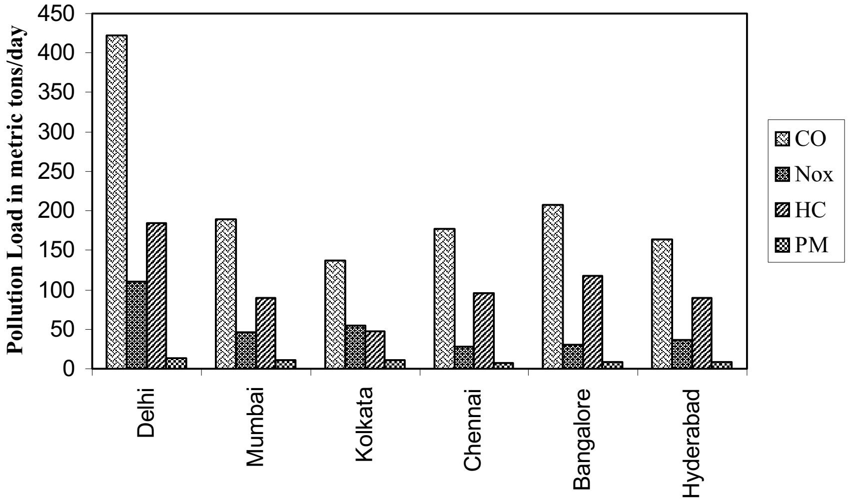

Figure 4.1.5 Pollutant load from transport sector in different cities in India (2002)

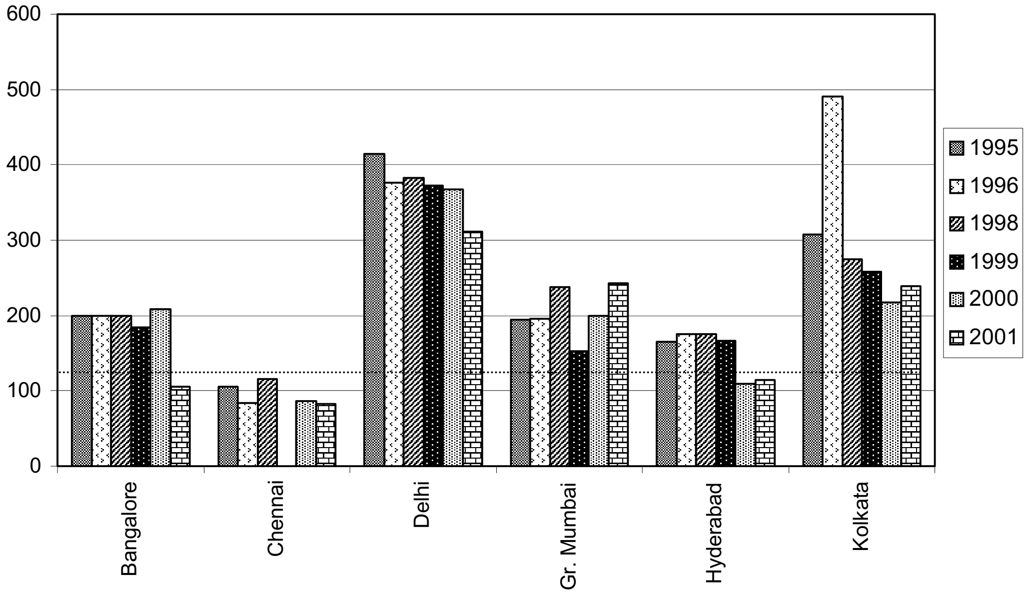

Figure 4.1.6 Changes in SPM concentration over a period of 1995-2001

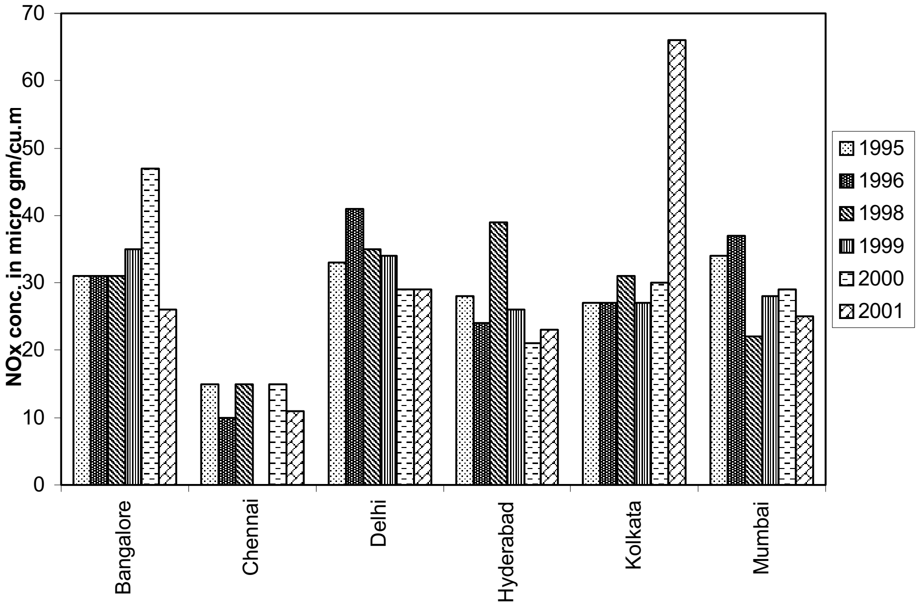

Figure 4.1.7 Changes in NOx concentration over a period of 1995-2001

Source: CPCB National Ambient Air Quality Monitoring Series (NAAQMS/8,10,15,21)

1.3 Future projection

1.3.1 Projection of vehicular stock

Increased economic activity and urbanization trends tend to raise the vehicular population and a study carried out at IGIDR (IGIDR, 2002) estimates that Mumbai vehicular stock would experience a 4-fold rise by 2020 under the existing economic growth levels (6.6% annual GDP growth rate). Table 4.1.14 presents the estimated mode wise vehicular stock for Mumbai for a time period of 1998-2020. Econometric models were used to predict the total vehicular stock and spread sheet model to predict the model split.

Table 4.1.14 Projected vehicular stock in Mumbai

Year	2-W	3-W	Taxi	Car	Bus	Total passenger vehicles	LCV	HCV	Total Goods vehicles
2005	451,000	91,600	25,100	267,900	12,800	848,400	17,000	10,400	27,400
2010	668,900	104,100	35,600	342,300	16,700	1,167,600	24,800	14,000	38,800
2015	1,087,900	148,300	33,800	476,800	20,000	1,766,700	37,200	20,900	58,100
2020	1,534,200	210,400	44,700	623,100	27,300	2,439,700	51,100	28,700	79,800

Source: IGIDR, 2002

Mumbai, traditionally, is a “public transport” city with major share of its travel demand catered by the train network and the feeder services, and is expected to continue to rely on public transport system for the next 20 years. Affordability in terms of number of vehicles per thousand populations is expected to be high in Mumbai. Mumbai is expected to experience uniform trends of growth in all modes of transport over the time period considered (IGIDR, 2002). The existing level of infrastructure growth would not be able to cater for the increasing needs in the next 20 years. Hence, there is a need for enhanced efforts to provide better transportation infrastructure for future travel needs.

1.3.2 Travel demand projections

Different modes of vehicles have different occupancy rates (TERI, 1997; IGIDR, 2002). Hence, the effectiveness of any transportation mode is measured in terms of passenger kilometers (PKM)/ ton kilometer (TKM) served by the respective mode. Two-wheelers have very poor occupancy (1.5 persons /vehicle) against buses (37 persons /vehicle). Passenger kilometers catered by buses is much higher than any other mode and hence, they cover major share of the travel demand in many cities. Due to the high occupancy rate, the emission per PKM is very low in case of buses compared to cars and two-wheelers. This makes the bus not only an effective transport mode but also environmentally efficient.

Passenger travel demand, an indicator for the travel demand is expected to grow by leaps and bounds in Mumbai during the years to come. A study carried out by IGIDR (IGIDR, 2002) employing econometrics and spread sheet models, estimates that total passenger travel demand for Mumbai would grow from 32 billion pkm in 1998 to 137 billion pkm by 2020 with an annual growth of 6.8%, which is higher than Delhi's growth rate. Freight travel demand is estimated to rise from 0.36 billion tkm to 1.37 billion tkm during the same time period. A better strategy to handle this growth is not just providing infrastructure to support the increasing stock of vehicles, but measure to control the number of vehicles without compromising on the travel needs for which, improved public non-motorized modes of transport is one of the feasible solutions. Table 4.1.15 presents the segregated mode wise estimated vehicle kilometers of travel in the year 2010 for different Indian cities (reproduced from the auto fuel policy expert committee report).

Table 4.1.15 Estimated vehicle kilometers of travel in 2010 for all major cities (million)

Vehicle type	Delhi		Mumbai	Kolkata	Chennai	Bangalore	Hyderabad
	Without Metro	With Metro					
Cars/Jeeps	521.82	496.97	163.20	109.26	94.69	123.12	89.02
Taxis	6.59	6.59	40.88	42.31	6.52	4.05	3.36
Two Wheelers	494.15	352.96	106.91	75.17	164.98	231.63	163.26
Autos – CNG	78.23	78.23	0.00	0.00	0.00	0.00	0.00
Auto – Petrol	24.33	24.33	84.52	34.68	49.34	86.94	52.92
LCVs	45.38	45.38	16.17	8.68	10.15	11.42	10.65
HCVs	23.47	23.47	17.72	8.57	9.05	8.21	17.67
Bus – CNG	27.45	26.33	0.00	0.00	0.00	0.00	0.00
Bus – diesel	8.85	8.85	17.41	29.06	9.40	14.83	17.38
Total	1230.27	1063.11	446.81	307.73	344.13	480.20	354.26

Source: GOI, 2002

Increasing travel demand leads to increased vehicle-kilometers and consumes more fuel and generates increased pollution and greenhouse gas emissions. Therefore, to minimise the pollution loads in the cities of the future, technological options will have to be explored in terms of improved automobile engines and fuels and also efficient public transport in lieu of personal transport.

1.4 Policy initiatives adopted

Similar to the case of Delhi, judicial body took an active part in providing guidelines to reduce pollution in the city of Mumbai. Mumbai High Court has set up a Committee on December 1999, headed by the Transport Commissioner to examine the pollution issues in Mumbai and to come with future directions in order to bring the pollution under control, particularly from urban transportation.

The Committee has come up with recommendations which are submitted to the honourable court in April 2000. Some of the recommendations made by the Committee are listed below:

- The sulfur content in diesel to be supplied in Mumbai city at all the fuel stations should be reduced to 0.05% by October 1st, 2000. It should be further reduced to 0.035% by April 1, 2003 and to 0.005% by April 1, 2005.
- The benzene content in petrol supplied in Mumbai city at all fuel stations should be reduced from 3% to less than 1% by October 1, 2000.
- With effect from May 1, 2000, all new buses to be purchased by BEST, should be CNG operated until EURO II compliant engines become available. BEST may exercise an option either to have CNG operated buses or EURO II or higher version diesel engine buses in such a manner that by April 1, 2005 at least 1000 buses are operated on CNG.
- Engines of all the existing BEST buses which are not even EURO I compliant must be changed to EURO II compliant engines by October 1, 2002.
- With effect from January 1, 2001, all taxis above the age of 15 years must be converted to CNG or any other clean fuel. Further with effect from January 1, 2002, all diesel taxis above the age of 8 years should be converted to clean fuel.
- With effect from January 1, 2001, all 3 wheelers above the age of 10 years should be converted on CNG or any other clean fuel. Further with effect from January 1, 2002, all 3 wheelers above the age of 8 years should run on clean fuel.
- The present permissible limit of 4.5% CO emission in respect of 2 and 3 wheelers should be reduced to 3% with effect from October 1, 2000 for Mumbai city to bring it at par with the CO emission level of 4 wheelers.
- All heavy commercial vehicles as well as light good vehicles to be registered in the Mumbai Metropolitan Region from April 1, 2000 must be EURO II compliant.
- With effect from January 1, 2001, all 2 wheelers registered in Mumbai Metropolitan Region and which are more than 15 years old shall be scrapped and their registration deemed to have been cancelled.
- With effect from January 1, 2001, all 3 wheelers registered in Mumbai Metropolitan Region and which are more than 10 years old shall be scrapped unless converted to clean fuel.
- With effect from January 1, 2001, all transport vehicles other than 3 wheelers and BEST buses over the age of 15 years shall be scrapped unless converted to clean fuel.
- All two stroke two and three wheelers in use vehicles in Mumbai should be fitted with Catalytic converter by July 1, 2001.
- All petrol driven vehicles registered in Mumbai prior to April 1, 1995 should fit catalytic converter by 1st July 2001.
- All catalytic converters supplied by the manufacturers for 2 wheelers will carry a warranty of effective working of the catalytic converter over a distance of 30,000 kms.

Apart from the interventions by the State level judicial body, the Supreme Court of India has come up with several guidelines in last three years. The Court has urged the government to accept the emissions standards EURO I, II etc. for the vehicles as adopted by European Commissions. Upon the directives from court a committee was constituted to develop a road map for adaptation of clean fuels in Indian transport sector. This committee headed by Dr. Mashelkar, Director General - Counsel for Scientific and Industrial Research (CSIR), Government of India has developed “Auto Fuel Policy (AFP) for India”. Table 4.1.16 presents the emissions standards as specified the AFP.

Two of the major initiatives towards emission control are enforcement of unleaded petrol and low sulphur diesel. These initiatives implemented by April 1st of 2000 and 1999, respectively for petrol and diesel have visible impact on air quality.

The specification of lead (maximum) in gasoline in India used to be about 0.56 gm/L in 1994. Since then Lead has been phased out from gasoline in India. From 1 February, 2000, only unleaded gasoline is sold in the entire country.

The sulphur content in diesel has been reduced by 75 per cent from a maximum of 1.0 % in 1996 to 0.25 % in the entire country within a period of four years from 1 April, 1996 to 1 January, 2000. The Government had approved setting up of 9 Diesel Hydro De-sulphurisation (DHDS) plants in 9 refineries for reducing the diesel sulphur content from 1.0 % to 0.25 % at a total cost of Rs. 55683.1 million (1237 million US$) in June 1997. This has enabled the supply of diesel with 0.25 % sulphur in the entire country from 1 January, 2000. As a follow up measure in all four metro cities, sulphur content in diesel has been reduced by 95 per cent (0.05 % Sulphur content). The details of unleaded petrol and low sulphur programs in the India are presented in Box 1.

Table 4.1.16 Exhaust emission standards for Indian vehicles

Category of vehicles/exhaust emissions	Unit	Standard effective (April 1991)	Standard effective, April 1996	EURO I
Gasoline				
Passenger cars				
CO	gm/Km	14.3-27.1	8.68-12.4	2.72
HC	gm/km	2.0-2.9		
(HC + Nox)	gm/km		3-4.36	0.97
Diesel vehicles				
Gross vehicle weight > 3.5 tonnes				
CO	gm/kWh	14.0	11.2	4.5
HC	gm/kWh	3.5	2.4	1.1
Nox	gm/kWh	18.0	14.4	8.0
PM	gm/kWh			0.36
Gross vehicle weight <3.5 tonne				
CO	gm/kWh	14.3-27.1	5.0-9.0	4.5
HC + NO_x	gm/kWh	2.7-6.9	2.0-4.0	
HC	gm/kWh			1.1
NO_x	gm/kWh			8.0
PM (engines with power > 85 KW)	gm/kWh			0.36
<85 KW	gm/kWh			0.61

Source: GOI (1990), GOI (1996), GOI (1997b)

Box 1
Gasoline lead phase out programme in India

Phase I	June 1994	Low leaded (0.15 g/l)	Cities of Delhi, Mumbai, Calcutta and Chennai
Phase II	1.4.1995	Unleaded (0.013g/l)	
Phase III	1.1.1997	Low leaded (0.15g/l)	Entire country
Phase IV	1.9.1998	Ban on leaded fuel	NCT of Delhi
Phase V	31.12.1998	Unleaded (0.013g/l)	All other capitals of states/UT and other major cities
Phase VI	1.1.1999	Unleaded only	NCR
Phase VII	1.4.2000	Unleaded	Entire country

Diesel Sulphur phase out programme in India

Phase I	April 1996	Low sulphur (0.5%)	Four metros and Taj Trapezium
Phase II	August 1997	Low sulphur (0.25%)	Delhi and Taj Trapezium
Phase III	April 1998	Low sulphur (0.25%)	Metro cities
Phase IV	April 1999	Low Sulphur (0.25%)	Entire country
Phase V	April 2000	Low Sulphur (0.05%)	NCR, Mumbai, Chennai, and Kolkata (in 2001)

Source: CPCB (1999)

Impacts of these initiatives are visible. For instance, about 3000 taxis and 9000 3-wheelers which are old enough have been scrapped so far in Indian cities. Oil companies have started supplying unleaded petrol and diesel with less than 0.05% sulphur content from April 1, 2000. From February 2000, they have started supplying HSD with less than 0.25% sulphur content. Improvement in Mumbai (SOx, Pb and NOx) and Delhi (all pollutants) ambient air quality could be attributed to the above measures apart from the other measures resulting from the court directives.

Apart from the measures which are reactive in natures, there are certain proactive initiatives in Mumbai urban transportation. Such measures aiming at providing better infrastructure and improve the performance efficiency are presented in the following section.

1.5 Major development initiatives in Mumbai towards improvement in its transport system

The establishment of Metropolitan Region Development Authority has set the long term planning of Mumbai on top priority and MMRDA (earlier called as BMRDA) has been implementing major planning and development initiatives in Mumbai concentrating on various domains of infrastructure. Four such major initiatives are Bombay Urban Transport Project, Mumbai Urban Development Project, Mumbai Urban Transport Project (MUTP), Mumbai Urban Infrastructure Project (MUIP). These projects supported by IDA provided much needed push for the development of transport infrastructure in Mumbai. Under MUIP and MUTP, Mumbai Metropolitan Region Development Authority is currently working on proving infrastructure sufficient to cater for the needs of Mumbai transportation for the next 10-15 years time. Following are details of these developmental initiatives take up in Mumbai.

1.5.1 Bombay Urban Transport Project (BUTP)

The first Bombay Urban Transport Project (BUTP) was implemented during March 1977 and June, 1984. The total cost of BUTP was Rs.391.4 million that includes a US $ 25 million loan from the World Bank. MMRDA was the borrower of the loan, and Brihan Mumbai Electric Supply and Transport undertaking (BEST) and Brihan Mumbai Municipal Corporation (BMC) were the executing agencies of the project. The project concentrated mainly on improving the bus transport system in Mumbai operated by the BEST by procuring buses, construction of flyovers, installation of traffic signals etc. The following can be listed as outcomes of BUTP -

- Procurement of 700 buses for BEST
- Construction of five fly-overs on the main arteries of Mumbai
- Construction / improvement of five bus depots and part of a major workshop for BEST
- Installation of new micro processor based integrated traffic signals at 77 junctions
- Construction of pedestrian bridges and underpasses at important junctions, road/bridge widening/extensions and channelisation
- Provision of new bus shelters and terminal.

1.5.2 Mumbai Urban Development Project (MUDP)

Soon after the completion of BUTP, the Mumbai Urban Development Project (MUDP) was successfully implemented during 1985-94. The project was formulated, coordinated and monitored by the MMRDA and implemented through Maharashtra Housing and Area Development Authority (MHADA), Municipal Corporation of Greater Mumbai (MCGM), City and Industrial Development Corporation (CIDCO), Thane Municipal Corporation (TMC) and Kalyan Municipal Corporation (KMC). The World Bank has provided assistance to this major development project. Following are the major activities/achievements under MUDP –

- Development of 88,000 serviced sites in Greater Mumbai, Thane and Navi Mumbai was undertaken under the Land Infrastructure Servicing Programme (LISP). This involved an expenditure of Rs. 2294 million.
- Upgradation of 35,000 slum households in Greater Mumbai was taken up under the Slum Upgradation Programme (SUP) with an expenditure of Rs. 75 million.
- Apart from these shelter components, an expenditure of Rs. 1116 million was incurred on procurement of equipment and civil works for improvements in municipal services under the Local Government Finance Administration and Services (LOGFAS) component of the project.
- Some major infrastructure works such as water supply and storm water drainage were also undertaken in Greater Mumbai and Navi Mumbai with a total expenditure of Rs. 750 million.

The IDA credit for this project is worth of Rs. 2,766 million (SDR 92.7 million) while approximately 30% of the project expenditure was financed from the internal resources of the implementing agencies.

1.5.3 Mumbai Urban Transport Project (MUTP)

As a sequel to the Bombay Urban Transport Project (BUTP) which was completed in the year 1984 at a cost of about Rs. 390 million, the MMRDA has formulated a multi-modal project viz. Mumbai Urban Transport Project (MUTP) to bring about improvement in traffic and transportation situation in the MMR with the World Bank assistance. MUTP envisages investment in suburban railway projects, local bus transport, new roads, bridges, pedestrian subways and traffic management activities. Mumbai Rail Vikas Corporation (MRVC), a joint venture of Railways and Government of Maharashtra, is set up for implementation of rail projects under MUTP and other projects of Railways in the MMR.

The total estimated cost of the project is Rs. 45,260 million (USD 943 million) out of which 57% (Rs. 26,020 millions ($ 542 million)) was taken as loan from the World Bank (Sanctioned in June 2002).

Some facts and figures that put forward the need for the ongoing Mumbai Urban Transport Project -

- Over 88% of the commuters in Mumbai travel by suburban trains or BEST buses
- Mumbai's Suburban Rail System carries about 64 lakhs (6.4 million) passengers per day
- About 4700 passengers travel in a 9-car rake during peak hours, as against its rated carrying capacity of only 1,700

Partners in MUTP -

- Government of Maharashtra (GOM)
- Indian Railways (IR)
- Mumbai Metropolitan Region Development Authority (MMRDA)
- Municipal Corporation of Greater Mumbai (MCGM)
- Bombay Electric Supply and Transport Undertaking (BEST)

It is agreed that the Government of Maharashtra shares 50% cost of the Rail Component or Rs. 17550 million. Mumbai Metropolitan Region Development Authority (MMRDA) provides the counter part funds of Rs. 9600 million on behalf of Government of Maharashtra. This multi-pronged approach provides a major hope for the future of Mumbai transport system.

1.5.4 Mumbai Urban Infrastructure Project (MUIP)

Mumbai is the commercial and financial capital of India, generating about 5% of India's GDP and contributes over one third of the country's tax revenues.

In addition, it handles major part of the port traffic of the country. With rapid urbanization and industrialization during the last three decades, the population growth has been mainly in the suburbs i.e. north of Mahim and Sion while the population growth in the island city has remained more or less stagnant (Yedla, 2003). The population in the suburbs increased from 5 million in 1981 to 8.8 million in 2001, while the population in the island city increased from 3.28 million to 3.30 million during the same period. The city of Mumbai with its present population of over 12 million generates more than 10 million daily passenger trips catered by suburban railway and public transport bus services provided by BEST. The ever growing vehicular and passenger demands, coupled with constraints on capacity augmentation of the existing network, have resulted in chaotic conditions during peak hours.

The five main north-south roads in the suburbs are not fully developed to the planned width, have many bottleneck points and constraints due to large number of intersections with major and minor roads. During the last 4 decades there has been growth in vehicular ownership in Greater Mumbai, particularly in the suburban areas, resulting in immense pressure and increasing bottlenecks. The vehicular population in the last four decades increased from 1.5 lakhs in 1971 to 1.29 million in 2001.

The World Bank funded MUTP focuses mainly on strengthening of mass transport particularly improvements in suburban railway services in terms of efficiency and capacity, with very few proposals of road improvements. On the above background and looking beyond MUTP improvements and considering the future travel demand by growing population, it has been considered necessary to take urgent steps to strengthen the road infrastructure in Mumbai. With a view to supplement MUTP, MMRDA initiated the process for an ambitious project known as Mumbai Urban Infrastructure Project (MUIP) with the main objective of road network improvements and efficient traffic dispersal system in Greater Mumbai. Following are the major objectives of Mumbai Urban Infrastructure Project -

- To prepare traffic dispersal model for efficient mobility and connectivity
- To develop major North-South road links in suburbs including a Mass Rapid Transit Connectivity (MRTC)
- To strengthen / augment the East-West Connectivity in the suburbs
- To provide efficient / fast pubic transport corridors
- To facilitate safe and convenient movement for pedestrians (Subways / FOBs / Footpaths) including Station Area Traffic Improvement Schemes (SATIS)
- To provide high capacity uninterrupted road connection to both the Airports
- To remove level crossings in Mumbai
- To provide bus terminals / bus depots and to create facilities for passengers

Both MUTP and MUIP are being executed and are expected to provide a better transportation system in Mumbai supported by sufficient infrastructure. However, it is to be seen on how far these two major development initiatives supported by improved vehicle emission norms and new vehicle regulations could meet the needs of ever growing transportation system in Mumbai.

1.5.5 Gaps in sustainability efforts

Within the field of sustainable transport there are several approaches that could be pursued and they are

- Reducing travel demand
- Greater reliance on public transport
- Greater reliance on non-motorized vehicles
- Improving traffic flow
- Improving the energy efficiency of motor vehicles
- Use of cleaner fuels
- Adaptation of alternative fuels
- Incorporation of sustainable transport principles into the urban design of new settlements

With the high growth rates in vehicular stock and travel demands in Mumbai, measures like improvement in fuel quality, enforcing stringent vehicle emission norms and control of old vehicles on roads etc. provide an end-of-the-pipe solution to the problem. Providing better infrastructure viz. more free ways, fly-over bridge networks would only increase the possibilities of further increasing the vehicular stock and hence the energy consumption and the related local and global emissions. From the explanation in the previous sections it is clear that planning and development departments of Mumbai have targeted at increasing reliance on public transport, increase traffic flow and improve the energy efficiency of motor vehicles by enforcing stringent norms. However, measures to reduce travel demand, increase reliance on non-motorized vehicles, and adaptation of alternative fuels such as battery operated vehicles are not covered –comprehensively - in their efforts. These are major gaps in the efforts towards sustainable transportation development in Mumbai. Hence, there is a need to develop strategies on how to promote non-motorized transport modes (NMT) and introduce alternative transportation fuels in Mumbai.

Expected population growth in Mumbai would further worsen the problem of urban sprawl. Having the disadvantage of unidirectional (towards north) growth, Mumbai would be further confronted by the need to provide transportation facilities to the increasing urban poor and that would prove to be a Herculean task to the city administrators. It is in this context where the non-motorized transportation modes (NMT) viz. walking, bicycles and try-cycles would prove useful. However, it should be planned in a way to integrate with the public transportation system so that both NMT and public transport complements each other. This would provide a long term solution for reducing usage of personal motorized vehicles and that can also reduce energy consumption and thus the emissions, both local and global.

1.6. Present scenario of NMT in Mumbai and scoping for future

1.6.1 Non-motorized Transportation (NMT) in Indian context

The definition of NMT includes any form of transportation that provides personal or goods mobility by methods other than the combustion motor (Guitink et al., 1994). Walking is the most familiar form of non-motorized transportation (NMT). Other common forms of NMT include bicycles; tricycles; human porterage; handcarts; animal drawn carts; and other human powered vehicles.

In the early year of last century, bicycles used to have a major share of daily trips. With the objective of speeding up the movements motor vehicles gained popularity over a period of time. Motor vehicles have slowly taken over completely sidelining the non-motorized modes of transport. Over emphasis on motorized transport in funds allocation for infrastructure development had further jeopardized the prospects of NMT. However, this trend is predominant in urban centers only, leaving bicycles still a major source of mobility in the rural areas. This particular trend is predominant in developing countries where as in the developed countries the motorization had penetrated into rural areas as well.

In many Asian countries, non-motorized bicycles (two-wheelers) and three-wheelers are common sights, employing special adaptations to the vehicle for goods transport, hawking or passenger hire. Walking accounts for two thirds of total trips in large African cities such as Kinshasa and Dar-es-Salaam. In Karachi walking and cycling account for 60 percent of total trips, and for 40 percent of work-related trips. In Chennai, India one third of the vehicles entering the central business district are bicycles. In Kenya, more than 90 percent of rural trips are on foot, four percent by bicycle, two percent by para-transit and only 0.5 percent by bus. In most of the Chinese cities 50-90 percent of vehicular passenger movements are by bicycle, with most of the remainder by bus.

In Mumbai 40-60% daily trips are made by NMT (Rastogi, 2002). However, use of bicycle is insignificant in Mumbai. Apart from bicycle being used as personal transportation mode, NMT has been adapted as a cost-effective solution for trash disposal, agriculture produce transport and wholesale delivery etc. Commercial applications dominate NMT uses in Mumbai. Figure 4.1.8 presents number of commercial non-motorized vehicles (NMVs) in Mumbai. It is interesting to note that the number of commercial NMVs is actually growing in Mumbai, in spite of the growing congestion on roads (or it may be adding to it).

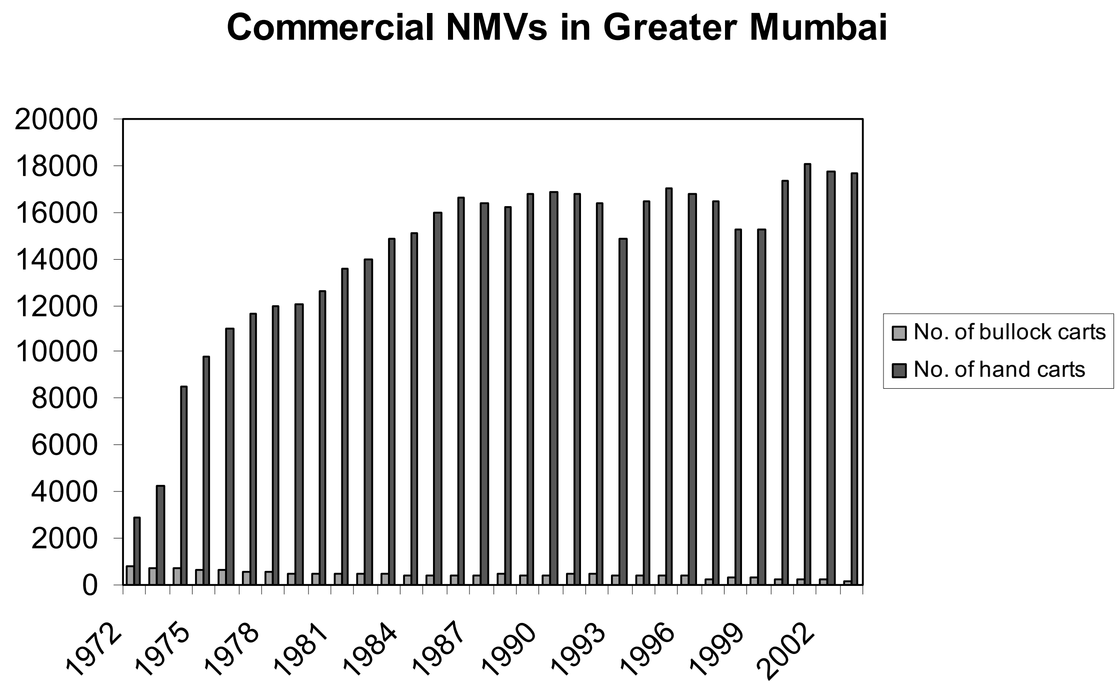

Figure 4.1.8 Number of commercial non-motorized vehicles (NMVs) in Mumbai over a period of 1972-2002

Source: prepared by the author with data from MMRDA, 2005

In Mumbai, number of road accidents are on higher side with no significant decrease over time which could be an indication for neglected infrastructure and facilities for NMT. Figure 4.1.9 presents the number of road accidents in Mumbai over a period of 30 year (1971-2003). About 30,000 people are meeting with accidents every year. Due to lack of proper pathways cyclists and walkers share road space with motorized traffic and this put the NMT users at a very high risk. Pictures presented in annexure showcases such situations in Mumbai.

Level of bicycle usage is linked to the developmental status of the place. In medium-sized cities in Japan, Germany and the Netherlands, 40-60 percent of all trips are made by walking and cycling, while in similarly sized cities in India this share is as high as 80 percent (Heierli, 1993).

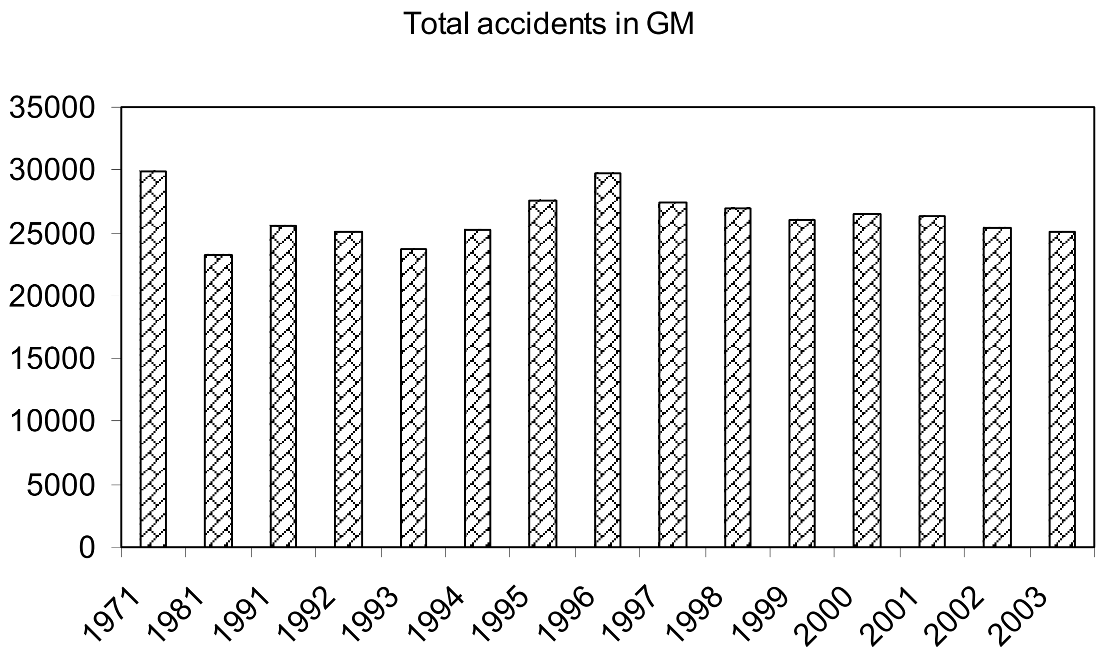

Figure 4.1.9 Total number (annually) of road accidents in Mumbai during the period 1971-2003

Though NMT users are the majority in many places, they are often neglected in the design and modernization of transportation infrastructure. New construction and upgrading often does not provide physical infrastructure (e.g., overpasses or shoulders) for the existing NMT users, sometimes resulting in higher NMT-automobile accident rates, longer travel times for NMT users, or even a complete elimination of NMT traffic. The result of this negligence is a transportation system that in many ways favor cars and other motorized traffic to the detriment of poorer segments of the population; thus consideration of NMT during infrastructure design is an essential element to providing equitable transportation opportunities (Guitink et al., 1994; Guitink, 1996).

In Indian metropolitan cities, with increasing urban sprawl and rising income levels, non-motorized transport modes tend to loose their importance. Share of bicycle trips out of the total trips in Delhi has declined from 17% in 1981 to 7% in 1994 (Mohan and Tiwari, 1999). Increasing trips lengths, due to the urban sprawl could be one major reason for this fall in share of non-motorized transportation apart from serious lack of infrastructure for NMT.

1.6.2 Scoping Mumbai for Non-motorized Transportation (NMT)

Greater Mumbai has population about 12 million and the travel needs of Mumbai are grossly met by a network of metro and bus services. Eighty percent of travel demand is met by the public transport while the remaining 20% is met by the personal modes of transportation like two wheelers, cars, taxis and auto rikshaws (motorized three wheelers). The feeder trips to rail were mostly by bus (Sharma, 1986). Commuting in Mumbai typically has three stages viz. Access Leg[3], Primary Leg[4] and Egress Leg[5]. Access leg occupies 9.7% of the total trip length where as primary leg averages at 85.3% and egress leg at 5%. Each of these components

3. Access Leg in commuting represents the distance covered between the origin and the access pint where the passengers get into a transport mode covering the prime leg.
4. Primary Leg is the distance between the two major access points in commuting. It constitutes the major travel distance in daily commuting.
5. Egress Leg represents the distance covered between public access points to the destination.

is met with different modes of transport. While the Primary Leg, the longest part of the journey, is typically met by either Metro or Bus, Access Leg and Egress Legs are shared among different modes. Figure 4.1.10 and 4.1.11 presents the share of different modes in Access Leg in Mumbai.

While cars and buses are marginal in meeting the access leg demand, walking, bicycles, two wheelers and auto rickshaws are dominating. Walking or combination of walking and bus to the access point of public transport is predominant. From Figure 4.1.11 it can be observed that forty seven percent (47%) of the access leg travel is still catered by motor vehicles where as only 7% is met by bicycles. Average access leg in Mumbai is about 2.3 km (Rastogi, 2002) with an overall average trip length at 15.06 km. It was reported in the literature that travel distance in the range of 3-5 kilometers is ideal for cycling (GTZ, 2005). Therefore, there is a scope for improving NMT in order to meet 100% access leg in Mumbai.

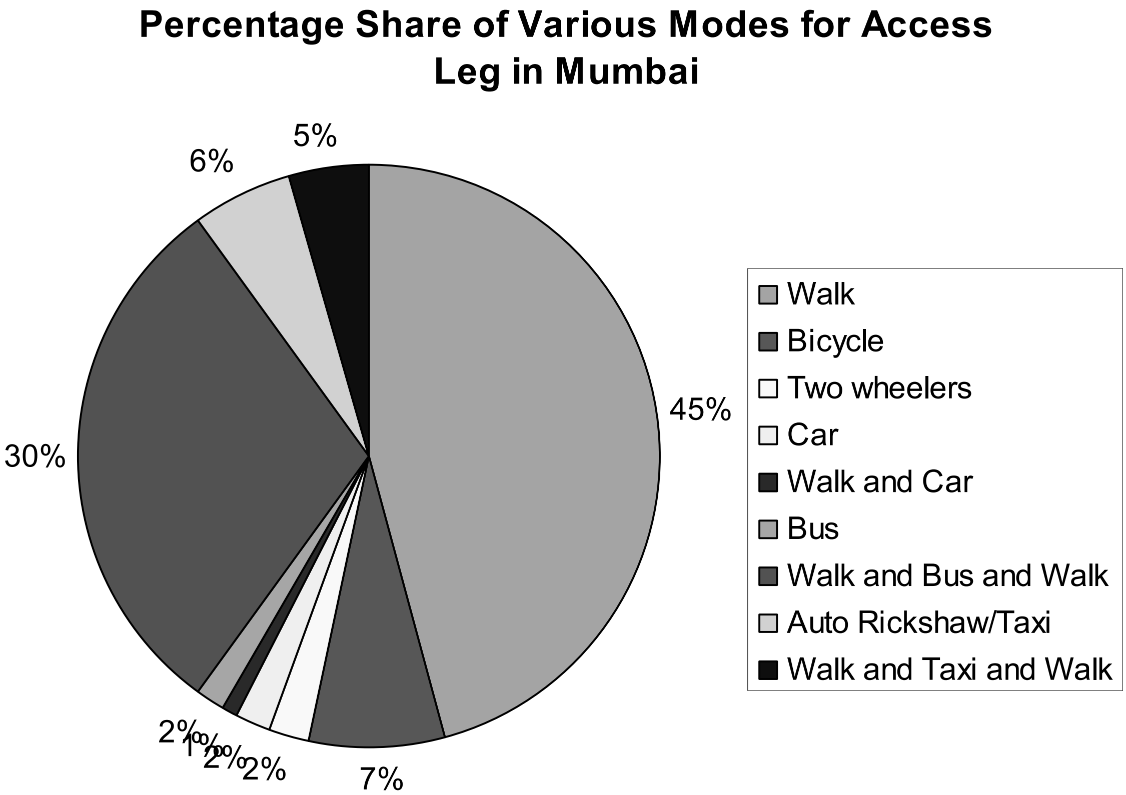

Figure 4.1.10 Percentage share of various Modes for Access Leg in Mumbai

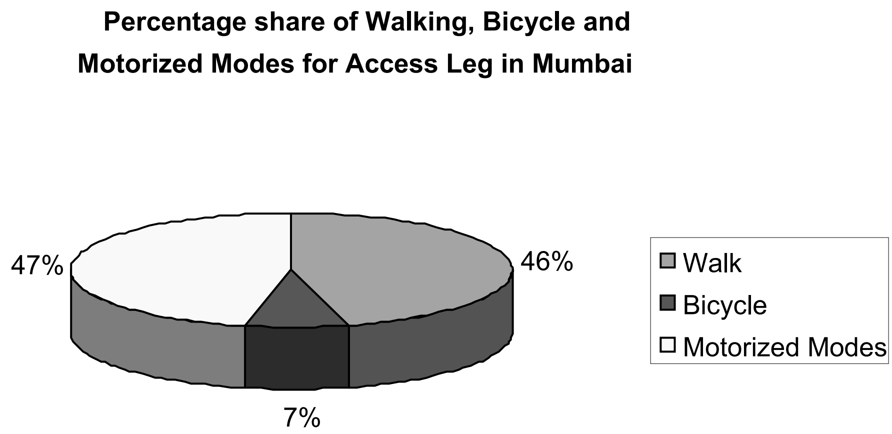

Figure 4.1.11 Percentage share of walking, bicycle and motorized modes for Access Leg in Mumbai

The commuting distance in Mumbai extends up to 36 km in north and up to 31 km in east with transit stops at 1.6 km in GMR. The transverse distance from commuting corridors extends up to 5-6 km, thus providing an ideal setting for bicycle promotion and inclusion as an access mode to transit facilities.

While NMT (particularly bicycles) is not very dominant in Mumbai, in spite of high rates of motorization, some of the Indian cities are still going well with non-motorized modes of transport. Figure 4.1.12 presents model split for major Indian cities.

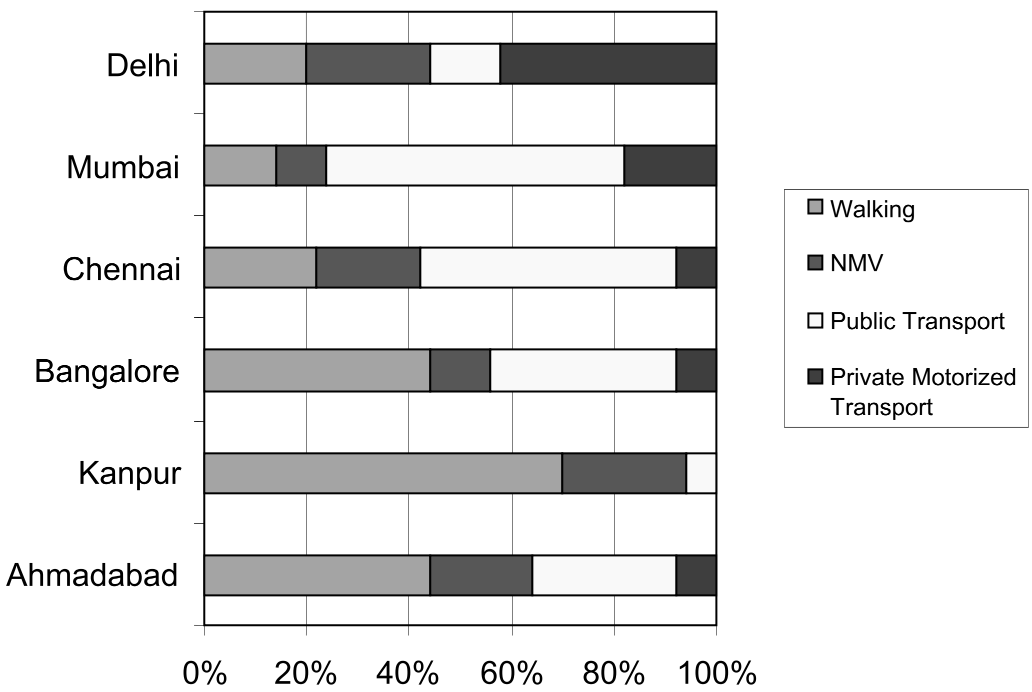

Figure 4.1.12 Model split in major Indian cities (Source: Pendakur, 2000)

However, the usage of NMT is inversely proportional to the size and economic status of the city. Kanpur which is relatively a smaller city has most of its trips met by NMVs. However, Mega cities like Delhi and Mumbai NMV share is not very significant. The size of city plays an important role in the usage of NMT and that is clearly seen in the usage of NMVs in Mumbai and Delhi. Delhi has vast area and hence traditionally a NMT city. In contrast Mumbai is squeezed into a small area and the usage of NMV is very low, which could be due to heavy congestion. Efficient public transport system in Mumbai adds to this fact. Pictures in annexure present such situations in Mumbai.

Mumbai, due to it extensive metro and bus network generates substantial short length trips. In a comprehensive study conducted by Rastogi (Rastogi, 2002) it was observed that the maximum airline distance between a household to the nearest train station (in Vile Parle area) is 2357 meters. The maximum detouring distance was 4020 meters. It was also reported that 80% trips are work related in the study areas. In another study conducted by Gupta in 1986 it was found that the average trip length by walk or by bicycle was 5100 meters. Commuting in Mumbai typically follows access leg - primary leg - egress leg. The short trips covered by three wheeler, taxis and buses can be successfully tapped for NMVs in order to reduce load on public transport, reduce congestion and also cut down on energy consumption and environmental emissions (particularly Greenhouse Gases).

The following sections looks closely at various advantages of NMT in social and economic terms other than environmental benefits and investigates possible reasons (barriers) restricting the implementation of NMT in Mumbai. It further identifies and assesses various policy alternatives and measures for better adaptation of NMT in Mumbai.

2. Strategies for the adaptation of Non-motorized Transportation (NMT) in Mumbai

2.1 Non-motorized Transport

2.1.1 Why Non-motorized Transport?

While non-motorized transport (NMT) modes are the lifelines of rural areas and small and medium cities, they provide benefits like reduction in congestion, energy efficient transportation and control on environmental emissions and greenhouse gas from transport sector in the urban centers (Tiwari, 2003). Following paragraphs explain such benefits -

Control over greenhouse gas emissions: Pedestrians, bicyclists and cycle rickshaw passengers generate no air pollution, no greenhouse gases and little noise. While emission standards and cleaner vehicles can greatly reduce certain emissions, reducing CO_2 and nitrogen oxides and ground level ozone through tail-pipe focused measures alone is proving exceedingly difficult. These emissions are growing rapidly with motorization, while the “cleaner” alternatives provide a slight dip in the emissions curves, they, in long run tend to continue with such emissions. Even the switching to public transport cannot give away with GHG emissions, though it is relatively better than personalized motorized transport modes. Thus NMT provide much needed platform for the control of GHG emissions from transport sector.

Control over congestion: With the Governments making motorization friendly policies jeopardizing the prospects of NMT, modern urban transport is facing tremendous levels of congestion. While fully occupied public transit vehicles are the most efficient users of the road space, bicyclists use less than a third of road space used by the private motor vehicles. Pedestrians uses less than a sixth. Further, bicycles need 15 times less parking space compared to cars along the roadside (GTZ, 2005).

Best transport mode for short trips: Though depends on the geography of the place, in most of the developing country cities, more than 50% trips are of short length. A decentralized city like Delhi and Bangkok would have that many more short trips. However, a city like Mumbai which spreads in one direction would also have dominant short trips (as a part of the travel for work which has both long and short trips) as the metro-based rapid transit system involves short length trips from home to the nearby access point to the public transportation mode. It essentially follows multi-model transit like walk and ride and ride and walk.

While the well planned German Cities have over 80% of their trips very short, Surabaya (Indonesia) which is only 15 kilometers across makes it possible, in principle, to make all trips by NMT (GTZ, 2005). Mean trip length in Delhi was reported to be 5.1 kilometers where in Indonesian City it was 3.3 kilometers. In Chinese cities like Ningbo it is as high as 6 kilometers (Rastogi, 2002). In 1998, Bagota had 70% of its trips under 3 kilometers covered by car, which otherwise could be ideal length for bicycle. Even in Asian cities whose per capita income is less than one twelfth of Germany have 60% of its short length trips (less than 3 kilometers) covered by motor vehicles. Following table (Table 4.1.17) shows such statistics –

Table 4.1.17 Share of different modes of transport in short length trips between 1- 3 kilometers

	Share (%) of short trips between 1-3 km		
	Motorized Modes	**Bicycles**	**Walking**
Surabaya	60	10	30
Germany	15	30	55
Mumbai[6] (2000)	40-50	5-7	45-53

GTZ, 2005; Rastogi, 2002

Anantharajan (1980) reported that three-quarter of trips by slum dwellers in Chennai were made by walk. While one-third covered by a distance of 1 km for journey to work and around 60% covered a distance up to 3 km by walk.

One of the advantages of NMT is that it provides a very flexible solution to accessibility, especially where resources are scarce. This is true not only from the user's perspective; but local level service providers and policy-makers are also becoming increasingly aware of the viability of NMT (Guitink et al., 1994).

Flexible: NMT provides a flexible form of transport where it is needed most in activities that are essential to the basic quality of life. People living in poverty face a wide variety of everyday problems related to mobility, such as access to employment, social services and activities, educational opportunities, and household chores. NMT is a multi-purpose tool that can be used for the door-to-door transport of persons and goods with improved travel time and route options.

Affordable: While buses may be affordable at the beginning of the month, fares often become prohibitive with dwindling cash over the following weeks, and people are left with no choice but walking. Affordability of NMT is a function of purchase price in relation to income (Rastogi, 2002; Pandakur, 2000). Operational costs rarely are a constraint with NMT. However, high retail prices frequently suppress the potential demand for NMT, such as bicycles, carts and spare parts. Table 4.1.18 and 4.1.19 presents the details of comparative prices of different modes of transportation. As explained in the tables, non-motorized vehicles are far less expensive and maintenance free compared to all motorized vehicles.

6. Derived from a study where the characteristics of commuters assessing rail transit by access mode are presented (Rastogi, 2002)

Table 4.1.18 Average prices of new vehicles from different modes of transport in few Asian Cities (Unit: 1992$)

City	**Bicycle**	**Cycle-Rikshaw**	**Motorized Rikshaw**	**Motorcycle**	**Car**
Phnom Penh	40	61	-	1690	25100
Dhaka	61	181	-	-	-
Kanpur	53	128	2500	1200	6400
Surabaya	138	150	-	1480	24600
Manila	176	790	1880	1760	31300
Chiang Mai	178	790	5940	1520	19800

Source: World Bank, 1995

Table 4.1.19 Average annual operating and maintenance costs for different modes of transport in few Asian Cities (Unit: 1992$)

City	**Bicycle**	**Cycle-Rikshaw**	**Motorcycle**	**Car**
Phnom Penh	3	5	174	600
Kanpur	15	85	349	1000
Surabaya	20	30	183	820
Manila	16	31	147	1130
Chiang Mai	16	32	239	1280

Source: World Bank, 1995

NMT for sustainability: NMT provides much needed transportation at an affordable price for the low income groups (urban poor). With the increasing urban sprawl and hence the travel distance for work, NMT is the only hope to achieve sustainable transportation. While the end-of-the-pipe approach provides relief with certain pollutants, NMT presents a possible long term solution for the Greenhouse Gas Emissions, particularly from urban transportation systems. Therefore, while the smaller cities are encouraged to continue their NMT usage, the metropolitan cities should consider integrating NMT into their long term transportation planning.

NMT provides other benefits like employment generation, savings in land requirements and so on which are presented in the following sections.

2.1.2 Socio-economic benefits of NMT

Bicycles, as well as other forms of non-motorized transport can bring significant economic, social and environmental benefits (Guitink et al., 1994). In the central business districts of many developing cities, congestion is a growing concern, affecting the health of inhabitants and economic activity. For instance, in Bangkok, an estimated $1.4 million worth of fuel is wasted every day by vehicles idling in traffic. Added to these economic costs, are losses of revenue caused by the hampered ability of businesses to deliver goods and services and increased employee commuting times. A study by the Engineering Office of the Bangkok Metropolitan Administration stated that, had the person-hours lost from the average 44 working days spent in traffic each year been put to productive use, the gross national product would have grown by another 10 percent (Pandakur, 2000).

NMT can provide substantial savings in infrastructure costs. Provision, operation and maintenance of motorized facilities require resources ten times that of NMT facilities and 5-6 times that of public transport facilities (Litman, 1998, Pettinga 1996, Pendakur et al., 1995; Sharma, 1986). In a complete overview comparing two transit access systems, Replogle (1984) reported that bike and ride system is far more cost-effective strategy, related to energy conservation and pollution reduction, as compared to park and ride system. The typical construction cost of park and ride lot was reported as $3640 per automobile space, where as the capital cost of secure bicycle parking was reported as $50-500 per space, both excluding the land cost. Although a typical unattended park and ride lot costs $150 or more per year for operation and maintenance, this figure ranged from a few dollars to about $70 per year for bicycle parking.

NMT provides substantial savings in land requirements not only by means of less demand for road space but also land required for parking. Automobile parking typically requires as much as 330 ft^2 of land per space as compared to 6-12 ft^2 needed for ground level bicycle storage spaces. And the bicycles can be parked in tier system which makes it that much more land efficient.

NMT provides direct economic benefits also such as savings in gasoline consumption, control over work loss due to congestion etc. It was reported in the Chicago area transportation study that the installation of secure bicycle parking at rail stations would reduce hydrocarbon emissions at a public cost of $311 /ton compared with $96415/ton for an express park and ride service. A preliminary analysis revealed that for each American park and ride commuter diverted to bike and ride travel, the gasoline use might be reduced by an average of roughly 75 gal (285 liter) per year. A similar analysis revealed that by diverting automobile commuters to bike and ride travel, the average savings might amount to roughly 400 gal (1500 liter) of gasoline each year for every new bike and ride commuter (Rastogi, 2002).

NMT has tremendous congestion reduction potential and related economic benefits. In US the congestion cost were reported to be varying between $100 billion and $300 billion (1990 price) per year which could be controlled by means of NMT (Goodland, 1994; Komanoff et al., 1993). The same is reported as equal to 10% increase in GDP for Thailand (Zegras and Birk, 1994) and 240 working days per annum for India (Sharma 1986).

By providing improved NMT facilities the motorized accidents can be controlled which otherwise costs $363 billion per year for US (1990 prices) and Rs. 25.125 million (1984 prices) for India (Gupta 1986).

Employment generation: Non-motorized transport, particularly bicycles and tricycles provide employment opportunities at different stages viz. manufacturing, servicing and repair of NMT fleet. The employment generation from NMT mostly belongs to informal sector. In Dhaka, Bangladesh about 380,000 people are directly employed as rickshaw pullers where another 80,000 are in ancillary services, which together accounts for one-fourth of total employment in Dhaka metropolitan area. This picture is much more staggering at national level with one million people in direct services and another 250,000 people in ancillary services making it 3.5% of the national labor force. NMT is particularly vital in providing employment for unskilled low-income workers. In Indian cities like Patna, public transport along with NMT offers major source of livelihood (Replogle, 1991).

Employment generation potential per unit of investment is higher in NMT. An investment of 100,000 Indian rupees in a conventional bus system in Patna would produce two direct jobs where as the same amount would produce six direct jobs in auto-rickshaw system and 75 direct jobs in cycle-rickshaw transport system. "*This is a clear indication of employment generation potential of NMT which can be successfully utilized in the context of poverty reduction in Asian Urban Centers (one of the Millennium Development Goals of UN)*".

The concept of "environmentally sustainable development" implies that mobility solutions must encompass new targets, such as reducing energy consumption and improving public health, safety and controlling environmental emissions including greenhouse gases. NMT provides the much needed degree of freedom in achieving sustainability in transportation. These requirements of sustainability have to reflect on transport and traffic policy, especially in urban areas, and international funding agencies like the World Bank, Sida and other UN bodies have to play their part in order to make it possible.

2.2 Strategies and measures to promote NMT in Mumbai

2.2.1 Methodological framework

The present work involved three stages viz. barrier analysis, identification of strategies/policies to implement the chosen measures, and assessment of policy measures to chose the final set of recommendations. Figure 4.1.13 presents the schematic design of the proposed work.

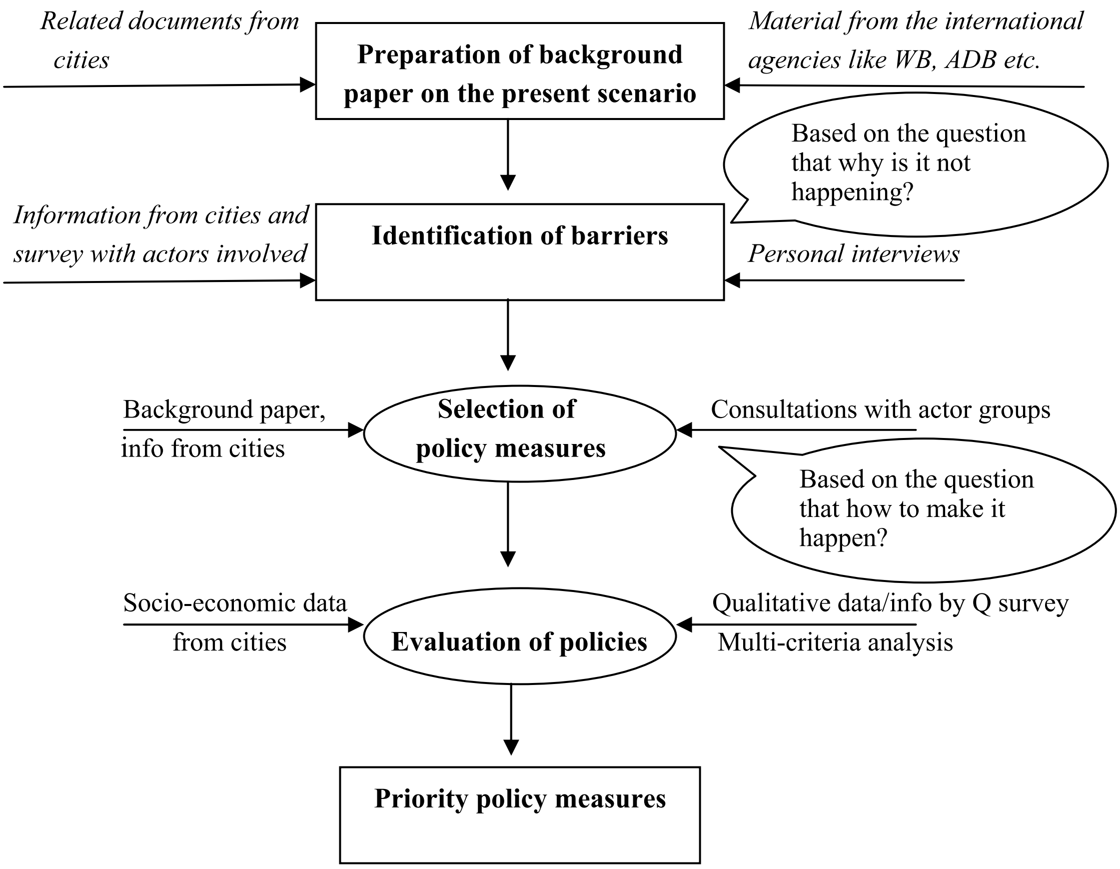

Figure 4.1.13 Flowchart of the policy analysis

Approach: Transport sector involves many actor groups viz. users, policy makers, energy and environmental experts, transportation planners, urban development authorities, transportation authorities, financial institutions, NGOs/NPOs, and community organizations (CBOs). Each one of them may have different objectives and hence may give very different priority for various alternative transportation measures. Thus, all the actor groups and their choices were considered while devising alternative options/policy measures in order to achieve successful implementation of non-motorized transportation (NMT).

Identification of barriers and policy alternatives: A focused group approach was adopted in identifying barriers and various policy alternatives to overcome those barriers in order to achieve better implementation of NMT in Mumbai. Questionnaire survey and expert consultations are the central approach for identification of barriers and alternatives policy options.

Assessment of policy measures to choose the final set for recommendation: Quantitative and qualitative analysis aggregated finally by means of multi-criteria analysis is the approach followed towards assessing the impacts of various policy alternatives (measures) and prioritizing them for the final recommendations.

Focus group of actors identified for the present study

For the present study, a focus group (multi-actor group) was formed with representatives from Policy Makers, Urban Planners, Transportation Planners, Law enforcing bodies, Users, Non-users, NGO/NPOs, Environmental Experts, and Transportation Experts. All the opinions collected from the entire sample by means of questionnaire survey and personal consultation are consolidated to arrive at a common pool of opinions. This questionnaire was used to gather opinion from the focus group in order to collect the comprehensive list of barriers and policy alternatives and measures. This also helped in eliminating certain default barriers/policy alternatives which may not be relevant to Mumbai. The questionnaire was not intended to be subjected to any major statistical analysis but only consultative.

Following are the list actors responded to the questionnaire or gave personal interviews/interactions –

- Users (of non-motorized transportation modes)
- Non-users (Users of motorized transportation modes)
- Transportation Planners from MMRDA
- Transportation Experts from Indian Institute of Technology (IIT) Bombay
- City Planners from MMRDA
- Police Commissioner (Traffic)
- Transport Commissioners from Transport Department, Maharashtra State
- NGO/Environmental Activists
- Policy Makers (Regional Transport Officers, Traffic inspection officers)
- Financial Institutions
- Environmental Experts (National Environmental Engineering Research Institute)

A total of 25 focus group members were consulted with the questionnaire and/or personal interviews.

2.2.2 Barriers to Non-motorized Transportation in Mumbai

Any effort to introduce new alternatives faces certain types of frictions in the system. Those frictions popularly termed as barriers can be broadly classified as administrative, financial, technical, social, cultural, infrastructure barriers. It is essential to identify right set of barriers so that necessary policy alternatives and measures can be devised to overcome those barriers. In the present study, based on consultations/questionnaire with 25 actors, the following list of barriers was identified as restricting forces for the penetration of non-motorized vehicles in Mumbai.

Social Barriers: *Safety of the bicycle rider* has been recognized as a major barrier all around the world (Tiwari, 2003; GTZ, 2005). The present study also confirms it to be an important issue controlling the usage of bicycles in Mumbai. In absence of special lanes or sidewalks bicycle riders in Mumbai share the road space with all other motorized modes and that puts them at a very high risk. Precisely for this reason it is hard to find young boys using bicycles. Pictures in annexure present some of evidences.

It is a generally believed that NMT (bicycles and walking) is *slow moving mode of transport* (World Bank, 1995). Precisely this is the reason for the existence of motor vehicles – to speed up the movements. However, the opinion survey in the present study reveals that slow motion is not a reason for not using NMT in Mumbai. *It was interesting to observe that walking is preferred due to the fact that the approach roads are far very congested and public and feeder (motorized three wheelers) modes of transport are far slower compared to that of walking. Thus slower movement is not a barrier for the improvement in NMT usage*.

Problem of theft has been considered a major barrier for the implementation of bicycles in different parts of the world (GTZ, 2005; World bank, 1995). However it is interesting to find that in Mumbai theft is not seen as a major issue controlling the usage of NMT (Bicycles). This could be a possibility that extensive usage of bicycles is not experienced in Mumbai and hence the respondents could not make a proper judgment. However, given the nature of extensive MRTS and fast moving lifestyles in Mumbai, it is likely that theft may not be a problem in enhancing bicycles usage.

However, like many other cities, *poor social acceptability of bicycles* has been identified as a major problem in implementing bicycles in Mumbai. Started to increase the speed of movement, motorized vehicles have become a status symbol in Indian cities. Thus bicycle is seen as a poor man's domain and that, to a great extent, limits the penetration of bicycle usage. This problem is universal but the solutions are not (World bank, 1995; Pendakur, 2000). *It is however, interesting to observe from the opinion survey that the usage of NMT in Mumbai is not limited to poor.* This essentially refers to "walking" because bicycle usage is not predominant in Mumbai. While it is a fact that other than poor also walks short distances in Mumbai, the defining line for "poor" in Mumbai is tricky with many tax payers living in slums (Rastogi, 2002; census of India, 2001). Social dimension needs to be examined carefully in order to understand the complete dynamics of it and its linkage to the implementation of NMT in Mumbai.

Political unwillingness doesn't seem to be a problem while the *attitude of both motor vehicle riders and the law enforcers* (police) was found to be important barrier. This essentially can be linked up to the lack of proper regulations in favour of NMT.

Lack of awareness doesn't seem to be making much difference in the choice of NMT in Mumbai. In the opinion survey it was observed that people are aware of the benefits but simply do not use it either because of social consciousness or lack of safety and infrastructure. However, *lack of promotional campaigns* was chosen as one of the barriers controlling the implementation of NMT in Mumbai.

Financial barriers: Financial barriers are the usual bottlenecks in the case of alternative technologies involving considerable investment, either capital or maintenance. Relevance of this type of barrier for NMT is only for bicycles and man pulled carts or tricycles. *Affordability* was found to be one of the major barriers for the promotion of NMT. However, it is observed that, instead of lack of affordability, it is the higher affordability that affects the choice. In the opinion survey it was observed that people do not own a bicycle because of their affordability to go for a motor vehicle. Given the fact that bicycle is not socially accepted, ownership of motor vehicle replaces bicycle. This presents a case of "negative effect".

However, the affordability of poor needs a careful assessment. At this juncture again it is necessary to bring the point that the definition of poor in Mumbai is typically different from the rest of the country. Though "*lack of financial mechanisms to support the poor to buy a bicycle*" was not chosen as a major barrier, it is essential to further examine the case with "poor urban dwellers" before finally concluding on it.

Infrastructure barriers: Lack of infrastructure has been regarded as a global bottleneck in implementing NMT (GTZ, 2005; Replogle, 1991; World Bank, 2002; World Bank, 1995). Traditionally infrastructure planning and development followed the needs and requirements of motor vehicles ignoring the facilities required for non-motorized modes. This problem is that much more acute in developing cities like Mumbai and Hyderabad where even pedestrians share the road space with the motor vehicles. Already non-existing/no-operational pedestrian pathways are encroached by small scale vendors making it practically impossible to use them. Thus, *lack of infrastructure* like separate lanes for bicycles (not even partially segregation), parking spaces at key shopping and transit points, pedestrian pathways and elevated or subway crossing etc. has been identified as a major barrier for the implementation of NMT in Mumbai.

Though not getting a good quality bicycles (*lack of quality bicycles*) in Mumbai is not a major barrier, it was observed that making good bicycles available would help promoting bicycles in Mumbai, provided the other aspects also improve at the same time (GTZ, 2005).

Institutional barriers: Institutionalization could be considered at local administration level as well as at national level. As issue related to bicycles deal with majority of public, it is necessary to institutionalize the process of integration into the mainstream transportation network (World Bank, 2002). *Lack of institutional arrangement to integrate NMT in transportation planning at city/municipality level* was identified as a major barrier in Mumbai. At the moment in Mumbai, there is no arrangement to integrating NMT in the planning and development of transportation infrastructure. Though MMRDA in its master plan for 1996-2011 spelled out the need for development of NMT, there are no clear measures of integrating it into the mainstream transport network. It is an interesting fact that even the ongoing development projects viz. Mumbai Urban Transportation Project (MUTP) and Mumbai Urban Infrastructure Project (MUIP) did not consider the integration of NMT with the other transportation infrastructure (MMRDA, 1995; Unpublished document from MMRDA).

Lack of integration of NMT in national transportation plans and frameworks was identified as another major barrier for the promotion of NMT in Mumbai. The present national transportation plan does mention about the promotion of NMT. However, it is not explicit on providing much needed framework for such integration (MMRDA, 1995). Most of the success stories of NMT are due to the fact that they have been integrated in their respective national plans (World Bank, 2002; GTZ, 2005). Institutionalization at national level is necessary because of the fact that funds for the transportation infrastructure developments are allocated at national level. Lack of planning skills for the integration of NMT network in the mainstream transportation was NOT chosen as a major barrier for the promotion of NMT in Mumbai.

Administrative barriers: Non-motorized transportation (NMT) modes constitute a major element in development of Mass Rapid Transit System. In order to be successful, the public transport system needs to be complemented by NMT. This fact is amply supported by the fact that 40-60% of daily trips in Mumbai are made by walking. In spite the fact that Mumbai is heavily dependent on its MRTS, NMT is not properly administered. The opinion survey conducted in the present study revealed that *lack of proper regulation for cyclists and their rights* and *lack of legal basis for NMT traffic management* are among the major barriers for the promotion of NMT in Mumbai. These aspects compliment with the institutionalization of NMT integration into mainstream transportation planning.

Natural/Culture barriers: As NMT involves hardship, it is important to consider the local conditions under which NMT is used. Mumbai has high levels of humidity and also considerable resuspension of dust. Severe monsoon and hilly terrain are certainly not so conductive for NMT usage. However, it is interesting to observe from the present survey that *climatic conditions like high humidity and monsoon* are not among the major barriers for the promotion of NMT. This observation needs further validation as it involves substantial personal bias in response. Based on the opinion survey the following are the major list of barriers for the promotion of NMT in Mumbai –

- *Lack of Safety of the bicycle rider*
- *Poor social acceptability of bicycles*
- *Attitude of both motor vehicle riders and the law enforcers (police)*
- *Lack of promotional campaigns*
- *Higher affordability*
- *Lack of infrastructure*
- *Lack of institutional arrangement to integrate NMT in transportation planning at city/municipality level*
- *Lack of integration of NMT in national transportation plans*
- *Lack of proper regulation for cyclists and their rights*
- *Lack of legal basis for NMT traffic management*

A study by Rastogi (2002)[7] had identified various reasons for the people in Mumbai not using walk or bicycle. It was reported that majority (24.14%) of respondents who do not use walking or bicycle mentioned that they do not like to use NMT. This could be attributed to the "lack of safety" as this could also drive people not to like NMT modes. It was interesting to observe from this study that "difficulty in carrying baggage" was chosen as second important barrier for not using walking/bicycle. Heavy sweating, dust and health are among the other important barriers identified. Only two percent (2%) respondents reported that walking/cycling "does not suit their status". Only 7.5% respondents' claim that they can afford automobile trip where as 10% says that availability of automobile trip is the reason for them not using NMT.

2.2.3 Policies and Alternative Measures (PAMs) for the promotion of NMT

This section presents strategies and policy measures identified to remove the above listed barriers in order to achieve better implementation of non-motorized transportation (NMT) in Mumbai. Same group of actors, as in the case of barriers identification, was used for the identification of appropriate policy alternatives and measures (PAMs). Questionnaire survey and personal interviews were conducted to aggregate the opinions of the group members (25 group members). Following are the list of policy alternatives and measures identified in the opinion survey -

Institutionalization policies: The full potential of NMT is best achieved through the development of comprehensive strategies and policies that involve all relevant levels of government with participation from all stakeholders in NMT (Guitink, 1996). In the present opinion survey to identify policy alternatives and measures it was identified that *policies to integrate NMT with the public transport system planning at city/municipality level* is an important move towards implementing NMT in Mumbai.

The Netherlands has demonstrated the integration of NMT into mainstream transportation system. At the regional and local planning levels it was recognized that adequate NMT provisions improve accessibility to centers of economic and social activity and can widen the range of personal mobility options. In The Netherlands proposals for NMT are being formulated as important components of comprehensive traffic and transport plans alongside car restraint measures and promotion of public transport. Integrating facilities for bicycles and pedestrians with mass transit systems can enhance public transport ridership by enlarging catchment areas. It would also result in fewer public transport stops, reduced vehicle operating costs, energy

7. a study based on an extensive and systematically designed questionnaire survey which was statistically analysed to arrive at these observations

use and reducing door-to-door travel times. In the privatization process of the Dutch railways, bicycle parking provisions are considered to be part of the infrastructure, just like tracks and platforms, which will remain under the financial responsibility of Central Government. Such measures of institutionalization would enhance the penetration of NMT in Mumbai as well.

Integration of NMT with the other travel modes at local level provides much needed link between different travel modes (Guitink et al., 1994). An example from Colombia illustrates such integration and the resulting benefits. Productos Ramos S.A., an industrial bakery, was faced with an aging fleet of delivery trucks. Not only did replacement mean a large cash outlay, but the 135 trucks often operated with partial loads and had trouble parking near their destination. An NMT solution seemed impossible due to the large distances between the manufacturing plant and the retail outlets. The bakery introduced a decentralized computerized distribution system-a fleet of 50 trucks hauled products to satellite warehouses, where a fleet of 904 cargo-tricycles picked up the goods for final delivery. As a result of this *inter-modal integration*, distribution costs dropped from 27 to 8 percent of total costs, and employment increased substantially (Heierli, 1993 and Lowe, 1989; Guitink et al., 1994). This kind of inter-modal integration can be applied both to passenger and freight transport in Mumbai.

Efforts at national level are also equally important in achieving better adaptation of NMT. *Formulation of National Strategy for NMT as a facilitating framework for local plans* and *Incorporation of NMT is national transportation policy* are identified as important policy measures to implement NMT in Mumbai. However, it is observed that national transportation plan has already provided a clause for NMT, but not to a required degree (MMRDA, 1995).

In the Netherlands, at the national level, the bicycle was returned to the mainstream of government transport policy in the debate on environment and mobility during the 1980s. As part of an integrated traffic and transport approach a Master Bicycle Plan has been developed, based on a policy statement that was approved by Parliament. The main objectives of the Plan are to: (i) get more people onto bicycles; and (ii) attract more people to public transport by improving the public transport-bicycle chain, by facilitating cycling to and from railway stations. Such efforts at national level would provide basis for local action of integration.

Though the present survey revealed that there is no need to make *policy to enhance the city/transport planner's capacity to integrate NMT into mainstream transportation system,* it was observed that *incorporation of standards for the bicyclists and pedestrians provisions in new road infrastructure design* would have a positive impact on the implementation of NMT in Mumbai.

Infrastructure policies: Lack of infrastructure was found to be one of the major barriers for the implementation of NMT in Mumbai. As a remedial measure, the focus group of this study opined that policies to *provide separate bicycle lanes on arterial roads* (fully integrated with motor vehicles/partially segregation/full segregation), *constructing wider pedestrian ways with cycling facility* and *providing subways and overhead passages* at major intersections would help enhance the usage of NMT in Mumbai. It was also found that policies to *provide bicycle parking places* at all public transport stations and public places would help enhancing the usage of NMT in Mumbai. However, theft was not considered as a major barriers and hence, protected parking lots may not be of top priority. *Policies to support R&D for quality bicycles* were NOT considered important and potential enough to influence the implementation of NMT in Mumbai.

However, for successful implementation, this infrastructure planning needs to be well integrated with the mainstream transportation planning (GTZ, 2005; Replogle, 1991; Pendakur, 2000). Otherwise it could lead to disastrous results. For instance, China has a history of nearly a hundred years in bicycle use. In the late 1970s, bicycle policies focused on financial incentives to both the purchase and use of bicycles. As a result, bicycle ownership more than quadrupled in the 1980s. The policy was successful in many ways, but the lack of an integrated system approach caused problems for other transport modes: public transport was confronted with a dramatic loss in ridership and the massive flow of bicycles caused congestion, impeded public transport and accounted for a high share of traffic accidents. Now, the city managers focus on severe bicycle restrictions and even outright bans. The creation of adequate segregated facilities for bicycles and public transport modes, as well as their integration, could have alleviated many of the current problems (Guitink, 1996).

An explicit NMT strategy is thus an important instrument for developing the potential of non-motorized based mobility. An NMT strategy must include long term objectives, steps to be taken to reach the objectives and guidelines.

In a study conducted by Rastogi (2002) it was found that people in Mumbai preferred to have "Physically separated lane in order to shift to NMT. Their priority followed the order of "physically separated lanes, Marked Lane (painted), Bikeways and priority crossing at intersections. It complements the finding from the present study that safety is the major bottleneck for NMT usage. In the same study, willingness of respondents in Mumbai to shift to NMT was tested and was found that 6-11% respondents are willing to shift to NMT under "modified facility scenario".

Financial policies: Urban poor is predominant in Mumbai with about 50% populations living in slums (Census India, 2001). However, Mumbai enjoys higher per capita income compared to that of national as well as state averages (CMIE, 2001). Thus, the affordability of Mumbai public is higher compared to the rest of the country. It was also identified in the previous section that low affordability is not a barrier for NMT in Mumbai. Moreover, it was observed that higher affordability (affordability for motor ride) is the reason for the poor adaptation of NMT (bicycle in particular).

Financial incentives provide penetration of NMT into industrial workers. The present study recognizes that policies to *support micro-credit system* (for urban poor) similar to the one given for villagers may not have much impact in promoting NMT in Mumbai. It opined that *policies to provide soft loans* and *relaxing excise duty on importing bicycles/bicycle parts* would have a positive impact. Similarly, policies to provide incentives for the bicycle manufacturing industry may not have substantial contributions in promoting NMT in Mumbai. This could be due to the fact that, if the market is created it would take care of the supply needs.

However, ownership of bicycle has strong correlation with income (Pandakur, 2000; Rastogi, 2002; World Bank, 1995). Data from Malaysia and India suggest that bicycle ownership becomes substantial-40 percent or more of households owning a bicycle-when household income levels reach about 10 times the cost of a bicycle (Barwell and Legget, 1986). Evidences from Nigeria show that households owning a bicycle had incomes 19 times its cost (Adebisi, 1985). The distinction between the purchase of new and second-hand bicycles is an important, but often overlooked, qualification. A survey in Kenya shows that 65 percent of bicycles are bought second-hand because of low incomes and lack of credit (Kaira, 1985). A study of conditions in Malawi indicates that with bicycles costing about 45 percent of annual household income, an average household simply cannot afford a bicycle without access to credit for which the poor are rarely eligible (Nyasulu et al., 1991). However, with almost double the national per capita income, Mumbai households enjoy a different level of affordability and thus it could be a counter acting fact for the promotion of NMT.

Mumbai population, on an average (based on a study conducted on two important locations), spends 4-5% of their income on transportation needs[8]. Following table (Table 4.1.20) presents the details of money spent on travel by a Mumbai citizen.

8. This excludes the capital costs in procuring vehicles

Table 4.1.20 Details of trip length and cost per trip and percentage income spent on travel

	Trip length	cost per trip	% income spent
Total	20.065	5.23	1.96
Access Leg	1.948 (9.71%)	2.33 (44.11)	0.87
Primary Leg	17.112 (85.29%)	2.19 (41.88)	0.82
Egress Leg	1.004 (5%)	0.69 (36.49%)	0.26

Administrative policies: One of the major barriers apart from the lack of infrastructure is lack of regulations guiding the roles and responsibilities of NMT users and lack of legal base for NMT management. The present study concludes that, *policies to make regulation safeguarding NMT users* and to *develop respect for the NMT users among the law enforcing officers (Police) and the motor vehicle users* would positively influence the implementation of NMT in Mumbai. This kind of administrative policies supports the integration of NMT into the mainstream transportation system in a long run.

Social policies: Lack of Safety for the bicycle rider was one of the major barriers identified. This can be taken care in terms of providing better infrastructure for NMT users. However, to change the social acceptance and attitudes towards the NMT users it was recognized that *policies to conduct awareness raising campaigns* are import and can influence the peoples' mindsets to a great extant and help NMT to penetrate well into the existing transportation system in Mumbai. For instance, it is easy to convince students and school going children by engaging a popular sportsperson or an actor in the awareness raising campaign for NMT. In a study conducted in Mumbai where the willingness of respondents to shift to NMT was tested, it was found that 11.5-12.5% respondents are willing to shift to NMT once the environmental benefits statement is given to them. This could be one example for the impacts of awareness (environmental and other benefits) programs.

Confronted with severe congestion and the negative environmental effects of increasing car traffic, many industrialized countries (including Japan, Germany, Denmark, Canada, Netherlands, and the UK) are now giving more attention to the potential benefits and complementary role of non-motorized transport. The full benefits of integrated transport systems are best seen in The Netherlands which has actively pursued a pro-NMT strategy over the last decade (Guitink, 1996).

Based on the present opinion survey, following is the list of policies identified to remove barriers and achieve better implementation of non-motorized transportation modes in Mumbai -

- Policies to integrate NMT with the public transport system planning at city/municipality level
- Formulation of National Strategy for NMT as a facilitating framework for local plans
- Policies to extend more specific incorporation of NMT is national transportation policy
- Incorporation of standards for the bicyclist and pedestrian provisions in new road infrastructure design
- Policies to provide NMT friendly infrastructure (separate bicycle lanes on arterial roads, constructing wider pedestrian ways with cycling facility, providing subways and overhead passages at major intersections and provide bicycle parking places at all public transport stations and public places)
- Policies to provide soft loans and relaxing excise duty on importing bicycles/bicycle parts
- Policies to make regulations safeguarding NMT users and to develop respect for the NMT users among the law enforcing officers (Police) and the motor vehicle users
- Policies to conduct awareness raising campaigns

2.3 Feasibility study of PAMs for Mumbai

This section presents the descriptive analysis of socio-economic costs and benefits of the chosen policy alternatives and measures. Based on multiple criteria these policies are prioritized adopting multi-criteria analysis.

2.3.1 Assessment of socio-economic and environmental benefits

Implementation of the above listed policies in order to realize the implementation of NMT in Mumbai results in micro and macro impacts spanning over inter and intra sectors. Following section presents such impacts for each of the policy alternative and measures identified.

Policies to integrate NMT with the public transport system planning at city/municipality level: Such integration demands additional budgetary allocations to meet the additional features and needs of NMT. Cities, with their limited resources, may need support from the Central Government and/or international financing agencies. Integrating NMT into the public transport system needs capacity building both for planners, and the construction teams.

Such policies require substantiation of the existing administrative set up and technological capabilities at city level. Thus, it not only creates more jobs but also burdens the Government with additional budgetary requirements. By integrating NMT with the public transport system one can achieve better results in terms of congestion reduction and environmental and public health benefits. Such integration policies may not burden the user unless the bicycle registration is made mandatory and also charged at parking places.

Formulation of National Strategy for NMT as a facilitating framework for local plans – This measures needs most of its efforts at national policy development. With vast network of research institutes in the area of transportation planning and handful of experts, development of such framework should not require much additional efforts. The National Government may need to constitute a committee to examine the possibility and develop such framework. As this would be a facilitating framework, it may not lead to additional economic burden either on National Government or Local Government. On first hand criteria, it may not have considerable employment generation potential or any other social and environmental benefits. However, presence of such framework would facilitate better adaptation of NMT at city level and such efforts would result in least costs.

Policies to extend more specific incorporation of NMT is national transportation policy – This policy measure would result in more explicit NMT strategy at National Level which means more budgetary allocation at National level for transportation development and also financial supplies to the State and/or Cities. Such National NMT strategy would result in more economic burden on the State/City administration. Such measures would result in substantial employment generation. Implementation of such strategies needs considerable capacity development activities, which adds to the burden on the Government. Users may also be subjected to additional burden if provisions are made for user fee as a mechanism of cost recovery. National NMT strategy would result in substantial environment and social benefits.

Incorporation of standards for the bicyclist and pedestrian provisions in new road infrastructure design – This alternative measure needs capacity development for the technical manpower at city level. As this is a measure at design level its employment generation potential could be very low. It may not lead to a direct economic burden on either National or local Governments. But such incorporation of standards makes it easier to implements the NMT features in the overall transportation planning. Thus it has high potential in resulting environmental and social benefits. This further leads to development and growth of NMT industry where in there is a possibility of increased employment.

Policies to provide NMT friendly infrastructure – This measure include construction of separate bicycle lanes on arterial roads, construction of wider pedestrian ways with cycling facility, providing subways and overhead passages at major intersections and provide bicycle parking places at all public transport stations and public places. This policy measure involves substantial economic burden on Local Government and National Government along with international aid. Construction of bicycle lanes costs substantially high and such projects in the developing countries need international support. Details on such costs are discussed in the earlier sections.

This policy measure has high potential for employment generation. It was reported in the literature that investment of Rs. 100000 in NMT would leads to 75 new direct jobs where as it would give 2 jobs in public transport system and only 6 in the case of auto-rickshaws. Thus, this policy has potential to create jobs both in the construction stage and operational stage.

Such infrastructure development involves cost recover process which may lead to user charges. However, the level of burden depends on the Government policy and less the burden on the user more on the Government.

Lack of infrastructure has been rated as one of the major barriers for NMT and provision such facilities would make headways towards sustainable transportation in terms of reduced congestion, energy conservation and environmental benefits. However, such success depends highly on the well designed awareness campaigns.

Policies to provide soft loans and relaxing excise duty on importing bicycles/bicycle parts – This would have a positive impact on bicycle and tricycle ownership. Though Mumbai enjoys higher per capita income compared to the other cities, commercial NMT vehicles needs such financial incentives for their penetration. As explained in the earlier sections, inter-modal transportation has great potential in commercial applications. This means some level of employment generation at commercial level NMT. This policy measure would burden the Government to an extent depending on what degree of subsidy is offered.

Policies to make regulations safeguarding NMT users and to develop respect for the NMT users among the law enforcing officers (Police) and the motor vehicle users – This policy measure involves considerable levels of monitoring and hence would needs additional man power and also burden on the Government. This needs capacity building and awareness programs over long term and hence burdens the Local Government. However, regulations have to made alongside with the infrastructure development in order to achieve the desired results in terms of NMT penetration.

Policies to conduct awareness raising campaigns – These are long term commitments and hence require considerable and committed resources from the Government. Non-Government organizations funded by international environmental agencies have a special role to play in this. This would have good long term benefits on environment and social criteria. Table 4.1.21 presents, indicatively, the above discussed impacts of each policy measure considered.

Table 4.1.21 Cost Benefits of Policy Alternatives and Measure to Implement NMT

Policy and Alternative Measures	Costs on Government	Burden on users	Employment generation	Environmental and Health Benefits	Congestion and other Social Benefits
Policies to integrate NMT with the public transport system planning at city /municipality level	√√√	- / √	√√√	√√	√√
Formulation of National Strategy for NMT as a facilitating framework for local plans	√	–	–	–	–
Policies to extend more specific incorporation of NMT in national transportation policy	√√√√	√	√√√	√√√	√√√
Incorporation of standards for NMT in new road infra-structure design	√	_	√	√√	√√
Policies to provide NMT friendly infrastructure	√√√√	√	√√√√	√√√	√√√
Policies to provide soft loans and relaxing excise duty on importing bicycles/bicycle parts	√√	_	√	√	√
Regulations safe-guarding NMT users and to cultivate respect for the NMT users	√	_	_ / √	_ / √	_ / √
Awareness raising campaigns	√√	_	_	√√	√√

'√√√√' Indicates high significance and '-' indicates no impact

Though each policy has its costs and benefits, for policy makers, in order to prioritize their choice, it is necessary to have a comprehensive idea on which policies stand better chances to be successful in achieving NMT implementation. Thus it is necessary to prioritize the policies. However, prioritization of policy measures would depend, highly, on the criteria based on which the comparisons are made. Thus, the policy measures are prioritized based on multiple criteria.

Costs and Benefits of Initiative to Promote NMT in Mumbai – An Indicative Presentation

While it is important to identify and prioritize specific policy alternatives and measures to promote NMT and their implementation, it is also important to build the basis capacity and infrastructure as a first step towards achieving such idea of NMT in Mumbai. Two such requirements are

- Sensitization of top officials and providing basic and advanced training for different levels of manpower involved in urban transportation and allied departments;
- Development of basic infrastructure viz. roads with proper footpath and dedicated bicycle lane (could be joined with Footpath in some cases), providing bicycle parking places at all metro train stations (73x2), and improving road intersections making them conductive for NMT users.

Providing these two basic blocks would result in various costs and benefits (and some co-benefits as well). It was estimated that capacity building in Mumbai by means of sensitization of top officials and training for middle and lower end officials would cost about 178,382 USD. This kind of training programme may be called for in every five year interval, after making a systematic need assessment study.

Provision of basic infrastructure includes widening of the existing network of urban roads (1973kms) and providing proper footpath and NMT lanes; improving the existing road intersections to support NMT users; and development of bicycle stands at all 73 metro rail stations (one bicycle stand on east and west sides of each station). Cost of providing footpath and NMT lane on Mumbai roads are calculated. Complete conversion of the existing road network to provide NMT in Mumbai is expected to cost about 51 million USD.

A ten percent conversion of roads to NMT friendly roads in Mumbai (with bicycle stands at all metro rail stations ad improved road intersections) would cost 15 million USD where as 100% conversion would cost as much as 136 million USD.

Promoting NMT has many benefits viz. reduced air pollution, reduction in CO_2 (greenhouse gas) emissions, energy saving, slow down in motorization, reduction in congestion and other social benefits as explained in the main text. To provide an indicative idea of such benefits, reduction of CO_2 and other environmental emissions was calculated in the present study.

Conversion of ten percent roads into NMT friendly infrastructure (which is expected to result in 10% reduction in the number of 3-weelers over the next five years) is estimated to result in a reduction of CO_2 emission by 7.63 million tons over the next five years. NMT promotional efforts with a possible 75% reduction in number of 3-wheelers over the next five years would result in reduction of 19.8 million tons of CO_2 over the same time period.

At ten percent conversion of roads to NMT friendly roads, the marginal abatement cost (MAC) of carbon dioxide was found to be as low as 1.97USD/ton of carbon. At 100% conversion of roads (75% reduction in 3-wheelers stock) to NMT friendly roads, MAC was found to be 6.87 USD per ton of CO_2 reduction, making it a likely initiative for future CDM activity. NMT is expected to result in substantial co-benefits in terms of reductions on carbon monoxide, hydrocarbon and oxides of nitrogen emissions. Details of these cost benefit estimates are presented in Annexure II.

2.3.2 Prioritization of policy alternative and measures

Establishing evaluation criteria

Criteria are an important platform to compare various policies for their merits and demerits in the process of selecting the most promising alternative policy options. In order to compare merits and demerits of the selected policy alternatives for the removal of barriers to the CEETs, a set of criteria was identified. Each of these criteria was given equal weights. Following are the list of criteria and their description –

Administrative costs – This includes physical infrastructure cost, cost of changing existing rules and regulations, capacity building of implementers and stakeholders, cost of hiring the consultants, cost of collecting required information, cost of program monitoring, etc

Financiability – Financing barrier removal policies can be a major challenge for the developing countries. Hence, financiability was selected as another criterion to choose appropriate policy options.

Environmental and social benefits – Potential to reduce environmental emissions (both local and global); potential to streamline the traffic in general; employment generation; reduction in accidents; more affordable transport for urban poor

Administrative capabilities – Policies should be practical and feasible to actually produce intended benefits. Implementation of barrier removal policies requires a good organizational set-up with appropriate infrastructure, manpower and technical support.

Political willingness – Willingness of political leaders to propose and promote NMT friendly policies.

Prioritizing policy alternative and measures – Multi-criteria approach

Each policy alternative was assessed based on each criteria identified. Performance of each policy alternative based on each criteria was assessed on 1 - 4 scale, with 1 representing "poor" and 4 representing "very good". This was carried out by personal interview (questionnaire survey) among actors viz. Environmental Expert, Policy Maker, NGO, Transportation Expert/Planner. Average of responses from all the respondents against each question was used as the final rating for the analysis. The alternative policy options are finally assessed by aggregating their assessment based on individual criteria to arrive at final ranking. Figure 4.1.14 presents this process schematically.

The following scale was used to rate the above PAMs, qualitatively, based on different criteria. Intermediate values viz. 1.5, 2.5, 3.5 were also used as and when required.

1	Poor
2	Moderate
3	Good
4	Very good

For instance – Implementing the measure - *Policies to integrate NMT with the public transport system planning at city/municipality level* - may need substantial improvement in the administrative capability – thus this PAM may get poor score (say 1) based on the criteria 'administrative capability'.

However, implementing the measure - *Policies to conduct awareness raising campaigns*- may not need any improvement in the existing administrative capacity – thus this PAM may get better score (3.5 or 4) based on the criteria 'administrative capability'.

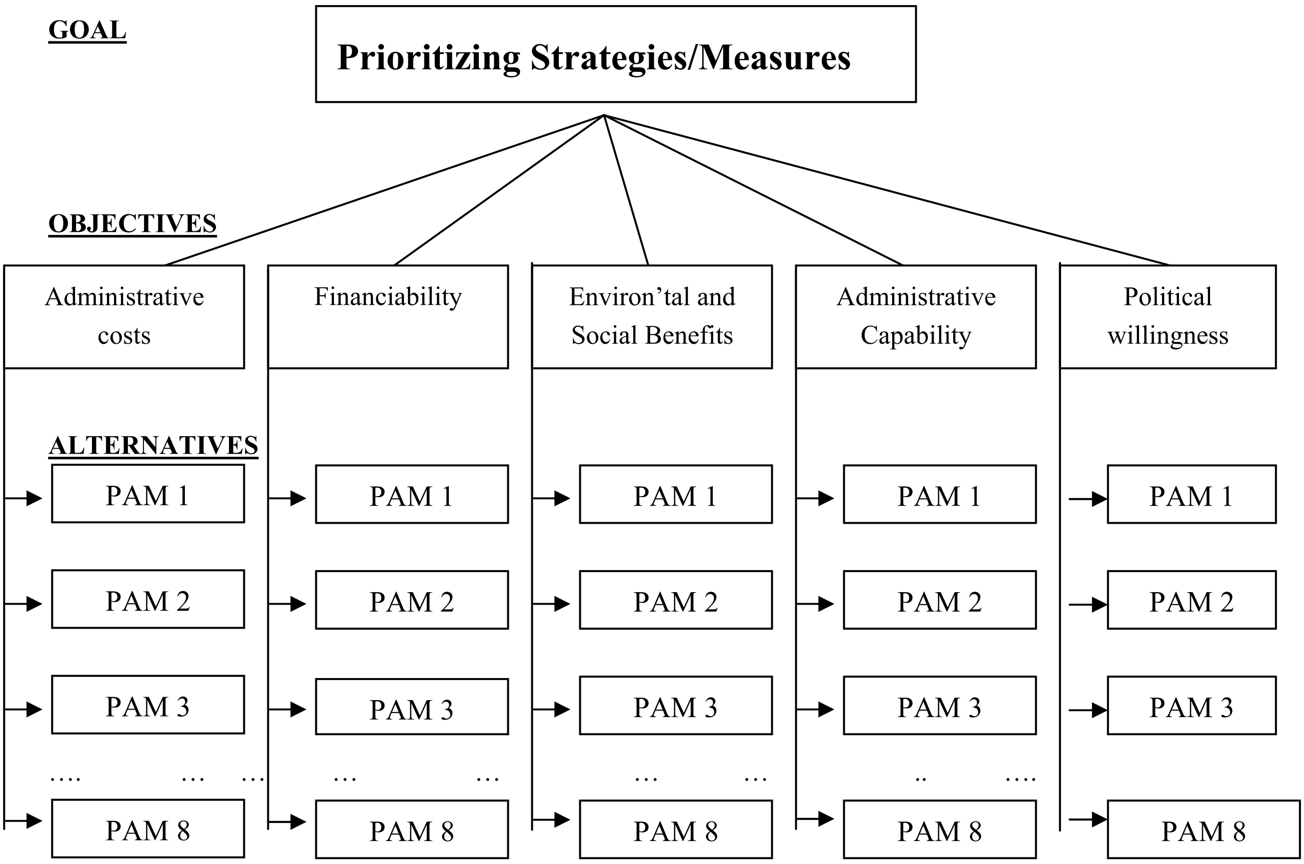

Figure 4.1.14 Schematic representation of Prioritization of Policy Measures using Multi-criteria Approach

Responses from all stakeholders are used to arrive at common ratings for the policy alternatives under each criteria, which is presented in Table 4.1.22. Total score and percentage scores for each policy measures are calculated as follows and presented in the same table.

Percentage total score of policy measure PAMi $= \left[\sum_{ci=1}^{n} (r_{ci} x w_{ci}) \Big/ 4 \right] x100$

Where 'r' is rating given for the policy measure; 'ci' is criteria 'i'; 'w' is the weight on criteria 'i'. Higher the score better the policy measure. PAMs with more than 50% score can be considered positively.

Table 4.1.22 Rating of Policy Alternatives and Measures based on different criteria

Policy Alternative and Measure	Administrative Costs	Financiability	Environment and Social benefits	Administrative Capability	Political Willingness	Score
Weights	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	
Policies to integrate NMT with the public transport system planning at city/municipality level **(P1)**	2.5	3.5	3.0	2.0	2.0	2.6 (65%)
Formulation of National Strategy for NMT as a facilitating framework for local plans **(P2)**	2.5	3.5	2.0	1.5	2.5	2.4 (60%)
Policies to extend more specific incorporation of NMT in national transportation policy **(P3)**	2.0	2.5	3.0	2.5	2.0	2.4 (60%)
Incorporation of standards for the bicyclists and pedestrians provisions in new road infrastructure design **(P4)**	3.0	2.0	3.5	2.0	2.5	2.6 (65%)
Policies to provide NMT friendly infrastructure (separate bicycle lanes, wider pedestrian ways with cycling facility, subways and overhead passages at major intersections and bicycle parking places at all public transport stations and public places) **(P5)**	2.0	1.5	3.5	2.5	2.5	2.4 (60%)
Policies to provide soft loans and relaxing excise duty on importing bicycles/bicycle parts **(P6)**	3.0	2.0	2.0	2.5	2.5	2.4 (60%)
Regulations safeguarding NMT users and to cultivate respect for the NMT users among the law enforcing officers (Police) and the motor vehicle users **(P7)**	2.0	3.0	2.0	1.5	2.0	2.1 (52.5%
Awareness raising campaigns **(P8)**	2.5	2.5	3.0	3.0	3.0	2.8 (70%)

Policies to conduct awareness raising campaigns are found to be the most effective measures in order to implement NMT in Mumbai. *Policies to integrate NMT with the public transport system planning at city/municipality level* and *Policies to incorporate standards for the bicyclists and pedestrians provisions in new road infrastructure design* followed the awareness raising policies in their priority. It is interesting to observe that the three top rated measures represent three categories of policies viz. campaigning, short term measures (infrastructure improvement) and long term planning (incorporation of NMT facilities in the road design itself). It clearly highlights the need for integrated approach in development activities.

2.4 Recommendations to promote Non-motorized Transportation in Mumbai

Mumbai transportation needs are met by an efficient mass rapid transit system with a well spread network of metro rail and bus catering for the primary leg and walking, bus and other modes of transport catering for the access leg and egress leg of daily commuting. With very insignificant share of daily trips from the bicycles, and with an average trip length of 2.3 kilometers, the access leg (and to an extent egress leg) provides a wide scope for furthering NMT usage in Mumbai.

Non-motorized transportation modes in Mumbai were found to be having barriers in the form of lack of proper infrastructure for NMT users; unsafe conditions for NMT users; poor social acceptability; lack of institutional arrangements to integrate NMT in transportation planning; lack of national NMT strategy; lack of legal basis for NMT usage and poor attitudes of motor vehicle riders and the law enforces. Though lack of affordability was a barrier, affordability to motor vehicle ride was also found to be dominant factor restraining NMT usage.

Through multi-stakeholder participation, it was identified that policy measures viz. Policies to integrate NMT with the public transport system planning at local level; Formulation of National Strategy for NMT as a facilitating framework for local plans; Incorporation of standards for the bicyclists and pedestrians provisions in new road infrastructure design; Policies to provide NMT friendly infrastructure; Policies to provide soft loans and relaxing excise duty on importing bicycles/bicycle parts; Policies to make regulations safeguarding NMT users; and Policies to conduct promotional campaigns could be used for better adaptation of NMT in Mumbai.

An indicative estimation of cost benefits of initiatives to promote NMT viz. capacity building and provision of infrastructure revealed that promotion of NMT is has substantial benefits both in the form of GHG and local emissions control. Marginal Abatement cost was found to be in the range of 2-7 USD per ton of carbon reduced. Initiative of providing basic infrastructure like converting the existing roads into NMT friendly ones, bicycle stands at all rail stations and modernizing road intersections for NMT usage was found to be costing in the range of 15 to 136 million USD.

Based on multiple criteria of *administrative costs* (for the policy implementation), *financialbility (*of the policy measure), *environmental and other social benefits*, *administrative capability* (required to implement the policy measure) and *political willingness*, policies to create awareness and capacity (building) were given higher priority followed by Policies to integrate NMT with the public transport system at city/municipality level and Policies to incorporate standards for the bicyclists and pedestrians provisions in new road infrastructure design in their order of priority.

Through careful examination of various policy alternatives; their ranking as derived in the present study; characteristics of Mumbai transport system; experiences from the other similar cities; and social conditions of Mumbai the following recommendation are made for the better implementation of non-motorized transportation in Mumbai city –

1. ***Policies to provide separate bicycle lanes*** (semi-separate to begin with but fully separate lanes for the roads planned for the future) and parking places at all metro (rail) and bus stations in the MRTS network. This is the basic policy requirement for NMT implementation in Mumbai.

2. ***Promotional and awareness campaigns*****:** Strong promotional/awareness campaigns and capacity building programmes need to be developed for successful implementation of NMT.

Changing behavioral patterns is as difficult as providing exclusive infrastructure for NMT in short time. A fast moving city like Mumbai cannot afford too much of a disturbance due to the infrastructure development works. Thus, for all practical purposes, inter-model integration provides a better solution. Humid climatic conditions and predominant presence of urban poor further supports this observation.

3. ***Inter-modal integration***: Mumbai presents different levels of commuting, different levels of affordability and conditions under which people travel. It would be increasingly difficult to replace some modes with NMT. Instead it would be better if inter-modal integration is attempted. Various policy combinations that could be considered for Mumbai with least disturbance for the existing transport system are –

   - ❖ Clear footpaths and signaled intersections/overpass crossings covering entire access leg
   - ❖ Partly separated lane (painted) for bicycles with designated bicycle parking without fee, next to the rail/bus stations
   - ❖ Partly separated lane (painted) for bicycles with designated parking places with charges integrated in the monthly bus/train cards/passes
   - ❖ Bicycle rentals adjacent to the rail/bus stations with parking fee integrated into the monthly train/bus pass and partly separated (painted) bicycle lanes
   - ❖ Increase in the initial fare of auto-rickshaws and provide indirect access to transit points with shorter routs ear-marked for bicycles with a parking space without fee next to the rail station

As these modals need less of physical infrastructure and more of an institutional and financial arrangements/mechanisms, it presents a high likeliness of success in Mumbai. These measures could be *short but immediate measures to kick off with NMT intensification*. Higher affordability of Mumbai people can be effectively captures with bicycle storage facilities with parking fee.

As a long term measures, according to the findings of this study, NMT needs to be integrated into the public transportation system in Mumbai. One potential way of doing that is to make the access leg completely catered by NMT. This essentially indicates the development of "bike and ride" modal for access leg of daily commuting.

4. ***Developing "bike and ride (and bike)" model commuting***: As Mumbai has an efficient mass rapid transit system in place, it would be better to complement it with a well designed NMT integrated transit system. With an average 2.3 km access leg followed by primary leg and much shorter egress leg, policies to replace the exciting "ride and ride (and ride)" (in line with the "park and ride" modal) mode commuting by "bike and ride (and bike)" mode would lead to successful adaptation of NMT.

   This would particularly be effect with the fact that Mumbai expands northwards and the metro transit points are spanned at 1.6 km. With major infrastructure and development projects under consideration in Mumbai it would be worthwhile giving this concept a consideration for long term implementation of NMT.

5. ***Bicycle lending system and the necessary financial mechanisms***: Though providing bicycle lanes and parking at mass transport transit points help people use bicycle for the access leg, it is essential to cater for the egress leg also to make it a complete loop of "bike and ride (and bike)". Thus, bicycle lending system needs to be introduced at important business centers. This needs to be supported by various financial

mechanisms and incentive structures. This along with motor vehicle restrictive policies in the business district[9] would result in faster adaptation of NMT. Major social benefit of this system is huge employment generation, particularly for the urban poor. Thus, it adds to one of the major Millennium Development Goals – Poverty eradication in urban centers.

This system, for its successful implementation over a longer period of time needs to be complemented by the policies to internalize the NMT provisions and standards in transportation planning and design.

Need for cost-benefit estimation of inter-modal integration: Inter-model integrated policies need to be assessed for their benefits in terms of affordability of transport for low income urban groups (as % income spent), reduction in congestion, energy saving and control of CO_2 and other emissions. In the case of multi-model integrated access, fee structure needs to be fixed based on the affordability study and a complete cost-benefit analysis of the "policy modal". In this context, Global Environmental Facility (GEF) projects can be encouraged as this would involve substantial GHG reductions.

NMT implementation in Mumbai needs to be approached in a holistic manner integrating it with the characteristics of the existing transport network and the needs of Mumbai traffic and the population. To be successful, NMT needs to play a complementary role to the existing mass transport system and any single policy or isolated effort would prove expensive. For practical purposes strategies could be formulated both for short and long term applications.

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Appendix I:

Present scenario of NMT in Mumbai (pictures)

All transportation modes sharing the same road …

Cyclists at risk

No safe passage for pedestrians

Pedestrians at risk

Pedestrians at risk

Pedestrian space being used for garaging and cleaning of vehicles …

Roads are wide enough to accommodate NMT lanes but …

Appendix II:

Measures to promote NMT – An indicative presentation of implementation costs and benefits

Mumbai metropolitan region has a total of 1973 kilometers of urban road network which includes all the roads developed and maintained by the municipal authority. In the existing situation, though some of these roads do have footpath provision, they are either inadequate or in poor conditions with most of it encroached by the street vendors and motor vehicles for parking. And there exist no instance of demarcated lanes for non motorized modes like bicycles (except in one or two selective places like Bandra-Kurla Complex which is a newly developed CBD). Existing road intersections are not conductive for the users of non-motorized modes of transport.

The metro rail system, which is a major share holder in passenger kilometers catered, has three major lines namely *western*, *central* and *harbour* lines. These three lines put together have about 73 railway stations to handle the flow of passengers. Each of these stations is supported by bus stations just outside the rail stations both on east and west sides. In the present scenario no bicycle parking place is provided at these stations (146 of them). Thus the only NMT mode used to access these rail stations, apart from bus, is walking.

As this has not been practiced, the existing machinery in Mumbai is not equipped to incorporate NMT in transportation planning. Both the top level officials as well as down the chain workers are not aware of the technicality and the advantages of NMT and hence, NMT remained an unutilized mode of transport which has potential to help cities towards sustainable urban transportation. Therefore, any initiative to promote NMT in Mumbai would primarily needs the following two initiatives –

I. Sensitization of top officials and basic and advanced training for different levels of manpower involved in urban transportation and allied departments;

II. Development of basic infrastructure viz. roads with proper footpath and dedicated bicycle lane (could be joined with Footpath in some cases), providing bicycle parking places at all metro train stations (146), and improving road intersections making them conductive for NMT users.

I. Following table (Table 4.1.a.1) presents cost of training program which includes sensitization of top officials, basic training for middle level officials and advanced training for working class officers from urban transportation departments in Mumbai. The costs are found to be about 178,383 USD (0.178 million USD). This includes all components like organizations expenses and personnel. This training is expected to have a trickling down effect and also carry forward effects. Such training may be scheduled once every 5 years depending on the need. Such need has to be assessed systematically from time to time.

Table 4.1.a.1 Cost of training for the promotion of NMT in Mumbai

Capacity Building Activity	Total Number of Persons	Duration (days)	Costs (USD)
Sensitization	18	2	3,235
Basic training	491	5	37,794
Advanced training	1796	6	137,353
Total			**178,382**

II. Second basic requirement for the promotion of NMT is provision of infrastructure that includes NMT lanes on the urban road network, improving road intersections and providing bicycle parking places at all rail stations (146 parking places covering all 73 metro rail stations).

It is assumed that 1973 kilometers of road in Mumbai has no proper provision for FP and NMT lane. However, under various IDA projects, Mumbai is undertaking widening of roads. Therefore, while calculating the cost of road widening to provide NMT lane and Footpath, already planned road widening has been considered as base case and the incremental costs in making a provision for Footpath and NMT lane are considered costs for the NMT initiative. Cost of providing footpath and NMT lane on Mumbai roads are calculated and presented in the table below (Table 4.1.a.2). The costs were calculated for varying degree of efforts viz. 10%, 20%, 30% of the existing urban roads in Mumbai are improved to provide NMT lane (till 100% at an interval of 10%). Complete conversion of the existing road network to provide NMT in Mumbai is expected to cost about 51 million USD.

Table 4.1.a.2 Cost of Providing necessary infrastructure for the promotion of NMT in Mumbai

Percentage road converted to NMT system	Cost in USD			
	Road widening	Bicycle stands	Modernization of intersections	Total
10	5,100,130	1,586,957	8,360,870	15,047,957
20	10,200,261	1,586,957	16,721,739	28,508,957
30	15,300,391	1,586,957	25,082,609	41,969,957
40	20,400,522	1,586,957	33,443,487	55,430,966
50	25,500,652	1,586,957	41,804,348	68,891,957
60	30,600,783	1,586,957	50,165,217	82,352,957
70	35,700,913	1,586,957	58,526,087	95,813,957
80	40,801,043	1,586,957	66,886,957	109,274,957
90	45,901,174	1,586,957	75,247,826	122,735,957
100	51,001,304	1,586,957	83,608,696	136,196,957

Note: one USD is equal to 46 Indian Rupees

Number of bicycle stands remained constant for all scenarios as it is assumed that even if part of the existing road network is chosen to for conversion to NMT, bicycle parking may be provided at all rail stations. It is assumed that a kilometer length of road would have 1.5 intersections. And the number of road intersections to be improved has been calculated accordingly depending on the kilometers of road chosen to make NMT friendly. A ten percent conversion of roads to NMT friendly roads in Mumbai would cost 15 million USD where as 100% conversion would cost as much as 136 million USD.

Promoting NMT has many benefits viz. reduced air pollution, reduction in CO_2 (greenhouse gas) emissions, energy saving, slow down in motorization, reduction in congestion and other social benefits as explained in the main text. To provide an indicative idea of such benefits, reduction of CO_2 and other environmental emissions was calculated and presented in this annexure. Following are the data used and assumptions made while estimating the environmental benefits of NMT initiative in Mumbai:

Assumptions:

- Increase in NMT usage would result in reduction of three wheeler stock (3-wheelers are the major feeders to the main modes of transport in Mumbai)
- Efforts to promote NMT halts the growth of 3-wheelers in the future years and future reduction in number of 3-wheelers due to the promotion of NMT is assumed to be from the base year's stock
- Maximum reduction in 3-wheelers over five years time could be 75% of the base year's stock as minimum demand for 3-wheelers would exist even if best infrastructure is provided for NMT
- Emissions from the existing stock of 3-wheelers are assumed to be the base case emissions
- Utilization rate of 3-Wheelers is 120 kilometer per day; 300 days a year
- Life time of 3-wheeler is assumed to be 10 years
- Emissions are calculated over the life time of the vehicles
- Annual growth rate of 5.7% is assumed for the 3-wheelers and this is used in estimating the number of 3-wheelers in the future years.
- Percentage reduction of 3-wheelers over time due to increasing NMT is spread evenly over years
- Fuel efficiency of 0.05 liter per kilometer is assumed for 3-wheelers
- Carbon (CO_2) content per liter of fuel is assumed to be 0.0033 tons
- Total emissions are calculated as number of 3-wheelers * carbon content in the fuel * fuel efficiency * VKM_{life}
- Percentage of change in NMT usage is assumed to be same as that of 3-wheeler reduction. For instance, 10% roads converted to NMT compatible roads is assumed to be resulting in 10% reduction in number of 3-wheelers over the same period of time

Following are the CO_2 emissions both for the base case scenario (business-as-usual) and alternative scenarios of NMT promotion. Table below (Table 4.1.a.3) presents the CO_2 emissions under BAU scenario, alternative scenario and the incremental benefits. Ten percent reduction in the number of 3-weelers (from the base year) over the next five years (due to promotion of NMT) would result in reduction of CO_2 emissions by 7. 63 million tons over the next five years. NMT promotional efforts with a possible 75% reduction in number of 3-wheelers over the next five years would result in reduction 19.8 million tons of CO_2 over the same time period.

Table 4.1.a.3 CO_2 Reduction benefits from NMT promotion in Mumbai

	Year	Number of 3-W in BAU	VKM life	**Total base emissions**	**No. of 3-W in NMT Scenarios**	**Total emissions in alt. scenario**	**Total emissions reduction**
Ten percent reduction in number of 3-W over the next 5 years	Base Year	103,983	360,000	6,240,677	103,983	6,240,677	0
	2007	109,910	360,000	6,596,396	101,903	6,115,863	480,532
	2008	116,175	360,000	6,972,390	99,824	5,991,050	981,340
	2009	122,797	360,000	7,369,816	97,744	5,866,236	1,503,580
	2010	129,796	360,000	7,789,896	95,664	5,741,423	2,048,473
	2011	137,195	360,000	8,233,920	93,585	5,616,609	2,617,311
			Total	**43,203,095**		**35,571,859**	**7,631,236**
Twenty percent reduction in number of 3-W over the next 5 years	Base Year	103,983	360,000	6,240,677	103,983	6,240,677	0
	2007	109,910	360,000	6,596,396	99,824	5,991,050	605,346
	2008	116,175	360,000	6,972,390	95,664	5,741,423	1,230,967
	2009	122,797	360,000	7,369,816	91,505	5,491,796	1,878,021
	2010	129,796	360,000	7,789,896	87,346	5,242,169	2,547,727
	2011	137,195	360,000	8,233,920	83,186	4,992,542	3,241,378
			Total	**43,203,095**		**33,699,656**	**9,503,439**
Thirty percent reduction in number of 3-W over the next 5 years	Base Year	103,983	360,000	6,240,677	103,983	6,240,677	0
	2007	109,910	360,000	6,596,396	97,744	5,866,236	730,159
	2008	116,175	360,000	6,972,390	91,505	5,491,796	1,480,594
	2009	122,797	360,000	7,369,816	85,266	5,117,355	2,252,461
	2010	129,796	360,000	7,789,896	79,027	4,742,915	3,046,981
	2011	137,195	360,000	8,233,920	72,788	4,368,474	3,865,446
			Total	**43,203,095**		**31,827,453**	**11,375,642**
Fifty percent reduction in number of 3-W over the next 5 years	Base Year	103,983	360,000	6,240,677	103,983	6,240,677	0
	2007	109,910	360,000	6,596,396	93,585	5,616,609	979,786
	2008	116,175	360,000	6,972,390	83,186	4,992,542	1,979,849
	2009	122,797	360,000	7,369,816	72,788	4,368,474	3,001,342
	2010	129,796	360,000	7,789,896	62,390	3,744,406	4,045,490
	2011	137,195	360,000	8,233,920	51,992	3,120,339	5,113,581
			Total	**43,203,095**		**28,083,047**	**15,120,048**
Seventy five percent reduction in number of 3-W over the next 5 years	Base Year	103,983	360,000	6,240,677	103,983	6,240,677	0
	2007	109,910	360,000	6,596,396	88,386	5,304,575	1,291,820
	2008	116,175	360,000	6,972,390	72,788	4,368,474	2,603,916
	2009	122,797	360,000	7,369,816	57,191	3,432,372	3,937,444
	2010	129,796	360,000	7,789,896	41,593	2,496,271	5,293,625
	2011	137,195	360,000	8,233,920	25,996	1,560,169	6,673,751
			Total	**43,203,095**		**23,402,539**	**19,800,556**

Marginal cost of abatement for CO_2 was calculated by adopting the following equation:

$$MC = \frac{\sum C_1 - C_0}{\sum E_0 - E_1}$$

where

E_0 Base level of emissions

C_0 Cost at E_0

E_1 Reduced emission level

C_1 Cost at E_1

Table 4.1.a.4 presents the MAC for CO_2 reduction by promoting NMT usage in Mumbai. At ten percent conversion of roads to NMT friendly roads, the MAC was found to be as low as 1.97USD/ton of carbon. At 100% conversion of roads (75% reduction in 3-wheelers stock) to NMT friendly roads, MAC was found to be 6.87 USD per ton of CO_2 reduction. They certainly present a competitive scenario for Carbon reduction and hence, this activity may even have a CDM potential in future.

Table 4.1.a.4 Marginal Abatement Cost of CO_2 reduction by promoting NMT in Mumbai

Cost of NMT implementation ($)		**CO_2 reduction (tons)**		**Cost/ton of emission reduction ($)**
10% roads converted to NMT	15,047,957	10% 3-W reduction	7,631,236	1.97
100% roads converted to NMT	136,196,957	75% 3-W reduction	19,800,556	6.87

Table 4.1.a.5- 4.1.a.7 presents possible co-benefits in terms of CO, HC and NOx reductions resulting from the NMT promotional initiatives in Mumbai. Apart from these co-benefits there could be other benefits from congestion reduction, reduced travel activity (motorized) and so on. A complete cost-benefit analysis including all these aspects would further support this initiative to promote NMT is Mumbai.

Table 4.1.a.5 CO Reduction benefits from NMT promotion in Mumbai

	Year	Number of 3-W in BAU	VKM life	**Total base emissions**	**No. of 3-W in NMT Scenarios**	**Total emissions in alt. scenario**	**Total emissions reduction**
Ten percent reduction in number of 3-W over the next 5 years	Base Year	103,983	360,000	16,097	103,983	16,097	0
	2007	109,910	360,000	17,014	101,903	15,775	1,239
	2008	116,175	360,000	17,984	99,824	15,453	2,531
	2009	122,797	360,000	19,009	97,744	15,131	3,878
	2010	129,796	360,000	20,092	95,664	14,809	5,284
	2011	137,195	360,000	21,238	93,585	14,487	6,751
			Total	111,434		91,750	19,683
Twenty percent reduction in number of 3-W over the next 5 years	Base Year	103,983	360,000	16,097	103,983	16,097	0
	2007	109,910	360,000	17,014	99,824	15,453	1,561
	2008	116,175	360,000	17,984	95,664	14,809	3,175
	2009	122,797	360,000	19,009	91,505	14,165	4,844
	2010	129,796	360,000	20,092	87,346	13,521	6,571
	2011	137,195	360,000	21,238	83,186	12,877	8,360
			Total	111,434		86,921	24,512
Thirty percent reduction in number of 3-W over the next 5 years	Base Year	103,983	360,000	16,097	103,983	16,097	0
	2007	109,910	360,000	17,014	97,744	15,131	1,883
	2008	116,175	360,000	17,984	91,505	14,165	3,819
	2009	122,797	360,000	19,009	85,266	13,199	5,810
	2010	129,796	360,000	20,092	79,027	12,233	7,859
	2011	137,195	360,000	21,238	72,788	11,268	9,970
			Total	111,434		82,092	29,341
Fifty percent reduction in number of 3-W over the next 5 years	Base Year	103,983	360,000	16,097	103,983	16,097	0
	2007	109,910	360,000	17,014	93,585	14,487	2,527
	2008	116,175	360,000	17,984	83,186	12,877	5,107
	2009	122,797	360,000	19,009	72,788	11,268	7,741
	2010	129,796	360,000	20,092	62,390	9,658	10,435
	2011	137,195	360,000	21,238	51,992	8,048	13,189
			Total	111,434		72,435	38,999
Seventy five percent reduction in number of 3-W over the next 5 years	Base Year	103,983	360,000	16,097	103,983	16,097	0
	2007	109,910	360,000	17,014	88,386	13,682	3,332
	2008	116,175	360,000	17,984	72,788	11,268	6,716
	2009	122,797	360,000	19,009	57,191	8,853	10,156
	2010	129,796	360,000	20,092	41,593	6,439	13,654
	2011	137,195	360,000	21,238	25,996	4,024	17,214
			Total	111,434		60,362	51,072

Table 4.1.a.6 HC Reduction benefits from NMT promotion in Mumbai

	Year	Number of 3-W in BAU	VKM life	Total base emissions	No. of 3-W in NMT Scenarios	Total emissions in alt. scenario	Total emissions reduction
Ten percent reduction in number of 3-W over the next 5 years	Base Year	103,983	360,000	13,102	103,983	13,102	0
	2007	109,910	360,000	13,849	101,903	12,840	1,009
	2008	116,175	360,000	14,638	99,824	12,578	2,060
	2009	122,797	360,000	15,472	97,744	12,316	3,157
	2010	129,796	360,000	16,354	95,664	12,054	4,301
	2011	137,195	360,000	17,287	93,585	11,792	5,495
			Total	90,702		74,681	16,021
Twenty percent reduction in number of 3-W over the next 5 years	Base Year	103,983	360,000	13,102	103,983	13,102	0
	2007	109,910	360,000	13,849	99,824	12,578	1,271
	2008	116,175	360,000	14,638	95,664	12,054	2,584
	2009	122,797	360,000	15,472	91,505	11,530	3,943
	2010	129,796	360,000	16,354	87,346	11,006	5,349
	2011	137,195	360,000	17,287	83,186	10,481	6,805
			Total	90,702		70,750	19,952
Thirty percent reduction in number of 3-W over the next 5 years	Base Year	103,983	360,000	13,102	103,983	13,102	0
	2007	109,910	360,000	13,849	97,744	12,316	1,533
	2008	116,175	360,000	14,638	91,505	11,530	3,108
	2009	122,797	360,000	15,472	85,266	10,744	4,729
	2010	129,796	360,000	16,354	79,027	9,957	6,397
	2011	137,195	360,000	17,287	72,788	9,171	8,115
			Total	90,702		66,819	23,882
Fifty percent reduction in number of 3-W over the next 5 years	Base Year	103,983	360,000	13,102	103,983	13,102	0
	2007	109,910	360,000	13,849	93,585	11,792	2,057
	2008	116,175	360,000	14,638	83,186	10,481	4,157
	2009	122,797	360,000	15,472	72,788	9,171	6,301
	2010	129,796	360,000	16,354	62,390	7,861	8,493
	2011	137,195	360,000	17,287	51,992	6,551	10,736
			Total	90,702		58,958	31,743
Seventy five percent reduction in number of 3-W over the next 5 years	Base Year	103,983	360,000	13,102	103,983	13,102	0
	2007	109,910	360,000	13,849	88,386	11,137	2,712
	2008	116,175	360,000	14,638	72,788	9,171	5,467
	2009	122,797	360,000	15,472	57,191	7,206	8,266
	2010	129,796	360,000	16,354	41,593	5,241	11,114
	2011	137,195	360,000	17,287	25,996	3,275	14,011
			Total	90,702		49,132	41,570

Table 4.1.a.7 NOx Reduction benefits from NMT promotion in Mumbai

	Year	Number of 3-W in BAU	VKM life	**Total base emissions**	**No. of 3-W in NMT Scenarios**	**Total emissions in alt. scenario**	**Total emissions reduction**
Ten percent reduction in number of 3-W over the next 5 years	Base Year	103,983	360,000	168	103,983	168	0
	2007	109,910	360,000	178	101,903	165	13
	2008	116,175	360,000	188	99,824	162	26
	2009	122,797	360,000	199	97,744	158	41
	2010	129,796	360,000	210	95,664	155	55
	2011	137,195	360,000	222	93,585	152	71
			Total	1,166		960	206
Twenty percent reduction in number of 3-W over the next 5 years	Base Year	103,983	360,000	168	103,983	168	0
	2007	109,910	360,000	178	99,824	162	16
	2008	116,175	360,000	188	95,664	155	33
	2009	122,797	360,000	199	91,505	148	51
	2010	129,796	360,000	210	87,346	142	69
	2011	137,195	360,000	222	83,186	135	87
			Total	1,166		910	257
Thirty percent reduction in number of 3-W over the next 5 years	Base Year	103,983	360,000	168	103,983	168	0
	2007	109,910	360,000	178	97,744	158	20
	2008	116,175	360,000	188	91,505	148	40
	2009	122,797	360,000	199	85,266	138	61
	2010	129,796	360,000	210	79,027	128	82
	2011	137,195	360,000	222	72,788	118	104
			Total	1,166		859	307
Fifty percent reduction in number of 3-W over the next 5 years	Base Year	103,983	360,000	168	103,983	168	0
	2007	109,910	360,000	178	93,585	152	26
	2008	116,175	360,000	188	83,186	135	53
	2009	122,797	360,000	199	72,788	118	81
	2010	129,796	360,000	210	62,390	101	109
	2011	137,195	360,000	222	51,992	84	138
			Total	1,166		758	408
Seventy five percent reduction in number of 3-W over the next 5 years	Base Year	103,983	360,000	168	103,983	168	0
	2007	109,910	360,000	178	88,386	143	35
	2008	116,175	360,000	188	72,788	118	70
	2009	122,797	360,000	199	57,191	93	106
	2010	129,796	360,000	210	41,593	67	143
	2011	137,195	360,000	222	25,996	42	180
			Total	1,166		632	534

IV.2 Promoting Reduction in Travel Demand in Transport Sector of Asian Cities: Case of Bangkok, Thailand

Ranjith Perera[1], Ariva Sugandi Permana[2], and Wanpen Charoentrakulpeeti[3]

1. Introduction

Cities in Asian developing countries are generally characterized by a relatively high density, low levels of motorization, relatively high public transport and bicycle usage, high density corridor orientations radiating from the city centre, and generally mixed land uses (SUTP, 2003). This statement brings into two situations; first, with respect to optimistic viewpoint, this situation provides a potential basis for sustainable urban development. Second, in a pessimistic viewpoint, it is believed that a low level of motorization in developing countries is a sign of contraction in development process rather than purposely controlled. This statement may also be misleading since cities in South-east Asian countries such as Bangkok, Jakarta and Manila show characteristics that are different from above description. However, the statements perhaps true for some cities in Asian developing countries.

Reduction in travel demand in transportation sector is one of the demand management interventions toward sustainable transport. Sustainable transport is a buzz phrase, which was coined in the late 20th century followings the definition of sustainable development proposed by Bruntland Commission in 1987, to describe all forms of transport which minimize emissions of carbon dioxide and other pollutants. Sustainable transport can mean public transport, car sharing, walking and cycling as well as technology such as electric and hybrid cars. The reduction of travel demand that minimizes traffic volume can also contribute to sustainable transport. This report attempts to discuss the reduction of travel demand by means of various possible interventions which are presently being undertaken as well as planned for making the city of Bangkok, a sustainable city.

1.1 Current urban condition

It is necessary to explore the conditions of Bangkok Metropolitan with respect to general situation of the Metropolitan. The comprehension on the urban condition of Bangkok would give an essential picture on the reduction of travel demand endeavors undertaken by authorities and stakeholders. Before going into this a brief historical background of Bangkok city is given below.

1.1.1 Brief history of Bangkok

Bangkok is the largest city in Thailand, as well as its capital city. As a metropolitan region, Bangkok is also the cultural, educational, political and economic center of Thailand. Bangkok has grown and expanded to include the area Thonburi, which had at one point been the capital of Siam, and the combined area is commonly known as Krungthep Mahanakhon for Thai people. It is only the foreigners who called the city of

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Bangkok, which in fact is a place name for a small hamlet called Bangkok ('Bang' means village and 'kok' means olive kind of tree). Krungthep Mahanakhon means the City of Angels.

Bangkok or "Krungthep Mahanakhon" was established as the capital of Thailand in 1782, the year in which King Rama I ascended to the throne. Between 1894 and 1906, during the reign of King Rama V, the country was divided into "monthons". Bangkok was in Monthon Krungthep which was under the Ministry of Urban Affairs. In 1937, the Bangkok Municipality and the Thon Buri Municipality were established according to the Municipal Government Act 1933. In December 1971, the Revolutionary Party, the ruling party, issued National Executive Council Order Number 24 which merged Changwat Phra Nakhon and Changwat Thonburi into single Changwat called "Bangkok and Thonburi Metropolis". At the same time, National Executive Council Order Number 25 merged the Bangkok Municipality and Thonburi Municipality into "Metropolitan City Municipality".

In 1972, National Executive Council Order Number 335 reorganized the form of local government in the metropolis by amalgamating the activities of the Metropolis of Bangkok and Thonburi, the Bangkok and Thonburi Provincial Administration, the Metropolitan City Municipality and Sanitation Administration into Bangkok Metropolitan Administration (BMA). In December 1981, the Bangkok Metropolitan Administration Act of 1975 was amended. The amendment stipulated that Governor and Deputy Governors of the BMA should be appointed by the Minister of Interior. In August 1985, the new Act came into effect. According to the Act, the Governor is elected by popular vote and four Deputy Governors are appointed by the Governor for four-year term. The Bangkok Metropolitan Assembly comprises of elected members, the number of members depends on the population of Bangkok Metropolis. One assemblyman represents every one hundred thousand people. At the district level, district councilor of at least 7 persons of each district are elected, the tenure is also 4-year term[4].

1.1.2 Population and jobs

The area of Bangkok is presently about 1,568.7 km2. The population of Bangkok as of 2005 was approximately 7 million people as shown in Figures 4.2.1 and 4.2.2 below. Figure 2 shows percentage of Bangkok Population as portion of total Thai Population. It makes the population density as of 2005 about 4,513.9 people per km2. This very highly populated city is currently faced with pollution problems in addition to traffic congestion and critical housing shortages, like any other large city. Bangkok's weather is hot and humid year round with temperatures ranging from 26 to 31 ^{O}C (78 - 90 ^{O}F). Most residents of Thailand are native Thais, although there is an influx of Chinese immigrants as well as Indians, Arabs, Malays and Europeans. Most Thais are welcoming and friendly towards visitors to Bangkok, as it is one of the most highly visited cities in Southeast Asia. In addition, Bangkok has an important influence on Southeast Asia's industrial and financial sectors.

The employment condition by industry in Bangkok in 2002 is shown in the Table 4.2.2 below. Data on employment shows that manufacturing was still predominant, and it seems the same trend also occur in 2003 and onwards. The manufacturing industries in Bangkok is predominated by non-polluting industries, since most of heavy and polluting industries have been moved to adjacent provinces, particularly to the Eastern Seaboard, Samutprakarn Province and Pathumthani Province. Data on population of Bangkok and Thailand according to age group for the year of 2000 is shown in Table 4.2.3. It shows that productive age group (15-59 years old) accounts for 4,684.0 thousand people (or 74 percent), while non-productive age groups (<15 years old and >59 years old) account for 1,636.0 thousand people (or 26 percent). As a comparison, Bangkok population contributes 10.43 percent of the total Thai population.

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4. Source: http://www.bma.go.th.

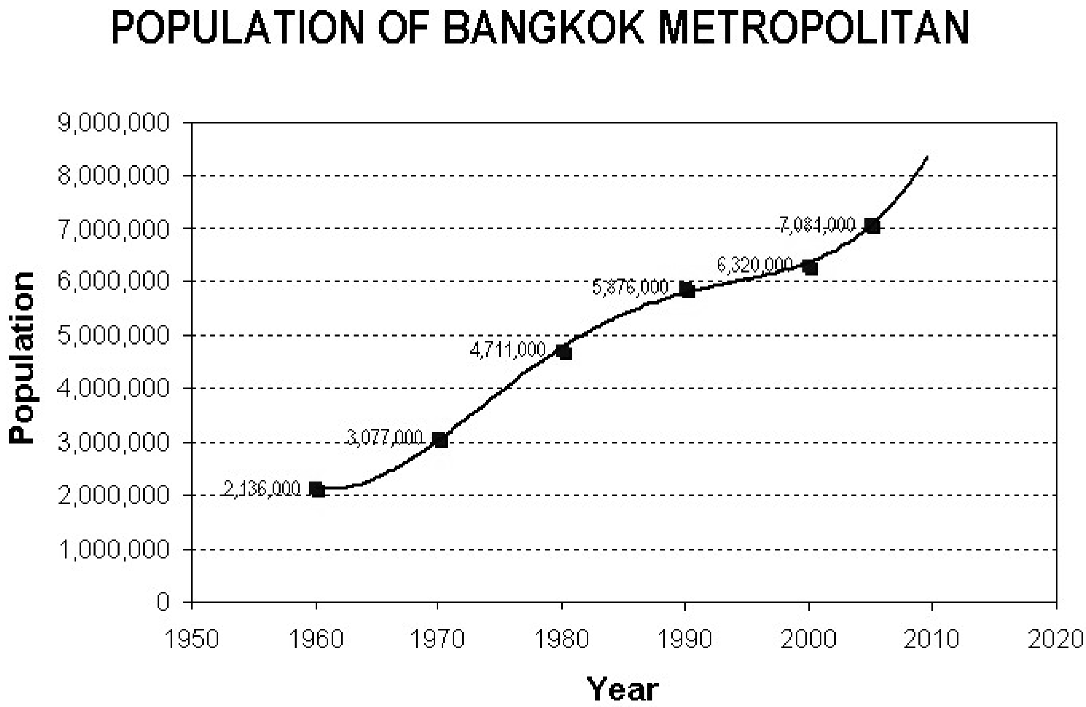


Figure 4.2.1 Population of Bangkok Metropolitan 1950-2010

Data Source: Pornchokchai (2003) and others

With respect to percentage of total population of Thailand, population of Bangkok shows relatively a stable proportion for the last two decades (see Figure 4.2.2).

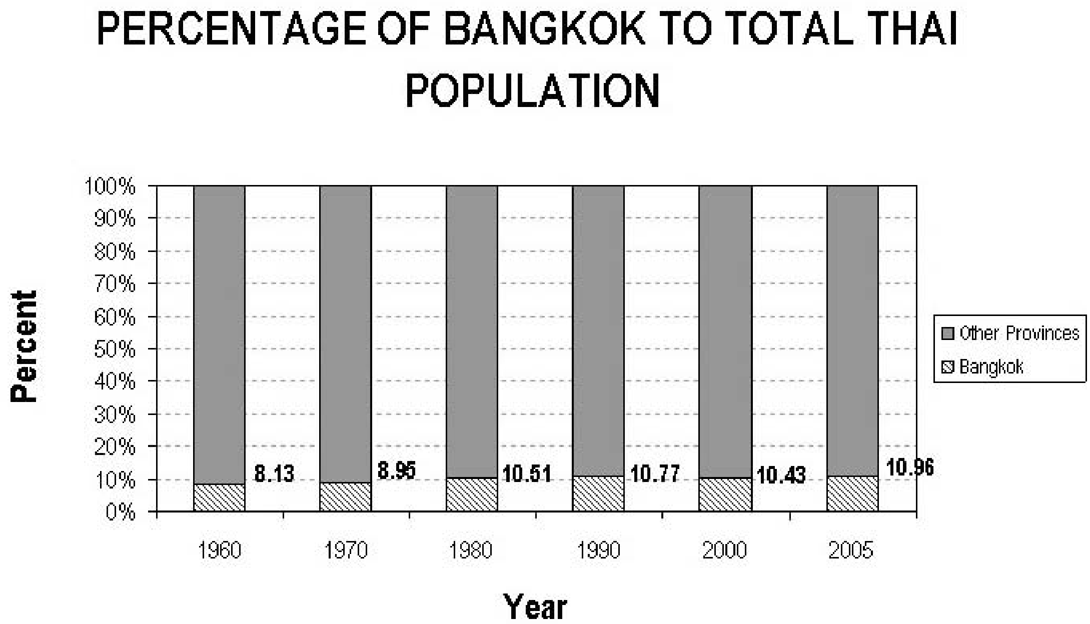


Figure 4.2.2 Percentage of Bangkok Population as Proportion of Total Thai Population 1960-2005

Data Source: Pornchokchai (2003) and others

According to "Demographia"[5], Central Business District in Bangkok consists of the Areas of Ploenchit, Sukhumvit, Silom, Suriwong, Sathon and Phatumwan. The area of Bangkok's CBD is about 20.2 km2. Total employment in the CBD based on 1990 data was 271,944, while the job density in the CBD was about 13,200 employments per sq km.

Table 4.2.1 Population of Bangkok

Year	Approximate Total Population of Bangkok	Percentage of the Population of Thailand
1960	2,136,000	8.13
1970	3,077,000	8.95
1980	4,711,000	10.51
1990	5.876,000	10.77
2000	6,320,000	10.43
2005	7,081,000	10.96

Source: Pornchokchai (2003) and Other Sources

Table 4.2.2 Labor Force by Industry in Bangkok Metropolitan Region

Industry	Bangkok (2002)	
	Estimate Number	%
Mining and quarrying	8,898	0.2
Manufacturing	1,592,742	35.8
Electricity, gas and water	115,674	2.6
Construction	520,533	11.7
Wholesale, retail trade, restaurants/ hotels	956,535	21.5
Transport, storage and communication	369,267	8.3
Financing, insurance, real estate and business services	587,268	13.2
Community, social and personal services	298,083	6.7
Total	**4,449,000**	**100.0**

Source: Chandoevit (2003), Thailand in Figure 1997-1998

Above table shows that service industries are predominant in Bangkok. This is not the case for surrounding provinces where manufacturing is dominant. This situation exists as a result of the relocation of most of the industries in Bangkok to the adjacent provinces, particularly Pathumtani Province, Samutprakarn Province and Eastern Seaboard.

The average annual rate of employment growth[6] in Thailand in the 1970s was 2.7 percent, compared with 2.9 percent in labor force growth caused by rapid population growth in the 1950s and 1960s. As a result, unemployment reached 1.7 million in 1985, which corresponded to an unemployment rate of around 6.3 percent. Agriculture was the major employer with about 69 percent of total employment in the mid-1980s, a decline from 84 percent in 1960. Between 1970 and 1983 manufacturing increased its share of the total employed labor force from 4.1 percent to 7.4 percent. Commerce increased from 1.6 percent to 8.7 percent, and services from 7 percent

5. Source: http://www.demographia.com, last accessed, 21 May 2006
6. Source: US Library of Congress web-site, (http://www.countrystudies.us/thailand/), last accessed 21 May 2006

to 10 percent during the same period. Based on this trend, the current employment rate in Bangkok's CBD is 3.0 percent. With this rate, current job density in the CBD is about 20,974 employments per km2.

Bangkok's CBD is largely commercial area in nature. Thus it has a single use instead of mixed use of land. Most of the Bangkokians are commuters and motorized-transport dependents. Promotion of mixed land use in this case should be undertaken in region basis and simultaneously promotion of balance between jobs and housing consequently might follow the same fashion. Promoting a "balance" of employment and housing at the sub-regional level has been identified as a way to reduce commute distances. However this idea could not be easily implemented since various employments may not be available at the same cluster with housing. Therefore commuting for workers is still required.

Table 4.2.3 Population by Age Group in Bangkok and Thailand (Based on Data of Year 2000)

Age Group	Bangkok (thousand)	Thailand (thousand)		
		Urban	Rural	Total
0-4	329.2	1,145.8	3,241.3	4,387.1
5-9	367.5	1,295.5	3,735.4	5,030.9
10-14	407.4	1,377.9	3,825.6	5,203.5
15-19	546.9	1,640.1	3,701.2	5,341.3
20-24	723.1	1,804.1	3,127.6	4,931.6
25-29	716.5	1,868.9	3,379.6	5,248.5
30-34	664.0	1,814.6	3,634.2	5,448.7
35-39	577.4	1,742.2	3,644.7	5,386.9
40-44	526.4	1,606.1	3,243.6	4,849.7
45-49	423.6	1,254.2	2,622.5	3,876.7
50-54	303.9	916.7	1,998.1	2,914.7
55-59	202.2	672.3	1,612.2	2,284.5
60-64	190.2	593.9	1,404.3	1,998.2
65-69	136.7	437.0	1,089.1	1,526.0
70-74	100.9	437.0	731.4	1,043.4
75-79	53.2	174.4	420.5	594.9
80-84	28.5	101.9	221.9	323.8
>85	22.5	76.4	150.3	226.8
Total	**6,320.2**	**18,833.7**	**41,783.5**	**60,617.2**

Source: National Statistical Office (2004), http://www.nso.go.th

The idea of balance between housings and jobs is that if people could live closer to their employment sites, they would do so to reduce commute time and costs. Balanced communities offer affordable, high-quality housing that is close enough to employment sites that residents can avoid commuting long distances on congested highways to get to work (USEPA, 2001). Those promoting a balance between job and housing suggest that increasing the housing opportunities near major employment centers allows workers to locate closer to their jobs and thereby reduce traffic.

1.1.3 Education level

In 2000 in Bangkok metropolitan, there were 5,562,368 people or about 93.8 percent of the total population which are older than six years are engaged with education, while the number of illiterate population for the same range of age was 303,971 people or 5.13 percent[7].

7. According to "2000 Population and Housing Census", Bangkok Metropolitan Administration

With respect to education at various levels in Bangkok metropolis, it showed that the number of people who completed the primary education level was equal to 2,095,219 people or 35.34 percent; those completed high school level (upper secondary school) was 1,801,452 or 30.39 percent, and those completed higher education level was 1,564,322 persons or 26.39 percent.

In comparison with the previous two population and housing censuses of 1980 and 1990 in Bangkok Metropolitan, the education level of people of six years old and up of 2000 it was found that people seems undergone education level improvement. It has increased from 3,621,785 (in 1980) and 4,940,213 (in 1990) to 5,562,368 (in 2000) or an increased change of 13.01 percent, while illiteracy rate of population has reduced by 14.10 percent.

1.1.4 Income level

Population of Thailand is more than 60 million as shown in Table 4.2.3. Compared with other neighboring countries, this figure is obviously 3 times that of Malaysia and 15 times that of Singapore. Thailand has a substantial rural population living at subsistence levels, and Bangkok accounts for more than 10 percent of the population The Thailand National Statistics Office has released figures on household expenditure and income, further reinforcing this.

Households in Bangkok and those in the neighboring provinces such as Nonthaburi, Pathumthani, and Samutprakan earn an average of Baht 27,514 per month (around USD 680), and spend about Baht 20,598 (around USD 510). However, nationwide the average is Baht 13,418 (USD 330) and Baht 10,908 (USD 270). Overall households in Bangkok earn and spend more than double of their neighborhood provinces. These differences are even more remarkable when one considers the extremes in income. A vast majority of farming families in the North and East earn considerably less while a highly cash-rich elite and upper middle class accounting for much of this spending. The average monthly income and expenditure for the whole country during the period of 1975-2001 is shown in Table 4.2.4 below. The table also shows the consistent declining in the average household size, from 5.5 persons per household in 1975 to 3.6 in 2001. If the trend is maintained, current household size perhaps decline to 3.5. This is also shown in Figure 4.2.3.

Table 4.2.4 Average Household’s Monthly Income and Expenditure in Thailand

Year	Average Household Size	Average Monthly Income (Baht)	Average Monthly Expenditure (Baht)
1975-1976	5.5	1,928	2,004
1981	4.5	3,378	3,374
1986	4.3	3,631	3,783
1988	4.0	4,106	4,161
1990	4.1	5,625	5,437
1992	3.9	7,062	6,529
1994	3.8	8,262	7,567
1996	3.7	10,779	9,190
1998	3.7	12,492	10,389
1999	3.7	12,729	10,238
2000	3.6	12,150	9,848
2001	3.6	12,185	10,025

Source: National Statistical Office of Thailand (http://www.nso.go.th)
USD 1 = THB 40 (as of July 2006)

With respect to expenditure, as shown in Table 4.2.4, the expenditure was mainly on "accumulated investments of sizable value" such as land and homes. On the whole, average income rose 5 percent on a year to year basis, but average household debt rose 12.6 percent compared to the year 2000, with farm workers reporting that expenses exceeded income by an average of 3 percent. The *National Statistics Office* employed a random survey methodology in each province, based on respondent's self report of income and expenditure in the period spanning January to June each year. A stratified, three-stage sample design was adopted for the survey since 1975-76 until 1986. The primary and secondary sampling units were Amphoes (Districts) and blocks (in municipal areas/urban areas) or villages (non-municipal areas/rural areas) respectively. The private households were the ultimate sampling units.

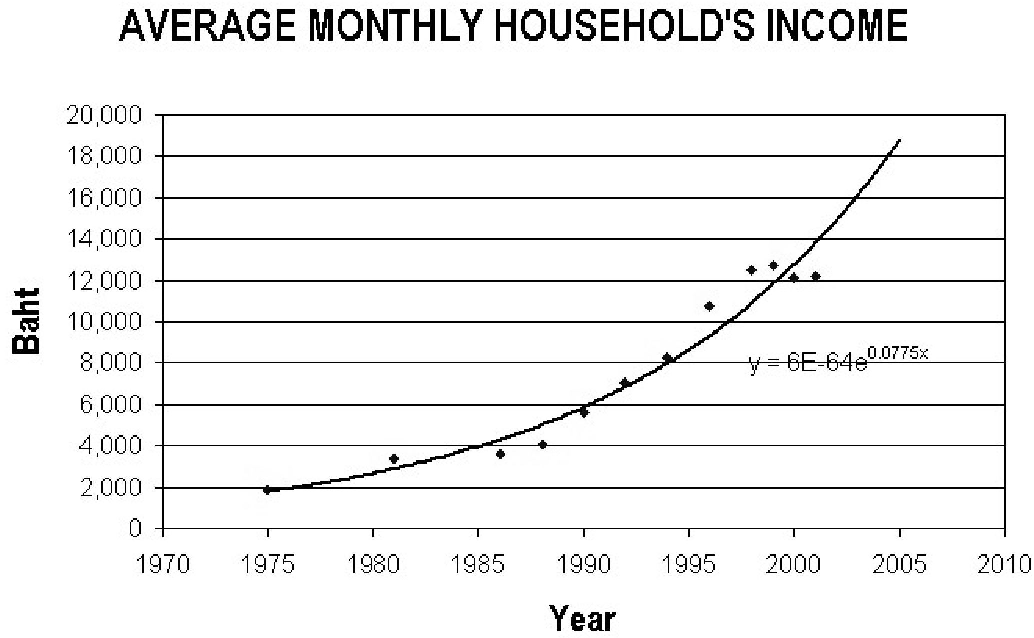


Figure 4.2.3 Average Monthly Income of Thai Households 1975-2001

Average monthly income of Thai households shows a trend of consistent increase over the years. These figures would be larger in the case of Bangkok and adjacent provinces. Since Bangkok is Thailand's center of economic activities with larger proportion of cash circulation compared with other regions within Thailand. Despite low average disposable income compared to other developed neighboring markets such as Malaysia and Singapore and averages worldwide, Bangkok does provide opportunities for marketers who spend time on targeting. Even within Bangkok, disposable income varies widely, and attention to market segmentation and targeting should be rewarding. The averages from the NSO data reported here also does not report the major differences in disposable income within other urban centers such as Chiang Mai, and tourist centers such as Phuket and Pattaya, the latter two catering to the highly profitable tourism industry with available foreign exchange.

1.1.5 Land use planning and zoning

Land use in Bangkok Metropolitan was classified into two broader zones, comprising of the inner city districts within 10 kilometers of the Rattanakosin Area which is the main concentration area for government offices, commercial activities, educational establishments and living quarters. The outer bound is defined as the next 10 kilometers ring functioning as the new central business district accommodating outward increase in the numbers of businesses and commercial activities. Presently, the key government operations and businesses and commercial activities are concentrated in these inner city bounds and it continues to be the major employment areas. Intensification of economic activities and continued demand for centrally located sites is the main reason for the rise in land price in these locations.

The outer part of Bangkok is defined as the 20-40 km ring from the centre and linked to it by radial roads northwards and southwards to Nonthaburi and Samutprakarn and eastwards and westwards to Chachoengsao and Nakhon Pathom (see Figure 4.2.4). Around 25 percent of these suburban areas were classified as residential areas; this figure is likely to increase given the continued rise in land prices in the inner city area as well as the deterioration in urban pollution which are the main discouraging factors for middle to upper income level groups to live in the inner city area. The remaining 75 percent of the land are utilized for manufacturing and commercial activities while large parts of the land remain under agricultural production. The outward expansions of economic activities together with the economic and environmental factors are likely to intensify land use in these fringe areas. Though linked with the inner city by expressways and arterial roads, of adequate distributor roads and access roads and lagging development of urban amenities are said to be the prevalent problems of these areas.

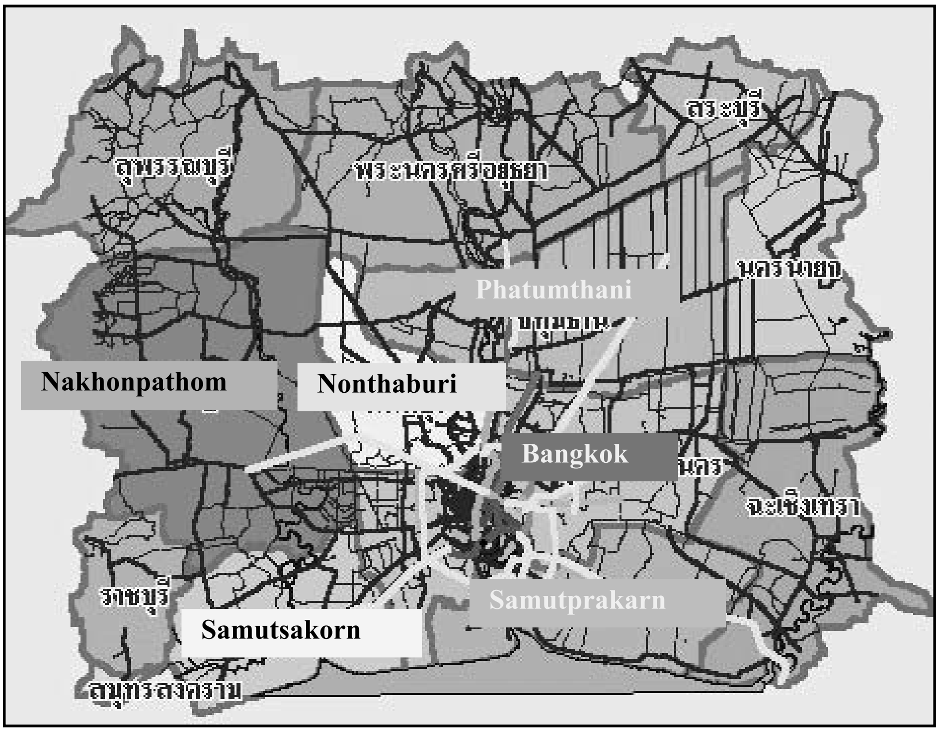


Figure 4.2.4 Bangkok and Adjacent Povinces

Between 1960 and 1970, Bangkok, with respect to spatial terms, has expanded by over 100 percent from an area of 96.4 km2 to 189.7 km2 with the incorporation of adjoining Thonburi province. By the late 1990s, the population of Bangkok has escalated to 5.8 million, equivalent to 10.8 percent of the total population of Thailand as shown in Table 4.2.1, and its area has extended to 1,568 km2. The functional area of the city would be greater than the population figures indicated since adjoining provinces such as Nonthaburi and Pathumthani have become residential towns for commuters who work inside Bangkok. A large percentage of blue and white collar workers in these two provinces as well as in Samutprakarn make up a sizeable day time population of the Metropolis. With the inclusion of the five vicinity provinces, the population of the extended Bangkok will be 8.1 million equivalents to 14.0 percent of the total population of Thailand. Between 1994 and 1995, Thailand's average rate of population increase was 0.6 percent. With out movement of people to the vicinity provinces, Bangkok's population actually reduced by an average of -0.2 percent during the same period. Population increase in the five vicinity provinces on the other hand was significantly higher than the national population growth rate ranging from 1.3 percent annually for Samutprakarn, 1.5 percent p.a. for Nakhon Pathom, 1.9 percent p.a. for Nonthaburi and equal rate of 2.5 percent p.a. for Pathumthani and Samutsakorn.

The pattern of urban land use has been mainly influenced by private developers due mainly to weak enforcements of planning and control measures of concerned authorities in the public sector. During the early 1980s, density increased on the eastern side of the city while urbanization on the western part of the city was mainly at the expense of loss of agricultural land. The recent completion of the outer ring road will have the same effect in generating urban sprawl as the arterial road Vipavadee Rangsit road, Phaholyotin Road, the Rangsit Nakhon Nayok Road have had in the past.

The declaration of '*Control Area'* places legal restraints on land usage, frontage access area, floor space allocations. A total area of 140,000 *rai*[8] to be preserved as the 'green belt area' on the east as well as on the western part of the metropolis on the eastern and the western part of the Metropolis as shown in Figure 4.2.1. Housing developments continued to expand despite these legal restraints. This was mainly due to rising market prices for land; lower returns from utilization of land for agricultural production as opposed to non-agricultural activities (i.e., primarily commercial, real estate development). Numerous private housing developments have been emerged to take opportunity of economic boom during the late 1980s, a period which increased business volume of professional developers and created many amateur developers. In the city centers the real estate developers engage with the construction of high rise apartment by mostly transforming slum areas to middle and upper class housings. The real estate development in Bangkok Metropolitan Region continues not only in the city centers but also in the peripheral provinces.

Vicinity provinces such as Nonthaburi, Pathumthani, Samutprakarn, Nakornpatom and Samutsakorn are packed with recent private housing projects of varying price ranges. The expansion of road infrastructure and bridges across the Chao Phraya River has been accompanied by ribbon development, leap frog phenomenon with limited spread effects on the hinterlands. The slowdown of the fever following the event of the Gulf war pushed many developers, professional and amateurs alike into bankruptcy. Nevertheless, land continues to be one of the less risky areas of investment. Since land tax is minimal, the opportunity cost for holding land as an asset was negligible and with financial institutions eager to lend large amount of capital using over-valued land as collateral, the Thai economy was heading for a predictable crash which eventually happened in the mid 1997.

The land use plan and its associates in Bangkok Metropolitan are principally considering the following legal basis:

- City Planning Act 1975;
- Land Reform for Agriculture Act 1975;
- Construction Building Control Act 1979;
- The Bangkok Administration Act 1985;
- The Environmental Act 1992;
- The Thai Constitution 1997; and
- Ministerial Regulation Number 414 BE 2542 (1999), the Open Space Plan and the enclosed information.

8. A local unit of area of which 1 *rai* is equal to 1,600 m2

By considering those legal bases, the Bangkok Comprehensive Plan was derived from the Land Use Plan which is enclosed in the Ministerial Regulation Number 414 BE 2542 (1999) and enacts as the implementation guidelines of the City Planning Act 1975.

The Bangkok Comprehensive Plan (1st revised edition) in 1999

Bangkok Metropolitan Administration has planned and made Bangkok Metropolitan Comprehensive Plan (1^{st} revised edition) in 1999 completely and been effective by the enactment of Ministerial Regulation Number 414 BE 2542 (1999), which was released under the City Planning Act 1975 and announced in the government gazette the royal decree edition 116 section 57 on 5th July 1999. The comprehensive plan has the objectives to guide Bangkok Metropolitan urban development and peripheral conservation and preservation for the purpose of comfort and better life of the citizen. This is shown in Figure 4.2.5.

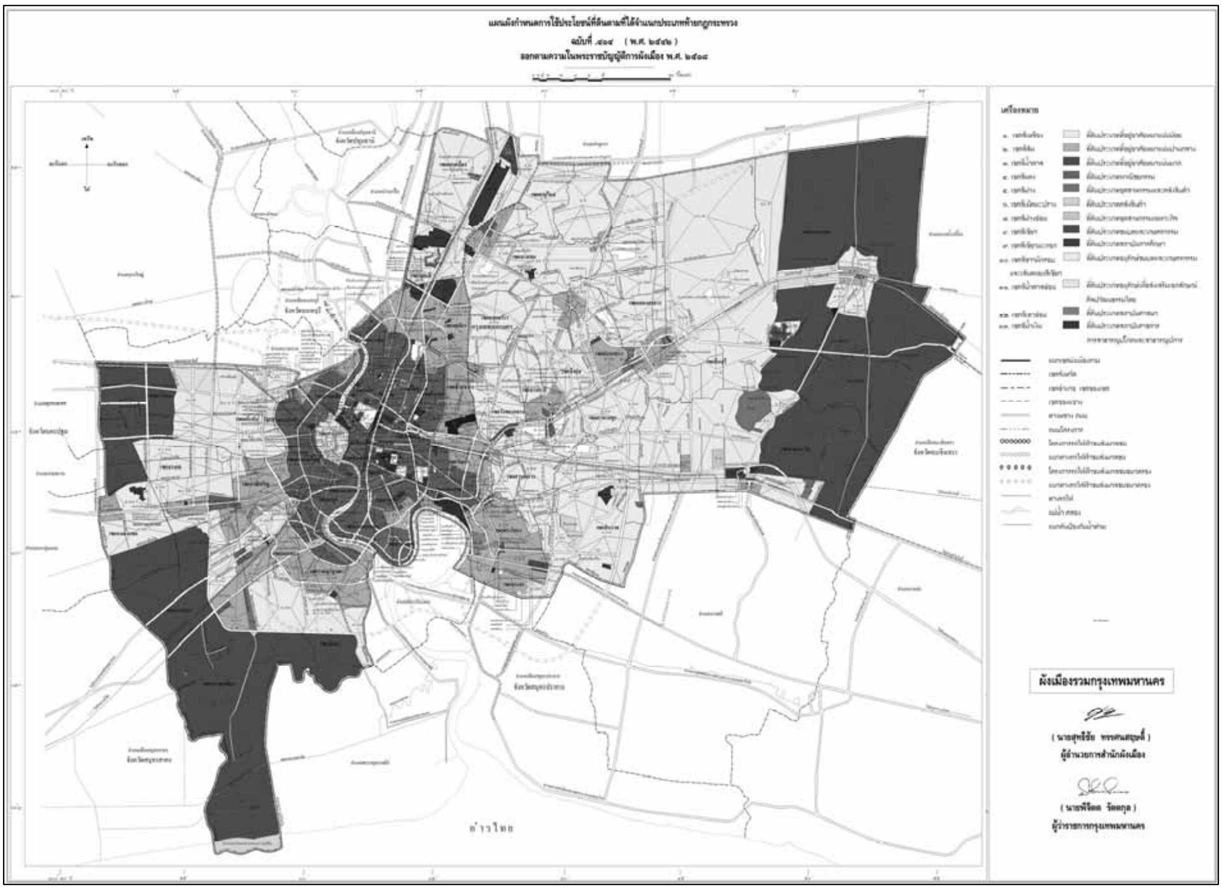


Figure 4.2.5 Bangkok Metropolitan Comprehensive Land Use Plan

Source: Bangkok Metropolitan Administration (http://www.bma.go.th)

The plan basically attempts to accommodate the preservation of historical and cultural heritage while promote accessibility of the city and provide fundamental requirement for future growth as shown in the following objectives.

Objectives

The comprehensive land use plan for Bangkok Metropolitan addressing five broad objectives to be achieved, those are:

- To conserve the historical and cultural heritages and to maintain the national identity.
- To preserve valuable natural and environmental resources, and simultaneously improve the quality of life;
- To create technological information based economy which is essentially centered by excellent administration and communication;
- To improve the city's accessibility by improving an efficient mass transit system;
- To achieve more efficient land use plan in order to accommodate future growth of the metropolitan.

To achieve the visions, Bangkok Metropolitan Administration undertakes the following strategies:

- **Strategy 1.** To develop polycentric city by strengthening existing business centers which are located in the city center (hatched area as shown in Figure 4.2.6) and develop other commercial and residential areas scattered in the outskirt areas (shown in red-shaded area).

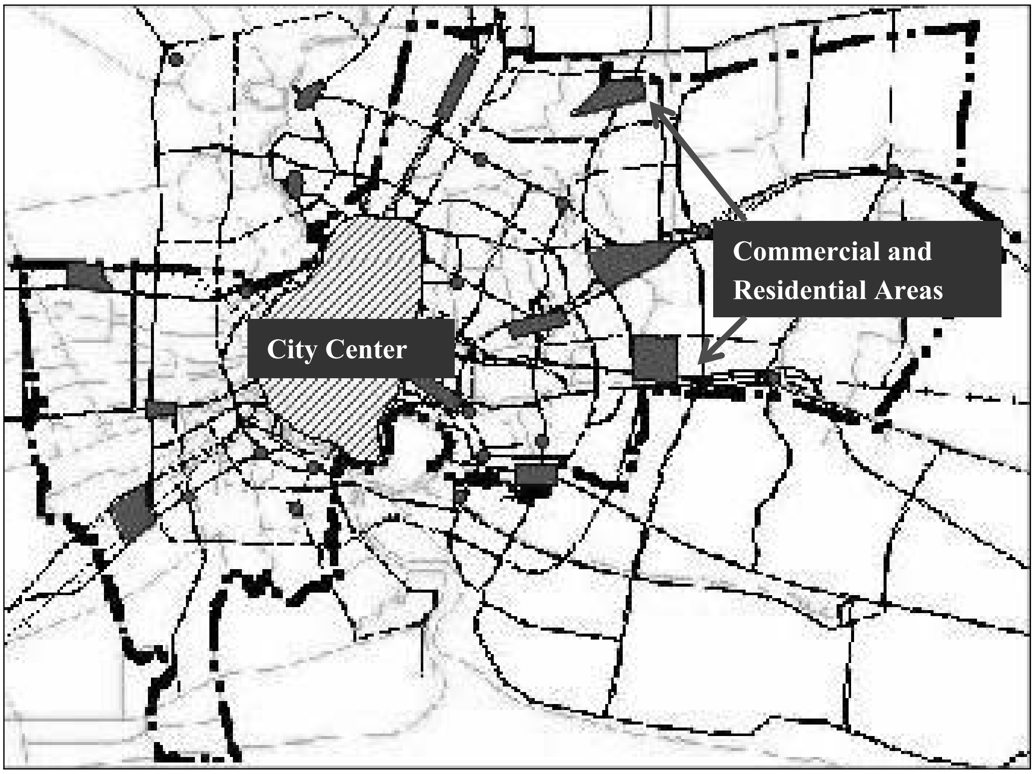


Figure 4.2.6 Implementation of Strategy 1

Source: City Planning Dept, BMA

- **Strategy 2**. To preserve and conserve cultural heritages in the areas around and nearby Rattanakosin Island, as shown by thick outlined area in Figure 4.2.7. This strategy is mostly implemented by means of building control.

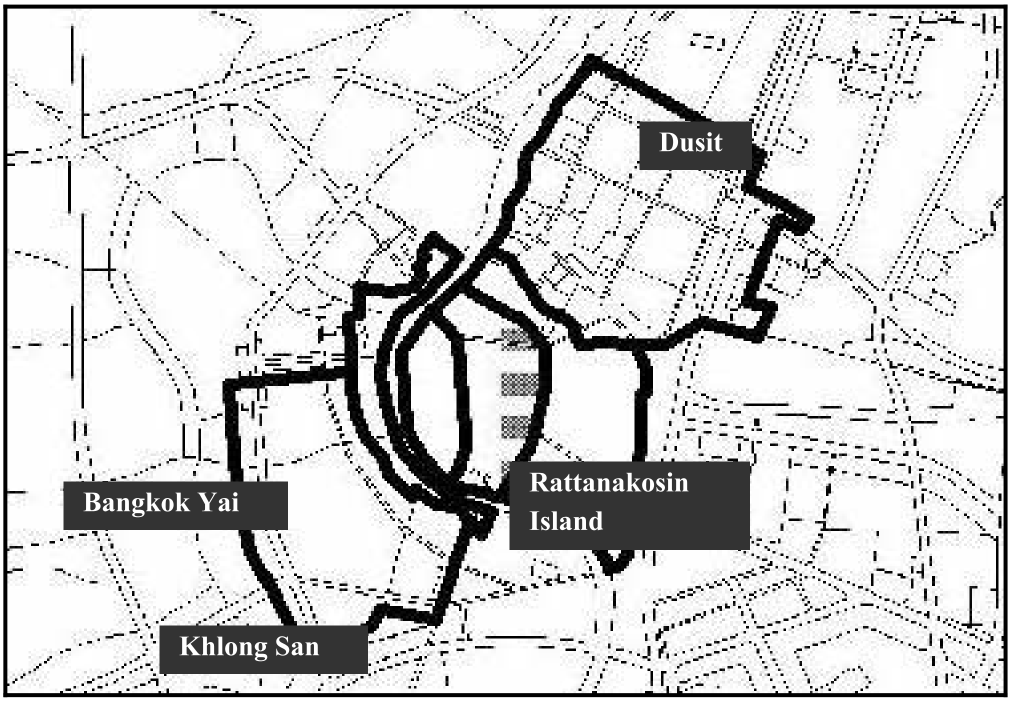


Figure 4.2.7 Implementation of Strategy 2

Source: City Planning Dept, BMA

- **Strategy 3**. To set up effective land use for future public transportation networks, and other public utilities and infrastructure nearby public transportation nodes/stations. These are shown in Figure 4.2.8 below, as represented by red dots.

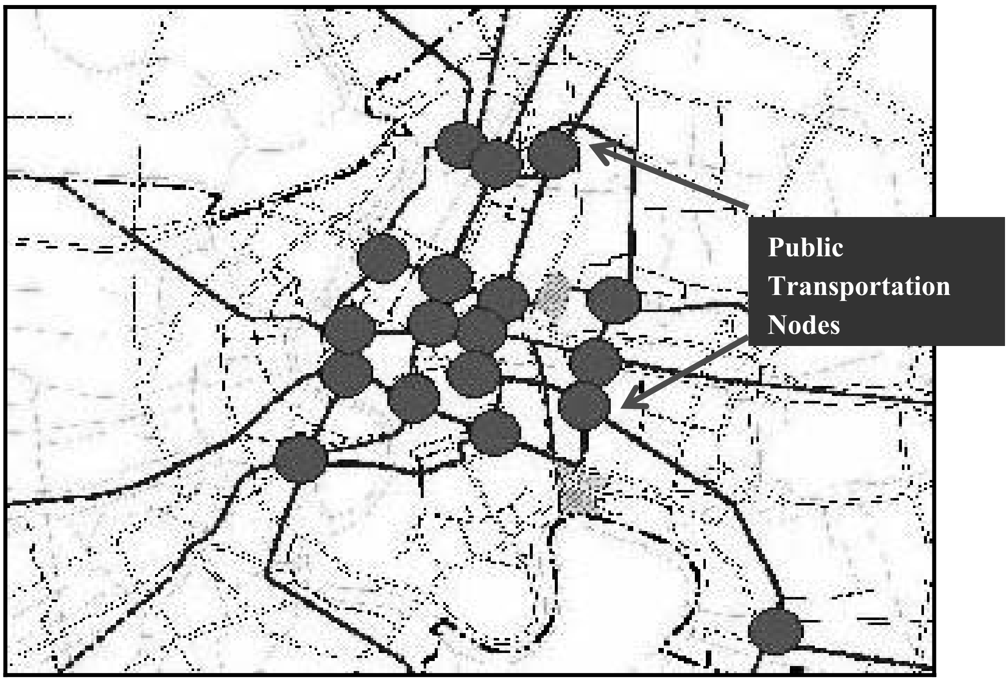


Figure 4.2.8 Implementation of Strategy 3

Source: City Planning Dept, BMA

- **Strategy 4**. To set up the special development areas for incoming future central business district, where highly convenient travel are required such as Chaeng Wattana Government Center, Bangsue Commercial Center, Rama III Special Development Area, etc. as shown in Figure 4.2.9.

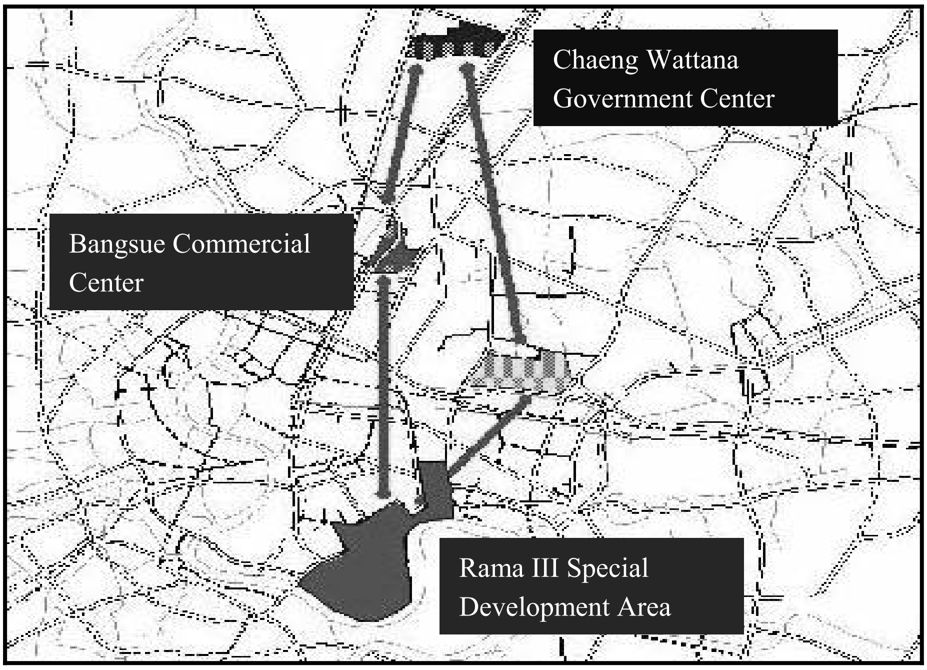


Figure 4.2.9 Implementation of Strategy 4

Source: City Planning Dept, BMA

- **Strategy 5.** To adjust the travel convenience by integrating all urban transport modes in Bangkok, through smooth transit system as shown schematically in Figure 4.2.10.

Figure 4.2.10 Implementation of Strategy 5

Source: City Planning Dept, BMA

- **Strategy 6**. To promote the urban environment by encouraging urban parks, reducing air and water pollution, and undertaking appropriate solid waste management, as shown by green-dot in Figure 4.2.11.

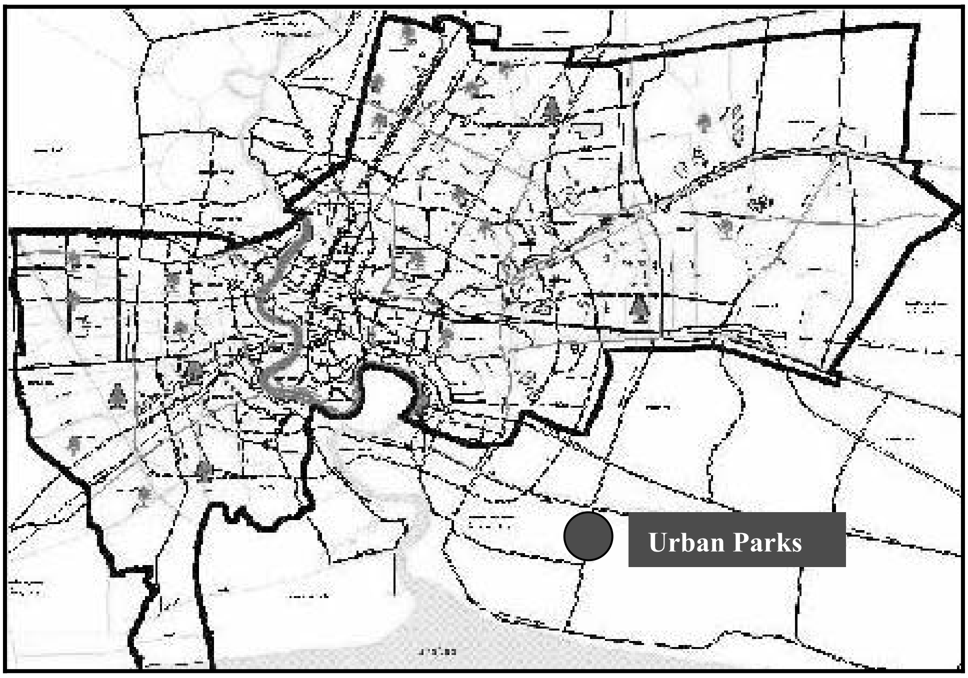


Figure 4.2.11 Implementation of Strategy 6

Source: City Planning Dept, BMA

- **Strategy 7**. To promote the balance between workplaces and residential zones, by promoting mixed land uses, as shown by yellow hatched area in Figure 4.2.12.

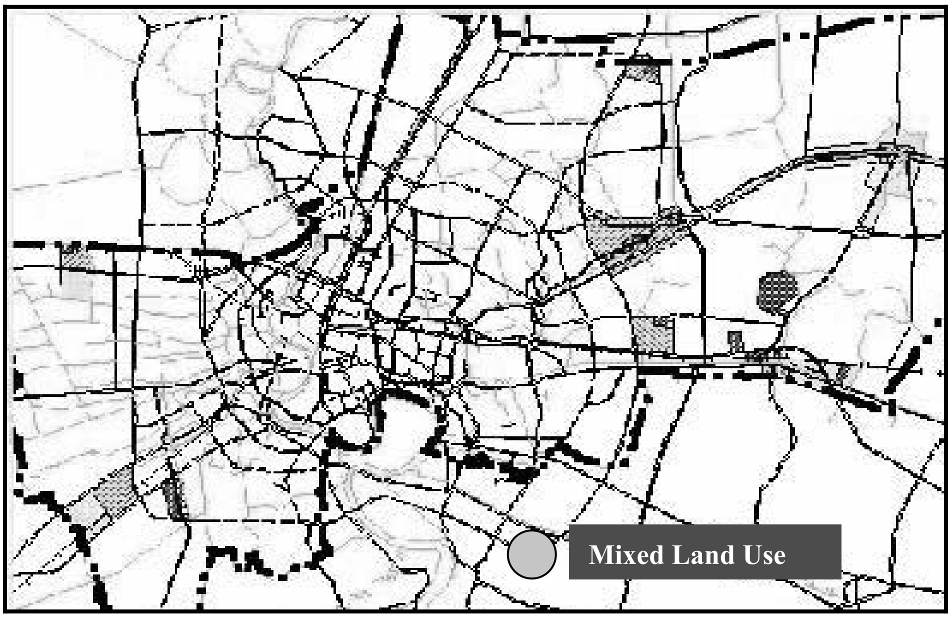


Figure 4.2.12 Implementation of Strategy 7

Source: City Planning Dept, BMA

- **Strategy 8**. To promote urban containment in order to reduce urban sprawl by encouraging major developments are undertaking inside the outer ring road frame. This is shown in Figure 4.2.13.

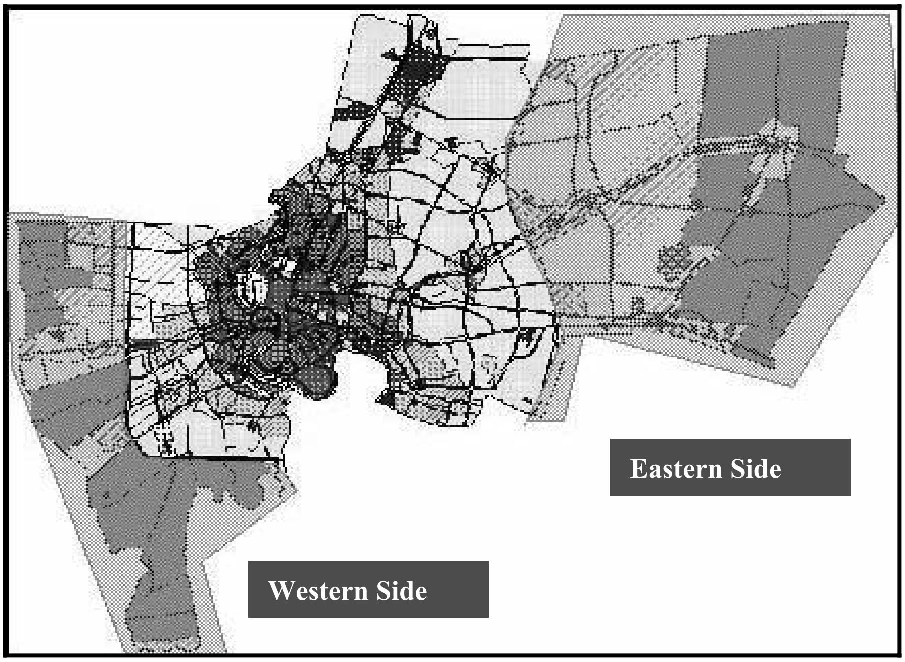


Figure 4.2.13 Implementation of Strategy 8

Source: City Planning Dept, BMA

- **Strategy 9.** To promote green-belt as urban containment means by keeping and preserving the rural and agricultural areas in the Eastern side for the purpose of delaying and preventing floods in Bangkok Metropolis. For the Western side, it is expected to facilitate draining water from Thonburi area. Nowadays, the western side area is good for living with clean environment and proximity to the city. Preservation should be continually undergone in this area to achieve good residential areas while maintaining the proximity to the inner city. This is shown in Figure 4.2.14.

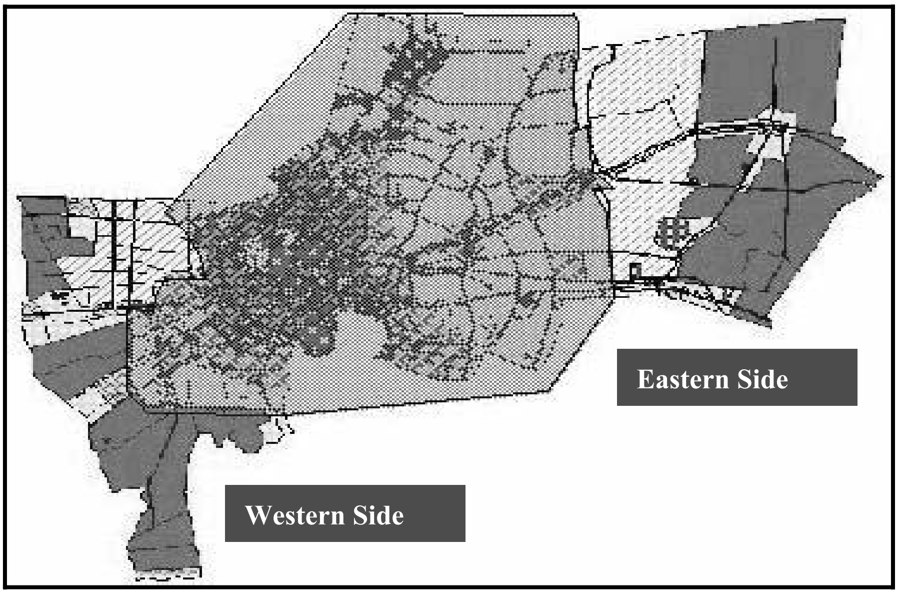


Figure 4.2.14 Implementation of Strategy 9

Source: City Planning Dept, BMA

With respect to the needs of guidelines to accommodate various transportation modes, the strategy 5, as mentioned earlier, tries to adjust the traveling comfort by integrating all urban transport modes in Bangkok, through smooth inter-modal changes. The existing circumferential loops mass rapid transport system (sub-way) employs inter-modal changes system with other transport modes such as sky-train (BTS), Bangsue Train Station and Northern Bus Terminal in Bangsue and Mochit Area. The sub-way has also two other transit points with BTS at Sukhumvit and Silom. BTS connects major commercial areas along Thanon Phaholyothin and Sukhumvit (Sukhumvit Line, light green), and along Thanon Ratchadamri and Silom (Silom Line, dark green) as shown in Figure 4.2.15.

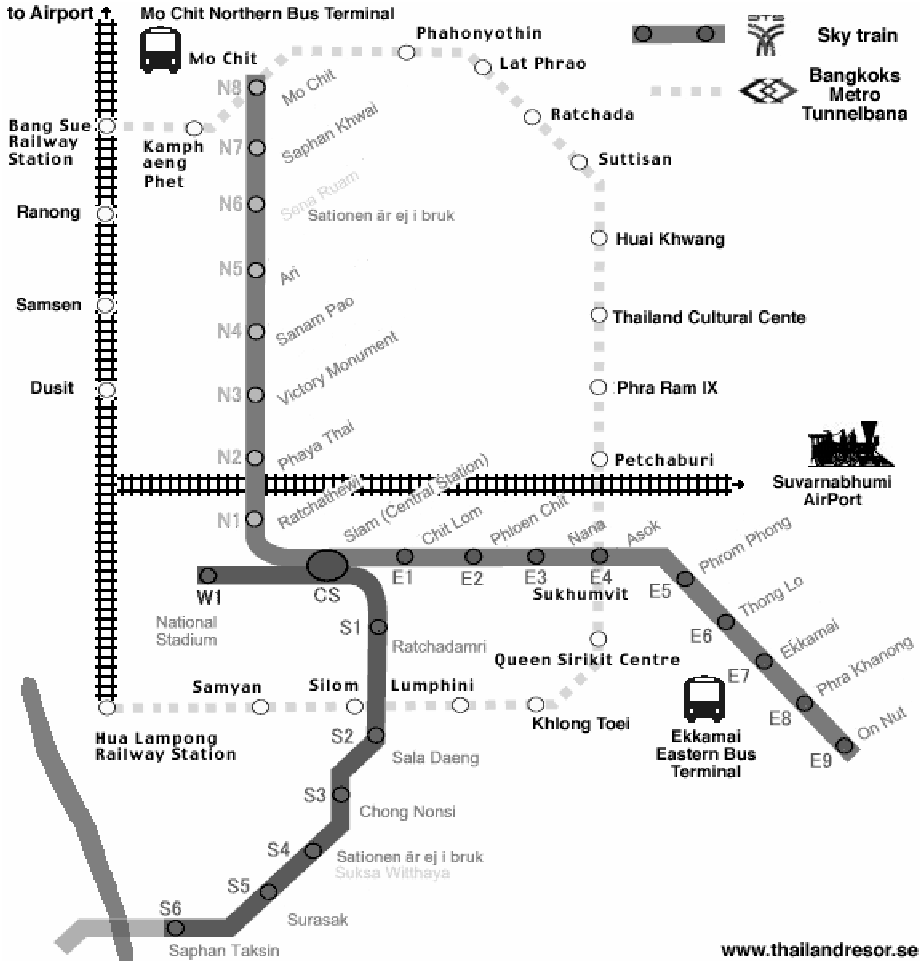


Figure 4.2.15 BTS Skytrain Lines in Bangkok

2. Current transportation condition

Bangkok has been expanding from Bangkok as a city (BKK), Bangkok Metropolitan Area (BMA) then expanded physically to be the Bangkok Metropolitan Region (BMR) those consist of Bangkok Metropolitan Area (BMA) and its five peripheral provinces, those are Samutprakarn, Nonthaburi, Pathumthani, Nakhon Pathom and Samut Sakhon. This BMR covers 7,758 km2. The BMR is then later extended to be Extended Bangkok Metropolitan Region (EBMR) which covers two other provinces. About 200 km2 in central area of Bangkok covers the old CBD and the high-density business areas.

There are various public transport modes available in Bangkok, as shown in Table 4.2.5. In terms of approximate contribution to passengers kilometer travel in a day (this contribution is shown in Figure 4.2.16), these public transport modes can be ranked as shown in the following section. Various types of land and water transportation infrastructure create Bangkok's transportation networks, which part of this transportation networks is shown in Figure 4.2.17.

City Buses. The capacity of bus to carry passengers is about 35 to 60 persons. There are 117 numbers of routes serve Bangkok and adjacent provinces along major roads. Together with other van and mini bus, these bus routes cover almost all corner of Bangkok. The routes are divided into 8 zones, where among zones are interconnected and overlapped in order to provide comfort and convenience for travelers. Most of the bus routes in Bangkok and adjacent provinces are overlapped in Victory Monument (Km 0 of Thailand).

BTS Skytrain and MRTA Subway. These transport modes are the most convenience mass transport system in Bangkok with affordable fare, however the routes are limited to certain lines only, therefore not all places are served by these modes. If it is integrated with other transport modes, it will create excellent transit system. One of the essential issues regarding the sustainability of these transport modes is ridership towards break event point of the project. To deal with this issue, Government of Bangkok Metropolitan with Bangkok Transit System and Mass Rapid Transit Authority have tried to promote the use of these transport modes by complementing various facilities for the comfort of passengers. However, it is frequently being criticized that the facilities are mostly not for vulnerable passengers such as elderly and disabled person.

Van/microbus and minibus. The capacity of van is 12 passengers including driver. The routes almost the same with city buses therefore it provides alternative to city buses. The van is facilitated with air conditioner, and offers more comfort than most of city buses. Some of the Vans are using CNG therefore it is quite friendly to the environment, however some older vans are using diesel. Van sharing system has been considered to have significant contribution to the improvement of urban air quality in Bangkok for reducing the use of private cars. One of their services is terminated at the park-and-ride lot in Mochit BTS station, therefore it is quite convenience transfer system to reach various major places in Bangkok.

Taxi. Taxi is the most convenient personal public transports that offers privacy and convenience compared with other public transport modes. This transport mode can serve any routes in Bangkok and adjacent provinces. All taxis are using CNG for their fuels; therefore taxi contribution to the improvement of air quality in Bangkok is essential. Taxi is operated under.

Motorcycles. This is the uniqueness of Bangkok, since not many countries provide private service for public transport system that anti-traffic congestion. This mode is privately provided by individual citizens, can serve any routes and even door-to-door services that may not be provided by other modes. Motorcycles taxis however do not institutionalized themselves in a legal organization rather than self-managed and self-organized among the drivers since all of the motorcycles taxis are owned by individual drivers.

Tuk-tuk. This is another type of hired taxi. These are very common in Bangkok and larger provincial towns where they operate much in the same manner as taxis. Fares are about **one third** cheaper than for taxis but Tuk-Tuks are open and leave the passenger exposed to the street pollution, especially annoying in Bangkok. In some provincial towns, Tuk-Tuks operate in the same mode as passenger pickups.

Table 4.2.5 Public Transport Modes in Bangkok Metropolitan Region

Transport Mode/ Capacity	Characteristics of each transport mode in Bangkok		
	Fare (as of May 2006)	**Route**	**# of Fleets/ Operation Time/ Average Frequency (min)**
Airport Buses (30-50 passengers)	Bt. 100.00 per person	From Don Muang Airport to the downtown of Bangkok: - No1. to Silom, - No2. to Sanam Luang, - No3. to Sukhumvit 55, - No4. to Hua Lam Phong	20/ Available 24 hours/ 30
Taxi (3 passengers)	- Bt. 35.00 for first 2 km. - Less than Bt. 5.00 per km. - Expressway tolls are paid by passenger. - From airport add Bt. 50.	Every where	53,000/ Available 24 hours/ None
Tuk-tuk (2 passengers)	- Fare must never be more than Bt. 200.00 per trip.	Every where, but taxis are strong competitor since the fare almost the same, while taxi more comfortable than tuktuk.	7,500/ Available 24 hours/ None
BTS Skytrain (1,000 passengers)	Starts from Bt.10.00 to Bt. 40.00 per person.	It covers mostly commercial area in the city centers. There are two lines: Sukhumvit and Silom.	40/ From 6:00 to midnight/ 10
City Buses (35-60 passengers)	Start from Bt.3.50 up to Bt. 18.00.	- Many routes within BMR. - There are both air condition and open-airbuses.	8,177/ From 5:00- 22:00/ 15-25
Microbus/ Van (12 passengers)	Bt.25.00 per person.	The same routes as city buses.	5,519 From 5:00- 22:00 1,103,800 p.km 15-25
Express Boat (100 passengers)	Start from Bt. 5.00 up to 15.00.	Routes to various destination along the Chao Phraya River and to as far as Nonthaburi from Wat Ra Singkhon.	47/ From 5:00- 20:00/ 20-30
MRTA Subway (>1,000 passengers)	Start from Bt 12.00 up to 30.00	From Bangsue to Hua Lamphong	44/ From 6:00 to midnight 10
Motorcycle Taxis (1 passenger)	Fare must never be more than Bt. 200.00 per trip.	Every where	50,000/ Available 24 hours None

Source: Thanaprayochsak (2005) and others.

With respect to passenger-kilometer traveled of those different transport modes, Table 4.2.6 shows figures of passenger-kilometer traveled per year for corresponding transport modes in Bangkok in 2005.

Table 4.2.6 Passenger-kilometer Traveled per Year for Various Transport Modes In Bangkok of 2005

Transport Mode	Capacity (Passenger)	Number of Fleets	Passenger-kilometer Traveled per Year
Airport Buses	30-50	20	864,000
Taxi	4	53,000	572,400,000
Tuk-tuk	3	7,500	40,500,000
BTS Skytrain	1,000	40	1,728,000,000
City Buses	35-60	8,177	6,623,370,000
Microbus/Van	12	5,519	2,384,208,000
Express Boat	100	47	28,350,000
MRT-Subway	1,000	44	972,000,000
Motorcycle Taxis	2	50,000	57,600,000
Private Cars	4	1,700,000	3,672,000,000
Motorcycles	2	2,300,000	1,490,400,000

Source: Analysis based on Thanaprayochsak (2005).

In more visual depiction, passenger-kilometer traveled undertaken by city buses was the largest contributors to the total passenger-kilometer traveled in Bangkok in 2005. It accounted for about 37.7 percent, while private cars as the second largest contributor give 20.9 percent of sharing (see Figure 4.2.16).

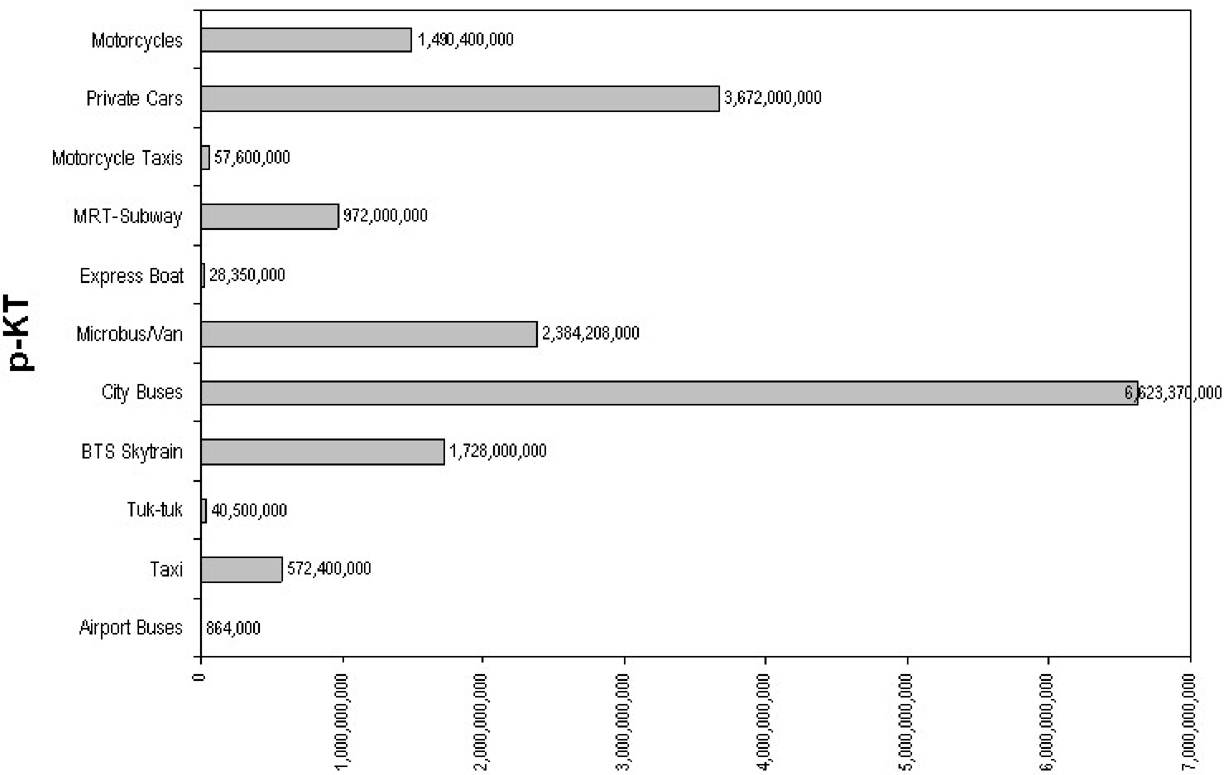


Figure 4.2.16 Passenger Kilometer Travel per Year in Bangkok in 2005

From the figure it is apparent that private car users are potential shareholder to be handled for alleviating congestion problems, air quality issues as well as promoting pedestrian friendly environment in Bangkok. Prior to take this action, expansion of excellent but affordable public transport and integration of all public transport modes with smooth transit system are indisputable to compensate the comfort that has been sacrificed by private cars users. Park-and-ride system needs more promotion and expansion. Current plan to expand BTS Skytrain and MRT in Bangkok seems well on track, however more attention is required in inter-modal transit system.

The Bangkok Transport Network is back-boned by BTS sky-train that serves two lines: Sukhumvit Lines and Silom Lines with total length is 24.0 km. While Chaloem Rachamongkhon Line MRTA subway connects Bangsue and Hua Lamphong, with total length of 20 km.

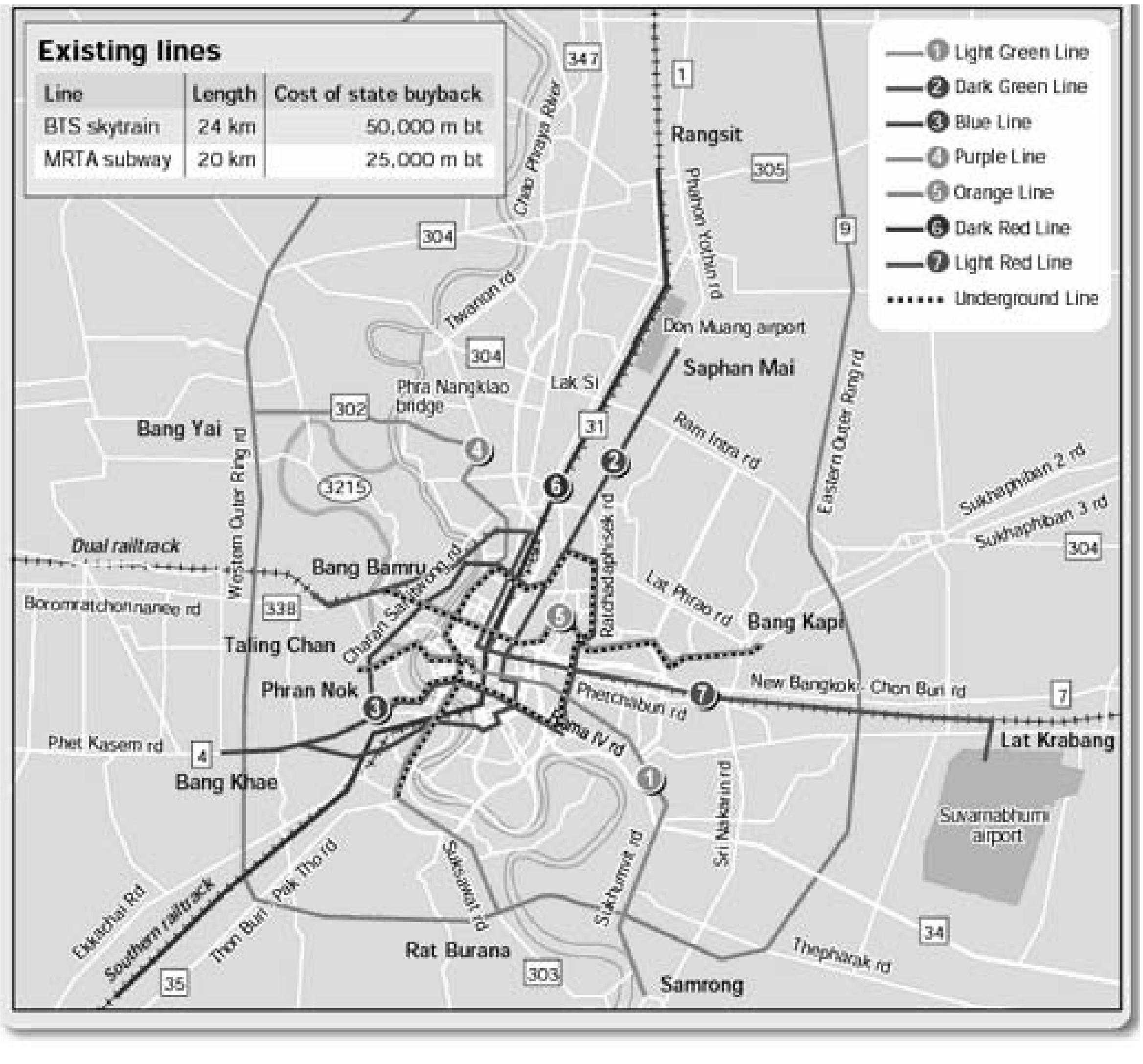


Figure 4.2.17 Bangkok Transportation Network

Source: www.bangkokpost.com

Existing Bangkok Transportation Network, as shown in Figure 4.2.17, shows different type of transportation modes either planned or existing. There are several types of transport modes in Bangkok as shown in table 4.2.6 above. The above table shows that city buses both air conditioned and non-air conditioned are the most contributors of transport modal splits in terms of passenger kilometer with more than 1.2 million passenger kilometer in a year. Taxi and Van are the second and third largest contributors in Bangkok Metropolitan Region.

The popularity of bus transport because of the variety of routes served by the bus compared with BTS sky-train of MRT subway. The fare is also comparably lower than those two modes of public transport. Table 4.2.7 shows an estimate of annual series of public buses, private vehicles as well as motorcycles in 1984, 1992 and 2005. In fact, motorcycles outnumber private vehicles and have significant increase during those periods. Total number of registered vehicles is shown in Figure 4.2.18.

Table 4.2.7 Number of Buses and Private Vehicles in Bangkok

Type of Vehicles	Year [estimate number]		
	1984	1992	2005
Public Bus	4,187	4,045	8,177
Private Car	544,096	1,045,896	1,770,700
Motorcycle	462,302	1,094,494	2,007,660
Population	5,177,000	5,964,000	7,081,000

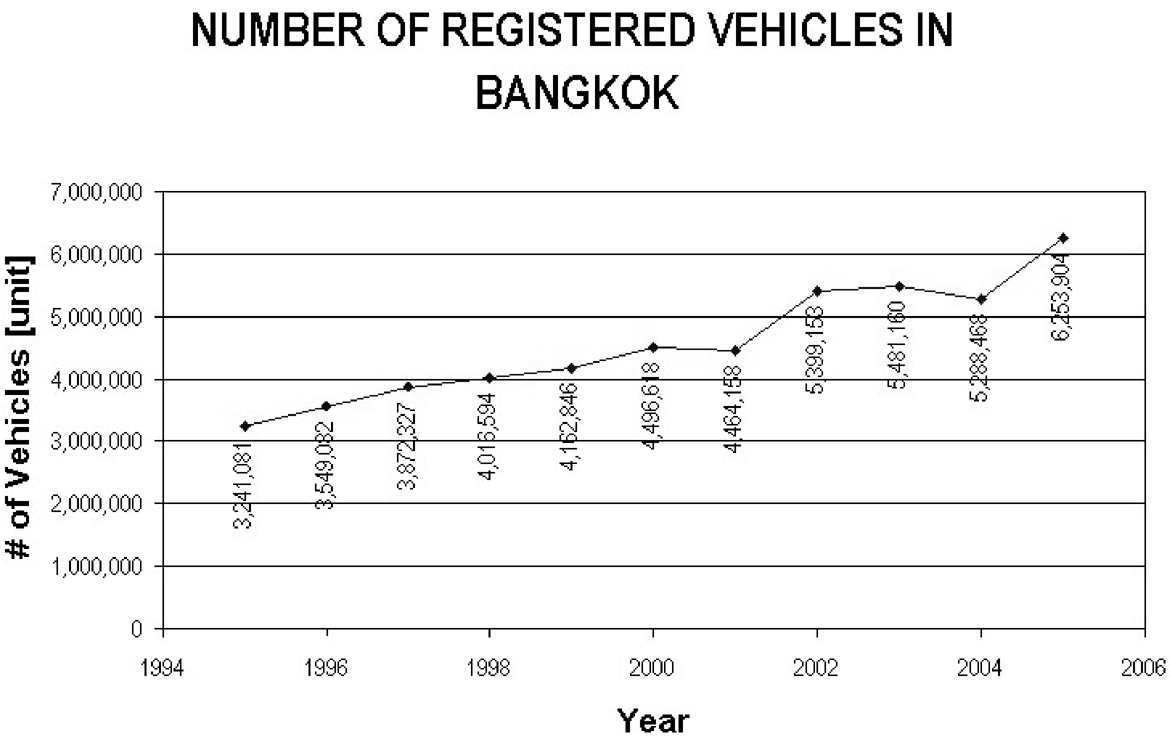


Figure 4.2.18 Registered Vehicles in Bangkok

Data Source: Department of Land Transport (2006)

Other than public bus, mass rapid transit of Bangkok (MRT, subway) is also getting more popular although still insufficient with respect to number of daily passenger. Figure 4.2.19 shows the overall plan of Bangkok Mass Rapid Transit Network.

The public transport system in Bangkok was drastically changed as the Bangkok's first subway was opened on July 3, 2004; while in the same year on December 5, the skytrain (BTS) celebrated its fifth anniversary. The skytrain's ridership is currently around 380,000 per day, and is expected to top 500,000 trips per day, in order to attain minimum number of passengers for break even point. However, passenger volume has risen steadily from 150,000 a day in its first year. Proceeds from the operator's fare-boxes and advertising have also climbed steadily and are now sometimes as high as eight million baht a day compared with just about three million baht when it was launched.

The skytrain is now complemented by the first subway system (MRTA) in Thailand. The Initial Project, the Blue Line (Hua Lamphong-Bang Sue Section), which has now been named the M.R.T. Chaloem Ratchamongkhon Line, first entered the public consciousness when H.M. King Bhumibol Adulyadej graciously designated H.R.H. Crown Prince Maha Vajiralongkorn to lay the foundation stone at Hua Lamphong Railway Station on 19 November 1996. Later, on 9 August 1999, H.M. King Bhumibol Adulyadej graciously bestowed the name "Chaloem Ratchamongkhon" on this Thailand's first underground line. The name means "Celebration of the Auspicious Kingship". This 20-km subway is now carrying around 140,000 passengers per day. In the initial promotional period which lasted until August 12, 2004, fares were just 10 baht per ride and the system carried 200,000 passengers a day on average[9].

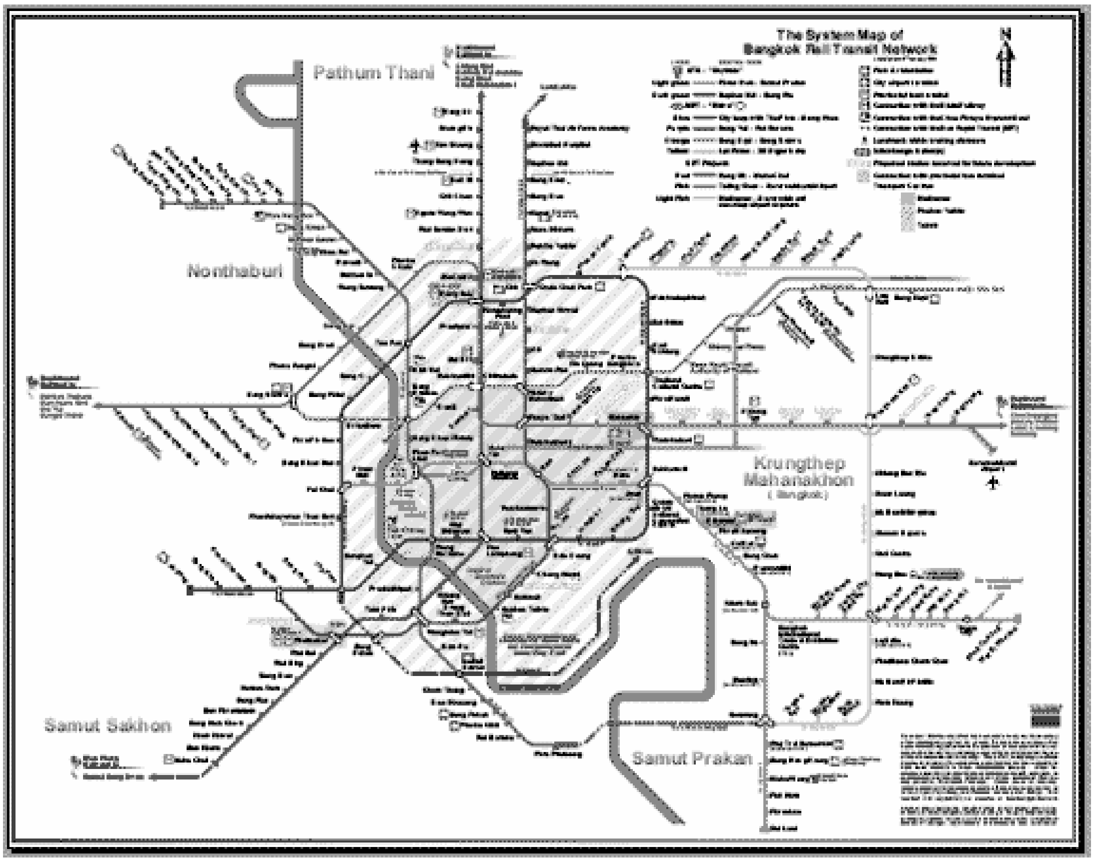


Figure 4.2.19 Overall Plan of Mass Rapid Transit Network

The opening of the subway system has brought an impact to property business. A survey by the research company Agency for Real Estate Affairs found that average rental rates for office space in buildings located near Bangkok's new subway line have increased by 10.25 percent while retail space rates along the route are up by 6.25 percent[10].

9. Source: http://www.mrta.co.th
10. Source: http://www.mrta.co.th

The subway system will continue to be expanded as shown in Figure 4.2.19[11]. The next expansion will be Purple line. On September 28, 2004 the Cabinet approves the detailed design and the construction of an initial extension section, the Purple Line: Bang Yai - Bang Sue section, which totally costs 46,704 million baht. The Purple line: Bang Yai - Bang Sue section starts from the north end of the Chaloem Ratchamongkhon line at Bang Sue station, then goes toward northwestern to Taopoon intersection, turns right and runs along Krungthep - Nonthaburi Road, passes Wongsawang intersection, then turns right at Nonthaburi intersection to Tiwanon Road and turns left to Ratana Thibet Road at Khae Rai intersection, crosses over the Chao Phaya River at Phranang Klao Bridge and runs along on Ratana Thibet Road, turns right at Bang Yai intersection. The line terminates at Khong Bang Pai area with approximately 23 km long.

Apart from those skytrain and subway systems, the conventional road cannot also be forgotten, since the value of per vehicle road length will easily indicate whether or not traffic congestion is worse. For this purpose length of road within Bangkok Metropolitan Region is necessary to identify. The road lengths in Thailand, in 2003, was in total accounting for more than 64,600 km, waterway is about 4,000 km, and railway is 4,071 km (http://www.bangkokpost.net/ecoreviewye2004/thailand.html), while in Bangkok itself, the length of road infrastructure, in the same period, was approximately accounted for 4,076 km (or about 38.72 sq km) in 1999 for all categories of road, and length of bridge was about 18,000 meters. This shows that almost 21 percent of the road length in Thailand is concentrated in Bangkok Metropolitan Region and its adjacent provinces. In the same time, the needs of investment in infrastructure in other provinces are required.

The remarkable growth of private car ownership as the growth of Thai economy, and in the same time the road capacity was comparably low. This has led to the condition of ubiquitous traffic congestion in Bangkok. To deal with the problems, a total length of 175.9 km of expressways has been constructed (ETA, 2005). The development of expressway has, to certain extent, affected the car ownership in Bangkok. Compared with other Asian Cities, Bangkok has 399 vehicles ownership per 1000 people. This comparison is shown in Figure 4.2.20.

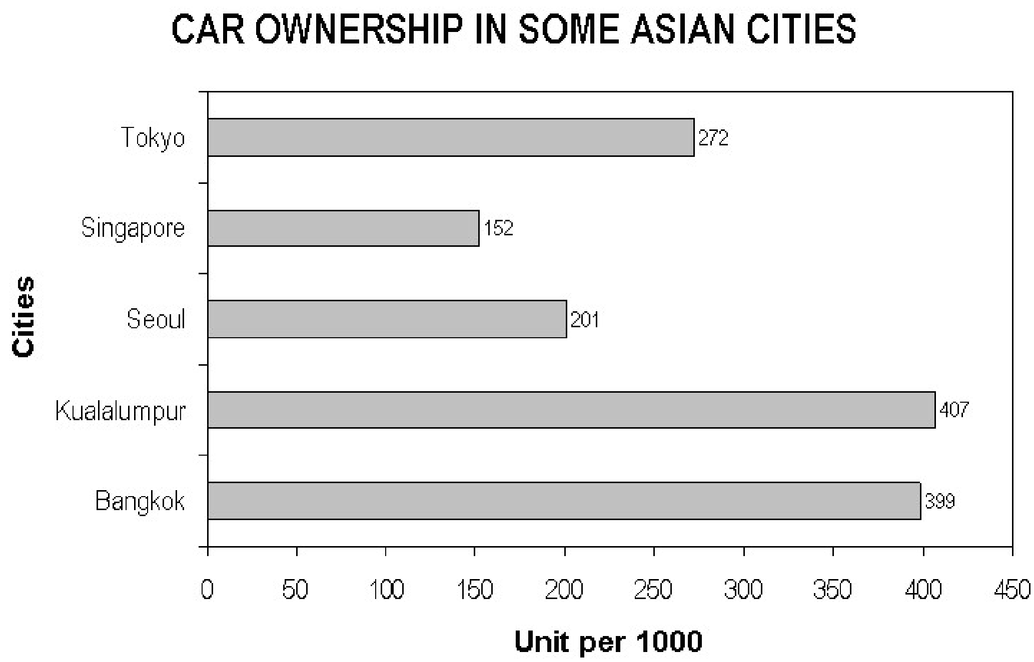


Figure 4.2.20 Car Ownership Comparisons

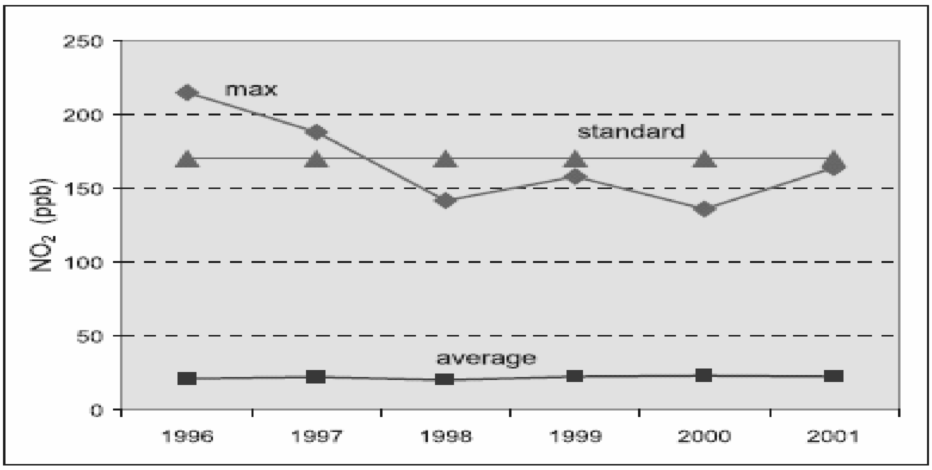
11. Source: http://www.mrta.co.th
13. Source: City Planning Department, BMA, http://203.155.220.217/cpd/

Study undertaken by Charoentrakulpeeti (2006) reveals that the share of modal split in Bangkok was dominated by private transport (57.3 percent), public transport (29.8 percent), para-transit (11.3 percent) and non-motorized transport (1.6 percent). These figures show that Bangkok is an automobile-dependent megacity. USEPA (2001) found that transit systems that are well designed and operated can reduce vehicle travel, resulting in reduced criteria pollutant and greenhouse gas emissions. A transit bus carrying 40 passengers requires only about one-sixth the energy consumption it takes to transport each person in a private vehicle. Transit also helps to reduce traffic congestion. One full 15 meters bus is equivalent to a line of moving automobiles stretching six city blocks, and one full six-car heavy rail train is equivalent to a line of moving automobiles stretching 95 city blocks (assuming traffic operates at 40 kph). Transit provides mobility to individuals of all ages, income levels, and abilities. With an aging population and increased attention being paid to linking low-income families to jobs, improved accessibility and mobility are particularly important. The domination of private transport in Bangkok would lead to the huge energy use for transport, besides the possibility of the increase of green house gas emission.

3. Greenhouse gas emission and air quality in Bangkok

Transportation is one of the potential sources of urban air pollution. With respect to greenhouse gas emission originates from transportation in Bangkok, some pollutants of green house gases were identified. Those air pollutants are including Nitrogen Oxide, Ozone, Carbon Monoxide and Sulfur Dioxide. Other important emissions that are generated by transportation which directly affect air quality in Bangkok are PM_{10}, TSP, and Lead.

Nitrogen Oxides. Nitrogen oxides, including NO_2, are mainly produced by fossil fuel combustion in urban areas. They play a major role in the formation of ozone, PM, and acid rain. Short-term exposure, even less than three hours, to low levels of NO_2 may lead to changes in lung function in individuals with pre-existing respiratory illnesses and can increase respiratory illnesses in children. Long-term exposure to NO_2 may increase susceptibility to respiratory infections and cause permanent alterations in the lung. Transport, in particular diesel-powered vehicles, is one of the major contributors to NOx emissions in urban areas. Emissions from power generation and industry are also significant sources in Thailand (Thailand Environment Monitor, 2002).



Source: PCD, 2002. Data came from 10 sites.

Figure 4.2.21 Concentration of NO_2 in Bangkok, all Sites Combined

Nitrogen dioxide levels are stable. In 2000, ambient and roadside measurements of NO_2 Bangkok were typically 20 percent of the national standard. As shown in Figure 4.2.21, from 1996 to 2000, ambient NO_2 measurements stabilized, although there is some evidence of growth in the recorded maximum during 2000. NO_2 concentration levels in Bangkok's suburban provinces were similar to those recorded in the city. This achievement is due particularly to cumulative effect of the improvement of urban transportation systems and the change of fossil fuel to natural gas has significant impact to the air quality improvement in Bangkok Metropolitan.

Ozone. Ozone is a highly reactive gas, formed by the reaction of VOCs and NOx in the presence of heat and sunlight. Ozone can cause a range of acute health effects including eye, nose and throat irritation, chest discomfort, coughing and headaches. Children who are active outdoors when ozone levels are high are most at risk. Ozone also affects vegetation and ecosystems, decreasing yields of commercial crops and plantations and lowering the aesthetic value of national parks.

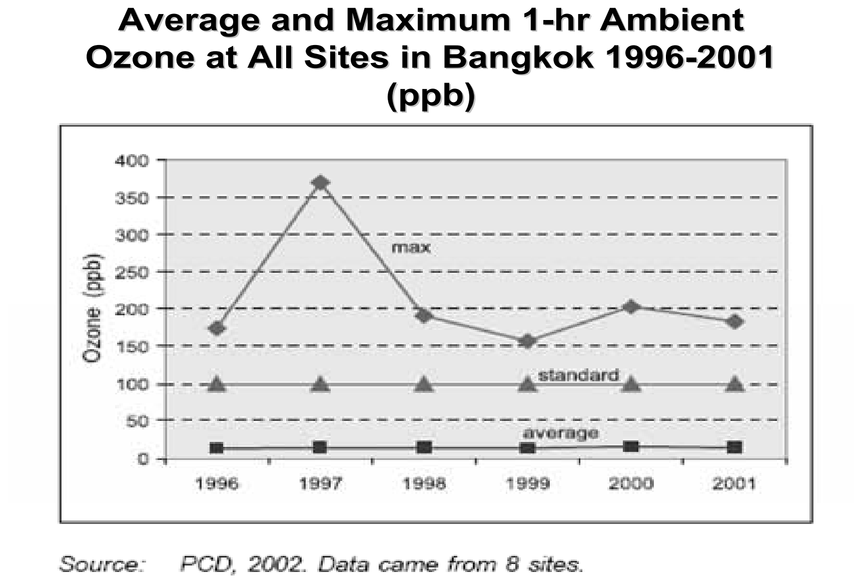


Figure 4.2.22 Average and Maximum Ozone Concentration at All Sites in Bangkok

Ozone levels are a cause for concern. In 2000, measurements of ambient ozone in Bangkok showed that while average concentrations are low at all monitoring stations, maximum values exceeded the standards significantly and frequently, as shown in Figure 4.2.22. High ozone concentrations are normally observed in the suburb areas downwind from center of Bangkok. Similar trends have been observed in Bangkok's adjoining provinces and throughout other urban areas in Thailand. Rising emissions of volatile organic compounds (VOCs) and NOx , which are precursors for O_3 along with meteorological conditions, are causes of increasing maximum levels downwind of urban centers. However, several studies indicated that O_3 problem in Bangkok is controlled by VOCs not by NOx. This means that VOCs emissions will have to be reduced in order to lower the levels of O_3 (Thailand Environment Monitor, 2002).

Carbon Monoxide. Carbon monoxide is an odorless, invisible gas, formed when carbon in fuel is not burned completely. The inhalation of CO can disrupt the supply of essential oxygen to the body's tissues –

thus posing a major health risk. Those who suffer from cardiovascular disease are most at risk. At high levels of exposure, CO can be fatal.

Automobiles are the largest source of CO emissions. Lesser sources include industrial processes, non-transportation fuel combustion, and natural or manmade fires. Peak CO concentrations typically occur during the colder months of the year, when CO automotive emissions are greater and nighttime inversion conditions are more frequent.

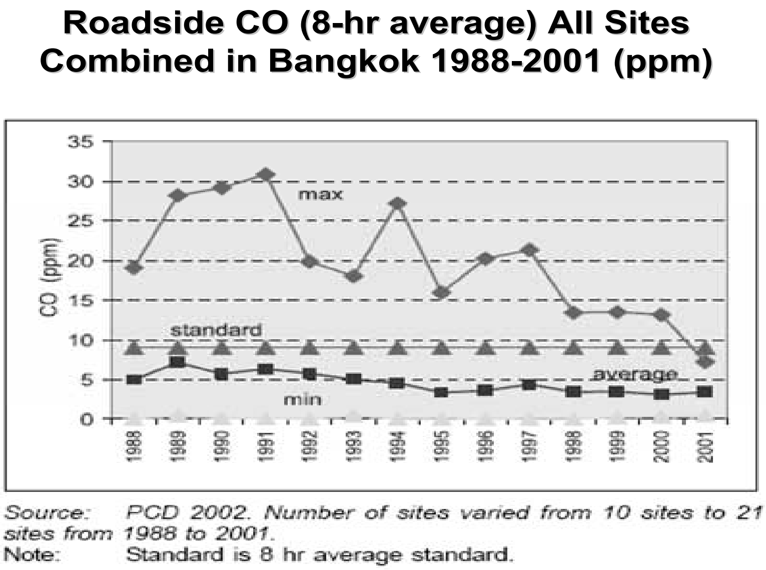
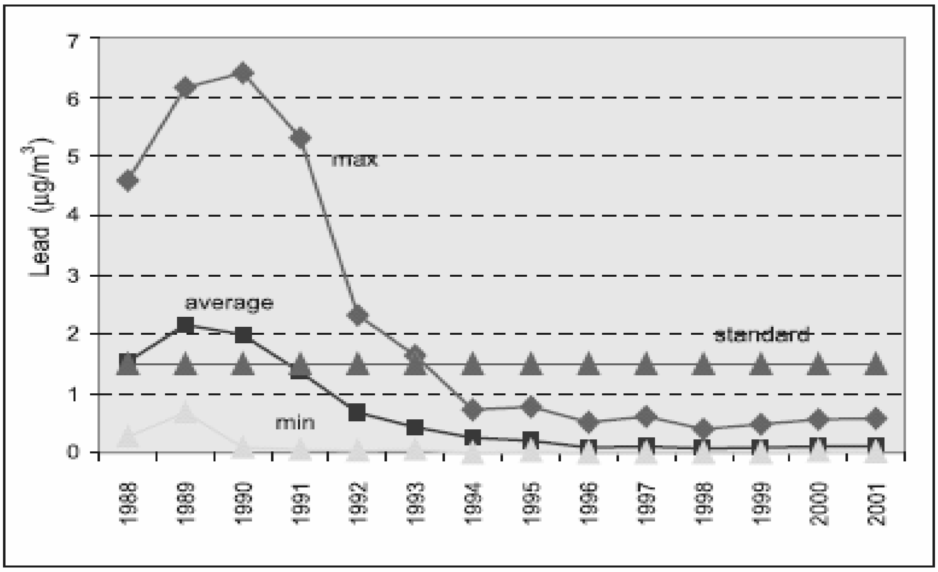


Figure 4.2.23 Concentration of Roadside Carbon Monoxide at All Sites in Bangkok

Levels are steadily declining. Roadside measurements from 1988 to 2001 show a steady reduction in CO over the 13-year period as shown in Figure 4.2.23. In Bangkok's adjoining provinces, average concentrations were similar to those observed in Bangkok. In the rest of Thailand, CO levels are very low and have exhibited a downward trend similar to that of Bangkok. This decline is due for the most part to the catalytic converters on automobiles, which were mandated in 1993 after introduction of un-leaded gasoline (Thailand Environment Monitor, 2002).

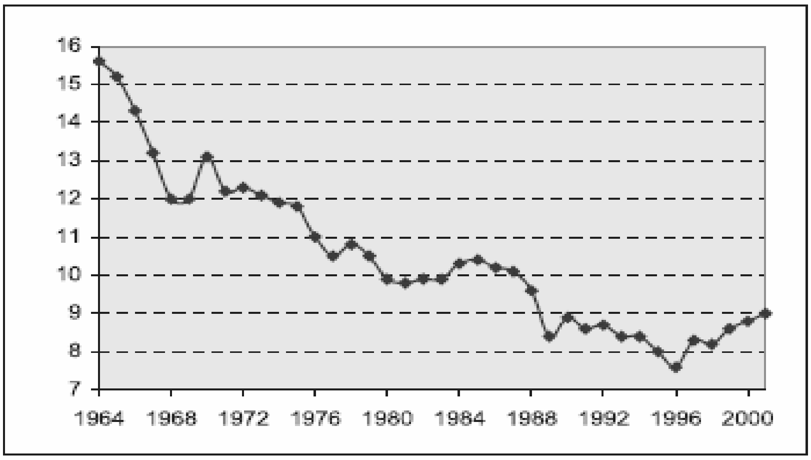
Lead.. Lead is a highly toxic element that can result in damage to the brain, kidneys, blood, central nervous system, and reproductive system. Children who are exposed to high levels of lead may experience slowed cognitive development, reduced growth, and other health effects. Lead in ambient air is not an issue in Thailand any more, since Thailand's complete phase-out of leaded gasoline at the end of 1995, observed lead levels have fallen to almost nil, as shown in Figure 4.2.24. A recent study found that since the early 1990s, there has been a statistically significant decrease in blood lead levels in school children and traffic police, two groups that face the highest risk of lead exposure (Thailand Environment Monitor, 2002).



Source: PCD 2002. Number of sites varied from 9 sites to 21 sites from 1988 to 2001.
Note: Standard is monthly standard.

Figure 4.2.24 Roadside Lead (24-hr average) in mg/m3 1988-2001 All Sites Combined, Bangkok

Visibility. One of the indicators of air quality due to particulate matter is visibility. Visibility measurements recorded at Bangkok's Don Muang airport over the last four decades reveal an interesting story. While the visibility worsened steadily between the 1960s and mid 1990s, it has improved since 1996, as shown in Figure 4.2.25. Because air pollution and reduced visibility are related, the change in the trend of visibility is similar to the PM_{10} levels measured for Bangkok. The visibility and PM10 measurements corroborate each other and support the expert opinion that air quality has improved in BMR in recent times (Thailand Environment Monitor, 2002).



Source: Department of Meteorology, 2002.

Figure 4.2.25 Average Visibility in Kilometer 1964-2000

The improvement of air quality in Bangkok is the result of various synergistic policies and strategies, particularly since the late 1990s. Along with the land use and urban planning policies, the following milestones are greatly contributed to the improvement of air quality in Bangkok.

- Shifting from leaded to unleaded gasoline in Thailand, and fully phased out in 1995. This program has contributed to the purity of urban air quality by diminishing toxic substance from the air.
- Introduction of van transit system for ride sharing in 1995. This system has contributed to the improvement of air quality through the reduction of number of vehicles on road.
- Shifting from two to four-stroke engines of motorcycles program in 1997 nation-wide. This program has a significant impact to the improvement of air quality in Bangkok and in other cities in Thailand, since motorcycles are predominant mode of transport with respect to number.
- The use of low emission fuels e.g. NGV for vans and buses and LPG for taxis and other private transport. This program has been able to remarkably reduce carbon monoxide, nitrogen-oxides, and sulfur-dioxides from urban air, and improve Bangkok air quality.
- Operation of Sky-train (BTS) to provide full capacity of services for public transportation system in 1999. This program is able to reduce the use of private transportation.
- Introduction of park-and-ride system to complement BTS operation in 1999. This program has reduced traffic congestion, improve energy efficiency used by transportation, and improve air quality.
- Operation of subway (MRT) to complement integrated public transportation system in Bangkok in 2004.

Due to those programs, Bangkok air quality has been improved particularly since 1999 and continue to improve as other synergistic program to improve air quality are on the way.

Transportation-driven urban air quality in Bangkok could not be separated from the policies on road infrastructure development. So far, attention paid by Thai Government as well as Bangkok Metropolitan Administration on the development transportation infrastructure particularly road is quite ample. It has been undergoing since the early development of Bangkok in 1900s (Rujopakarn, 2003). This policy has brought into two different consequences: stimulate economic development in the country, while encourage affordable people to possess and use private cars in the absence of excellent public transit system. The following section shows investment on road infrastructure in Bangkok.

4. Investment on road infrastructure

The National Government of Thailand seems so far more prefer in developing road systems than rail systems, it was reflected in the budget allocation particularly during the Eighth Five-Year Development Plan (1997-2001) where budget allocation was emphasized more on road development. There are at least five main organizations those dealing with road and railway development in Bangkok; those are Bangkok Metropolitan Administration and Department of Highway for road development, while railway development is handled by State Railway of Thailand, Mass Rapid Transit Authority for railway system, and Expressway and Rapid Transit Authority for expressway. Table 4.2.8 shows budget allocation for road and railway systems development in the periods of 2001-2005.

Table 4.2.8 Land Transport Infrastructure Investment

Type of Infrastructure	Year [Figure in Mill Baht]				
	2001	2002	2003	2004	2005
Road and Bridge	3,216	2,527	1,711	1,611	2,732
Expressway	5,388	4,921	10,697	9,288	0
Total Budget for Road Development	**8,604**	**7,448**	**12,408**	**10,899**	**2,732**
Mass Rapid Transit	115	130	165	5,650	4,976
State Railway	57	30	191	NA	126
Bangkok Mass Transit System (BTS)	3,196	2,770	5,883	4,976	0
Total Budget for Railway Development	**3,368**	**2,930**	**6,239**	**10,626**	**5,102**
Bus Transport	126	115	130	165	195

Source: Charoentrakulpeeti (2005).

Road infrastructure development is closely connected to residential development. In some cases, road infrastructure follows the development of residential areas, and this is undesirable. In many cases where implementation of land use plan is excellent, the development of residential areas go after road infrastructures. The development of residential area in Bangkok is explained below.

5. Residential development

Residential development in Bangkok metropolis has expanded continuously following the economic growth and increases of population, which resulted in the demand for increased residence. The study undertaken by Government Housing Bank (2002) between the period of 1991 and 2000 showed that the number of residences of the real estate projects registered in Bangkok metropolis and the vicinity was up to 1.15 million units, while registered housings in Bangkok metropolis itself was 680,926 units consisted of the housing estates and condominiums were 356,566 and 324,360 units respectively, as shown in Table 4.2.9. However, the spread of the housing estates were mostly in the outer adjoining areas the city and peripheral provinces. These are predominantly located in the eastern adjoining areas, while the condominiums concentrated in the eastern areas and the eastern inner cities. The real estate projects in the vicinity spread dominantly in Nonthaburi and Pathumthani provinces with the development of the areas extended from Bangkok metropolis along the main roads. In other provinces, the extent of condominiums outnumbered the real estate projects; this was due to the social conditions and the factor on the land price.

Thai Farmers Bank Research Center (2002) forecasts the trend on the demand for residences in Bangkok between the periods of 2002 and 2006, expected to be at the levels of 40,000 to 60,000 units in 2002. Since there were promoting factors on expansion of the purchasing power due to stimulation by the government sector, the demand for dwellings increased in 2002, and this demand continuously increased in 2003 and then lowered in 2004 because the demand has already been met. In the next phase, the demand for dwellings tends to be back under the mechanism of the normal market. It is expected that the demand for dwellings in the year 2006 is at the level of 30,000-50,000 units per year. Nevertheless, the demand for basic dwellings may vary depending on three essential factors that are economy, housing price and interest rate. Moreover, the Research Center also evaluated that under the current market condition the demand for new houses in the housing projects should have a proportion of about 40 percent of the total demand of all the housing at 16,000 to 24,000 units.

Table 4.2.9 Number of registered houses of Bangkok and the vicinity during 1991-2000

Area		Housing Estate		Condominium		Total	
		Number	%	Number	%	Number	%
Bangkok	Eastern inner area	37,361	10.48	107,370	33.10	144,731	21.26
	Western inner area	13,277	3.72	21,218	6.54	34,495	5.07
	Eastern middle area	121,304	34.02	159,731	49.24	281,035	41.27
	Western middle area	91,002	25.52	22,164	6.83	113,166	16.62
	Eastern suburb area	67,183	18.84	10,408	3.21	77,591	11.39
	Western suburb area	26,439	7.41	3,469	1.07	29,908	4.39
Bangkok		**356,566**	**100.00**	**324,360**	**100.00**	**680,926**	**100.00**
Vicinity	Nonthaburi	94,364	25.31	50,889	54.09	145,253	31.11
	Pathumtani	100,393	26.92	17,311	18.40	117,704	25.21
	Samutprakarn	82,274	22.07	16,373	17.40	98,647	21.13
	Samutsakhon	33,050	8.86	5,032	5.35	38,082	8.16
	Nakornpatom	62,789	16.84	4,472	4.75	67,261	14.40
Vicinity		**372,870**	**100.00**	**94,077**	**100.00**	**466,947**	**100.00**
Bangkok & the Vicinity		**729,436**		**418,437**		**1,147,873**	

Source: Government Housing Bank (2002)

On the supply side of housings, the competition in the housing market tends to be fiercer. This was because of the return of numerous developers. The Thai Farmers Bank Research Center forecasts the number of housings completely built in Bangkok metropolis and its vicinity would expand to no less than 5 percent or about 36,000 units.

It was predicted also that the trend of the real estate of office buildings would still be low, as the demand for office buildings for the new or expanded businesses would be low growth as well. It is shown from the fact that development projects of the many office buildings were interrupted. The demand for the office spaces in the near future is expected not to expand very much because the facts that the economy that is still sluggish. Nonetheless, a reduction of rental costs of the grade-A offices in the business center of Bangkok metropolis can attract more customers.

6. Urban planning decision making

Bangkok is a singular primate city and national capital of Thailand, in a Middle Income Country (MIC). It is now likely to have nearly 11 million people by 2015 within a municipal area of 1,568.7 km2 called the Bangkok Metropolitan Area (BMA). For all purposes this is through a national-local government interface on land composed of a high density central city and a medium to low density extended city. However, through national intervention, five surrounding districts totaling 7,754 km2 is added to the BMA so as to constitute a non-statutory Bangkok Metropolitan Region (BMR) enabling thereby leverage for a population well in excess of 11.00 million by 2015. This is through a low density third outer layer and a national-provincial-municipal interface. This then could be considered to constitute Bangkok's extended metropolitan region (EBMR) in three configurations on a canvas encompassing 9,323 km2. Land is increasingly in private ownership and speculative in nature and with no firm spatial umbrella for coordinated development; in this scenario an increasing percentage of people are getting marginalized despite a continual increase in average per capita income, especially, within the BMA.

The Town and Country Planning Act for Thailand came into force in 1966. The Department of Town and Country Planning (DTCP) however, was created several years earlier. It functions within the Ministry of the Interior. In 1960, they published “The Greater Bangkok Plan” as a development guide to government agencies but with no legal backing. The DTCP is required to prepare plans for the whole country in terms of regional plans, provincial structure plans, general plans, specific plans and rural development plans. They work closely with the National Economic and Social Development Board (NESDB) which is located in the Prime Minister’s office with a mandate for socio-economic planning. The DTCP is required to prepare plans for all seven regions of Thailand as identified by the NESDB i.e. North, North-East, South and Central region as divided into four smaller regions - i.e. BMR, Western, Eastern and balance of Central region. They are currently finalizing plans for the BMR. No provincial structure plan has been finalized; neither have any general plans and which are required for urban settlements in Thailand been yet approved.

At Bangkok Metropolitan level, the department in charge of city planning is currently Department of City Planning under the Bangkok Metropolitan Administration. This department has long been servicing the citizen of Bangkok for years, as reflected in its history. The city planning work for Bangkok was formally initiated in 1953. The Bangkok Municipality established the City Planning Section as part of the Public Works Division. In 1961, The City Planning Section was promoted to be the City Planning Division which was part of the Public Works Department. During this period, it comprised of two main sections; (1) City Planning Section, and (2) Surveying and Statistics Section. Later in 1966, The Traffic Engineering Section was established. In 1967, The City Planning Division was transferred from the Public Works Department to be under the Permanent Secretary for the Bangkok Municipality.

In December 1972 The Bangkok Metropolitan Administration (BMA) was established. In this period, the City Planning Division was transferred to be under the Permanent Secretary Office for the BMA. There were 3 Sections: (1) Secretary Section, (2) City Planning Section, and (3) Surveying and Statistics Section, with 65 staffs in the City Planning Division. In 1974, The City Planning Division was reshuffled their organizational structure by dividing into 4 sections; those are (1) Urban Planning Research Section, (2) Mapping Section, (3) Urban Planning Section, and (4) Planning Control Section. There were totally 93 staffs in this period. In 1978, The City Planning Division, under the supervision of the Permanent Secretary Office for the BMA, was again reshuffled their organizational structure. They were further divided into 5 Sections; those are (1) Secretary Section, (2) Urban Planning Research Section, (3) City Planning Section 1, (4) City Planning Section2, and (5) City Planning Section 3. There were 227 staffs in the division since then. The organizational structure is shown in Figure 4.2.26.

This Department has tried to be transparent in their services to the citizen, by involving citizens’ views and aspirations in their planning. Although not all of the decisions are made with public consultation or involvement in this respect, however, the transparency in their services make citizens possible to involve.

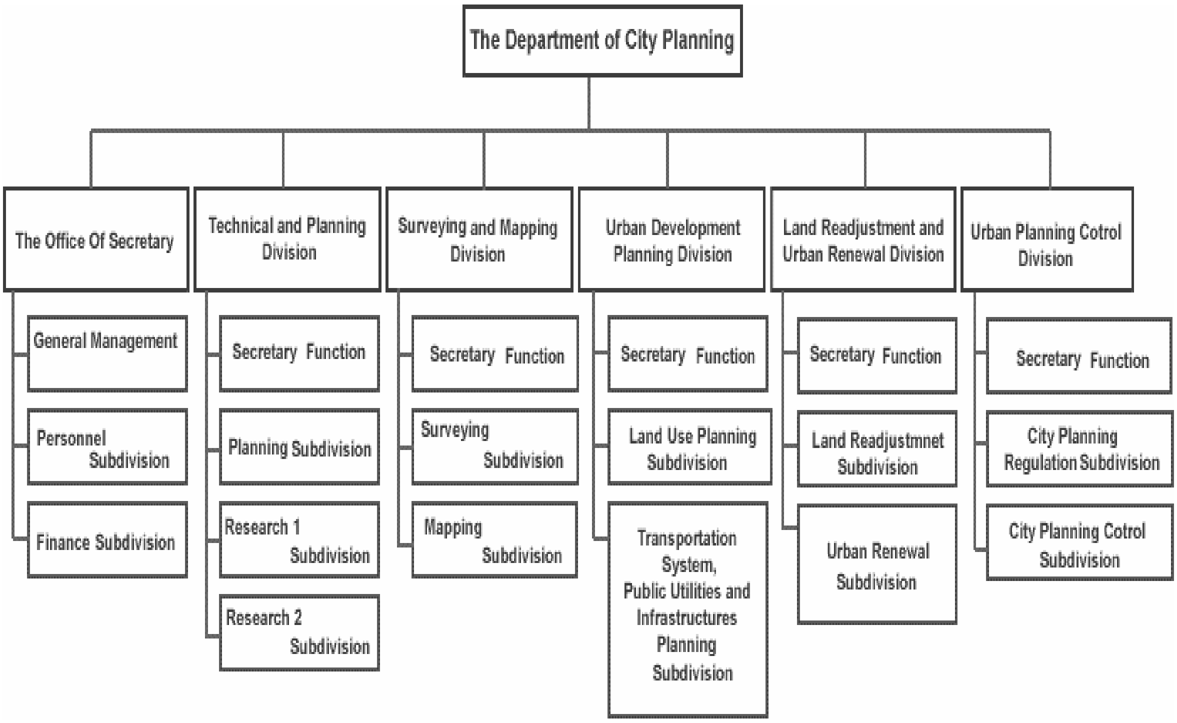


Figure 4.2.26 Organizational Structure of Department of City Planning, BMA

Questionnaire were sometimes distributed to the citizens to gain opinion from the citizens on their wish and aspiration, however, as it was predicted that instead of acquiring patterned citizens' views on city's plans, the citizens' viewpoints were greatly affected by their own conditions. For example, citizens who were living in congested area with paved land want city plan to provide more greenery; in the different manner, for the citizens who were living in low density rural-pattern residential area want more commercial area and supermarket to be provided in their neighborhood. These are some examples on what Department of City Planning has tried to the most transparent possible to serve the citizens. The followings are service provided by the Divisions under the Department of City Planning of BMA[13].

- The Department of City Planning's Information Service Center offers the latest information about the city plans, city planning works, and laws, which citizen can obtain the service directly from the office of City Planning Department.
- The Surveying and Mapping Division provides the building map, district map, Bangkok map upon request.
- The Land Use Checking Services offers the information about the Bangkok regulations such as construction prohibit, modification, or building according to The Bangkok Comprehensive Plan. It also offers legal consultancy for those who have problems about the city plans.
- The Land Readjustment and Urban Renewal Information Service provide all information about the land readjustment and urban renewal in Bangkok area. It opens to people, authority and others who are interested in obtaining information at this division.
- The Technical and Statistics Reports Information Service offers the technical and statistics information about the city plans and other related information.

- People, authority and others, who are interested to obtain information about the Bangkok transportation network, can contact The Urban Development Planning Division.

Under the Town Planning Act 1975 (BE 2518) , BMA as a local government authority assumes responsibility for preparing the Comprehensive Plan, therefore the functions of the City Planning Department are to undertake surveys and research on population, transport, infrastructure etc. which are necessary for preparing the comprehensive plan, the specific plans, conservation plans, land readjustment project, etc. Other than Town Planning Act 1975, the followings are laws and regulations those related to the tasks of City Planning Department. The lists are arranged hierarchically and chronologically[14].

- The Thai Constitution 1997
- The Accident Prevention From The Entertainment Act 1921
- The Petrol Keeping Act 1931
- The Building and Land Tax Act 1932
- The Hotel Act 1935
- The Local Maintenance Tax Act 1965.
- The Petroleum Act 1971
- The City Planning Act 1975
- The Petrol Act 1978
- The Petroleum Authority of Thailand Act 1978
- The Building Control Act 1979
- The Condominium Act 1979
- The Onshore Traffic Act 1979
- The Onshore Transportation Act 1979
- The Bangkok Administration Act 1985
- The Cemetery and Crematorium Act1985
- The Expropriation Act 1987
- The Environmental Act 1992
- The Urban Cleaning Act 1992
- The Factory Act 1992
- The Health Act 1992
- The Public Road Act 1992
- The Service Place Act 1966, 1978 and 1992
- The Historical Site, Antique, and National Museum Act 1961 and 1992
- The Nursery Act 1998
- The Land Management Act 2000

14. Source: City Planning Department, BMA, http://203.155.220.217/cpd/

- The Danger Material Act 1992, 2000
- The Land Digging and Filling Act 2000.

Above legal sources of planning have contributed greatly to the current state of Bangkok Metropolitan. Some particular legal bases have also shaped Bangkok Metropolitan towards the encouragement of mixed land uses which, to certain extent, discourages the needs of motorize travel.

7. Policies on dense and mixed land use planning in Bangkok

Mixed-use development can occur on a number of levels: site-specific, neighborhood, or subregional. On a site-specific basis, individual buildings or complexes can be designed to incorporate a variety of uses. For example, a single building might include apartments, offices, and retail. At the neighborhood level, mixed-use development refers to the arrangement of different uses across several blocks or acres of land so that they are not physically isolated from one another. Finally, at the subregional level, mixed-use often aims to balance jobs and housing so that people have the opportunity to live closer to their places of employment (USEPA, 2001).

Mixing land uses encourage more efficient use of the available urban infrastructures and facilities, because more users share same facilities; in addition, mix land uses can have direct positive effects on habitat preservation and reducing runoff since mixed-use developments have the potential to use surface parking lots and transportation infrastructure more efficiently, and requiring less pavement. In the mixed-use, the office buildings may be facilitated by retail shops and restaurants, the infrastructure that supports the building i.e. the roads and parking lots is in use for more of the day. Office traffic arrives during rush hour and uses the parking lot during the day. That parking can be used in the evenings for restaurant and theater traffic. The alternative is two sets of roads and parking lots one set serving office buildings and another that serves retail and entertainment areas. This situation is supposed to be occurred in Bangkok.

The density increase and mix-used of the land in Bangkok have been so far undergoing in a natural manner, since there is no such explicit policy or regulation that control the density and mixed land use. In contrary, regulation on type, use and dimension of building are deeply regulated, as described in the following sections.

The presently effective main law on land use of Bangkok is based on City Planning Act 1975, which is implemented with the support of Ministerial Regulation 414/1999 and other laws and regulation. For the case of Bangkok Metropolitan, Bangkok Metropolitan Administration is the organization which is responsible for declaring city's policies, while the Department of City Planning is the responsible department to implement those policies. There are no such clear policies on dense and mixed land use in Bangkok, in addition that during the past 30 years, land use in Bangkok has been changed without appropriate guidelines and control measurements of land and building uses. The land occupation expanded from the inner city along the main roads to suburbs and then invaded agricultural areas around Bangkok and the BMR. Besides, there has been increase in high-rise buildings without standards or organization for building controls, which may cause many other problems. The major impacts are that mixed land use undergoes in leap-frog or ribbon development forms; building uses and development problems, flood and drainage problems, and green area expansion (Pimcharoen, 2004).

Amid the insufficiency in policy and regulation on dense and mix land use in Bangkok, concept of multi-habitation has been brought in for implementation in city districts such as Ladkrabang (Meesiri and Perera, 2004), and Eastern Corridor (Panitchpakdi, 2004). The concept of multi-habitation is principally equivalent to mix land use with socially mixed built-up areas through community-based planning process as proposed by Fujii (2002). In comparison with land use control, building control has more detail and advance control systems. The main objective of building control is to ensure that all buildings work comply with standards of safety, amenity and matters of public policy. There are six objectives of building control systems in Bangkok Metropolitan with different target areas, as described below.

7.1 To preserve and conserve historical sites and national heritage

There are five target areas of historical site and national heritage to be preserved and conserved by undertaking appropriate building control at specific target areas, such as shown in Figure 4.2.27:

- **Inside Rattanakosin Island, Area 1**. The following constructions are prohibited: Row house, shop house, factory, commercial building, public building or any building other than religious building, government building, and other institutions building, are prohibited in area 1. All buildings should not higher than those existing buildings and not higher than 16 meters.

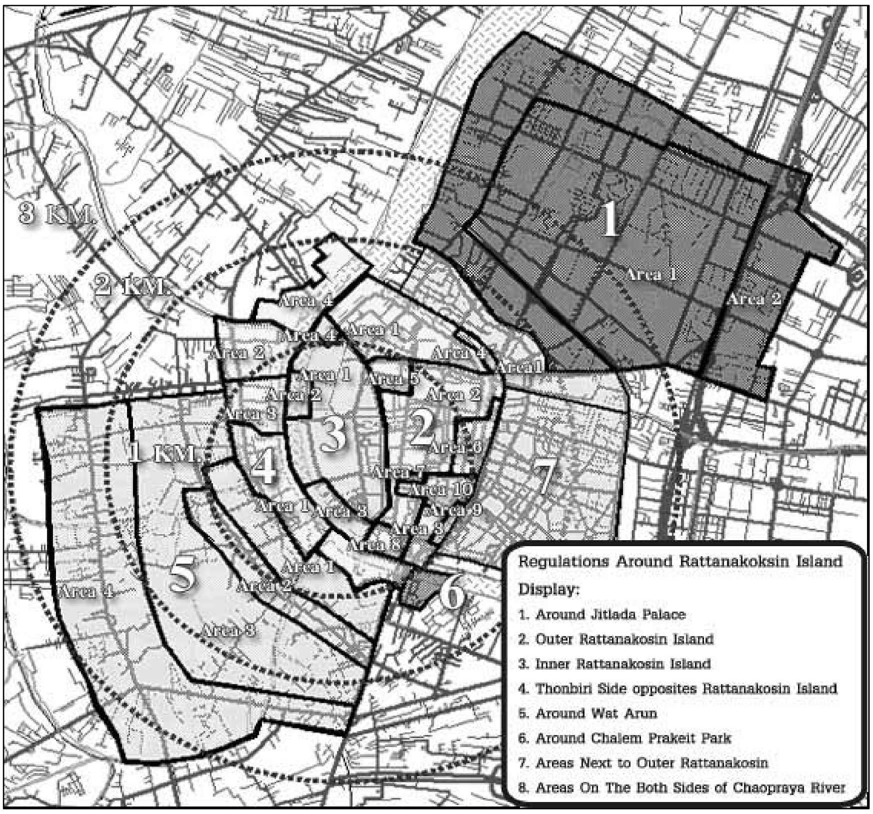


Figure 4.2.27 Building Control in Rattanakosin Island

Source: City Planning Department

- **Inside Rattanakosin Island, Area 2, 3 and 4.** The following constructions are prohibited: factory, building used for unpleasant business, hotel, entertainment building, warehouse, convention hall other than convention hall of government, school, and university. Row house, shop house, crematorium, petrol station, commercial sport complex, signboard that has accumulated space more than 5 square meters, and building that is higher than 16 meters are prohibited in area 2, 3 and 4.

- **Around Rattanakosin Island, Area 1, 2 and 3.** The following constructions are prohibited**:** factory, building is used for unpleasant business, hotel, entertainment building, warehouse that has storing space more than 80 square meters, restaurant that has space (to set up a table) more than 300 square meters, market, convention hall other than convention hall of government, school, and university. Row house, shop house, crematorium, office building that has space more than 300 square meters, department store that has space more than 300 square meters, petrol station, sport complex, signboard that has accumulated space more than 5 square meters, and building that is higher than 16 meters are prohibited.

- **Around Rattanakosin Island, Area** 4, 5, 6, 7, 8, 9. The following constructions are prohibited: restaurant that has space to set up a table no more than 400 square meters, private convention hall that has accumulated spaces in all levels no more than 300 square meters and office building.
- **The Areas of Thonburi as the opposite of Rattanakosin Island, Area 1, 2**. The following constructions are prohibited: Any building except religious building, government building, institution, and residential building other than row house, shop house, townhouse, dormitory or apartment that is not higher than 16 meters.
- **The Areas of Thonburi as the opposite of Rattanakosin Island, Area 3**. The following constructions are prohibited: factory, building is used for unpleasant business, hotel, entertainment building, warehouse, restaurant, market, convention hall except convention hall of government, school, and university. Row house, shop house, crematorium, department store that has space more than 300 square meters, petrol station, gas station, sport complex, signboard that has accumulated space more than 5 square meters, and building that is higher than 16 meters are also prohibited.
- **The Areas of Thonburi as the opposite of Rattanakosin Island, Area 4 and 5.** The following constructions are prohibited: factory, building is used for unpleasant business, hotel, entertainment building, warehouse that has storing space more than 80 square meters, restaurant that has space to set up a table more than 400 square meters, market, private convention hall that has accumulated spaces in all levels more than 300 square meters except the convention hall of government, school, and university. Row house, shop house, crematorium, department store that has space more than 300 square meters, petrol station, gas station, sport complex, signboard that has accumulated space more than 5 square meters, and building that is higher than 16 meters are prohibited.
- **Wat Arun Rachawararam Area 1, 2, 3 and 4.** The construction of buildings those are higher than 16 meters, 24 meters, 40 meters and 70 meters are prohibited in the respective areas.
- **The Areas nearby the Outer Rattanakosin Island.** The areas nearby the outer Rattanakosin Island in Wat Sam Praya sub-district, Ban Patom sub-district, Pra Nakorn district, Wat Sommanas sub-district, Ban Bat sub-district, Klong Mahanak sub-district, Tepsirin sub-district, Pomprabsatrupai sub-district, Pomprabsatrupai district, and Sumpantawong sub-district, Jakkrawat sub-district, Talad Noi sub-district, Sumpantawong district. The following constructions are prohibited: (1) within area 1, building that is higher than 20 meters. (2) within area 2, building that is higher than 37 meters. (3) within area 3, building that is higher than 16 meters.

Above policies clearly encourage the preservation of historical buildings within Rattanakosin Island while discourage any extensive commercial development. These policies are expected to reduce traffic which is generated particularly by journey for shopping, at the same time public transportation is expected to accommodate the need of travel of the tourists within this area.

7.2 To keep the security of the high level institutions and some specific area

There are five target areas of historical site and national heritage to be preserved and conserved by undertaking appropriate building control at specific target areas, such as shown in Figure 4.2.28.

- **Within the radii of 200 meters and 300 meters**. Construction of building that is higher than 16 meters within 200 meters, and building that is higher than 24 meters, within the radii of 200 to 300 meters (the radius is measured from the center of the Victory Monument).

- **The Areas around Chitralada Palace, Area 1.** Building that is higher than 24 meters within 200 to 300 meters radius is prohibited.
- **The Areas around Chitralada Palace, Area 2.** The following constructions are prohibited: Any building except residential building (single house), residential shop house, residential apartment, commercial building that is not categorized as row house, shop house, school, medical service (house) building, religious building, public building, government building, institution that is not higher than 20 meters.

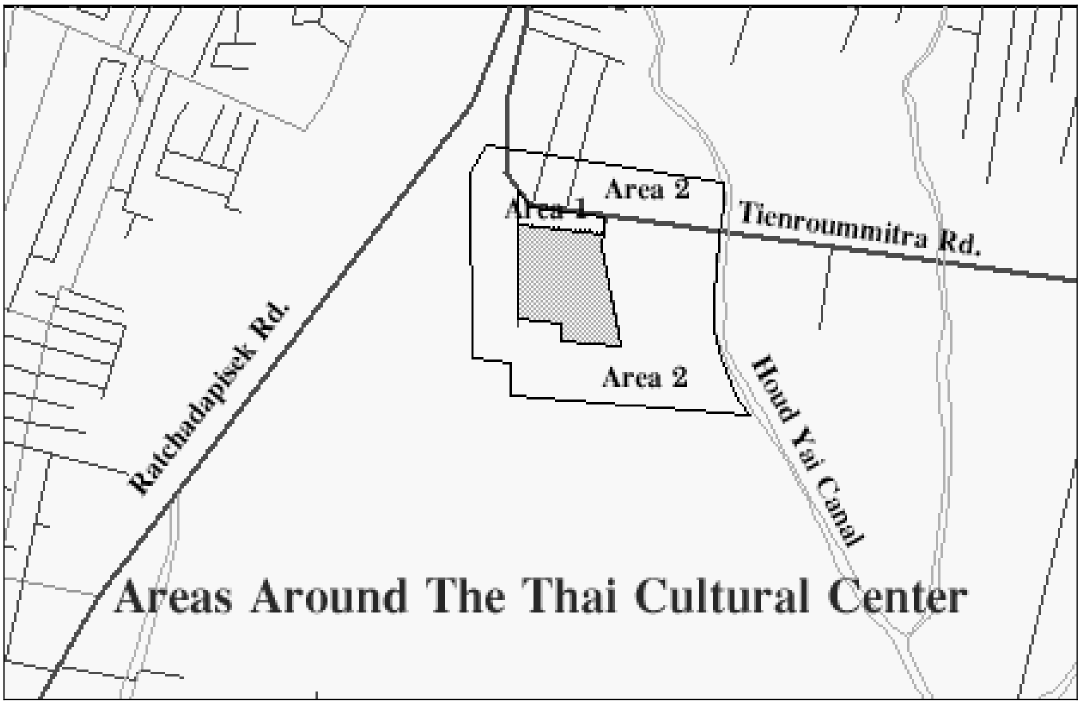


Figure 4.2.28 Areas around Thai Cultural Center

Sosource: Department of City Planning, BMA

- **The Ares around Cultural Center of Thailand, Area 1.** The following constructions are prohibited. Any building except residential building, commercial building not higher than 9 meters and not a row house or shop house. The commercial building must have the ground floor space not more than 80 square meters.
- **The Ares around Cultural Center of Thailand, Area 2.** The following constructions are prohibited: row house, shop house, building higher than 9 meters, building that has accumulated space in all levels and in the same building more than 1,000 square meters, factory, building used for unpleasant business, hotel, entertainment building, market, warehouse, petrol station, explosive material warehouse, tank tower, cemetery or crematorium, billboard that has accumulated space more than 5 square meters or higher than 9 meters.
- **The Areas around Rama IX Royal Park, Area 1, as shown in Figure 4.2.29.** The following constructions are prohibited: any building except residential building (single house), government building, institution, commercial building that is not row house, shop house or large building, sport complex, which serves not more than 750 people and not large building, government sign, electric sign and business name sign that has accumulated space not more than 5 square meters, however the mentioned building must not higher than 15 meters.

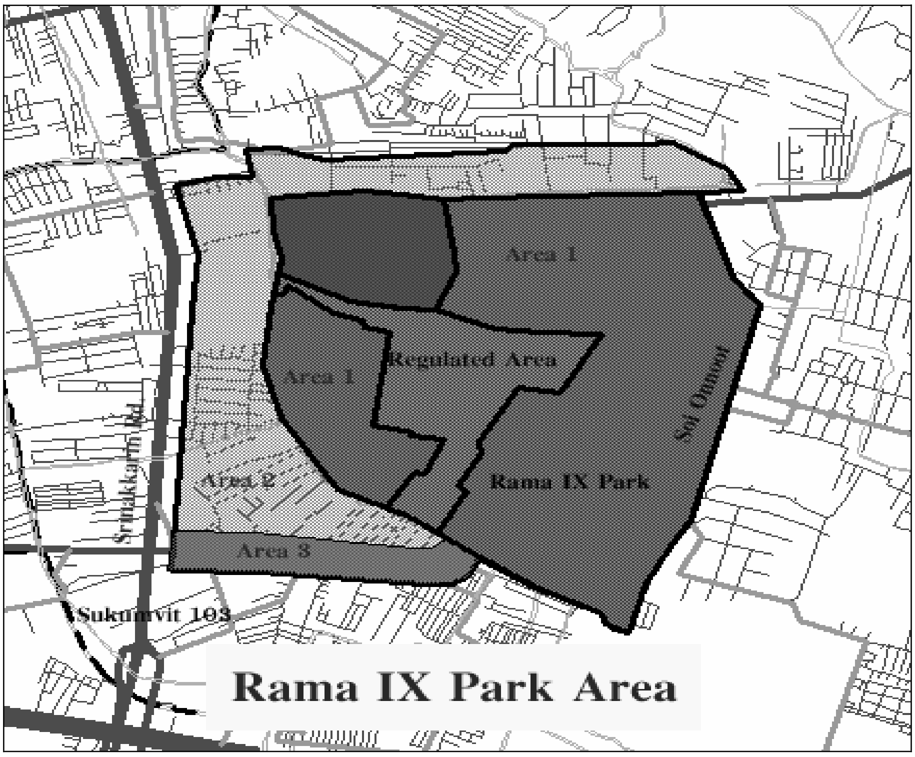


Figure 4.2.29 Areas around Rama IX Park

Source: Department of City Planning

- **The Areas around Rama IX Royal Park, Area 2.** The following constructions are prohibited: any building except residential building (single house), government building, institution, commercial building, warehouse that has storing space more than 100 square meters, animal husbandry in the building that is not for commercial and has accumulated spaces not more than 100 square meters, private school, sport complex, medical service (house) building, aid organization, nursery, however mentioned building must not higher than 23 meters.
- **The Areas around Rama IX Royal Park, Area 3.** The following constructions are prohibited: row house, shop house, commercial building, large building, entertainment building, hotel, department store, warehouse, and factory.
- **The Areas around the Honor Celebration of Somdejsrinakarin Park.** Building that is higher than 16 meters within controllable areas is prohibited.
- **The Areas Along the sides of Chaopraya River.** The following constructions are prohibited: (1) Within 3 meters both sides of Chaopraya River except dam, tunnel, bridge, road or drain, fence, wall or gate. (2) Within 3 to 15 meters of both sides of the Chaopraya River bank, the only following building can be constructed: building that is not higher than 8 meters and not a row house or shop house and the building must have distance from the property line no less than 2 meters or distance from other buildings no less than 4 meters. (3) Within 15 to 45 meters from both sides of the Chaopraya River bank, a building that is not higher than 16 meters can be constructed.

Above policies are expected to control traffic generated by journey for shopping by restricting excessive development of commercial area, while encouraging more culture-based tourists visits in the area. Although this effort is limited to confine within certain area only, however the contribution toward the reduction of travel demand for commercial purposes can be discouraged. In line with this effort, environmental aspect has also been considered towards Bangkok as sustainable city. This issue is briefly given below.

7.3 To keep good environment around residential area

To achieve the objectives, residential areas in Bangrak, Pathumwan, Payathai and are regulated. There is prohibition in the construction of row house, shop house, commercial building, public building, factory and others, except the buildings those have been regulated in each area according to ministry enactment released in the city planning laws.

7.4 To locate flood areas following Bangkok flood prevention project

To achieve this objective, the construction, modification and changes in use of buildings are prohibited in Meenburi district, Klong Sib sub-district, Koo Fang Neau sub-district, Nongchok district, and Khlong Sam Prawet sub-district, Lumplatew sub-district, Ladkrabang sub-district, Ladkrabang district, Bangkok.

7.5 To conserve the rich farming in urban area

Farming Areas in Pasijareon, Taling Chan and Tungkru Areas. To achieve the objectives, the following prohibition is lifted: (1) Any building within the specific areas except government building, school or medical service building that has no overnight bed for patient, residential building that has no more than 2 floors and not higher than 12 meters, which is not a row house or shop house and the ground floor space has no more than 100 square meters, dam, bridge, tunnel, and animal husbandry building farming related building. (2) Within 70 meters along the both of Bang Wag, and Chimplee road sides, and the both of Buddha Monthon route no. 1 road sides, Buddha Monthon route no. 2 road sides, Outer Ring road, and Bankok Noi-Nakorn Chai Sri road, some types of building such as animal husbandry building, farming related building such as barn and silo cannot be constructed. (3) Row house, shop house, where the building uses common wall.

7.6 To prevent traffic problems and promote road-side order along important main highway

The regulation covers the areas of Sri Ayuthaya road sides, Chaopraya, Ratchadaphisek (Asoke-Vivawadee, Thaksin-Taphra, Wongsawang, Sonthornkosa-Sukhumvit and Wongsawang-Khlongprem), Srinakarin, Rama IX, Sukapibam 1, Sukapibam 2 (Bangkapi-Minburee), Ram Inthra and Suwintawong, Khrungthorn-Taling Chan bridge, Bangkok Noi, Nakhon Chaisri, Rama II, Borrom Rachachonee, Outer Ring Road (Kanchanaphisek), Chalongkrung, Cheasumpan, Suwintawong, Romkao, Soi On Nut, Khrung Thonburi, Petchburi-Rama IX, Sathorn Bangkolaem, Bangkok-Chonburi, Narativas Rajnakkarin, Buddha Monthon, Ngamwongwan, Somdej Prachao Thaksin and Petchkasem. The regulation covers mostly the prohibition of constructing row house, shop house, commercial building, large building, entertainment building, hotel, department store, warehouse, factory within 15 meters along both sides of the road.

Building controls as one of traditional urban management practices should ideally be compensated by excellent services provided by the city authority for the citizens, as a give-and-take process between service providers and all strata of the customers. One of the services that the city authority should provide is pleasant environment for the citizens. Adequate urban parks, civic center, and pedestrian friendly environment are among the facilities that should be available and accessible to all citizens.

8. Promotion of pedestrian friendly environment

Pedestrian friendly environment supports the reduction of travel demand by encouraging more non-motorized transports, such as walking and cycling. Bangkok has attempted to create the environment that is friendly to all pedestrians. This effort is discussed in the following sections.

8.1 Policy guidelines

In general, there is no such explicit policy of the Bangkok Metropolitan Administration to promote pedestrian friendly environment. The efforts are limited to promotion of pedestrian friendly atmosphere in areas such as Khao San road in Banglamphoo District and Siam Square in Patumwan District. With this condition, Bangkok is notoriously not a pedestrian friendly city. The pedestrianisation in Khao San road is mainly extended to accommodate tourism business rather than fundamental efforts for better urban environment.

Similar situation with the promotion of pedestrian friendly environment, the introduction of traffic calming by various physical means such as humps, chicane and woonerf or non-physical means such as traffic sign are not commonly undertaken. The Bangkok's roads tend to maximize traffic speed and volume by constructing multi-lanes, rigid pavement and straight alignment of roads, thus the traffic calming in most of the urban roads in Bangkok is not very common. However, traffic calming is regularly undertaken in residential neighborhood roads. The construction of humps is the most frequently seen in the residential roads, but so far, no explicit policy or regulation to standardize the traffic calming, therefore traffic calming undertaken in residential area is more on the residents initiative rather than regularize by the city authority. Beside tends to maximize traffic speed in Bangkok in order to avoid traffic congestion, there are numerous constraints as well in creating pedestrian friendly environment.

Those constraints of the implementation of pedestrian streets, as admitted by the city authority, are among others:

- The absence of legal basis for creating pedestrian friendly environment, although design of some parts of the city is in place;
- Lack of budget for operation of the facilities;
- Lack of cooperation with other stakeholders for construction design and maintenance of the pedestrian friendly facilities;
- Overlapping in functions and responsibilities among the relevant organizations, which may void responsibilities on construction and maintenance of the facilities;
- Lack of cooperation between public and private organizations as well as people;

The pedestrian friendly environment should also include facilities for vulnerable people such as elderly people, women and children. This is to ensure that all strata of citizens can be served in just and equal manner. Other than those traffic calming facilities, the provisions of supporting facilities for pedestrian such as street sign (mostly in English), directional sign (in major area, is written in English), drinking water taps, public telephone, etc are common in Bangkok. Some promotions of pedestrian friendly environment are also undertaken.

8.2 Initial steps of the promotion

Bangkok is more a motorized dependent city, because of that Bangkok is notoriously not a pedestrian-friendly city. Asian cities, including Bangkok, are very dense and highly mixed in their land use and are suitable to non-motorized modes because of the short trip distances required to satisfy most needs. However, with rising wealth a number of factors are seriously undermining the potential of these modes to continue contributing to travel needs.

As Bangkok does, non-motorized modes in many of Asian Cities are being forced off the road; while in a reverse way, Tokyo the wealthiest of all Asian cities maintains one of the highest rates of walking and cycling in the world, it accounts for 42 percent of all trips, while in Bangkok this figure equal to 1.6 percent (Charoentrakulpeeti, 2006). Non-government and other organizations are increasingly calling the authority to consider the non-motorized modes in urban planning and transport decision making in Asia. This call is grounded on environment and safety consideration.

Aspects of the built environment such as building orientation, street connectivity and design, and building design all contribute to the relative friendliness of that area to pedestrians and bicyclists, and to the general aesthetic appeal of an area. Together, these are often referred to as "microscale" urban design factors small-scale elements that affect the safety, convenience, and desirability of living and working in areas of higher density and of using transit and non-motorized modes of transportation (USEPA, 2001).

There are several ways to promote pedestrian friendly areas and traffic calming in order to improve non-motorized traffic. One of the most effective ways of assisting non-motorized modes is through carefully designed traffic calming schemes such as provision of humps[15], chicane[16] and woonerf[17]. Traffic calming's principle aim to improve road safety for pedestrians and cyclists by creating environments in which the speed of traffic is significantly reduced. In practice, the effects of good traffic calming schemes reach far beyond improvements in road safety to include streetscape enhancement as well as reductions in noise, emissions and fuel use and in many cases, improvements in the economic performance of shops.

To achieve the goals of traffic calming, the redesigning of streets is required. This often includes reclaiming road space from motorized vehicles in order to provide bikeways and wide footpaths. Traffic calming in retail and commercial districts generally leads to very large improvements in the human quality of the environment which attracts more people and increases the economic performance of the businesses in the area. Traffic calmed districts, particularly in inner areas which may have been depopulating over the years, are also more attractive for redevelopment and residential revitalization. Through improving street environments, particularly safety for children, traffic calming can thus also contribute to a more sustainable city through bringing people back to live, work or shop in areas with inherently low automobile dependence.

Traffic calming can be interpreted in a narrow sense in terms of redesigning streets as described above, or in a broad sense in terms of a transport planning philosophy that attempts to reduce automobile dependence using a variety of mechanisms. These broader mechanisms include improved transit and land use changes, which build in less car use.

Walking and cycling characteristics in Bangkok are very depressing. The low levels of walking and cycling are due to the safer and more pleasant conditions for a motorized travel. It is recommended that if priority is given to improving pedestrian and cycling conditions in Bangkok, there will be a significant shift from car to other modes. Apart from initiating a modal shift there are other impacts of pedestrianisation, in commercial area it can bring economic benefit to the retailers on the pedestrianised area.

A pilot project of pedestrian friendly environment has been initiated and promoted in a famous commercial area for tourists in Bangkok. The selected area is Khao San Road, a street located in Banglampoo district. It is a famous destination for many local and foreign travelers and backpackers. The location is suitable for

15. Protuberant parts of road surface to reduce traffic speed on it.
16. A series of sharp, slow turns designed to reduce speed at a certain point on the road.
17. A street in which the needs of car drivers are secondary to the needs of users of the street as a whole. It is a space designed to be shared by pedestrians, playing children, bicyclists, and low-speed motor vehicles.

backpackers as it provides cheap lodging and boarding facilities. Apart from the motels, Khao San Road has food stalls, travel agencies, souvenir and music shops. The road has been pedestrianised as a part of the government policy with the help of the local police station. The Tourism Authority of Thailand helped in promoting the project. The project was implemented in the year 2001. The Khao San Road Area is shown in Figure 4.2.30. There are other types of pedestrian friendly environment in Bangkok, those are: Siam Square for better walkways, and Silom Road for safer crossing for pedestrians in long block without signal.

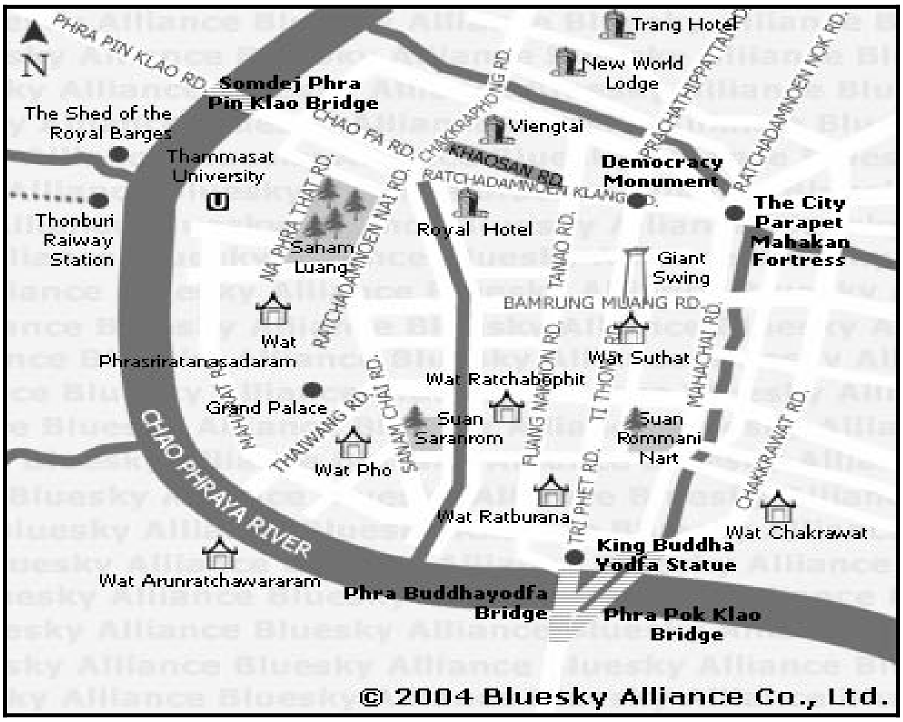


Figure 4.2.30 Khao San Road Area

A study on the outcomes of Khao San pedestrianisation shows that pedestrianisation tends to increase the sales volume as it attracts more visitors to the area of implementation. Even though the economic condition of the country is good and rising unappealing areas don’t attract visitors resulting in closures in businesses in that area, pedestrianisation can be a remedy to such a situation.

Figure 4.2.31 Situation in a Corner of Khao San Road: Traffic is calmed without enforcement

Khao San road is not particularly pedestrian friendly yet rather than the condition of Khao San road enables the pedestrians to walk freely on the road. The existence of street vendors and road-side shops along Khao San road are the main reasons of the pedestrians to take a free walk. Pedestrians of the Khao San road are mostly tourists, since this road is a famous tourist's area in Bangkok similar to Silom area. Khao San road is a one-way mixed traffic road, with any kind of vehicle may enter the road freely, and however the traffic is predominantly taxis and private cars of the shoppers and tourists. Limited or no-entrance policies for vehicles are locally undertaken at the main entrance of Khao San road by security guard to control the traffic within this road. Although not a quite pedestrian friendly street, however, priority is given to pedestrians. This is a self managed pedestrian friendly environment, which can only be undertaken at very limited area.

Figure 4.2.32 Mixed one-way traffic and roadside shops in Khao San road create “Pedestrian Friendly Environment”

Another quasi-pedestrian friendly environment exists at Ratchadamnoen Nok Avenue. Although it is not purposely intended to be pedestrian friendly street rather than provision of friendly environment of major protocol roads but the atmosphere seems friendly for pedestrian at least in terms of shady and pleasant walkways.

Although Ratchadamnoen Nok Avenue is not particularly intended to create pedestrian friendly environment, however, with existing pedestrian facilities that create shady and green environment for the pedestrians particularly bus riders, this avenue enables pedestrians to pleasantly and safely walk along the avenue. This situation has contributed to the reduction of motorized travel demand for the short distance along this avenue. This avenue is mostly institutions and government areas. Provision of excellent connections for pedestrian among existing offices, would significantly reduce the need of motorized travel demand particularly short-distance travel for the officers and staffs those work in this area. It is quite possible to implement with current specific policies to control this area.

Figure 4.2.33 Shady Environments with Bus Stop at Ratchadamnoen Nok

Figure 4.2.34 Another Pedestrian Friendly Environment at Sanam Luang, despite lack of Facilities

Figure 4.2.35 A rare Urban Parks near Sanam Luang creates Pedestrian Friendly Environment

Figure 4.2.36 Signboard that is written in local language (Thai) is not quite compatible in this tourists area

USEPA (2001) found that changes in individual microscale aspects of urban form, such as adding sidewalks and street benches, may not be sufficient to achieve changes in vehicle ownership or mode choice if the region as a whole is oriented toward vehicle travel. For example, an analysis of travel in Palm Beach County, Florida, found that transit mode share was minimal in all communities examined despite differences in design, presumably because the entire region is relatively auto-dependent, with limited transit service. Similarly, other studies have found that in a low-density area characterized by a wide separation of distinct land uses, sidewalks and attractive landscaping are unlikely to prompt residents to walk to shops and stores. Some newly built neotraditional communities may not significantly reduce vehicle travel if they are not regionally accessible or transit-accessible.

Figure 4.2.37 Point of Interests should be facilitated with Pedestrian Friendly Environment

Pedestrianising a street requires consensus from all stakeholders such as retailers, customers, police, authorities, users and public at large. In many cases pedestrianisation fails if there is a void in the consultation process among the stakeholders. If there is a strong approval from the stakeholders the project will probably be more successful. Pedestrianisation, traffic calming, mix land use and adequate urban transit system will contribute to the reduction of motorized travel demand particularly by using private cars.

9. Summary and conclusion

Discussions have been carried out on various issues related to population, land use planning and transportation as well as urban air quality which are affected by transportation, in the framework of promoting the reduction of travel demand in transport sector. Some conclusions can be summarized as thematically itemized below.

9.1 Population and jobs

The employment condition in Bangkok (based on Year of 2002) was predominated by service industries, it accounts for 64 percent of the total workforce. This figure would probably be similar with present condition although with slight variation. If it is compared with adjacent provinces, the predominant economic activity was manufacturing, it accounts for about 80 percent. This condition occurs due to the government policy on the relocation of industries from Bangkok to adjacent provinces. The impacts on travel demand would be shifted from Bangkok to adjacent provinces, similarly in terms of industrial pollution.

Data on population of Year 2000 shows that productive age group (15-59 years old) accounts for 4,684.0 thousand people (or 74 percent), while non-productive age groups (<15 years old and >59 years old) account for 1,636.0 thousand people (or 26 percent). As a comparison, Bangkok population contributes 10.43 percent of the total Thai population. The estimate population in 2005 was about 7,081,000 people or equivalent to 10.96 percent of total Thai population.

If it is assumed that Central Business District in Bangkok consists of the Areas of Ploenchit, Sukhumvit, Silom, Surawong, Sathon and Phatumwan, therefore the CBD area of Bangkok is about 20.2 sq km with total employment in the CBD based on 1990 data was 271,944, with job density in the CBD was about 13,200 employments per sq km. From travel demand viewpoints, this situation has affected the need of travel towards the central business district from the periphery of the city, since housing and job are not quite balance in Bangkok CBD. Provision of excellent public transport with other supporting facilities is required to restraint the fulfillment of travel demand by private cars.

9.2 Land use planning and zoning

Bangkok land use plan was manifested by Bangkok Comprehensive Plan which is enforced by the support of the Ministerial Regulation Number 414/1999 and enacts as the implementation guidelines of the City Planning Act 1975. The first revision of Bangkok Comprehensive Plan was undertaken in 1999. The comprehensive plan has the objectives to guide Bangkok Metropolitan urban development and peripheral conservation and preservation for the purpose of comfort and better life of the citizen. Land Use control was undertaken by the Department of City Planning, under the Bangkok Metropolitan Administration.

The plan has also addressed the promotion of mixed land use in certain areas. It is commendable amid current distinct segregation between residential and commercial or institutional areas. Promotion of mixed land use would gradually accomplish job and housing balance; therefore transportation is undertaken in locality and thus improves possibility to reduce motorized travel demand, providing that “within walking or cycling distance” is fulfilled and pedestrian friendly environment is created. In case of Bangkok, to accomplish this situation seems “still long way to go” by examining the current trends of Bangkok toward motorized dependent Megacity. However, political willingness of the authority as reflected in the plan to promote mixed land use is appreciable.

9.3 Bangkok Comprehensive Plan

The comprehensive land use plan for Bangkok Metropolitan is addressing five broad visions to be achieved. The vision covers the guidance on preservation and conservation while improving accessibility of the city and attempting to achieve an efficient land use. To achieve these visions, nine specific strategies have been formulated. The strategies are, in principle, the guidance to strengthen the strong points of the city, to minimize the weak points and threats, and at the same time, to explore the opportunity that the city has in order to support the vision.

The plan is creditable with regard to conventional urban management towards the accomplishment of Bangkok Visions: Bangkok as Fashion City, International Education Hub, Air Asia Hub, Kitchen of the World and Medical Tourism Node. However in more specific issues, full attention are still required to address the promotion of reduction motorized travel demand in Bangkok Metropolitan, because current fact of car dependent city is stigmatized to Bangkok requires fundamental transformation in the planning.

9.4 Transportation condition in Bangkok metropolitan

Bangkok has been expanding from initially Bangkok as a city, then Bangkok Metropolitan Area (BMA) later expanded physically to be the Bangkok Metropolitan Region (BMR) which is in fact BMA plus five adjacent provinces, those are Samutprakarn, Nonthaburi, Pathumthani, Nakhon Pathom and Samut Sakhon. This BMR covers 7,758 km2. The BMR is then later extended to be Extended Bangkok Metropolitan Region (EBMR) which covers two other provinces. There is various types of transportation facilities that forms Bangkok transportation network. This network includes road, toll way and water. BTS sky-train and MRTA subway are the back-bone of Bangkok Transport Network. The BTS sky-train serves two lines: Sukhumvit Lines and Silom Lines with total length is 24.0 km. While Chaloem Rachamongkhon Line MRTA subway connects Bangsue and Hua Lamphong, with total length of 20 km.

City buses are the most contributors of transport modal splits in terms of passenger kilometer with more than 6,632 million passenger kilometer in a year, while private cars and MRT plus BTS are the second and third largest contributors in Bangkok Metropolitan Region. The popularity of bus transport because of the variety of routes served by the bus compared with BTS sky-train of MRT subway. The fare is also comparably lower than those two modes of public transport for the same distance. Water transport is also important transport mode in Bangkok, however, since the routes are not as vary as land transport, the contribution of water transport in terms of passenger kilometer is not as high as city buses.

The fact that private cars as the second largest contributors has brought into reflection on need of the reduction of motorized travel demand by wisely handling this potential contributors. The issue is how to gradually alter private cars users into public transport customers. The possible responds to this issue are: provision of excellent but affordable public transport in Bangkok with smooth inter-modal transition along with pedestrian friendly environment and other excellent urban facilities to attract private car users to use public transport. This alteration must offer significant socio-economic benefits for the private car users, otherwise the program will not be successful.

9.5 Investment in road infrastructure

The Government of Thailand seems more preferable to develop road systems than railway; since budget allocation was emphasized more on road development. Existing data show that the investment in road infrastructure in Bangkok has slightly fluctuated from 2001 to 2004, from 8,604 million baht in 2001, 7,448 million baht (2002), 12,408 million baht (2004) and declined to 10,899 million baht (2004), and in 2005 dropped to 2,732 million baht, since no expressway development was undergoing. These figures were significant compared with railway development for the same period; those are 3,368 million baht (2001), 2,930 million baht (2002), and increase to 6,239 million baht (2003), 10,626 million baht (2004), and 5,102 million baht (2005).

The budget was allocated through various departments or organizations. There are at least five main organizations those dealing with road and railway development in Bangkok; such as Bangkok Metropolitan Administration and Department of Highway for road development, while railway development is handled by State Railway of Thailand, Mass Rapid Transit Authority for railway system, and Expressway and Rapid Transit Authority for expressway.

The investments seemly reflect preference of government to entertain private car users instead of strengthening public transport. This policy brings impacts on the enhancement of notorious fact of Bangkok as car dependent megacity, and this is certainly unsustainable. The development priority is expected to be given to the augmentation of public transportation systems towards excellent Bangkok integrated transit systems.

9.6 Urban planning and decision making

The current department in charge of city planning in Bangkok Metropolitan Administration is Department of City Planning. This department has long been servicing the citizen of Bangkok for years. The City Planning Division, under the supervision of the Permanent Secretary Office for the BMA, was again reshuffled their organizational structure. They were further divided into 5 Sections; those are (1) Secretary Section, (2) Urban Planning Research Section, (3) City Planning Section 1, (4) City Planning Section 2, and (5) City Planning Section 3. There were 227 staffs in the division since then.

Under the City Planning Act 1975, Bangkok Metropolitan Administration is designated as local government authority that assumes responsibility for preparing the Comprehensive Plan, therefore as an element of the Bangkok Metropolitan Administration, the City Planning Department are principally preparing this comprehensive plan. To appropriately undertake this function, the City Planning Department has the six divisions as the followings:

- Office of Secretary;
- Technical and Planning Division;
- Survey and Mapping Division;
- Urban Development Planning Division;
- City Planning Control Division;
- Land Readjustment and Urban Renewal Planning Division.

This Department has tried to be transparent in their services to the citizen, by involving citizens' views and aspirations in their planning. Although not all of the decisions are made with public consultation or involvement in this respect, however, the transparency in their services make citizens possible to involve. There are some examples on what Department of City Planning has tried to the most transparent possible to serve the citizens, such as on-line information on city planning related regulation and inquiry needed by the citizen.

9.7 Policies on density and mixed land use

Since there is no such explicit policy or regulation those control the density and mixed land use, as a result of this situation, the density and mix-used of the land in Bangkok is undergoing in a naturally developed manner. In contrary, regulation on type, use and dimension of building are appropriately guided and regulated. The regulations comprises of six objectives with numerous targeted areas within Bangkok Metropolitan Area.

Bangkok Metropolitan Administration is the organization which is responsible for declaring city's policies, while the Department of City Planning is the responsible department to implement those policies. As it has been mentioned earlier that there are no such clear policies on dense and mixed land use in Bangkok, in addition that during the past 30 years, land use in Bangkok has been changed without appropriate guidelines and control measurements of land and building uses. The land use is naturally expanded from the inner city along the main roads to suburbs and then invaded agricultural areas around Bangkok and the BMR, as the result, the mixed land use undergoes in leap-frog or ribbon development forms; building uses and development problems, flood and drainage problems, and green area expansion.

Amid the insufficiency in policy and regulation on dense and mixed land use in Bangkok, concept of multi-habitation has been brought into ideas for implementation such as multi-habitation, although the ideas have not been formally adopted by the Bangkok Metropolitan Administration. In general, the concept of multi-habitation is equivalent to mixed land use with socially mixed built-up areas trough community-based planning process. Although some ideas on the promotion of mixed land use are reflected in the planning but explicit implementation of the plan needs to be addressed to support the promotion of the reduction of motorized travel demand in Bangkok.

9.8 Urban air quality and green house gas emission

Air quality in Bangkok has been improving considerably since the end of 1990s, as shown by the reduction of concentration of all air pollutants from transportation sector, such as CO, NOx, SOx, O_3, Lead and PM. This significant improvement is made possible due to the presence of political willingness of the authority on the issues. This has created synergistic policies and strategies that leads to that accomplishment. Some important milestones toward the success of improvement of air quality in Bangkok are: fully phased out of leaded gasoline in 1995; introduction of van transit system for ride sharing in 1995; shifting from two to four-stroke engines of motorcycles program in 1997; the use of low emission fuels e.g. NGV for vans and buses and LPG for taxis and other private transport; operation of Sky-train (BTS) to provide full capacity of services for public transportation system in 1999; introduction of park-and-ride system to complement BTS operation in 1999; operation of subway (MRT) to complement integrated public transportation system in Bangkok in 2004; and urban planning.

9.9 Promotion of pedestrian friendly environment

There is no such explicit policy of the Bangkok Metropolitan Administration to promote pedestrian friendly environment. Due to this state, current efforts are limited to promotion of pedestrian friendly atmosphere in a clustered area such as Khao San road in Banglamphoo District and Siam Square in Phatumwan District. This is resulting in the fact that Bangkok is not a pedestrian friendly metropolitan; Bangkok is more motorized dependent and tends to augment over the years.

In the same time, the introduction of traffic calming by various physical and non-physical means such as humps, chicane and woonerf or traffic sign are not commonly undertaken. The Bangkok's roads tend to maximize traffic speed and volume by constructing multi-lanes, rigid pavement and straight alignment of roads, thus the traffic calming in most of the urban roads in Bangkok is not very common. Traffic calming is regularly undertaken in residential neighborhood roads. The construction of humps is the most frequently seen in the residential roads, but so far, no explicit policy or regulation to standardize the traffic calming, therefore traffic calming undertaken in residential area is more on the residents initiative rather than regularize by the city authority.

Some facilities to support pedestrian friendly environment have been constructed and operated. These facilities have more complementary than main functions and some facilities are being criticized for not to support vulnerable and disable people. Accessibility of BTS and MRT is questioned for disable people, since very few or absence of such facilities.

Pedestrianisation by creating pedestrian friendly environment in the city would encourage the citizens to use non-motorized transport for traveling within the area, and discourage motorized travel particularly by using private cars. Adequate urban transit systems would encourage the citizen to use public transport instead of private transport; this would increase the efficiency of energy transport, and finally would create better urban environmental condition. Other element that can contribute to reduce travel demand is by creating mix land use particularly the mixing between jobs and housings, with the proximity between housing and job, supported by adequate pedestrian friendly environment, the need of motorized travel demand can be reduced, energy efficiency can be improved, and then ultimately more pleasant urban environment can be created.

9.10 Conclusion

Above discussion has brought into a conclusion that the increases of welfare of Bangkok citizen, as reflected in their income, as well as the policy of the Bangkok Metropolitan Administration which gives priority to road development, has created Bangkok as one of the most dynamic car-dependent metropolitan. With current policy, the growing number of vehicles in Bangkok is quite remarkable, and restricting this is somehow not possible, however some interventions to are still possible to be undertaken. In demand side, the reduction of travel demands can be carried out through promotion of mixed land use that is expected to reduce travel demand. In the same time, promotion of pedestrian friendly environment could also support the reduction of travel demand. Those two issues have been slightly addressed in current Bangkok Comprehensive Plan. However, the impacts of this plan would not be instantaneously influence present state of Bangkok Metropolitan.

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IV.3 Promoting Reduction in Travel Demand in Transport Sector of Asian Cities: Case of Shanghai, China

Haixiao Pan[1]

1. Introduction of development of Shanghai and urban planning

Shanghai is a typical representative of metropolis of both China and other developing countries: it has an extremely dense population and a transport system that has not fully mechanized; at the same time, it has to adapt itself to the rapid development of economy and motorization course. On the other hand, Shanghai is a typical representative of cities during the transformation of economic system: the changes will exert great influence on the choice of resident behavior of their travel. In the Central City generally, the land use is highly mixed. The built-up area extended almost double in twelve years from 1991.

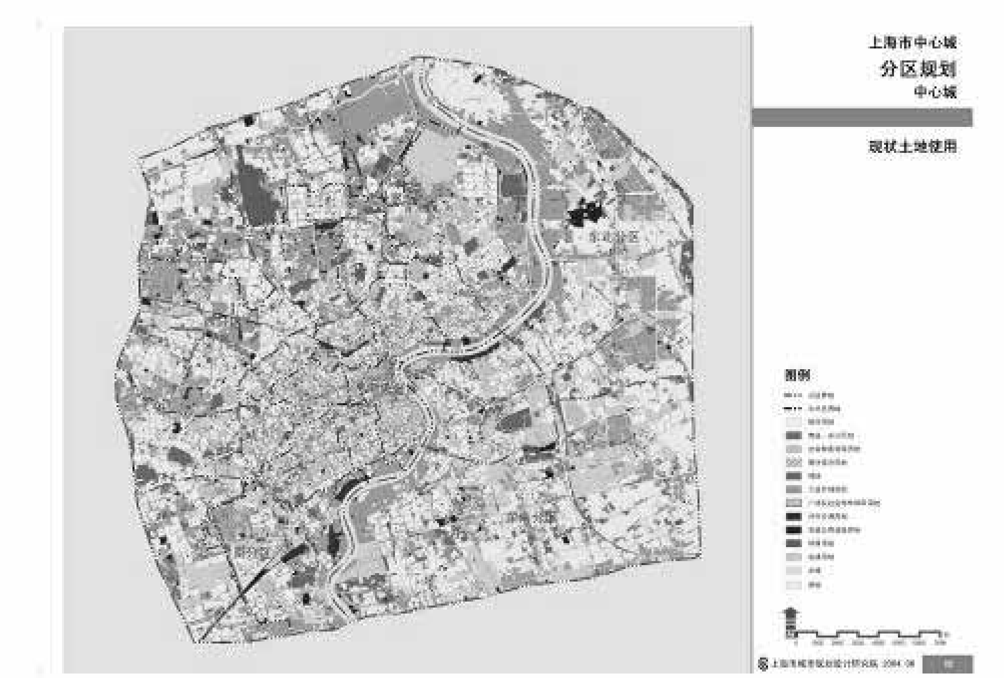


Figure 4.3.1 Land Use in Central City (Within the Out-ring)

1. Professor, Department of Urban Planning, Tongji University, Shanghai, China

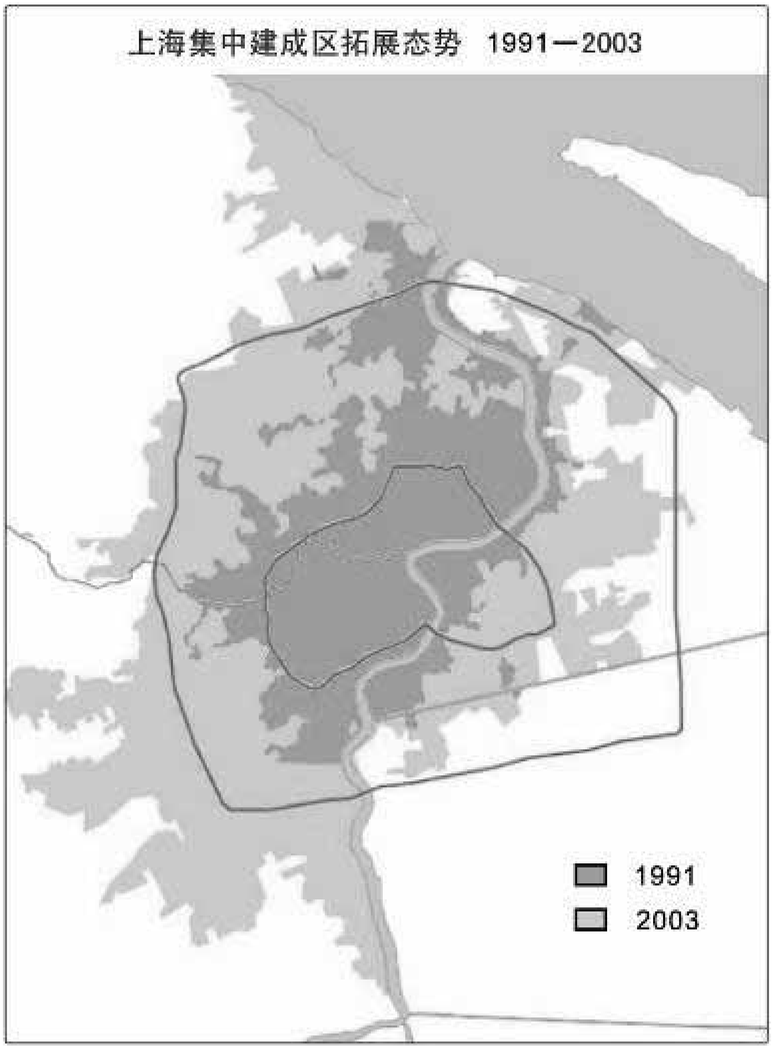


Figure 4.3.2 Urban Extension between 1991 and 2003

1.1 The increase of population and employment

As part of the national economic development strategy, the Chinese government is resolved to construct Shanghai into an international financial and commerce center. Since the late 1980s, Shanghai has speed up in city construction. The rapid growth in economy and population also greatly transformed the physical environment.

1.1.1 The increase of population

The whole population in Shanghai is composed by two parts: registered population and floating population. Up to the end of 2005, the permanent population was 17.78 million in 2005, while the registered population was 13.6 million; in 2004, it was 13.52 million and in 2003, it was 13.42 million. The registered population increased by 310 thousand from 2000 to 2005, with an annual increase of more 62000 people. Permanent migrant population increased by 1.39 million, with an annual increase of 0.28 million people. The major part of population increase is caused by the immigration from other provinces. Up to 2005, the natural increase rate of registered population has been negative for 13 years continually. The population growth is mainly caused by the immigration from other provinces. In 2005, the immigration was 0.13 million and the emigration was 34.6 thousand, thus the actual immigration was 95400 people. Compared with the immigration of 0.16 million and emigration of 55.6 thousand in 2000, both the immigration and emigration decrease. The immigrating growth rate of registered population is the lowest since 2000.

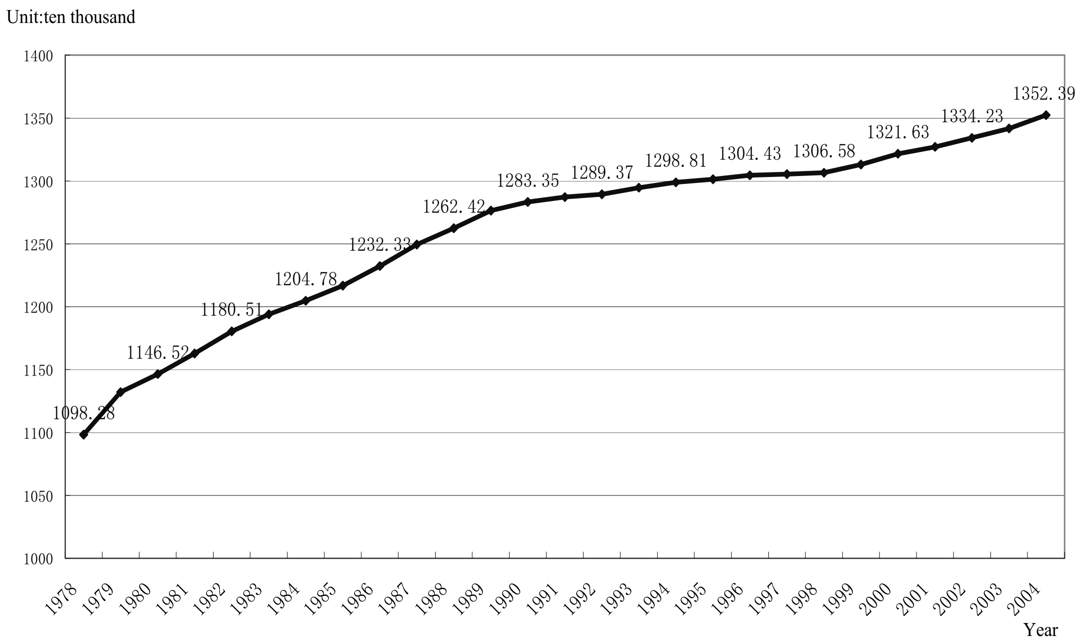


Figure 4.3.3 The growth of registered population in the past years

Figure 4.3.4 The Population of Shanghai in Recent Year

Among the permanent migrant population, 22.2% live in the city center, 17.9% live in Pudong, 33.1% live in suburb, 25.4% live in exurb and 1.3% live in Chongming County.

1.1.2 Proportion of population of different age groups

The proportion of people older than 60 in Shanghai is 19% in 2004, which is higher than the national average. Shanghai has become an aging society.

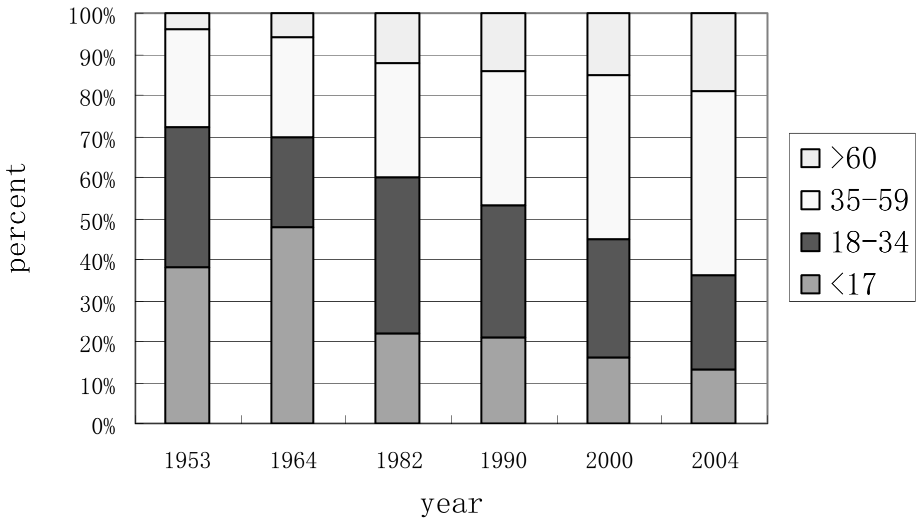
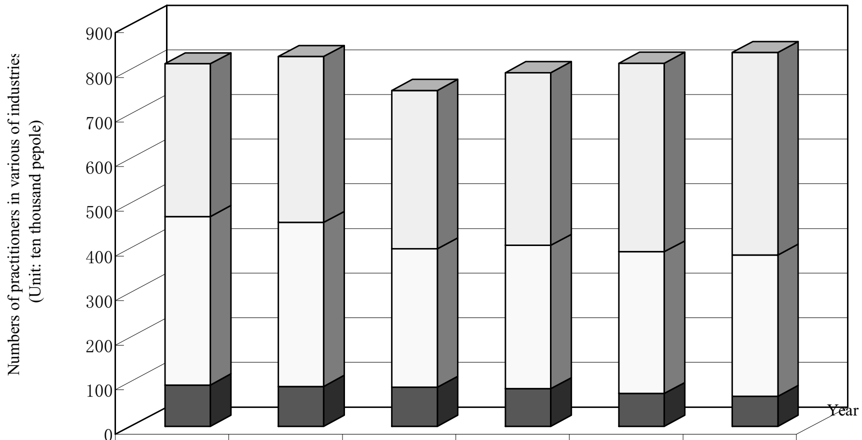


Figure 4.3.5 Proportion of registered population of different age groups in main years

From 1980's to now, proportion of youth (18-34years old) decline apparently. On the contrary, proportion of middle age (35-59years old) increase apparently. It could be forecasted that aging society will emerge in Shanghai in future.

1.1.3 The increase of employment in the past years



	1999	2000	2001	2002	2003	2004
the tertiary industry	342.12	372.08	355.17	386.87	422.21	453.61
the secondary industry	377.28	367.04	309.91	320.93	317.12	315.97
the primary industry	92.69	89.23	87.18	84.24	73.72	67.29

Figure 4.3.6 The composition proportion of three industries

Data source: Shanghai Statistics yearbook

The composition proportion of three industries was 0.9:48.9:50.2 in 2005, with the tertiary industry employment occupying more than half. The industry structure is rationalized and the industrial base for economic development is reinforced.

The development of the tertiary industry is supported by the government. The national government regards it as an important field in promoting employment and in upgrading the economic structure. In the past three years, the employment in the tertiary industry in Shanghai increased by more than 17%, and the population employed in the tertiary industry was more than 4.5 million. And this trend is expected to continue.

1.1.4 Population and employment in each district

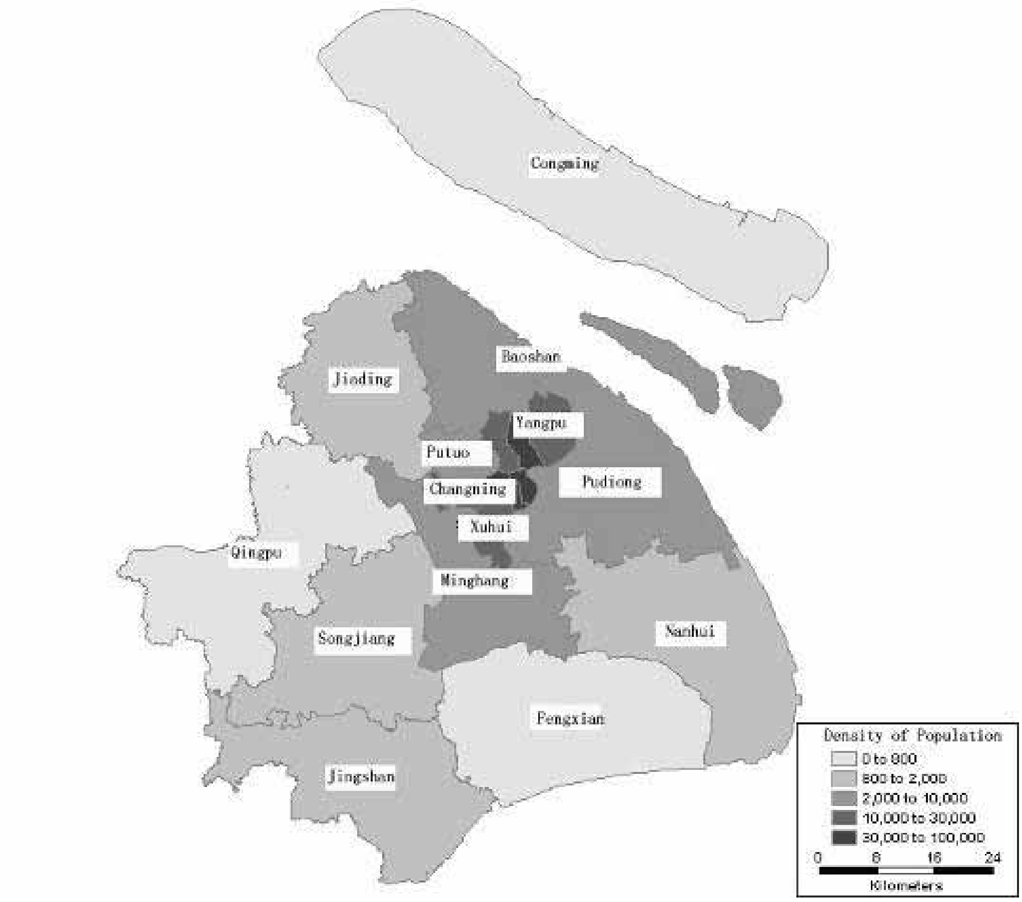


Figure 4.3.7 Registered population density of each district in 2004(county)

Data source: Shanghai statistics bureau

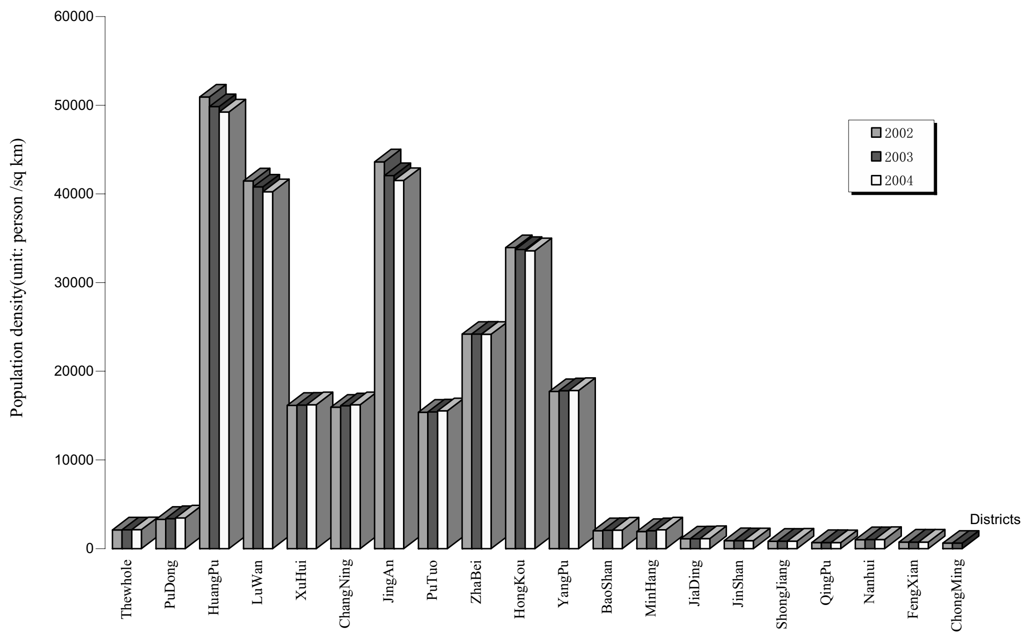


Figure 4.3.8 Registered population density of each district (county)

The most populated area is Huangpu district, with 49251 people per square kilometers. And the lowest is Chongming Island, with only more than 600 people per square kilometers.

Employment in each district

Table 4.3.1 Population in each district of Shanghai (Unit: ten thousand)

Name	Area (Km^2)	Total population	Floating population
City wide	**812.19**	**934**	**174**
Huangpu	12. 41	51	7
Luwan	8. 05	27	3
Xuhui	54. 76	99	16
Changning	38. 30	67	11
Jingan	7. 62	26	3
Putuo	54. 83	111	21
Zhabei	29. 26	76	10
Hongkou	23. 48	78	10
Yangpu	60. 73	120	14
Pudong	522. 75	279	79
Near Suburban	**1245.75**	**396**	**145**
Minghang	371. 68	171	72
Baoshan	415. 27	131	34
Jiading	458. 80	94	39
Far Suburban	**4282.56**	**384**	**111**
Jingshan	586. 05	59	7
Songjiang	604. 71	89	36
Qingpu	675. 54	74	28
Nanhui	687. 66	89	18
Fengxian	687. 39	73	22
Congming	1, 041. 21	66	6

Note: Number of population come from 1% sample survey in 2005. Floating population in this investigation should be those stay in Shanghai for more than half a year.

1.2 Economic development and income level

The GDP of Shanghai in 2005 was 914.395 billion Yuan, increasing by 11.1%. Among which, the added value of the primary industry was 7.965 billion Yuan, decreasing by 9.7%, the added value of the second industry was 447.592 billion Yuan, increasing by 12.1%, and that of the tertiary industry was 458.838 billion, increasing by 10.5%. The income of residents in both urban and rural areas increases. According to the survey, the dispensable income per capita in city was 9657 Yuan in the first six months, increased by 13.4% compared with the corresponding period last year; and that in the rural areas was 5361 Yuan, increased by 9.1%. Savings of the residents continue to increase.

1.2.1 Family income and expenditure

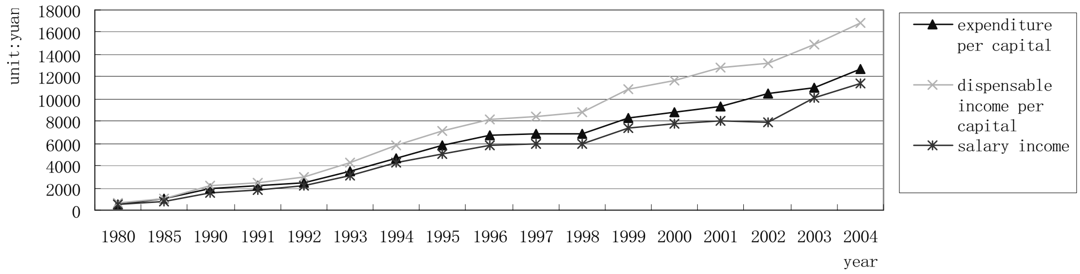


Figure 4.3.9 Family income and expenditure per capital in main years

Table 4.3.2 Dispensable income and expenditure of city residents (2000-2004)

Index(Yuan)	**2000**	**2001**	**2002**	**2003**	**2004**
Dispensable income per capita	11718	12883	13250	14867	16683
Expenditure per capita	8868	9336	10464	11040	12631

1.2.2 Expenditure on transport

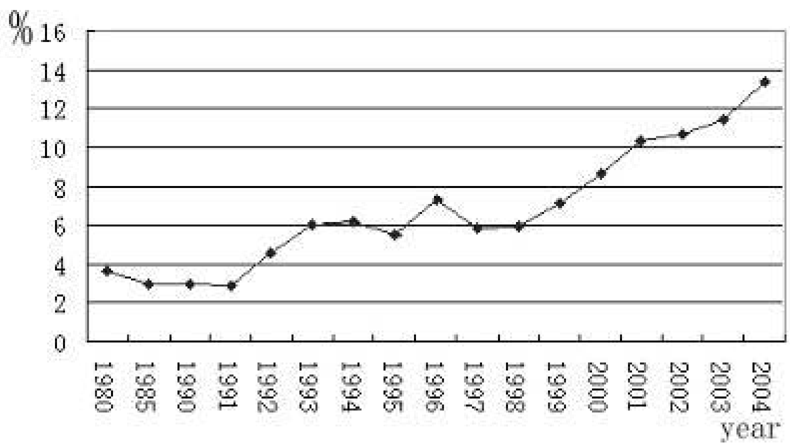


Figure 4.3.10 The proportion of travel expense in total income (unit: %)

From Figure 4.3.10, the date illustrated that the proportion of travel expense in total income are increased in the past years. From 1980 to 1996, the proportion has doubled. Furthermore, from 1996 to 2004, the proportion has doubled again.

1.3 Land use plan

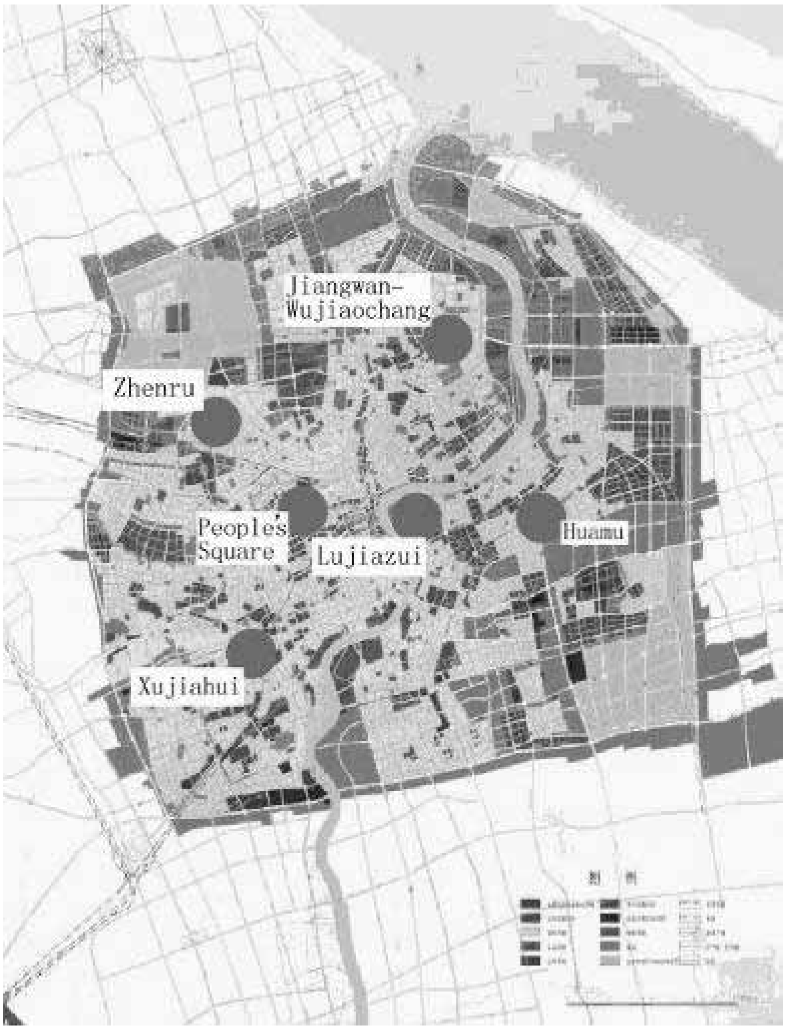


Figure 4.3.11 land use planning of Shanghai central city (2000)

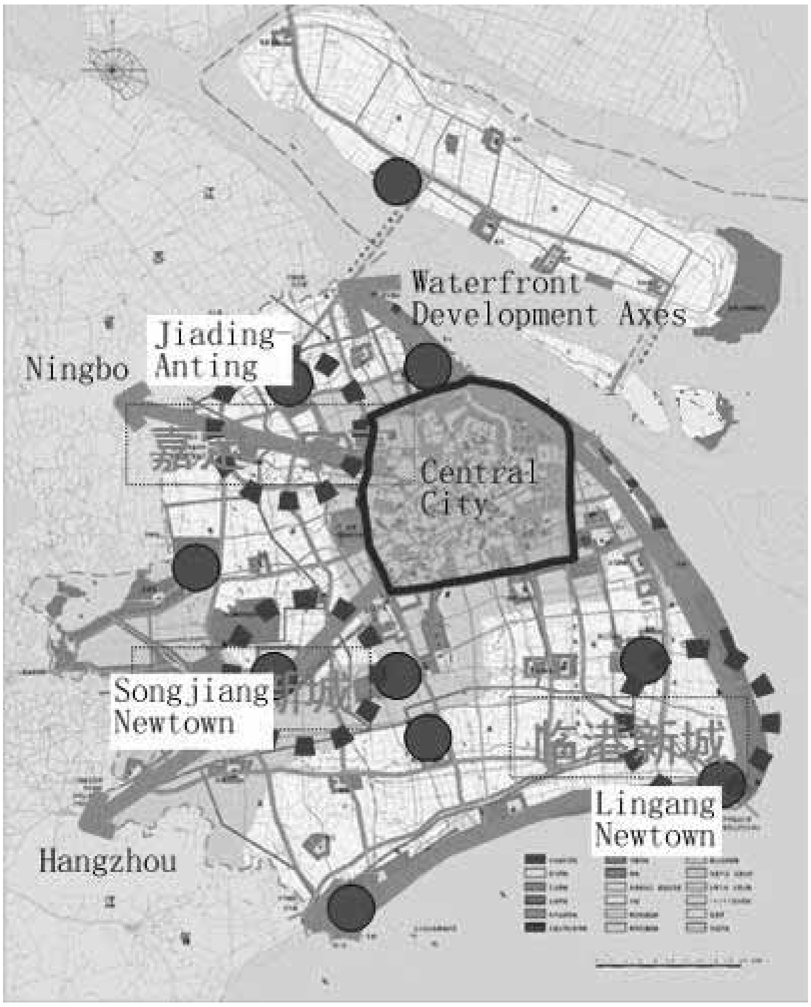


Figure 4.3.12 land use planning of Shanghai Region (2000)

The following are some plans in the collective programming of Shanghai in a new era:

- Expand development areas along the Yangtz River and the coast.
- Construct towns and industry strips consisting of Baoshan new town, Waigaoqiao port zone (free trade zone), airport new town, Lingang new town, Shanghai petrol chemical industry region, Jinshan new town etc along the coast.
- Boost the functional development and construction of Pudong,
- Concentrate on the construction of new towns and central city, and construct Chongming Island as an important strategic space for further development in the 21st century.

The new towns are mid-sized cities developed from the towns in which the district (county) government locates, or supported by important industries and infrastructures. There will be 9 new towns according to the plan, which are Baoshan, Jiading, Qingpu, Songjiang, Minhang, Nanqiao Fengxian, Jinshan, Lingang new town and Chongming, chengqiao. In Jiading, Songjiang and Lingang new town, with the population up to 0.8-1 million.

In the central city (within the outer-ring), there will be a central business district and five city functional centers. The central commercial district comprises Xiao Lujiazui in Pudong（from Pudong Road south to

Dongchang Road） and Bund in Puxi (east of Henan Road, the region between Hongkou port and Xinkai river).

The people's square serves as the municipal center, and there are four sub-centers, namely Xujiahui, Huamu, Jiangwan-Wujiaochang, and Zhenru. Xujiahui sub-center serves the southwest of the city, Huamu serves Pudong region, Jiangwan-WujiaoChang the northeast of the city and Zhenru the northwest of the city.

1.4 A city planning guideline compliant with different transport modes

In the process of city planning, the designer plans the transport establishment mainly according to *Urban Road Transportation Plan and Design Criterion* (GB 50220-95), it defines the proportion of road space, road length and area density, the composition of the road intersection with pavement, bike lane, carriage way and the planting, providing the guideline to public transport service standard, bike, individual vehicle and parking etc.

1.4.1 City roads

1. City roads include four types: expressway, arterial road, and sub-arterial road and branch way.
2. The proportion of city road area should be 15% to 20% of the land used for city construction.
3. The area of road per capita in city planning should be 7 to 15 square meters.
4. The planning of city road network should be compliant with the expansion of city land use, and is in favor of the development toward mechanization and express traffic.
5. The determination of the form and layout of city road network should consider the following factors: the distribution of land use, traffic source and distributing center of passengers and goods, flux and direction of traffic, the terrain, the layout of urban rails and existing road system etc.
6. The density of land development should accord with the transportation capacity of the traffic network and the road transit capacity.
7. If the two districts are developed separately, there should be at least two roads running through the neighboring districts.
8. There should be at least two roads at each direction in the major entrance/exit of the city.
9. The inner ring road should be at the periphery of old urban area or city center.
10. The outer ring road should be within 1 to 2 kilometers from the boundary of the city. Organizing the traffic at the cross when the radial arterial roads intersect with the outer belt road.
11. The outer ring road should be accommodation road for automobiles; other vehicles should run on the roads outside the belt road.
12. The ring road may adopt half ring or full ring according to the terrain, flux and direction of traffic etc.
13. The technical capacity of ring road should not be inferior to that of the arterial road.

1.4.2 Public transport

1. The fleet size of bus in a city should be defined by the population of it. In shanghai, there're one standard bus for every 800 to 1000 people.
2. When a city's GDP is over 500 billion yuan, it is fit for the construction of subway. When a city's GDP is over 300 billion yuan, it is fit for the construction of light rail.

3. When a city's population is over 1 million, it is fit for construction of urban rail. When a city's population is over 2 million, it is fit for construction of express urban rail.
4. Improve the service of urban rail system, make sure that the urban rail service will be punctual, increase the the capacity in rush hour by shorting the intervals, improve the interchange between urban rail and other transport system and make the most of the efficiency of urban rail system.
5. Optimize and adjust the bus network in each district, bus lines should be synchronous with the construction of urban rail system. Accelerating the development of bus way; providing more express bus service with the help of overhead road, update the vehicles; using clean energy source and construct the bus/trolley information indication system.
6. Improve the efficiency of taxis, construct more taxi waiting areas or stations, control the fleet size of taxis, develop car leasehold and suburb taxis moderately, establish the comprehensive information managing system for taxi service, improve the telephone dialing service system.
7. The bus service coverage rate at radius of 300m from bus station should not be less than 50% of the city land use area. The bus service coverage rate at radius of 500m should not less than 90%.
8. When passengers transfer in different bus, the distance for change in the same direction should not exceed 50m, in the different direction should not exceed 100m. The contraposition of stations should be staggered at a distance of 30m in the marching direction of vehicles.
9. The density of public transport route network at the city center should be no less than 3-4km/square km, and 2-2.5km/square km within the whole city.
10. The average passenger transfer rate of public transportation should not be larger than 1.5, the non-linear coefficient of public traffic lines should not be larger than 1.4. (The non-linear coefficient means the ratio of the linear distance of two points and the actual distance of bus route between them).
11. For the stations set up at grade crossings and interchanges, the distance for transfer should not be larger than 150m, and mustn't be larger than 200m.
12. There should be public transport stations within 50 meters from the entrance/exit of long distance bus station, urban rail station and passenger's boot terminal.
13. In the express way and arterial roads, the bus station should not occupy the carriage-way; the station should adopt the bus bay. The bus bay in the urban area should provide at least two parking spaces.
14. The terminal station of bus and trolley should provide off-road space for parking. The area is usually 1000 to 1400 square meters. If there is change for bicycles, there should be extra area.
15. For taxis stations, the service radius should not larger than 1 km. The land area should be 250 to 500 square meters.
16. The facilities in bus stations, vehicle maintaining station, etc should match the development size of public transport, and the land used for that purpose should be guaranteed in master plan.
17. The layout of bus station should be setup according to the type and number of buses. The bus parking lot should consist of large, medium and small parking lots, and distributed dispersedly. The layout of vehicle maintaining stations should concentrate the high-level maintenance and disperse low-level maintenance facilities, and should be combined with the parking lot.

1.4.3 Bicycle traffic

1. Promote the rational circulation of bicycles. Encourage the long distance bicycle travel transferred to public transport system. Exert the advantage of bicycles in short distance travel and feeding long distance bus.
2. In general circumstance, there are special paths for non-motorized vehicles to separating motorized vehicles from non-motorized vehicles, and forming a continuous regional bicycle path net work. Parking facilities should be provided in passenger interchange hub and city center and downtown etc.
3. Strengthen the management and execute the law strictly. At the same time, reducing the conflicts between motorized vehicles and non-motorized vehicles and reducing the accident rate from bicycles.
4. In planning, we should establish a network that can assure the continuous network of bicycles, which should consist of separated path for bicycles only, paths for bicycles on the sides of arteries, city branch road and the roads in residential areas.
5. The planning and design of arteries should make the bicycles and motorized vehicles run in separate paths.
6. For the road on which the bicycle flux in one direction exceeds 10000 per hour, there should be parallel roads to divide the flux. In the intersection, when the bicycle flux exceeds 5000 per hour at the cross, there should be measures to divide the flux in the planning of road network.
7. In design of environment along the bicycle paths, we there should also consider security, lighting, and tree shading establishments.

1.4.4 Individual motorized vehicle

1. The individual motorized traffic has negative influence in road space, environmental protection and energy consuming etc. The government should regulate the development of individual motorized traffic through traffic demand management.
2. Expand the amount of cars under the precondition of improved traffic demand management. Keep a balanced growth between cars and the road capacity. Applying different policies and using various traffic demand management measures to regulate the running of cars according to the difference of road capacity in different time and at different places.
3. Unify the policies of issuing license plates, make policies to promote the possession of private cars, and control the use of cars in congested area etc.
4. The downtown is usually the most jammed area. Therefore, through the control of providing parking lot, the amount of vehicles passing these areas can be controlled effectively. The measures include: allotment of parking space, parking space charging, and the quota of garages in shortage etc.
5. Control the motorbikes according to the district. Ten years ago, the motorbikes were forbidden to ride in city center. The scrap motorbike's license tag cannot be reused unless the owner buys a car.
6. Propel the electric bike rider to change to public transportation. Considering the efficiency of city transportation, the slow modes of transport including electric bike are used only in mid and short distance travel. With the consummation of public transport system and the improvement of service, the electric bike will be washed out (traffic management authority's opinion).

1.4.5 Parking charge

The increase of motor vehicles in Shanghai has urged the government to put forward more rigorous parking policy to relieve the parking and traffic pressure in the urban center.

1. Parking control area

   The parking control area contains 110 square kilometers within the inner ring and implements different management measure according to different areas. Under permitted condition it could establish road parking space and provide convenience to car in the residential areas, hotels, restaurants, touring sight spots, hospitals and so on which have parking demand. Parking in the internal ring is prohibited where no “parking area” sign is established.

   Road parking charge

   The road parking charge: daytime parking (7:30 - 19:30) takes periodic metering; night-time parking (19:30 - 7:30 the next day) apply a unit fee charging; It may implement monthly charge which provides nighttime, weekend or national holiday parking service to the circumambient parking service. The road parking area exercises same charging standards for all motorized vehicles. According to physical circumstances, the starting time of unit fee charging of nighttime parking could be brought forward to 17:30 or postponed to 22:00. It may properly reduce the standards at weekend and national holiday.

2. High limit of public parking area (garage) charging

   On the current basis for establishing in scale, the top limit of public parking area is not more than 15 Yuan per hour; half-hour shall be the charge unit when exceeding one hour’s stopping time, and charging standards be halved correspondingly as well. To promote the more public parking space, it allows and encourages the business enterprise to reduce charging standards. Parking area of exclusive use could open to the society when necessary procedures has been finished, the charging standards of which refers to the public parking area standards.

3. Keep on generalizing centralized “Parking Meter”

   It has perfected the technical functions of the “Parking Meter” for generalization of centralized “Parking Meter” that could print bills, at the same time, the Beijing West Road/Shimen Second Road would be in trial in advance to gather experience (now the “centralized Parking Meter” is in course of trial run). In 2006 it keeps on prompting “Parking Meter” periodic metering, which would be in first use in road parking areas of key districts.

Table 4.3.3 Road parking charging standards

<table>
<tr><th rowspan="4">Area</th><th colspan="6">Daytime</th><th rowspan="4">Night-time</th><th rowspan="4">Monthly (night-time, weekend and holiday)</th></tr>
<tr><th colspan="2">Manual charging</th><th colspan="4">Parking Meter charging</th></tr>
<tr><th rowspan="2">With in the first hour</th><th rowspan="2">Over one hour, every half an hour</th><th colspan="3">Within the first hour</th><th rowspan="2">Over one hour, every half an hour</th></tr>
<tr><th>0-15 min.</th><th>15-30 min.</th><th>30-60 min.</th></tr>
<tr><td>Key area</td><td>15</td><td>10</td><td>4</td><td>4</td><td>7</td><td>10</td><td>10/time</td><td>400/month</td></tr>
<tr><td>The rest areas within the inner ring</td><td>10</td><td>6</td><td>3</td><td>3</td><td>4</td><td>6</td><td>8/time</td><td>300/month</td></tr>
<tr><td>Zone between the inner and out ring (including towns outside the outring ring)</td><td>7</td><td>4</td><td>2</td><td>2</td><td>3</td><td>4</td><td>5/time</td><td>200/month</td></tr>
</table>

1.4.6 License tag auction

In order to control the growth of motorized vehicles in Shanghai and decrease the pressure to urban traffic, since 1994, the license tag of private car in Shanghai has exercised auction by tender with reserve price, from 2000, Shanghai has changed into public auction without bottom price for the license tag limit to car. Meanwhile, in 2000, 14,000 license tags were granted, the average successful bid was 14,416 Yuan, in 2001, 15,900 license tags, the average successful bid was 14,521, in 2002, 3,1850 license tags, the average successful bid was 31,721, in 2003, 53,068 license tags, the average successful bid was 34,349.

The auction policy of license tag has restrained the increment speed of motorized vehicles in Shanghai, as compared to Peking; the increment speed of motorized vehicles is evidently lower. This has relieved the contradiction between the road supply and traffic demand to a certain degree. At the same time, the license tag auction has brought in some unexpected influence, such as the decrease of the demand for low-quality vehicles, increase of car purchase cost, suppression of the residents' desire to purchase cars. There is also the phenomena of registering license tag outside Shanghai, so that it is lose of revenue for Shanghai. Restriction of driving on major road in peak hour for the car without Shanghai licence has been adopted, to control the fleet size of the car without the tag of Shanghai, but owned by a Shanghai citizen.

1.5 Summary of master plan in Shanghai in the past

1.5.1 Initial master planning sketch of Shanghai urban construction in 1958

Background and police objective

In 1956, Mao Zedong put forward that China should develop industry along the coast to support industry inland, which gave a new chance to the development of Shanghai. In 1958, the State Council ratified ten counties of Jiangsu Province (such as Jiading, Shanghai, Songjiang) belong to Shanghai, which provided an important opportunity for Shanghai's development. To meet the needs of industry development and land-use adjustment, Shanghai established《Initial master planning sketch of Shanghai urban construction in 1958》, which put forward the polices of developing industry zones in near suburban and satellite towns.

Planning strategies

Industry layout There are eight new industry zones in this plan, among them, Wujin and Minghang are planned to be satellite towns along Huangpu river.

Housing construction Improve housing condition by redevelopment of slum in old city.

Infrastructure construction Construction of main roads in this plan embodied initially the city road pattern of ‘circle (Zhongshan Circle Road and Zhou Jiazui Road)＋radiation’.

Implementation effects

In 1958, this plan guided the construction of municipal facilities and industry zones in near suburban. Some large factories were settled to Wujin, Minghang, Anting, Jiading and Songjiang, which are better in construction conditions.

From then on, Shanghai has been developed to a conurbation city which includes industry zones in near suburban and satellite towns in far suburban.

In 1972, the factory of petroleum chemical industry of Shanghai was built in Jinshanwei which near Hangzhou Bay. In 1978, the factory of iron and steel of Baoshan was built on southern bank of Yangtze River. At the same time, Jinshanwei and Wusong-Baoshan was built as two satellite towns. By these projects, Shanghai has been guided to a spatial pattern of central city and two wings. The two wings of Shagnhai are northern area of Hangzhou Bay and southern bank of Yangtz River.

1.5.2 Outline of Shanghai master plan（1981）

Background and police objective

Up to 1980’s, Shanghai still faced many city problems, such as confusion in land-use, lack of infrastructure, traffic congestion and lack of housing space. To guide the development of Shanghai city,《Outline of Shanghai master plan》was established in 1981. In this plan, Shanghai was definite as one of the economic centers in China and important international port.

Planning strategies

Direction of city development This plan put forward following policies: construction and reconstruction of central city, development of satellite towns, development of two wings which are northern area of Hangzhou Bay and southern bank of Yangtze River, enhance the construction of small towns in suburban. Central city should be reconstructed to have several function zones. Pudong and Lujiazui should be developed to modernized city proper. Wusong, Jinshanwei and Minghang should be developed quickly as satellite towns. There should be polices which could incentive workers and their family members move to satellite towns. Towns and factories in northern area of Hangzhou Bay and southern bank of Yangtz River should be developed with priority.

Housing construction At the edge of central city, there should be several large communities be constructed. There should be constructions of high rise residential building in Hongqiao road, Yanan road and Tianmu road.

Industry layout Industry land-use in central city should be regulated strictly. Step by step, there should be concentrated to industry zones. Factories which has serious pollution and dangerous articles should be reformed or move out of central city.

Suburban highway In this plan, there are four national highway combined with city main road, which could provide convenient connection between central city and each satellite towns and other provinces.

Central city road There should be road system constituted with express road, main road, sub-main road, branch road and culture-commercial road. Step by step, there should be traffic net work that cars and pedestrians flow separately as well as motor vehicles and non-motor vehicles go by different lane. The major points are: Construction of south-north main road, reconstruction of Zhongshan ring road, construction of out-rings, expanding the road section with serious congestion, and improvement of traffic condition cross Huangpu River.

1.5.3 Shanghai city master plan scheme（1986）

Background and police objective

In 1986, the State Council approved ‘Shanghai city master plan outline’, which is the first city master plan scheme approved by central government for Shanghai. In this plan, Shanghai was definite as one of the economic, science and technology, culture centers in China as well as important international port.

Planning strategies

City land-use In 1982, the area of Shanghai central city was 149 square kilometers. This plan put forward that total area of central city in 2000 should be no more than 300 square kilometers. Furthermore, Shanghai should be a conurbation city with convenient connection between central city and suburban towns.

City structure There are four level of regional spatial structure in this plan. The first level is central city. There should be several zones with comprehensive functions，which could provide convenient environment for working and living of residents. And there should be convenient connections between each zone. The second level is industry towns and satellite towns in near suburban, as well as ‘two wings’. The third level is suburban towns. The fourth level is little rural towns. This plan put forward that port and other functions should be constructed in Pudong area which has large development space.

Construction of satellite towns Satellite towns should have comprehensive functions. There should be convenient connections of traffic and communication betweens central city and satellite towns, as well as each satellite towns. There should be high-capacity and high-speed passenger transport, which could reduce the commute time to no more than one hour between central city and satellite towns as well as two wings. The information communication facilities of satellite towns and two wings should be constructed as soon as possible.

City road plan In old district, the key intention should be dredging of the congestion area and construction of south-north main road. In new district, the road net work should adapt needs of development of conurbation city and construction of ‘two wings’. There are three principles in central city road system planning: combination of road-transportation planning and land-use planning, combination of road construction and traffic management, combination of road system planning and public transportation planning together. Followings are the main contents of the plan: express main road was constituted with three south-north line and one east-west line; the width of main road is 32-40 meters. Culture-commercial road is traditional commercial road in history. Branch road should connect neighborhood and make confluence of car flows. Furthermore, it should install bicycle-only road system. The width of branch road is about 20 meters. In this plan, there should be five new projects for crossing Huangpu River traffic.

urban rail plan Initial plan about under-ground urban rail is: Four diameter lines, one radius line, one circle line and one half-circle line.

Implementation effects（1983－1995）

Infrastructure The construction of following projects are finished: three bridges across Huangpu River, inner-ring line, viaduct road, two highways (Hujia and Shensong) and Huqing first-class highway, Shanghai railway station, the first underground urban rail line, Hongqiao international airport. The reconstruction of some important roads is also finished.

Residence From 1983 to 1995, there are more than 130 new neighborhood constructed. Many slums are been cleaned.

Public buildings Reconstruction of People Square area has been finished. The following projects are finished: government office building, Shanghai museum, Shanghai theatre. People thoroughfare and people's square green field have been reconstructed, which including construction of underground market and commercial street has also finished, as well as parking space and underground rail station.

Economic Development zone The following economic development area have already been constructed: Minghang economic development zone which mainly for industry projects, Hongqiao development zone which mainly for finance, trade and international conference exhibition, Caohejing new economic&technology development zone. Construction of important infrastructure has been finished in Pudong new district.

1.6 Summary of the past road and transportation plan in Shanghai

1.6.1 City road plan from 1959 to 1964

In 1959, 'Shanghai main road system plan' was established. This plan put forward strategies as following: the main road system should be 'circle plus radiation' which connected central city with industry zones in near suburban and satellite towns as well as large public building areas; dredging freight transportation away from central city by Zhongshan ring road; improving traffic condition by construction of south-north main road; providing conditions for the development of Pudong by construction of transportation facilities across Huangpu River.

In 1964, 'Shanghai city main road system plan' was established. The objective of this plan was definition of direction and width of Shanghai city main road, with detailed road design in the scale of 1/2000 and 1/500, which could be use as formally designed documents. Width of main road should be 24-60 meters. For the first time, this plan analyzed the amount of cars could be hold in planning system, as well as in how much level could traffic conditions be improved by planning. The conclusion is that the road area in Shanghai is very limited. So public transportation should be encouraged, on the contrary, cars and bicycles should be restricted.

From 1959 to 1964, there are several roads constructed and reconstructed according to the plan. Such as Caoan Highway (to Anting), Huming road (to Minghang), Yixian road and Tongji road (to Wusong), Gonghe new road (to Pengpu). The construction of some radiation roads are also finished, as well as the reconstruction of Zhongshan ring road.

1.6.2 Road system planning in 1973

Background and police objective

From 1960's, contradiction in road capacity and transport demand is extremely protruding because of increase of commuting. For the width of road is not enough, there're lots of traffic congestions and accidents due to the confusion of bicycles, pedestrians and cars. Furthermore, the capacity of main road intersection is limited. Crossing of railway and city road also do a bad influence on traffic. There are little square and parking lot near large public activity centers and large public buildings, which led to traffic congestion and confusion. For road system, there're three contradictions: 'bee waist traffic', lack of south-north main road and inaccessible of south part of the city. To solve those problems, road system planning had been prepared.

Planning strategies

It's the first time to prepare road system plan include branch road after 1949. In past master plans, there're only road plan with main road.

There're five important aspects in this plan: (1) Solve the problem of 'bee waist traffic' by using the capacity of the internal road and scattering the car stream to periphery; (2) Construction of south-north main road and improvement of south city traffic; (3) Construction of the second tunnel cross Huangpu river; (4) Construction of main road system according to the location, traffic and surrounding environment; (5) Reconstruction of branch road step by step.

Implementation effects

After 1976, some bridges were finished, which provide large crossing capacity across Suzhou river in west of Shanghai. The congestion of some crossings of railway and city road was relief by construction of four overpasses. To 1978, many radiation roads are constructed or reconstructed. The first tunnel cross Huangpu river was finished.

1.6.3 Main road system plan of central city in 1984

This plan combines city main road system in central city with highway system in suburb. The objective is to provide conditions for the development of conurbation city and the development of 'two wings', increasing the city road space ratio so as to improve the road system's passing capacity.

This plan emphasizes on the 'tangent' theory. But the following plan still uses the pattern of 'grid, circle and radiation'. The main road system is three ordinate and three horizontal lines of inner city and three circle and ten radiation lines of outer city.

1.6.4 City comprehensive transportation plan（1986～1992）

From 1986 to 1992, Shanghai comprehensive transportation plan was finished on base of traffic survey, traffic forecasting and evaluation model. By quantitative analysis, this plan put forward following polices: strengthen traffic management, make enough fund to construction of transportation facilities, develop public transportation preferentially, strengthening construction of urban rail and a unified public transportation system.

Up to 1995, the following projects are finished: reconstruction and extension of Hengfeng road, reconstruction of Wusong road , Waitan and South Zhongshan road, reconstruction of Jiangsu road, construction of East Yan An road tunnel, Nanpu bridge, Yangpu bridge, Inner Ring Viaduct road, south-north viaduct road, Huning highway, Metro Line No.1 line. The traffic condition of Shanghai began to getting better, due to the sudden increasing in transport capacity.

2. The basic status of transport in Shanghai

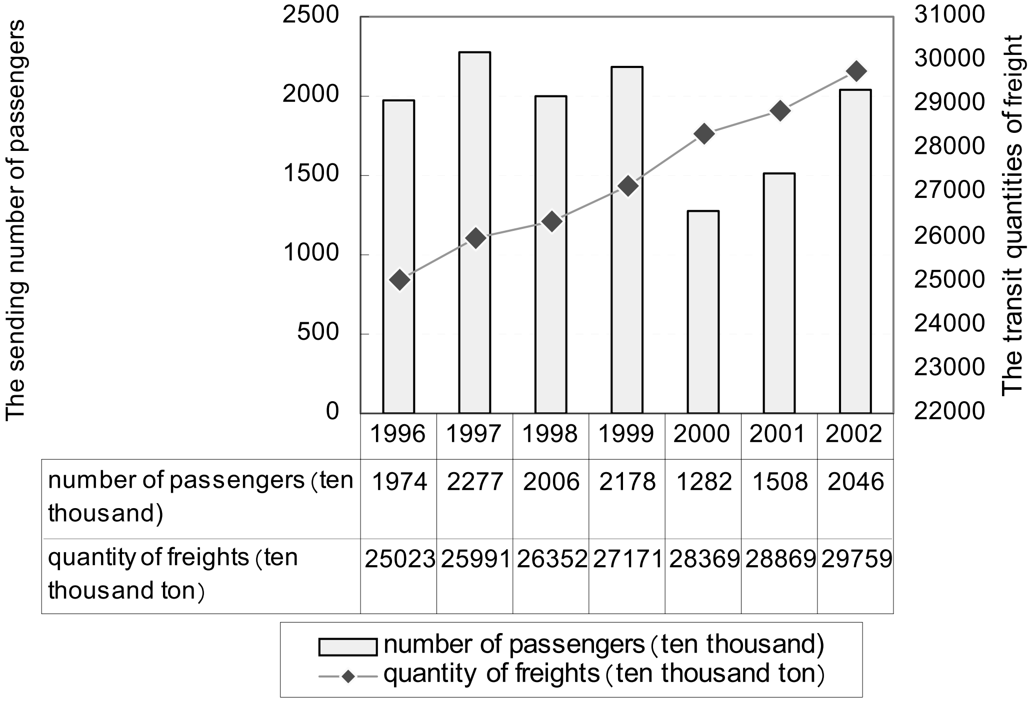
2.1 Brief

The rapid growth of economy and population means that the transport demand increase. For the planners of city transport, the most important is whether the local traffic system operates well, whether the supply and demand of traffic is balanced. Like many cities in the process of industrialization, the original traffic system in Shanghai was designed for non-motorized traffic. The area of road is only 9% of the total land use area in the city, far behind the rate of 20%-25% in European cities (World Bank, 1996). On the other hand, Shanghai is among the most densely populated cities in the world. Especially in the city center, the population density is extremely high, with about 5 million people living in an area about 100 square kilometers. The area of road per capita is so low that the road net always operates beyond its capacity. Even at the present motorization level, the road network at the city center has no superfluous capacity. The roads are narrow, so the motorized vehicles and non-motorized vehicles interfere with each other and cause traffic confusion and accidents.

During the last decade, Shanghai accelerated its course of city transport infrastructure construction, constructed a mass of transport establishments, and widened some important road sections. But because of the population density, the widening and construction of city roads requires large amounts capital.

2.2 Transport infrastructure construction

By the end of 1990s there is the decrease of passenger through highway. In the 21st century, with the construction of express ways and the expansion of network, the passenger through highway increases again. In 2002, the passenger was 20460 thousand, increasing by 36% compared with that of the previous year. Freight transportation through highway increases steadily. The amount in 2002 approached 300 million tons.



	1996	1997	1998	1999	2000	2001	2002
number of passengers (ten thousand)	1974	2277	2006	2178	1282	1508	2046
quantity of freights (ten thousand ton)	25023	25991	26352	27171	28369	28869	29759

Figure 4.3.13 Development of highway transportation from 1996 to 2002

2.2.1 Construction of road and bridges

Up to 2005, the total length of the road (including highway) in Shanghai was 11825 kilometers with the road space of . Up to the end of 2004, the mileage of express ways in Shanghai that are open to traffic was 485 km. There are 1576 intercity long distance bus routes. And the freight transportation in 2004 amounted to 316 million tons, increasing by 2.9%. Passenger was 24650 thousand, increasing by 20.1%.

Up to the end of 2001, the growth rate of highway is higher than that of city roads. The proportion between the increment of road length and the increment of carriageway was 4:1 and 3:1 respectively, which is a reflection of Shanghai municipal government's policy of accelerating the development of highway in the suburbs.

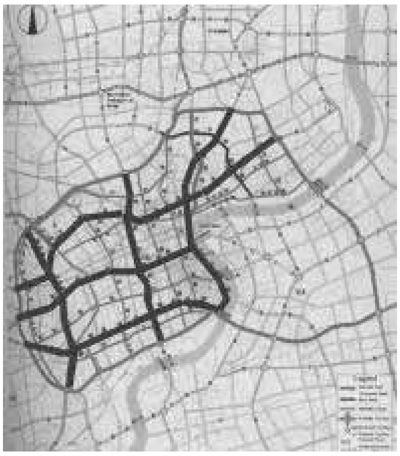


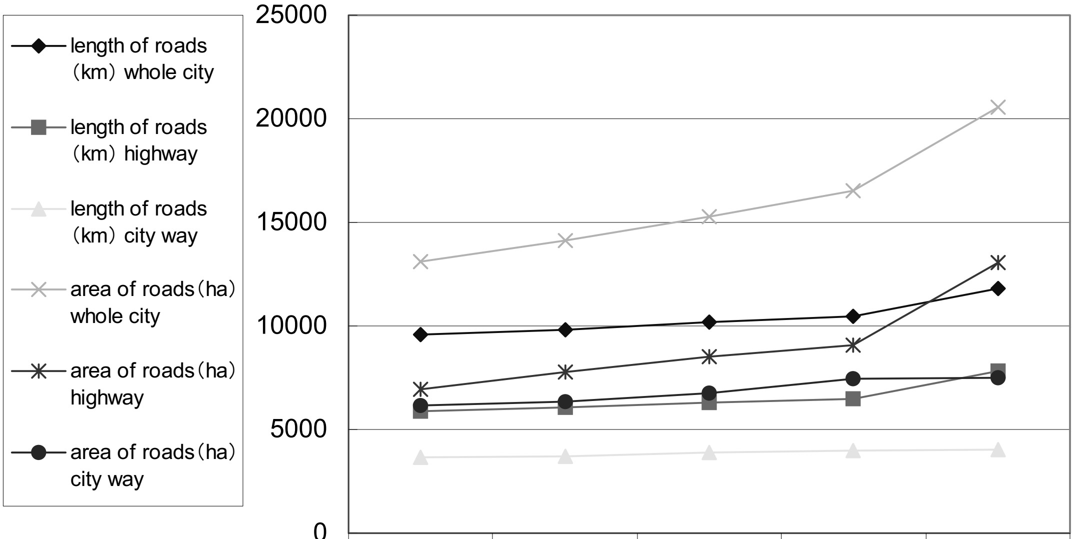
Figure 4.3.14 Main road of Shanghai

The main arteries in Shanghai downtown area include three ordinate and three horizontal lines. The three horizontal lines include south line: Lujiabang—Hongjiao Road, mid-line: Yanyan Road east—Yanan Road middle, and north line: Zhoujiazui Road—Changning Road. The three ordinate lines include east line: Zhongshan Road south—Siping Road, mid-line: Luban Road—Gonghexin Road and west line: Caoxi Road north—Caoyang Road.

Table 4.3.4 Basic status of the construction of roads

Year	length of roads（km）			Area of roads（ha）			Area of roads for MV（ha）		
	city wide	highway	urban road	city wide	highway	urban road	city wide	highway	urban road
2000	9568	5894	3674	13088	6935	6153	9976	5671	4305
2001	9800	6079	3721	14106	7774	6332	11068	6467	4601
2002	10191	6287	3904	15286	8523	6763	11805	7076	4729
2003	10451	6484	3967	16510	9067	7443	12631	7584	5047
2004	11825	7805	4020	20558	13063	7495	14977	9782	5195
growing rate	5.52%	7.50%	2.29%	12.18%	18.04%	5.11%	10.79%	14.89%	4.84%

Data source: Shanghai city planning and transportation institute



	2000	2001	2002	2003	2004
length of roads(km) whole city	9568	9800	10191	10451	11825
length of roads(km) highway	5894	6079	6287	6484	7805
length of roads(km) city way	3674	3721	3904	3967	4020
area of roads(ha) whole city	13088	14106	15286	16510	20558
area of roads(ha) highway	6935	7774	8523	9067	13063
area of roads(ha) city way	6153	6332	6763	7443	7495

Figure 4.3.15 Basic status of the construction of roads in Shanghai

The total amount of bridges in Shanghai was 553 in 1990, 4432 in 2000, 7483 in 2003 and 7622 in 2004

2.2.2 Urban rail transport

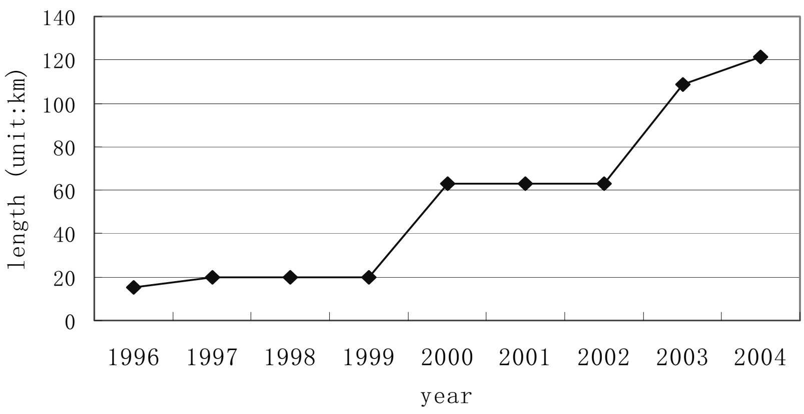


Figure 4.3.16 The change of urban rail transit length（Unit: Km）

Currently, there are 5 urban rail in Shanghai, with a total length of 121.23 km and 68 stations. It is planned to 2010 there will be 11 lines of total 400km in length open to public. And according to the long-term plan, the running lines will be 17, and the total length will increase to 810 km.

Table 4.3.5 The change of urban rail transit length

Index	unit	1996	1997	1998	1999	2000	2001	2002	2003	2004
The length of urban rail	km	15.21	20.06	20.06	20.06	62.92	62.92	62.92	108.65	121.23

Table 4.3.6 Running status of urban rail traffic (1997－2004)

Index	unit	1997	1998	1999	2000	2001	2002	2003	2004
The number of Urban rail carriages	number	96	96	96	216	216	330	445	611
The total number of passengers	Million passengers	11 174	12 606	10 921	13 556	28 270	35 739	40 604	48007

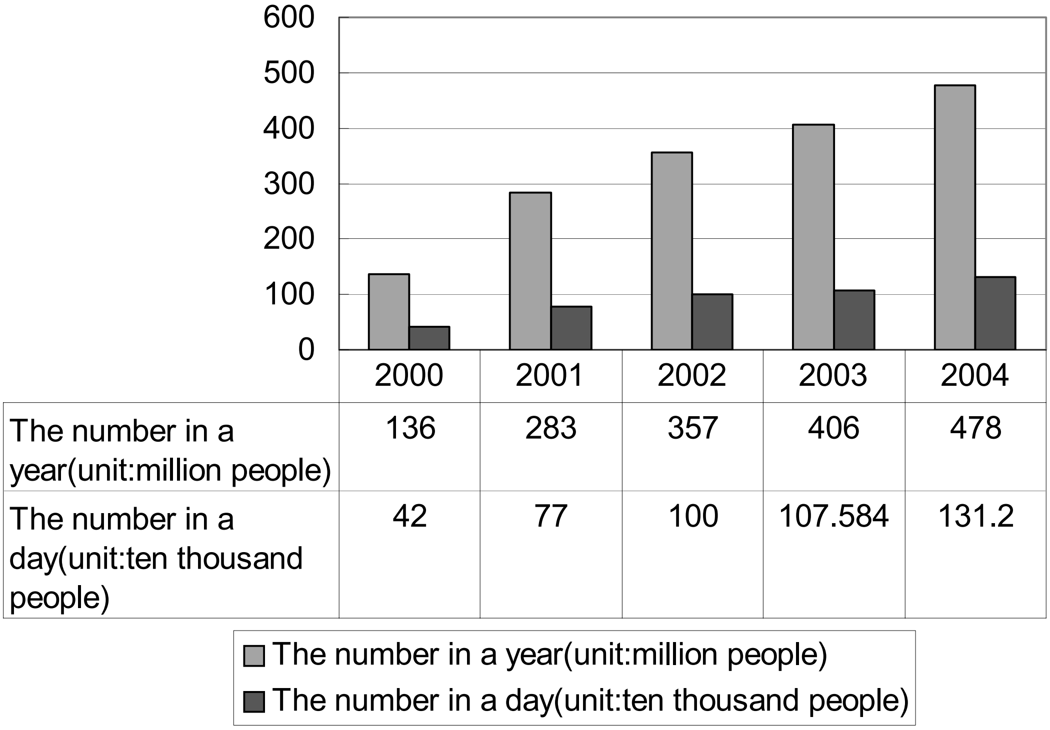


Figure 4.3.17 passenger flux in urban rail traffic

The passenger through urban rail increases steadily from 2000 to 2004, with an annual increase of nearly 37%. The passenger per day also rises, with an annual increase of 35%.

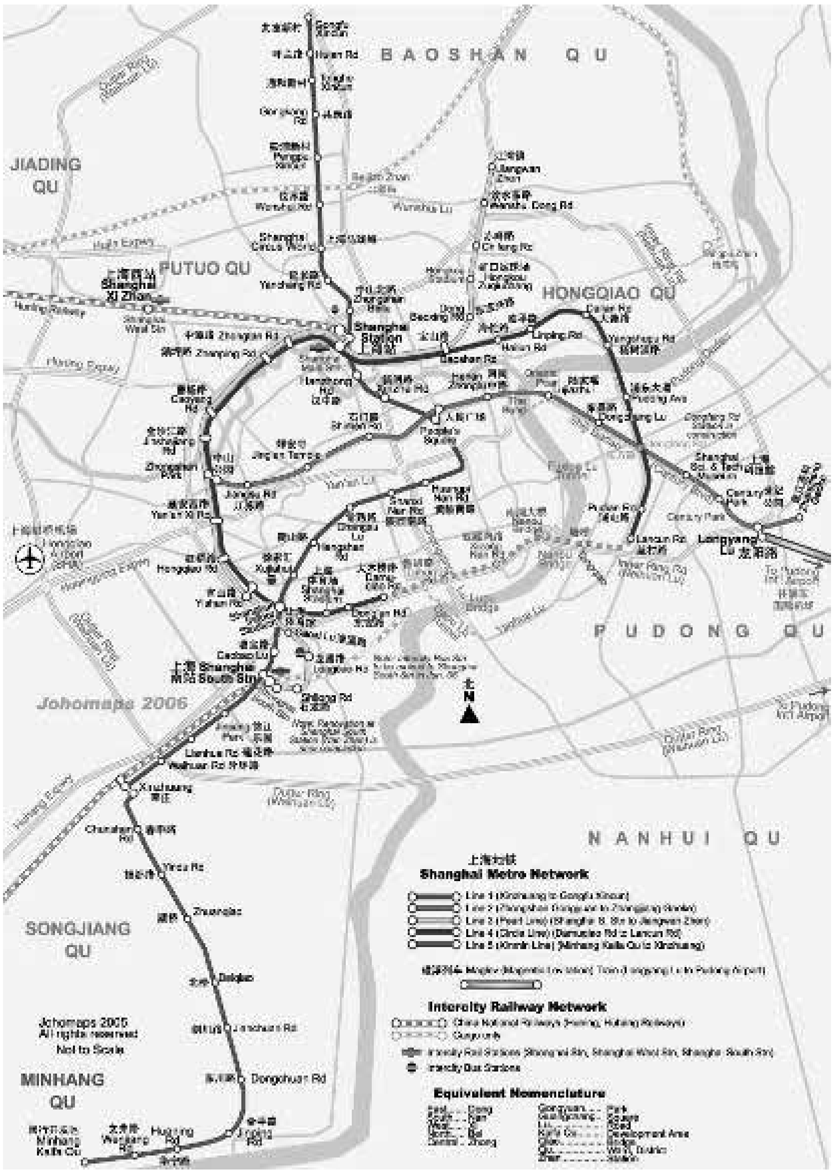


Figure 4.3.18 Shanghai urban rail traffic map

2.2.3 Bus lines and vehicles

Up to the end of 2005, the total amount of bus in Shanghai was 18000, with 1180 thousand seats. The bus/trolley lines amounts to 948 and the total length is 22000 km.

By 2004, Shanghai has constructed 5 bus-only roads, including Yanan Road, and the total length amounts to 15 km. Added by the 4 newly constructed roads, the roads for bus only amounts to 9. However, among which completed by 2004, all but Yanan Road are segmented, thus exerting little effect. In 2005, the newly constructed bus only way were 21.6 km and were on trail. By 2010, there will be 110 km bus only way within the inner ring inner ring, which can improve the service level of buses and at the same time, meet the travel demands for 2010 World Expo.

Table 4.3.7 The development of public transportation

year	Bus line in city	The vehicles in public transport（ten thousand）	The number of taxi（ten thousand）	The passengers of public transport（billion）	Urban rail passengers（billion）	Rate of increase（%）
2000	978	1.79	4.29	26.49	1.36	24.1
2001	991	1.81	4.69	26.84	2.83	110
2002	951	1.85	4.75	27.75	3.57	26.1
2003	952	1.86	4.87	41.46	4.06	13.6
2004	948	1.82	4.87	43.96	4.8	18.2
2005	940	1.8	4.8	44.09	5.94	23.8

2.2.4 Parking establishments

By 2005, there were 565 thousand parking spaces in center city, among which the parking space in the city center was 38%, and that in the periphery was 62%. The parking space in the residential area was 60% and in the non-residential area 40%.

2.3 Travel demand

2.3.1 Increase of motorized vehicles

Table 4.3.8 The development of possession of civil vehicles

Years		1996	1997	1998	1999	2000	2001	2002	2003	2004
The ownership of civil vehicle		466354	538378	582678	676367	1042895	1208611	1390300	1737600	2028500
private vehicles		342771	383372	386849	425463	491929	55007.3	623000	719000	835100
	Passenger vehicle	196603	226575	244270	276836	326863	37194.6	450900	540300	646900
	Freight vehicle	126584	134645	123088	128584	143788	15990	172100	178700	188200
Motorcycle		98707	130236	183251	238250	537691	62748.4	740900	984600	1138500

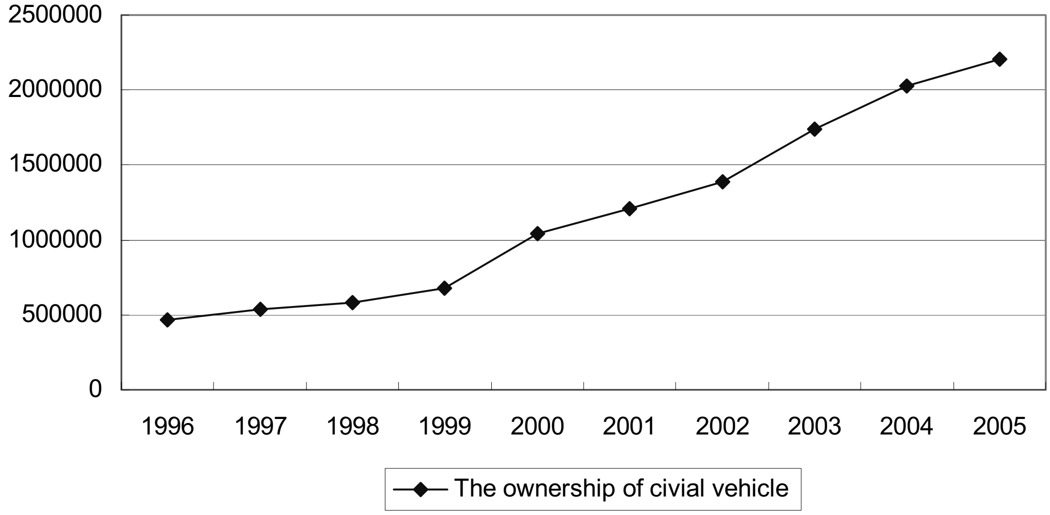


Figure 4.3.19 Increase of the possession of civil vehicles since 1996

The possession of civil vehicles rises steadily since 1996, with an average increase rate of 19.5%. By the end of 2004, the possession of motorized vehicles was 2020 thousand, among which the automobile was nearly 860000 (passenger cars 609 thousand, private passenger cars 311 thousand). 90% of the increment of passenger cars is from private passenger cars in the last three years. Besides, there are 100000 automobiles with license plate of other places running in Shanghai.

2.3.2 Characteristic of travel

In 2005, the total amount of trip per day was 41000 thousand times, and the trip of automobiles was 5000 thousand times per day.

Travel time and travel distance. The traffic in central district increase steadily while the traffic in periphery increase even faster. According to a research about the vehicle speed, traffic concentration in center city is intense. 40% of the vehicle speed in arteries was less than 15 km/h, 20% was between 15 to 20 km/h, and the average speed was 18 km/h. urban rail passengers travel distance was quite longer than bus trip, the average distance is 9 km by urban rail, 1.5 times of the bus trip. 40% of the rail passengers transfer from other vehicles. The average walking time is 10 minutes for passengers of urban rail traffic.

The effect of urban rail passenger transportation becomes obvious gradually. The passenger flux still concentrates in the central district. In 1995, the average time per trip through public transport was 62 minutes, and the distance was 6.6 km. In 2004, the time was only 58 minutes and the distance 8.4 km.

Trip purpose. Generally, the intensity of trip increases incessantly. Trips for non-working purpose increase greatly. Commuting trips such as going to/from work or schools increase with the expansion of population, increasing by 20% compared with that of 1995. Non-commuting trips such as shopping, entertainment and business increase obviously with the development of economic activities, increasing by 100% compared with that of 1995.

Trips distribute. The absolute amount of trips increases in every aspect, and the distribution of area are transferring toward periphery. Compared with that in 1995, the increase in the central district is the lowest, with an increase rate of 25%; the periphery is the highest, with an increase rate of 70%; and the suburb the middle, with an increase rate of 45%. The traffic entering/leaving center city increases greatly. There were 3.46 million people and 350 thousand car entering city center each day

Tide traffic. There is still the feature of tide in the passage toward central district. In the period from 7:00-9:00 am, the proportion of people entering and leaving central district is 1.4:1.

Mode split. Figure 4.3.20 shows the travel modes split of the Shanghai in 2004.

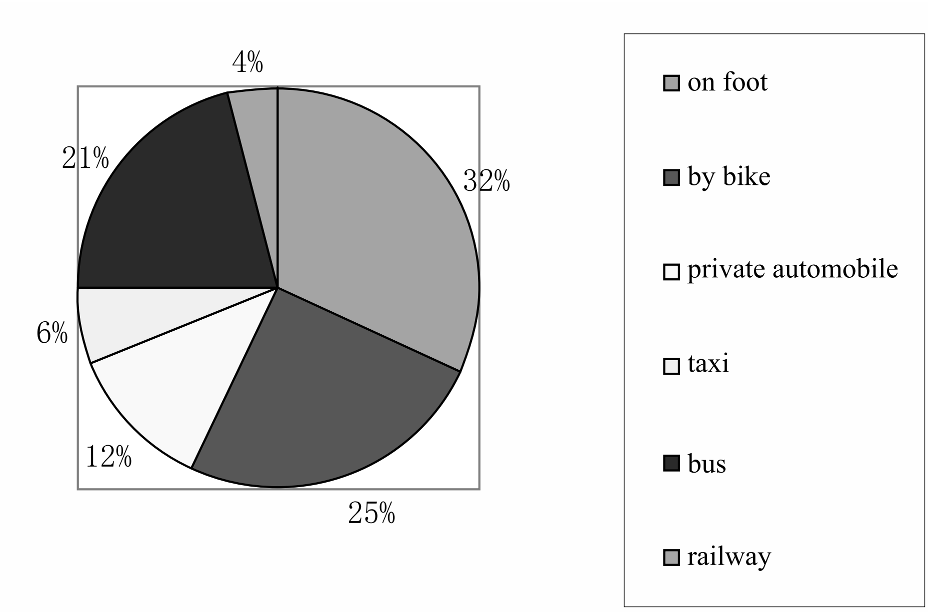


Figure 4.3.20 the travel modes split of the Shanghai (2004)

2.4 Investment in city infrastructure construction

From 1991 to 2004, the investment in city infrastructure construction amounted to 547.138 billion Yuan, with an annual increase of 25.7%, and occupies 23.4% of the investment in capital asserts in the same period.

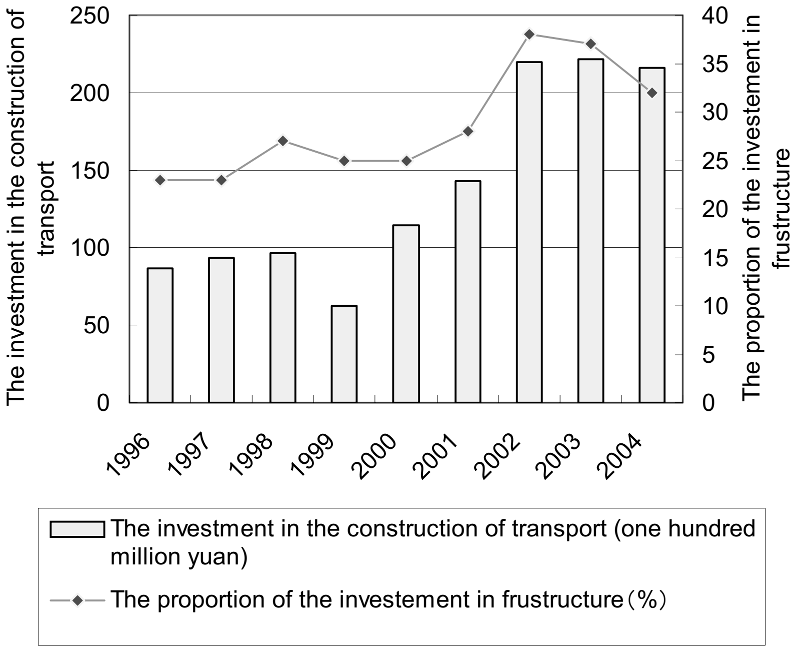


Figure 4.3.21 The proportion of investment in city infrastructure construction in the total investment in capital asserts

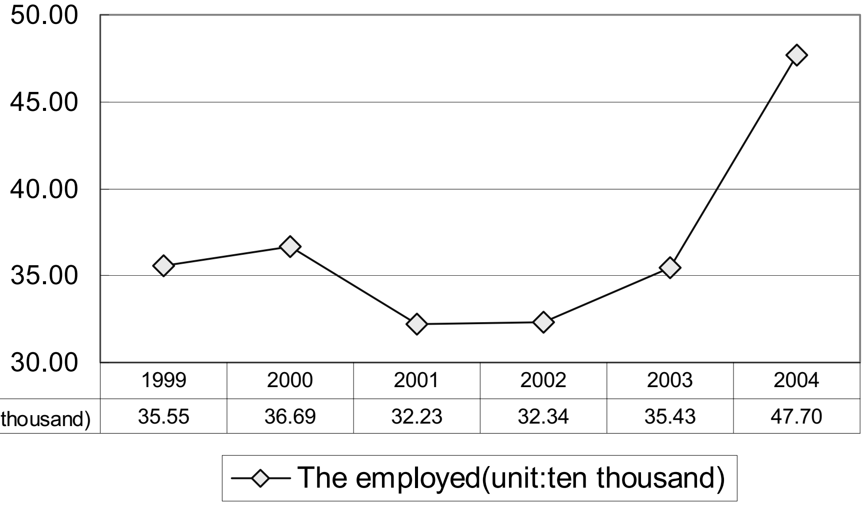
Table 4.3.9 Investment in city infrastructure

Year		2000	2001	2002	2003	2004	2005
The investment in capital asserts		1861.17	1984.31	2158.41	2452.11	3084.66	3542.55
The infrastructure in city		451.35	510.78	583.49	604.62	672.58	885.74
	The proportion in capital assets	26.7	25.7	27	24.7	21.8	25
Public transport and communication		146.31	168.42	171.25	349.069	371.35	443.91
public utility		109.22	92.25	148.42	143.9592	184.8	41.33
the city construction		128.95	177.89	201.68	34.21532	26.92	276.28
The investment in real estate		551.86	620.31	720.23	901.24	1175.46	1246.86

The investment in transport infrastructure increased from 14.286 billion Yuan in 2001 to 21.966 billion Yuan in 2002, among which the investment in urban rail was 12.47 billion (including the investment in magnetically levitated train project 5.58 billion Yuan). The proportion of passengers by buses, taxis and urban rail:2:1.

Investment in transport infrastructure was 22.158 billion in 2003, among which the investment in urban rail was 8.89 billion, amounting to 40.6% of the total investment.

2.5 Employments of transport sector



	1999	2000	2001	2002	2003	2004
The employed(unit:ten thousand)	35.55	36.69	32.23	32.34	35.43	47.70

Figure 4.3.22 the amount of practitioner in transportation, storage, mail and telecom

The practitioners in transportation, storage, mail and telecom varies from 1999 to 2004, and the average increase rate was 7.1%. In 2004, the increase rate was 34.63%.

2.6 Emission of greenhouse gases from motor vehicles

The air pollution of Shanghai is the complex pollution of oil and soot, and the major pollutant is particles. Through the adjustment of energy source structure, the soot air pollution is controlled effectively, but the pollution of emission in center city is still serious. The pollutant is mainly the NOx discharged by the motor vehicles. The average thickness of nitrogen dioxide of the city was 0.044 mg per cubic meters, and the thickness in the urban areas increased by 0.002 mg per cubic meters compared with 2000, which indicates the pollution of mission rises again. The average thickness of sulfur dioxide was 0.024 mg per cubic meters, and the thickness in the urban area decreased by 0.002 mg per cubic meters compared with 2000. The average thickness of inhalable particles in urban areas was 0.100 mg per cubic meters.

Table 4.3.10 The result of monitoring the major pollutants in the air in Shanghai

Season	NO2（Milligram /m³）			Pm10（Milligram /m³）	SO2（Milligram /m³）		
	City proper	Suburban	Whole city	City proper	City proper	Suburban	Whole city
1	0.072	0.034	0.047	0.126	0.05	0.017	0.026
2	0.059	0.036	0.042	0.097	0.034	0.014	0.022
3	0.045	0.033	0.036	0.061	0.039	0.013	0.02
4	0.075	0.038	0.051	0.114	0.05	0.022	0.027
Whole year	0.063	0.035	0.044	0.100	0.043	0.017	0.024

Data source: Shanghai environmental protection bureau

Remark:

1 The source of pollutant is closely related to the emission discharged by automobiles.

2 According to the rules of National environmental protection bureau, from 2001, the monitoring object changed from NOx to nitrogen dioxide and from general suspended particles to inhalable particles.

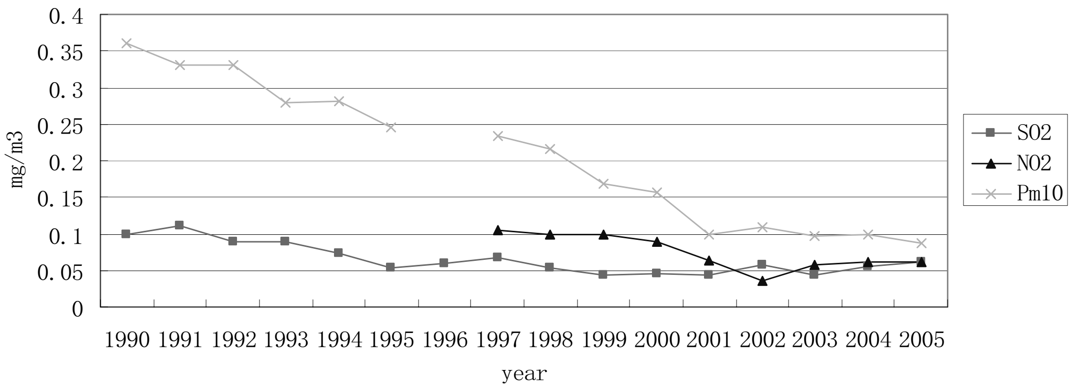


Figure 4.3.23 SO2, NO2 and Pm10 in Shanghai from 1990 to 2005

Date source: Shanghai Environmental Protection Bureau

From 1990 to 2005, the total volume of SO2, NO2 and Pm10 together in Shanghai declined. However, the volume of SO2 goes up because of fast economic development and increasing demand for energy after 2002. The volume of NO2 was stable in recent five years.

According to the research in 2002[2], emission of NOx increased to 397 thousand tons, among which 21.4% was from motorized vehicles. Thus it can be seen that the emission from vehicles is not the major pollutant of NOx in the city. But the study of pollution based on region showed that the major pollutant in central district was from vehicles, and in the suburbs was from immobile pollutant. In the central district.

Studied the content of lead in the dust in streets of Shanghai urban areas and suburbs, some people analyzed the features of distribution of lead in the dust. The result showed the content of lead in the dust in streets of urban areas was 28~4443mg/Kg, the average content was 264mg/kg, which was ten times as much as that of reference soil environment in Shanghai; the content of lead in the dust in streets of suburbs was

2. Fu Qingyan, Yang Dongqin, Huang Rong, Chen Guohai, Qiu Jibing, Chen Changhong, The atmosphere capacity in the development of motor vehicles in Shanghai, Environment science, supplement of 25th volume, June, 2004

155~364mg/kg, the average content was 237 mg/kg, which was 93 times as much as that of reference soil environment .The lead pollution in the area within the inner ring and on both sides of Huangpu River was the most serious, with an average content of lead 359 mg/kg. The most concentrated lead polluted area was in downtown and along arteries, with an average content of lead 642 and520 mg/kg respectively.

In Shanghai atmospheric environment protecting planning (2000-2005), there are following polices to reduce pollution of NO2 in central city in premise of normal development of mobiles:

(1) Carrying out strict environmental standard of new car. From Jan 1st, 2003, Europe II standard should be applied to light car; from Jan 1st, 2004, heavy car should fit for Europe second stage.

(2) Strengthen pollution inspection and safeguarding management of cars. Up to 2004, I/M institution and net work should be finished. Furthermore, there should be strict street inspection and yearly inspection.

(3) Regulation of diesel oil pollution. Prohibit of unqualified cars.

(4) Encourage using of clean fuel in public transportation. Strengthen renewing and replacement of taxi.

(5) Develop public transportation preferentially. Implement regulation to control the volume of traffic flow, through traffic management and license tag control. Develop public transportation which mainly constituted with urban rail. Encourage transportation transfer between private transportation and public transportation. Improve traffic condition of central city and decline pollution of mobile source.

Decline road dust through establish standard of construction, vehicle, facilities and road cleaning. Carry out comprehensive management from environment, police, and traffic management department.

Control pollution of petrol motors. Strictly control number of motors, fasten replacement of petrol motors with clean fuel. Eliminate petrol motor eventually. There’re following polices: (1) Provide conditions to eliminate petrol motors through development public transportation. (2) From Jan 1st, 2002, carry out prohibiting of production and sales of petrol motors. Stop providing license tag. Implement prohibiting of petrol motors step by step. In 2005, prohibit petrol motors in whole city. (3) Strengthen management and propaganda, encourage eliminate petrol motors through market economic ways.

3. The city planning decision-making mechanism in Shanghai

3.1 The establishment and implementation of planning

In the market economy, as an important measure in macro control, city planning plays a more and more important role in macro control, integrative balance, and supervision. At present, the legislation of city planning is not consummate in China (including Shanghai). In the process of city planning and construction, different interest groups dispute with each other and make the relation complicated. The present city planning system is faced with many difficulties in harmonize the relationship between the national government, local government, developers, and citizens in the distribution of city resources and benefits, and in the process of city planning and construction.

Shanghai is directly under the jurisdiction of the central government like Beijing, Tianjin and Chongqing. Thus the administration structure is different from that of other provinces. Shanghai has two levels of governments and three administrative levels. In the process of administration, the decision-making, authorization and implementation of planning are separated, and supervised by the two levels of city and district governments respectively. In the administrative level, the municipal planning bureau is in charge of the city planning in general, planning of separate districts and the detailed planning of important districts (such as the Lujiazui CBD and both sides of the Century Road); the district and county planning bureaus are in charge of the authorization of projects, and there are three administrative levels. The municipal planning bureau is responsible for the foresighted, overall planning and supervision.

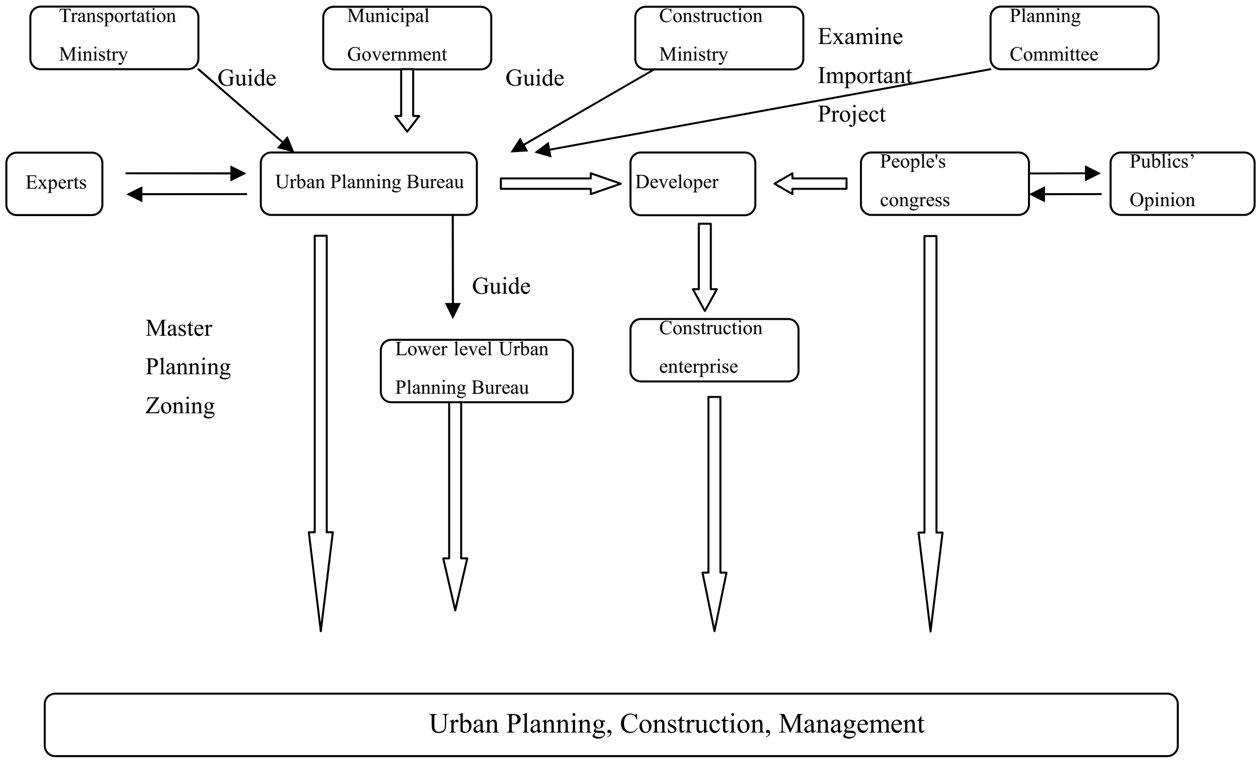


Figure 4.3.24 departments involved in city planning

According to the legislation, the city must make two kinds of planning in the development: Master plan and detailed plan. The master plan determines the city size in population and land use, overall arrangement and the strategy in city transport development. It mainly includes the following aspects. The planning program of city and town system, including establish the comprehensive development strategy of urban and rural areas, determine the objective and protecting requirements in the environment, land and water resources, energy, natural and historical cultural heritages etc, establish the space control principles, predict the total population and urbanization level of the city, determine the population., functions, arrangement and construction standards, determine the city transportation development strategy in principle, establish the city planned area, analyze the city function, constitute the city character and objective, establish the areas that will be forbidden for construction or limited for construction. Some of these are compulsive.

The detailed plan includes regulatory detailed plan and constructive detailed plan.

The regulatory detailed plan is established by departments in charge of city planning according to the master plan of the city or district plan that have been authorized. The regulatory detailed plan mainly include: determine the borderline of the lands of different kinds in the programmed area, determine the architecture type in the land that are suitable or not for construction or conditionally, determine the height, density, capacity, and green area in each land, determine the correspond public establishments, the location of entrances and exits, parking places, red line distance of the buildings etc, establish the guideline principles on the dimension, form, color and other factors in city design. The type of the land use, density, height, capacity, greenbelt, infrastructure and correspond public service facilities determined by the regulatory detailed plan should be compulsive. The constructive detailed plan should be more detailed with the requirement index from the corresponding regulatory detailed plan.

City road transport plan should include city road transport development strategy plan and city road transport comprehensive network plan.

City road transport development strategy should include the following aspects. Determine the objective and level of city transport development; determine the mode structure of city traffic; determine city road transport comprehensive network, the location and scale of establishments for passenger and goods transportation both internal and external. Propose solutions to the important technical and economic problems in the implementation of city road transport plan, propose advice about the policy of transportation development and transport requirements management.

City road transport comprehensive network plan should include the following aspects. Determine the city public transport system, the connection of various transportation modes, the distribution and scope of large public interchange and public transport stations. Determine the width of red line, intersection and the location and size of squares, public parking lots, bridges, and docks. Balance the demand for travel and the road capacity. Evaluate the technical and economic effect of the network plan program, and propose suggestions about timing the sequence of the construction of transport projects.

During the past ten years and more, intense investment has been put on urban transportation construction, the multi-modal urban transport system has come into being. The serving quality of public traffic improves incessantly, and the traffic management also improved. Problems such as the difficulty in taking bus, and traffic jam on the road that have accumulated for many years are relieved to some degree. Facing the new challenge in the new century, Shanghai municipal government decided to compile the White Book about Shanghai City Transportation. The book has been completed in 2004 and approved by the municipal government. The White Book is a comprehensive document integrating long term plan, short term plan, policies and measures. It is composed of four parts: strategy, establishments, operation, and management. The plan for long term objective is 2020, and the plan for short term objective and measures is 2005.

3.2 Government departments involved in city transport

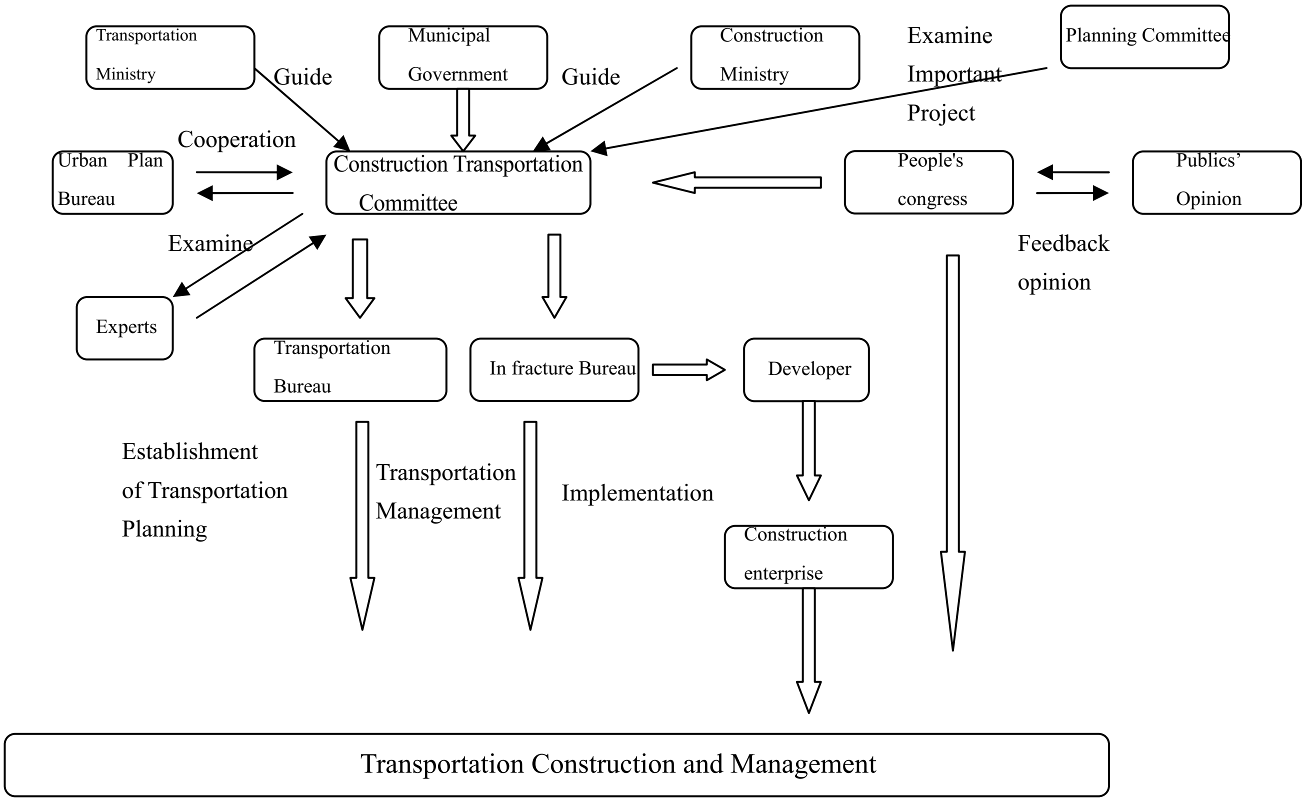


Figure 4.3.25 departments involved in city traffic

In the past, the urban planning bureau was responsible for urban transport planning. But as the transport construction is becoming so important in city development, the trend is to establish an intensive, multi-modes city transportation authority. A powerful government department is required to integrate various resource. Therefore, the city construction and transportation commission is to be in charge of the establishment and implementation of city comprehensive transportation plan.

3.3 Transport management mechanism

There are two departments responsible for transport management, one is the urban planning bureau and the other is Shanghai city construction and transportation commission. The former is responsible for the establishment of city master plan, district plan, and detailed plan, and manage and supervise the implementation of city construction projects. And the later is responsible for drafting local regulations about urban and rural construction, traffic and city management; organize and coordinate the establishment of important policies in construction and transportation; coordinate the various transportation means including roads, waterway, urban rail and aviation etc. The management of city transport operation is in the charge by transport management bureau which is subordinate to the commission. The construction of city transport establishments are carried out by companies, including private and state companies. The capital source of public establishment construction includes: appropriate funds from financial department, from the of land leasing, loans from banks domestic and abroad, investment from enterprises, individuals and other organization domestic and abroad, urban maintenance fund, and toll fee from roads and bridges etc.

Like many other cities in China, the local government in Shanghai has an important role in influencing and regulating the travel behavior of citizens. And compared with other developing countries, Shanghai municipal government is more authoritative in city construction and management. And this authority comes from the possession and control of the land by the municipal government. In the market economy, the local government still plays a decisive role in the distribution of land, the investment and construction of transport facilities, and the supply of commercial and social service facilities etc. However, the enormous authority will not guarantee the effectiveness of policy. In fact there are many methods to influence the transport demand and may be some of them are suitable to the specific problems and system structure in Shanghai. Shanghai should try to improve the frame of making and implementing policy, and make it more efficient.

4. Opportunities and barriers of density & mixed land use planning

Shanghai plans to follow the principle of decentralization to form the multi-level city-town system composed of “central city - new cities - central towns - towns” and the “multi-core, multi-axis” spatial layout structure composed of the coastal development axis, the development axis of Hu-Ning and Hu-Hang as well as the composite cities and towns at all levels. To study the policy and management influencing Shanghai’s population density and the mixed land use, we need to make comparisons from multiple levels of central city, fringe areas, new cities and other towns.

Restricted by the national policy orientation and the actual situation of the city, Shanghai’s overall urban development focuses on controlling the population and guiding the reasonable spatial distribution of population; advocating the intensive use of land and the farmland protection; controlling the intensity of real estate development in the central city, protecting historical and cultural buildings, removing the industrial enterprises with negatively influencing the environment, and attracting the service industry; accelerating the construction of satellite new city to absorbe the increasingly growing immigrants, emphasizing the balance of employment and residence, providing the complete service facilities inside the residential area and meeting the resident’s basic needs for service. These policies orientation can be fully embodied in the laws and regulations, structural establishment, and practical implementation, etc.

However, due to some social economic factors, the urban development has also encountered some problems. For example, the population is not effectively controlled; the central city and other towns spread disorderly with over-high development intensity; the lack of the good competition mechanism leads to the low efficient use of land; the residential quarters of some fringe areas have no appropriate public service utilities and infrastructures; during the course of the upgrade and reconstruction of the city, some interests of low-income class have not been protected; because of the government sector’s poor management and the developer’s unremitting pursuit for economic interests, some historical and cultural blocks suffer from the ruins at various degrees, etc.

4.1 Laws and regulations

4.1.1 Intensive use of land, strictly controlling per capita land usage area and the index of land used for single construction project

Because of rapid urbanization, a great deal of land is occupied for urban construction. In order to economize the use of land and standardize the criteria on construction land of each city, the Ministry of Construction issued the *Classification of Land in Cities and Standards for Land Use of Construction Project*[3]. The use of urban land in Shanghai should also accord with the document. By way of per capita land index and land index composition, the intensive use of land in Shanghai can basically be guaranteed.

3. The Ministry of Construction of PRC, *Classification of Land in Cities and Standards for Land Use of Construction Project*, March, 1990

(1) The per capita land usage area of Shanghai is very low in terms of the whole country.

According to the standards, different per capita land indices are determined for different cities to conduct classified control of land use in newly-development area.

Table 4.3.11 Per capita land index in cities

LEVEL	LAND INDEX (M^2/ PERSON)
Ⅰ	60.1~75.0
Ⅱ	75.1~90.0
Ⅲ	90.1~105.0
Ⅳ	105.1~120.0

Currently, the per capita land area of Shanghai is 113 $M^{2.}$ The per capita land area in downtown areas is relatively smaller than that in rural areas, which represents a compact land use type in cities.[4]

Table 4.3.12 Basic Information about Shanghai[5]

	AREA(KM^2)	POPULATION(10^3)	DENSE(10^3PERSON /KM^2)	SCOPE
City Wide	6340	17780	2.8	Shanghai City
Central City	660	11430	17.3	Outer Ring
City Core	108	4080	37.8	Inner Ring

(2) The composition of land used for construction in Shanghai varies in different regions.

The standards also further classify the structure of land use types for better definition.

Table 4.3.13 Planned per capita construction land indices

TYPE	LAND INDEX (M^2/ PERSON)
Residential Land	18.0~28.0
Industrial Land	10.0~25.0
Road and Squares	7.0~15.0
Green Space	≥9.0
Public Green Space	≥7.0

4. Ye Guixun, Spatial Development Strategies for Shanghai, China Architecture & Building Press, November, 2003, P19
5. Lu Ximing ect, *Shanghai Transport Development Plans*, 2005.7

Table 4.3.14 Structure of planned construction land

TYPE	PERCENT (%)
Residential Land	20~32
Industrial Land	15~25
Road and Squares	8~15
Green Space	8~15

As to the construction land composition of Shanghai, per capita land use indices and land use structures are decided according to the urban layout. In downtown areas, the percentage of residential areas and public facilities will be higher; in rural areas, the percentage of industrial land will be higher. The mater planning of Shanghai displays rational control on land use amount and composition and also provides a valid foundation for population evacuation and intensive use of land.

4.1.2 Emphasize the idea of neighborhood unit, strictly regulate to provide residential area with all kinds of public service facilities

According to the *Code for Planning and Design on Urban Residential Areas*[6], the layout of residential areas can be divided into many types, such as residential districts-residential quarter-residential clusters, residential districts-residential clusters, residential quarters-residential clusters, as well as, independent clusters. Supporting facilities in residential areas should tally with the resident population scale. The total area of supporting facilities can be decided flexibly according to the planned layout.

Table 4.3.15 Classified control on the scale of residential areas

	RESIDENTIAL DISTRICT	RESIDENTIAL QUARTER	RESIDENTIAL CLUSTER
Household	10000-15000	2000-4000	300-700
Population	30000-50000	7000-15000	1000-3000

Table 4.3.16 Indices of balanced control on residential land use (%)

	LAND	RESIDENTIAL DISTRICT	RESIDENTIAL QUARTER	RESIDENTIAL CLUSTER
1	Residential Land (R01)	50~60	55~65	70~80
2	Public Building(R02)	15~25	12~22	6~12
3	Road (R03)	10~18	9~17	7~15
4	Green Space(R04)	7.5~18	5~15	3~6
	Total	100	100	100

The classification of urban residential areas is based on the concept of neighborhood units. Therefore, in newly-development districts, public service facilities will be prepared for per thousand residents; the facilities

6. The Ministry of Construction of PRC, *Code for Planning and Design on Urban Residential Areas*, March, 2002

include: education, medical health, culture & sports, commercial services, financial & postal services, community services, city public utilities, administrative management and other eight kinds of facilities. The construction level of public buildings in residential areas should be in accordance with the population scale and the facilities must be incorporated into planning, built and put into use at the same time with residential buildings. As to former urban areas, the framework of business shops at the ground floor also conduces to the mixed use of land and the use of residents during walking.

Table 4.3.17 Residential Public Service Facilities Standard

Unit : M^2

	RESIDENTIAL DISTRICT		RESIDENTIAL QUARTER		RESIDENTIAL CLUSTER	
	Building Area	Land Area	Building Area	Land Area	Building Area	Land Area
Total	1668-3293 2228-4213	2172-5559 2762-6329	968-2397 1338-2977	1091-3935 1491-4585	362-856 703-1356	488-1058 868-1578
Education	600-1200	1000-2400	330-1200	708-2400	160-400	300-500
Hospital	78-198 178-398	138-378 298-548	38-98	78-228	6-20	12-40
Culture and Entertainment	125-245	225-645	45-75	65-105	18-24	40-60
Commercial	708-910	600-940	450-570	100-600	150-370	100-400
Community Service	59-464	76-668	59-292	76-328	19-32	16-28
Financial	20-30 60-80	25-50	16-22	22-34	-	-
Infrastructure	40-150 460-820	70-360 500-960	30-140 400-720	50-140 450-760	9-10 350-510	20-30 400-550
Administration	46-96	37-72	-	-	-	-

The index of per thousand residents provides a basic criterion for the designing of urban residential areas. Meanwhile, if allowed by policies, real estate development enterprises will make their decisions on household types and facility distribution according to market demands. However, during the actual process of development, because the local government cannot provide a beautiful, healthy and green environment, some residential districts will be enclosed by walls, thus resulting in the isolation of land.

In effect, residential areas in different districts of Shanghai are development in different ways. In downtown areas, there are mainly land redevelopment projects and small-sized living quarters; large-sized living districts centralize in rural-urban fringes where people usually choose road transport. In areas around Minhang District there appears a development pattern of TOD; while in suburban areas where travel is convenient by car, there are some detached villas which serve as an alternative for some people with a high income and private cars.

In the past, people held some incorrect views toward urban and rural construction. For example, the functions of new towns were relatively unitary and there were few residential quarters in industrial zones, thus resulting in the separation of the working population and their residences or their living in factories with poor conditions.

With the enlargement of industrial zones, the upgrade of people's living standards and the demands on better living qualities, people will move out of there and choose motorized commuting. In the end, the urban traffic will become more crowded.

4.1.3 Control the real estate development in central city, encourage to create the public activity space suitable for all citizens

According to regulations in *Shanghai Urban Planning & Technical Administration*[7], all projects developed in Shanghai whose construction area is above 30,000 m^2 must make detailed plans and carried out after approval. All high-rises and mid-rises for public and living purposes whose construction area is below or equal to 30,000 m^2 should take as reference the "Building Density and Far Index Table".

Table 4.3.18 Building Density and Far

		INSIDE INNER RING				INNER RING-OUTER RING				OUTSIDE OUTER RING	
		I		II		III		IV		V	
		D%	Far	D%	Far	D%	Far	D%	Far	D%	Far
Low-rise detached house Other Low-rise house				20 30	0.40 0.90	18 27	0.35 0.80	18 27	0.35 0.80	18 25	0.30 0.70
Residential	Mid-rise High-rise	33 25	2.0 4.0	30 25	1.8 4.0	30 25	1.8 3.5	30 25	1.7 3.5	27 25	1.6 3.0
General Office	Mid-rise High-rise	50 50	4.0 8.0	45 45	3.5 7.5	45 40	3.0 7.0	40 40	2.5 6.5	40 40	2.5 6.5
Flat Office Hotel	Mid-rise High-rise	50 50	3.0 6.0	45 45	2.5 5.5	45 40	2.5 5.5	40 40	2.2 5.0	40 40	2.0 5.0
Commercial	Mid-rise High-rise	70 70	4.0 8.0	65 65	3.5 7.5	60 60	3.0 7.0	55 55	2.5 6.5	50 50	2.5 6.0
Commercial-Residential	Mid-rise High-rise	50 50		50 50		45 45		45 45		40 40	
Industrial	Low-rise Mid-rise High-rise			60 45 30	1.2 2.0 3.5			50 40 30	1.0 1.6 2.5	40 35	1.0 1.4
Warehouse	Low-rise Mid-rise High-rise			60 45 30	1.2 2.0 3.0			50 40 30	1.0 1.6 2.0	40 35	1.0 1.4
Public Green											

7. Shanghai Bureau of Urban Planning, *Shanghai Urban Planning & Technical Administration* and supporting documents, February 4, 2002

The construction volume control index for satellite cities, county town , Minhang District and Jiading District is the same with that for inner ring-outer ring as defined in the “Building Dense and Far Index Table”; rules on the classification of central and ordinary areas are clearly specified.

The density control index for industrial zones at the municipal level and towns is the same with that for ordinary areas between the inner ring and the outer ring as defined in the “Building Density and Far Index Table”.

Technical specifications determine for construction in old urban areas will be opened to the public. The construction area can be expanded under the precondition that relevant regulations are satisfied.

Table 4.3.19 Open Space Encourage Police

FAR	OFFER 1M^2 OPEN SPACE ,ADDED AREA(M2)
<2	1.0
>=2,<4	1.5
>=4,<6	2.0
>=6	2.5

Due to the development mechanism and the administration system, currently the intensity of land development is directly linked up with the profit of land. Thus, different land functions have encountered some trends and problems listed as below:

1. In the central city, the land available for urban development is insufficient.. This is only attainable for the high intensity office buildings and residential buildings, which is inconsistent with the original intention for urban real estate development control. In some cases, to promote the city renewal still needs the special policy or allowance of the government;

2. In the fringe area, the land cost is relatively low, and it can be used to develop the residential area with favorable environment and low price. But now it also develops towards the way of high intensity, and it lacks the public service facilities like schools, hospitals, public traffic, etc.;

3. Generally the suburban towns are planed to become new cities with comparative balance of employment and residence. It falls far behind the central city with the respect of transport conditions or service facilities, so these new cities mainly absorb part of the new immigrants, but they cannot relieve the central city’s large population pressure. As Minhang District and Baoshan District are close to the central city and have favorable transport conditions, they get comparative rapidly development.

4.2 Administrative policies

4.2.1 Perfect urban system, guide dispersion of population

In order to decentralize the dense population in downtown areas, the Master Planning for Shanghai put forward the following strategies to optimize population distribution:[8](1) strengthen overall control of the population. Population growth should accord with social and economic development as well as resource and environmental capacity; full consideration must be given to the acceleration of urban-rural integration, the combined development of cities in the Yangtze River Delta Area, the continuous perfection of the transport system and the

8. *Overall Urban Plans of Shanghai*, 1999-2020

influences of overall population control on population growth. According to the future 20-million-populatioin sized city in 2020, comprehensive urban plans will be made. The growth of the registered population should be strictly controlled, the size of non-registered permanent population should be adjusted in a reasonable way, and the management of the nomadic population will be enhanced. (2) The population in downtown areas should be strictly controlled and the shifting of population from urban to rural areas should be promoted as soon as possible. Up to 2010, the permanent population in downtown areas will be controlled at 8.5 million; from 2010 to 2020, further efforts will be made to control the population growth. (3) The attraction of suburban towns will be reinforced to promote population accumulation. Better living, transport and eco-environmental conditions as well as more employment opportunities will be created to attract people to move there and contribute to the reasonable distribution of the population in urban areas.

During the tenth "five-year plan" period, Shanghai proposed to place the top priority on "one city and nine towns" (namely Songjiang New City, Anting, Luodian, Zhujiajiao, Fengjing, Pujiang, Gaoqiao, Zhoupu, Fengcheng and Baozhen), and to enhance the "reaction" of rural towns against downtown areas. During the 11th "five-year plan" period, Shanghai will reorganize the pattern of town and country according to "1966 Plans", so as to eradicate the dual-mode structure between town and country, break the contradiction between rural and urban areas through a new terraced system, decentralize the urban population and realize the migration of the population to the suburbs. The detailed content is as follows: one central city: within the outer ring of Shanghai, with an area of about 600 Km2; nine new cities: Baoshan, Jiading, Qingpu, Songjiang, Minhang, Fengxian South Bridge, Jinshan, Lingang New City and Chongming Chengqiao (whose planned total population is about 5.4 million; among them, Songjiang, Jiading and Lingang New City are the fastest development ones whose planned population scale is 0.8-1.0 million and whose total population is around 2.7 million); 60 new towns: establish 60 independent and distinctive new towns whose total population is about 50 thousand for the purposes of centralized development of the population and the industry, intensive use of land and rational allocation of infrastructures; as for new towns with abundant resources and great potentials, their population will reach 100-150 thousand; 600 central villages: central villages are basic residential units in the countryside, decentralized natural villages will be merged together in a suitable way and public facilities will be built rationally.

Shanghai's reasonable distribution of population mainly relies upon the interception of part of the new immigrants by the towns at all levels, in particular, the residential area construction at the surrounding of the industrial parks to realize the balance of residence and employment. In the meantime, during the course of reconstruction and renewal of the central city under the guidance of the local government, millions of people involved in the relocation program are centralized in the towns close to the centre city, including Pujiang, Jiangqiao, and Tangzhen, etc.

4.2.2 "Advance the tertiary industry and retreat the second industry", realize the upgrade of industrial structure

In recent years, Shanghai has exerted many efforts to adjust its industrial structure; therefore, a huge population is redistributed spatially. Now the spatial redistribution of Shanghai's population features the movement of population and job opportunities to the suburban areas and the movement from the country to the town is rarely seen. In the early 1990s, Shanghai's industries were mainly concentrated in areas along the inner ring and fringes, thus bringing many problems to the society and the economy; the mixture of industrial zones and residential districts resulted in disturbance to one another; a vast area of industrial land influenced the transforing of urban functions.

Economic development principles determined for the latest round of urban development plans of Shanghai are "the tertiary industry first, and then the secondary and the primary ones". There are altogether three levels. At the first level, areas within the inner ring will put emphasis on the tertiary industry and keep moderately some "city type" industries; at the second level, areas between the outer ring and the inner ring will stress the development of high-tech, highly value-adding and non-polluting industries and the adjustment, regulation and perfection of current industrial zones; at the third level, emphasis will be put on the primary industry and the second industry, and efforts will be made to upgrade the economic scale and the intensive level, build century industrial zones and develop actively modern agriculture and tourism in the countryside.

In order to promote the construction of major industrial bases and industrial parks at both the national and the municipal level, efforts will be pooled together to build micro-electronic industrial base, an international motor town, Shanghai chemical zone, a top-quality steel industrial base, Lingang New City industrial base and Shanghai shipbuilding base. The building of "1＋3＋9" industrial parks at the national and municipal levels will be continued. The leading role of high-tech in driving forward industrial development should be brought into full play; the development of high-tech industries (such as software and bio-pharmacy) and the building of research & innovation bases should be reinforced; Shanghai's industrial level must be upgrades; the investment environment and the service level should be further improved; industrial agglomeration must be strengthened to form internationally competitive industrial chains and clusters.

Industrial zones in towns should be combined together to improve competitiveness, and scattered industrial sites be merged. In light of adjustments in administrative division, industrial zones and scattered industrial sites at or below the town level will be incorporated to further improve the intensity and the beneficial results.

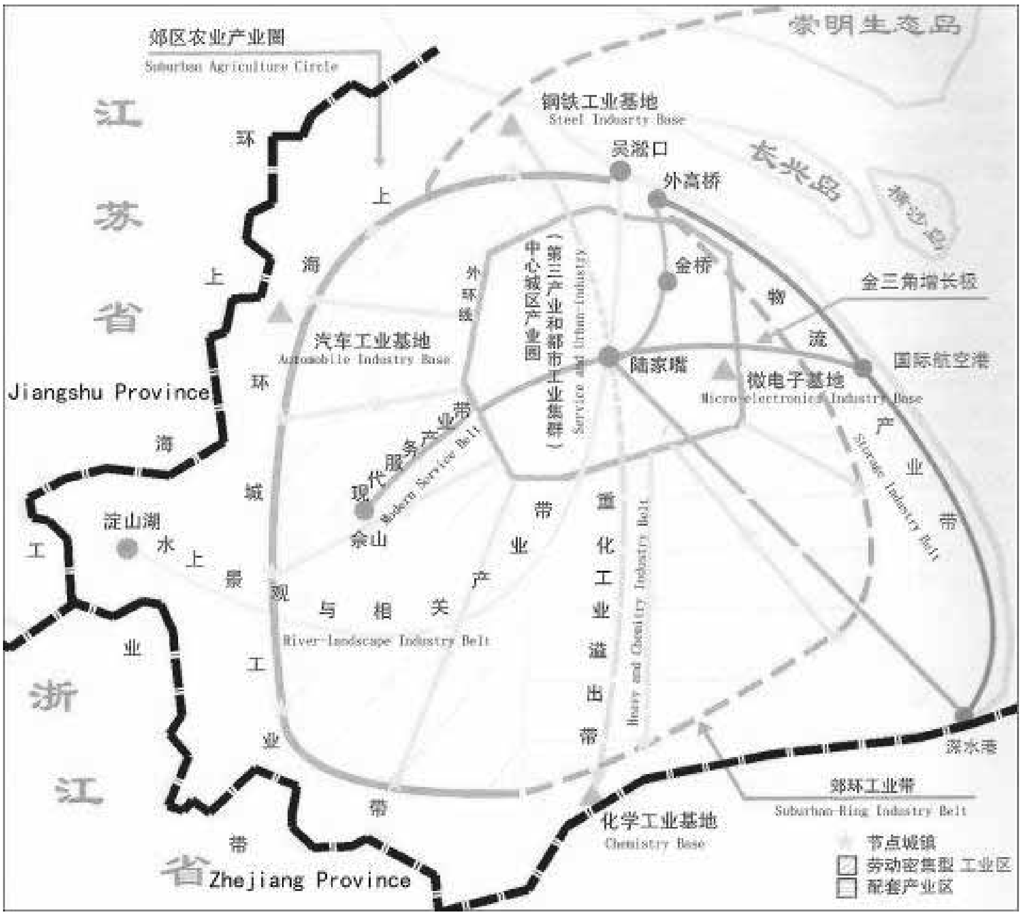


Figure 4.3.26 Shanghai's industrial space layout

Data source: Wang Zhan, WTO and Development in Shanghai, Shanghai University of Finance and Economics Press, 2003.4

4.2.3 Adapt to adjusted land and real estate market system, standardize land assignment and real estate development

The bidding for the No.26 parcel of land of Hongqiao Development Zone in 1988 ushered in the assignment of land use rights. In October, 1996, the Municipal Government of Shanghai issued the *Measures of Shanghai Municipality on the Assignment of Land Use Rights*, stipulating that the land used for six kinds of operational purposes should be acquired via the means of assignment. In 2001, the government of Shanghai amended the *Measures of Shanghai Municipality on the Assignment of Land Use Rights*, stipulating that the assignment of land use rights can be realized in the following ways: agreements, bidding, auction and other methods approved by the municipal government. Afterwards, it issued *Proposed Measures of Shanghai Municipality on the Auction and Public Bidding of Land Use Rights*, prescribing that the assignment of the right of using six kinds of land should be made through bidding and auctions and specifying the corresponding range and procedure and land supply plans.

In December, 2002, Shanghai succeeded in the application for hosting the 2010 World Expo. This historic breakthrough, the promising potentials of development at both sides of the Huangpu River and the achievements made in building Shanghai into an international metropolitan attract many real-estate developers from other cities or other countries to do business in Shanghai; meanwhile, many overseas investors begin to invest a great deal in the field; thus, the competition becomes increasingly fierce. However, due to the coexistence of assignment and bidding for land, illegimate operations and renting may exist. Therefore, in order to standardize the real-estate supply in Shanghai's land market, since the latter half of 2003, Shanghai began to reinforce the administration of operational land assignment and laid down rules that public bidding must be made for newly-increased land used for six operational purposes, namely, commerce, tourism, entertainment, finance, service and market apartment; six kinds of operation land in industrial parks, scientific parks and development zones, that once was non-commercial land such as industrial land and education land should be included in the range of public bidding. Agreement or invitations for bid are prohibited.[9]

Reforms in Shanghai's land market system have influenced the spatial distribution of urban land prices, will further affect spatial functions and development intensity and make the values of houses and buildings approximate to the market. Since the adoption of the bidding system and the implementation of reforms in China's housing policies, the real-estate industry became more and more market-oriented and non-public projects (houses, shopping malls and office buildings) were mainly undertaken by state-owned or private enterprises. From 2002 to 2004, the prices of houses had increased by 20%. Increases in the price of land and houses motivated developers to enhance the development intensity, thus bringing pressure to urban residents if they want to better their living conditions.

In 2005, in order to control rises in house prices, Shanghai issued the *Proposal to Reinforce Real-estate Market Control and Promote Its Healthy and Sustainable Development*. In the document, the objective of Shanghai in controlling the real-estate market is clarified, namely, the principle of "giving priority to residences, resident consumption and ordinary market houses" should be upheld. It is required that the price of market houses should be further lowered; accessory market houses and medium and low-price market houses respectively with an area of 10 million m^2 with an area of will be newly built, and the area available for selling will be 20 million m^2.

Since the 1990s, so as to motivate and develop the real-estate market, Shanghai associates houses with registered permanent residences and taxes:

(1) 1994 saw the beginning of the policy that buyers of houses can acquire blue-printed permanent residence certificates. The policy stipulated that if those from other provinces or cities invest in Shanghai, purchase markethouses or are employed by enterprises in Shanghai, they will get blue-printed permanent residence

9. Land Resource News Net, Considerations on the Implementation of the Land Bidding System in Shanghai and Its Effects, April 21, 2004

certificates and enjoy the same treatment with Shanghai residents in areas like schooling, application for business licenses, installation of gas and telephones, etc. The implementation of the blue-printed permanent residence policy has contributed a lot to the prosperity of the real-estate market and the construction and development of market residences in the city. The policy was annulled on April 1, 2002.

(2) In 1998, the policy of drawback at the purchase of houses was carried out. In 1998, in view of the recession in the real-estate market, Shanghai began to implement the policy of drawback at the purchase of houses to encourage people with a high income to buy appartment. From June 1, 1998 to May 31, 2003, all Chinese and foreigners who have purchased market house and paid income tax can enjoy the deduction of income tax after their purchasing of the houses.[10]

Blue-printed permanent residence certificates and tax drawback are all incentive policies adopted under the economic environment of that time. To a certain extent, the policies have encouraged people from other places to invest and settle down in Shanghai, which promote the rapid development and maturity of the real-estate industry. Such people are mainly concentrated in downtown areas; the phenomenon also exerts influences on the population and composition of such areas.

4.2.4 Improve urban living environment, promote city renewal

In recent years, due to the active and rapid development of Shanghai's economy, urban construction has been a hotspot issue. A large number of urban residents has been resettled because their original residences are dismantled. According to the statistics of the Municipality Land Bureau, within the inner ring of Shanghai, the area of old-style residences was about 40 million m^2 before the founding of New China; in 1990s, after the "365" reforms, half of the dangerous sheds were dismantled; at the end of 2000, houses with an area of about 20 million m^2 were dismantled. More than 1 million residents are moved from urban to suburban areas.[11]

In the past 10 years, Shanghai made adjustments in the industrial structure, carried out on a large scale land replacement in downtown areas, and relocated many residents. From 1992 to 1998, within the inner ring, 713 industrial enterprises and 891 industrial sites in all were moved to other places, and 5.05-million-m^2 land was used by the real-estate industry or the tertiary industry. The residential population was also moved to other places.

The simultaneous reconstruction of old urban areas and the development of new areas is a direct inducible factor for changes in the urban population. Along with the acceleration of reconstruction of key old downtown areas (Huangpu, Luwan and Jing'an Districts), there is an increasing number of projects in old residence dismantlement, land renting, road widening and relocation of governmental offices. The industrial structure is being adjusted; rapid development can be seen in the construction of residences in suburban and fringe areas (Yangpu, Hongkou, Zhabei, Putuo, Changning and Xuhui Districts), and a great number of residents are relocated from downtown areas to the newly-built residential clusters in suburban and fringe areas. From 1995 to 2000, the number of permanent residents in downtown areas has decreased to only 637 thousand, which shows that the population is still moving from urban to rural areas and nice achievements have been scored.

4.2.5 Embody social impartiality, provide housing for low-income class

In order to improve the housing conditions of the citizens, Shanghai municipal government has implemented the policy of interest allowance for house loans by low-income families. The beneficiaries are citizens whose income per capita is lower than the criteria, and house unit price is not higher than 3500 Yuan to the new apartment not large than 90 square meters. Shanghai started the "two 10 million" project in 2005, namely 10

10. People's Net-East China News, A Road Map of Shanghai's Real-estate Policies; The Fight between a Material Hand and an Immaterial Hand , April 13, 2005

11. Lu Jianpu, Changes in the Population Distribution of Shanghai Since 1980s, a master dissertation of Tongji University, March 2, 2003

million m^2 correspond commercial building, 10 million m^2 ordinary commercial building of middle and low price. These commercial buildings will be supplied to the relocates and the qualified mid-and-low income residents. The location of the “two 10 million” project has been brought into the overall consideration of city planning, taking into account the population layout in the future, the reconstruction of old urban areas and the construction of suburban new towns. The bases that have been determined in Songjiang, Minhang, Nanhui etc take into account the development in Songjiang new town, Pujiang, and Lingang new town etc. On one hand, it can boost the construction and development of suburban towns; on the other hand, it can effectively control the construction cost since there has been consummate public establishments such as commercial and medical services in the towns. The planned location for the projects should be close to the existing and planned railway lines and major public transport service corridor, so that the citizens can enter the city road nearby and save trip time. The planned area should select the areas that have some industrial bases to provide employment. For instance, the Zhoukang base in Nanhui is close to Kangqiao industrial park, Luodian base in Baoshan is close to Baoshan refined steel base. The relocatees can get employed nearby, thus reduce the trip cost of workers and relieve the traffic pressure in central district. At the same time, it can bring along the development of industries in that area and attract the suburban population. In accordance with the sources of relocates from central district, the corresponding commercial building bases will be in every direction of Shanghai, so that the residents can move to a nearby place and keep a balance of population.[12]

4.2.6 Implement “Two Increases and Two Decreases” policy, control the development intensity of central city, improve urban spatial environment

In order to strengthen the management of existing and planned appropriative lands such as civic public establishments and public service establishments, guarantee the construction of infrastructures, improve transportation in the city, restrain the population scale and buildings in the central district, increase public service establishments, public greenbelts and spaces, promote the function of central district, improve the environment and relieve population pressure, the government brings forward the policy of “two increases and two decreases” in the construction and planning of central district, namely increase the public green space and public spaces, decreases buildings and density . In the approval of project, it is not allowed to change the property of land, building volume and building height. The planning and construction of suburbs should implement the policy of “three concentrations”, and are not allowed to change the compulsive requirements on the property and control line of planned land. Shanghai will implement a policy, controlling FAR within 2.5 and that office building within 4.0.

[13]Up to the end of 2004, of the 376 projects left by historic problems in the ten districts in central town, 186 have passed the pilot study or acquired construction project license, about 57% of the over-capacity projects. The construction volume in the central district decreased by 4043 thousand square meters, about 16.8% of the approved construction volume. Besides, the area of increased green space is 204.5 thousand square meters.

4.3 Stakeholders involving

Shanghai is developing rapidly. With the reform in economy and society, the status and roles of government, enterprise, and public change constantly.

4.3.1 Transform urban governmental functions, gradually retreat from business operation, increase public service

In 1996, the t barycenter of management of Shanghai government departments lowered, and established a new system of “two levels of governments, three levels of administration” in the city and “three levels of

12. Five planning principles establish lodgeable environment standards, two 10 million pays attention to the basic life of the public, http://www.sh.gov.cn, April 6, 2005

13. The policy of “two increases and two decreases” has achieved obvious effects in central district, http://www.shanghai.gov.cn, January 28, 2005

governments, three levels of administration" in suburbs and counties. The management system in city construction consummates, constructing a frame combining macro management and micro management, and improved the efficiency. Everyone is now participating in city management. Abiding by the principle of separating the decision-making, implementation and supervision of planning and separating the powers of making, approving and supervising planning, establish three management levels, define the management responsibilities of city and district/county planning bureau. For example, Shanghai city planning bureau is mainly responsible for the management of CBD and the planning of important segments and areas, while transfer the powers of establishing and managing planning to the district planning bureaus.

The de-centralizing of city construction and management powers activates the enthusiasm of local governments in economic development, but it also brings along some problems. Some of these problems include the disagreement between the local objective and unitary objective; the corresponding infrastructure does not match the intensity of development etc.

4.3.2 Allow enterprises to take part in more development fields in more ways and gradually become the main body of land development

As the construction industry is unlashed, city development, which used to be dominated by state owned enterprises, is now a field open to many kinds of enterprises. Because of the interposition of domestic capital and foreign capital, city construction has more model and becomes mature.

In the reconstruction of old urban areas, some projects are economic benefit oriented. Stated owned companies and developers that have governmental background force the mid-and-low income residents to move out from the central district and build high-grade residence to attract the high-income people. The cost of relocation is rising and the enterprise must strive to be intense in construction.

In the development of residential area in periphery, some enterprises may acquire extensive land, which is propitious to overall development and the correspondence of public establishments. However, some residential areas are far from the concentrated area, with inferior infrastructure and public traffic, causing difficulties to the life and trip of residents.

4.4 Public opinion reflecting

Since the 1990s, the public of Shanghai has participated in city construction and planning. Shanghai built a city planning exhibition hall to represent Shanghai's development planning, and the citizens understand and express their opinion about city construction in various forms.

Based on the information rendered by the media and the information we've collected via investigation, as to urban development, we can see that the public are primarily focusing on the following fields about the city development:

(1) Sunshine spacing. Residents are highly concerned with the problem that the height and width of newly constructed buildings will affect the sunlight hours in their home. Citizens have taken the laws and regulations to maintain their own rights of sunshine.

(2) Demolition of old urban areas. The dismantling and removing of residences is caused by the renewal of city and infrastructure construction. In recent years, the citizens no longer accept the development passively; instead, they try to negotiate with the government and developing companies through various channels, which caused an increase in the project cost.

(3) Public service facility. The residents living in the central city are mainly concerned about the service faculties, for example, parks, public transport, etc., whereas the residents living in the fringe area and other towns are not satisfied with the availability of the supporting facilities like schools, hospitals, public transport, etc.

According to The Outline of the 11th Five-Year Plan for the Economic and Social Development of Shanghai, public participation in city planning should be encouraged. The program and related information should be published. Propagandize city planning to the society and citizens to improve their consciousness on it. Invite more citizens to participate in the implementation and supervision of planning through legal procedures and channels, and establish a good environment in which all participate in the implementation of planning and act abiding by the planning.

4.5 Economic and socially favorable factors to the mixed use of land

4.5.1 Urban economic development will increase the land development intensity and absorb more people and trades

(1) The overall economic strength of Shanghai has increased, which provides a nice foundation for urban rebirth, new town development, and infrastructure improvement. Increases in people's income and the upgrading of their payment level, coupled with investment from surrounding areas or foreign countries, have provided energies for urban development activities;

(2) The development of the tertiary industry in downtown areas has brought many employment opportunities; continuous improvement of the environment will add to the vitality and attraction of downtown areas and result in a high concentration of building and population density;

(3) The increasing maturity of the urban real-estate market and the guiding role of the government conduce to the intensive use of the land; competitions in commercial services of old urban areas become more fierce, facilities of all kinds are close to consumers, and there are many supermarkets and convenience shops in densely-populated areas.

4.5.2 The Ageing of the city and the cultural manners of different regions will further influence the resident's demand for urban functions

(1) Because of living habits and surrounding service facilities available, Shanghai residents prefer to live in downtown areas;

(2) Because of the short distance between residential areas and working places and available regular bus, the traveling distance of residents is usually short;

(3) Shanghai now faces the problem of ageing; urban residents have certain demands for the mixed use of land and hope that within their walking range there will be public facilities like primary schools;

4.6 Timing points of view

4.6.1 Total population will continue to increase and be allocated primarily along the major traffic axes and nodes

In recent years, the total population of Shanghai keeps increasing and there are no radical changes in the situation that people live mainly in downtown areas. The range of urban areas is expanding. On one hand, it is necessary to reduce the population density within the inner ring by means of old town reconstruction, building density control and industrial structure adjustment; on the other hand, residential areas must be developed and traffic facilities constructed to direct the newly-increased population to suburban areas, especially rural-urban fringe areas.

In the past 10 years, 1 million people in all are relocated; the population density within the inner ring has obviously decreased. Due to the increasing difficulties in reconstruction and relocation, the process of governmental direction will slow down. Problems like social equality and commuting caused by population relocation have caught people's attention.

By relying on various industrial parks, the new cities and towns at all levels will attract more immigrants. The new cities will have to face the higher pressure of infrastructure like public transport, water and power supply, etc. and the public service facilities like schools, hospitals, etc..

4.6.2 The land development intensity will maintain a high level, the degree and rationality of the mixed use of land will be further improved

Currently, Shanghai has a high urban density and also a high land mixture degree. In past years, Shanghai was quite active in development activities and had a huge demand for land. However, the available land resources are relatively limited and there is no effective control on development activities; in the end, the proportion of high-rises increases quickly and the original places occupied by dangerous sheds and factories are turned into office and shop building or public parks. In order to subvert the trend, Shanghai Municipal Government put forward a policy of "dual increases and dual decreases". The development intensity at downtown areas and other areas should be different; the height and the volume of buildings should be limited in a suitable way, and policies on building density should be not so rigid.

As to the urban layout of Shanghai, the mixed use of land is emphasized to reach a balance between employment and residence, reduce the traveling distance and time of residents, and satisfy their diversified demands.

5. Analysis of affecting factors for urban pedestrian system

5.1 Policy and Criterion

In the construction process of the city, the design of pedestrian facilities mainly conforms to state code for *Urban Road Transportation Plan and Design Criterion* (GB 50220—95), which includes:

5.1.1 Fundamental regulations

1. The design of pedestrian transportation system in city should be determined by the flux and the orientation of pedestrian flow. And various effective measures should be adopted respectively according to local conditions, in a bit to satisfy the requirements of the pedestrians, ensure the traffic security and continuity of the pedestrians, The planning of pavements, pedestrian bridge, pedestrian subway, pedestrian street, urban river bank pavement or shade pavement should be tightly connected with the pedestrian system in bus station, passenger terminal squares, urban rest and assembly square, so as to form an intact urban pedestrian system.
2. The pedestrian facility should comply with the requirements of barrier-free transportation.

5.1.2 Pavement, crosswalk, pedestrian bridge and subway passage

1. When facilities such as side trees, bus stations, bus waiting booth are arranged along the pavement, they should not disturb the normal passing of pedestrians.
2. It should be assured that the passing ability of pavement should be calculated according to the actual network width of pavement.
3. The width of pavement should be calculated according to pedestrian flow, the minimum width should be no less than 1.5m. The width of pedestrian path and its passing capacity should be in accordance with the regulations of Table 4.3.20.

Table 4.3.20 The width of the pedestrian belt and its passing capacity

Location	Width (m)	passing capacity(person/h)
On the urban road	0.75	1800
Station, dock, pedestrian bridge and subway passage	0.90	1400

4. On the main and sub-main road of the city, the intervals between crosswalk and subway passage should be 250～300m.

5. When the width of the road exceeds four lanes, the crosswalk should establish a pedestrian refuge island in the central compartment belt of the driving lane or the compartment belt between motor driveway and non-motor driveway.

6. Under one of the following situations, pedestrian bridge or subway passage should be established:

   - The pedestrian flux of a crossing road is more than 5000 persons/h, and at the same time, the car traffic volume is more than 1200 vehicles/h;
   - The pedestrian flux crossing roundabout reaches 18000 persons /h, and at the same time the car traffic entering roundabout 2000 vehicles/h;

7. When the pedestrian crosses expressway:

   - The intersection of rail and urban road will be blocked more than 1000 pedestrians or being closed for more than 15min for the passing of a train.
   - The design for pedestrian bridge or subway passages should comply with the requirements for urban landscape, as well as combines with nearby architectures on or under ground facilities; the entrances of pedestrians or subway passages should establish human flow assembling place, the area of which should be no less than 50 sq.m.

5.1.3 Pedestrian district

1. The intervals of emergent exits in pedestrian street should be no larger than 160m, the density of road network within the district should be 13—18km/sq. km.

2. The road in pedestrian district should satisfy the requirements of passing of goods delivering truck, cleaning truck and fire engines. The width of the road should be 10～l5m, and small squares can be inserted within the district.

3. The area of pedestrian road and square within the pedestrian district can be calculated by 0.8—1.0 person/ sq.m.

4. The distance from pedestrian street to the sub-arterial road of the city should be no more than 200m; the entrances of the pedestrian district to the parking lot of bus should be no more than 100m.

5. There should be large-scaled MV or NMV parking lots or multi-layer parking garage nearby the pedestrian district. The distance to the entrance of pedestrian district should be no less than 100m and no more than 200m.

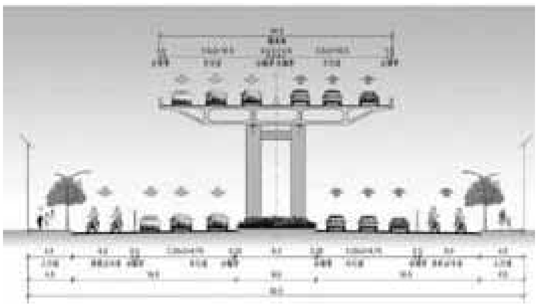
5.1.4 Pedestrian design standard for residential district

The roads within residential district should be designed in accordance with state code for Urban Residential District Plan Design Standard(2002 edition), among which, pedestrian road has been considered as part of the road system. To avoiding motor vehicle disturbing pedestrians is a basic principle in the residential district design.

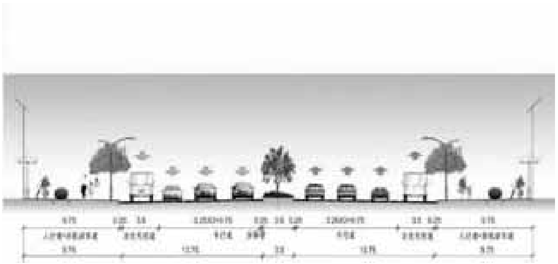
1. Roads within residential district can be divided into: residential roads, community roads, group roads and inter-house roads. The width of the roads should conform to the following regulations:
   - Residential road: the width of red line should be no less than 20m;
   - Community road: the width of road should be 6m-9m,
   - Group road: the width of road should be 3m-5m;
   - Inter-house road: the width of road should be no less than 2.5m;
2. Road within residential districts should conform to the following specifications:
   - The main roads within the community should have at least two exits and entrances; the main roads within the residential district should connected with the outer roads in at least two directions; the motor vehicle road's entrance and exit to the outer space should be at least 150m separately;
   - In the public activity center of the residential district where there should be barrier-free passage for the disabled.
   - If the terrain slope of the residential district is larger than 8%, it should be assisted with ladders to solve vertical transportation. And the slope for bike should be established along the ladder.

5.1.5 Road hierarchy

The urban road can be divided into freeway road, main road (arterial), sub main road (sub-arterial) and branches. The typical section of these four types of roads is as follows.

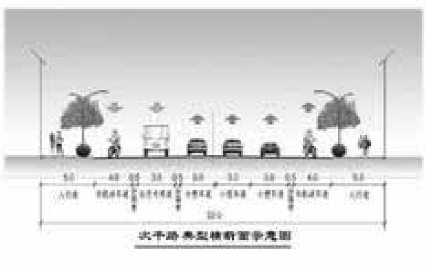


Section of Freeway



Section of Main Road

Section of Sub Main Road



Section of Branch Road

Figure 4.3.27 road hierarchy

Figure 4.3.28 road near Zhongyuan block with bike lane

Figure 4.3.29 road near Zhongyuan block , parking with bike

Figure 4.3.30 road near Luwan block, pedestrian way

Figure 4.3.31 Road near Babaiban block, with bus stop shelf

Figure 4.3.32 Road in Jiading district, with trees

All the road in Shanghai road reserve spaces for pedestrian .But because of the noise and pollution of the freeway and main road, the pedestrian condition is not so good comparing with sub main road and branch road.

5.2 Stakeholders involving

In China, urban road construction department is different in different provinces. The pedestrian road in Chinese cities is the composing section of urban road. The pedestrian facilities such as pavements, crossing bridge and subway passage are the appertain facility of urban road. urban pedestrian system plan is diffused in other kind of specialized plan (such as resident area plan, urban design for the center of the city), which results in the discontinuity of pedestrian system or the ignorance of the road using right of pedestrians in the distribution of road using right.

5.2.1 The construction and implementation of pedestrian system

1) The construction and implementation of urban pedestrian road

As mentioned above, the planning and implementation of urban comprehensive transportation should be charged by urban construction and transportation committee. In the comprehensive transportation plan, however, the specialized planning for urban pedestrian system will not be done but will provide some broad guideline. The setting plan for the urban pedestrian facility is usually determined in detailed plan, or in further urban design. As for the approving of detailed plan and urban design project, all are charged by the plan bureau of various districts and counties except some important areas (such as Lujiazui business zone and the two sides of Century Ave.

The construction of pedestrian facilities is usually charged by Shanghai Municipal Engineering Bureau, which is an underlining unit of urban construction and transportation committee. It takes charge of the construction of urban municipal facilities, which include the maintenance of pavement along the street, street bridge and subway passage, as well as the pedestrian facilities.

2) Pedestrian transportation management facility

The setting and management of crosswalk marking and signal should be taken charge of by traffic police departments.

5.2.2 The maintenance facilities on pavements

To satisfy the daily requirements of the citizens, , facilities are established, such as books and newspaper booth, bicycle repairing point and bicycle parking lots. For example, the books and newspaper booths all over the city are established by special companies. As for the position of the books and newspaper booth, Shanghai Urban Planning Bureau constitutes Guidance for the Distribution Principle of Oriental Books and Newspaper Booth. I The set up of booths in the pedestrian passage of pavement and public space should ensure that the width of the public passage is no less than 3 meters. The distance between the booths with the pedestrian bridge should be no less than 15 meters.

Figure 4.3.33 books and newspaper booth

Figure 4.3.34 bicycle parking lots

5.3 Implement condition

Several case will be presented here to show the implementation, which including: Babaiban Block is located in the downtown area of the city; Zhongyuan Block is located outside the central ring roads; Jiading Block is a new satellite town.

5.3.1 Location of the three blocks

1) Babaiban block

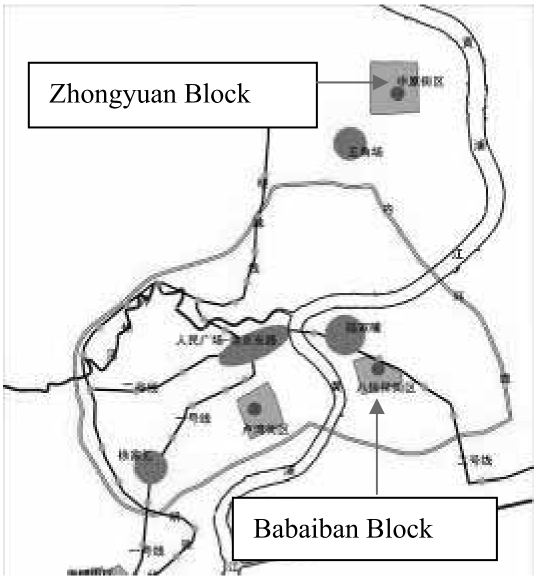


Figure 4.3.35 Location of the Zhongyuan Block and Babaiban Block

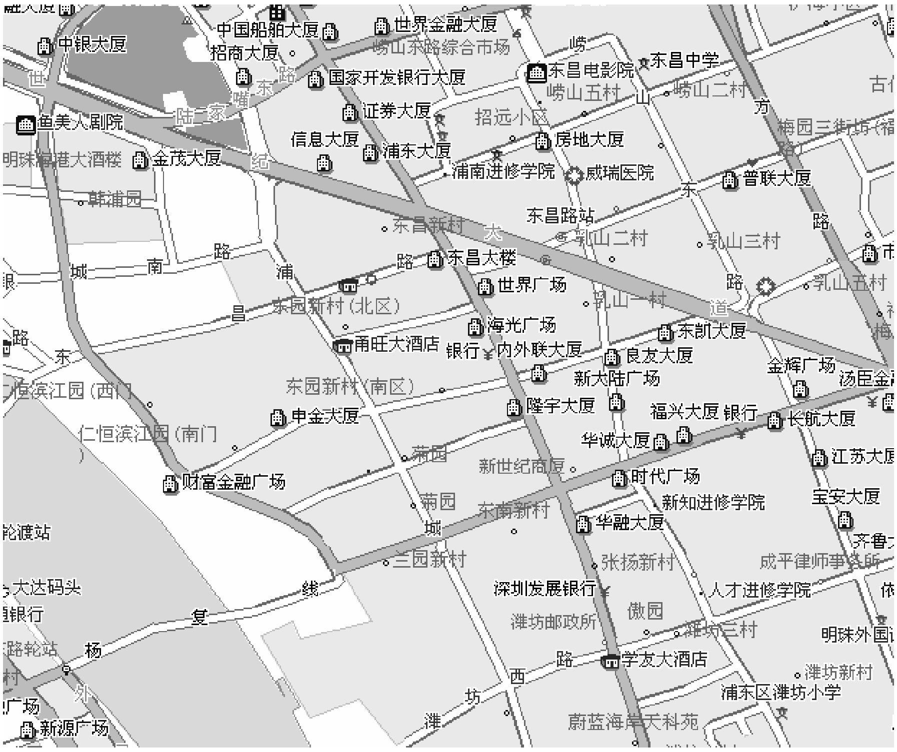


Figure 4.3.36 Babaiban road net

Babaiban Block is a new area emerged in the 1990s. It has been positioned as a large commercial block with all kinds of commercial establishments, such as Shanghai No.1 Yaohan, Time Square, New Shanghai Shopping City, Hualian Commercial Building Household Appliances City, Yongle Household Appliances New Continent Plaza Store, Oriental Bookstore, etc., and provides convenient commercial service for local residents and the people living in the Pudong New District and the neighbourhood.

2) Zhongyuan block

Figure 4.3.37 Zhongyuan road net

Zhongyuan Block is located in the northeast of the downtown area of the city emerged in the 1980s and the 1990s. It is situated at the edge of the city and in the midst of the inner ring and the out ring, about 11.5km away from the People's Square. It is an important component part of the Wujiaochang Sub-region, and it is composed of five new villages, namely Gongnong, Minxing, Shiguang, Kailu and Guohe.

Zhongyuan Block is an important residential area in the Yangpu District. The construction project of the Urban Rail Line 8 will greatly promote the development of Zhongyuan Block. It will actively readjust the land of use, coordinate with the establishment of the Wujiaochang Urban Sub-centre and build a large comprehensive commercial establishment oriented to the whole city.

Zhongyuan Block's land distribution is of apparently circle mode. The central area is used for residence, whereas the outlying area is used for industry, storage and municipal administration. The land use is of a large scale and obvious zoning. Moreover, the residential area has unitary function and lacks service facilities. Thus, people's sphere of activity is relatively large, that is to say, people have to undergo the long trip distance in order to reach their destination.

3) Jiading district

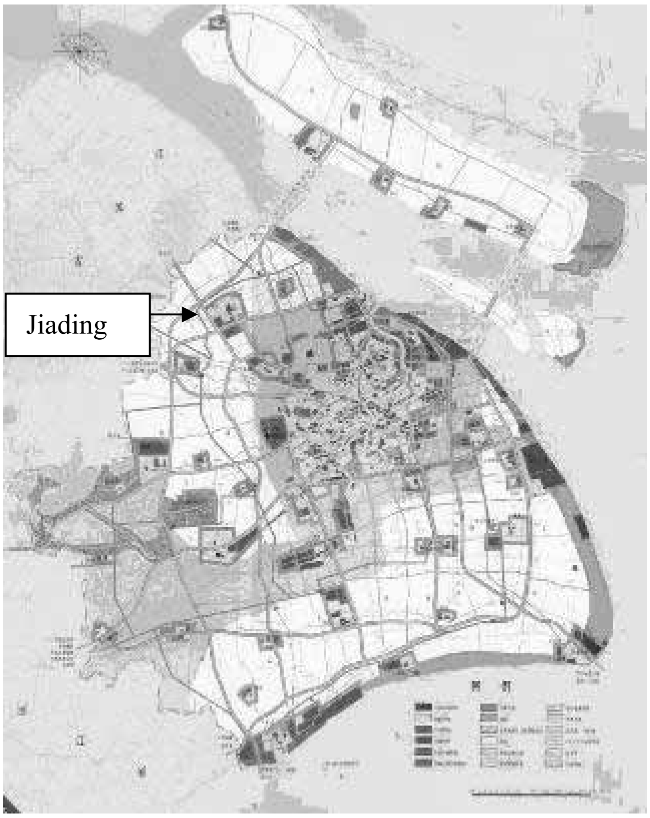


Figure 4.3.38 location of Jiading

Figure 4.3.39 Jiading road net

Jiading District is located in the northwest suburb of the city. It is a modernized comprehensive industrial city mainly specializing in automobile industry and allied industry for automobile industry, and it is also a central town in the west of the city. It borders Hu-Ning Highway in the south, connects with Jiangsu province in the west and belongs to Jiading District in the north. It is 32km away from the downtown area of Shanghai and 20km away form Shanghai Hongqiao Airport.

Jiading District is a newly developed area with a large scale of land use and obvious functional zoning. As the local land price is cheaper than downtown area, its building density is low, and the mixed use of land is unobvious.

5.3.2 Status quo of land use

Land use within 2Km radius has especially important influence to the daily activities of the people and their choice of travel mode.

1) Babaiban block

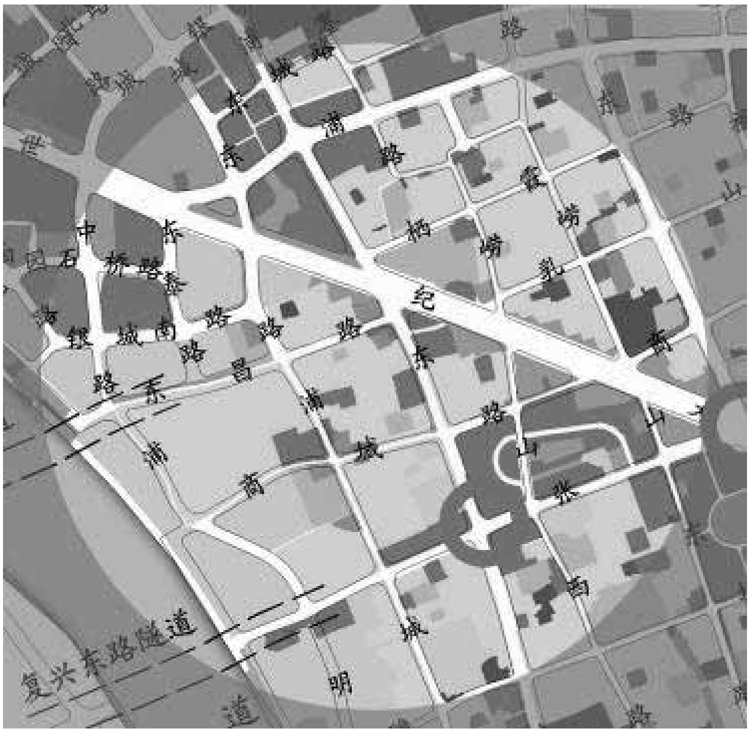


Figure 4.3.40 Sketch Map of the Land Use Status Quo of Babaiban Block

On both sides of the Century Avenue there are a lot of large office buildings and commercial establishments. Thus, in the land use composition of Babaiban Block, the land used for administration and office and the land used for commerce occupy a large proportion. The high ratio of land used for commerce provides the residential area inside the Babaiban Block with favourable living service conditions. As the large office buildings and commercial establishments are centralized, the urban block design pursues the large scale and high grade in overall image, and the whole block is in large scale.

There are business office buildings and huge business facilities along the two sides of the Century Ave, so in the composing of the land, the proportion of these two kinds of land is relatively high. Along the Huangpu River are some industrial storage land and the sum of these two kinds of land accounts for more than 15%.

The large-scale development of Babaiban Block began from the 1990s. The design of urban block pursues large-scale, high-rank. The scale of the whole block is relatively large. The road design seeks “big block, wide road”, in a bit to suit the quick and high efficient travel of the car, which in turn ignores the demand of pedestrian and bicycle.

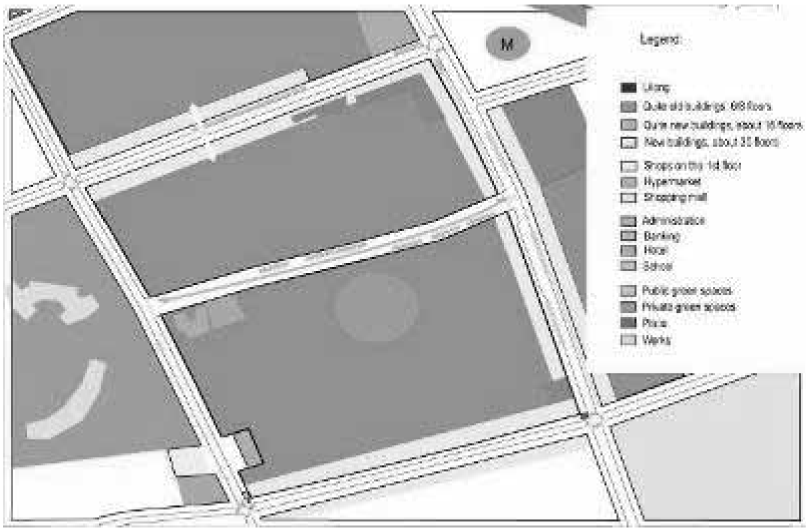


Figure 4.3.41 Babaiban Block land use

2) Zhongyuan block

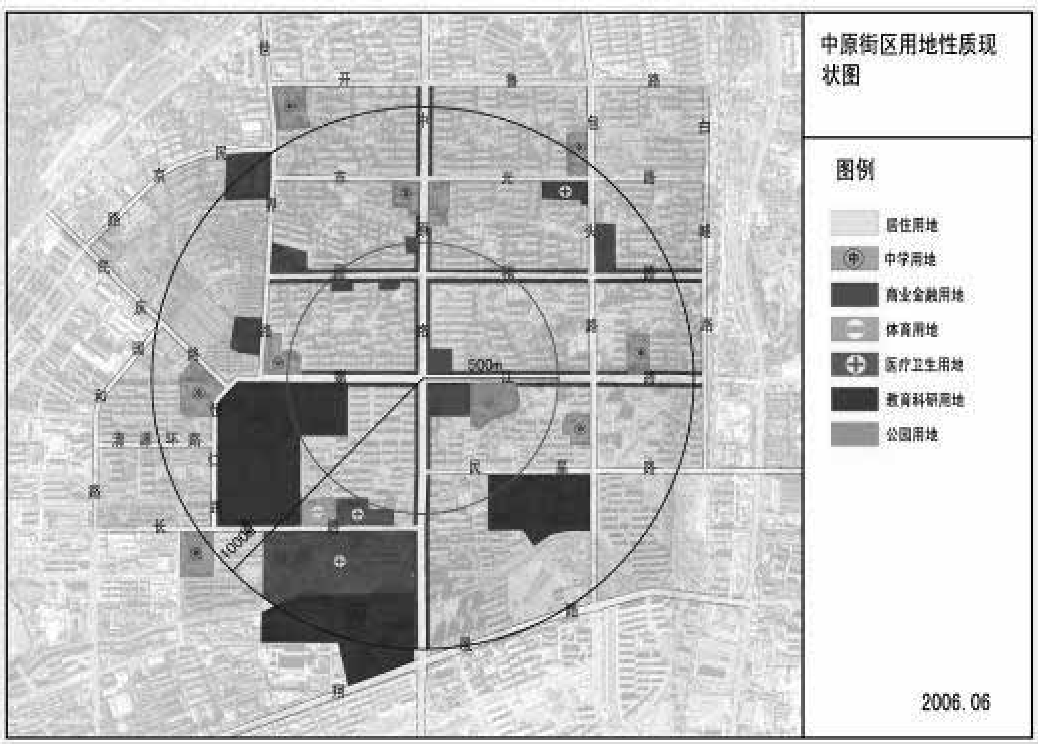


Figure 4.3.42 Sketch Map of the Land Use Status Quo of Zhongyuan Block

The design of the residential area adopts the mode of “residential area – uptown – combined layout”. Basically, they are five to six-storied housing buildings; It is equipped with sufficient separate public service facilities that can meet people’s daily needs.

The local land is of obviously mixed distribution pattern. Normally, the distance between the residential area and the shopping centre, hospital, school is less than 1,000m. This is a favourable condition for short-distance transport. One can reach their destination either by bike or on foot.

The land arrangement of the block presents obvious circle mode. The central residential area is for living. And the periphery is for industry, storage and municipal utility. The scope of the block is relatively large. Furthermore, within the residential area, the function is unified and the service facilities are not sufficient. Therefore, for some purpose people still have to travel longer distance.

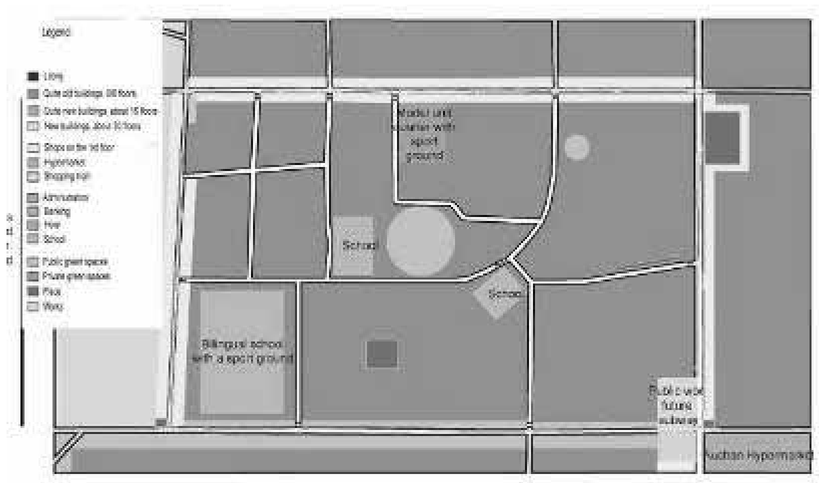


Figure 4.3.43 Zhongyuan Block Land Use

3) Jiading district

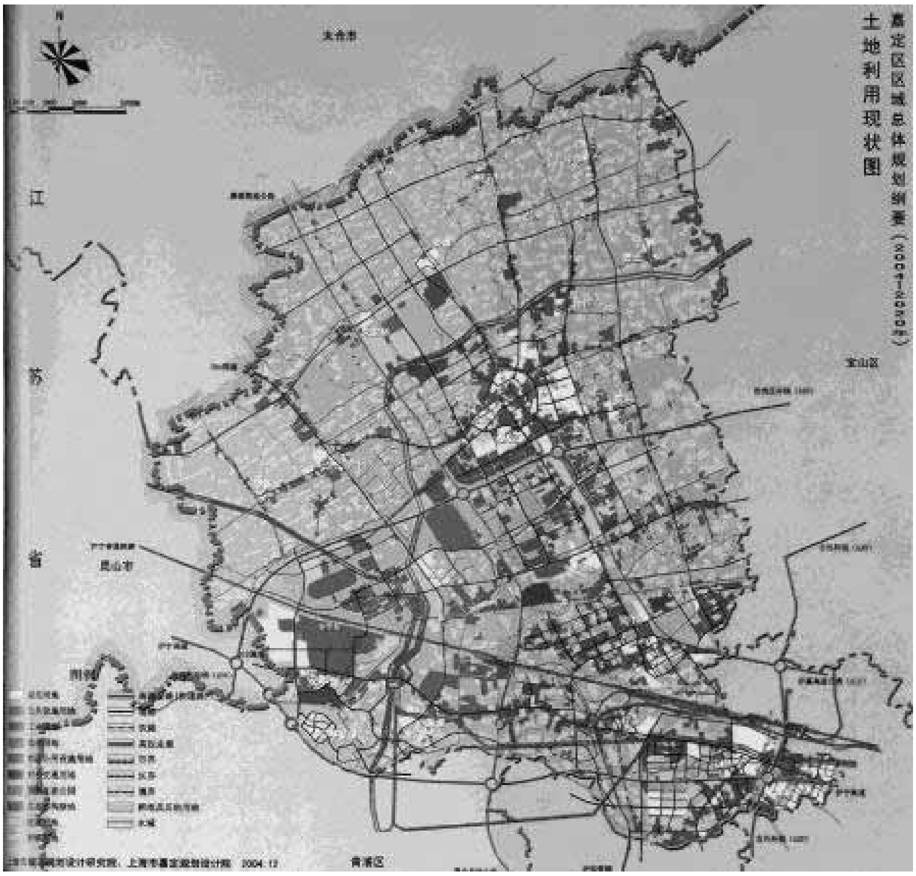


Figure 4.3.44, 4.3.45 The figure above is status quo of land use in Jiading

In Jiading, most of the land use for resident, only in south of part there are some industrial land.

In Jiading the land use mode is singleness, and the scale is more large than the other districts, the photos can show the condition.

Figure 4.3.46 In the old town building density is high.

Figure 4.3.47 The river side is not designed to recreation

Figure 4.3.48 The transformation of the old city transit facilities

Figure 4.3.49 In the new area the building scale is big.

Figure 4.3.50 In the new area the building density is low.

Figure 4.3.51 Building density is low, land use mode is singleness.

Figure 4.3.52 In the new area the utilization of town pedestrian way is low.

Figure 4.3.53 Pedestrian cross the road is difficult because of the too wide road and fast traffic passing through

Figure 4.3.54 This is the new development in Anting, because of it is far away to urban centre, there are few resident in the it.

Figure 4.3.55 As a new regional development, Jiading environment is good.

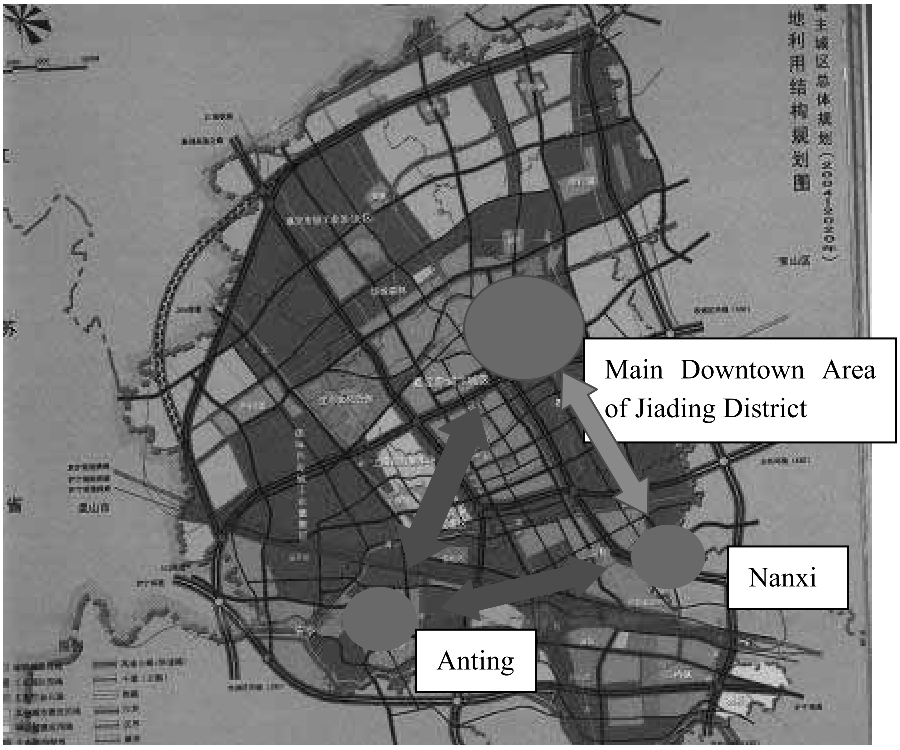


Figure 4.3.56 relationship of the three area of Jiading

Planning for Jiading

The downtown area is the main body and core of Jiading New City. Focusing on modern service industry, world-class sport and leisure industry and high-tech industry, it becomes a modernized urban area with distinguishing cultural charm and city characteristic, strong cohesion force and sustainable innovative power, and it is a full embodiment of traditional culture, modern civilization, sports, leisure and ecology.

Driven by the construction of the core area of Shanghai International Auto City and Jiading New City's external transport pivot, aiming at becoming one of the most important auto industrial bases in China, Anting is a modernized urban area with the distinguishing feature of the suburbs of the city, unique style, complete supporting facilities and comfortable living environment.

Featuring largely in modern residence, ancient town and urban industry, Nanxiang is important for the dispersion of the large population in the centre city, and it is a modernized urban area with favourable environment, transport convenience, complete supporting facilities, reasonable use of land and the harmonious combination of traditional and modern landscape.

The development orientation is on the basis of the northern old city area and with the core of the southern regional public activity centre. Construction of the southern regional public activity centre will be the main focus of urban development in the near future. The total area of land used for municipal construction is 63.8km2. Among it, the land used for town construction is 47.8km2. The per capita living area is 95.6m2.

Regional development objective

1. Optimize the functional and spatial connection between each functional blocks, form the comprehensive competitive force of the city and build Jiading into a combined type city with reasonable functional layout and highly efficient operation system.

2. Rely upon the construction of the large-scale infrastructure and public activity centre, form the perfect urban functional structure and adapt to the functional requirement of regional public activity centre.
3. Form the comprehensive industrial manufacture system guided by auto industry, as well as the modern service industry system and the modern commerce trade logistics system oriented to the regions.
4. In combination with the sport and leisure industry with the main body of Formular-1 Event, and the modern urban commercial service industry, utilizing the historical and cultural resource of Jiading. By relying upon the modern urban public activity centre system, develop the distinctive tourism industry.
5. Coordinate with the expressway, rail transport and BRT public traffic system, etc., form regional and intercity convenient, highly efficient transportation system.
6. Set up the modern education and scientific research system adapting to the trend of knowledge-based economy and conforming to the requirement of technological innovation.
7. Form the ecological environment with the harmonious existence of mankind and nature, and create the favourable urban landscape environment for production, living, tourism and recreation.

Regional development scale

1. Population Scale

   By 2020, Jiading District's total population will be 1.25 million. Among it, the urban population is 1.15 million, the urbanization ratio is 92%. The total population outside Shanghai Outring is 1.15 million. Among it, the urban population is 1.05 million, the urbanization ratio is 91.3%.

2. Land Use

   By 2020, the total area of land used for urban construction is about 210km2.

   The relatively low price of land and the dispersed distribution structure result in the incompactness of land use and the low building density. What's more, It lacks the complete community service facilities in comparison with the above two mentioned blocks.

Example of Jiading land use

Figure 4.3.57 the plan of a new residential area

The residential in Jiading, the planned total number of 245 households. The FAR is 1.8 with green area rate of 38.5%, which is difficult to achieve in the Shanghai urban center. Meanwhile provide a parking spaces on ground and underground for each household.

5.3.3 Present situation of road traffic

1) Present situation of road traffic of Babaiban block

Public transport is an important indicator for road transport facility. The high level of construction of the public transport facility provides people with the possibility of selecting the most appropriate means of transportation. Babaiban Block has complete transport facilities and renders high-level public transport service. Merely take he Babaiban Station at the Pudong South Road for example, there are many buses bound for 21 routes. In the meantime, Metro Line 2, 4 also set the station at Babaiban Block.

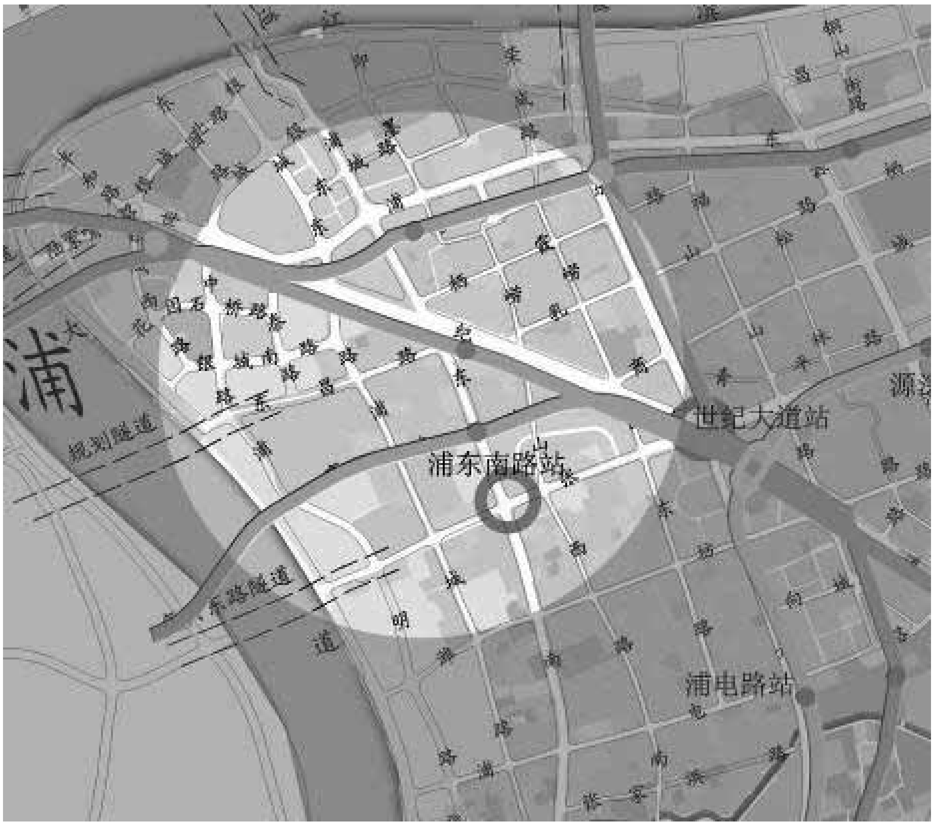


Figure 4.3.58 Rail Traffic Map of Babaiban Block

The road net density and the road area density are also two important indicators for evaluating the urban road traffic facility. Both indicate the wide space for people, vehicles. However, few can be seen on the street, it means that Babaiban Block's road net density and road area density is not very favourable, which is caused by the large building scale and the wide street to a great extent, so generally speaking, its accessibility is not very optimistic.

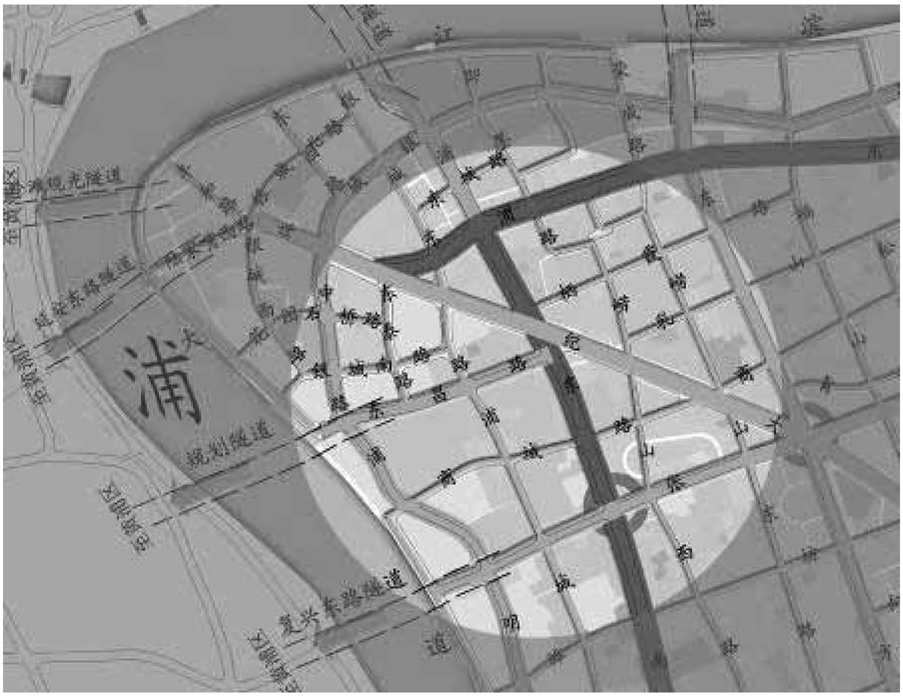


Figure 4.3.59 Road System Diagram of Babaiban Block

2) Road traffic analysis of Zhongyuan block

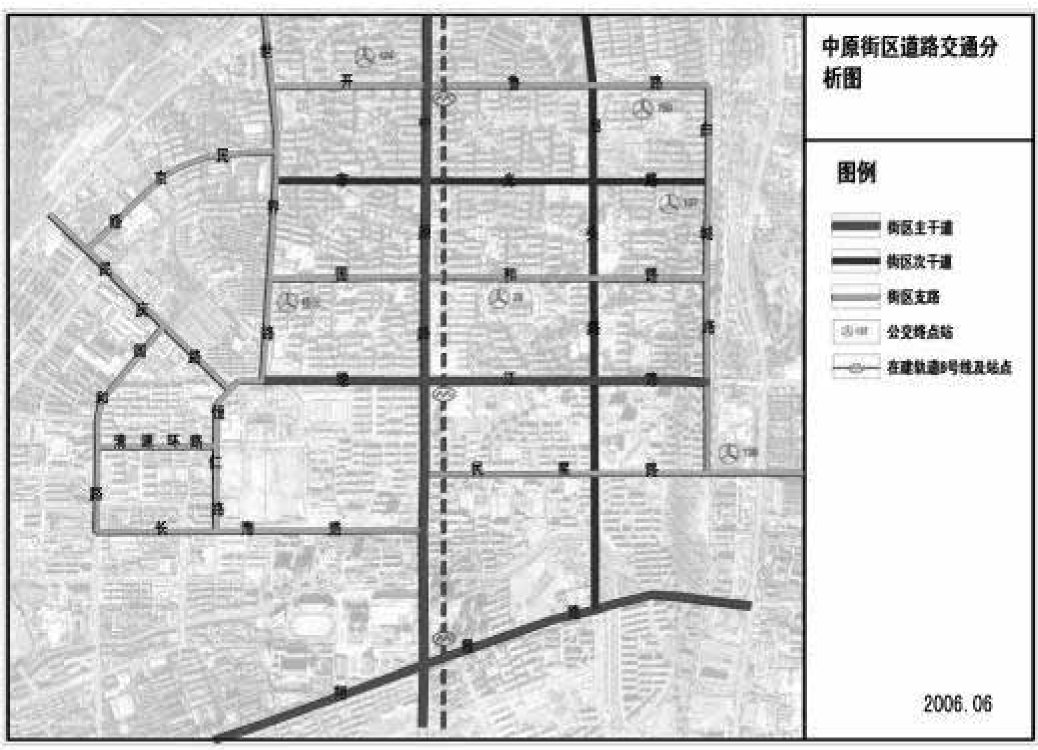


Figure 4.3.60 Map of Road network of Zhongyuan District

Zhongyuan Block's road net structure is basically of grid. All roads are allocated in three levels, which are main road, secondary main road and branch road. The red-line width is 30m to 40m, 20m to 30m, 15m to 20m separately.

Generally speaking, Zhongyuan Block has favourable transport conditions and developed public transport system. It is a full embodiment of the policy of giving priority to the development of public transport. The construction of Metro Line 8 will greatly improve the local people's travel conditions.

3) Present situation of road network of Jiading district

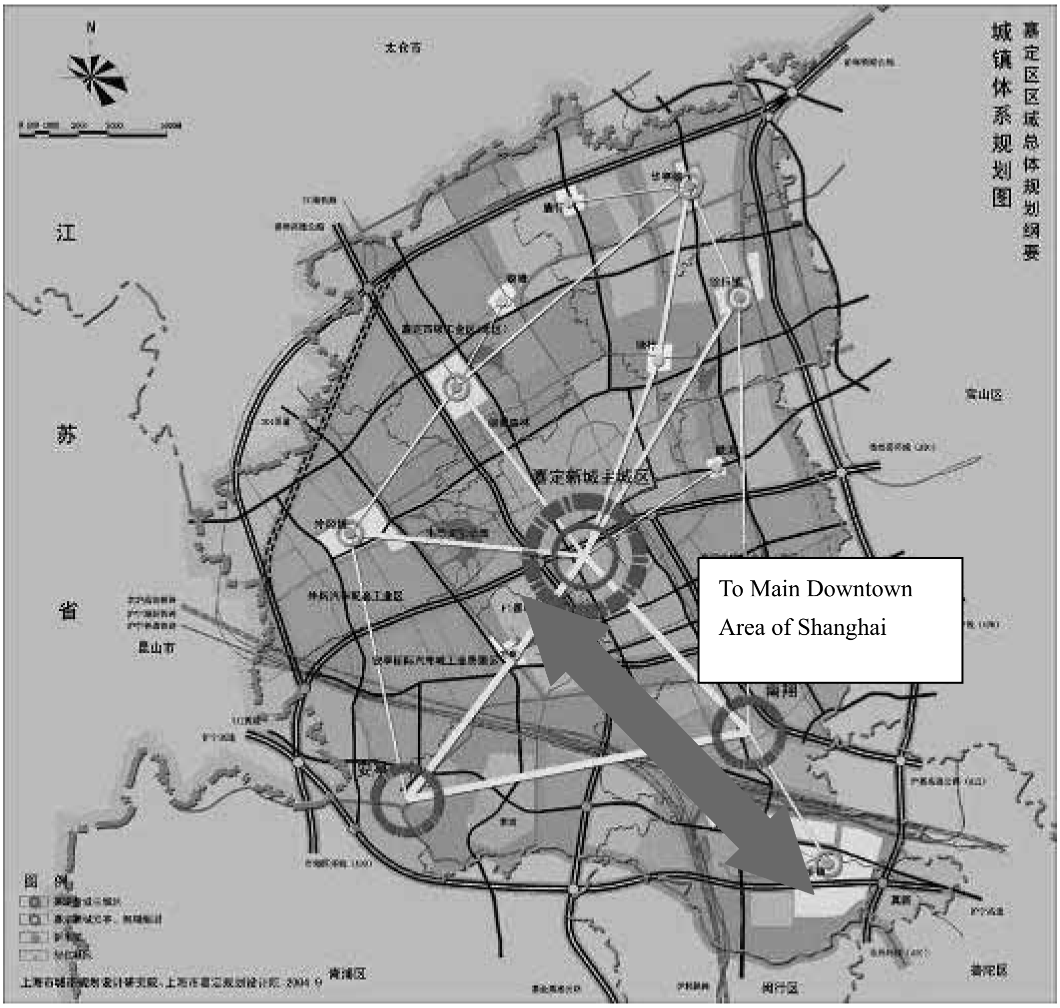


Figure 4.3.61 Analytic Map of Road Traffic of Zhongyuan District

Inside the downtown area, it has formed the main road system with "two main roads in length and two main roads in breadth"; the main road system of "three breadthways and four lengthways"; the secondary main road system of "seven breadthways and four lengthways", plus a lot of branch roads. The total length of the planned road in the downtown area of Jiading new city is 473km.

Jiading connects Shanghai via Hu-Jia Highway. It connects with the surrounding areas via the suburb ring roads, Hu-Ning Highway corridor passing through Jiading.

5.3.4 The construction situation of pedestrian facilities

The downtown area of Shanghai and the main roads with large flux have street bridge or subway. And other street crossing mode is at grade, which is to set crosswalk marking and traffic signal.

There are subway, overbridge and cross walk in Shanghai. Because of the higher cost of building overbridge and subway, most of them are built in business district.

Figure 4.3.62 Urban pedestrian facilities in Shanghai

1) Pavements

In the development of the city, Shanghai pay great attention to the reconstruction of urban pedestrian environment. In this survey, each block has its characters.

Zhongyuan Block

Jiading Block

Zhongyuan Block

Babaiban Block

2) Crosswalk

The typical crossing facilities is the ground crosswalks.

Zhongyuan Block

Zhongyuan Block

Jiading Block

Babaiban Block

3) Entrance to a residential block

Signs of deceleration, speed limitation, motor vehicle ban are established in the exit and entrance, which limits the traffic volume and speed of the motorized vehicle at the entrance and exit and makes the non motor vehicle and pedestrians more safer.

There is a circumrotated gate in the entrance and exit to a residential block for the using of pedestrians.

Jiading Blcok

Zhongyuan Block

Passageway of house in Jiading Block

Passageway for Pedestrian in Zhongyuan Block

4) Road within the residential area

The road of the entire block adopts the mode of the combination of vehicle and pedestrians. There are no pedestrian pavements along the road, and the vehicles are parked along the road.

Since the main road is bending half-ring shape, the design of other roads also prefer converting shape rather than beeline shape, which can limit the vehicles' speed, benefit the pedestrian and create excellent life atmosphere.

Zhongyuan Block

Zhongyuan Block

Zhongyuan Block

Zhongyuan Block

Zhongyuan Block

5) Bicycle parking

Bicycle parking is insufficient on most roads.

Zhongyuan Block

Jiading Block

Babaiban Block

6) Pedestrian facilities

Usually, entertainment facilities are established along living road, or the road can be established as pedestrian road for leisure life enjoyment. These facilities can become the rest place for the residents. This is a road near Tongji University named Sujiatun Road.

7) Existing problems

Due to historical reason, in the central area of the city, the pavement for pedestrian is not wide enough which result in bike parking disturbing pedestrian.

At the same time, the invading of car on pedestrian path also exists, which hobbles the smoothness of pedestrian. This situation occurs in every block.

5.4 Public reflection

The survey to the residents in the three blocks shows that the satisfying degree of pedestrian convenience is high because service and bus stop is nearby. However, the phenomenon of vehicle's occupation of road in urban center Block is relatively serious for its narrow road, which affects the outgoing of the residents in certain degree. In Babaiban Block, since the construction scope of the block is relatively large, more attention has been paid to motorized vehicles, which increases the pedestrian distance of the residents and lows the satisfying degree of pedestrian environment.

Table 4.3.21 Evaluate the environment and convenience of pedestrian condition

	VERY GOOD	GOOD	NOT BAD	WORSE	WORST
Pedestrian environment	14%	34%	34%	16%	2%
Convenience of pedestrian	20%	52%	18%	9%	2%

Most residents feel Pedestrian environment is good and pedestrian is Convenience.

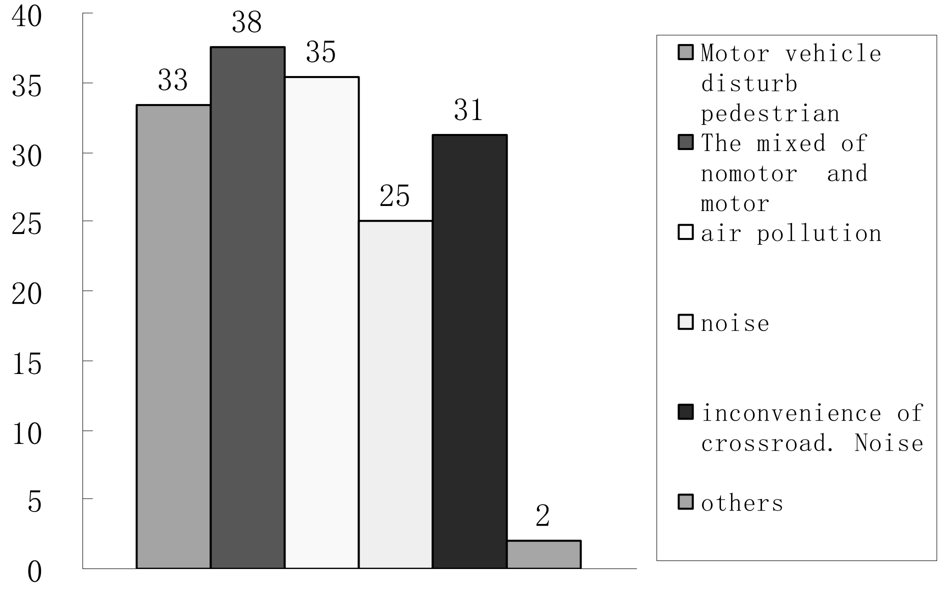


Figure 4.3.63 the reason why pedestrian condition inconvenience

As the figure above, most of response thinks motorized vehicle disturb pedestrian, The mixture of no-motorized and motorized and air pollution others as the main reason of complain.

In the survey, we also find that the pedestrian is not only for commuting, but also for leisure and exercising; it has become a mode of leisure and exercising. Many interviewees think that, compared with other transportation mode, they will choose pedestrian when time is sufficient, since it can achieve the purpose of exercise.

5.5 Economical and social benefits of improving pedestrian environment

5.5.1 Economic factors

1. The developer begins to attach more importance to the providing of comfortable pedestrian environment for the residents in the development of the community, in a bid to increase attraction to the buyer.
2. With the development of the economy, the municipal government can further provide excellent pedestrian public space.
3. The increment of income and the purchase power of the residents will further enhance the choosing ability of the residents, which impulse the developer to pay more attention to the improvement of pedestrian environment.

5.5.2 Social factors

The residents' transportation need has a tendency of developing to multi-mode and multi-level. Pedestrian is not only a mode of commuting, but also a manner of leisure and exercise. In this way, the requirements for the pedestrian environment of the residents become more and more high, which will accelerate the enhancing of pedestrian environment.

5.6 Timing point of views

- Walking as a basic mode of transportation in the past development process in a very long time we have been ignored. Our city has pay more attention to the development of public transport, building roads and bridges to meet the transportation needs of residents.

- Along with economic development and urban construction of the walking environment-oriented city, in the beginning, only some road in city center has been changed to be a pedestrian only road. Now more attention has been paid to the entire city.
- The demand for connecting to public transport by walking will increase to meet day-to-day trip to meet diversity demand, including leisure and health reason. Some on branch road public recreational facilities for pedestrian should be developed. Meanwhile during develop pedestrian facilities, more attention to the coordination of nature, environment and residents.

IV.4 Promoting Reduction in Travel Demand in Transport Sector of Asian Cities: Case of Yokohama, Japan

Noriko Kono[1] and Tomomi Hoshiko[2]

1. Summary of background information

Yokohama is a popular place to live in Japan, with its proximity to Tokyo, its image of modern, cultural, and urban lifestyles, and its abundance of nature. For example, Yokohama ranked 6th at All Japan e-city by the indicators of IT, business, and life standards (2000, Nikkei Business Publications, Inc). Also, it has the world's second largest Chinatown, and its revitalized waterfront, the Minato Mirai 21 district, has the nation's most popular commercial facilities, parks and tourist spots.

The city also boasts healthy economic figures. The citizen income per capita is one of the highest for Japanese cities, and the city's tax revenue is 1.316 trillion yen, the third largest in Japan after Tokyo (6.040 trillion) and Osaka (1.748 trillion yen). Yokohama port is the one of the largest in Japan, and in 2005, the annual number of incoming ships reached 43,400, the largest in Japan, surpassing the Tokyo and Nagoya ports. The amount of trading goods seen in Yokohama port is the second largest (10.5 billion yen), just after Nagoya (12.4 billion yen).

The next section will cover the basic demographic data of the city including population and urban density, and also it looks at the city's transportation conditions including environmental aspects.

1.1 Urban condition

Population

Yokohama has been a bedroom community of Tokyo after WWII and during the 1980s economic boom. The population in Yokohama in 2003 was 3.53 million, and in 1978 the city surpassed Osaka to become the second largest in Japan after Tokyo. The increase in population during the Economic Boom can be seen from the 1960s, although recently is has been leveling off.

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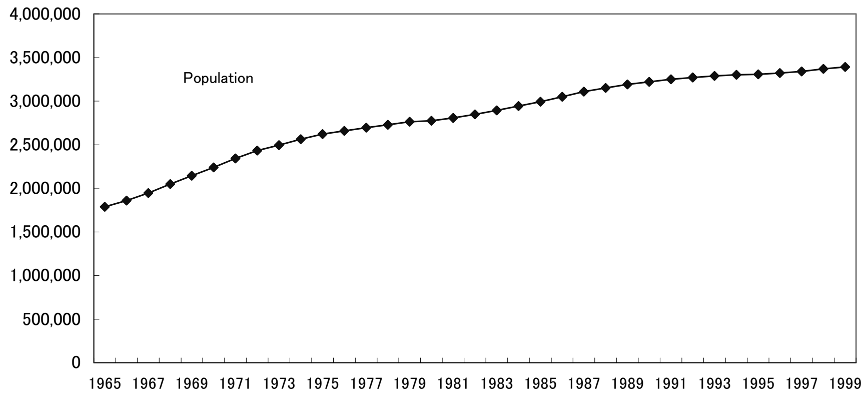


Figure 4.4.1 Population of Yokohama (1965-2000)

The daytime population in Yokohama is much smaller than the nighttime population, compared to other large cities in Japan. For example, Tokyo and Osaka have a 137.5 % and 141.2 % daytime/nighttime population ratio, respectively. However, Yokohama's daytime/nighttime population ratio is only 90.5 %, and other cities smaller than Yokohama have a smaller percentage of daytime population. This fact is unfavorable for a metropolis since it shows it a lack of core activities during the daytime. The local work force most likely commutes to Tokyo, making Yokohama possess the characteristics of a bedroom community.

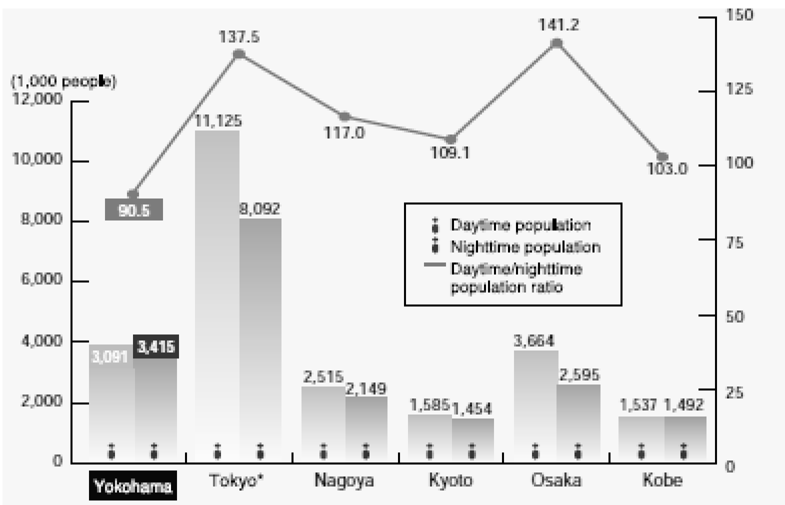


Figure 4.4.2 Daytime/Nighttime population in major Japanese cities

In the city, an aging population is a concern, but not as serious as other areas of Japan. The population in the city is shown in the Figure which shows a trend of the graying of the population. The population of 65-year-olds and above has risen 6.3 times in 35 years, while the population of 15-year-olds and under has remained almost the same. Compared to the "All Japan" figure, the city has a younger population.

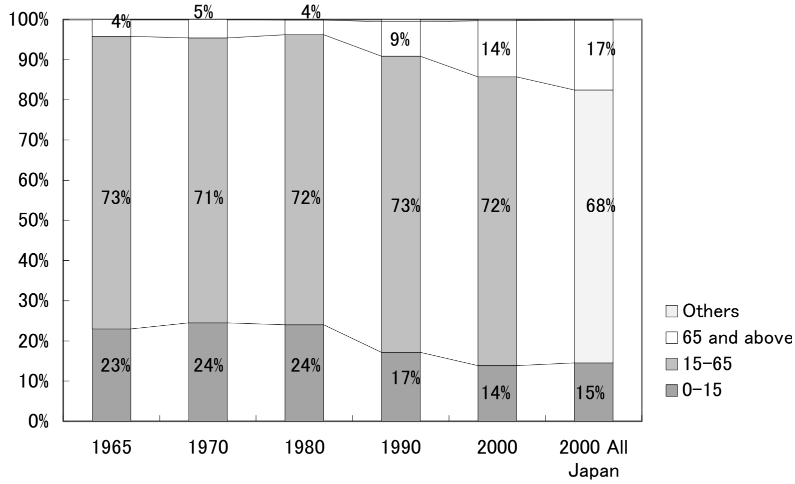


Figure 4.4.3 Rate of population of Yokohama by age

Table 4.4.1 The number of population by age

Age/Year	1965	1970	1980	1990	2000	2000 All Japan
0-15	411,315	547,613	666,549	551,426	474,656	18,472,499
15-65	1,302,221	1,587,300	2,001,333	2,373,769	2,463,151	86,219,631
65 and above	75,379	102,600	102,998	278,000	477,053	22,005,152
Others	-	-	2,794	17,136	11,791	228,561

Source: Metropolitan census 1965-

Trends in citizens' movement

Citizens' movement for the city of Yokohama reflects the large number of commuters to the Tokyo area. The number of trips to Tokyo, the most frequent destination, is more than 600 thousand trips/day. Tokyo is followed by Kawasaki (270,000), Shonan (210,000), and the center part of Kanagawa prefecture (170,000).

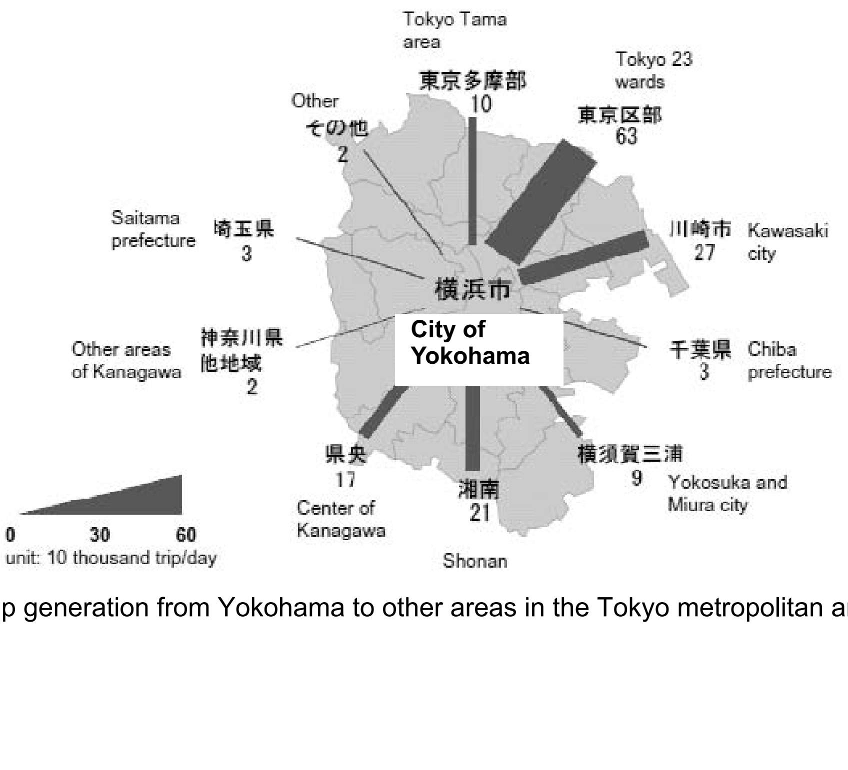
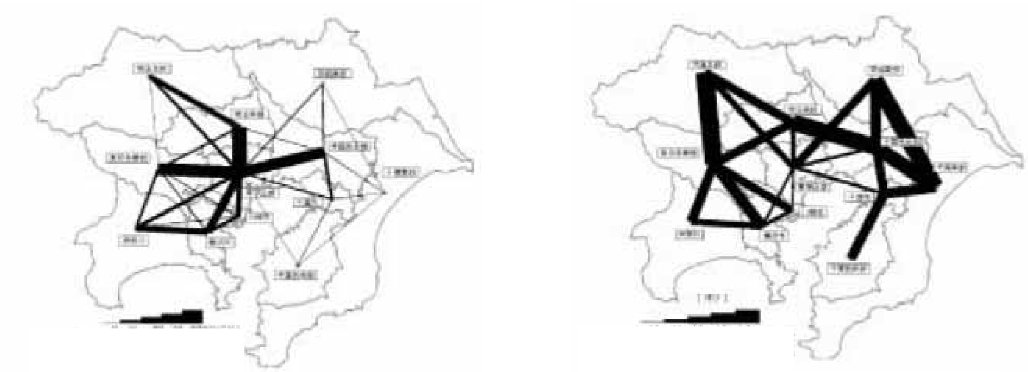


Figure 4.4.4 Trip generation from Yokohama to other areas in the Tokyo metropolitan area

If we look at the overall number of trips in the Tokyo metropolitan area, the number of trips to the area of Tokyo's 23 wards is still the largest (Figure 4.4.5) However, the growth rate in 1998 is larger in suburb to suburb trips—around 130 % and 150 % more. This means that the traditional radiated movement of Tokyo-surrounding areas has shifted to the circular movement of Yokohama, Saitama, and Chiba as they have become important as business hubs. These diagonal and circular trips are not only confined to business trips, but also to more private trips.

Yokohama, as part of the Tokyo metropolitan district, and with a 3.5 million population, needs to have some autonomy as a city. The city of Yokohama needs to be a business hub for the Tokyo metropolitan area with a professional business and service industry.



Trip generation in Tokyo metropolitan area (1998)

Growth of trip in regions 1988-1998

Figure 4.4.5 Trip generation in Tokyo metropolitan area

Source: Tokyo Metropolitan Area trip generation

Old neighborhood and new neighborhood

Yokohama will be divided into two parts for analyzing policies. The 18 wards will be roughly categorized as follows. The separation was decided through the interview with the city official:

- The old neighborhoods include these wards: Tsurumi, Kanagawa, Nishi. Naka, Minami, Isogo, Kanazawa.
- The new neighborhoods include these wards: Aoba, Tsuzuki, Konan, Kohoku, Midori, Asahi, Hodogaya, Seya, Izumi, Totsuka, and Sakae.

Figure 4.4.6 Wards of Yokohama city

Population density

The urban density of the city is shown in Figure 4.4.7. The population has almost doubled and the city is becoming highly populated year by year.

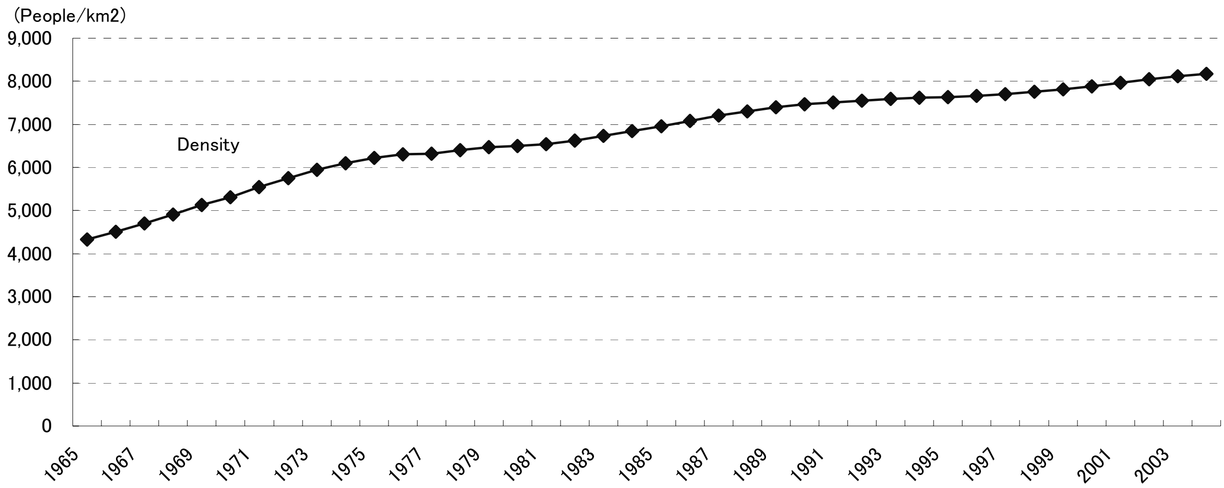


Figure 4.4.7 Urban density (population/ km^2)

Source: Metropolitan census. 1965-.

The densest wards are the Minami-ward (15,306), Konan-ward (11,179), Nishi-ward (10,877), and Hodogaya-ward (9,072). The old neighborhoods have a denser population, averaging 8,440 people per square km^2, while the new neighborhoods average 7,346 people per square km^2. The larger person per household number in new neighborhoods indicates more families with children.

Table 4.4.2 Density by ward

Old neighborhood									
	Area(km2)	Households	Population			Persons per household	Density per km2	Increase	
			Total	Male	Female			Households	Population
Tsurumi	32.38	105,497	250,823	130,909	119,914	2.38	7,746	-27	35
Kanagawa	23.43	91,006	207,280	107,616	99,664	2.28	8,847	34	-83
Nishi	6.98	34,370	75,918	38,579	37,339	2.21	10,877	92	110
Naka	19.44	55,952	118,479	62,015	56,464	2.12	6,095	91	113
Minami	12.63	81,881	193,315	96,895	96,420	2.36	15,306	53	66
Isogo	19.02	66,094	167,773	84,094	83,679	2.54	8,821	-22	-90
Kanazawa	30.66	75,380	206,325	103,341	102,984	2.74	6,729	111	196
	144.54	510,180	1,219,913	623,449	596,464	2	8,440	332	347
New neighborhood									
	Area(km2)	Households	Population			Persons per household	Density per km2	Increase	
			Total	Male	Female			Households	Population
Kohoku	31.37	122,531	284,397	146,552	137,845	2.32	9,066	105	208
Hodogaya	21.8	77,498	197,762	100,095	97,667	2.55	9,072	58	115
Asahi	32.78	91,435	250,425	125,525	124,900	2.74	7,640	77	102
Konan	19.86	80,968	222,007	111,800	110,207	2.74	11,179	78	153
Midori	25.42	54,372	150,093	75,760	74,333	2.76	5,905	41	47
Aoba	35.05	95,583	256,458	130,424	126,034	2.68	7,317	96	256
Tsuzuki	27.89	46,113	132,143	67,614	64,529	2.87	4,738	192	455
Totsuka	35.7	90,518	245,962	124,677	121,285	2.72	6,890	100	95
Sakae	18.55	43,089	120,572	59,748	60,824	2.8	6,500	43	22
Izumi	23.56	48,362	142,887	71,393	71,494	2.95	6,065	74	82
Seya	17.11	43,198	121,015	61,124	59,891	2.8	7,073	58	48
Old neighborho	289.09	793,667	2,123,721	1,074,712	1,049,009	3	7,346	922	1,583

Note: The old neighborhoods include these wards: Kanagawa, Nishi. Naka, Minami, Isogo, Kanazawa, Tsurumi. The new neighborhoods include these wards: Konan, Hodogaya, Totsuka, Sakae, Izumi, Seya, Kohoku, Midori, Asahi, Aoba, and Tsuzuki.

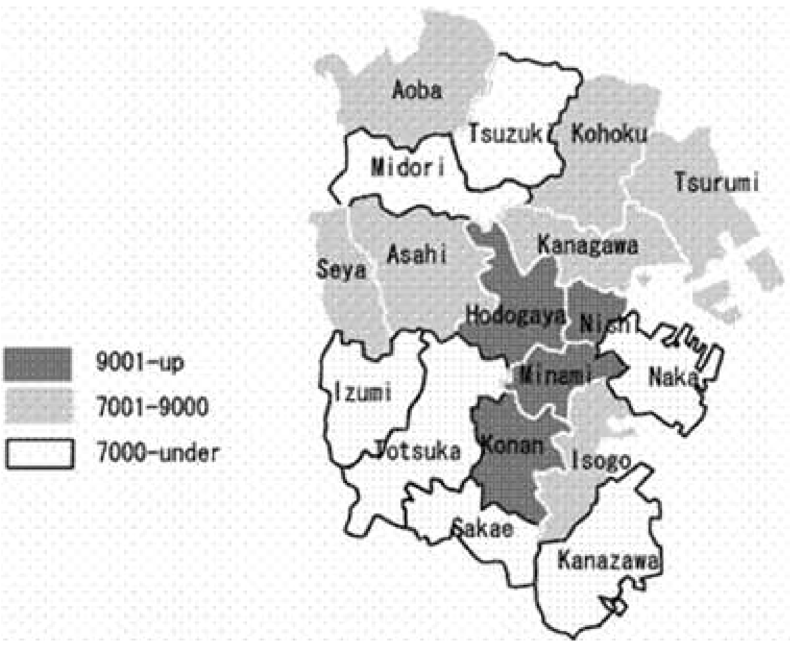


Figure 4.4.8 Density distribution of each ward

Job density

The following table shows that the secondary industry, especially manufacturing is decreasing, while the tertiary industries, such as wholesale & restaurants, real estate, service, and public businesses are increasing.

Table 4.4.3 Shift of number of offices and employees in Yokohama

			(Number of Office)					(Number of Employee)	
	1986	1991	1996	2001		1986	1991	1996	2001
Agriculture	92	77	84	82	Agriculture	617	555	614	680
Forestry	1	1	1	1	Forestry	22	16	4	3
Fishery	1	2	1	0	Fishery	123	14	3	0
Mining	6	2	1	3	Mining	90	38	4	15
Construction	9,515	10,764	11,546	10,482	Construction	107,806	125,755	134,539	108,926
Manufacturing	11,128	11,824	10,289	8,682	Manufacturing	233,007	240,557	200,931	173,487
Electricity, gas, heat & water supply	90	99	97	105	Electricity, gas, heat & water supply	9,071	9,348	8,441	8,096
Transportation & communication	4,486	4,485	4,419	4,098	Transportation & communication	97,619	103,311	108,076	101,236
Wholesale & restaurants	53,071	51,942	52,960	47,791	Wholesale & restaurants	330,488	372,417	427,058	416,612
Finance & insurance	1,712	1,922	1,998	1,739	Finance & insurance	37,129	43,939	41,764	32,462
Real estate	9,298	9,678	9,257	8,568	Real estate	23,984	30,542	32,426	31,071
Service	28,268	31,527	33,897	35,100	Service	265,488	352,201	403,243	442,717
Public business	277	300	334	349	Public business	29,756	30,554	31,390	32,379
All industries	117,945	122,623	124,884	117,000	All industries	1,135,200	1,309,247	1,388,493	1,347,684
			(Rate)					(Rate)	
Agriculture	0.08	0.06	0.07	0.07	Agriculture	0.05	0.04	0.04	0.05
Forestry	0.00	0.00	0.00	0.00	Forestry	0.00	0.00	0.00	0.00
Fishery	0.00	0.00	0.00	0.00	Fishery	0.01	0.00	0.00	0.00
Mining	0.01	0.00	0.00	0.00	Mining	0.01	0.00	0.00	0.00
Construction	8.07	8.78	9.25	8.96	Construction	9.50	9.61	9.69	8.08
Manufacturing	9.43	9.64	8.24	7.42	Manufacturing	20.53	18.37	14.47	12.87
Electricity, gas, heat & water supply	0.08	0.08	0.08	0.09	Electricity, gas, heat & water supply	0.80	0.71	0.61	0.60
Transportation & communication	3.80	3.66	3.54	3.50	Transportation & communication	8.60	7.89	7.78	7.51
Wholesale & restaurants	45.00	42.36	42.41	40.85	Wholesale & restaurants	29.11	28.45	30.76	30.91
Finance & insurance	1.45	1.57	1.60	1.49	Finance & insurance	3.27	3.36	3.01	2.41
Real estate	7.88	7.89	7.41	7.32	Real estate	2.11	2.33	2.34	2.31
Service	23.97	25.71	27.14	30.00	Service	23.39	26.90	29.04	32.85
Public business	0.23	0.24	0.27	0.30	Public business	2.62	2.33	2.26	2.40
All industries	100	100	100	100	All industries	100	100	100	100

Source: Jigyoutoukeisho. 2001.

Land use plan and zoning

During WWII, Yokohama slowed down its development. The population had decreased to 620,000 from 860,000 in 1939, due to the conscription of men and the evacuation of women and children. Because Tokyo was severely damaged with the air raids at the end of WWII, the priority of the redevelopment went to the capital area and Yokohama old downtown still looked like a recently bombed town even 10 years after the war (Tamura 1983).

Developers constructed numerous residential buildings for various social classes in the inner city and the city had only a small business center in the 1960s. Most of the professionals commuted to Tokyo since there was little job availability in Yokohama except for manual labor at waterfront industrial sites (Tamura 1983).

The figures below show the transitions of land use in Yokohama’s coastal area. In 1927 this land use was mostly industrial, as the commercial and residential uses were seen in inner areas.

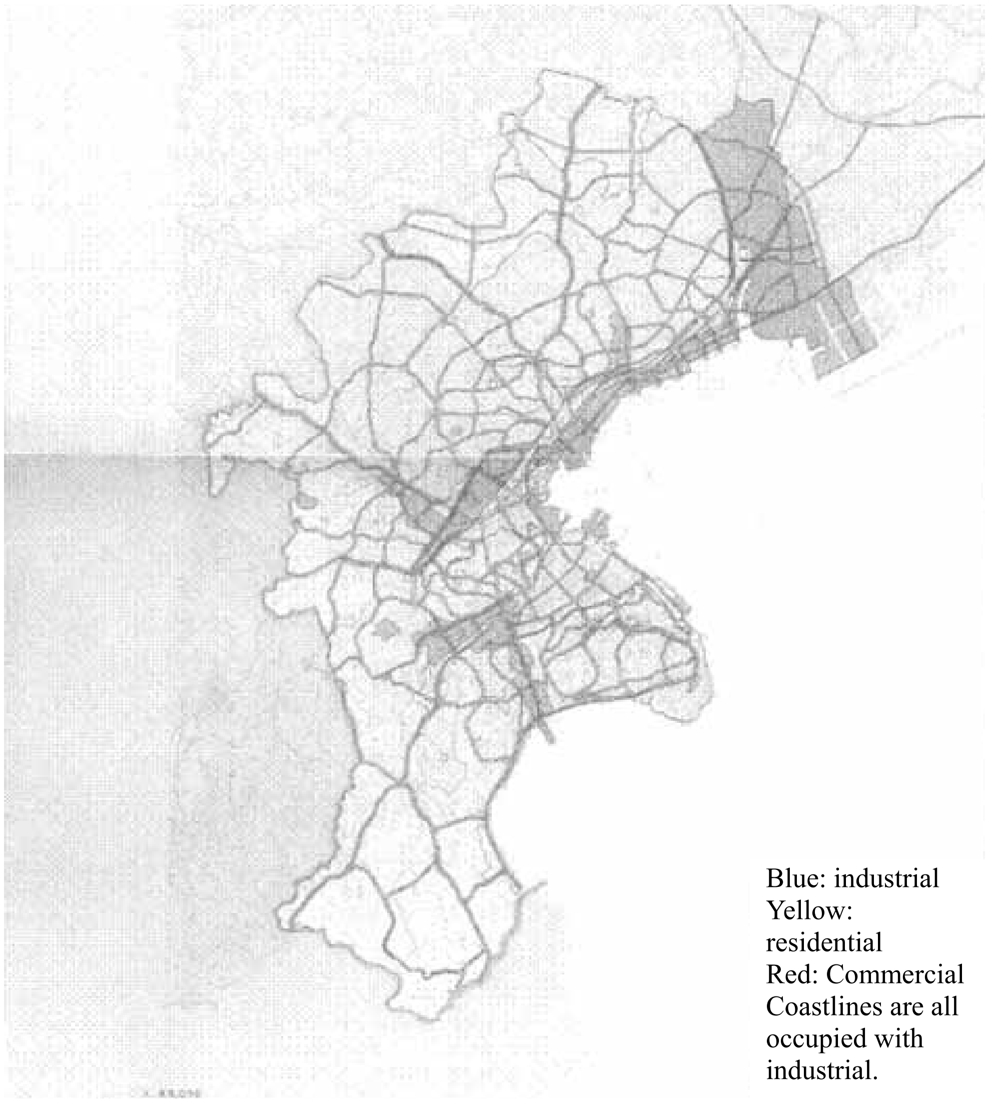
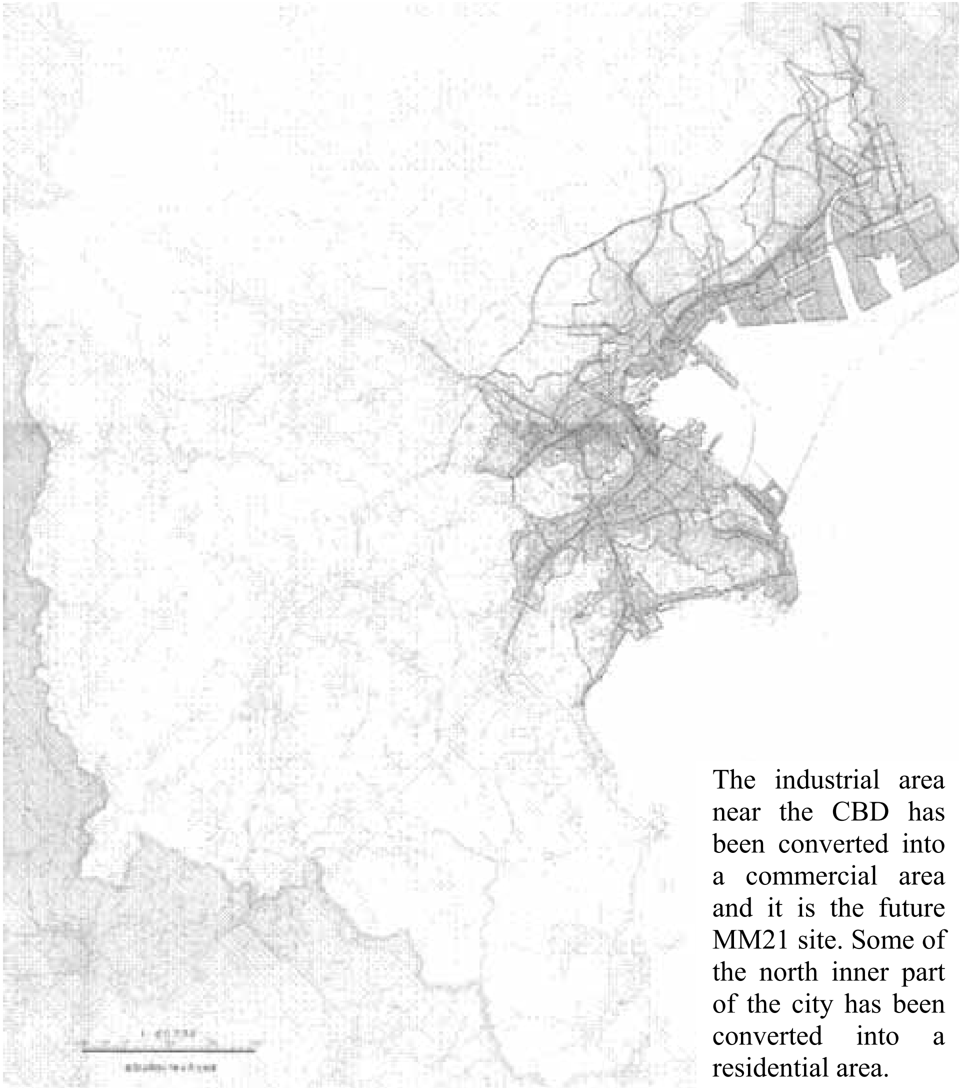


Figure 4.4.9 Yokohama coastal area land use in 1927



The industrial area near the CBD has been converted into a commercial area and it is the future MM21 site. Some of the north inner part of the city has been converted into a residential area.

Figure 4.4.10 Yokohama coastal area land use in 1946

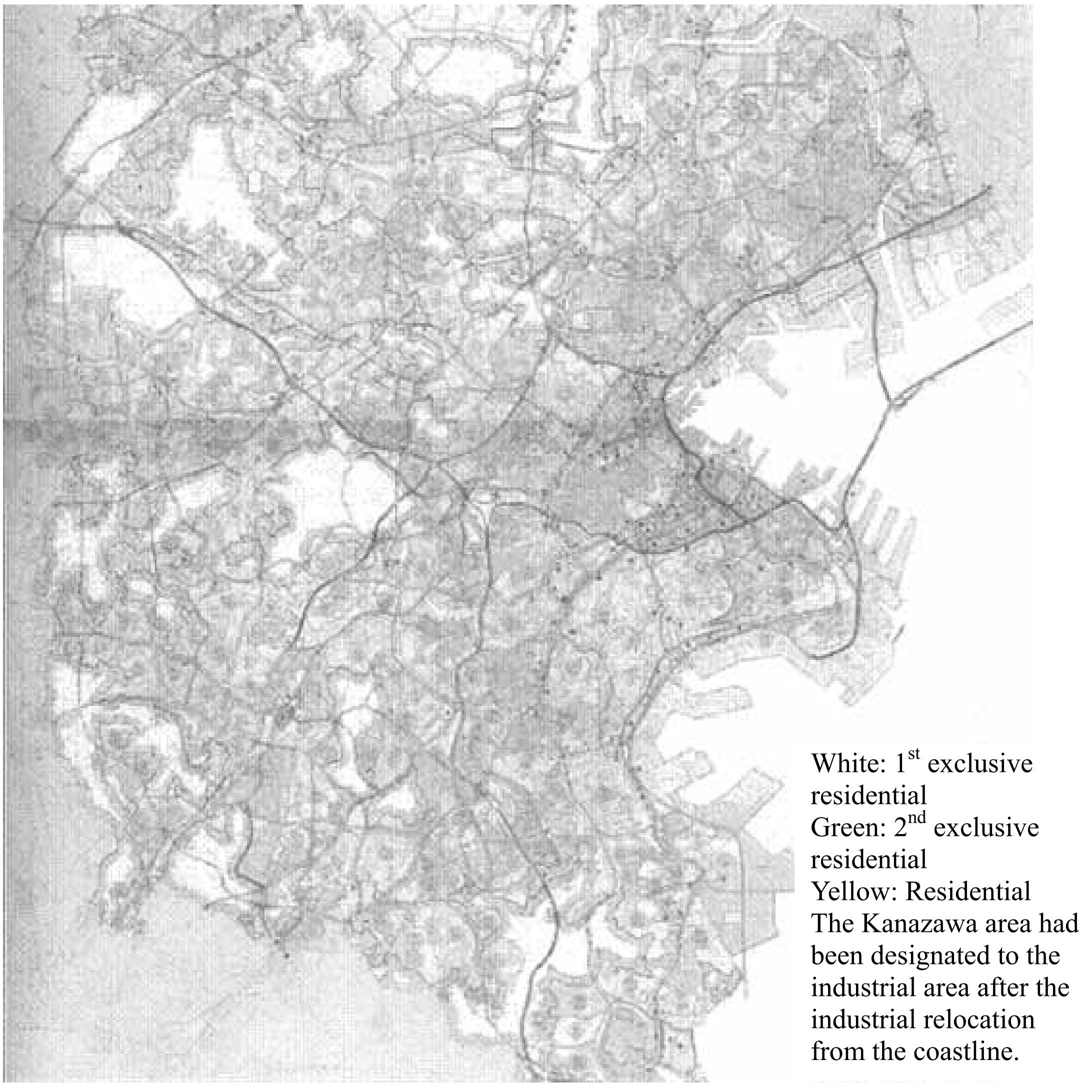


Figure 4.4.11 Yokohama coast area land use in 1980

Planning a business core

In 1965, Yokohama announced a redevelopment plan (Six major projects which included Revitalization of CBD, Creation of Kohoku New Town, Construction of Yokohama Bay Bridge, etc). This was the first attempt for a Japanese municipality to make a concrete, long-term master plan of its own city. The planning of Minato Maria 21, in order to have a CBD independent of Tokyo, was announced at this time and the goal was to have a working population of 190,000 in the area by 2010.

Table 4.4.4 Basic Goal for MM21 Plan

・ **Projected Population**
Work force: 190,000
Residential: 10,000
・**Land Usage**
Buildings
(offices, commercial, and residential sites) 87 ha
Roads and railways: 42 ha
Parks and greenery: 46 ha
Port facilities: 11 ha
Total: 186 ha
・ **Development period**
Fiscal 1983 to 2010
(Land Readjustment <including a 5-year reimbursement period>)

Source: Minato Mirai 21 Corporation

The planned industrial relocation in CBD waterfront area was executed in 1965. The industrial land use in CBD moved to the suburbs in 1983, and this is one of the earliest industrial relocations in the country.

Urban design guidelines

Regarding the historic districts and downtown, registration and accreditation of historical buildings are stipulated in the municipal by-laws. Historical buildings are well reserved and renovated and they are one of the major tourist spots of the old downtown. CBD has been characterized by the "Gentlemen's agreement" for Minato Mirai 21's "Basic Agreement on Town Development Under Minato Mirai 21" since the CBD is emphasizes pedestrian networks. Suburbs in Yokohama are characterized by community plans for each ward, which stipulate the promotion of pedestrian-friendly designs.

Summary on urban condition

The urban condition in Yokohama is characterized by densely populated residential neighborhoods. In particular, the old neighborhood area has a density of more than 8,000 people per square km. The residential neighborhoods have been developed for the commuters to the Tokyo area in the past, and the city is famous for its larger nighttime population than daytime one. However, recently the trend has changed to suburb-to-suburb commuting, a phenomena popular in the developed world. The city's efforts to revitalize the center are slowly making progress, as seen by the industrial relocation and Minato Mirai 21 projects.

1.2 Transportation condition

Fixed rail operation

Yokohama has four railway companies (JR East, Tokyu Railway, Keikyu Railway and Sagami Railway), a municipal subway line and bus networks. The city has two major railway stations: Yokohama Station and Shin-Yokohama Station. All four railway companies and the subway line pass through Yokohama Station, which is located in the city center. Shin-Yokohama Station is located outside of the city center, about 10 minutes from Yokohama Station by the JR Yokohama Line or the municipal subway. The Shinkansen trains (bullet trains) stop at the Shin-Yokohama Station. This following section will discuss the data on transportation including air quality data.

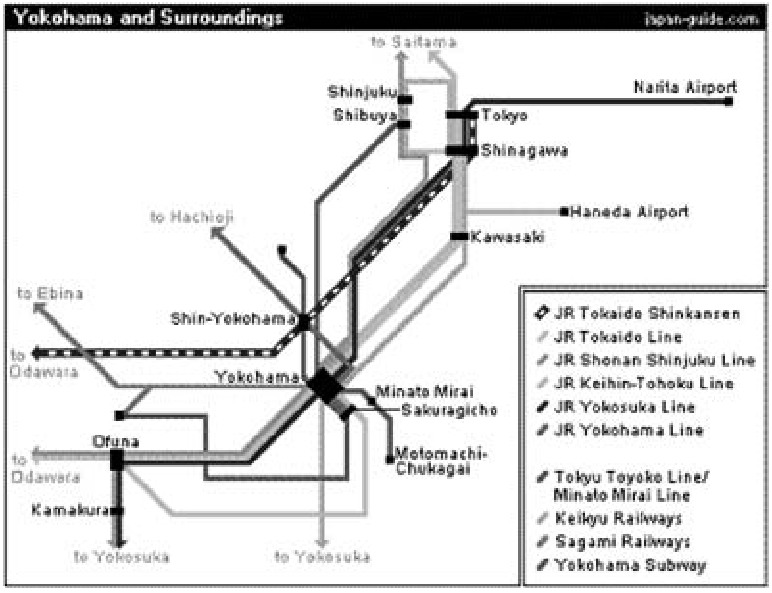


Figure 4.4.12

Source: Japan guide.com (http://www.japan-guide.com/e/e2360.html)

Bus operation

Yokohama's bus operation is unique. The bus companies are both municipal and private. There are seven private bus companies in Yokohama. The buses run in a fixed rate of 210 yen for adults and 110 yen for minors or at a metered rate. The system is very complex. The municipal bus network and railway services are used by 470,000 people daily as a convenient means of public transportation. The municipal bus service includes regular route buses and regular sightseeing buses. The municipal buses include low-floor vehicles, non-step CNG vehicles and also small-sized buses. In 2005, the city announced some of their bus routes would be privatized as some of the public routes had been hugely in debt.

Table 4.4.5 Municipal bus operations

Item		*Busses serving regular routes*	*Sightseeing buses*
Length of operating route		566.3km	40.5km, 27.9km, 34.2km
Number of routes		153	3
Average length of routes		8.6km	-
Number of stops		1,345	-
Number of vehicles		1,002	3
Daily average	Maximum number of vehicles in operation	884	4
	Operation distance	112,198 km	147 km
	Number of passengers	471,114	81

Source: City of Yokohama

1.2.1 Transportation data

Modal split

The "modal split" ratio in Yokohama for each transportation mode is shown in Figure 4.4.12. Railways occupied the largest proportion of modes in 1968, 1978 and 1988. However, the proportion of private vehicles surpassed the railway in 1998. On the other hand, busses and walking have decreased.

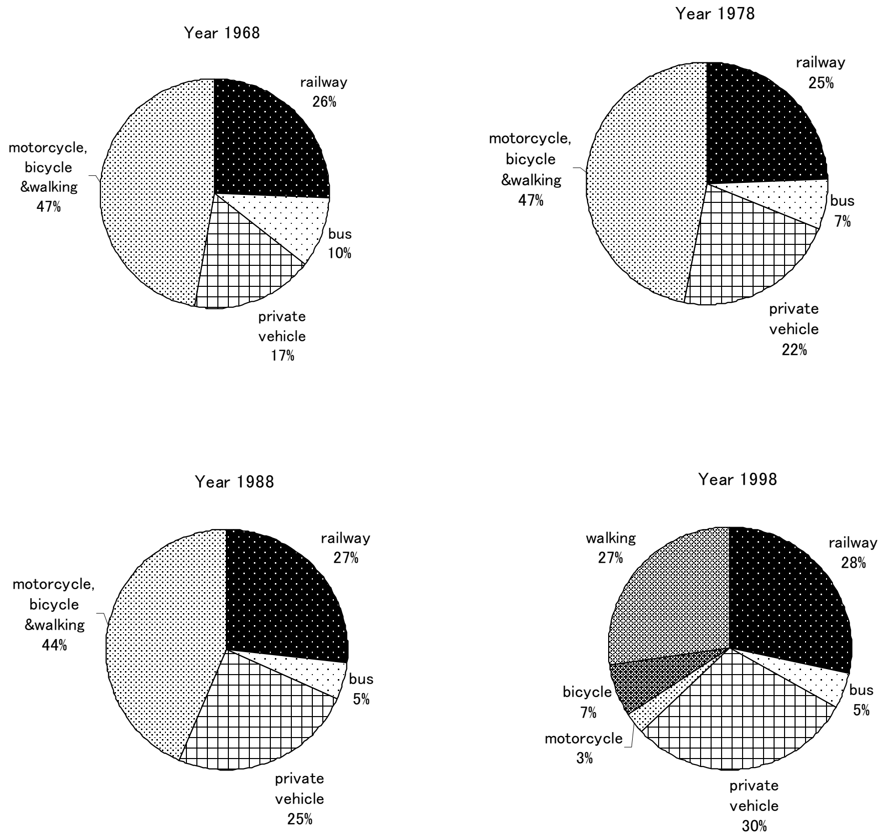


Figure 4.4.13 Modal split in Yokohama in 1998

Source: Yokohama urban development bureau

The modal split of the old neighborhoods and new neighborhoods in Yokohama is shown below. It seems the number of private vehicles in new neighborhoods is much higher than in the old neighborhoods. Private vehicle usage is higher in the new neighborhood and the transit usage (railway and bus) is higher in the old area (38.4%) than the new area (29.2%). Interestingly, walking is higher in the new neighborhood (28.3%) than the old one (25.9%).

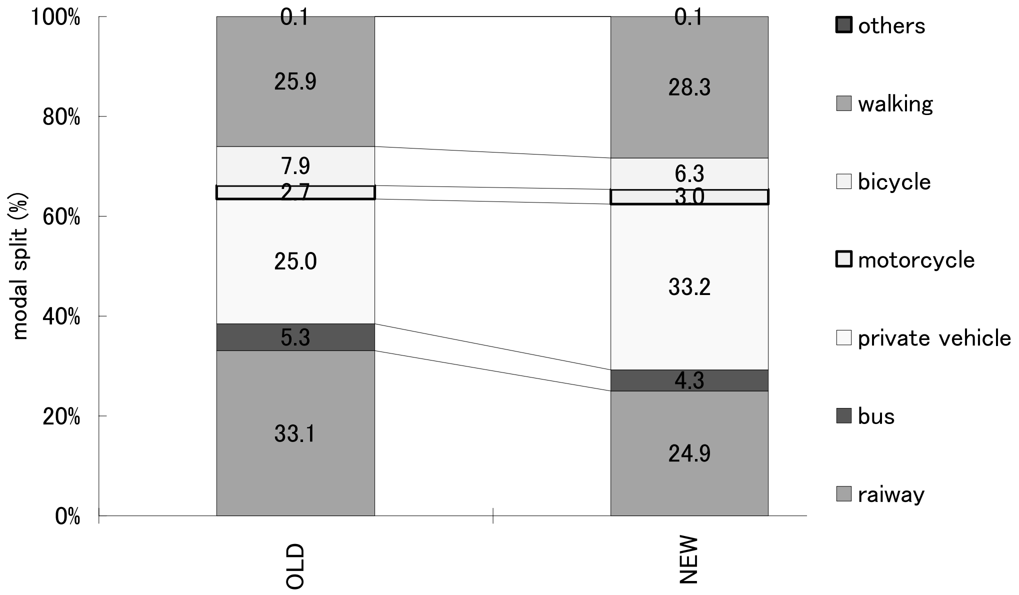


Figure 4.4.14 Average modal split in the old neighborhood and the new neighborhood

Note: The old neighborhood: Kanagawa, Nishi. Naka, Minami, Isogo, Kanazawa, Tsurumi. The new neighborhood: Kounan, Hodogaya, Totsuka, Sakae, Izumi, Seya, Kohoku, Midori, Asahi, Aoba, Tsuzuki See page 4

Number of passengers and kilometers traveled for major public transport

Figure 4.4.15 shows the change in the number of passengers for each public transportation mode in the city. The private railways exceed other public transportation throughout the period indicated in 4.4.15 with around 600 million passengers annually. The number of JR and subway passengers has increased steadily, and in 2004, JR was the second largest transportation mode, behind private railways. The subway, surpassing the city bus for the first time, was the third largest transportation mode in Yokohama in 2004. In fact, the city bus dropped to fourth in 2004. The new transportation system, the sixth mode of public transportation which runs along the seaside, carries around 16 million people annually.

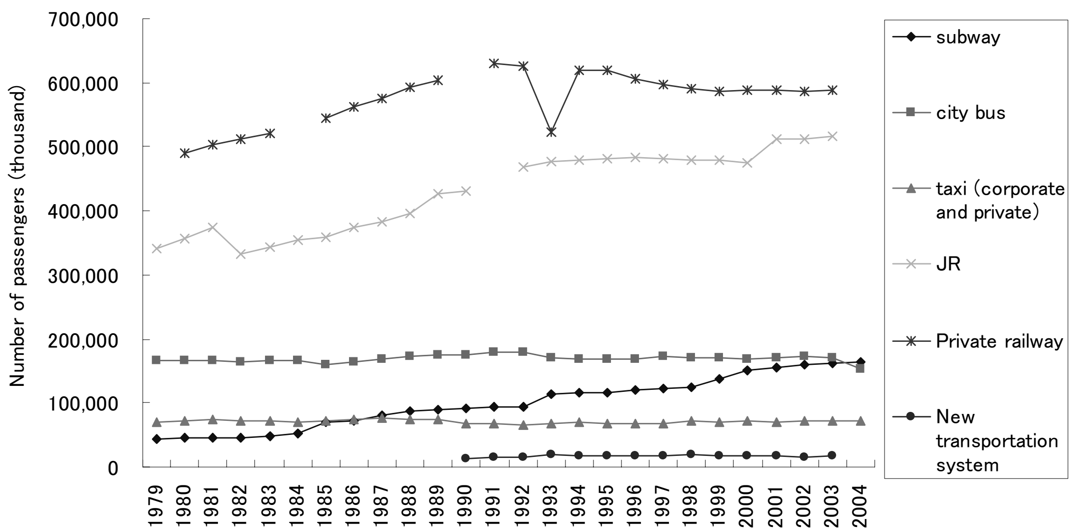


Figure 4.4.15 The number of passengers of each transportation mode

Source: Metropolitan census and Yokohama-shi toukeisho (Statistics of Yokohama)

The number of vehicle kilometers traveled (VKT) for each transportation mode is shown in Figure 4.4.15. Along with the opening of new subway lines, the VKT for the subway has continued to increase. In contrast to the steady trend of the number of passengers at a relatively low level as shown in Figure 4.4.14, VKT for taxis fluctuates at a much higher level than those of the city bus and subway. The fluctuation may be explained by the stagnant economic situations in Japan (Figure 4.4.16).

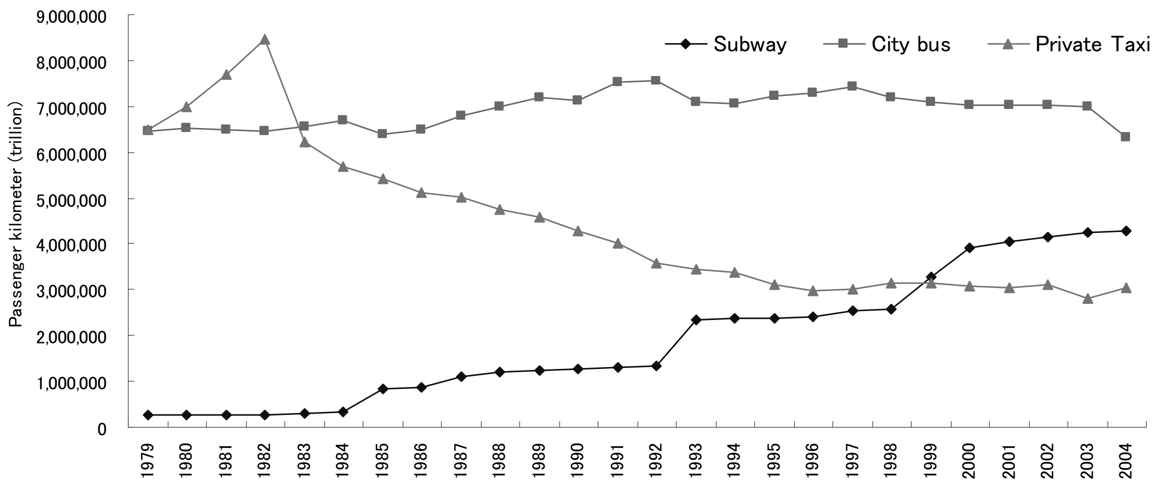


Figure 4.4.16 Vehicle kilometer traveled of each transportation mode

Source: Metropolitan census and Yokohama-shi toukeisho (Statistics of Yokohama)

- **Road transport**

The car ownership

Figure 4.4.17 shows the number of registered vehicles in the city covering all types of vehicles. As shown in the Figure 4.4.17, the number of vehicles has increased drastically: approximately 60,000 in 1960, 680,000 in 1980 and 1.5 million in 2003. In 2003, the vehicle number per capita was 0.42 in the city.

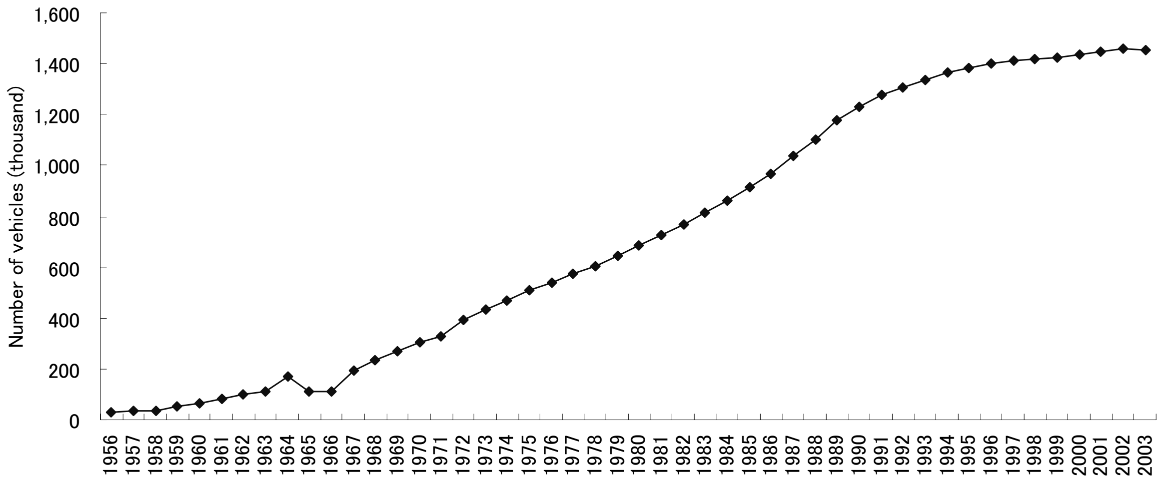


Figure 4.4.17 The car ownership in Yokohama

Source: Metropolitan census

Roads and bridges

Figure 4.4.18, 4.4.19, and 4.4.20 show the length and area of roads and bridges, and the number of bridges. Due to the change in calculation methods of road length and area in 1997, the data before and after 1997 are not consistent in Figure 4.4.18. Except for the measurement change, the length and area of roads and bridges in Yokohama have been increasing steadily as shown in Figure 4.4.19 and 4.4.20. The total length of bridges almost doubled over the years. On the other hand, the number of bridges has not changed much from 1979-2003. This implies that new and longer ones have replaced old and smaller bridges.

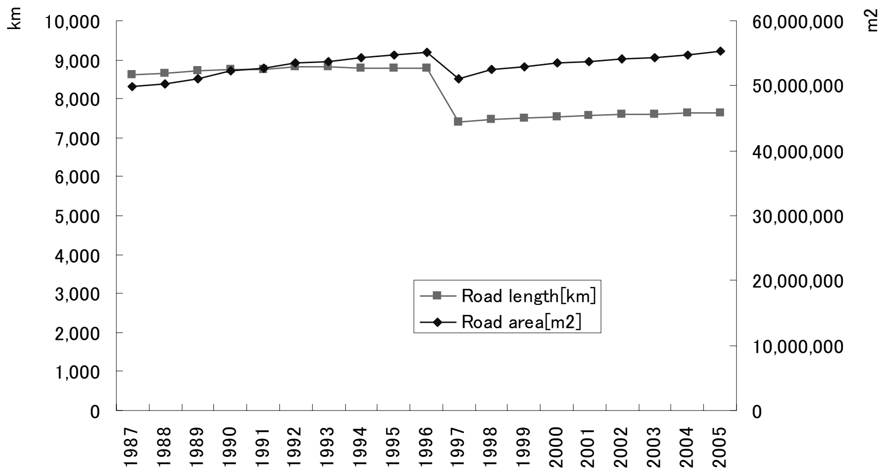


Figure 4.4.18 Road length and area

Source: Yokohama-shi toukeisho (Statistics of Yokohama)

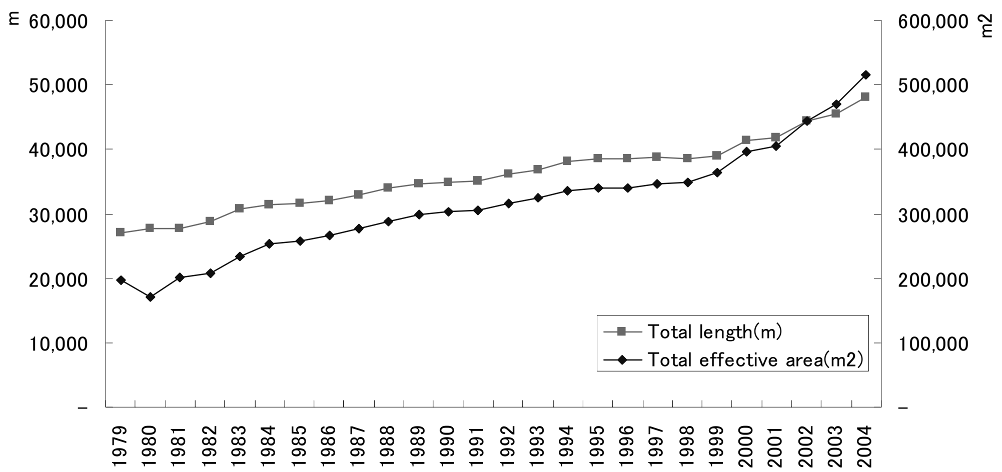


Figure 4.4.19 The total length and effective area of bridges

Source: Yokohama-shi toukeisho (Statistics of Yokohama)

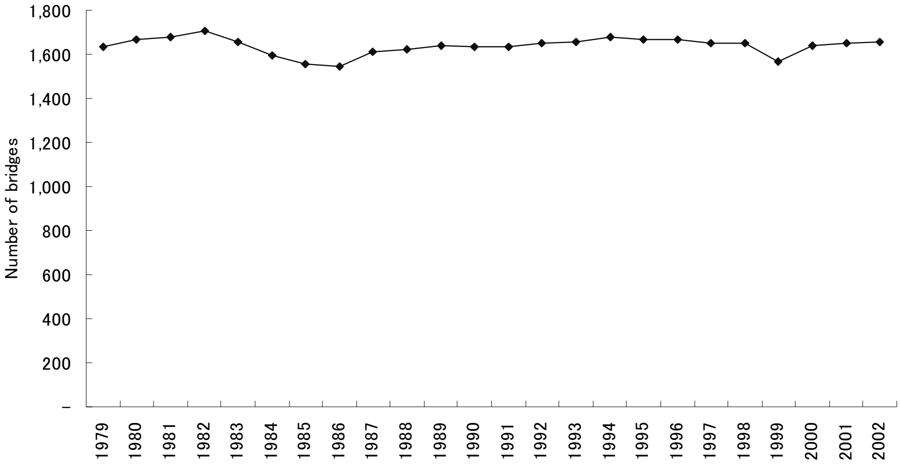


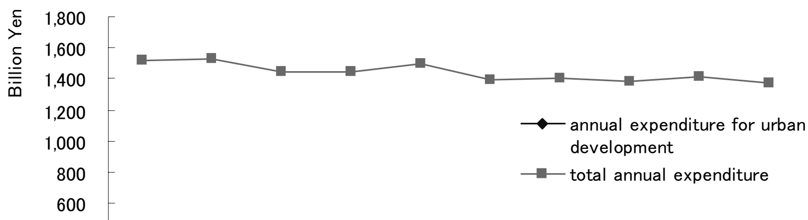
Figure 4.4.20 The number of bridges

Source: Yokohama-shi toukeisho (Statistics of Yokohama)

• Investment in urban transportation policies

Investment for urban development

The annual expenditure for urban development, composed of mostly the expenses for construction and maintenance of roads and bridges has been decreasing as shown in Figure 4.4.21. It fell to 246 billion yen in the fiscal year 2004. Figure 4.4.22 shows the breakdown of annual expenditure for urban development, shown by the ratio to the total annual expenditure. The proportion of the expense for roads, bridges and streets has also been decreasing, settling at around 6% in recent years.



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
annual expenditure for urban development	436	410	356	353	344	305	299	275	276	246
total annual expenditure	1,523	1,528	1,451	1,451	1,501	1,399	1,402	1,384	1,412	1,375

Figure 4.4.21 Annual expenditure for urban development

Source: Yokohama Financial Bureau

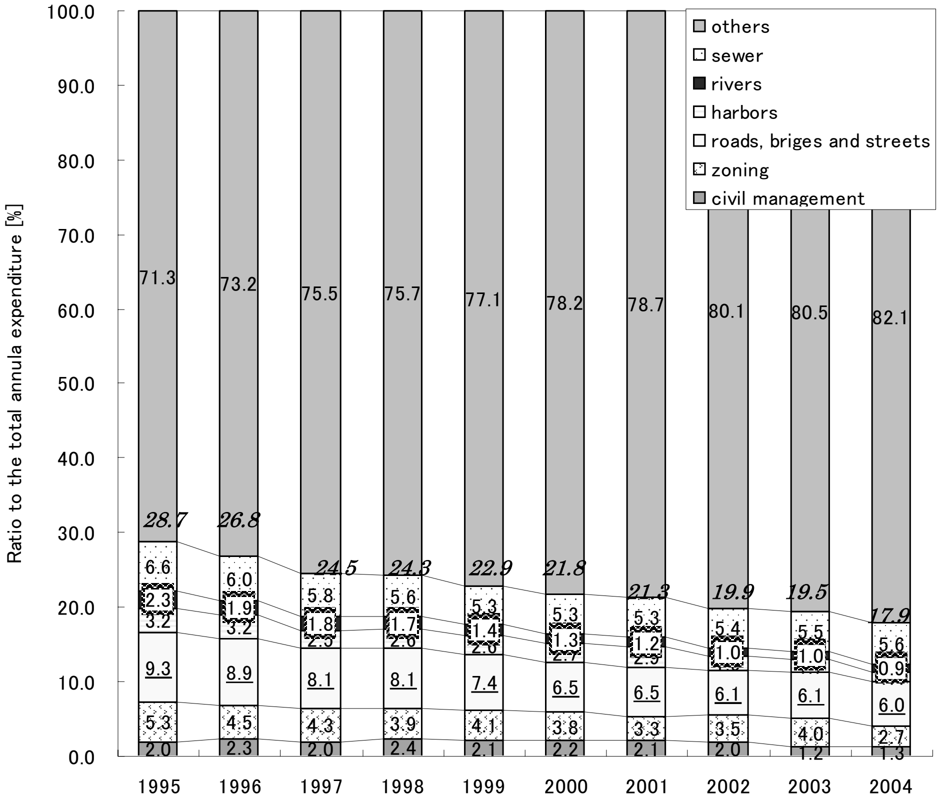


Figure 4.4.22 Breakdown of annual expenditure for urban development: ratio to the total annual expenditure

Source: Yokohama Financial Bureau

1.2.2 Environmental data

Air pollutants

Figure 4.4.23 shows the SO_2 concentration of ambient air in Yokohama. It peaked in 1967 and this trend can be seen in other major cities in Japan (Kono 2005). The concentration decreased to less than the annual average of 0.01 ppm in the 1980s, which is far less than the US Environmental Protection Agency's (USEPA) health based national air quality standard of 0.03 ppm annual average. This change can be explained by the increased interest in environmental pollution among politicians and practitioners in the late 1960s which resulted in the enactment of the "Air Pollution Control Law" in 1968. As a result, the National Diet also eagerly pursued the discussion on industrial pollution in 1970.

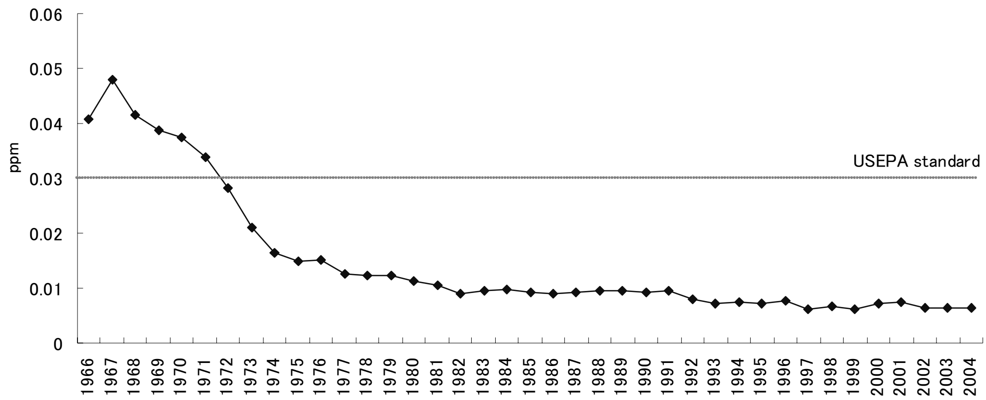


Figure 4.4.23 Annual average of SO2 concentration in Yokohama (Ambient air)

Source: Yokohama environmental pollution monitoring center

Figure 4.4.24 and 4.4.25 show the NOx and NO_2 concentration in Yokohama both in roadside and in ambient air. The NO_2 was fairly stagnant during the 1980s and 1990s both in ambient air and roadside air, but in the 2000s, emissions decreased to less than 0.04 ppm in annual average, which is also below the USEPA's health based national air quality standard of 0.053 ppm.

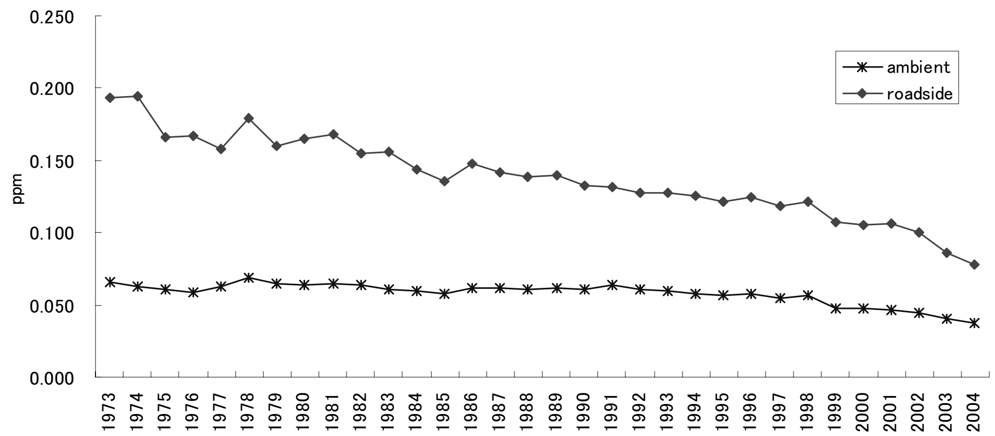


Figure 4.4.24 Annual average of NOx concentration in Yokohama

Source: Yokohama environmental pollution monitoring center

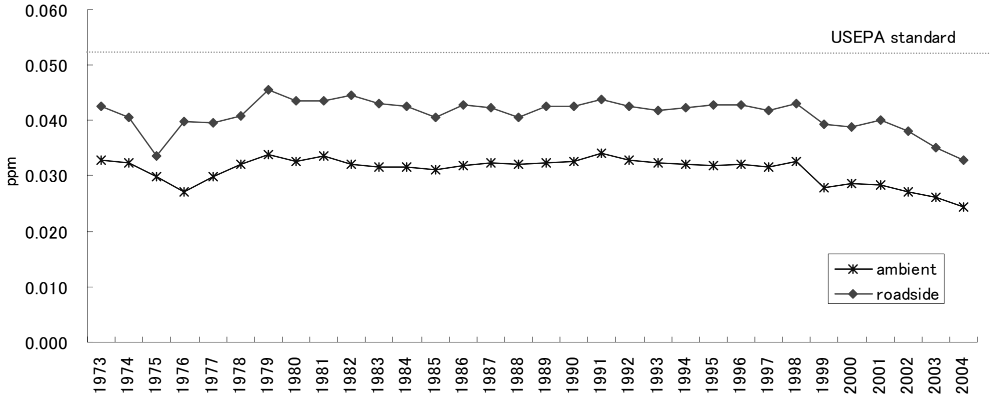


Figure 4.4.25 Annual average of NO2 concentration in Yokohama

Source: Yokohama environmental pollution monitoring center

As for dust fall shown in Figure 4.4.26, after the peak in 1966, the accumulation has been steadily decreasing. The MOEJ does not set the standards for the dust fall. Generally speaking, in health science, more than 10 t / km^2 / month is considered to be unfavourable for human health. The level in Yokohama has decreased to less than 10 t / km^2 / month in 1973-1974 and the present level is around 4 t / km^2 / month. Moreover, the SPM concentration has been decreasing gradually from the early 1980s, and in the 2000s, it is at the level around 0.05 mg / m^3.

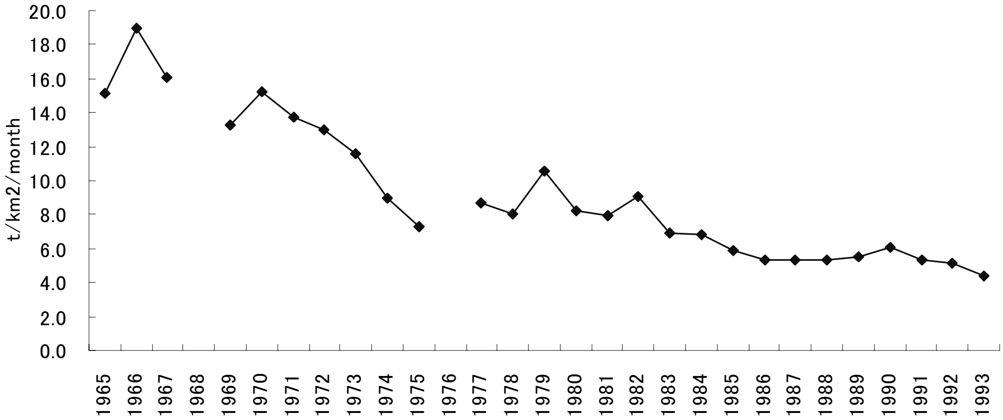


Figure 4.4.26 Annual average of dust fall in Yokohama (Industrial area)

Source: Metropolitan census

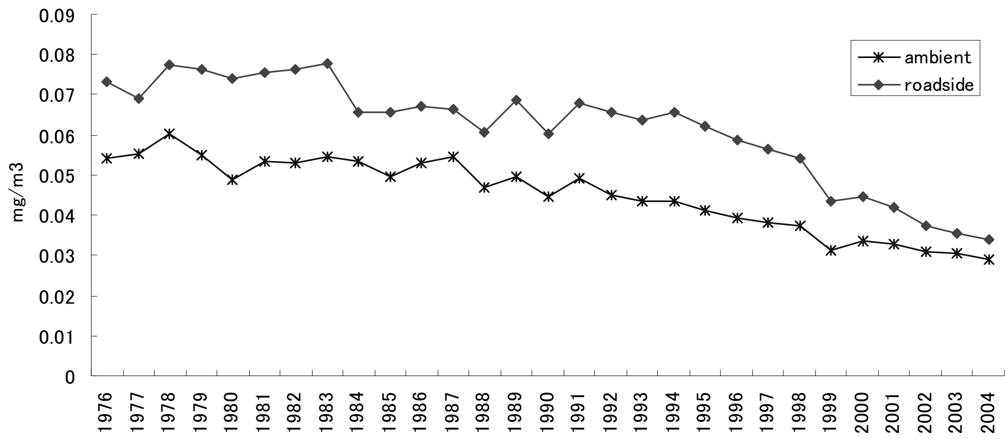


Figure 4.4.27 Annual average of SPM concentration in Yokohama city

Source: Yokohama environmental pollution monitoring center

GHG emissions

The total GHG emission in Yokohama was 21.5 million t CO2-equivalent in 2003, which was equivalent to 1.6% of that of the national level and the CO2 emission was 18.8 million t CO2-equivalent (Table 4.4.6). Regarding individual sector emissions, the transport sector has the highest emission rate, 24.7% of the total, followed by energy (22.5%), household (19.8%), and industry (13.6%), as shown in Figure 4.4.28.

Table 4.4.6 Total CO2 emission in Yokohama

Unit: 1,000 t CO2-equivalent

	Energy	Industry	Household	Business	Transport	Waste	**Total**
1990	3,310	3,440	3,110	1,880	4,190	610	16,530
2000	3,850	2,790	3,800	2,790	4,840	1,020	19,080
2001	3,760	2,560	3,780	2,740	4,860	950	18,660
2002	3,900	2,540	3,850	2,800	4,830	860	18,780
2003	4,220	2,560	3,710	2,710	4,640	940	18,770

Source: Yokohama environmental planning bureau

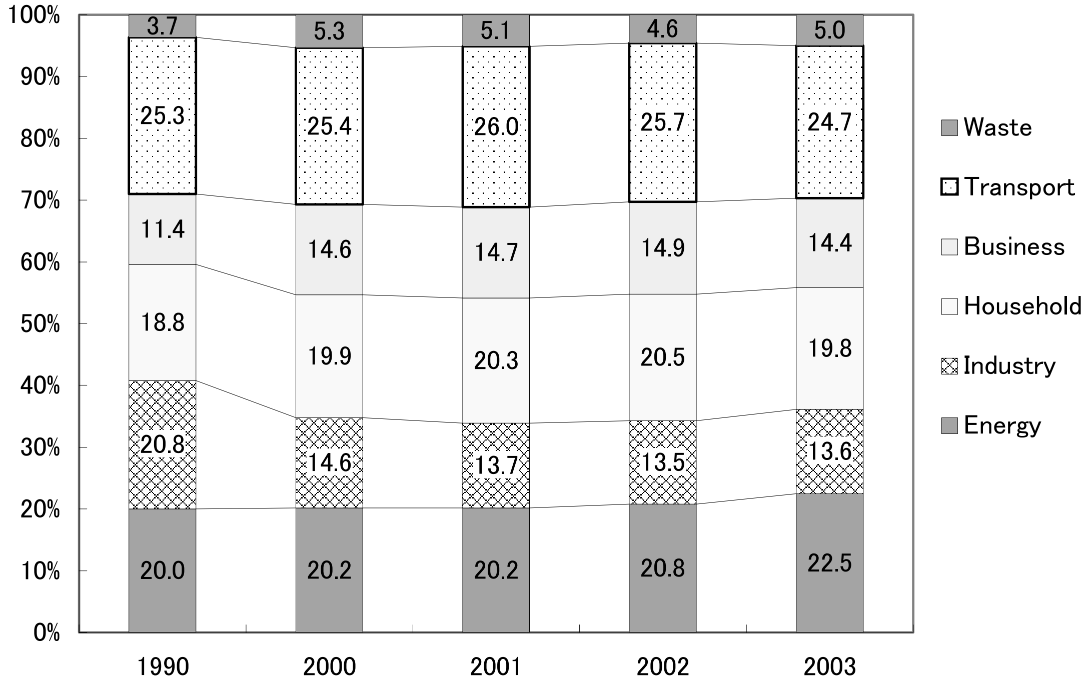


Figure 4.4.28 CO_2 emission rate from each sector in Yokohama

Source: Yokohama environmental planning bureau

The proportions of CO_2 emissions from energy, household and waste sectors (22.5%, 19.8% and 5.0%, respectively) were higher than those of the national levels (6.8%, 13.5% and 1.9%), and those from the business and transport sectors were almost at the same level. On the other hand, emissions from the industrial sector were much lower (13.6 %) than the national level (37.9%) due to the relatively small distribution of industrial areas in Yokohama city.

Compared to 1990, the standard year, the total GHG emission in 2003 increased by 26.3%, which was more than three times faster than that of the national level increases. This was caused mainly by the increased emissions from the business, energy and household sectors.

The GHG emission per capita was 6.09 t CO2-equivalent, which was about 58% of that of the national level (10.49 t CO2-equivalent). The reason for this lower per capita emission rate is due to the relatively small industrial area, vehicle ownership and vehicle travels per capita in Yokohama compared to the national average.

Relationship between population density and CO2 emission/person

The relationship between population density and CO2 emission/person in each ward is shown below in Figure 4.4.29. As the population density increases, the CO2 emission per person decreases. This tendency can be seen in Nishi ward and Naka ward, although the emissions are actually higher than other wards.

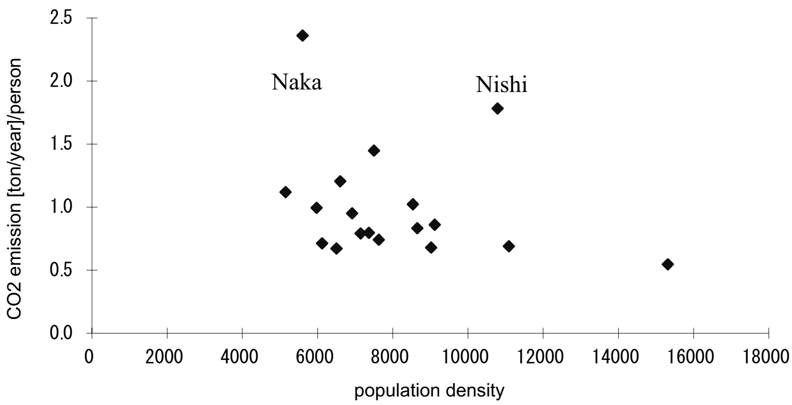


Figure 4.4.29 Relationship between population density and CO2 emission/person

Relationship between VKT/person and population density

In 4.4.30, the relationship between VKT/person and population density is shown and the original data of vehicle trips are calculated by destination basis. Among the 18 wards of Yokohama, 16 of the wards follow an inverse proportion trend. The two wards from the CBD districts, Naka and Nishi wards are characterized by a high share of railway trips. The highest VKT/person values are 16.4 km/person for Naka ward, and 13.9 for Nishi ward.

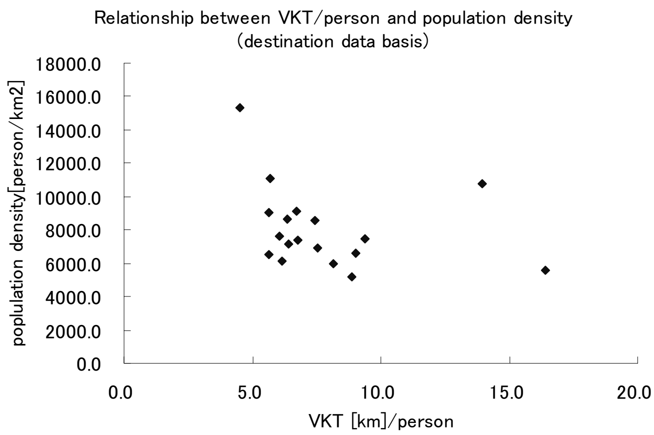


Figure 4.4.30 Relationship between VKT/person and population density

Relationship between CO_2-emission/person and population density

As CO_2 emission is calculated by VKT multiplied by emission coefficient [g-CO_2/km] for each type of vehicle, CO_2 emission becomes proportional to VKT. This implies that vehicle types in each ward are similar, as the estimated formula has a high R square, despite different CO_2 emission coefficients for each vehicle. Therefore, the relationships between VKT/person and population density, and between CO_2 emission/person and population density have the same trends. Accordingly, it can also be said that the high density in Yokohama leads to lower CO_2 emission, and it can also be said that high density leads to less traffic as mentioned in the former section (Figure 4.4.31).

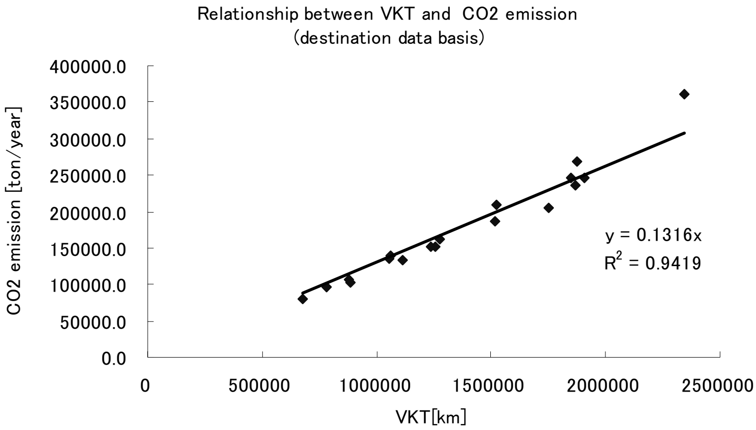


Figure 4.4.31 Relationship between VKT and CO2 emission (destination data basis)

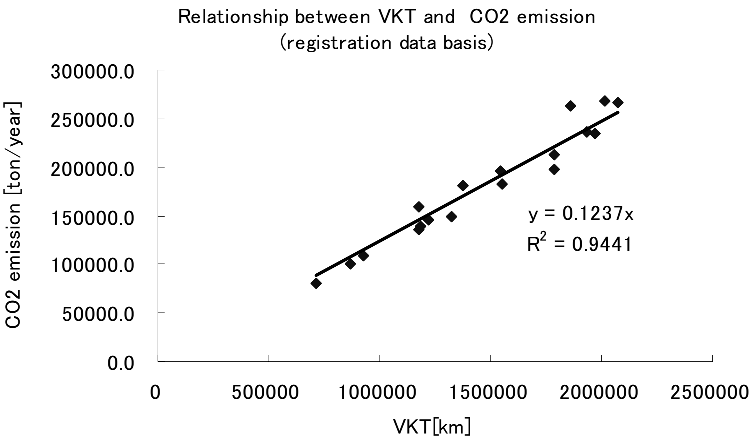


Figure 4.4.32 Relationship between VKT and CO2 emission (registration basis)

1.3 Urban planning framework

National regulatory framework

The City of Yokohama is one of 11 designated cities (Seirei-shitei-toshi) and the urban planning jurisdiction falls to the city, independent from prefecture government. Although a designated city has the right to plan, it needs to follow a strong top-down decision making system of the central government.

The legislative framework is characterized by a centralized system. Figure 4.4.33 shows the historical evolvement of the urban planning laws in Japanese urban planning. The City Planning Act (CPA) that is now being applied all over Japan was enacted in 1968. Before this act, quite a few laws on urban planning were already in existence. Those laws dealt with national and comprehensive land use planning, for example, the Comprehensive National Development Act and the National Land Utilization Planning Act. Other laws relating to urban planning such as the Building Standard Act and the Land Readjustment Act were applied under the rules of the City Planning Act (Igarashi & Ogawa, 1993, p.14-15; Kumata, Sakano & Srinivas, 1997, p.23-24)

Figure 4.4.33 also shows that there are quite a few other acts that are pertinent to this study. The Building Standard Act (BSA) in particular is indispensable for urban planning in Japan. In 1950, it had already been codified before the CPA. It revised the "Old" City planning Act of 1919 and set the basic standards of building construction as well as zoning plans. It contains a section called "overall provisions" or "concerning overall regulations" which covers virtually all city planning regulations, since it defines the floor area ratio and lot coverage. Shapira, Masser, & Edgington (1994, p. 63) note that BSA is "more than a building code"

Comprehensive National Development Act (1951)
National Capital Region Development Act (1956)
Kinki Region Basic Development Act (1963)
Chubu Region Development Act (1966)
Development of the New Industrial Cities Act (1962)
Development of the Special Areas for Industrial Consolidation Act (1964)
Basic Laws for Pollution Control (1967)

⇓

City Planning Act (1968)

↙ ↓ ↘

Land Use Zoning	**Promotion Areas & Specific areas**	**Urban Development projects**	**Urban Facilities**
Agricultural Land Reservation in Urban Promotion Areas Act Building Standard Act (1958)	Port and Harbor Act Parking Lot Act Distribution Business District Act Cultural Properties Protection Act Ancient Cities Preservation Act Urban Green Space Conservation Act	Land Readjustment Act (1954) New Residential Built-up Area Development Act Urban Renewal Act Development of Suburban Development Districts and Satellite Towns	Canal Act Local and Private Railway Act Motor Vehicle and Terminal Act Parking Place Act River Act Road Act Sewage Act Wholesale Market Act Waste Disposal and Public Cleansing Act

Figure 4.4.33 History of Japanese City Planning Laws

Numerous national laws were integrated into the City Planning Act of 1968. Some laws made previously still exist under the influence of the City Planning Act.

Source: Igarashi & Ogawa. 1993. Urban Planning: Beyond utilitarianism. p. 15; Kumata, Sakano & Srinivas. Urban Planning in Japan. 1997; Shapira, Masser, & Edgington. 1994. Planning for Cities and Regions in Japan.

The other trait of the City Planning Act is that it is undergoing many changes. In particular, during the 1980s, many amendments were made to relax the floor area ratio. Some changes have increased the scope of the Act. In 1992, the head of the Urban Planning Bureau of the Ministry of Construction (MOC) contested that even he had difficulty interpreting it since it had expanded so much (Igarashi & Ogawa, 1993, p. 43).

This lack of clarity has limited citizen's ability to interpret the Act and has supposedly reduced their participation in urban planning because they are unable to understand it fully. Moreover, greater decision-making power was given to the MOLT since municipalities need guidelines from the MOLT to help them understand the Act (ibid., p. 44).

National administrative framework

The administrative framework also requires a strong top-down decision-making model. To claim their own decision-making powers in this top-down framework, municipalities use two methods: youkou (Agreement) and jourei (Ordinance). In the 1960s, as the government insisted on strong industrial development according to the national plan (1st zensou), the population in big cities and their surrounding areas were housed in dense, variegated developments. The developers did not take care of urban facilities, such as roads, sewage, parks, schools, fire stations, disposal factories, and hospitals to the extent necessary for large residential development.

Table 4.4.7 Distribution of Decision-Making Powers in Urban Planning

Control: Strong ⟷ Weak

Category of Urban Planning	Details	Prefectural Governor's decision and			Municipality's decision and Prefectural Governor's approval
		Minister's approval	Minister's approval in metropolis	No Minister's approval	
Decision of UPA and UCA			✓		
Land Use Zoning	3 Metropolitan Districts		✓		
	Other cities				✓
High Intensity Use Special Zoning District					✓
Urban Block Area					✓
Fire Preventive District					✓
Aesthetic Zone					✓
Scenic District			✓		
Parking Development Area					✓
Harbor District	(Important Harbors)	✓			
	(Others)		✓		
Special Preservation Area of Historic Landscape		✓			
Landscape Preservation Areas	Metropolitan Districts (Tokyo, Osaka, Nagoya)		✓		
	Others				✓
Distribution Business District		✓			
Agricultural Green Block					✓

Conservation District of Traditional Buildings					✓
Aircraft Noise Prevention District			✓		
National Road		✓			
Prefecture Road	More than 16 meters		✓		
	Less than 16 meters			✓	
Municipality Road	More than 18 meters		✓		
	16 ~ 18 meters			✓	
	Less than 16 meters				✓
Highway		✓			
Rapid Train		✓			
Parking lot					✓
Car terminal	Economy car		✓		
	Trucks				✓
Airport	Category 1	✓			
	Category 2, 3		✓		
	Others				✓
Parks	National Park	✓			
	More than 4 ha		✓		
	Others				✓
Cemetery	More than 10 ha		✓		
	Less than 10 ha				✓
Other public space					✓
Waterworks	Supply for Water			✓	
	Other supply				✓
Electricity, Gas					✓
Public sewage	covering more than 2 municipalities			✓	
	Others				✓

Source: Made from T. Igarashi and A. Ogawa. 1993. / Architectural Institute of Japan. 1993.

As a result, this burden was imposed on the prefectures and municipalities. Therefore they tried to protect their urban planning rights through the several ways remaining to them in this strong top-down system. The youkou (Agreement) is a contract between a developer and a municipality. The developers have to observe some rules imposed by the municipality before they are allowed to proceed with development.

In 1967, the City of Kawanishi, which was established for commuters to the City of Osaka, suffered from rapid and disordered residential development. It was agreed that the developers were only allowed to develop their sites if they made public facilities as well. In 1968, the City of Yokohama then succeeded in having even stricter youkou than that of Kawanishi.

A master plan in Japan has been required for each municipality from 1993. All the municipalities came up with some plans, but due to a lack of urban planners in Japan, the plans were either too technocratic or too vague in focus (Kono 1998). There are no legal powers in the master plan so municipalities need to come up with a detailed legal document in order to pursue the plan.

Present Yokohama planning department

Yokohama is famous for the innovative Planning Bureau which tries to avoid the vertical decision making in Japanese urban planning. It was created in 1968 when municipalities in Japan had no idea how to integrate each city's bureau. The bureau succeeded in creating the 1965 plan which announced the 6 big projects to revitalize Yokohama. Now the Planning Bureau is in every municipality. However, the Planning Bureau should be in charge of some integrated and urgent issue of the city. So nowadays the one in Yokohama is not only dealing with the issues of urban planning, but also informatization, internationalization and so on.

In the forty years after the innovative planning bureau had been created, the mayor has changed four times: Mayor Asukada, who created the foundation of urban renewal of downtown Yokohama; Mayor Saigo, who continued Asukada's work; Mayor Takahide, who emphasized infrastructure development and urban amenity; and the present Mayor Nakata, who continues to impress the nation with his drastic policies on informatization. The bureau also has changed its name several times: Planning Bureau, Financial Planning Bureau, and the Urban Management Bureau.

Forty years ago, the engineers were the center of urban planning and dealt with the new physical shape of the city while governing policy. However, planning a city requires conceiving of a lot of aspects including social welfare, crime prevention, and environmental protection. Moreover, the public has to become more vocal in expressing their feelings.

In this context, the scope of urban policy and urban planning has changed. The following shows the current bureaus of urban planning in Yokohama:

Table 4.4.8 Present bureaus in charge of urban planning policies

Name of the Bureau / Division	Description
Urban Management Bureau (Toshi keiei kyoku)	The integrative coordination of other bureaus and important policy making and coordination
Community Planning Coordination Bureau (Machizukuri chousei kyoku)	Urban planning, building construction and housing policies
Planning Division (Machizukuri chousei kyoku Kikakuka)	Planning and coordination for core policies of urban planning, building construction and housing policies
Urban Improvement Bureau (Toshiseibi-kyoku)	Integrative Planning, coordination and implementation concerning urban improvement
Planning Division (Toshiseibi-kyoku Kikakuka)	Investigation, planning and implementation of urban improvement projects Basic principles for land use planning Enforcement and Amendment of the Yokohama Urban Master Plan

Source: Mr. Akimoto, personal communication, 2006 (All English translation is from the City of Yokohama)

In short, the integrated urban policy making, including social policies, will be pursued by the Urban Management Bureau. Coordination and implementation concerning urban improvement, such as creating a master plan, will be made by the Urban Improvement Bureau. The procedures for urban planning will be covered by the Community Planning Coordination Bureau.

The difference between urban improvement and urban planning is not so clearly articulated and the division of duties overlaps in some bureaus. The Community Planning Coordination Bureau uses urban planning of procedural matters, and Urban Improvement Bureau uses it as integrative improvement (Mr. Akimoto, personal communications, 2006).

In fact, the division of duties depends on the each person's capability to work. Political will to make the integrated policies seem weakened as the re-coordination of the bureaus. The core policies are vague and the role of each bureau is not clearly defined for urban planning in the city of Yokohama. It has also become a rather vertical decision-making system. The Urban Management Bureau does not play a leading role. Rather, it tends to just summarize the other bureaus' ideas. (Mr. Akimoto, personal communications 2006)

Though Yokohama is a Designated City, whose jurisdiction of urban planning has been transferred from the prefecture government, there remains a strong, top-down influence from central government regulations (Regulations of landscapes). A vertical decision-making system (Each section of the city corresponds to a section of the Ministry of Land and Transport, the Ministry of Agriculture, Forestry, and Fishery, the Ministry of Finance, etc. .) is still conspicuous and there is little interaction with other Ministries. Moreover, there is little public participation in the planning process compared to other developed countries.

2. Descriptive analysis on policies of dense and mixed land use

This section will look at the dense and mixed land use policies in the City of Yokohama. The dense and mixed land use policies are characterized in setting up FAR of the Building Standard Act explained in 1-c. Land use planning policies are represented by other special ordinances by municipalities.

Central government policies

As we explained in the previous chapter, national law for land use planning and zoning is very loose compared to other developed countries (as it only stipulated on FAR). Table 4.4.9 below shows the comparison between Japan and Germany, as an example of developed countries. Japanese laws do not regulate the number of stories for each building. While in Germany, as one of the most advanced urban planning framework in the advanced world, the laws have regulations in number of stories. Moreover, the lot coverage and FAR for residential areas is confined to the low levels of 20%-40% (Igarashi, 2003).

Table 4.4.9 The list of the land use planning regulations in Japan (First existed) and Germany
Land use and zoning regulations in each category in Japan (%)

Land use zoning	Lot percentage	FAR
Restricted residential 1	30-60	50-200
Restricted residential 2	30-60	100-300
Residential	60	200-400
Neighborhood Commercial	80	200-400
Commercial	80	400-1000
Quasi industrial	60	200-400
Industrial	60	200-400
Restricted Industrial	30-60	200-400

Land use and zoning regulations in each category in Germany (Story, %)

Land use zoning	Number of stories	Lot percentage	FAR	Surface-to-volume ratio
Garden city	1	20	30	
	2	20	40	
Restricted residential 1	1	40	50	
general residential	2	40	60	
Mixed use	3	40	100	
	4 or 5	40	110	
	5 or more	40	120	
Village area	1	40	50	
	2 or more	40	80	
Central City	1	100	100	
	2	100	100	
	3	100	200	
	4	100	220	
	4 or 5	100	240	
	6 or more			
Commercial	1	80	100	
	2	80	160	
	3	80	200	
	4 or 5	80	220	
	6 or more	80	240	
Industrial	–	80		900
Resort	1	20		

Source: Igarashi 2003.

Although /the present act is already too lenient, the central government policies have emphasized loosening urban planning policies further after the economic boom in order to expand office space. It did not change its momentum in 2000s in the name of braking the rapid drop of the price of the real estate. The Prime Minister Koizumi set up the Urban Reform Committee (Toshi saisei honnbu) in 2001, which encourages high dense development by private sectors, allowing no limit of FAR in the downtown of mega-cities (Tokyo, Yokohama, Osaka, Nagoya, and Fukuoka) and sometimes with generous subsidies.

Igarashi (2003) notes that these kinds of lax land use regulations do not contribute to a better urban living standard as large developers will pursue profitable developments such as commercial facilities and luxury condominiums, while ignoring needed urban facilities such as childcare homes for working mothers, and social welfare buildings for seniors and disabled people. Although rather loose urban planning regulations are rampant all over Japan, Yokohama tries to manage its own planning by pursuing a higher quality city with a master plan descended from the 1965's 6 big projects.

Recently, discussion by the central government (Ministry of Economy, Trade and Industry-METI) on the amendment of "3 Community Planning Acts (Machi-dukuri 3 pou)" has given a boost to the Compact City ideas in suburbs. It regulates suburb development in order to promote the deserted inner city commercial zones. They prohibit the large size mega-marts to be built in suburban areas. The table below shows the summary of the Acts in suburb and central area. This will contribute to create a dense CBD in the future and control urban sprawl.

Table 4.4.10 Summary for the 3 Community Planning Acts

Policies	*Concrete policies*	*Goal*
Tightening of the suburban regulations	• All big commercial facilities only allowed at commercial and quasi-industrial regions • Permission needed for constructing new hospitals, schools and welfare facilities • Restriction on conversion of agricultural land	• Restriction on development of suburban style mega marts. • Restriction on expansion of cities
Relaxing the central commercial development	• Subsidy for constructing condominiums • Subsidy for constructing hospitals or welfare facilities • Shortening the time for opening retail shops in central commercial areas	• Guide more residential and commercial land use to central cities • Activate more convenient commercial facilities

Source: Yomiuri newspaper, January 11th, 2006

Old neighborhood

• Regulatory

"Basic agreement on Town Development under Minato Mirai 21" promotes the mixed land use at the "site-specific mixed land use," and "subregional level mixed land use" (USEPA 2001). As for the "site-specific mixed land use," The Agreement for MM21 stipulates the regulations for the "Activity Floor". Lower floors of buildings ("activity floors") are generally offered for use as shops, showrooms, service facilities and others open to the public, particularly along the network of pedestrian space. Such floors are designed to maintain continuity of the street's liveliness while being scaled for pedestrians. "Subregional level mixed land use" is shown in Figure 4.4.34. It shows the variety of zones to ensure the high standard of the area (Yokohama 1988, 2003). Although this is only an agreement, the owners in MM21 all have agreed to follow the guidelines (Kono 1998).

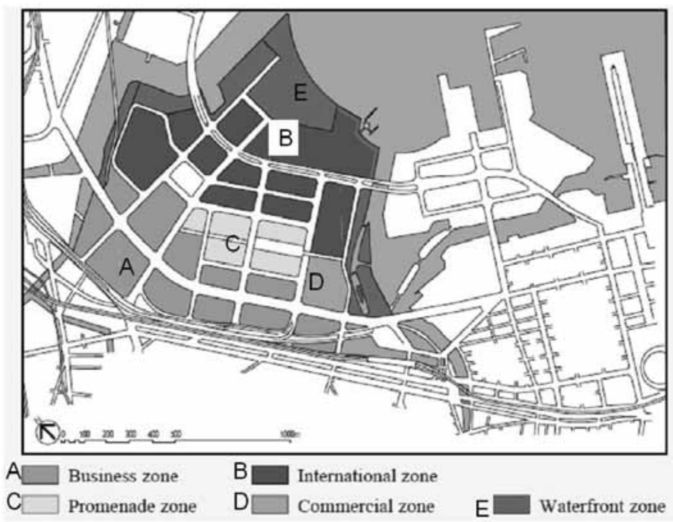


Figure 4.4.34 Zoning for MM21district

• Administrative

The administrative office that is in charge of Minato Mirai 21 development is Yokohama MM21 Corporation. The Corporation is the joint public-private venture with many private companies, and is in charge of creating and updating the MM21 Basic Agreement. The constituents include the city of Yokohama, Kanagawa Prefecture, Urban Development Corporation, Japan Railway Construction Public Corporation, Japan National Railways Settlement Headquarters, land owners, and local business circles.

From its establishment in 1984, the Corporation has been successfully in charge of: (1) Attraction of new business participants; (2) Coordination and promotion of community development; (3) Improvement of radio and television reception and the promotion of greenery and recycling; (4) Coordination of district facility improvements; (5) Conducting surveys and studies concerning area development; (6) Public relations; and, (7) Management of public and other facilities. Many joint public-private ventures made in the 1980s were not successful in Japan. Perhaps the key to this venture's success may be the long-term stable policy goals by the city and each landowner owns a big chunk of land. If land is divided by small fragmented area, project is not so successful (Kono 1998).

• Stakeholders

As we saw in the administrative section, the MM21 Corporation involves the city of Yokohama, Kanagawa Prefecture, Urban Development Corporation, Japan Railway Construction Public Corporation, Japan National Railways Settlement Headquarters, land owners, and local business circles. Also, as the area was a former site of industry, there were no former residents and it did not have to include citizens. However, as the area contains more living populations, the coordination of the residents needs to be emphasized more. While the historic district is already a mix of land use, local commercial corporations are vocal in promoting the small retail businesses in the neighborhood.

• Public opinion

The public opinion on mixed land use design in CBD and historic areas is unavailable presently.

• Economic and socially favorableness

Mixed land use will enable the city to have a sound economic base, since Yokohama has lacked business center characteristics in the past. Especially, the business zones and commercial zones in MM21 are aimed at creating employment for 190,000 people. Although the employed population was still only at 50,000 people in 2003, its commercial facilities and other entertainment facilities attract 42 million people annually, with favorable figures in municipal tax revenues, investments in construction projects, and business operations.

Table 4.4.11 Effects of the Minato Mirai 21 project

Number of persons employed	50,000 (2003)
Number of visitors	42 million (2003)
Number of companies operating in this district	980 (2003)
Municipal tax revenues	¥11.0 billion (Fiscal year 2002)
Investments in construction projects	¥1.97 trillion (cumulative)
Business operations	¥860 billion (Fiscal year 2000)

Source: Minato Mirai 21 Corporation 2006

New neighborhood

The Compact City idea was proposed by the city in 2006 (Watanabe, personal communication, 2006; Yokohama City 2006). The city has not prepared specific implementation tools to promote the idea, but it gives a broad overview on how they can promote a more concise development. The city emphasizes a transit-oriented compact city, and it ensures each railway station as a core for each suburb which contains commercial facilities, recreational cores and so on. By designing each railway station to have power of attracting people, so the transit-oriented multi-core city will be realized. They think this will eventually be able to promote dense, mixed land use neighborhood. This will shed some light on suburb development of Yokohama, despite being neglected with its focus on central core development.

• Regulatory

No concrete regulations for suburban areas have been made in Yokohama at the municipality level.

• Administrative

The Planning Department of Yokohama comes up with compact city idea in suburbs. Still the concrete administrative framework has not been made.

• Stakeholders

According to the *White paper for lifestyles of Yokohama citizens 2006* (Yokohama City 2006), the suggested policy is based on the opinions from suburban residents. The opinions from adjacent enterprises were also solicited. As the suburbs are mostly for upscale residential areas, the coordination for the present residents will be strongly needed in the future.

• Public opinion

An opinion poll in 1999 shows that 80 % of the Yokohama suburban population recognizes the affluent nature of the area; at the same time 70 % of them answer that they are satisfied with the commercial facilities nearby (Yokohama City 2006). The result shows that the residents would prefer mixed land-use suburbs rather than isolated, single land use residential areas.

• Economic and social favorableness

Compact city will facilitate attractive residential areas, which will promote a lively real estate market for the area.

• Timing points of view

Being a huge bedroom community lacking facilities such as nursery homes (Yokohama City 2006), strengthening the suburban area will assist the City's multi core development.

3. Descriptive analysis on policies of TND

This section will look at the policies on Traditional Neighborhood Design-TND, which is the design suitable for both pedestrian and non-motorized friendly design. The design also ensures the human scale in buildings and lot sizes. This design is an antonym for sprawl suburb. Unlike the car-dependent conventional suburban development, it allows the various transportation modes.

Central government policies

The Ministry of Land and Transport (Former Ministry of Construction) has had policies of TND in the past. For example, in the late 1950s, the ministry pursued pilot programs for promoting "play roads" (yugi-doro) in the bigger cities of Tokyo and Osaka. In 1969, another pilot program called "shopping parks" (kaimono-koen) in Hokkaido was conducted, and it spearheaded the rise of pedestrian areas. Moreover in 1972, "school zones" were created and this is one of the earliest attempts in the world. In 1974, "life zone (seikatsu-zone)" was stipulated for a community to prepare human scale, all modes accommodating community (Kamioka 2006).

In 1996, the "community zone" policy was declared with numerous new attempts, such as integration between the maintenance of the roads (national government or municipal ones) and transportation regulation community and promoting public participation. The community zones use humps and chicanes, as well as urban designs which segregate the main street and residential area. Nowadays, this policy has evolved to a "street for comfortable living" with not only pedestrian access but also bicycle access taken into account (Kamioka, 2004).

Old neighborhood

• Regulatory

The agreement among Minato Mirai 21 landowners defines the small blocks descended from the old neighborhood and it is appropriate for a pedestrian-friendly neighborhood.

• Administrative

The Urban Improvement Bureau tried some pilot cases of promoting bicycle use in the historic and CBD areas in 2004. They coordinated with the police department and CBO/NGO, and are ready to serve a leading role on promoting TND.

• Stakeholders

The land developers of MM21 have agreed to work on Traditional Neighborhood Designs (TND). To realize a lively and rich urban life, a "Common Space" area will serve as a mediating area, connecting the interior and exterior space. Such Common Space is freely accessible to anyone, taking various forms such as passages, courtyards or indoor arties. In addition, the display of public art is encouraged in this space (MM21 Corporation, 2006).

• Public opinion

A non-profit organization called "Nice Yokohama" promotes *Hama-chari* (abbreviation for Yokohama bicycle). The system allows one to use a city bicycle inside Yokohama for one day, paying a 500 yen fee and 1,000 yen deposit at any of the 5 bicycle rental stands in Yokohama downtown and CBD. Bicycles can be returned to any of the 5 stations when finished. The service is open 6 days a week except Mondays. The NPO requires some simple questionnaires to the users for future improvements. An opinion poll in 2004 shows that 90.6 % of the tourists who rented the bicycles say that they enjoyed the usage of them.

• Economic favorableness

The TND is a small investment compared to the other urban road facility. Or, it can be implemented just by city ordinance or agreement with no cost.

• Social favorableness

According to an opinion poll among 177 individuals who attended the social experiment of the Car Free Day on October 2005, 81% of the attendants answered that vehicle usage is a problem in the city. 89% answered that vehicle usage should be reduced in the future. People also feel the central commercial district should be pedestrian and bicycle friendly, with easy access. Less than 10% of the people answered that a vehicle friendly urban design is important (Car Free Day Japan 2005).

More than 40% of the people wish for future improvements in public transit such as buses and light rails, 30% wish for future bicycle improvements, and less than 3% people think the mobility of vehicles should be improved. Nearly 80% of vehicle users answered that they would switch to public transit, if the condition were improved (Car Free Day Japan 2005).

This shows that most people who attended the event would like to have TND in the central city. Even if they are present car users, they are willing to switch to bicycles. We can conclude that there are some social favorable perceptions of public transportation in the city.

New neighborhood

• Administrative

Presently, ward offices in the suburbs have set up the TND as a general goal, yet not so many concrete urban planning measures have been introduced. The Compact city idea will create a TND promoting administrative foundations in the future.

• Regulatory

The Master plan recommends pedestrian friendly neighborhoods, but there are no statutory requirements in the master plan. The Compact city idea was suggested by the Urban Improvement Bureau, yet no concrete regulatory tools have been made.

• Stakeholders

In the previously mentioned compact city idea, the city endeavors to make the railway stations located in suburban areas more attractive to customers by encouraging commercial facilities and other service industries. The residents' opinions should be included more when concrete policies are pursued. This can be said the Transit Oriented Development – TOD now the popular concepts for suburban development in North America.

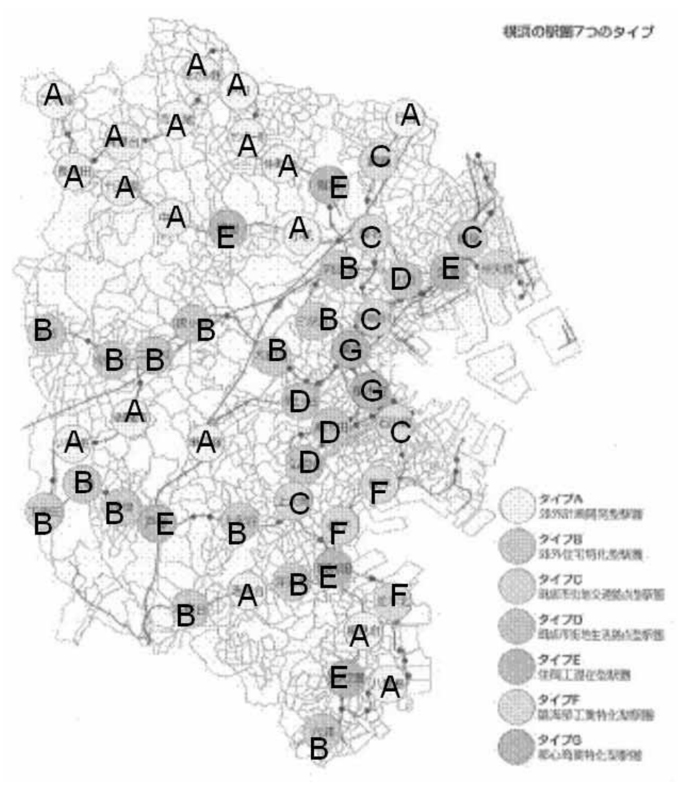


Figure 4.4.35 Seven types of TOD in Yokohama

Source: City of Yokohama

A: Suburb core
B: Suburb residential core
C: Transit core
D: Residential core
E: Mixed use core
F: Coastal industry core
G: Downtown core

• Public opinion

60% of the suburban population thinks that public transit is convenient in a recent survey (Yokohama City 2006). More careful surveys are needed to promote a concrete plan for TND.

• Economic and social favorableness

The opinion poll shows that people want to have an accessible public transit and pedestrian-friendly community in the future (Yokohama City 2004).

4. Conclusions

Yokohama is the second largest city in Japan, and it always has been considered a bedroom community of Tokyo. It is a home for 3.56 million people (2004), and an aging population is becoming a concern. Urban density is around 8,174 people / km2 (2004) with the highest in the central district: 9522.2 people / km2 (2004). Regarding the job density, the service sector is increasing as the manufacturing sector is decreasing rapidly.

Modal share of private vehicles is increasing, as the population of suburban areas, where the area is less dense and allows more vehicles, is increasing. Subway passengers are increasing and in 2003, outnumbered the bus passengers. Also VKT is increasing for subways. Extension for subways is planned for 2008. The length of roads and bridges are steadily increasing. Overall expenses on urban infrastructure are decreasing, so as the transport section with increase on welfare and other public services.

Industrial related pollutants such as SOx, dust falls, and SPM are decreasing. The transport sector emissions such as NOx are stagnant except for SPM. For example, GHG emissions peaked in 2000, but have been stagnant since. GHG emission in energy, household and waste sectors are higher than those of national levels, as the industrial sector is lower than the national one.

Because the urban planning framework in Japan is top-down and vertical in terms of regulatory and administrative aspects, municipalities needs to protect their urban planning by setting up some concrete goals with city ordinances and agreements. Yokohama was well-known for its innovative and well run Planning Bureau. However the present administrative framework of planning bureaus is a little dispersed and does not take the examples from previous successful models.

Yokohama's mixed land use plan is to avoid loose national land use regulations by setting up some concrete goals. Yokohama's central district is already highly dense and mixed. It has been successful in maintaining the standards of living by setting up an "Agreement" among landowners. As for the suburbs, the compact city idea, not yet completed as a concrete set of policies, will create suburban communities with reasonably dense and mixed land use.

Traditional Neighborhood Design in the Yokohama central area is being promoted and involves many of important stakeholders. The city government, retailers, and citizen organizations are all active and vocal in holding events like bicycle rental experiments and Car Free Days. In the suburbs, again, the compact city idea will promote the transit oriented, pedestrian and NMT friendly community.

Overall, Yokohama has great potential for building highly dense, mixed land use in the core of the city, surrounded by moderately dense, transit-oriented small towns. In historic and mixed land use areas, because of the Agreement with multiple stakeholders, a high quality, dense business and commercial core will exist. A large number of people who prefer urban lives may live here. Suburban areas will have small multiple cores represented by the railway stations, with commercial and service facilities. They will represent a moderately dense residential neighborhood with the railway stations, yet pedestrian and NMT friendly communities. It can be said that they try to develop a multi-core Transit Oriented Development metropolis.

Kamioka (2002) mentions some low dense area the railway might use more energy, viz., emit more GHGs, than vehicles.) But he also mentions that with this density, no railway emits more GHGs than single occupant vehicles. For Asian cities, with dense populations and high economic growth, the approach of Yokohama city could be one of the best models.

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IV.5 Car Restraining in Beijing: Evaluating the Factors that Impede or Facilitate

Jiang Kejun[1] and Huang Liya[2]

1. Introduction

Beijing is the capital city of People's Republic of China, and it also is the political and cultural centre of China. The total area of Beijing is about 16410 km2 which includes 15 districts and 3 counties, with a resident population of 15.38 million in 2005, . From 1990 to 2005, the annual of population growth rate is about 2.3%. The total of household in 2005 is 4.51million, with 1.17 in rural area. Gross domestic product (GDP) of Beijing is 688 billion RMB in 2005, with the annual growth rate 11.4% from 1990. (Beijing Statistic Year Book2006,2006).

Both the high economic growth rate and the rapid increase of population in Beijing have stimulated the growth of vehicle stock. Vehicle stock has amounted to be 2.45 million in 2005, with an average growth rate of 7.7% compared with that in 1995 (Beijing Statistical Year Book2006,2006). Private car grows dramatically. In 1980, only 22 cars were registered for private purpose and this number amounted to be 992 thousand by the end of 2005, while it is 243thousand in 2000, with an annual average growth rate 32% during that period. Car ownership, 24 cars per 100 households, shows that Beijing has been a society of motorization (Beijing Year Book2006,2006). This kind of astonishing growth rate brings heavy pressure on the limited road network whose growth rate is much lower, oil supply and environment emissions. China become a net oil-importing country in 1994 and 30% of oil consumed now is imported abroad. (China Statistical Year Book 2005, 2005)

The speeding-up urbanization process in Beijing, along with population immigration and higher economic growth rate, has resulted in rapid growth in transportation demand which causes higher energy demand and emission of pollutants. So far in Beijing, the transport sector has became one of the biggest consumers of oil products, and meanwhile it also becomes a major contributor to the rapidly deteriorating air quality as its increasing energy demand has caused serious air pollution. The local pollutants from vehicles' energy consumption mainly include carbon monoxide (CO), hydrocarbons (HC), oxides of Nitrogen (NOx), suspended particulate matters (SPM) and Lead (Pb), etc, while Carbon Dioxide (CO2) is the main greenhouse gas emitted from the transport sector, contributing to climate change. Among these pollutants, CO, HC and Pb emissions are very significant from the gasoline vehicles, whereas, diesel vehicles contribute largely NOx and particulate matters (SPM)(Hao et al, 2006) In 2004, NOx emission from vehicles accounted for 74% of the total in Beijing (Hao et al., 2005).

As transportation infrastructure in Beijing such as roads and mass transport modes (including bus, tram, rail etc) still have not been able to match the demand till now, the worse road condition, poor vehicle maintenance and serious traffic jam all contribute to pollutant emission, and a major share of urban transport in urban area is catered by several personal transport modes. Ever since 2000, share of traffic volume by private car in

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Beijing is increasing and share of public transport is decreasing. In 2005 the traffic volume by public transport is 28% while it is 26% in 2000.(Beijing Transport Commission, 2006).

The worse road condition, poor vehicle maintenance and serious traffic jam all contribute to pollutant emission.

Central and local government have put much effort to control the worse situation of air pollution in Beijing, and have made significant progress (Cai et al, 2006). Compared with other cities in China, Beijing took the leader to combat environment degrading due to political reason and preparation for Olympic in 2008. A series of policies have been carried out by Beijing municipal government from 1998 to reduce the emission from urban transport sector, including issuing new tail-pipe emission standard, introducing alternative fuel vehicles (AFVs), scrapping bad polluting vehicles, enhancing inspection & maintenance system (I &M), increasing parking fee, developing public transport system especially accelerating the development of MRTs. As the city has been experiencing rapid growth in number of vehicles and transportation demand and so on, these policies of controlling the pollution emissions from the transport sector has gained immense importance over the past few years.

There is no specific policy to limit car ownership in Beijing. As the national government has put vehicle manufacture industry to be one of key sectors for economic development, limitation on the ownership of vehicles was not recommended. Related Policies, including developing public transport and increasing parking fee etc., mainly focus on promoting the development of high efficient transport mode and the reduction of car use.

For further concordant, sustainable development of society, economy and environment, Beijing municipal government has set a series of targets as following in 2005 (Beijing Development and Reform Comsission,2005):

- Long-run targets: sustainable development target in Beijing, to be a large size international metropolis.
- Medium-run targets: fully meet the requirement of National Environmental Quality Standards in 2010. (for air quality, meet the second level standard).
- Short-run targets: low down the pollutants’ concentration in the air in Beijing.

Therefore in order to improve local air pollution, more policies will be adopted to control emission from vehicles. Limit car use will be one of major targets for policy options in future. There are discussions to use more policy options including fuel tax, road pricing, further development of public transport system, parking pricing, development of road network, and public awareness.

Large city, rapid increase of car, challenge on air pollution, congestion and noisy pollution, pilot city for action on environment, large potential to implement further policies are major reason to select Beijing as case study in this report.

2. Factors and challenge for car growth in Beijing

2.1 Factors for car growth in Beijing

Income growth, car pricing decreasing, government promotion, lack of alternative transport, better infrastructure are major driving force for rapid car increase in China. Among them, income growth, lack of alternative transport mode are most important ones.

- income increase

In 2005, Gross Domestic Products (GDP) of Beijing was 688.6 billion RMB(US$87billion), with the growth rate 11.4% from 1995 GDP per capita is 44772 RMB in 2005 (US$5667), comparing with that 567RMB in 1990 and 1548RMB in 1995. Per capita total income is 19533RMB in 2005, much more increased from 2067RMB in 1990 and 6748RMB in 1995. Annual income of one household could pay for one low price car in Beijing. This means it is time for family car to get into high panaration in Beijing(Beijing Statistic Yearbook 2006, 2006).

- price decrease of vehicles

During last 15 years, with industry productivity increase and market competition, together with WTO accession, car price decreased a lot. Figure 4.5.1 shows the price decrease for selected typical cars in China. There are nearly 40% of price decrease, when personal income increased a lot. At present the car price in China is nearly same with international price, or even lower. The major reason of the decrease of price is due to strong competition in China. Number of car manufactured in China increased from 337000 in 1995 to 2,8million in 2005.

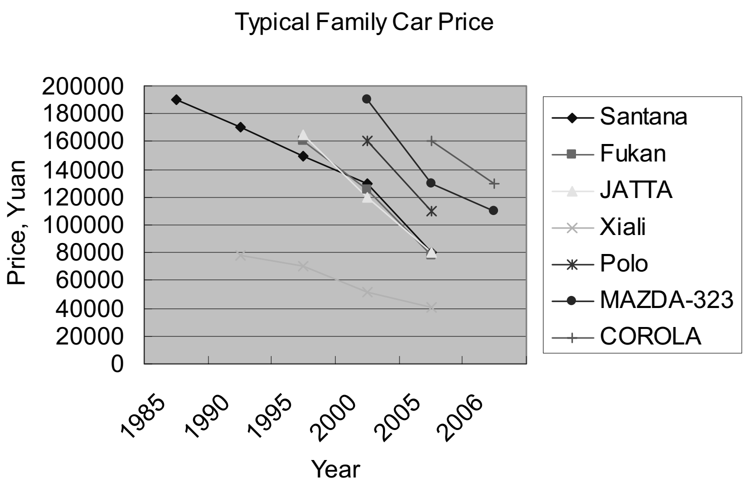

Figure 4.5.1 Typical family car price in China (data collected by authors from market)

According to the regulation of WTO, tariff of car decreased within 5 years from 70% to 80% to 25% by 2006. And the tariff of vehicle components decreased to 10% by 2006.

- Lack of sufficient public transport system

As a large city with population more then 15million, public transport system in Beijing is still not well developed, especially subway and metro system. Number of buses increased from around 6000 in 1990 to 18801 in 2005(Beijing Statistic Yearbook 2006, 2006), but there is difficulties to use bus because of slow speed and inconvenience(such as long distance to exchange between buses, subways, and very crowded during rush hour). Bus passengers suffer much with overall urban road congestion worsen. And the most important, Beijing is lack of efficient public transport system such as subway (now subway in Beijing is only 114km in total). With traffic jam going worse, normally it takes long time to travel with bus. Recently published survey shows nearly 50% bus user takes more than 1.5 hour for commute. In the meantime. Beijing is spreading out with city development, more and more people buy apartment outside city where public transport not well available, they have to rely on private cars. All these factors make using private car more attractive.

- City transport infrastructure

One of Beijing municipal government targets is to provide better transport condition for people. Increasing average vehicle travel speed in city is a major indicator of transport development in Beijing. Beijing is going to be a city suitable for vehicle use by constructing more and wider road inside city. By 2005, total length of road in Beijing is 5260km with high level road (more then 4 lanes with speed limit 70km/hour) 3012km, compared with that 3276km and 2320km in 1990. Better road condition results more vehicle use, and actually did not improve transport much (Beijing Yearbook 2006, 2006). Average vehicle speed in Beijing keep decrease from 18.6km per hour in 1996 to 16.8km per hour in 2005 (Beijing Transport Commission, 2006).

- Easy financing or loan for buying car in Beijing

Because car is getting more and more use in household in Beijing. Banks found their business opportunities in car bank loan. Started from 1999, bank loan was initialled for buying car (NDRC, 1999). Four banks started to provide loans. This provides much more opportunities for car purchasing. By October 2006, loan for car reached 180billion Yuan in China (Beijing Youth, 2006).

- Government promotion

Started from middle of 1990's, vehicle manufacture industry was set up as a one of key industries in China to be leading development economic sector. In order to promote the industry, it is listed to one of leading industries in national plan. And policy to encourage car purchase was made in China. In some cities, there are local regulation to limit car use. For example, Beijing, Shang Hai, Chong Qing etc. had regulation to limit mini car(with cylinder size less then 1000cc) use in downtown area. State government made announcement to ask local government to remove the car limitation regulation. And now some cities have removed the control on mini-car use, such as Beijing. This is also driven by domestic policy to encourage consumptions. Because domestic consumption is not enough, saving rate is very high compared with that in other country, it is nearly 50% in 2005. Therefore government put private car as one of important area for domestic consumption.

- Urban culture and lifestyle

To own a car is a symbol of better life and rich life, this is very common feeling for Chinese. And now there are more choice of cars with various style, giving car to be one part of life style in Beijing. In early 1990, there are only 2 to 3 type of cars suitable for family use with old fashion. But now there are more than 100 type of cars available for family use, and they are quite same with cars with other countries. This provide much basis for people to buy car as a symbol of life style.

2.2 Problems caused by growth of cars

- Traffic Congestions

According to information announced by Beijing Transport Administration Aagency, traffic congestion has increased a lot in recent years in Beijing. In 2003, and 2005, number of congestion area in Beijing reached to 84 and 63. Even though there are decrease in 2005, but it was more serious congestion in these congestion area and congestions overall all urban area is getting worse. (Beijing Transport Administration, 2006) It is reported the congestion area increased to be more than 110 in 2006, with average speed 50% decreased compared with 10 years ago. (Beijing Times, 2006)

Serious congestion mainly comes from increase of car. After 2000, more than 80% of newly increased vehicle in Beijing is car[3]. Because heavy vehicles are limited during rush hour, car is the major reason for the congestion.

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3. Data collected from sale of vehicles in Beijing.

- Air pollution

Beijing is one of cities with worst air pollution in the world. In recent years, sources of air pollution in Beijing has changed from coal burning whose primary pollutant is SO_2 to transport driving whose primary pollutant is NOx and CO. The annual concentration of NOx in Beijing ranks first in all north cities in China in recent years, exceeding the national standard (described in following text) 3.02 times in 1998 and mainly caused by transport pollution. On the other hand, the concentration of SO_2 and TSP are still worse than the national standard. Table 4.5.1 shows trend of concentration of those pollutants.

Table 4.5.1 Annual concentration of air pollutants in Beijing in recent years

	1986	1990	1996		2000		2004	
	Concentration*	Concentration	Concentration	Rank position **	Concentration	rank position	Concentration	rank position
SO2($10^{-3}g/m^3$)	0.124	0.122	0.099	15	0.124	7	0.055	15
TSP($10^{-3}g/m^3$)	0.346	0.374	-	-	-	-	0.149	20
NOx($10^{-3}g/m^3$)	0.071	0.098	0.117	1	0.133	1	0.071	1
Comprehensive air pollution index***	-	-	4.309	10	6.612	7	6.11	16

Notes: * Yearly average.
** The position of specified pollutant concentration of Beijing among all north cities in China
*** The comprehensive air pollution index is calculated by adding index for PM, SO2 and NOx. It is used in China to compare air quality among regions.
Source: China Environment Yearbook (1997-2005)

It was estimated that CO, Hydrocarbons (HC)) and NOx emission from transport sector amounted to 788 thousand tons, 143 thousand tons and 79 thousand tons in 2002 respectively, accounting for 57%, 82% and 58% of total emission in Beijing, respectively (Jiang et al, 2003). In 2004, NOx emission from vehicles accounted for 74%. (Hao et al., 2005). Even though emission standard was implemented in Beijing, car is still a major contributor for the emissions due to rapid increase of vehicle fleet.

- Noise pollution

Even through there is not much data to show the noise pollution, but noise pollution does become a serious problem now. There were already several conflicts between resident near by main road and road administration. There are many reports on noise pollution through media, and this is becoming an important factor to impact decision on road construction (Beijing Youth, 2005).

In 2004, there are 293 roads with total length 596.1km were monitored in urban area for noisy. Average traffic is 5654 vehicles per hour, 3% lower than that in 2003. Average noisy level is 69.6, where 68.1 in urban and 70.3 in suburb, nearly same with that in 2003. Noisy level is 69.1 in suburb area in Beijing (Beijing Environment Protection Bureau, 2006).

2.3 Policies to remove the negative effects

From 1998, in order to response to worsen air pollution in Beijing, and preparing for Beijing Olympic Game in 2008, Beijing municipal government initiated action programs to improve air quality. Very strong policy package were given by setting up action period. By end of 2005, there are altogether 12 periods for the action. There are more than 100 policy and measures have been implemented in Beijing. Many strict policies were implemented with focusing on urban transportation, including implementation of emission standards, eliminating old cars, etc. Data from Beijing Environment Protection Agency shows that air quality in recent years is better than that in the same period in 1998. But there is still a long way to go to improve the air quality significantly. 100 billion RMB (US$12.5Billion) will be invested by Beijing to improve its environment quality from 1998 to 2007, accounting for over 4% of total GDP in Beijing (Beijing Environment Bureau, 2002).

Inside the policy and countermeasure package, policy and countermeasures linked with transport mainly include:

- Compelling retirement of bad-polluted vehicles from the end of 1998;
- Issuing of weekly air quality report from March, 1998;
- Implementing of EUI standard from Jan 1, 1999 and EUII standard in 2003; national emission standard III in 2006, It is planned to implement national emission standard IV by 2008;
- Penetration of clean fuel vehicles in public transport sector started from Sep, 1999;
- Installing of tail-pipe purifying device for vehicles in use to meet the new emission standard.
- Acceleration of MRT construction.
- Remove limitation on compact car use in Beijing in beginning of 2006.
- Provide clean fuel for vehicle in order to start National Emission Standard III.

Besides the policies and countermeasures in the 12 stages, there are several other policies to improve urban transport system to mitigate the negative impact.

- Vehicle consumption tax. The vehicle consumption tax came in 1984 included in national consumption tax. In 2006, in order to promote compact car from the view point of energy efficiency and environment effects, it was revised to be: 3% tax for cylinder size less1 litter, 5% for larger than 1 litter and smaller than 2.2 litter, 9% larger than 2.2 litter and smaller than 3 litter, 14% for larger than 3 litter and smaller than 4 litter, 20% for larger than 4 litter. Purpose of consumption is to guide consumption. (State Administration of Taxation, 2006).
- Parking fee. Parking fees in Beijing were increased in June 2002, as one important measure to reduce vehicle use and promote public transport system. Parking fees differed by region, parking time and vehicle type.
- Road construction. By recognizing the weak of urban transport in Beijing, Beijing government put much effort to improve the city road system. By 2005, total road in Beijing reached 19009km, with 16.55km per 10000 people**,** 133.1km/100square kilometre. There are 4010km in urban area, with rapid road(with vechile speed 80km/hour in central city) 165km, mainstream road 638km. For whole city including suburb area, total express way(speed limit 100 to 120km/hour) is 525km, first level road 560km, second level road 2198km. In 2004, total investment for road construction is 4.7billion for 57 projects (Beijing Transport Administration, 2005).
- Public Transport. At beginning of 1990s, public transport development was given priority in Beijing's transport and city development. "Public Transport First" actually appeared in city five year planning. The serious problems are mainly caused by rapid growth of personal transport and slow development of public transport, especially of MRTS. By end of 2005, total number of bus is around 18800, compared with 12976 in 1990. Much better bus transport system was established. However problem for bus transport is the slow speed and over load during rush hours for major bus lines. This is really

discouraged use of bus system in Beijing. In order to improve the situation, started from 1997, bus lane was introduced in Beijing, first in Chang'An Street. Up to now, there are 45 road with bus lane, with total length 105.4km. Normally the bus lane operated from 7am to 9 am and 17pm to 19pm. It is planed the bus lane will reach 200km by 2008. Another important thing is Beijing started Rapid Bus Transport system in 2005, and it is planed to extend this system to be more than 200km by 2008 (Beijing Transport Commission, 2006).

2.4 Discussion on these policies and countermeasures

Policies and countermeasures adopted by Beijing government to improve air quality are effective. Compared with 1998: days with air quality above national standard reached 62% in 2005, while it was only 55% in 1998 (China Year Book 2006, 2006). Some improvement on environment pollution and congestion could be seen, but with limited effects because emission from transport is still increasing. Some discussion on successful stories and problems are given in flowing section.

- Success of Beijing's policies and countermeasures

1) By the end of 1998, 30 thousand bad polluting "yellow-mark-cars" have been scarped.
2) Penetration of AFVs in pubic transport sector is significant. By the end of 2002, 50 percent of taxi-cars have converted to LPG car (dual fuel), about 32000. Alternative fuel buses amounted to 5000 (40% of total bus stock), in which CNG-bus stock is 1800.
3) In 2000, Beijing started to use emission standard for vehicles to limit pollutant emissions. EURO Emission Norm was adopted. Since 2006, Beijing implemented national emission standard III(correspond to EURO III). This contributed much to pollutant emission control. Without this policy, the air pollution in Beijing could be much worse.
4) By the end of 2004, the total length of MRTs has been 114 km in Beijing. There is big progress comparing with that in the period of 1969 ~1998 when length of MRT was only 42 km and was kept stable almost 30 years.
5) Air quality in Beijing was improved in the period of 1999~2005 while vehicle stock kept increasing. The improvement was contributed both by vehicle emission control and energy structure optimization in Beijing, that is shift coal to natural gas.

- Problems with these efforts

1) Still hard to change the current trend of rapid increase of vehicle in Beijing, especially private cars. There is lack of strong policies on this.
2) Share of public transport to total passenger traffic volume is decreasing due to increase of private car, even though number of buses increased a lot. In 2005 the traffic volume by public transport is 28% while it is 36% in 2000 (ERI, 2002; Beijing Times, 2006).
3) Quantity of public transport has increased a lot, but quality did not follow up wel. Even though "Public transport first" was set up as principal in city development planning, however it seems this is not yet fully followed. Even with newly construct subway lines and bus lines, bad convenience could be seen in many place. For example exchange between subway lines and buses was badly designed by far away with each other(most famous one is metro line 13 and subway line No.2, the linkage is not good). Due to congestion in city, speed for bus is quite slow. Only in the case of bus lane(lane limited to be used by bus), the speed of bus could competed with other vehicles during rushing hour.
4) City design are going to the direction to construct main road to suitable for vehicle use. Much effort

was put into releasing congestion, rather than developing a systematic transport system. In recent years people using bicycle is reducing. Sprawl of city is one of the driving force for this, but worse situation for bicycle user and walker is another important reason. Ignore design for bicycle lane and sideway is big problem. Now there are around 10million bicycle in Beijing. Number of people using bicycle is decreasing because shifting to car and worsen condition to using bicycle.

5) Road construction focus on main road is quite doubtful. Serious problem for urban transport in Beijing is caused by lack of very well road network. Due to historical reasons, many place in Beijing is blocked by buildings belonging to one organization with closed area (such as Tsing Hua University). It is very common there is no any road crossing for one or two kilometres. This give very heavy burden on main road. And construction of main road also have very bad impact on traffic for these road cross the main road. Now it is very well known the bad traffic to cross these main road. Normally these main roads are half closed with fence in middle of road, and very few cross for other road in order to keep the main road better traffic. This really blocked other direction’s traffic. In the meantime, development of main road also very bad for non-mobile transport, it is quite hard for walkers and bicycle to cross the main road, and people was encouraged to use car instead of walk and bicycles. Construction of main road in old town also damaged the old city.

6) Slow progress for subway and metro construction in Beijing. Even though there has been big plan for subway and metro development in Beijing and now there are four line under construction, but in previous years the development of subway and metro was very slow, making big pressure in near future for urban public transport system. Subway and metro are final solution for a mega city. Now Beijing is developing quickly, later construction of subway and metro could increase the cost lot, and failed to contribute to city resident area allocation.

7) There is still lack of strong pricing signal for limitation on use of vehicle. There is progress on parking place raising, but still within limited area. Discussion on road using charge is still reminding discussion. The pricing policy should be made at early time and also pre-announced.

8) Heavy financial burden arose by MRT. The initial cost of Metro and light rapid transit (LRT) is about 500~600 and 200 million Yuan per kilometre, respectively, and at least 10 billion Yuan is required for each proposed line. The investment is too large for government to afford it alone. To resolve the problem, some new financial approaches are now under discussion to attract social and market investment.

3. Beijing and its transport picture in relation to car restraining

3.1 General picture of Beijing

Beijing locates in north-east China plain. Average temperature is 13.2 ℃ with highest monthly average temperature 27.9 ℃ in August and lowest monthly average temperature -2.9 ℃ in February. Total permanent population increased from 10.8million in 1990 to 15.4million in 2005, with 12.9million in urban area. Per capita total income increase from 2067.3Yuan (US$590) in 1990 to 19533Yuan (US$2382) in 2005. Total area of Beijing is 16410km2 including suburb area, with 1024km2 in the urban area. Beijing’s neighbours include another large city Tianjin, and Hebei Province. Western, northern and eastern Beijing are mountain area, which is major destination in weekend for people living in Beijing (Beijing Statistic Yearbook 2006, 2006).

Total GDP in Beijing is 688.6billion yuan (US$840billion) in 2005. Tertiary industry is major industry in Beijing by taking share of 69.1% with secondary industry 29.4%. Heavy industry is being removed from downtown area to suburb area or even outside Beijing due to air pollution program and high cost to operate in Beijing.

According to Beijing city plan, population will reach 18million in 2020. Annual GDP growth rate will be around 9% up to 2020, while tertiary industry keep extending.

3.2 Transport in Beijing

In 2005, motor vehicle stock is over 13 times of that in 1985, up to 2.83 million, with an annual average growth rate of 13.8%. Among in these motor vehicles, there are 2.64 million for passenger transport (including bus, trolleys, cars and motorcycles), accounting for 93.4%, 187000 for freight transport, accounting for 6.6%. Because of specific features of Beijing's urban transportation, there are almost 12 million non-motor vehicles in Beijing, including 11 million bicycles. However, the proportion of vehicle stock for public transportation dropped gradually in these years. In 1980, it accounted for 2.02%, where in 1998 it has dropped to 0.89%, 2005 0.56%. By the end of 2005, clean fuel buses, including bus-LPG and bus-CNG stock amounted to 3400. The overall road length for public transportation is 18670km in 2004. Vehicle stock for taxi service grew dramatically 1990s, and keeps the number after that due to government control, seeing in table . But its share in total vehicle stock has not changed much, just around 5%. The rapid increasing of vehicles stock in Beijing has caused many problems including heavy traffic jam, bad air and noise pollution.

The economy system reforming and opening policy began in 1978 has made it possible for people to purchase cars and other automobiles for daily and commercial purpose. Private automobiles began to be a statistical item of Beijing automobile management sectors in 1986, after that, the development of it went into fast growing stage.

Up to the end of 2005, private car amounted to 992000 units, accounting for 40% of total vehicle stock in Beijing. In average, every ten thousand population has 160 private cars and every 100 households have 22. By contrast, there are totally 314505 private automobiles in 1995, accounting for 39.11%, and 29.18 and 8.48 for every 1000 persons and 100 households respectively.

Table 4.5.2 private automobiles in Beijing

	1995	1998	2000	2004
Vehicle stock	804229	1163338	1364718	216.7
Private automobiles	314505	697707	855231	129800
Mix(%)	39.11	59.97	63.7	63%
Unit/1000persons	29.18	63.92	68.80	100
Unit/100households	8.48	18.20	21.2	33.6

Source: Beijing Statistical Yearbook (2004,2006)

It is believeds that more and more families will have their own cars as car price coming down and China entering into WTO. It is estimated by other study[2] that the stock of family cars will amount to 510 thousands and 2.17 million in 2000 and 2010, respectively. So the growth of motor vehicle in Beijing in future will heavily depend on the growth of family cars.

With the increase of vehicle in Beijing, congestion became a serious problem in Beijing. Construction of road was emphasized by local government. By 2005, total road in Beijing reached 19009km, compared with 14600km in 1995 (Beijing Statistical Yearbook 1996 and 2006).

By end of 2004, total number of bus is around 18600, compared with 6600 in 1990. Up to now, there are 45 road with bus lane, with total length 105.4km. Normally the bus lane operated from 7am to 9 am and 17pm to 19pm. It is planed the bus lane will reach 200km by 2008. Another important thing is Beijing started Rapid Bus Transport system in 2005, and it is planed to extend this system to be more than 200km by 2008. MRT extended to 113km in 2005, and now there are four subway lines under construction, another four lines will start construction in next two years (Beijing Transport Commission, 2006).

3.3 Future transport development scenarios in Beijing

A research in Energy Research Institute focus on future urban transport development. Due to income increase, urban transport in Beijing will develop rapidly. Car ownership keep increase and it is expected by 2020 nearly every family has one car in Beijing. This do give big pressure on urban transport and environment issues. This study tried to identify possible future picture of urban transport in Beijing, and answer questions on if possible policies measure adopted what will happen to reach a lower energy use and emission pathway.

In order to understand possible future for energy use and environment emission from urban transport in Beijing, analysis on the transport scenario for Beijing was conducted. Three scenarios were defined to describe possible future development trends in urban transport in Beijing. These are described below.

Government promotion (BaU): Present transportation policies will continue; present vehicles with lower energy use will become gradually more popular. This is given based on review for the policies adopted and planed by local government.

Technology Progress (TG): Additional environment-friendly policies such as emission standard, public transport promotion policies will be introduced, and present vehicles with lower energy use such as high fuel economy gasoline vehicle and new diesel vehicles will become rapidly more popular.

Clean future (CF): Additional policies and countermeasures will be introduced to increase the environment performance of transportation, such as the introduction of advanced cars (e.g. hybrid cars, fuel-cell cars), policies to encourage mini cars, integrated design of transportation system and city function area, top priority given to public transit, use of bio-gasoline, and public involvement.

In the model analysis, transport was divided into several mode in order to provide provision in detail based on technology classification. In each model, sub-mode was given to make further classification, and then technologies were provided. The transport mode and technology scenario is given in table 4.5.3. The scenario data is given based on the government planning, and income increase, travel demand etc. Energy and emission is calculated based on use of each technology in targeted year.

Table 4.5.3 number and traffic volume (baseline scenario and technology progress scenario)

	2000	2002	2010	2020
Vehicle, 1000	1365	1765	3900	5900
MRT,km	54.0	75.0	340	1000
Bus,1000	13	14	20	23
Private car,1000	321	458	2426	4106
Truck,1000	214	184	300	350
Motor cycle,1000	332	343	400	430
Bicycle,1000	9887	11010	11000	11000
Road passenger Traffic volume, billion person-km	74.9	81.2	139.4	166.5
Share of public transport(%)	31.3%	30.1%	32.7%	32.8%
Share of private transport				
Car	33.3%	39.9%	62.2%	71.1%
Taxi	10.1%	9.1%	5.3%	4.4%
Bicycle	31.2%	27.1%	14.6%	7.9%
Business bus	20.7%	19.7%	14.9%	14.1%
Motor cycle	4.6%	4.2%	3.0%	2.5%
Railway freight traffic volume,billion ton-km	20	21.9	25.5	31.0
Railway passenger traffic volume,billion person-km	6.27	7.6	9.5	14.0
Air passenger traffic volume, billion person-km	19.8	24	51.5	101.3
Air freight traffic volume, billion ton-km	1.7	2.3	3.6	7.1

3.4 Cars in Beijing

Booming of car could be tracked started from end of 1980s, with the manufacture of Germany car in China, Volkswagen's Santana. After that, another two famous car, Citroen's Fukang, Volkswagen's Jatta got into market, and dominated sale. Beginning of 2000s, much more brand of cars manufactured in China, and really provide nearly same cars in other famous car market countries. By 2005, there are nearly 100 new car get into market, and some of them are first manufactured in the world. Top ten big sale cars in China include Volkswagen's Santana, Citroen's Fukang, Volkswagen's Jatta, Volkswagen's Audi, Tianjin First Automobile's Xiali, Hyundai's Elantra, Volkswagen's PASSAT, Chery's Fengyun, Jili's Haoqing. Family car in normally has cylinder size 1.6 litter.

During last 10 years, price of car decrease a lot, this is major driving force for car get into family. Figure 4.5.1 presents typical car's price change in China.

4. Existing policies and policy measures

4.1 National and local policies

In order to promote sustainable development in China and in Beijing, a package of policies were implemented by national government and Beijing government. These policies focus on emission control from vehicle, promotion of high efficiency vehicles, widely development of public transport system, transport network development, intelligence transport system development etc. Compariing with national government policies, Beijing government made more relative policies to abate worsen traffic, environment pollution.

Among these polcies, development of public transport system is very close relationship with car using in Beijing and other cities. Recently national government (NDRC and Ministry of Construction) made clear statement for public transport development. However public transport development is a really local government issue rather than national government. In order to avoid local air pollution and traffic jam, many large cities in China made their own plan to develop public transport. For example, Beijing city put public transport development the first rank for urban transport. There will be more than 1000km mass railway transport system in Beijing by 2020 based on its planning. And Beijing made plan to make full effort to increase the share of public transport to by similar with some large cities in other countries. But we think public transport development is still lag behind.

4.2 Fiscal policies

Fiscal policies mainly cover tax for vehicles, parking fees, and fuels. Beijing government also made financing policies on public transport such as subway construction.

- Vehicle consumption tax. This is implemented in 1994 as one of component of national tax reforming, listed in “Consumption Tax Regulation of China”. The tax is given based on engine size, given as: 3% tax for cylinder size less1 litter, 5% for larger than 1 litter and smaller than 2.2 litter, 8% for larger than 2.2 litter. In 2006, in order to promote compact car from the view point of energy efficiency, it was revised to be: 3% tax for cylinder size less1 litter, 5% for larger than 1 litter and smaller than 2.2 litter, 9% larger than 2.2 litter and smaller than 3 litter, 14% for larger than 3 litter and smaller than 4 litter, 20% for larger than 4 litter. Purpose of consumption is to guide consumption.

- Parking fee. Parking fees in Beijing were increased in June 2002. Parking fees differed by regions, parking time and vehicle type. In the daytime, parking fees of outdoor parking lots located inside the No 4 Ring Road are now 2 yuan per hour for small-sized and 4 yuan per hour for large-sized vehicles, and outside the No. 4 Ring Road they are 1 and 2 yuan per hour, respectively. In the night-time, parking fees for different regions are the same, 1 yuan per hour for small-size vehicles and 2 yuan per hour for large-size vehicles. Before that, parking fee is 1 yuan for 4 hours during the day time. At the same time, some other kinds of parking fee were also increased in early 2003, especially for eight central areas. In eight downtown central commercial areas such as the Wangfujing, Dongdan, Xidan, Qianmen, and Financial Street areas, etc., the parking fees are now 5 yuan per hour for small-sized vehicles and 10 yuan per hour for large-sized vehicles.

  In order to limit private transport use, improve traffic congestion in urban area, and promote public transport, parking fee was increase as an important countermeasure in Beijing. Even thought it is hard to say how much traffic really reduced due to the parking fee increase, but it does impact the decision for people to travel to the area by using private car or other ways. So far the policy is quite successful and implemented without much difficulty. Not much public opposite was seen, and the administration system was established. This provide good basis for further parking pricing. And Beijing government made decision recently to further increase parking fee in a quite large area within third ring road to cover nearly all the downtown area in near future.

- Gasoline and diesel consumption tax In 1998, gasoline and diesel consumption tax was implemented. 0.2yuan/litter for unleaded vehicle use gasoline, and 0.1yuan/litter for diesel. Compared with the high gasoline and diesel price in Beijing, this is quite small impact on the prices.

- In order to construct sufficient transport infrastructure in Beijing, a considerable of investment is essential. Experience in the past reveals that it very difficult to fully depend on the government funding to construct the transport system in Beijing. Therefore, Beijing Government has brought forth some preferential policies and measures to attract investors from domestic and abroad to participate in the construction and operation of transport infrastructure in Beijing. These preferential policies increase the fund resources available for the construction of MRTS. In 2003, “Beijing City Infrastructure Special Allowance Operation Regulation” was announced by Beijing government, targeted getting more funding raising, accelerating city infrastructure construction, providing better public service. In the regulation, road, subway, metro and other public transport construction were included. There are four ways for the operation: 1) The infrastructure project could be invested, constructed, operated by companies within specific period, then transfer to government; 2) The infrastructure project could be operated by companies within specific period, then transfer to government; 3) The infrastructure project operated by companies within specific period; 4) other ways agreed by government. Budgetary funds from government, project-based bonds, loans from domestic banks, as well as loan from the World Bank and Japan are often used for MRTS construction. Taking the construction of No.5 subway line as example, Beijing Municipal Government has signed an initial agreement with Canadian Lanvanlin Corporation . According to this initial agreement, Beijing Government and Lanvanlin Corporation would provide 2.5 billion RMB and 1.5 billion RMB respectively as registered capital to established a new corporation that would take charge of the construction and operation of the No.5 subway line. And Lanvanlin Corporation would raise another 6~7 billion RMB in Canada to support No.5 subway construction. Company from Hong Kong joined construction of line No.4.
- Price for public transport is a topic discussed for long time in Beijing. Now price for bus and subway is decided based on cost with subsidy from Beijing government. Public transport price is kept to be low level in order to encourage people to use public transport. When the price is changing, public can join the process to decide price for bus and subway. Discussion is organized by newspapers and Public Meeting for Price was organized by government when new price is designed. In 2005, subsidy from government on bus system is 1billion yuan, and 0.5billion yuan on subway (BTA, 2006). By end of 2006, Beijing government decided to further reduce the price of public transport. By using IC card, there will be 60% discount for bus ticket, for more then.

4.3 Urban planning

- General urban planning

In 2004, Beijing City General Planning was made by Beijing government. In the planning, there are four strategies for space planning: 1) regional consistent development, by enhancing coordinating with nabour cities including Tianjin and other cities in Hebei Province; 2) Strategy shifting of urban function, by development of new towns outside centre urban city; 3) protection of old town by reducing city functions in the area; 4) integrating rural and urban area, by enlarging satellite towns.

According to the plan, total population will be around 18million in 2020, with 13.5million registed population, 16million in urban area. Population distribution will be leaded to new town and small town, by reducing centre urban population. By 2020, centre city population will be controlled to be around 8.5million, with new town population 5.7million, and small town 1.8million. In centre city area, there xwill be 5.4million population in urban centre, 2.7million in surrendered area, 0.4million outside.

By 2020, total land use for construction will be limited to 1650 square km. Land use of centre city is 778square km, new town 640 square km, other small town 212 square km. The city land space distribution will be Two-Axis, Two-Stripe, Multi-Centres. Two Axis is east-west axis along Chang’an street, south-north axis along traditional Beijing middle axis. Two Stripes are eastern development stripe including Tongzhou, Shunyi, Yizhuang, Huanrou, Miyun and Pinggu, and western development stripe including Daxing, Fangshan, Changping, Yanqing, Mentougou. Multi-Centres means Beijing will become several national centres for China and the world, including ZHongguangcun high-tech zone, Olympic Zone, Central business district (CBD), Haidian technology innovation zone, Shunyi modern manufacture area, Tongzhou integrated service centre, Yizhuang high-tech development centre, Shijingshan integrated service centre (Beijing Development and Reform Commission, 2005).

- Road construction

In order to develop transport in Beijing and improve traffic congestions, road construction is a major target in Beijing government. By 2005, total road in Beijing reached 19009km, with per capita 16.55km, 133.1km/100square kilometre. There are 4010km in urban area, with rapid road 165km, mainstream road 638km. Total express way is 525km, first level road 560km, second level road 2198km[4]. In 2004, total investment for road construction is 4.7billion yuan for 57 projects (Beijing Transport Administration, 2005).

It is planed to invest on transport infrastructure before 2010 with 5.2% of GDP in Beijing. And the investment will mainly focus on branch road network development, rather than main road development in previous years (Beijing Transport Administration, 2005).

However taking much effort on road development will put Beijing to be a city suitable for vehicle use. Much more wider road with more then four lanes. And now even more and more road which is not main road are separating by partition in middle road. All these are encouraging people to use car, and then bring congestion again.

- Public Transport

In the last more than ten years, due to rapid increase of private car, the share of public transport in passenger capacity tended to drop gradually, showing by table 4.5.4. The length of rail-based mass rapid transport system (MRTS) was only 44 kilometres in 1998 and 114 kilometres in 2005, much lower than that in similar international cities, such as Paris, Seoul, Tokyo, Moscow and New York. By contrast, personal transport was developing by a rapid growth rate. Up to 2001, the share of private automobiles in total vehicle stock has been amount to 67.9%, increasing by an average growth rate of 21% when compared with that in 1995. Rapid growth of private transport has been caused many problems, such as low transport efficiency, congestion and bad pollution.

Table 4.5.4 Mix of transport mode in Beijing

	1990	1995	1998	2000	2004
Public transport (%)	48.21	33.59	34.68	31.1	21.6
In which: MRTS	5.22	4.80	5.77	6.38	5.05
Personal transport (%)	51.79	66.41	65.32	68.9	78.4

Note: public transport refers to transit bus and subway; personal transport refers to private vehicles, bicycles, vehicles owned by social organizations and companies.

Source: ERI **(2004);** AIT report **(2002)**; Beijing Transport Administration, 2005

4. Rapid road has speed limitation of 80km/hour with closed lanes, no signal; mainstream road has speed limitation 70 to 80 km/hour with separate lane. First level road has separate lane with traffic 1500 to 30000 vehicles per day; second level road has the capacity of 3000 to 7500 vehicles per day.

The serious problems are mainly caused by rapid growth of personal transport and slow development of public transport, especially of MRTS. By end of 2004, total number of bus is around 16000, compared with that in 1990. Much better bus transport system was established. However problem for bus transport is the slow speed and over load during rush hours for major bus lines. This is really discouraged use of bus system in Beijing. In order to improve the situation, started from 1997, bus lane was introduced in Beijing, first in Chang'An Street. Up to now, there are 45 road with bus lane, with total length 105.4km. Normally the bus lane operated from 7am to 9 am and 17pm to 19pm. It is planed the bus lane[5] will reach 200km by 2008

Subway and MRT development in Beijing is speeding up. Up to the year of 2004, the length of rail-based mass rapid transport system (MRTS) was only 113 kilometres, much lower than that in similar international cities, such as Paris, Seoul, Tokyo, Moscow and New York. In view of the growing passenger travel demand, low efficiency of current transportation mode, and strict environmental requirement, Beijing government decided to take great effort to develop MRTS in the new century. A detailed project has been worked out. In the near future, the construction of rail-based mass transportation system is expected to boost greatly. The success of applying for hosting 2008 Olympic Game also stimulates the project. Now there are 113km subway under construction (in 2006).

Improve the urban transport efficiency in Beijing, forming a favorable public transport system, with well constructed public transport system is the target of Beijing government. Up to 2008, 60% of people's daily trip would be met by public transport network, 20% met by bicycles and the left 20% met by private transport. And 33% of public transport demand would be met by MRT, and in the year of 2020, the share would increase to 55% (Beijing Transport COmmission, 2005).

Beijing government make city development plan, components on transport was given as following:

- By the end of 2010, 13 subway lines and 2 extension lines are planned, and the total length of subway will be up to 408 kilometres.
- By the end of 2020, the downtown area will have 20 subway lines, totaling 700 kilometres.
- An additional 360 kilometres of the MRTS will link the central downtown core with the 14 satellite towns located on Beijing's outskirts and suburbs of the city, including light rail lines, suburban railways, tram lines, and magnetic suspension railways.
- For the non rail-based public transport system, the focus over the next seven years is to optimise the transportation network. With the downtown area as the centre and radiating out to the suburbs and residential areas, the final network will be highly accessible, rapid, and convenient.
- By 2008, the fleet of transit buses will number 18,000 (from about 10,000 now) with 650 public transport lines.

"Public transport first" policy was confirmed. More than 20 main roads have bus lanes, and bus routine and bus stop were designed in city planning, giving more convenience to public transport use. (BDRC, 2006)

4.4 Environment policies

Emission control for vehicles is an important way to reduce pollutant emissions from transport. Beijing leaded emission control There is rapid increase of vehicles in Beijing. Started from 1999, emission standard (Europe Emission Standard I) was used. Europe emission standard II adopted in 2002 for new vehicles. It is

5. In specific time period, the lane is only available for bus use. Typical time period includes 7:00am to 9:00am, 17:00pm to 19:00pm, and 7:00am to 8:00pm.

plan to adopt Europe Emission Standard III in 2005. National schedule to use similar system also was announced.

- emission standards

Pollutants Emission Standard for Light Vehicle (DB11/1-5-1998) was implemented in Beijing from January 1, 1999. This new standard is a kind of local compelling standard and it is equal to European Standard No.1.

The step to implement further emission standard is moving quickly. By June 1 2006, Beijing implemented National Emission Standard III (correspond to EURO III), to be the first city in China, with one year earlier than national plan. And it is planed to implement National Emission Standard IV by 2008 (correspond to EURO IV).

4.5 Fuel

Availability of High Quality Fuel is very important for emission control in transport. In order to promote introduction of emission standard for vehicles, high quality fuel standard was announced. The first step is use of un-lead gasoline which started from June 1997 firstly in Beijing. In order to introduce emission standard of European Standard III in 2007, fuel provider was asked to produce cleaner (sulphur content less than 150ppmv) gasoline and diesel before 2007.

4.6 Others

- Emission checking system. Before the introduction of emission standard, there was no emission checking system in Beijing. At first two working stage checking system was used in 1998, and it was improved to use simple working checking system from 2003.
- Intelligent transport system. An Intelligent Transportation System (ITS) effectively applies advanced information, communication, control and computer technologies to the whole transportation system, through which the close coordination between people, vehicles and roads can be realized. ITS can help to establish a large-scale, versatile, real-time, accurate, high-efficiency, low-energy-use and low-pollution integrated management and service system of transportation.
- ITS provides support for transportation participants who can be subdivided into two subsets: (1) transportation users and customers, the (2) transportation managers and organizers. ITS is expected to provide convenient traffic conditions, mainly information services, for the former and powerful supportive and controlling tools, mainly supportive decision-making information, for the latter.
- Government projects on transport. Since the latter period of “ninth-five-year-plan,” Beijing preliminarily established 12 intelligent transportation systems, including a transportation controlling center, a command and deployment system, a transportation monitoring system, a signal controlling system, a transportation induction system, and a global positioning system (GPS) for traffic police vehicles, a “122” call-the-police system for traffic accidents, an automatic monitoring system on traffic violations, a traffic information collection and disposition system, a computer lattice system for traffic management, a digitalized management system and an information management system. The detailed implementation of some of these systems is as follows:

- Transportation monitoring system: 175 camera-monitoring points have been established creating seamless camera monitoring of ring roads.
- Transportation signal controlling system: Central controlling of 252 urban crossings and coordinated control of six main roads. The computerized real-time optional controlling of the Ping-an Street crossing and the Liangguang Street crossing has been realized, with good results.

- Transportation induction system: Presently there are nine of outdoor display screens being used on the No. 2 Ring Road and linking road. Through the command sent by the command center, the information displayed on the screen can be scrolled and changed.
- GPS for traffic police vehicle: 240 traffic police vehicles have been equipped with GPS. If a traffic accident happens, the command center can identify which vehicles are near the accident and dispatch the nearest one to solve the problem as soon as possible by wireless telephone.
- Automatic monitoring system of traffic violations: In total 402 sets of equipment have been installed and can automatically monitor seven kinds of traffic violations, 24 hours a day. The system data and video images of 53 crossroads can be retrieved automatically.
- Collection and disposition system of traffic signals: 500 annular-coil monitors installed on 80 crossings of main urban streets can collect traffic flow capacity information. 144 monitoring sections installed on the No. 2 Ring Road and No. 3 Ring Road can collect real-time traffic information about flow capacity and average speeds of vehicles.

Another one policy related to parking is to reduce parking log in down town area, to give more space for transport and bicycle lane. More than 500 car parking log along road were removed this year. This gives less incentive for people to use car to downtown area.

Recently there are several important progress for low energy use vehicles. One is hybrid car with could reduce around 60% energy use comparing with normal car. Several car manufactures will bring this technology to China and start production in 2005. Another one is the development of fuel car is much more promising now. It is expected fuel cell car will be commercially on road in 2010 to 2015. To encourage using of high efficient car is one of policies options for government now, such as tax exemption or subsidy.

5. Strategic analyses

5.1 Emerging direction of major car restraining policies in Beijing

There are a lot of successful story for policies implemented. However with the continuous rapid increase of vehicles in Beijing, negative impacts of vehicle is getting serious. There are more difficulties to improve further air quality and congestion in Beijing, and much more strong policies is needed for future.

Recently there are discussions and several studies on future policies and countermeasure for urban transport development. They mainly include:

- Fuel tax. Fuel tax is a national policy. After more then 7 years discussion, it is announced in China's 11th Five Year Plan that fuel tax will be implemented before 2010. It is said the tax will be started when gasoline price gets stable. Even though the tax it levied to replace existing road construction fee, but it provide much better basis for people to use vehicle, and this could be a start for further introduction of gasoline tax. However the detailed tax system is not yet fixed and now is under study. Initial idea is to levy 1 to 1.5 yuan/litter for gasoline and diesel at first stage, then generally increase it to be near level in Europe around 2020.
- Road pricing. One discussion is about to levy road fee when vehicle drive in some area. This will be the most effective one to control use of vehicles. It is proposed to implement road fee for area with second ring road (also named as traffic jam fee).
- Public transport development. Public transport was again emphasized in the new city development plan (Beijing Development and Reform Commission, 2006). In the plan, strong support was given to public

transport. By 2020, share of public transport will increase to more than 50%, and subway, metro and rapid bus system will take more than 50% of public transport.

- No-entry regulation. In some area, no vehicle is allowed to get in. Wangfujing Commercial area is the first one in Beijing to limit vehicle use. And it is proposed to extend this policy to other area where public transport well available.
- Parking pricing. Beijing government already decided to use parking price as a way to control vehicle use in urban area. It is planed to use parking price 5yuan/hour for car within 4^{th} ring road, which covers major part of urban area in Beijing.
- Road network development. Together with city development plan, road network development is also key component of the plan. Focus will be given to branch road development, rather than main road development. Better design for bicycle lane and sideway should be key point of the road construction.
- Public awareness. One of the important policy is to increase public awareness on transport. Involvement of public for their choice on travel will strongly support better transport system.

5.2 Role of actors in the policy making process

5.2.1 Actors

1) National government agency

Actors for transport related policy making in national government agency include:

- National Development and Reform commission (NDRC): major responsibilities include: transport development planning, emission standards, vehicle fuel efficiency standards, fuel tax, consumption tax, road pricing, fuel quality.
- State Environment Protection Administration: major responsibilities include environment regulation, vehicle emission standard, fuel quality.
- Ministry of Transport: responsibilities include: road development planning, road charges.
- Ministry of Finance: responsibility include financial policy on transport development, subsidies for public transport.
- National Tax Bureau (TB): fuel tax.
- Ministry of Construction: development of subway system, city planning.

2) Beijing government agency

- Beijing Development and Reform Commission (BDRC): sustainable development policies, urban planning, transport planning, environment planning, road pricing, parking pricing, fuel quality, emission standard.
- Beijing Environment Protection Administration: emission standard, fuel quality regulation.
- Beijing Transport Administration (BTA): transport planning, transport financing policy, road network development, public transport development policies, road pricing, parking pricing.
- Beijing Municipal Commission of Urban Planning (BMCUP): city planning, subway, metro, and other public transport planning.

3) Research teams

Research teams play important role in policy making supporting, by providing research output to government. Most of policies for urban transport were studied by various research teams before final policy making. Research team from Tsinghua University, Beijing Academy of Social Science, China Automobile Research Centre are major supporter. Recommendation from research teams are very important for the policy making and implementation.

4) Public involvement

With the government reforming progress, public can also join the policy making process. Before the important policy making, there will be public opinion survey period to get comments from public. For example, Beijing City Planning 2004-2020 was disclosed to public through website and exhibition for several weeks, to get public comments. Other important policies also have similar process. For some decision having close relation with public such as pricing, public hearing of witnesses is regulated.

5) Industries

Industries could also have strong influence on some policy making process. For example new emission standard need involvement of vehicle manufacture industry and oil industries.

5.2.2 Role of actors

1) Fuel tax

Fuel tax is decided by national government. Major actors is given in table 4.5.5.

Table 4.5.5 Actors and their function for fuel tax policy making

	Functions
NDRC	Heavily involved in the proposing process, support the policy from the view point of energy saving and environment protection. But also rising questions on impact on farmer. Play a role for balancing the negotiation.
SEPA	Support the policy, because of better environment effects
MoF	Joined the discussion. Basically support the policy, but made several time statement to wait for better timing on oil pricing to fall down.
TB	Joined the discussion, support the policy. Fuel tax is matching the tax reforming in China.
Ministry of Transport	Oppose the policy because fuel tax will replace road construction fee collected by Ministry of Transport. And There will be employee problem for people to collect road construction fee.
Industry	Petroleum industry did not support this because this policy will have strong impact on their profit. As state owned enterprise, they joined the discussion.
Public	Diverse.
Research team	Research team did contribute a lot for the policy proposal by taking research project on fuel taxes. However original research output failed to cover enough factors which

2) Road pricing

Road pricing policy is a local policy. It has relationship with pricing, urban road infrastructure, transport administration. Table 4.5.6 gives major actors for the policy option.

Table 4.5.6 Actors and their function for road pricing policy making

Actors	Functions
BDRC	Organizer for transport development strategy, including pricing for road using with focus on congestion. BDRC will be the leading agency for road pricing. Pricing also is administrated by BDRC in Beijing.
BTA	Support the policy and joined the discussion
Public	Now opposed the idea, because this will increase the travel cost. However attitude maybe change depend on the regulation on pricing. For example, after road construction fee is replaced by tax, the pricing system for car use could be more rational.
Research team	Research team did contribute a lot for the policy proposal by taking research project on road pricing. But among researchers there are still arguments. Tsinghua University, Transport Research Institute of NDRC made study on road pricing.

3) Public transport development

Table 4.5.7 gives major actors for the policy option.

Table 4.5.7 Actors and their function for public transport development

	Functions
BDRC	Role to make city development plan, in which public transport is one important component. Infrastructure Division is responsible for urban transport.
BTA	Government agency for public transport development plan, budget, and construction project administration.
Beijing Finance Bureau	Administration on public transport budget.
BMCUP	Urban planning, where public transport is key component
Beijing Construction Bureau	City construction project administration. Important for public transport infrastructure development.
Beijing Bus Company	
Private investors	Potential benefit for investment in public transport.
Public	Strong support

4) No-Entry policy

Table 4.5.8 gives major actors for the policy option.

Table 4.5.8 Actors and their function for no-entry policy

	Functions
BTA	Government agency for urban transport, joining decision making process on no-entry area.
BMCUP	Urban planning, provide urban land use planning for urban area.
Public	Strong support
District government	Major decision maker. Not very much agree with the no-entry area idea, mainly due to local development concerning.

5) Parking pricing

Table 4.5.9 gives major actors for the policy option.

Table 4.5.9 Actors and their function for parking pricing policy

	Functions
BDRC	Role to make city development plan, in which public transport is one important component. Infrastructure Division is responsible for urban transport.
BTA	Government agency for public transport development plan, budget, and construction project administration.
Beijing Finance Bureau	Administration on public transport budget.
BMCUP	Urban planning, where public transport is key component
Beijing Construction Bureau	City construction project administration. Important for public transport infrastructure development.
Public	Strong support

6) Road network development

Table 4.5.10 gives major actors for the policy option.

Table 4.5.10 Actors and their function for road network development

	Functions
BDRC	Role to make city development plan including road network.
BTA	Government agency for transport development plan.
Beijing Finance Bureau	Administration on road construction budget.
BMCUP	Urban planning
Beijing Construction Bureau	City construction project administration.
Public	Support

7) Public awareness

Table 4.5.11 gives major actors for the policy option.

Table 4.5.11 Actors and their function for public awareness policy

	Functions
BDRC	Role to make city development plan including road network.
BTA	Government agency for transport development plan.
Beijing Environment Protection Bureau	Administration on road construction budget.
Public	Support

5.3 Timing

- Fuel tax. Fuel tax is already in the schedule of government. In 11th Five Year Plan, it is clearly mentioned fuel tax will be implemented during 11th Five Year Plan(year 2006 to 2010). Now Ministry of Finance is studying on it. By reviewing the discussion process of fuel tax in last several years, it is expected to present the fuel tax system in near future. The energy intensity target in 11th Five Year Plan also is a positive factor to promote fuel tax to be implemented in near future. To reach the energy intensity target, it is expected to have more energy related policies to reach the target. And energy intensity increase in 2006 raised much demand on policies in near future, fuel tax could be one of important policy in the policy options. However balancing benefits for various stakeholders still need some process to negotiate, including impact on economy, public awareness and acceptance, oil price uncertainty, relationship with road construction fee, etc.
- Road pricing. The policy is under discussion and getting into attention of government. This still need more negotiation between government agencies by considering impact on car user, congestion, investment, administration issues. Implementation of the policy depends on the final decision of local government and other policies on urban transport.
- Public transport development.

5.4 Air pollutant

- Fuel Tax. For sure adoption of fuel tax could contribute to pollutant emission reduction by reducing using of vehicles. Study shows there will be around 8 to 10 percent energy reduction in 2010 for vehicles use by using fuel tax in China (Jiang et al, 2006). Therefore this will reduce emission from urban transport. By thinking about air pollution control program in Beijing and plan for Olympic in 2008, this policy could be easily adopted by local government. Emission control is a important factor to facilitate the policy.
- Road pricing. Road pricing certainly could reduce car using in specified area, therefore reduce pollutant emission from cars.
- Public transport development. Compared with car, travel by public transport normally can reduce fuel use 60% to 90%, and there will be 50-80% emission reduction (Jiang et al, 2003). Development of public transport has significant emission reduction which contribute to air pollution control. Compared with other vehicles, it is easier to use clearer bus or alternatives fuel vehicles. This gives strong support for public transport development in Beijing.

- Parking pricing. Whether the policy can significant reduce emission depends on public transport development. Alternative transport mode has to be provided. In general increasing parking price could reduce car use, and then reduce pollutant emissions.

5.5 Level of uncertainties on key assumptions

- Fuel tax. Even through there are some uncertainties on the impact of fuel tax on less use of car in Beijing, but experience from other countries presented good practice on less car use and promote alternative transport mode (IGES, 2005; Jiang et al, 2006; Huang et al, 2006). Recent years oil price increase already shows the effects on less car use and higher sale of energy saving cars. However to make the policy more efficient, policy to promote alternative transport mode should also be designed and implemented (Jiang et al, 2004).
- Road pricing. Effect of road pricing on traffic is quite well proven by experience in other countries. This is a major driving force to facilitate the policy. But uncertainty on cost-benefit balance is barrier for implementation of this policy.
- Public transport development.

5.6 Key implementation issues

- Fuel Tax. Fuel tax is promoted by national government, and quite match local government development target on energy security, air pollution control. There will be no barrier for authority on the policy.

  Strategy compatibility: consistent with national tax reforming and sustainable development strategy.

  Implemented by : national government

  Political feasibility: High

  Administrative and Institutional feasibility: Medium. Need negotiation among government agency.

  Financiability: Not much on this.

  Compatible to prevailing local context: High.

- Road pricing. This is a local policy, no conflict with national policy. This could be one of policies to support national sustainable development strategy. Local government (BTA) will implement this policy. Major barrier is road pricing need large investment to construct the system, and also has competition from other policy options. Origionally the policy is designed for the area within second ring road in Beijing, it need monitoring system for the road to get in the area, and electronic paying system is also needed for vehicles. This give difficult administration and raise the cost for administration. There policies to promote public transport system such as more bus lane and subway could also discourage car using in the area.

  Strategy compatibility: not conflict with national policy.

  Implemented by : Beijing government

  Political feasibility: High

  Administrative and Institutional feasibility: low. Need to construct road monitoring system, and also need new administration system.

  Financiability: initial cost on this is high.

  Compatible to prevailing local context: High.

- Public transport development. This is a local government policy with fully support from national government. Local government agency is the implementation authority for the policy. Development of public transport is already in the government schedule and have made effort on it. However the development of public transport in Beijing failed to support the urban transport development. Traffic by public transport decreased in last several years from 38% in 2000 to 26% in 2005 (BTA, 2006). Therefore implementation of public transport need very strong implementation to support the urban development in Beijing. In the 11th Five Year Plan of Beijing, public transport again is put to be the first rank of city development targets. Investment limitation is general removing because Beijing government already decided to increase the investment on public transport, especially subway. And more and more policies were made to get private investment. Biggest problem for public transport development is it do need very well designed city planning and changing the mind of city development for a sustainable development oriented city.

  Strategy compatibility: consistent with national sustainable development strategy.

  Implemented by : national and Beijing government.

  Political feasibility: Very high

  Administrative and Institutional feasibility: High. There are already existing administrative system

  Financiability: Need large investment. With government income increase rapidly (Beijing government revenue increase to 111.7billion Yuan in 2006 compared with 59.2billion in 2003) (Beijing Taxation Bureau, 2006). Public transport investment should be major part of government investment.

  Compatible to prevailing local context: High.

- No-entry policy. This will be implemented by Beijing government, together with district government.

  Strategy compatibility: no conflict with national policies.

  Implemented by : Beijing municipal government

  Political feasibility: Medium. There will be conflict with congestion problem.

  Administrative and Institutional feasibility: High. No additional administration system needed.

  Financiability: Need not much investment.

  Compatible to prevailing local context: Medium.

- Parking pricing. This already adopted and will continue to extend by Beijing government. Barriers include acceptance of public, administration. High cost for parking could bring strong opposite from car users. But with increasing of public awareness and serious congestion in downtown area, this could be understood by public. Beijing government already announced that the parking fee will be increased, to discourage car use and release the pressure for car parking. Fully effort to develop better public transport system could also support this option.

  Strategy compatibility: no conflict with national policies.

  Implemented by : Beijing municipal government

  Political feasibility: Medium. Public acceptance is major barrier, and another barrier is public transport system is still very well developed.

  Administrative and Institutional feasibility: High. No additional administration system needed.

  Financiability: Need not much investment.

Compatible to prevailing local context: High.

5.7 Cross sectoral impacts

- Fuel tax. Impact on other sectors is key factor to imped implementation of fuel tax in China. Major arguments on the fuel tax is impact on farmer, impact on vehicle fuel sensitive sectors such as taxi, transport business, acceptation of public. Increase income of farmer is key concerning of government, using of fuel tax will have negative impact on farmer's expenditure. But this could be soften by new national program on new countryside development and policy to reduce agriculture related taxes (NDRC, 2005).
- Road pricing. There will be negative impact on taxi business, but could be solved by taxi pricing system. Public transport will not be impacted.
- Public transport development.
- No-Entry policy. There will be some impact on public transport and taxi business, but depend on the regulation. For example no-entry policy could be excepted for public transport. No-entry policy could have positive impact on taxi business.
- Parking pricing.
- Public awareness. Raising of public awareness on less using of car could have strong contribution on environment protection. Normally less using car comes together with environment protect during public education.

6. Discussions and conclusions

From this report, we may give following finding:

- Number of vehicle has been rapidly increasing from early 1990s, this brought negative impact on urban transport system and local environment.
- Increase of car is major source for vehicle increasing in Beijing, and also major contributor for negative effects, including air pollution, congestion and noisy pollution.
- Income increase, decrease of car price are key driving force for rapid increase of cars.
- A package of policies were implemented by Beijing government to improve environment and transport. They are effective to control the worsen situation.
- Among the policies, encouraging car using policies include development of road, removing of compact car use in Beijing.
- Among the policies, policies to limit car use include increasing parking fee, increasing consumption tax for larger engine passenger vehicles.
- With the policy implementation, air quality is improving, but congestion and noisy pollution are getting worse.
- It is forecast the number of vehicle will keep increasing, around 5 to 6 million by 2020.
- Improve air quality and provide good urban transport system is key task for Beijing government, as targeted in Beijing long-term planning.

- More policies should be implemented in near future to reduce pollutant emissions and improving congestions.
- Fiscal policies including fuel tax, parking pricing, road pricing could be good options in near future, with good experience locally or in other countries. This could constraint car use in Beijing.
- Parking pricing already implemented in Beijing and it is quite successful. There is no strong public opposition and now government planed to extend the pricing by increasing the rate and using it in large region.
- Using of parking pricing policy is most important one for constraint of car use in Beijing. Now there is good basis for further extending. However major barriers include public acceptance and lack of sufficient public transport system.
- Public transport should be further emphasized and development to support a well constructed urban transport system. This could further encourage people to use less car.
- Subway and metro could contribute much to a well constructed urban transport system in Beijing. Even though it is has high initial cost, but it will finally provide convenient and rapid urban transport system. The subway system should be early constructed to avoid higher cost. Now the development of subway and metro has good opportunities because of very large domestic investment available. Financing policies to attract various investment should be designed.
- Reducing ownership of cars has conflict with national government to promote vehicle manufacture industry, and encouraging domestic consumptions. However option could be found to reduce utilization of cars when ownership of cars could be high.
- In order to implement other policy measures, construct a convenient and fast public transport system, and a road system for non-vehicle transport are very important. When car use is limited, alternative ways for transport should be provided, public transport, non-vehicle transport are the options,

Rapid increase of car dominated vehicle increase in Beijing. This trend is expected for next 15 years together with income increase and population increase. Seeking policy to control car use is one of key policy demand for Beijing government. From this report fuel tax, road pricing, public transport development, parking fee, no-entry zone, public awareness raising are major policy options discussed. Due to national government policy to promote car manufacture to be important economy development driving force, limitation of car ownership was not discussed here. Focus is given to reducing car use while no limitation for car ownership.

There are potential to implement these policies in near future in Beijing. Key factors impacting policy making process on these policies are discussed in this report, and they are briefly summarized here:

- Fuel tax. Clear government direction shown in 11^{th} five year plan gave most important driving for the policy. However balancing among sectors do need time to discuss, this will impede early adoption of fuel tax in China.
- Road pricing. Effects to control traffic from car is certain, this is major driving force to adopt this policy. Implementing issues including high cost and hard to monitor are major factor to impede the policy.
- Public transport development. Public transport development is the only way to solve urban transport congestion and emission problem in a extra-large city like Beijing. There is no doubt to develop public transport, this is very strong support for the policy, confirmed by local government planning. However what kind of effort should be given to public transport was not very clear in last decades and present worsen situation for public transport. This will still be a problem in future for further public transport

development, not yet get very common understanding for biggest effort on public transport, even there are argument among researchers. Large demand for investment is key reason for the problem.

- Parking fee. It is certain that this policy will be implemented in Beijing in near future. Experience from other country give strong support on this policy. Implementation issue such as better alternative transport mode especially subway development is major concerning now.
- No Entry policy. There are potential to use this policy in some area in Beijing such as part of Xidan where is commercial centre. But this will worse the congestion.
- Public awareness. There is no argument on this. But further investment is necessary and more public involvement.

Experience from other cities in China and other countries are very important for policy making in Beijing. Looking for policy options in other cities actually is most important source for initial idea of policy options in Beijing, in past years and also in future. There are some uncertainties for the policy options to be implemented in Beijing, but experience from other cities can strong support the policy making process. Special situation for Beijing is 1) rapid increase of income, this make infrasture change quickly, and mind change quickly; 2) Keeping stable social-economic development is a major concerning of national government, implementation of policies need much negotiation among various stakeholders, especially policy related with pricing which could have potential impact on poor people. Therefore experience from other cities or countries could be learned with adoption to local condition.

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Appendix : Numerical data

1. Geographic, demographic and economic information

Table 4.5.a.1 Area of Beijing by district and counties

Item	Land Area
Total	**16410.54**
Dongcheng	25.34
Xicheng	31.62
Chongwen	16.52
Xuanwu	18.91
Chaoyang	455.08
Fengtai	305.80
Shijingshan	84.32
Haidian	430.73
Fangshan	1989.54
Tongzhou	906.28
Shunyi	1019.89
Changping	1343.54
Daxing	1036.32
Mentougou	1450.70
Huairou	2122.62
Pinggu	950.13
Miyun	2229.45
Yanqing	1993.75

Table 4.5.a.2 Population in Beijing (10000 persons)

	1990	1995	2000	2004	2005
Population					
Year-end Total Population	1086	1251.1	1363.6	1492.7	1538.0
Male	545	627.0	710.9	779.9	778.7
Female	541	624.1	652.7	712.8	759.3
Year-end permanent Residents Registered	1032.2	1070.3	1107.5	1162.9	1180.7
Employment	627.1	665.3	619.3	854.1	878.0
Fully Employed Staff and Workers	454.9	470.9	434.2	446.4	448.4

Table 4.5.a.3 GDP and Population in Beijing (current price, 10^8 RMB,)

	GDP Billion	Permanent Population million	GDP Per Capita Yuan
1980	13.9	9.04	1,537
1986	28.5	10.28	2,772
1990	50.1	10.8	4,880
1995	150.7	12.5	12,237
2000	316.1	13.6	19,397
2004	606.0	14.93	28,687
2005	688.6	153.8	44,772

Table 4.5.a.4 Population in Beijing (unit: 10000)

	Permanent Population	Urban Population	Rural Population
1980	904.3		
1985	981		
1990	1086	798	288
1995	1251.1	946.2	304.9
2000	1363.6	1057.4	306.2
2001	1385.1	1081.2	303.9
2002	1423.2	1118.0	305.2
2003	1456.4	1151.3	305.1
2004	1492.7	1187.2	305.5
2005	1538.0	1286.1	251.9

Table 4.5.a.5 GDP in Beijing

		1990	1995	2000	2004	2005
Gross Domestic Product	(100 million yuan)	500.8	1507.7	3161.0	6060.3	6886.3
Primary industry		43.9	72.2	76.6	93.4	95.5
Secondary Industry		262.4	645.8	1033.3	1853.6	2026.5
Tertiary Industry		194.5	789.7	2051.1	4113.3	4764.3
Per Capita Gross Domestic Products	(yuan)	4635	12691	24121	41099	45439

Table 4.5.a.6 Household income

		1990	1995	2000	2004	2005
Per Capita Annual Disposable Income of Urban Households	(yuan)	1787.1	5868.4	10349.7	15637.8	17653.0
Per Capita Net Income of Rural Residents	(yuan)	1297.1	3208.5	4687.0	7172.1	7860.0
Saving Deposits of Urban and Rural Residents	(100 million yuan)	226.6	1254.0	2923.2	6122.3	7477.6
Urban	(100 million yuan)	188.0	1111.5	2663.3	5692.8	6968.9
Rural	(100 million yuan)	38.6	142.5	259.9	429.6	508.7
Total Wages	(100 million yuan)	118.9	382.0	695.5	1315.1	1520.1
Average wage of Staff and Workers	(yuan)	2653	8144	15726	29674	34191

2. Beijing political/road/public transport map

Figure 4.5.a.1 Planning of Beijing Road network

3. Transport infrastructure: Road/rail/subway length and respective amount of investments if available

Table 4.5.a.7 Number of transport routes

	2000	2004	2005
Railway	26	26	26
Highway	2989	3268	3316
Civil Aviation	156	568	600
Air China	112	306	316
China Xinhua Airlines	44	262	284
Petroleum and Gas Pipelines	8	9	10

Table 4.5.a.8 Length of transport (unit: km)

Year	Railway Operating Length	Highway Operating Length
1980	707	7339
1986	876	8849
1990	876	9648
1995	875	11811
2000	996.9	13597
2001	987	13891
2002	987	14359
2003	964.4	14453
2004	964.4	14630
2005	965.6	14696

Table 4.5.a.9 Investment in transport in Beijing (unit: 10000yuan)

		2000	2004	2005
Investment in Transportation		1226260	1689371	1923688
Railway		54728	75913	56871
Highway		342853	305067	281701
Aviation		21046	16044	97752
Posts and Telecommunications		682042	684606	738351
Transportation Subsidiary Services		125591	607741	749013

4. Travel activity characteristics: Share of various modes of travel (road, rail, public, private, non-motorized)

Table 4.5.a.10 Passenger traffic in Beijing (unit: 10000 person)

Year	Total	Railway	Highway	Civil Aviation
1980		2762		58.4
1986	7336.7	4106	3059	171.7
1990	7480.3	3770	3490	220.3
1995	8913	4017	4250	646
2000	18396.1	4458.4	13009	928.7
2001	22469.1	4749.6	16630	1089.5
2002	28384.3	5032.3	22103	1249
2003	30520.2	4351.8	24940	1228.4
2004	49749.8	5436.8	41463	2850
2005	60840	5779	51925	3137

Table 4.5.a.11 Freight traffic in Beijing (unit: 10000 tons)

Year	Total	Railway	Highway	Civil Aviation	Pipeline
1980	7571	3356	4213	2	
1986	22641	3030	18794.2	6.3	810.5
1990	26647.9	3051	23326	9.5	261.5
1995	32184.6	2974	29087	17	106.36
2000	30716.7	2611.7	28010	34.7	60.3
2001	30607.1	2505.4	28007	37.7	57
2002	30961	2347.7	28375	44.3	194
2003	30924.9	2264.8	28361	45.1	254
2004	31700.23	1958.6	29256	73.3	412.33
2005	32509.1	1976	30050	77	406.1

Table 4.5.a.12 Share of Public Transport in Beijing

	1990	1995	1998	2000	2004
Public transport (%)	48.21	33.59	34.68	31.1	21.6
In which: MRTS	5.22	4.80	5.77	6.38	5.05
Personal transport (%)	51.79	66.41	65.32	68.9	78.4

Table 4.5.a.13 Public transport in Beijing

		2000	2004	2005
Operating Vehicles (year-end)	(unit)	14191	21711	20840
Buses	(unit)	12976	18612	18801
Mini-Buses	(unit)	3251	1652	598
Trolley Buses	(unit)	628	555	473
Subways	(unit)	587	892	968
Operating Routes				
Number	(line)	682	621	626
Buses	(line)	666	539	578
Mini-Buses	(line)	222	63	29
Trolley Buses	(line)	14	15	15
Subways	(line)	2	4	4
Length	(km)	15638.8	19110	19135
Buses	(km)	15411.1	17116	17924
Mini-Buses	(km)	4151.7	1690	907
Trolley Buses	(km)	173.7	190	190
Subways	(km)	54	114	114
Passengers Carried	(10000 person-times)	406691	513876	525606
By Type of Vehicles				
Buses and Trolley Buses	(10000 person-times)	363213	442691	450845
Mini- Buses	(10000 person-times)	15717.9	10532	6785
Subways	(10000 person-times)	43478	60653	67976

5. Vehicle population (total, by type), car population, buses serving public transportation, taxies

Table 4.5.a.14 passenger transport in Beijing, 1000

	1995	2000	2002	2003	2005
Vehicle, 1000	804	1365	1765	2030	24561
Subway, km	42	54	75	98	114
Bus, 1000	6.6	12.6	14.4	15.2	18.8
Private Car	0	243	458	670	992
Trucks	205	214	184	186	177
Motor Cycles	226	332	343	356	362
Bicycle	8310	9887	11010	11000	11000

Table 4.5.a.15 Taxis Service in Beijing

		2000	2004	2005
Operating Units	(unit)	497	277	277
Company limited			109	109
Self-employed taxi driver	(Nos.)	1164	1157	1157
Operating Vehicles	(unit)	65127	55463	70217
Cars		62613	51561	66000
Coaches		2013	3902	4217
Passengers Carried	(10000 person-times)	62406	64378	71072
Cars		59770	58758	65000
Coaches		2153	5620	6072

6. Fuel consumption by road transportation by fuel type

Table 4.5.a.16 Technical indicators for transport in Beijing

		2000	2004	2005
Highway Freight Traffic				
Petroleum Consumption of Trucks Per 100 Ton-km	(liter)		7.77	7.76
Diesel Consumption of Trucks Per 100 Ton-km	(liter)		4.68	4.72
Railway				
Diesel Consumption of internal-combustion Engine Per 10000	(kg)	28. 7	27	25
Electricity Consumption of electric power Engine Per 10000	(kwh)	92. 9	104.2	93.4
Civil Aviation				
Aviation-oil Consumption Per Kilometer	(kg)		0.32	0.35

Table 4.5.a.17 Energy use in transport in Beijing

		1990	1995	2000	2002	2005
Gasoline	10000tons	56	74.4	105	151	225
Diesel	10000tons	30	35	52	74	103
Natural Gas	Million c.m			36	44	351
LPG	10000ton			2.8	3.7	0.72
Electricity	TWh	0.45	0.76	1.14	1.25	1.4
Kerosene	10000ton	43	65.1	117	144	189

7. Information on level of road congestion

Table 4.5.a.18 Traffic information for Beijing

	1994	2005
Average Vehicle Speed, km/hour	24	13
Share of cross with heavy traffic jam	8%	60%

8. Emission standard

Table 4.5.a.19 Emission Standard for vehicles belonging to the first type (unit: g/km)

	First stage	Second stage	
Time limit	Jan.1 1999 ~ Dec.31, 2003	Jan. 1, 2004 ~	
		Petrol-fueled	Diesel-fueled
CO	3.16	2.2	1.0
HC + NOx	1.13	0.5	0.7
PM	0.18	-	0.08

Notes: first type vehicle refers to these whose passengers can not exceed 8 except the driver.
Source: New Vehicle Emission Standards in Beijing, in Energy-saving technology in transportation sector, 1999.

Table 4.5.a.20 Emission standard for vehicles belonging to the second type (unit: g/km)

Time limit	Quantity(RM)		RM<=1250	1250<RM<=1700	RM>1700
First stage: Jan. 1, 2001~ Dec. 31, 2003	CO		3.16	6.0	8.0
	HC+NOx		1.13	1.6	2.0
	PM		0.18	0.22	0.29
Second stage: Jan. 1, 2004 ~	CO	Petrol-fired	2.2	4.0	5.0
		Diesel-fired	1.0	1.25	1.5
	HC+NOx	Petrol-fired	0.5	0.6	0.7
		Diesel-fired	0.7	1.0	1.2
	PM		0.08	0.88	0.17

Notes: the second vehicle refers to all these not belonging to the first kind.
Source: New Vehicle Emission Standards in Beijing, in Energy-saving technology in transportation sector, 1999.

IV.6 Bus Rapid Transit in Jakarta: Evaluating the Factors that Impede or Facilitate

Heru Sutomo[1], Fajar Saumatmaji[2], and Restu Novitarini Djarwoningrum[3]

1. Introduction

Jakarta, Indonesian capital with population of around 7.5 millions (Statistics Jakarta, 2004) is striving with transport and environmental problems. World Bank ranked Jakarta as the third most polluted city, not to mention the serious congestion takes place everyday. The dominating private motorcars including motorcycles is evident. Road public transport share is estimated 38% (Sutomo, 2001). Urban rail share is even small at under 1% (Jakarta Land Use Department, 2001)

Public transport in Jakarta relies heavily on bus services. There are various bus sizes in operation ranging from 9-seater up to 50-seater. But, generally the bus service is very poor in quality running on old buses. A limited number of air-conditioned services are available in some main routes. Most buses operated by private companies without a clear service quality standard in place. Security, safety and naturally comfort are far from adequate. Buses compete for passengers creating a dangerous traffic operation and overcrowding is common. Fare was set at Rp 1300 (US$ 14c) for regular and Rp 3300 (US$ 35c) for air-conditioned service flat at all distances. After a big increase of petrol price in November 2005 the fare was adjusted to USD 22c and USD 38c. Buses don't run on schedule and there is no fare or route integration. After the economic crisis, situation became even worse because the revenue could not cope with the increasing cost of operation especially the cost of spare parts. Bus availability fell down very seriously to only around 60% and bus renewal simply did not work.

A new bus system is still being developed trying to eliminate the drawbacks of the current system. The buy the service scheme will be adopted where buses will operate in a specified quantity and quality of service. They will be paid on kilometerage basis. The buses operate on what so called busway scheme, where buses will occupy median lane with bus stops located in the median of the road. Access to bus stops is by means of the existing pedestrian bridges or signalized pelicans. A demonstration project was launched in a 13-km main line of Blok M-Kota, the main CBD corridor of Jakarta in January 2004.

The paper will describe the system in more detail and evaluate the factors that impede or facilitate the development of the busway system. Operation and management systems will be discussed along with financial calculation. The project is now facing an organizational problem although funding is already secured. International assistance was another key factor to assure the success of the busway project, especially on the application of the 13-km demonstration project. In the late 1980's, the bus lanes commencing are seriously violated and severe congestion resulted. Such failure has brought a serious impact on the future role of bus service for Jakarta. The notion of the poor public transport will never be able to be resolved is growing among the member of public and the politician.

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Another important note to be considered in this paper is, if we talk about Jakarta, we can not separate the city with its surrounding agglomeration area covering Bogor City, Depok City, Tangerang Regency and Bekasi Regency. Many information and data in this report will refer to the condition of Jakarta alone and with the agglomeration of the city. This agglomeration usually called as JABODETABEK (or JAkarta, BOgor, DEpok, TAngerang and BEKasi) or BODETABEK (BOgor, DEpok, TAngerang and BEKasi).

2. Policy challenge of public transport in Jakarta

As urbanized areas have expanded outward to BODETABEK (Bogor Depok Tangerang Bekasi), around 760,000 workers commute to Jakarta every day. The average trip length for "to work" purpose has increased from 6.68 km in 1985 to 8.51 km in 2000, while the length for "to school" trips also increased from 2.69 km to 3.52 km. This increase in trip length has imposed a heavier burden on the transport network in terms of person kilometres (SITRAMP, 2001)

The concentration of travel demand in CBD area causes traffic congestion on the road network as well as overcrowding of buses and train. Trip attraction of "to work", is concentrated in the central area enclosed by the railway semi-loop line, the newly developed "Sudirman-Kuningan Golden triangle" area and areas along the Cawang – Grogol – Pluit toll road (Jakarta Intra Urban Tollway S-W section). The trip attraction of these areas accounted for 53 percent of the total trip attraction of "to work" trips in DKI Jakarta (SITRAMP, 2001).

2.1 Public transport condition in Jakarta

2.1.1 Financing, fares and government support

Provision of public transport services is generally carried out by private sectors. Government may provide funding for surveys, studies and the construction of terminals and shelters. Investments for bus fleet are done by private sector once a private operator is given a licence to run a bus. The term licence under current system means a permit issued by local government transport office for anyone or a company to run a bus on a specific route. The license is based on an individual bus and that particular bus cannot be run elsewhere. It's like a permit for a bus owner to legally transporting people on a route and all the risk belongs to him/her. For issuing this licence the government charges a sum of fix amount of money for each bus-based licence. A single route is operated by differing individual buses and each of them competes for passenger with other buses.

The government set bus fares considering the operating cost of one route assuming there is a level of demand reflected in approximately 70% of load factor. The government set the number of buses on one route and the fare set applies to all routes on a flat fare basis. There is no government financial risk upon setting the fares. It is therefore obvious that a bus owner competes to obtain permit on a highly-demanded route leaving routes with low demand are not properly served.

Since no ticket system is generally in place, because all financial risk belongs to operator, the monitoring and control system does not work in most places. Obviously, no evaluation is normally conducted and hence no proper planning is practiced. Operators concern only in the net revenue which does not automatically tell the services sold i.e. number of passengers carried. Even the revenue is not subjected to be reported. Consequently, and this happens in many instances, the government issue more number of bus licenses than what actually needed to achieve 70% load factor. Oversupply of fleet will then reduce individual bus revenue and in many cases create problems e.g. some demonstration or bus stop operating.

Fare level determination is more of a political exercise than a business process. Since bus fares are associated with charging money to the public at large, it must be approved by the parliament at the local level. Members of parliament tend to protect the public by trying to keep the fare level low in order to be "reachable" by general public or more of those with low income. Here, the long run marginal cost pricing does not work. And for whatever the fare level is set, all the consequences go bus operator, even when there is a concessionary fare for school.

The above system clearly prevents the promotion to deliver good services. It is widely evident that no successful bus renewal can really take place. Hence, old buses with high level of breakdown are common sightings in many cities, and Jakarta is no exception. To be able to sustain in coping only with operating cost- forgetting the investment or depreciation cost- buses tend to race competing for passengers during peak times and, in contrast, making longer stop to accumulate passenger during off-peak times.

The role of road transport is still dominating in the national and urban context. With the absence of clear directives of promoting public transport, the growth of car and motorcycle ownership is substantially high and this is reflected in the more congested urban traffic and in many cases in inter-city road traffic movements.

Having depressed by economic crisis in the late 1997, the growth of vehicle ownership had been somewhat low in the period 1999 to 2001. Economic recovery began to emerge in or around 2002. In the next three consecutive years of 2003 to 2005 the growth of vehicle ownership was shooting high at around 18% per annum. Year 2004 marked the record of around 0.5 million motorized vehicles and 4.5 million motorcycles sold in a year. Only in 2006 the growth is getting reduced rather substantially. The car sales in the first semester (Jan-June) 2006 are down 40% than the same period in 2005 (Auto Bild, Aug, 2006).

The changes of modal share between public transport and private transport use are depicted in Table 4.6.a.7. This table shows that there has been a steady decline of the role of public transport serving Jakarta. Despite this obvious decline, there hasn't been any evidence that both central and local government taking systematic action to control the dominance of private transport. One serious problem was the poor vehicle condition and then followed by dangerous driving behaviour due to the financial problems especially triggered by the economic crisis from 1997. On one side, the cost of spare parts was increased as the exchange rate quadrupled but, due to the public outcry, the government didn't feel appropriate to increase the fare on the other side. The victim was clear, the public transport industry. Stretching such period had just made things worse. Most bus operators are in critical condition.

In 1998, the central government introduced a special protecting scheme for public transport operator's i.e. special loans for bus operators especially to cope with the costs of spare parts. Most of urban public transport operators received the loans. But, due to the nature of such scheme, where it was implemented in an emergency situation, the organizational and administrative aspects were rather ignored. Now, most of this loan became bad loans and considered as a faulty scheme.

2.1.2 Institutional issues

Route licensing based on vehicles

Local Government gives an approval to operate bus public transportation by issuing route license with operational conditions and standard service qualities. In practice, the route license has never existed, what applied is vehicles' license to operate in a certain route. The consequence is nobody responsible of the service in a route. There is no service standard and sanction in this scheme.

The control of the above system is also found difficult. For example, to control the route compliance, there is a term "timer" i.e. route supervisor. But this system creates new mafia group who illegally charge informal fees from the bus crew. This mafia group interfere the operational of bus system because they can influence the bus to shift the route.

The current licensing system is also considered as the cause of bus renewal program failure. When the vehicles' age is set, it applies to individual bus. If a fleet is provided in one instance, renewal will follow the same manner, and hence very hard. This system undermines the advantage of average fleet age, which gives an option for more flexible fleet renewal.

Organizational changes and issues

In 1999 the centralistic governmental system running in Indonesia for almost fifty years has come to an end and replaced by decentralization system. The decentralization system begins when The Law No. 22 year 1999 on regional autonomy is officially declared. Parts of central government authority were given to local government except for foreign affairs, defence, justice, monetary, fiscal and religion. Now that the decentralization regime is fully implemented, transport sector is in the hand of local government. Considering the nature of the Jabodetabek region, a well-communicated integrated development is especially crucial. As the "Urban Transport Strategy Review" issued by the World Bank pointed out, the multiple jurisdictions of equivalent size and status seen in the BOTABEK (Bogor – Tangerang – Bekasi) region may be unwilling to concede any power or financial control to another authority at the same hierarchical level, a situation often seen in cities like Manila or Caracas. The Jabotabek region is considered to be more inter-dependent than the other regions because significant transport interactions occur across the administrative boundaries. Thus, close communication is also significant to implement traffic management measures. For instance, regencies and municipalities presently have a forum for coordination called Bakorlintas (Badan Koordinasi Lalulintas or Traffic Coordination Agency), consisting of Transport Authority, Infrastructure Office, and the traffic police. Among others, traffic control and management, bus operation, and route licensing should be planned regionally to achieve coherent systems and services.

Some law enforcement is always essential to implement traffic management measures. Therefore, a poor image of Indonesian police, due to corrupt and inconsistent law enforcement certainly deteriorates the credibility of any traffic measures which rely heavily on strict enforcement.

This problem is closely related to the institutional issues that the BODETABEK government faces in the transport sector, as pointed out in this chapter. Major obstacles in the effective implementation of projects are overlapping authorities and the lack of coordination among related agencies. Although it cannot be attributed only to the lack of coordination or the lack of skilled personnel, the project realization in some regency is not unsatisfactory at around 80 percent or less, if we talk about the budget. Many causes are possible. Yet, the problem is generally due to the lack of project management skills, including planning, operation, financial management and managerial skills. Therefore, a structural training system should be considered to enhance the overall capacity of the local governments.

2.1.3 Market issues

The monetary and economic crisis, which commenced in the late 1997, has had a severe negative impact on urban public transport with a sharp increase in operational costs. Bus fares, however, had not risen correspondingly until April 2000, and revenues are not sufficient to sustain the current bus services.

Government commitment to protect and develop public transport sector can be regarded as insignificant. Right form the beginning, public transport had already been in the hand of private companies. The licensing system has given the bus operator to run the service without a clear standard of services, and consequently, the government does not provide any financial assistance should the service runs deficit. The private operators bear all the operation and financial risks and without a clear service standard requirement they are free to provide the service even at a low quality. Practically, the government has very little control over the bus operators. To make things worse, the licensing system works permanently. Once an operator obtains the license, it will keep it for life. So, there is very little threat of losing business even after they violate the regulations.

For over 20 years, the public transport planning and design were non existent. The route planning was done without using a proper transport planning analysis. In most cases, the operator proposes a new route and they will run the service. In most cases, there is no ticketing system in place. So, there is no data on the patronage and revenue and consequently, there is no evaluation phase. As a result, the routes can be grouped into two: “lean” and “fat” routes. A fat route has a bigger demand and more passengers. A bus operator tries to obtain part of the licence for this route, so bribery is common. In contrast, in lean route only few buses running and may be under deficit condition. So, the trend is there is an oversupply service on fat routes and undersupply on the lean routes. And the regulation sets the same license fee for both.

2.1.4 Historical, and socio cultural factors

In several main cities in Indonesia, including Jakarta, a formal road public transport system was introduced in the early 1970’s. In many of them, the appearance was associated with the closure of tramlines or urban railway lines built by the Dutch in the early 1900’s. This could also be regarded as the emergence of private transport, especially after the political stability was achieved following the revolution against pro-communist Soekarno era who was toppled in 1966. The New Order under Soeharto took the country’s administration and declared a 25-year development plan in 1969. In the earlier times, people mobility used traditional means such as Becak (pedal powered three cycles), Sado or Dokar (horse drawn cart) and bicycle. Privately owned cars and motorcycles were already in use, though in a very small number.

In the Indonesian urban context, differing from most western cities, the presence of public transport was much later than private transport. This historical difference may have an impact on the public perception on public transport. Due to longer history of private mode of transport, motorcars are considered as superior against public transport. Even now, owning and using cars or motorcycles can reflect the social status of the owner.

The perception of public transport as a second class way of movement is reflected at least in two ways: (1) the public transport word in Indonesian is literally “general transport”, where general means for the general people, i.e. in the old time poor people, (2) public transport service is set at a low standard, much lower than it’s private transport counterpart. The unsuccessful developments in improving public transport in Jakarta for over 30 years indicated the resistance of politicians and the public to admit that public transport should be provided for all people and hence must have a high quality level of service. Not until the introduction of Jakarta busway did changing the image of public transport really take place. This can be regarded as a revolutionary change in social perception against public transport, especially when compared to the relatively easy public acceptance upon the revitalization of public transport in the western world.

2.1.5 How BRT answer the public transport challenge ?

With the implementation of BRT in Jakarta, the financial and fare problems can be easily handled because the BRT uses the Buy the Service system, in which the transaction between the passengers and the operator is conducted indirectly and the government guaranteed that the income of the bus operators will be worth the service given.

Perceived from the institutional point of view, this new system can also overcome the existing problems. Implementing kilometer based payment system instead of the vehicles, there will be no ‘fat’ and ‘skinny’ routes anymore. The operators are appointed through tender system using the service standard issued by the government. Consequently, the government can control the service during the operation, giving sanction to the operators who violate the contract.

Using well managed BRT and with the government guarantee, the public transport business attracts private investors. It is shown when the government plan to put the corridor IV, V, VI and VII on tender, some private companies were interested in offering proposals.

Other advantage from the BRT operation is the indirect change in the attitude of the bus crew and the community. The bus crew who used to be reckless when driving, race with other public transports, halt and take passengers anywhere, halt too long and wait for the passengers is now gradually change the habit. The community indirectly learns and changes their attitude in using public transportation. Queuing custom and discipline is improved, like getting on and off the bus only in the available bus stop and paying with the tickets bought in certain places.

However, the implementation of this system still faces challenges from the public transport operators who are still preserving old paradigm. It is caused by the reform process of the public transports that happens relatively quickly, which makes the recent business opportunity of public transport operation is enjoyed only by some big public transport operators.

2.2 Air quality condition in Jakarta

Swisscontact, in its 2002 report, stated that Jakarta Metropolitan city ranks as one of the most polluted city in the world. Primary sources of air pollution are recurring from forest fires and the country's large fleet of highly polluting vehicles.

Other research conducted by Shanti Syahril et al in 2002 concluded that in 1998, vehicle emissions contributed in Jakarta is approximately 71% NOx, 21% SO2 and 71% PM10 to total emission loads based on the vehicle population that comprised of 29% passenger cars, 10% trucks, 8% buses and 54% motorcycles (Figure 4.6.a.10).

On the other hand, based on the share of emissions by vehicle type for NOx, SO2, PM10, CO and THC, the same research estimated the passenger cars emitted more than 30% of the entire measured vehicle emission load. Motorcycles emitted more than 20% of both PM10 and CO and 40% of THC. Trucks released approximately 30% of the NOx, SO2 and PM10 emission load, and buses emitted no more than 20% of all parameters measured (Figure 4.6.a.11).

Further, it also predicted total emission loads from various sources during 2005 and 2015 in Jakarta. Vehicle emissions contributed to approximately 73% NOx, 18% SO2 and 72% PM10 total emission loads in 2005 and 71% NOx, 15% SO2 and 70% PM10 total emission loads in 2015 (Figure 4.6.a.12).

In the light of the research results about air quality condition mentioned above, several researches estimated the Health Cost due to air pollution from transportation sector. In SITRAMP (Study on Integrated Transportation Master Plan) for Jabodetabek Phase II conducted by JICA and Bappenas, health cost due to PM10 had reached Rp 2.815 Trillion in 2002. A research by Shanty Syahril (2002) estimated economic costs associated with PM10, NO2 and SO2 in 1998 would have reached 181.4 Million USD and this figure would increase to 402.64 Million USD by 2015. The most recent study conducted by the Jakarta Transportation Office entitled the 2004 Jakarta Macro Transportation Pattern, predicted that the impact of congestion would have reached 9 billion Rupiahs annually, comprising 3 billion Rupiahs of vehicle operational cost, 2.5 billion Rupiahs for time lost and 2.82 billion Rupiahs of health cost.

To cope with the problem mentioned, The City Government of Jakarta made a breakthrough by operating BRT system or popularly introduced as Busway, starting from January 2004. The results were quite satisfactory. According to the survey conducted by the Institute for Transportation and Development Study (ITDP), 7 months after BRT operation in Jakarta, the ridership had increased to 320,000 passenger-km/days or 40,000 trips/day. Within 7 months, with 40,000 trips per day, the level of NOx had been reduced from 0.271 to 0.076

metric tonnes/day or 16 metric tonnes. Meanwhile, the level of PM10 had fallen from 0.029 to 0.002 metric tonnes/day or 2.3 metric tonnes . As for global emission of GHG, the reduction is quite amazing. It declined up to 1,710 metric tonnes.

2.3 Review on existing BRT policies

Referring to the first study (SITRAMP, 2002), the aim of the proposed new public transport system is more on the reform of the financial, operational and organizational aspects of the existing fragmented, uncontrollable system running under some kind of monopoly. A major change in the licensing system shifting from quantity licensing into quality licensing is planned. These kinds of changes need much more preparation and systematic steps involving many stake holders in the public transport industry. However, many people in the government, having seen the positive response from the public, tend to focus more on the physical developments rather than other important agenda.

One important achievement in securing public transport reform towards the BRT system was when the new local regulation (Perda) on Public transportation was enacted in 2004. This regulation backs up some unusual features of Busway, such as the use of central lane, boarding alighting using right side doors, the exclusive lane, the arrangement in the intersections, ticketing, preventing vendors and entertainers which ensure the adequate quality can be delivered. The establishment of busway administration Trans-Jakarta and the involvement of the old operators and the rearrangement of the route are also important points in the regulation. This regulation secures the co-ordination between Office of Transport- responsible for implementing the new busway system, Public Works- responsible for preparing the busway infrastructure and Parks- responsible for median, street furniture, parks, and trees. These regulations also pave the way for each office to propose budget to support the implementation.

The adoption of CNG technology in the public transport sector was decided as part of blue sky program (it's like clean air scheme). The first part was the application to taxis. Voluntarily, some part of taxi fleets were installed converter enabling it to run on petrol and CNG on a switch. Those who applied enjoyed a cheap CNG price which is around half that of petrol. Problems will be occurred in the supply side. As the number increasing without adequate refilling station provided, taxi drivers complained on the time loss due to difficulty in refilling. Even worse, the poor traditional maintenance system and the problem of poor quality of the CNG created various problems. Nowadays, practically most taxis reverted to use petrol again.

Under the busway scheme, CNG buses started to be introduced in January 2005 when the route 2 and 3 were added after first year the system running. The decision in using CNG was regarded as so abruptly that inadequate preparation was in place. Buses were imported where there was no local agent available for the chosen make of the bus. Since the import was conducted by three different operators, the supply of the bus has been very late. So, there has been s serious shortage of buses when existing buses of Route 1 have to share with Route 2 and 3. Even after 8 months, the bus supplied reached only about 40 percent from what is required.

The supply system in terms of CNG refilling station for buses is still underway. The new opened one is simply not sufficient to supply the increasing number of buses. The old refilling stations normally used for taxis do not perform well due to the lower pressure. As a result, buses have to refill at least once in a day, where according to the specification, there is no need to do that when a bus is fully refilled. A poor quality of gas supplied is also complained the bus operators. The presence of water and oil brings serious impacts on engine performance. This problem will remain exist until the government's plan to build two new stations is completed.

3. Transportation system in Jakarta

3.1 Description of study area

3.1.1 Geographical condition

Jakarta is a lowland area with average elevation around 7 meter above the sea level. It is located between $6^o12'$ South Latitude and $106^o48'$ East Longitude. Based on Governor Decree No.1227 of 1989, the area of DKI Jakarta province consists of 661.52 Km^2 : 6.997,5 Km^2 land area and 6,977.5 Km^2 sea area. It has more than 110 islands, which spreads throughout Kepulauan Seribu (Thousand Islands) and also has 27 rivers/drains/canals used as water sources, fishery and urban business.

The DKI Jakarta province is divided administratively into five municipalities and one regency as follow.

1. South Jakarta with area of 145.73 Km^2,
2. Central Jakarta with area of 47.90 Km^2,
3. East Jakarta with area of 187.73 Km^2,
4. West Jakarta with area of 126.15 Km^2,
5. North Jakarta with area of 142.30 Km^2, and
6. Kepulauan Seribu Regency with area of 11.71 Km^2.

According to the administrative boundary, this province is bordered by Java Sea at the north, West Java Province at the south and east and Banten Province at the west as seen in Figure 4.6.a.2).

Generally, climate condition of DKI Jakarta is tropical zone, with the highest temperature is around 33,80 ^oC during the day and the lowest temperature is around 23.1 ^oC during the night. The rainfall in the year 2004 reached 2,105.5 mm, with humidity was recorded 78.4%.

3.1.2 Social and demographic

A. Population

In the middle of 2004, Jakarta population was recorded 7.47 million (Statistic Jakarta, 2004). Since the area of DKI Jakarta is only 661.5 Km^2, hence its population density reached 11.3 thousands/Km^2, and it becomes the densest city in Indonesia.

Male population are greater than female, as shown by sex ratio parameter more than 100% (Statistic Jakarta, 2004). In terms of citizenship status, Jakarta consists of 4.49 thousands foreigners and the rest are Indonesian citizens (Statistic Jakarta, 2004). Meanwhile, number of population aged 10 years and over with junior and senior high school education is around 58.72%, with elementary school education around 20.66% and university education is around 10.18% (Statistic Jakarta, 2004).

For economic activities, population aged 15 and over can be divided into two groups; labor force and non labor force. The number of labor force is 4.1 million and non labor force is 2.52 million (Statistic Jakarta, 2004). Further, the number of working population is about 3.5 million, but there are about 602.74 thousand looking for work. Most of the people work at trading, services and manufacturing sector which contribute 35.58%, 23.05% and 20.88% respectively (Statistic Jakarta, 2004). By its status, it can be identified that about 68.07% of workers work as employee and about 28.97% works as employer and 2.96% as family workers (Statistic Jakarta, 2004).

B. Economy and trading

The economic growth of DKI Jakarta in 2004 was 5.24%, this figure is higher than in the previous year which was 4.62% (Statistic Jakarta, 2004). During this period, the highest growth was reached by transportation and communication sector (8.67%), financial, ownership and business services sector (5.8%) and trade, hotel and restaurant sector (5.51%) - (Statistic Jakarta, 2004).

The highest growth on manufacturing industry sector was reached by transport equipment, machinery and apparatus (8.81%) and other manufacturing products (5.06%). Meanwhile, restaurant subsector are 6.5% and bank 4.16% (Statistic Jakarta, 2004).

During 2003, GDRP (Gross Domestic Regional Brutto) at current price in DKI Jakarta reached 284.72 trillion rupiah, while in 2004, it reached 320.37 trillion rupiah. The biggest contribution to total GDRP was given by trade, hotel and restaurant sector (23.51%), finance, ownership and business services (22.51%) and manufacturing industry sector (20.58%) (Statistic Jakarta, 2004).

3.1.3 Land use

The development of land use since 1999 is dominated by the extension of residential area which was a conversion from greenery area. The development of industry area were mostly at the west and east areas of Jakarta. According to Indonesia Industrial Estate Directory 2001, the development of the eastern area of Jakarta is shown by the development of industrial town at Cibitung – Bekasi and Cikarang – Bekasi (about 30 - 37 km from Jakarta). At the west, is the development of Bumi Serpong Damai Area and Lippo Karawaci. Table 4.6.a.2 and Figure 4.6.a.1 shows the trend of land use utilization in DKI Jakarta.

3.2 Transport picture

The development of transportation system in DKI Jakarta follows Governor's Decree No 84 year 2004 on Macro Transportation Pattern in the Province of DKI Jakarta and is directed to:

a. improve the accessibility of all area in Jakarta province and its surrounding and rearrange the transportation mode in an integrated manner

b. develop mass transport system

c. promote the use of public transport and train

d. reduce the excessive use of private vehicles

e. develop more primarily road network, bus priority, light rail transit (LRT) and mass rapid transit (MRT)

f. improve non toll road network and develop new roads

To achieve the above goals, several development scenarios were set for the year of 2007, 2010 and 2020:

a. development of bus a s public transport system

b. development of mass public transportation

c. development of road network system

d. development of railway transport system

e. development of alternative transport system

f. development of traffic restraining

3.2.1 Railway transport profile

Railway service in Jakarta is served by electric and diesel trains known as Jabotabek Railway. According to Directorate General of Land Transport in 2004, the total length of Jabotabek railway is 155.6 km and divided to 7 service lines: North, Central, West, Tangerang, Merak, Bogor and Bekasi (see Table 4.6.a.6).

Five service lines formed radial services and the rest formed circular services. These lines have electrified double track except for Tangerang and Merak lines which still run on. The central line, stretching 19 km from Manggarai to Jakarta Kota already uses elevated track. Figure 4.6.a.3 shows the railway network in Jabotabek.

The total number of passengers served by the Jabotabek railway amounts to 400,000 persons per day, according to the SITRAMP railway passenger survey conducted in June 2000. This passenger volume accounts for only two percent of the total person trips made by motorized modes of transport in Jabotabek. The passenger demand varies from line to line according to the service level. The line which carries the largest passengers demand appears to be the Central Line and Bogor Line. These lines carry about 300,000 persons per day, which accounts for 73 percent of the total Jabotabek railway passengers. This condition indicated that the southern part of Jakarta really depends on railway transportation for travelling to Jakarta.

Survey result showed a decrease of trip movements in inner Jakarta from 26.7% in 1998 to 21.7% in 2000. Meanwhile, an increase occurred on trips between Bogor - Tangerang - Bekasi from 6.3% to 9.6%. Commuter trips from DKI Jakarta - Botabek was steady.

Economic crisis in 1997 contributed a significant impact to the decrease of Jabotabek railway passenger demand. The percentage of passengers' growth from 1998-2000 is 6.4% annually. This number is far below the previous years which reached 17.8% in 1997-1998 and 16.9% in 1996-1997.

Followings are Jabotabek Railway development plan scenarios:

1. Scenario 2007 is set based on RENSTRA (Strategic Plan) of DKI Jakarta year 2002-2007, which is to improve the service of Jabotabek railway according to PT. KAI's (Indonesia Railway State Owned Enterprise) plan.
2. Scenario 2010 is based on RTRW (Land Use Plan) of DKI Jakarta on the development of railway transport system with reference from Jabotabek Railway development and railway network in RTRW 2010. Several modifications were proposed on the network particularly on East – West lines.
3. Scenario 2020 is based on RTRW DKI Jakarta which covers the development of mass transport system/MRT which is urgently needed. MRT network consists of Jabotabek railway network and MRT/Metro/Subway network.

3.2.2 Road transport profile

Road network in DKI Jakarta is developed by Public Works Office which involves road administration. Road transportation in DKI Jakarta is supported by 7,616.27 km road network consisting 94.18 km toll road, 162.04 km national road, 1,475.85 km provincial road and 5,884.20 km municipal road (Table 4.6.a.5). Total road length in DKI Jakarta is approximately 10% of total road length in Java. The comparison between road length and total area in DKI Jakarta is only 4 %, which is ideally for a city as big as Jakarta is 10 – 15 %.

In greater context, road network pattern in Jakarta consists of ring road system i.e inner ring road and outer ring road which also act as primary arterial road, radial network which serves the area outside the inner ring road towards the area inside the inner ring road and grid pattern road network in the city centre.

Motorization growth in Jakarta and BOTABEK area is quite high in line with the improving income of the population. Eventually, this motorization level will influence the mobility of its citizens meaning that trips level of the citizens in DKI Jakarta and BOTABEK will also increase. This high motorization level also indicates the need for transportation system supply to accommodate the traffic growth.

In 1985, Home Interview Survey result done by ARSDS (Arterial Road System Development Study) showed the trip level of Jakarta's people is 1.67 trips per person per day (motorized and non-motorized). The addition of total trips level will cause relatively high traffic growth. Demand estimation is based on O-D matrix in Jakarta in 1990 by JMTSS (Jakarta Mass Transit System Study) and TNPR (Transport Network Planning and. Regulation).

Data from above studies showed that beside the trips of Jakarta's population in the city there are also trips done by non Jakarta's (BOTABEK) people in the city. The growth of total trips were estimated around 3,63% annually. From 9.7 million trips by motorized vehicles in 1990 it was estimated to increase to 16 million trips per day in 2005. Table 4.6.a.15 shows the commuter's flow between Jakarta and BODETABEK in 2000 (SITRAMP, Phase I – JICA).

Followings are road transport development plan scenarios:

1. Scenario 2007 is set based on RENSTRA DKI Jakarta year 2002-2007, which is to develop road network with reference to the plan to improve busy intersection / "bottleneck" by "flyover and underpass", and the development of "missing link" and road widening/capacity increment.
2. Scenario 2010 is based on RTRW (Land Use Plan) of Jakarta on road network system to be directed to arterial road network development that supports ports, airports, primary and goods terminals. RTRW 2010 also indicates several missing links to be developed.
3. Scenario 2020 is based on RTRW DKI Jakarta which covers the development of arterial road network so the "arterial road spacing" can achieve an ideal condition and increase the capacity of roads and intersections.

3.2.3 Public and private transport profile

The mode split for public transport (trip based) has declined in the last 20 years. According to Jakarta Mass Transit System Study, 1992, mode split for public transportation was 49.1% and private vehicles were 50.9%. Previous study by ARSDS in 1985 reported 57% for public transportation and 43% for private vehicles, and 61% for public transportation and 39% for private vehicles in 1972 (JMATS, 1972). Based on Macro Transport Pattern of Jakarta as described in Figure 4.6.a.13, modal share for private cars and motorcycle in DKI Jakarta is higher than in Jabodetabek, meanwhile for non motorized transport, DKI Jakarta has a lower number compared to Jabodetabek.

The above surveys showed that there is a decreased in public transport use and increased of private vehicles use. Further, this condition will results in the decrease of the efficient use of transport infrastructure, which will obstruct the effort to overcome congestion problem. The level of congestion in Jakarta is getting worse year by year, perceivable from the imbalance of road length growth and the growth of private vehicles ownerships. Based on the statistic data of 2001 to 2004, the average of the road growth rate is 8%, while private vehicles growth rate is 13% (see Table 4.6.a.12 and Figure 4.6.a.9)

The stable and steady economic growth in Jakarta has prompted the city to cope with higher level of public mobility as the public income improves. The ease in obtaining and the low cost operation of motorcycles has attracted substantial new users. It is evident in many cities with poor quality of public transport has promoted the shift of public transport users to motorcycle riders. Jakarta is no exception. In addition, the sprawling development of greater Jakarta has pushed many new residential developments further away to almost all direction. The commuting time of people in Jakarta keeps increasing. A two hour commuting time was unusual some ten to five years ago, but not nowadays.

Years ago, motorcycles in Jakarta had not been taken as a favourable means of transportation because of their image as second-class vehicles and it was not the government's orientation to provide proper infrastructures for this kind of vehicle. It is noticeable from the width of roads in Jakarta that provide better facility for cars and other big vehicles. In contrast, in other cities in Indonesia, motorcycles are more favourable to the people because roads are relatively narrow and typically suitable for small towns. Generally, the operating time for public transports is very limited hinders the mobility of the people who do not have a motorcycle.

However, in its development, when the traffic congestion in Jakarta roads gets worse, more people favour motorcycles. Its small physical features penetrate jammed traffic easily, that subsequently cuts the travel time. People's interest in motorcycles is increased after the monetary crisis struck Indonesia in 1997 and the significant fuel price rise in 2005. Moreover, on the streets, motorcyclists feel as if they have the privilege of getting on the pedestrian walk without getting fined. Thus, people nowadays do not see motorcycles as second-class vehicles. Instead, they see them as the most sensible choice of transportation mode, perceiving from the speed, comfort, and relatively cheap to own and run. It is not surprising that within 1999-2004 the average growth of motorcycle is 18% per year, while cars' is only 11% (see Table 4.6.a.8).

Public transport system in DKI Jakarta area is dominated by bus system based on road network. The service level of this bus system depends on the traffic condition and the number of operating pubic transport fleets. However, the condition of public transport main supporting infrastructures such as terminals and bus stops still need extra attention.

Most of bus fleets consisting of large buses and medium buses small buses are provided by a large number of operators. Large buses operators are PPD (State owned company) and Mayasari Bhakti (private), Bianglala, and Steady Safe. Medium buses are supplied by several cooperatives such as Kopaja and Metromini, and for small buses by Microbuses and APK operating in suburban areas).

Bus services provided by private operators and government are regulated by the government. Fare also set by the government and route licensing issued by Transportation Office. Based on report from Transport Office, the number of public transport in DKI Jakarta has decreased during 1995 – 1999 and increase again in 1999 – 2002. This is probably due to the economy crisis in 1997. Meanwhile in 2002 based on Transport Office data, it was identified that, routes that serve DKI Jakarta were dominated by large buses. And the operating fleet was only 66.2% from the issued licenses. This shows the difficulty of the operators to supply the adequate number of buses.

Table 4.6.a.15 describes the estimation of daily bus passengers' number in DKI Jakarta during 1991-2000. The table shows that the growth of passengers is not accommodated by the growth of buses.

Future plan for private transport (in 2020) is the implementation of "Transport Demand Management" which is directed to traffic restraint scheme based on the network development of public transport system, and restriction zone. To complement, the future plan (in 2020) related to public transport is the extension of "bus priority" network for East – West and North – South. Improve the capacity of bus system by operating articulated bus both "single articulated" and "double articulated". It also important to develop integrated transportation network, consist of road network, mass transport system/railway system and public transport system. In every scenario, mass transportation system will be the priority to be developed which is supported by road network with adequate efficiency.

3.2.4 Low-occupancy and high-occupancy public transport profile

Low occupancy public transport is represented by rickshaw (becak), *ojek (*motorcycle taxi), *bajaj* and taxi, and for high occupancy public transport is represented by *mikrolet* (micro buses). Among those, *ojek* has the lowest capacity (1 person) and *mikrolet* is the highest (12-18 persons).

Becak is a short distance non motorized transport with capacity of 2 persons and human powered. *Becak* is one of the oldest modes of transport that entered Indonesia in the 30's with approximately 100 units. In the late 50's, *becak* has grew to 25,000 to 30,000 units in the city. In early 70's, the number of *becak* has increased to 100,000 to 150,000 unit with *becak* drivers approximately 250,000 to 350,000.

In 1980's, the number of *becak* decreased to 55,000 unit due to the existence of new motorized transport mode i.e *bemo* (in the 60's) and *helicak* (in the 70's). In 1988 with the issuance of Local Regulation No. 11/ 1988 on Public Order in DKI Jakarta Area, becak is officially restricted in Jakarta.

Ojeks are mode of transport using motor cycle that serves short distance trips. Usually, it functions as a feeder from residential area to collector or arterial road. *Ojek* has formally not been recognized as public transport, but in practice, this transport mode exists and quite popular among local people. The number of ojek drivers in Jakarta is approximately 17,000 persons (The Association of Indonesian *Ojek* Society or *Asosiasi Masyarakat Ojek Indonesia* – AMOI, 2006) compare to the early 2000 which is only 500 persons. This huge development was triggered by the economy crisis and more jobless people, therefore *ojek* has become an easy informal way as their source of income.

Bajajs are three wheelers motorized vehicles and usually operate in the neighbourhood roads due to its small size and the high level of manoeuvre. It acts as a feeder as *ojek*, but its existence has been recognized as one of public transport. The capacity of a *bajaj* is 4 persons including the driver. *Bajaj* came to Indonesia in 1975 and the supply from India was stopped in 1980. *Bajajs* use 2 strokes engine running on petrol mixed with oil and produced thick white smoke. The number of *bajajs* from 1991 to 2004 is relatively steady in amounting 14,612 units. In 2003, The City government of DKI Jakarta planned to replace all *bajajs* with KANCILs (acronym for *Kendaraan Aman, Nyaman, Cilik, Irit dan Lincah* or small, safe, comfortable vehicle) which has adopted more environmentally friendly technology. This program is temporarily stopped because there was a resistance from *bajaj* owners who reject to replace their *bajaj*. Therefore, in 2006, The City Government of DKI Jakarta begins to introduce CNG fuelled *bajaj*.

For medium to high income group, the community can use taxi for their daily transportation. The number of taxi in DKI Jakarta in 2004 based on Governor's Decree is 26,096 units, but in the field only 20,000 taxis were operated. From 1991-2000 the number of taxi experience a growth of 44% with average annual growth 4.9%.

For medium range transportation, people uses vans locally referred to as "*mikrolet*". These are the most popular modes of public transport in DKI Jakarta as they are cheap in fare and provide access to most part of the city. As vans are in "passenger car" class, they formally seat 8 passengers. However, in practice they seat 12 - 14 passengers. The number of *mikrolet* in 2004 is 12,984 units which serve 145 routes.

3.2.5 Trends of cars growth and major reason

In line with the development of road infrastructures, economy growth and public income, the number of vehicles also increases (see Figure 4.6.a.7). In 1990 to1997, the growth of vehicles was relatively high for all types of vehicles. Even after 1997, when economy crisis hit Indonesia, the growth of vehicles number was still increase to a lesser extent.

Generally, bus services in Jakarta are very poor in quality running on old buses. Only limited numbers of air-conditioned service are available in some main routes. Most buses operated by private companies without a clear service quality standard in place. Security, safety and naturally comfort are far from adequate. Buses compete for passengers creating a dangerous traffic operation and overloading is common. Buses don't run on schedule and there is no fare or route integration. After the economic crisis, situation became even worse because the revenue could not cope with the increasing cost of operation especially the cost of spare parts. Bus availability fell down very seriously to around 60% and bus renewal simply did not work.

Due to the deterioration of public transportation condition, and the decline of air quality in DKI Jakarta, many travellers maintain to use private vehicles. In 2005, based on the BPLHD (Badan Pengelola Lingkungan Hidup Daerah or Local Environment Management Office), the number of days with good air quality in Jakarta was only 28 days. Thus, it is affirmable that during 2005, the good air quality days enjoyed by Jakarta residents are not more than one and a half month, a certain flop compared to the ones in 2000, 2001, and 2004.

One of central government policies that facilitate the growth of car is the deregulation in 1999 which announced a new automotive policy aiming at developing an efficient and globally competitive automotive industry. Major schemes were introduced. One is the elimination of the local content scheme. Under the new policy, imported car and components are subject to import duties based on tariff lines regardless of local content achieved. The elimination of the local content scheme is significant since it took effect six months before the deadline set by WTO. Second, duties on imported cars and component were further reduced. Almost all tariffs lines have now been lowered as shown in Table 4.6.a.19. In addition to the changes in import duties, the central government also issued a new schedule of taxes that apply to luxury cars (Table 4.6.a.19).

Another government policy to encourage vehicles growth is the annulment of Governmental Decree Number 41 Year 2005 on the implementation of tax on luxury goods (PPn-BM) for motorcycles as much as 5-10%. The data from Jakarta Metro Police Department shows that up to 2005 the number of vehicles in Jakarta had reached 4.9 million and it was predicted by GAIKINDO (Gabungan Asosiasi Industri Kendaraan Bermotor Indonesia or Association of Indonesian Automotive Industry), that in 2006 it would increase by to 500,000 units.

3.3 The BRT and public transport picture and linkages

Public transport system in DKI Jakarta area is dominated by bus system with 5,300 bus fleets (large and medium size), 9,800 small buses (micro buses) spread in 358 routes. But looking at the mode split of public transport, as explained in Chapter 3, the share is decreasing.

This phenomenon shows that even though Jakarta was served by adequate number of fleets but due to low service quality and non integrated system, the public transport is no longer favourable for the residents. To cope with the problem, The Government of DKI Jakarta had implemented several measures.

It began in the 70's when the first generation of bus services served the city after the closing of the tramways, There were about 8 private bus operators using small buses to serve the entire city. The second generation of bus development in Jakarta was started in 1985 when those operators were merged into one company called PPD (Perusahaan Pengangkutan Djakarta – Jakarta's Transportation Company).

In the third generation, the system used bigger buses, double decker and articulated buses. In the 90's a scheme called RMB (*Rute Metode Baru* or New Route Method) was introduced (the fourth generation). The significant step in this part was the introduction of bus lanes for the first time in Jakarta and in the country. Also introduced in this phase was one-man operator and driver is paid on a fixed amount basis.

The above measures have proved to be failed and the use of private vehicles increasing from year to year. The City Government of DKI Jakarta realized that a reform in public transportation must be done. The reform (fifth generation) of bus as public transportation began in 2001 when DKI Jakarta undertook an evaluation for the potential of Bus Rapid Transit (BRT) as a mass transit option in Jakarta. With the adoption of BRT idea, a new concept of good public transport was introduced to the people of Jakarta. With comfortable buses and on time schedule would makes the users satisfy with the service. The first corridor was planned connecting the Blok M bus terminal and shopping district in South Jakarta to the Kota (city) railway station in North Jakarta. The selection on this corridor was due to the concentration of important government and business offices, and major hotels. With the introduction of BRT, people could leave their cars in Blok M and use the BRT to reach Kota in 45 minutes while with private cars it would take 1.5 hours.

Around year 2000, the national government's aspirations for a metro in the similar corridor were re-awakened by an offer of a very low-interest loan from JBIC (Japanese Bank for International Cooperation), but DKI Jakarta would have been responsible for repaying at least 30% of the loan, (there may have been more conditions such as 50% Japanese contractors) and to date they have been unwilling to move forward. Nevertheless, the metro in the Blok M – Kota corridor (approximately 16 km) remains in the Jakarta Master Plan.

In the mid 2001, the establishment of first demonstration corridor has been the planned by DKI Jakarta government. DKI Jakarta's Governor Sutiyoso, decided in December of 2001 that a Bus Rapid Transit System could serve the transit needs more quickly and at less expense than the metro. An ITDP-sponsored visit by former Mayor of Bogota Enrique Peñalosa to Jakarta in November of 2001 convince Governor Sutiyoso and Deputy Governor Budihardjo that they could solve their mass transit needs with a much lower cost of BRT along the lines of TransMilenio in Bogota.

In the process of the development, the government received many challenges and critics from the community, NGOs, bus operators, bus crews and legislative bodies. But with a strong leaderships of the governor, DKI Jakarta Transportation Office kept moving forward to prepare the implementation of BRT. In early 2002, Jakarta's legislative body approved the BRT proposal with total budget Rp 120 billion (for infrastructure and bus provision.

On the technical process, the most challenging issue to solve was the dedicated BRT lane. This dedicated lane created debates in the community. At the existing condition, streets on corridor I have 5 to 6 lanes (one direction) and 1 lane is already used for bus lane (at curb lane). People had the perception with another dedicated lane for BRT would reduce road space. This shouldn't be a problem, because in the ultimate condition, the buses at the slow lane would be shifted to BRT and the slow lane could be used for general traffic. The implementation of 3 in 1 also supports the BRT in reducing the number of vehicles in the area. Problem might occur on streets which did not have bus lanes, and in this condition the road space would significantly be reduced. But this problem could be solved by restricting on street parking.

On the regulation side, The City Government of DKI Jakarta should prepare a regulation as the foundation to develop and operate the BRT. The existing regulation, i.e Law No.14 year 1999 did not regulated BRT implementation. Therefore, in November 13, 2003, The City Government of DKI Jakarta issued Local Regulation No. 12 year 2003 on Traffic, Road Transport, Railway, River and Fery in DKI Jakarta Province. This regulation accommodates the development and operational of BRT in Jakarta.

For institutional arrangement, The City Government established a public company namely TransJakarta who will be responsible in managing the system. To run the services, TransJakarta invites a private company, which was set up by those who ran the services with the same or similar route. The operators were merged into one company i.e PT. Jakarta Express Transportation (PT. JET) and signed a contract management TransJakarta to operate and manage the first corridor. The operating cost per km is Rp 8,200 with ticket fare Rp 3500. For ticketing, TransJakarta hired another company.

The first corridor was officially launched in January 2004. Based on several criteria, the performance of the first corridor has been quite satisfying. The number of passengers increased from 28,000 per day to 56,000 per day in 2006. The target headway which was 1.6 minute has been accomplished, therefore the system can secure 6000 to 7000 passengers per hour per direction. The third indicator is travel time. The target 45 minutes travel time was also accomplished, compare to regular bus that need 120 minutes for the same corridor. The fourth indicator is the percentage of mode shift from private cars to BRT. The mode shift according to ITDP is 14% way beyond the targeted of 4-5% by SITRAMP. The fifth indicator is financial performance. After 10 months operation, The City Government has received revenue of Rp 35 billion, the operator consortium has gained 34.3% IRR and for the ticketing company 20.9% IRR. Both private companies are expected to achieve the break even point in 7 years. With this extreme well performance, the government has no difficulties to assure the legislative body to approve the second and third corridor. In January 2006 the second corridor (Harmoni – Pulo Gadung, 14 km) and the third corridor (Kalideres – Harmoni, 19.8 km) were officially launched.

The next phase of BRT development is under construction. The operation of another 4 corridors (see Figure 4.6.a.4) is estimated to be launched in 2007 (Transport Authority of DKI Jakarta, 2006). They are: Corridor 4: Pulogadung – Dukuh Atas (11.85 km), Corridor 5: Kampung Melayu – Ancol (13,5 km, Corridor 6: Ragunan-Kuningan (13.3 km) and Corridor 7: Kampung Rambutan-Kampung Melayu (12.8 km). According to DKI Jakarta Macro Transportation Pattern (2004), there will be 15 corridors serve the City of Jakarta in 2010.

4. Policies and plans related to BRT implementation in Jakarta

4.1 Urban planning policies and plans

The urban development of DKI Jakarta has reached its surrounding cities i.e BODETABEK (Bogor, Depok, Tangerang and Bekasi). Currently, the population of DKI Jakarta is relatively low and the trend shows a zero growth. This implicates the development of Jakarta's buffer cities such as BODETABEK area which developed as residential area with a massive commuter nature who still rely their life (work) on Jakarta. This phenomenon mostly developed in the southern area, and the result is a large commuter traffic flow movement.

The existing urban structure of the Jabotabek region is simple. The region is clearly dominated by the most developed Jakarta with the old core of Bogor which is a much smaller but nevertheless important urban center to the south. Tangerang, Bekasi to the west, east and Depok, the intermediate between Jakarta and Bogor. All of which are less distinctive and concentrated, but are nonetheless towns with separate identities.

According to the urban hierarchy by the Kimbangwil (Pemukiman dan Pengembangan Wilayah or Housing and Area Development), Jakarta is designated as Class I and the other four are Class II. There are presently 14 urban centres regarded as Class III, having 100,000 – 300,000 urban residents. (Refer to Table 4.6.a.16).

It now appears that large-scale private sector developments are playing a more dominant role than earlier envisaged, with a substantial number of middle-class population moving into estate type residential developments. Their spending power represents a latent demand for a range of businesses which can create a network of commercial, sports and recreation centres as well as services. Many new town development projects have been initiated by the private sector to fullfill the above opportunities. (Refer to Table 4.6.a.17)

These real estate housing complex developments have caused transport problems by depending on the existing arterial roads in suburban areas. Most residents move to this type of housing complexes on the premises of commuting by a car. In the absence of an arterial road network, the developers merely provide access roads to the existing arterial roads and add more traffic to the already saturated roads. In this regard, it is of great importance to establish a road network development masterplan and to determine the responsibilities of the public and private sectors.

Rapid urban development has been taken place within central Jakarta during the 1990s. Some areas, which were previously utilized as residential areas (urban Kampung) have been converted to high-rise offices and commercial buildings. The most remarkable area is the so called “Golden Triangle” in Jakarta, which is enclosed by Sudirman St, Gatot Subroto St, and Rasuna Said St. More than 50 percent of work places in Jakarta are located in the central area, enclosed by the semi-loop railway lines and the newly emerging urban centers. Comparing work place density between 1985 and 2000 indicates that the central area with its high job density has been expanding outward and the southward; expansion in particular is outstanding. The magnitudes of the old centers such as Kota, Senen, Manggarai, Jatinegara, and Tanah Abang have declined.

4.2 Public transport and investment policies and plans

The plan for developing ultimately 15 BRT routes has been announced in 2004 following the success of the Route 1. With these 15 routes, most of Jakarta is very well served by this new system. The success also brings requests from neighbouring towns like Bekasi and Tangerang to also be served by the extension of this system. The plan to construct transfer facilities and attractive terminals is put in place. A major construction in the Kota terminal and Harmony transfer point is now underway. The Jakarta busway will serve as the backbone of public transport system and act as connection to the other system i.e. urban rail and the planned of MRT and the under-construction monorail system.

Learning from the quick damaging effect of the busway operation to the surface of the existing central lane, many parts of the lane is now reinforced with concrete pavement, especially near the stops. Starting from the construction of Route 4, 5, 6 and 7 in 2006, the Public Works Office constructs a new concrete pavement along these new lines.

A new ticketing system is being prepared making possible for transfer passenger to change the route using a single ticket. The existing system is actually the Bogota system, where passengers purchase a card just to enter the bus stop. This is a single ride ticket system. A multiple ride ticket is in operation for several stations.

The government has been preparing a monorail system running a loop connecting important commercial points and shopping malls. There will be 2 lanes called Green Line and Blue Line. The length of Green Line is 14.8 km with average speed 40 km/hour, headway 4 minutes and estimated travel time 27 minutes per direction serving 15 stations. The blue line has shorter length with less stations to serve (13 stations) with estimated travel time 22 minutes per direction. The development of monorail has started in 2002 during the era of President Megawati and to date it experiences a stagnant stage due to the unclear regulation, and the financial arrangement as the foundation to implement the monorail.

Quite a number of mass transit system configurations have been discussed in the past that focused, inter alia, on how such a system is to be integrated with the existing heavy rail and road transport systems. In fact, a basic design study for a MRT along the Fatmawati – Kota corridor was finalized in 1996 under the umbrella of a commercial arrangement between DKI Jakarta and private parties. The full implementation of this MRT initiative came to a hold as a consequence of the 1997 financial crisis. The basic design was subsequently revised in 1999 with one primary objective in mind, namely to decrease the initial investment cost thereby improving the overall economic and financial viability of the MRT project itself.

The 1999 revised basic design study reviewed the basic design study undertaken between 1995 to 1997 by the DKI Jakarta and the private sector Indonesian-Japanese-European Group (IJEG). The 1999 revised basic design paid particular attention to the effects of the 1997 economic crisis on the MRT’s project outlay features in technical, economic and financial terms. The study recommended implementation of the MRT on the same corridor, namely from Fatmawati to Kota.

The revised basic design recommended splitting implementation into two principal phases as follows:

1. Phase I: stretch from Fatmawati to Monas. This Phase I is to be sub-divided into three sub-phases, namely (a) Phase I-1 Fatmawati to Senayan; (b) Phase I-2 Senayan to Dukuh Atas; and (c) Phase I-3 Dukuh Atas to Monas; and
2. Phase II: from Monas to Kota.

4.3 National and local policies related to development of automobile industry

The fall of the industry due to the economic crisis which struck ASEAN and even the world, resulted the fall of the Indonesian automotive market, from circa 398,000 units (1997) down to circa 58,000 units (1998). Year 1999 saw the start of the recovery, being at circa 93,400 units, and developed into circa 126,000 units by mid 2000, surpassing the 1999 market (See Figure 4.6.a.14).

Political stability, security and trusted government will give further growth to the Indonesian economy, and it is expected that the target of 240,000 units (in any category of vehicle) by year 2000 will be achieved. On the other side, the opening of the market since July 1999 was giving positive gestures to aspects such as alternate choices to the consumers, while competition of imported CBU against local ones forced local industries to face and carry out hard competition. The import regulation mechanism, transparencies, awareness, and industry players responsibilities, both government and privates (industry and consumer) become important and should be safeguarded.

At the end, priorities through development programs such as small passenger cars, multi purpose vehicles (van, minibus), commercial vehicles, and motorcycles; the component industries which are the automotive industry main target, are expected to be the foothold in the free market started in year 2002 in ASEAN and year 2010 in the world market.

Automotive production in Indonesia started in 1927 when General Motors put up an assembly plant in Jakarta. The activities then were limited to trading and simple assembly. In 1950s, the company was nationalized under Program Banteng whose target was to build a national car industry. But Program Banteng was completely shelved in the early 1960s because of the shortage in foreign exchange.

The national car industry program revived in the late 1960s when The New Order government gained power in 1968. The new government set as part of the national agenda the development of an independent industrial sector through import substitution policies. The automotive industry was considered strategic for the following reasons: (1) it supplies the transportation requirement of the public; (2) it contributes to economic growth, creates employment opportunities and facilitates the introduction of high technology in the nascent market; and (3) it generates income for the government from import duty and taxes.

To ensure the success of the automotive development program, several policies were instituted. The most notable was the import ban on completely built-up (CBU) cars in 1971 after it was required that all investments in the sector should have domestic equity or be in the form of joint venture between foreign and local producers. Under the so called domestic sole agency scheme, a local company is assigned sole agent for the importation of vehicles in completely knocked down (CKD) form, assembly and distribution of built-up units. In addition, the government also protected the industry by implementing tariff and non-tariff barriers such as quota and local content scheme. As a result, many automotive companies and plants were put up. By 1972, there were more than 22 assemblers producing more than 20 brands and more than 50 models. However, since the sole agents and assemblers were formerly trading companies, they generally have limited knowledge of car production and little motivation to develop the industry.

In 1977, the government introduced the deletion program that required the assemblers to use locally produced components. The program was meant to provide opportunity for the supporting industry (i. e., parts manufacturing sector) to develop. The program initially covered replacement parts that were already produced locally. Subsequently, major components were included. For the latter, the government set target dates. Thus, for commercial vehicle manufacturing, targets were set to use locally produced glass parts by 1978, chassis by 1979 and engine block by 1984. Those who failed to comply with the targets were sanctioned with 100 percent import duty on components that are being locally produced. It was expected that at the end of the program, the automotive industry would have become independent of imported components.

4.4 Air pollution and congestion control policies and plans

To control air pollution there are several policies at national and local level implemented. Government Regulation No 41 Year 1999 on Air Pollution Control stated that new vehicles are subjected to type approval emission standards which are Euro II standard by 2005. Minister of Mining and Energy Decree No 1585 year 1999 proclaims lead phase out in gasoline nationwide by January 2003 (which in August 2002 nationwide schedule revised until 2005). DKI Jakarta has accomplished unleaded gasoline by July 2001. Jakarta Local Regulation No. 2 year 2005 on Air Pollution Control mandated to private and public vehicles to undergo emission test and increase the use of alternative energy such as gas. To comply with the regulation, The City Government of DKI Jakarta has decided to use CNG fuel for BRT corridor II and III (185 – 200 units).

One of the efforts to reduce air pollution, The Government of Jakarta promoted a campaign “Bike to Work” program. Since 2004, a Bike to Work Community has been established with a mission to create special lane for bicycle in every roads in Jakarta. This mission received full support from The City Government.

To control congestion, since 1992 The Government of Jakarta started the Traffic Control Area program or known as Three in One (3 in 1) program covering several major roads in Jakarta (Gatot Subroto St, Sudirman St and Thamrin St). The purpose is to restrict private vehicles to enter the area in peak hours (06.30 – 10 AM and 4.30 – 7 PM) unless carrying passengers at least three . After 12 years implementation, the result is far from the expectation because people seeking ways to enter the area, for instance by hiring a jockey (this term is used for persons who are hired to ride private cars so the number of people in the car become at least 3 persons). Therefore, the number of vehicles in the area was not significantly reduced and the congestion still occurs and the main purpose of the program to reduce the use of private vehicles or shift their travel at non peak hour failed. This condition occurs because public do not have better alternative to enter the area such as good public transportations system.

When BRT was implemented at the same area of 3 in 1, one lane was dedicated for BRT lane. Some congestion was predicted to increase because smaller space occupied with the same number of vehicles. In this situation, the 3 in 1 scheme is in line with BRT, where the people particularly commuters now can leave their cars and use BRT as the alternative transport to enter the area. In the future, The Government of DKI Jakarta is planning to upgrade the 3 in 1 scheme to road pricing scheme. But the technology and policy to support such plan is still under way.

Another measure to reduce congestion is by eliminating on street parking. Although this measure may not reduce number of trips, but at least it can put more difficulty to private cars users.

4.5 National and local policy transportation tools

The rebound of vehicle ownership in Indonesia can be associated with low petrol price and the loan interest rate. The highest fuel price increase was in November 2005 where regular petrol was up from Rp 2,400 (US$ 26c) to Rp 4,500 (US$ 49c). It’s an 87% increase! In 2004 the price was even just Rp 1,810 (US$ 20c). It can be concluded that the most recent 87% fuel price increase did affect the vehicle sales in 2006. The pre November 2006 fuel prices at US$ 20-26 cents did not affect the vehicle sales. The price of unleaded super fuel (92 octane) also changed in September 2005 from Rp 2,450 (US$ 27c) to Rp 5,700 (US$ 62c).

It's evident that the government keeps trying to cut fuel subsidy gradually for better economic performance. In the last fuel increase, the government stated that the following price increase is due in not so long period in an attempt to bring closer to the market price which is estimated at Rp 6,600 (US$ 77c).

The high rate of vehicle sales in Indonesia was also made possible by the stable exchange rate at Rp 8,800 per 1 US$ and lower interest rate of single digit (2002-2004). The slower rate was evident when the exchange rate went up at Rp 9,200 nowadays and the higher interest rate of above 13% in 2006. The lowering taxes related to automotive industry was introduced by government in 2003 i.e. import taxes.

To balance the high growth of car and motorcycle sales and to promote the renewal old public transport vehicles, government introduced import-tax-free scheme in 2003. The impact was the significant influx of second hand buses and trucks, but the renewal didn't progress as expected. The condition of city bus fleets are not improving even in these days. However, many good quality intercity coaches and tourists buses are now in the streets. This indicates that the improperly-regulated city buses may have caused the unsuccessful fleet renewal because the financial and organizational aspects are not reformed yet.

For the first time, the central government is introducing route tendering on a competitive basis for Jakarta Airport to Bandung direct bus service in 2006. This is part of the public transport operational reform. Currently, the operation is run by DAMRI- a public company on a monopoly basis with poor services from airport to Jakarta and the surrounding areas.

At the local level, Government of Jakarta is preparing the new procurement system for the provision of new busway routes of 4, 5, 6 and 7 which is due to operate early 2007. This, again, is the first provision using competitive tendering system using quality licensing scheme. An operator capable of providing a service to comply certain standards with lowest bidding price in Rp/km will be awarded the licence. This major change in the system which is still under preparation indicates a lot still to be done to make the operators understand how the system works and a set of training is envisaged to be very necessary.

Parking control has never really been adopted as a tool for traffic and transport management both by central and local government alike. Central government issued a guideline for parking provisions for public buildings in 1996. In this guideline, parking is not seen as a tool for traffic restraints policy. Practically, parking is more regulated for the purpose of local government income by means of what so called "retribution". Retribution is a fee charged to those received some forms of service from public sector. So, those who use some part of road are subject to pay retribution. The local regulation generally governs the locations and the level of parking fee to be charged. Normally, the fee is flat, no time, duration nor location dependent. This system gives ample room for misuses and violation and practically no control mechanism is in place. Road-side parking business in then generally "managed" more by mafia system than under government control. In some areas, there is collusion between government officials and the mafia people. As government has little control over parking, the mafia tends to "sell" the parking spaces uncontrollably, even in the city centre or CBD's. Private vehicle users generally can get parking space easily on the cost of disrupted traffic operation and congestion and even leading to illegal parking practices.

Consequently, local government can generally be regarded as experiencing lost and lost rather than win-win. Not only can they claim adequate income from parking retributions but also suffering from the disrupted traffic and severe congestion in the city centre areas. In many cities, revenue from parking retribution can only reach about 15% to 20% from the potential revenue as in the survey. Typically, parking fee in Jakarta is Rp 1,000 in minor streets and Rp 2,000 in major roads and CBD areas irrespective of the duration. But in reality, parking attendance frequently charges more and even worse the ticketing system in most cases is not in place.

5. Strategic analyses

5.1 Role of key actors

5.1.1 Jakarta Transportation Office (JTO)

Within this office there is a System Development Section which in so many years has been actively carrying out studies to formulate new ideas or developing new approach to tackle transportation problems in Jakarta. Its capacity of the human resources is well above average. The head of this section as well as some 5 out of 24 are of master level mostly in transportation, some of them graduated from a leading UK university. In the course of searching a new system for public transport, this section in collaboration with Gadjah Mada University was exploring a major reform of the current system. This kind of collaborative effort differing from the ordinary consultation work managed to initiate a different approach and was able to identify the root problems and hence could come up with appropriate alternative of solutions.

Another significant role of JTO in making the new bus system possible was preparing the new Local Regulation (Perda) of DKI Jakarta No. 12 Year 2003 which was securing the implementation of unusual new system such as utilizing central/medium lane for the busways and the boarding-alighting operation from the "wrong" side of a bus. Without this regulation in place, it would rather be difficult to construct the unusual arrangement of the new system and some resistance may arise from public as well as central government.

5.1.2 Academics

As the first step leading to the new bus system in Jakarta, the Transportation Study Unit (Later in 2001 changed into Centre for Transportation and Logistics Studies) at Gadjah Mada University was commissioned in mid 2002 by JTO via System Development Section to explore the new bus system capable of solving the long standing current problem, such as fierce competition, poor service, license without quality standard. This centre using multi-disciplinary approach rather than conventional engineering approach looked the issue in a more comprehensive way. This strong centre belonging to the largest university in the country managed to come up with a stronger bus priority scheme overcoming the failure of bus lane program introduced in early 1990 which ended up with high violation and poor service since there was an inherent weak financial system prevailing (Traffic and Transport Authority Jakarta Province, 2001).

The result of the study was a clear priority system for public transport in Jakarta stronger than the old bus lane combined with a transparent financial analysis to assure the good quality of service delivered. These two approaches actually were in favour of public transport users i.e lower income group. This strategy was somewhat appropriate for Jakarta bus system which was in the verge of marginalizing as demonstrated by the bus availability which was down to below 60% at that time. The study also indicated the consequence of the approach involving a bigger role of government to do the institutional and financial reforms including the inevitably risk of subsidy. The role of academics as generally regarded for being independent in its view had been significant in introducing and convincing top politicians in accepting the new bus system. Fortunately, the strong financial capacity of Jakarta budget allowed this unpopular subsidy option which otherwise might be a hurdle for other cities.

The more recent regulation concerning consultancy service provision is giving much smaller room for a government office to commission a work to a (public) university as it happened in the above study. This may be a potential weak area to sustain the ongoing reform which still needs innovations and new ideas backed up by scientific approaches and engineering methods including financial engineering which university research may have such answers.

5.1.3 Office of Vice Governor for Development Affairs

As there had been a new fundamental approach for the proposed bus system coming from academics and was regarded by the JTO as being potentially suitable to improve the system, the JTO felt the need to assure the proposed system to be adopted by the provincial government. To do this, the JTO approached and advised the new system to the Deputy Governor in a way to attract more attention from related institutions within Jakarta provincial government. It was fortunate that the deputy governor was a very senior government official with a strong knowledge of Jakarta development as he was formerly the Head of Planning Agency for so many years. Apparently, he is an engineer and very much communicable in many ways.

Having been informed on the potential success of the new system and then was attracted, his role in making the progress from idea into reality was very significant. He was bridging the communication between the academics who brought the new system to the related sectors and offices within the provincial government as well as to the top politicians i.e. the governor and the local parliament.

His role in the process of formulating the new bus system into a clear and complete solution was extremely unusual. He coordinated regular meetings between academics and the related sectors in formulating the new system, so that a participative planning was underwent. Instead of the academic consultant working in isolation, the regular meetings typically every two weeks were a very intensive and effective communication medium so that the related offices were at the same time educated to the new system which later on has speeded up the implementation phase. It's worth noting that co-ordination is notoriously known as being the weakest point in the governmental environment. Without the outstanding role of the vice governor, there might be a conflicting interest among such parties involved in the planning process and formulation of the new system might not be that easy.

Among key parties regularly involved in the meeting were Public Works Office responsible for infrastructure provision, Planning Agency responsible for coordination with other sectors and budget planning and JTO who actively developed the new system and the bus operators. Their involvements had proved to be beneficial in making their respective works went hand in hand with other offices in making the new bus system into reality.

The most significant role of Vice Mayor was to make the clear way for political decision on the new bus system. To convince the governor and further to make his decisive stand in favour of the new system was done in only one meeting. More amazingly, the positive response from the parliament and consequently securing the funding for pilot project for the first route came only from one meeting and only one month from the decision made by the governor. In general case, these two processes may take at least 6 month or a year.

5.1.4 Jakarta Planning Agency (JPA)

The above planning process safeguarded by the deputy governor sent a message to all concerned on the importance of this new bus system. The intensive participatory process had forced the JPA to accommodate the needs for the new system in terms of securing the related activities to be budgeted in the right amount and in the right time. These coordinated plans were made possible by the active role of JPA.

The role of JPA also covered the institutional and financial aspects resulting from the new system. The budget to cover the cost of operation of the new bus system was never before recognized by the local (or even national) budget system. The JPA decided that the buses owned by the government were to be operated by private sector and their costs were on a government payroll. Meanwhile, all the revenue i.e fare-box and others such as advertisement revenue would go directly to income office of government. JPA and Bureau of Economic Affairs had decided to form the operating body of the new system known as TransJakarta in a form of “management body”. It managed the operational costs of all bus operation in route 1 using the budget allocated for it. It was also is responsible for fare collection and then deposit it to income office.

5.1.5 ITDP (Institute for Transportation and Development Policy)

This New York based international transportation NGO actively promoting BRT took important part in the introduction of BRT to Jakarta. Prior to Jakarta, this organization from year 2000 supported the development of new design of Becak (pedaled three wheeler) in Yogyakarta in collaboration with Gadjah Mada University. As from 2001, ITDP started its support to develop BRT in Jakarta. This coincidence between ITDP initiative and the Jakarta’s plan for a new bus system was really an advantage. A series of co-ordination meetings were arranged in a way to make two plans to synergize.

The significant role of ITDP were twofold: (1) to influence the top politicians especially Jakarta governor and also Yogyakarta mayor when they invited ex Bogota Mayor Penalosa to visit Jakarta and Yogyakarta in the late 2002 introducing the success of Bogota BRT; (2) to facilitate the understanding of BRT system among related parties from Jakarta by sponsoring a study visit to Bogota in two occasions in 2003 (February and May). The first batch was composed of 32 people from various government institutions, members of parliament, media and NGO’s. Not only were the delegate able to take part in an international seminar “Ciudad Humana” of Human City but, more importantly, a special 2.5 day training was arranged for Indonesia delegates on BRT and the success of Bogota.

In the course of preparation of the Jakarta busway ITDP had also provided some technical assistances by means of disposing experts required to assist the analysis of demand and in conducting the demand modeling and they also appointed Pelangi, an environmental NGO to publicize and advising public and other NGO’s on the new BRT system for Jakarta.

5.1.6 Trans Millenio, Bogota

Arranged by ITDP, Trans Millenio conducted a special 2.5 day training session for Indonesian delegates while they were visiting Bogota. This training gave a clear and detailed BRT system especially that of Bogota. The tour to the facilities such as terminals, garages, maintenance facilities and traffic control centre brought a clearer picture on how the system works and how the role of government in making sure the services are delivered in a high quality standard. This training also detailed the step by step to prepare BRT. This enlightening training has brought about a stronger confidence to the participants to adopt or proceed with the Jakarta BRT plan.

The impact of the visit and training was remarkable. Each of the participants showed a confidence in their work leading to the introduction of the Jakarta busway. Some resistance coming from the public or some groups of the public were reduced as many of them found the answer from one or more participants or through one way or another. The general public pessimisms arose in the early stage was reduced. This phenomenon has paved the way to the implementation of the first route relatively smoothly.

5.1.7 Public relation activities

The public distrust on the government competence in improving public transport was high in the beginning of the bus system improvement around 2002. This is so because many past improvement attempts ended up in a failure. This high pessimism was also there when the busway idea was first introduced. Strong resistances from NGO’s and media were inevitable. The role of foreign actors such as ITDP was quite significant in giving assistance to smooth thing out. A systematic approach to make the general public aware on the new system was adopted in collaboration with a leading local environmental NGO “Pelangi”. Despite the resistance, the related parties kept going with the plan because of the better knowledge they had and the confidence they built as the time moved on.

Upon recognizing the importance of public relation by means of close public communication to educate the public, the JTO hired the top public relation company “Fortune” to assist them in conveying the goodness of the new bus system to the public as well as the public transport users. The fruit of these outstanding public communications was quite evident, especially to the lowering level of resistance and upon seeing how the new system works most of the criticisms disappeared.

5.1.8 Governor

One most important role in the success of Jakarta busway was of the governor. Upon having a clear knowledge on the new system i.e. from various sources such as academics, ITDP and more importantly from his own visit to Bogota accompanied with some 40 representatives involved in this project (senior advisors, key technical advisors, bus operators, police officers, parliament, members, NGOs, members of the press, consultant and bus suppliers), the governor showed a firm confidence that he would implement the new system in January 2004, just a year away from the first batch visiting to Bogota (ITDP, 2003).

The governor consistently led and monitored the preparatory works. The decision to construct the infrastructures and in the provision of buses was made in a short time. To speed up the process the provision of buses was carried out by appointing two companies to build the 54 buses instead of using the standard tender system for government procurement. Later, this non-tender mechanism became a pitfall which is now bringing the former Head of JTO into a trial for corruption on bus price mark up suspect.

As the governor is actually an army, he foresaw the need to secure the system working as planned with a high level of security and safety. Upon preparation of the opening, the governor showed his strong leadership by giving a security brief to 1,400 security personnel to assure the demonstration project went well. He was also very active in spreading the knowledge of the new system through all sorts of media. This was one key success to the soft launching of the new bus system in 15 January 2004. This launch answered all the public doubts on the new system and quickly received a very positive response from the public.

5.2 Timings

One key success of the Jakarta busway is associated with the right timing. The new system was introduced right in the era of government reforms as a result of economic crisis starting in 1997. It occurred right in the worst condition of bus system, and public transport industry in Jakarta which otherwise many operators may have gone bankrupt. Consequently, the success has brought a high hope for the future of public transport industry.

5.2.1 Bottom line condition of public transport

The economic crisis has brought a serious impact on public transport. The soaring foreign exchange rate up to four times simply put pressure on the spare part costs and hence operating cost, while the fare simply could not be increased in the same way. A serous deficit of public transport operation brought the bus availability down to around 60% and no bus renewal possible. The patronage was down to the lowest rate. Many companies gone bankrupt and an urgent action to save the public transport industries were called for.

The new bus system for Jakarta was proposed just in the right time when the system was in the bottom line level. In that very crucial moment when public transport services were getting scarce a quick action is required. Although at that time, the Jakarta government might have proposed a railway of a subway plan, it’s simply inappropriate to adopt it in a short period. Consequently, bus improvement was the only sensible option. But, the idea of BRT was really unexpected by the public as well as many parties, politicians, even central government (Ministry of Transportation) because most attention was focused on economic recovery. It was therefore understandable that the plan for the new system was easily accepted by politicians and practically there was no financial problems encountered in the implementation.

5.2.2 Wave of reforms in public sector

In an attempt to promote economic recovery following the crisis, the government launched overall reforms in all sectors especially in public services. New ideas and breakthroughs were expected and introduced in that time. This wind of reforms nationwide created a conducive atmosphere for public transport reform to take place. This made the adoption of new concept of BRT to be easily acceptable because public saw it as part of the reform from transportation sector. It was also seen possible to introduce a different system such as assigning median lane for the busway and a special design of high floor buses matching with the shelter floor of 1.10 cm high. This was a radical change in the engineering design.

The reform environment gave way the introduction of operational financial subsidy on the cost of running the buses. This was perhaps the first occasion of such subsidy for urban public transport system in Indonesian public transport history. Normally, subsidy is given to provide the low patronage bus system in remote or rural areas.

5.2.3 Balancing private transport high growth

As the economic recovery progressing, the high growth of public income is evident as one can notice the new vehicle sales. As from 2003, the car and motorcycle industries have been enjoying a high growth of demand. The record of vehicle sales reached its peak in 2004 with around 5 million vehicles sold and is estimated in the higher level for years to come. This rapid motorization especially the remarkably high motorcycle sales have brought impact on the public transport patronage. This trend keeps on going until these days (Kompas, 2006). The successful introduction of new BRT system for Jakarta will give a balancing role to compensate the high growth of private transport. This idea is shared by other cities which then also plan to adopt the similar idea like Jakarta busway.

5.2.4 Governor's term of office

In the new election system of governor's as part of decentralization scheme in Indonesia, a direct election is adopted. Here the public accountability of a governor is a pre requisite. A governor may stand only for two consecutive terms of five year each. When the new bus system was introduced, the current governor is in his early second term. This made him to feel "nothing to lose" when making an important decision. The decision of adopting BRT system for Jakarta benefited from this situation. One could also see how the governor led the introduction of this new system with less pressures and resistances.

For a comparison, Yogyakarta city which also planned to introduce a smaller scale of BRT in October 2005 failed to proceed with the demonstration project. The mayor saw the possible risk on the failure of the system which could affect his plan to stand for the mayor for the second term five months later. This shows that the public transport is a politically risky area to make major changes on the current system.

5.2.5 Response from bus operator

The relatively fast bus reforms in Jakarta may provoke other positive changes, especially within the government sectors, central and local because the capacity of their human resources are reasonably adequate to respond to such changes. The story may, in contrast, be different if one look from the private operators' perspective. Even some leading bus operators currently running the BRT in Jakarta are not really regarded as "proper" operator having adequate knowledge to run buses considered from the international standard. Most companies still do not have or employ experts or qualified personnels with public transport competence. They run the business on a traditional manner- "they do the business the same way their ancestors did". The changing process among bus operators has been very slow.

It is clearly evident that most of bus operators are not able to "see what's going on" during the course of the major changes in the new bus system and hence the public transport industry. They do not receive adequate training to make them understand how to change from their "business as usual" to the new system. There has not been a systematic capacity upgrading program from the government to make them fully prepared to adapt and adopt to the new system. This situation may not give impact in the short period, but in the longer run their prevailing low attention on maintenance aspect as seen in today's operation may affect the sustainability in providing the services in a high standard as set today.

5.3 Potential pollution and congestion reduction

5.3.1 Pollution reduction

The potential pollution reduction resulting from the introduction of Jakarta busway has been identified by ITDP in their technical assistance activities for Jakarta. A lowering GHG (green house gases) is also estimated by means of some shifts of private car users to BRT. As previously mentioned, according to the survey conducted by the ITDP, 7 months after BRT operation in Jakarta the level of NOx had been reduced from 0.271 to 0.076 metric tonnes/day or 16 metric tonnes. Meanwhile, the level of PM10 had fallen from 0.029 to 0.002 metric tonnes/day or 2.3 metric tonnes. As for global emission of GHG, the reduction is quite amazing. It declined up to 1,710 metric tonnes.

As part of Blue Sky program of Jakarta, the route 2 and 3 are now operated using CNG buses and also the proposed routes of 4, 5, 6 and 7 which are due to operate early next year. Considering the fact that CNG is largely available in Indonesia since it's a CNG exporting country, the adoption of CNG buses certainly will bring about lower air pollution as cleaner emissions resulted from CNG buses. However, a CNG bus is still a new technology for most bus operators in Indonesia.

Attempt to introduce CNG for public transport vehicles, especially taxis and in a smaller scale buses has started in around 1998. Public CNG refilling stations were provided by national government but only in few places. It's widely known that the cost of provision and running a filling station is high, although the price is lower than petrol. When it was introduced in the late 1990's the price was less than half of petrol price. But the price keeps increasing and now it's about 25% less than petrol. So, the attractiveness of CNG is not as strong as before. Coupled with the difficulty in locating the filling station and some mechanical hassle in the maintenance of the engine, most taxis and all buses formerly using CNG reverted back to ordinary fuel.

Learning from the past failure in introducing CNG for public transport vehicles in Jakarta, it's worth no note that similar problem may arise for newly introduced CNG BRT buses. Recently, lower pressures in the refilling process makes the buses have to refill during its daily operation, even in some cases 2 refilling. The design is no refilling during one day operation. Some potential mechanical problems are identified such as high engine working temperature. So, despite the potential pollution reduction from the introduction of BRT in Jakarta, there is a potential mechanical problem which needs some technological interventions to sustain the regular services.

5.3.2 Congestion reduction

It is not clear whether congestion can be reduced by the introduction of BRT in Jakarta. With around 20% (ITDP's presentation document, 2004) shifts from private vehicle users, the impact to the traffic congestion may be insignificant considering the very high growth of vehicle ownership occurring these days. In the first few weeks of opening, the afternoon congestion along route 1 was quite severe which necessitated the government to apply afternoon 3-in-1 scheme. Initially, the afternoon period was 16.30 to 18.30 and then extended to 16.00 to 19.00. This introduction gave a significant reduction on the afternoon/evening peak congestion.

After two years running, it seems that the congestion both in the morning as well as evening peaks is growing worse. It's likely that due to the improving public income, more and more cars are filling the street and the users manage to "fill" their car with 3 passengers to benefit the 3-in-1 scheme. This indicates the need to convert the system into some kind of congestion charge using financial charging approach as in Singapore or London. The Jakarta government is planning to install this system, but still unclear which system to adopt. The congestion may also be associated with the very limited development of busway feeder system especially from the suburban areas.

5.4 Uncertainties

5.4.1 Image, safety, security

The strong new image of Trans Jakarta busway is very much appreciated by general public. It can be seen that more people in the medium-high income group who have previously never seen a bus as a means of transport now they do. Many working people use the system. One strong feature compared to using traditional bus is the feeling of secure and safe. The door which is always closed and the presence of security personnel on the bus and the stops create a secure feeling. The boarding alighting by means of a dual door (bus door and bus stop's door opening simultaneously at a flat level) create a safe feeling to all users, even children and the elderly people.

The need to make sure that the doors in buses and at the bus stops operate properly at all times is a challenge by itself. Here the maintenance of the buses which is the responsibility of bus operators and those of the bus stops which the responsibility of Trans Jakarta is a crucial thing. Now there are some doors at the bus stops do not work properly, also some doors at the bus do not open or close properly. These mechanical problems may jeopardize the image which is the key to the BRT success in Jakarta.

The absence of pickpocket in the new BRT system is a strong point and must be maintained. The presence of a security at the bus door is a key for security including avoiding pickpockets, but at the same time increasing the staff cost and may be considered unusual to the international standard. But the removal of this person without a suitable security means to avoid pickpockets such as cameras may bring the system lacking of security and may have potential for pickpocket to operate.

5.4.2 Speed and violation

The exclusive roadway provided to the BRT makes it possible for the bus to run smoothly at higher speed than the general traffic, especially during peak times. This is made possible because of the presence of traffic polices and security personnel securing the dedicated busway to operate properly. As the number of such personnel is now decreasing, the violation from private vehicles misusing the busway is growing, especially at junctions and busy intersections. This will inevitable be lowering the bus speeds along the corridor. This thing can no longer be tolerated. Should this thing keeps happening, the Jakarta BRT may lose its speed advantage against general traffic which is one strong point of success in attracting passengers.

5.4.3 Fare and government subsidy

In the current financial system, the costs of bus operation are borne by government budget on a direct payment by Trans Jakarta to the bus operators on a monthly basis. The revenue from the fare is collected separately then deposited to the Revenue Office as the government income. Although the subsidy is theoretically the net deficit between the two, but the fund allocated is for total cost of operating all buses and the staffs and overhead cost at TransJakarta and consequently resulting in a big number. In 2006 the figure of operating cost allocation is around Rp 230 billion with fare level of Rp 3,500 (last year the fare is Rp 2,500), while the revenue is still low (around Rp 130 billion) and there was a discussion that the parliament will reduce the subsidy to about Rp 130 billion only. The financial performance of route 1 which has a high patronage after 2 years running (2004-2005) showed revenue very close to cost (TransJakarta Discussion Document, 2006). After the opening of route 2 and 3 which is running at a higher unit cost (because it runs on CNG and the buses are provided by operator) the overall budget is much more than the revenue. This low revenue is also associated with the free transfer between route 1 to route 2 or 3 and vice versa.

It must be understood that the main goal of the BRT is to promote the use of public transport as much as possible. Since the plan is to ultimately develop 15 routes making up a comprehensive network enabling easy transfer, it is inevitable that in the course of development of the routes, some deficit may occur. For this, an overall economic and financial benefit cost analysis needs to be carried out to assure that even providing subsidy is still a better option than the cost of congestion if no such scheme is in place. This phenomenon is quite common in the western cities.

5.5 Key implementation issues

5.5.1 National-local plan compatibility

The plan to promote public transport is a priority program of central government i.e. Ministry of Transportation (MOT), Directorate General of Land Transport (DGLT). MOT has been promoting bus priority schemes to some cities and has selectively provided a small number of buses; for example the city of Batam have received 10 city buses as this city managed to introduce a bus demonstration project with high floor, bus stop leveled system in 2005. As Jakarta has already a strong financial capacity, MOT do not put Jakarta in the priority list for bus improvement plan. MOT has confirmed to assist at least 6 cities namely Bogor, Bandung, Yogya, Surabaya, Malang and Batam which already running.

Although Jakarta BRT scheme do not receive any assistance from central government, but de facto MOT had granted Jakarta a full support to develop the system to cover the neighboring town such as Bekasi, Tangerang. MOT also adopted the Jakarta BRT system to become the national standard. MOT is currently preparing the revision of Law on Traffic and Transport to accommodate the recent developments of BRT system.

Apart from supporting the BRT development, MOT has also been supporting the Jakara plan to construct monorail and also the plan for a Mass Rapid Transit (MRT) system which have long been in the masterplan but never realized so far. However, due to the high financial burden both for central and Jakarta government, the progress has been quite slow.

5.5.2 Implementing bodies

The plan of Jakarta BRT was originally developed by Jakarta provincial government i.e. via JTO. The JTO was also the implementing body of the scheme. All the funding to meet the investment costs came from Jakarta budget. The Public Works Office (PWO) is responsible for the preparation of roadway. The provision of busses, terminals, bus stops and bus garages are the responsibility of JOT. The Office of Economic Affairs was responsible to prepare and establish the Trans Jakarta organization. The Planning Agency was responsible for the preparation of budget and coordinating the works of related offices including the Office of Parks who is responsible for medians, trees, parks which were affected by the BRT scheme.

Trans Jakarta is responsible for managing the bus operations including contracting out routes to operators, payments of bus operations, ticketing and collection of revenue, setting quality standards and supervising operators' performance in delivering services, and public relation functions. JTO retains the power of planning and evaluating the routes, demand analysis, bus stops infrastructure provision, empowering bus operators, facilitating existing operators to form consortium company, conduction supporting studies and researches and setting up regulations and guidelines.

Since the implementing body is the Government of Jakarta, all the routes planned are within the administrative boundary of Jakarta Province, not covering the greater Jakarta known as Jabodetabek. The demand for this BRT services, however, is spread to a much wider area than the 14 routes planned. Thus, the need for BRT extension to cover Jabodetabek area ought to be undertaken by central government i.e. MOT.

5.5.3 Institutional setting

In the first phase, prior to the opening of Jakarta BRT in January 2004, Trans Jakarta was established based on Governor Decree No.110 Year 2003. Trans Jakarta acts merely as an executing body. Trans Jakarta is responsible directly to the Governor but in co-ordination with JTO. Trans Jakarta is responsible for contracting out government owned buses to private operator known as JET (Jakarta Express Transit), paying out the operating costs of buses to the operator based on Rp/km, quality control of bus services, provision of ticketing system, collection of fare-box revenue and deposit it to Jakarta Revenue Office. Trans Jakarta does not use the fare collected to directly finance the operating costs of buses.

The JET is a consortium company made up of bus companies formerly running along the route 1 which were then removed upon the opening of this route. Instead of using tender system, the JTO appointed this company to run route 1. This similar arrangement is adopted for route 2 and 3. Route 2 and 3 are operated by Trans Batavia which is formed by four existing companies: Mayasari Bakti, PPD, Steady Safe and Metromini.

As from 2007, Trans Jakarta will be converted into a Public Services Body (PSB) which is a new format for a government body to run a public service. Under this new scheme, Trans Jakarta may use the revenue to directly finance the operation of the bus services. It can also act like a private company, making use of the available asset for commercial purpose. In the new system, the PSB will be under JTO and not under Governor. The aim is to reduce the government net deficit in running the BRT.

5.5.4 Financial arrangements

Jakarta government is responsible to meet all the costs associated with the development and then running the BRT system. For the route 1, all costs were borne by the government. The total investment was around Rp 120 billion (US$ 13 million): Rp 64 billion (US$ 7.1 million) for infrastructure and Rp 56 billion (US$ 6.2 million) for bus provision (Dagun, Save M, et al, 2006). To run the system, an annual budget is allocated to finance the bus operation and is administered by Trans Jakarta. Trans Jakarta is also responsible for collecting the bus fares and deposit it to the Revenue Office. The unit cost of bus operation for route 1 is around Rp 8,200/km (US$ 90 cents) (Dagun, Save M, et al, 2006).

Arrangement for route 2 and 3 is slightly different. Government is only responsible to finance for infrastructure provision, while investment for rolling stock i.e. buses is the responsibility of private bus consortium. Trans Jakarta is contracting out the services and paying out the overall operating costs including the costs of bus provision. The unit cost of overall bus operation for route 2 and 3 is Rp 12,200/km (US$ 1.4) (TransJakarta Discussion Document, 2006).To provide services for fare collection and ticketing, Trans Jakarta is in a contract with a private firm. The ticketing system is very similar to the system in Bogota. All the ticketing infrastructures – hardware and software - are provided by private company.

Jakarta is considered “very rich” in terms of its financial capacity. Their annual budget in 2003 when the BRT was under construction was approximately Rp 14 trillion (US$ 153 billion). The expenditure for the BRT at that period was only Rp 120 billion (US$ 13 million) or only 0.8 percent of the budget. Other cities in Indonesia may not have a comparable financial capacity.

5.5.5 Compatibility with local context

Historically, and still now busses are still the main type of public transport serving Jakarta. The poor quality of urban rail makes it popular only to the lower income group. But, bus services have always been available for all income group because there are various level of services available, namely economy class with some standing, express non air conditioned (Non-AC) and express air conditioned (AC) all seated. The presence of BRT is combining all the current services: it's air conditioned but allowing standing (35 seated and 50 standing). This makes the Jakarta BRT very popular among all users. The fare is also in between the economy class and the express AC. So, when the new Jakarta busway was introduced and simultaneously followed by the removal of existing services all classes, there was no complaint from the users. So, the new BRT has managed to set a "single uniform level at service" instead of providing separate types of services which of course making the arrangement easier and also cheaper.

People of Jakarta love Trans Jakarta busway very much. They are proud of eventually having a system comparable to the world class cities. They are aware that the new system works, meeting their needs and reflecting their identity. People know that the system is attracting international attention and they learn that more and more visitors come to see the new system. During weekend, when the commuters are not using it, people love to use it for various leisure purposes. School children are often introduced to the new system by introductory tours during weekends, especially saturdays.

People along the route, mostly workers love to also use the system for leisure. Lunch time is a busy time when workers can now move about easily finding their favorite restaurants for a meal. It's interesting to note that the patronage is mostly high at all times. Of course there is a tidal pattern: in the morning the passenger flow is northbound (from Blok M to Kota) and the reverse case in the afternoon. But after the opening of route 2 and 3 (both are east-west direction) which is crossing route 1 in the middle i.e. in Harmoni Transfer Point, such tidal flow is not so strong anymore.

The south end station of Blok M is also a big commercial centre but it experienced a sharp decline in its business due to the competition with newer and bigger malls in the north part of Jakarta . After the opening of the BRT, it's gaining again its popularity. Many commuting users drive their car to this station and then hop the BRT. The BRT is also very popular among foreign experts and workers working in the corridor.

5.6 Cross sectoral impacts

5.6.1 Pedestrian facilities improvement along the route

Following the introduction of Jakarta BRT route 1, there is a strong need to improve pedestrian walkway along the bus corridor. Some establishments showed the interest by voluntarily improve their facade of front part of the building to give attractive environment for pedestrians. PWO has also been undertaking pedestrian walkway improvement along the corridor and this has changed the pedestrian environment which attract more people to walk or use the BRT system.

5.6.2 New bus terminal at Stasiun Kota and Harmony Transfer Facility

Following the success of route 1, the north end of route 1: Stasiun Kota which is the north old city railway station is renovated to create a smooth and attractive connection between railway and BRT system by means of underground construction. This intermode terminal will make both systems more attractive and will also promote the redevelopment of Old Jakarta City which has been rather slow in progress. It's estimated that this terminal will be able to regenerate the economic activities in the old Jakarta City areas.

Prior to the opening of route 2 and 3 which are crossing the route 1, the government decided to build the transfer facility at the transfer point of these routes which is called Harmoni. During the construction, the temporary transfer point was at Merdeka Barat station, some 1 kilometer away from Harmoni. The Harmoni transfer point is ready to operate as from September 2006. This transfer point is one of its kind. BRT users can change among three routes at this point for free.

5.6.3 Pedestrian bridge improvement and elevator provision for disabled

Since most of the pedestrian bridges (17 out of 20) used to access the BRT stops were the existing structure, it was relatively easy and cheap to construct the bus stops. Connection from the new BRT bus stop and the existing pedestrian bridge was by means of a sloped (1:8) landing. But the original access to the bridge was using steep stairs which make the bridges unpopular among users. To improve it, JTO have converted most of the stairs into sloping ramps making use the available space in the roadside. Now BRT users can manage the slope to reach the bus stops in a much easier way than before. To further improve the access, there are two locations now equipped with elevators. Although the BRT system is now friendlier to the disabled people, but still not many of them is seen using it. Perhaps more campaign is needed to promote the use from this group.

5.6.4 Railway station interconnection at Dukuh Atas

Having established the BRT along the main road of Jakarta CBD connecting Blok M which is like the new city of Jakarta and Stasiun Kota which is located in the old city area the impact is like having a strong railway line. This has prompted the need to revitalize the existing urban railway line which crossing the BRT line at Dukuh Atas station. The National Railway Company (NRC) managed to reopen the service connecting Dukuh Atas station to Serpong which serves the biggest housing complex in the south west Jakarta of Bintaro Jaya and Bumi Serpong Damai (BSD). This service quickly received a strong response from the public and many users ending up at Dukuh Atas station change to using the busway. Responding to this, JTO has constructed a sheltered gangway connecting this station with the nearest BRT bus stop. This is the first relatively smooth transfer facility between rail and BRT giving the users protection against weather and it's very well used.

5.6.5 Feeder services provision by private sector

The development of feeder services by JTO has been facing a lot of problems unlike the busway system. One main reason is because the each feeder route is run by different operators. The old licensing system is based on individual vehicle. This makes very difficult to institutionalize the payment to feeder services because the deal can only be done on individual buses, and hence a contractual arrangement cannot be applied. The possible solution is to adopt feeder system in Bogota where each feeder route is contracted out to a company similar to the contract of the main route.

What is surprising is the response from some big real estate companies. As part of their marketing strategy, they voluntarily set up some feeder services available to the residents from their housing complex and many of this service are running very well in terms of patronage and the good quality of services comparable to that of busway.

6. Discussion and conclusion

6.1 Discussions

6.1.1 Policy development

The rationale of choosing new bus system which then known as Trans Jakarta busway as a transition awaiting plan for the MRT combined with the fact that after the economic crisis there was a serious decline of the bus patronage threatening the sustainability of the industries has given a strong motive for a rapid action. The bus operators running the business in a traditional way simply could not cope with the scale of the impact of economic crisis on public transport system in Jakarta. The public complaint on the poor quality and the significantly decreased number of buses giving rise to the low frequency of services have also put the pressure for a swift and significant changes to rescue the bus service and the role of government was called for. However, at that time i.e. from 2001 onwards, the Jakarta master plan study was still underway and then it was completed in 2003. Due to the strong pressure for immediate action, the local government was looking for ways to speed up the changes.

The above condition forced the preparation of the new bus system (i.e. the busway) ran side by side with the transport masterplan study (SITRAMP, 2004). It is interesting to note that initially the busway was not part of the plan, although a bus priority scheme was proposed in this study. As a result, the study team had to harmonize the work so that the busway plan can be incorporated in the study.

The small study of Academic Analysis for a new Jakarta bus system running in 2002 was initially meant for preparing the updated version of local government regulation on people and goods transport. However, due to the above pressure, this is the only entry point and became the “vehicle” for preparing the new bus system. Considering the scale of this study, it was not possible to undergo a proper and full scale study for a new BRT system for Jakarta. As a result, this study was made use to “develop” the new BRT system even without a proper plan. Even in this study, neither demand analysis nor a feasibility study was undertaken. Instead, this study was marked by intensive meetings to define, discuss, prepare the then so called Jakarta busway (BRT).

When the Governor, after learning the study results, was convinced that the busway plan was good for the public at large especially the existing public transport users with relatively a small amount investment needed, he declared to adopt and implement the scheme in the first instance. This important political decision acted as a “command” to all government officials of Jakarta. When the similar support was obtained from the parliament, under the similar reason: friendly to people of lower income level, the plan was unanimously accepted as the Jakarta prioritized program. All resources and funding were channelled to support this plan. This has speed up all the preparation.

It is interesting to note, that even a very important decision like building the BRT which will have an impact to the future of a mega-city like Jakarta can be made without an expensive comprehensive and detailed preparatory study despite the fact that the new system is completely different from the existing one. Only by a general picture of the new system, as the result of the study, which has a potential of removing the current bad-practices of bus system such as stopping everywhere, racing and competing for passengers is adequate for making a decision which can alter the history of public transport in Jakarta.

On the political side, there were some speculations that another impetus for the rapid and such big a decision like the busway was associated with the term of the Governor in the office. When the decision was made, the governor was already in the second term of his office- which is also the final term. People say that “he has nothing to loose” in making such big decision, even if it would probably end up in failure.

6.1.2 Key success factors

Suitable technology

The decision to opt for BRT which is still based on conventional bus technology with minor physical modification can be considered appropriate. The existing bus operator does not need to be trained to adopt the new system in terms of bus provision, operation and financial calculation. The difficulties in accepting the new system by the existing operators in the beginning of 2003-2004 periods required the government to invest in the bus fleet. Private operator is chosen to operate and they get paid for the amount of services delivered. This first step became important as a learning phase. Once the operators learn to operate the buses and the amount of payment they receive, many bus operators show a strong interest to run the new system, even when the provision of buses must be borne by them.

Since BRT is still basically based on conventional buses, it gives opportunity to involve a fairly good public participation in the planning and development process. Right from the beginning, the idea was developed along with various related parties within the government institutions as well as some embers of the public. This has brought a notion that the Trans Jakarta Busway was actually developed by the people of Jakarta and they have the feeling of ownership of the plan. This is very important since each parties will willingly do its part in the development of the system which made the development of the new system went relatively smoothly and quickly.

Bogota inspiration

"Seeing is believing" is a word to describe how the trip to Bogota has opened up the Jakarta delegation's eye. Having seen that the Bogota system, although looks unusual i.e. having bus lanes in the central part of the main road, but it's relatively easy than for example urban railway system. The road widths are comparable between Jakarta and Bogota but the traffic was much busier in Jakarta than in Bogota. The high floor buses and the matching high floor bus stops were not an unusual construction and can be adopted easily. The delegate also learned that the less traffic in Bogota was due to a strict traffic restraint scheme was in operation i.e. only two last number plate admitted to operate in a single working day i.e 1 and 2 operating on Monday, 3 and 4 on Tuesday and so on. Jakarta has already introduced the 3-in-1 traffic restraining scheme since 1992 although it is not very strict as that in Bogota.

What is then very inspiring was how Bogota system managed to consolidate the individual bus operators to establish a merger company without much of a conflict. In Jakarta, the bus operators are generally very hard to accept a new program or to make any changes on the current system. The very vital role of the local government in making the changes in Bogota has also prompted the delegates that government should be in the forefront of any changes or in introducing a new system. The new knowledge on risk sharing has inspired further the delegates that the success of BRT comes from the close co-operation between government and the private bus operators.

The re-arrangement of bus routes into main or trunk routes and integrated with feeder route was also very enlightening in a way to produce a real "bus network", because in Jakarta each route operates as an individual route isolated with others. This has made the current Jakarta system was not popular for users from the periphery areas since they have to make many transfers and pay more.

Self confidence

The planning process in Jakarta coupled with the trip and training in Bogota simply built the confidence not only to Jakarta government officials but also to other members of delegates i.e. from NGO and media. The feeling of "if Bogota can, Jakarta also can" appeared among the delegate and this marked the stronger commitment to work together among them.

This self confidence has made the planning and implementation phases faster. The government not only built the infrastructure but also purchased the rolling stock. On the first year, 54 new buses were prepared then followed by another 70 after the opening. All of which cost the government around US$ 12 million. The reason of purchasing was the reluctance from the private sectors because there was still uncertainty on the success of this new system.

The construction of the first route was practically focused on building the bus stops. The busway occupied the existing central lane, only placing lateral physical separators. The utilization of existing pedestrian bridges to become the access to the central bus stops did not need major modifications except building the ramps to reach the bus stops. As the median was already wide enough to cater for the placement of the bus stops, the construction works was simple and even did not disrupt the traffic operation. All of which enabled construction works lasted to only less than six months.

To prepare the operation of the new buses, the government appointed a company to run and maintain the bus. Before that the Trans Jakarta was founded to be in charge of managing all the new system. As the buses were actually the government assets and operated by the private company, it is found difficult to assure that the operator runs and maintain the buses properly, because they do not own them. This supervisory works are then becoming demanding and time consuming. Problem will occur at the end of the fleet service life as to who will bear the bus replacement. Learning forms this,the government then decided that the buses are to be provided by the operators.

Proper timing

The economic crisis in 1997 which went up to 2001 simply brought the public transport services in the verge of a collapse. The extra ordinary increase in vehicle prices and spare parts has cost failure in fleet renewal and vehicle maintenance. The fleet availability went down to a mere 60% and in a very poor condition. The quality and the quantity of services were in the works situation. At this point, the demand for a fundamental change to improve the system was mounting high. The presence of a new bus system was seen as a big opportunity to save the public transport from falling into a worsening state if not marginalizing. At that period, the public complaints on the poor service of pubic transport especially buses was culminating. Many local governments were not ready to cope with the situation, even the MOT was not taking anticipative measures.

Learning the above situation, the plan to introduce new bus system like TransJakarta Busway was inevitably seen by general public as an opportunity to save the system from worsening situation. The plan was also seen as the government responsibility in respond to the situation. All these have led to the plan moving smoothly without much of political resistances as normally the case of public transport issue. It was also evident that is such situation the Governor and the Parliament shared the idea and accepted the plan in the first instance. This was a rare case for such an important issue.

Proper timing meant also that the Governor was able to decide swiftly and firmly on the new bus system because he had no risk of losing popularity since he was in his last term of administration. Even in this situation some government leaders like Sutiyoso the Governor of Jakarta tend to produce something which can be remembered after retirement. And Sutiyoso is doing it well. He gained a strong popularity after the success of Jakarta Busway so that he then proposed the idea of forming Jabodetabek as a single province. By doing so, he indicated that the development of greater Jakarta can be done in a much more co-ordinated way. This idea is still under national discussion.

6.1.3 Constraints

Too much focus on physical matters

Having seen the success of Route 1, the government has been very ambitious in developing the next routes. Route 2 and 3 were opened 2 years after the Route 1 was launched in January 2004 and route 4, 5, 6 and 7 are expected to operate in 2007. The strong financial capacity of the Jakarta provincial government has been giving a strong push to construct the infrastructures for next routes. These extensive physical constructions of new busways made of concrete in the central lanes of some major trunk roads have cost the public severe road congestion due to civil works. Many public complaints arose and this might affect the popularity of the new system.

Many people may have forgotten that the new system contains a set of fundamental reforms within the public transport sector itself. There are important agendas for changes in financial, operational, management, institutional matters yet to be accomplished. This is actually the core of adopting the new system. The physical characteristics are the only the new “clothing” to create the new image, but the key to sustain the system lies on the reforming the current system.

One important change is to move from quantitative licensing system (tender based on number of vehicles) into qualitative one (tender based on the service quality, such as how many km per day to be travelled) – (Transport Authority of DKI Jakarta, 2005). This is a very fundamental change where a route licence is given only to operator who manages to deliver the services meeting the standard in a given cost of operation. This will bring a competitive bidding system for an operator to obtain a licence to run a route. Never before has this system been known to both government and the private operators. To do this there are a lot to prepare. Although, such preparation is now still undergoing, but most people on JTO still use quota i.e. the number of buses as one important parameter for tendering a route, which is the quantitative licensing approach. Even in one route, there will be more than one operator which will make things complicated.

The totally new system unknown to the current operators needs substantial efforts to educate them. To do this, an extensive and intensive training system is in a great need. But, so far there is no systematic training program being planned. Most bus operators still run the new bus system in the usual old way. And this may bring a potential risk because the need for a high quality of bus services needs a comprehensive and skilful maintenance strategy and some technology acquisition plan.

The longer term plan such as the institutional and financial matters are even more important. The current TransJakarta organization body operates like a government office not like a company. In the near future this should be upgraded into a public or when it’s ready a private company so that it can be competitive. The government financial support is still needed in the development phase until 15 routes and the feeder routes established. It may be the case that some forms of subsidy are still required until the market of the new system reaching its maturity, or even after that.

The current complementary traffic restraint scheme of 3-in-1 which is getting less effective needs to be reviewed. A financial based road pricing may be more effective to restraint further the traffic in along the BRT corridors. Besides the current 3-in-1 does not generate revenue and the cost for enforcing is getting more expensive. The potential change to a road pricing scheme may generate financial revenue which will help in managing the potential subsidy as above.

Feeder system: neglected

The success of route 1 is not followed by the plan to develop the feeder bus system. Following the opening of route 1, a feeder system was introduced. A passenger may purchase a combined ticket containing one ride preceding the BRT ride or one ride succeeding the BRT ride. Using part of the ticket, the feeder bus operator will claim the payment from TransJakarta based on the number passenger it carried. This system failed to continue working. The feeder buses on many occasions refused to carry busway passengers on their buses, because they prefer to carry cash-paying passengers. With busway passengers they still have to claim the payment which they regard as not attractive.

The above first form of feeder system using existing bus services did not work properly. The next form of feeder was then modified using some form of contract and special arrangement between the operator and Trans Jakarta. This system works better. Nevertheless, the number of feeder bus lines is still limited. Some big property developers initiated a special service connecting their complex to the nearest busway stop. But this service runs in separate payment system.

CNG: a potential hurdle

Learning the failure of introducing CNG for public transport vehicles in the late 1990 i.e. for taxis and some buses and still no concrete solution until now, it's too risky to reintroduce CNG buses while the development of the new BRT system is still in its early stage and many other more important things to be sorted out.

The adoption of CNG bus technology for route 2 and 3 has brought some operational problems related to CNG provision and vehicle operation and maintenance. It looks that the CNG adoption is too early considering the success of route one is only for physical and financial change. This problem may have a serious impact on the sustained development of busway system unless a systematic solution especially in the reliable supply and refilling system can be obtained.

Route and company re-organization

This issue is one of the most difficult part of the bus system reform and also one area which are not properly handled. There is no special study or work to reorganize the route, especially when some old similar routes were removed making the way for the busway route. In order to minimize the conflict, when the first route was put in place, similar existing routes were removed. Some of them were redirected to other route(s). The companies having the routes removed were then advised to form a new company and they have a privilege to participate in running the new route. For the case of Route 1, the new company is PT. JET which runs and maintains the government owned buses.

Similar to the above, when route 2 and 3 were launched, it was operated by Trans Batavia which is a merging company of Metromini, Stady Safe, Mayasari Bakti and PPD. This company was also appointed based on the reason as above. The problem of appointing a company as in the first and second case, although it made the preparation for the bus operator was simple and naturally fast, it is actually against the common practices that the provision of goods and services for the government should be done on a competitive tendering system. So, there is some problem still left to assure that procurement of busway services for the next route is advisable applying a competitive tendering system.

The formation of the new company which is coming form several different companies happened to be running towards a wrong direction. Instead of forming a legally new company, the joining companies form the new company as if it is affiliated with its original company. The problem arises when the performance of this new company is poor because decision making is still significantly influenced by its "mother company".

Institutional issues

To manage the operational aspects of the new busway system, TransJakarta was founded based on Governor Decree. Trans Jakarta is an "executing body" for the busway system. This body is to report directly to the Governor. But this body is not a (public) company. This body administers the administrative and financial matters including supervising the bus operation, arrange payment to the bus operators and collect the fare-box revenue.

As TransJakarta is not a company, it cannot use the revenue directly for operational requirements. So, the stream of cash-out in terms of payment to the operators based in kilometer travelled and the stream of cash-in i.e. fare-box revenue must still be separated. Cash-out is by means of local government budget which Trans Jakarta has to submit a proposal for one year. Cash-out is regarded as government income. The fare-box revenue is send directly back to the income budget/ financial office. So, it is not easily visible the balance between the two.

Since Trans Jakarta is responsible directly to the Governor, the relationship with Office of Transportation is not simple and is nor clearly defined. Bearing in mind that all the study and the plan was carried out of the

Office of Transportation, and TransJakarta is only an implementing agency. This poor relationship between the two has hampered the development phases toward the next phase of the busway. Poor co-ordination between the two also makes many process and procedures run late.

As from June 2005, the status of Trans Jakarta was modified. Trans Jakarta was then under the Office of Transportation. This new status creates more complication in relation to the line of communication. Under the new arrangement, the problem of separation between cash-in and cash-out still occurs. Trans Jakarta simple administers the busway system but most “manage” professionally. The risk of deficit is still fully manages by the government.

On the public side, government has initiated the establishment of City Transportation Council. (CTC). This council consists of various individual representing the public i.e. from operator, association, NGO and academics. This body gives advice to the Office of Transportation as well as to Trans Jakarta. The line of communications between related parties neither is still nor defined in detail. This creates problem of co-ordination.

Financial support

The payment from TransJakarta to the operators: JET and Trans Batavia is on 2 weekly basis. For every kilometer run of bus government via Trans Jakarta pay out based on the unit price of around Rp 8,000 (US$ 88c) for Route 1 and Rp 12,540 (US$ 1.4) for CNG based Route 2 and 3 (TransJakarta Discussion Document, 2006).

TransJakarta assign JET to perform bus trips of around 3-4 million kilometer per month. A slightly smaller assignment also applies in Route 2 and 3.

In the first year of running, the patronage increased from 30,000 to around 50,000 per day. In this period, the system ran in deficit of around Rp 20 billion (US$ 2 million). In the following year the patronage increased further to around 80,000 passengers per day. At this stage, the revenue was already outweighing the cost.

In the third year, after the opening of route 2 and 3, the deficit condition emerged again. And since the number of buses for route 2 and 3 is still below requirement (70 out of 126), the total number passenger carried is still low but growing. One main transfer point between route 1 and 2 and 3 is still under construction and also the terminal. When the terminal and transfer point completed, it is estimated the system will invite more and more passengers. Under the current fare level, it is estimated that the patronage and hence the revenue will still be increasing and if a subsidy is required, it will not be a lot.

Capacity building of operator

After the system has been in place for three year running, the new bus operators may have learned how the system works. But, the knowledge of the new system, i.e. the change on how to adapt and adopt the operational, financial and institutional aspects are still limited. The operators still excessively exploit the buses by running long hours and long distance. Attention to the fleet maintenance is still low as usual. This may affect the quality of the fleet in the near future. They also employ drivers on working long hours exceeding the regulation on driving. This traditional way of operating the company should be reformed by improving the capacity for existing and the new company. Otherwise, vehicle breakdowns, accidents, poor maintenance system will like to happen. To do this a systematic training program must be prepared. Operators need to learn the modern way of running a bus company. By doing this, it will bring the capacity of the local bus operator comparable with their counterpart form different countries.

Implication to other Asian cities

Public transport in big cities in Asian region operates in a similar manner as that in Jakarta i.e. most operational aspects are in the hand of private sector. The role of government is limited in issuance of operational licence, where all the financial risk is borne by the private bus operator. The problem of poor quality of services and the degrading role indicated by the lowering of the rider ship is also typical occurring in this region. This situation was also experienced by the Latin American cities like Bogota, Quito and Santiago. Looking at the success story in the Latin American cities and then adopted successfully in Jakarta, there is a potential successful application for other Asian cities.

The success application in Jakarta has been possible due to the financial back up from the local government i.e. the infrastructure costs and subsidy for the operation of the services. However, such costs did not significantly put burden to the current government budget. For Jakarta the costs for first route is just Rp 120 billion out of Rp 14 Trillion budget (0.9% only) - [Dagun, Save M, et al, 2006]. It, therefore, implies that there is a potential adoption of the Jakarta model to other Asian cities since the financial resources needed is insignificant.

There is, however, a potential hurdle in adopting the financial and institutional setting of the Jakarta BRT because it involves a greater role of the government i.e. establishment of a new public institution i.e. Trans Jakarta and the provision of a public transport operation subsidy. This kind of “more government involvement”, to some people, can be seen as a backward step toward the current trend of public service provision: privatization. So, unless there is a long term objective of revitalizing public transport, as part of adopting sustainable transport principle, the implementation of BRT like the one in Jakarta may not be justified because in the short term there is a financial risk to the government which may not be favourable to some politicians to opt for one.

6.2 Conclusion

The development of BRT in Jakarta known as Trans Jakarta Busway is a unique yet fundamental process of change from over 30 years of traditional bus industry in Indonesia into a transparent, accountable modern bus system comparable to other international cities. This swift process did not come accidentally, but several factors did make it possible, though some tough challenges are still awaiting. The followings are some conclusions.

1. The lowest state of public transport due to economic crisis in 1997-2001 has given room for the adoption of a new bus system.
2. The emerging idea of BRT from 2002 is very timely considering the urgent need to save the public transport from bankruptcy.
3. The adoption of the plan by the Governor and his strong commitment has paved the way to receiving political support from the parliament and getting general public support
4. The strong financial capacity of Provincial Government of Jakarta has made the speedy implementation possible. The period from the first commissioning of the early study of new bus system to the opening of the Trans Jakarta Busway is just around 2,5 years. This may be the fastest in the world.
5. The role of international community such as ITDP (Institute for Transport and Development Policy) of USA has been very substantial especially in giving access to BRT knowledge from Bogota. Many aspect of Jakarta BRT is similar to Bogota.
6. The participative panning process of Jakarta BRT has created a strong ownership among government offices and the public of Jakarta. People love the new system and it has created a totally new image of bus service in Jakarta.

7. The ambitious implementation of the new BRT has focussed more on physical infrastructures. Other important reforms agenda such as operational, financial, management, institutional aspects are still urgently to be done.
8. TransJakarta Busway is developed in response to the crucial worsening condition of public transport which needs immediate actions. Though, it seems successful in this short term, unless a clear further development looking at a longer perspective is formulated the sustainability of providing the service in conjunction with other modes of public transport may be impaired.

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Appendix: Numerical data

1. Geographic, demographic and economic information: Jakarta political/road/ public transport map, population (urban, rural), area, gross regional product, average household income, share of economic activities by primary, secondary, tertiary sectors

Table 4.6.a.1 Population, Area and Population Density based on Administrative Area

Municipality	Population	Area (km^2)	Population Density ($person/km^2$)
(1)	(2)	(3)	(4)
South Jakarta	1,707,093	145.73	11,714
East Jakarta	2,103,525	187.73	11,204
Central Jakarta	893,195	47.90	18,531
West Jakarta	1,565,708	126.15	12,411
North Jakarta	1,182,749	154.01	8,336
Kepulauan Seribu	19,596	11.81	1,659
Total Jakarta (2004)	**7,471,866**	**661.52**	**11,295**
2003	7,456,931	661.52	11,272
2002	7,461,472	661.52	11,279
2001	7,423,379	661.52	11,221
2000	7,578,701	661.52	11,454
1999	7,831,520	661.52	11,836
1998	7,818,573	66.152	11,819

Source: BPS-Statistics DKI Jakarta, 2004

Table 4.6.a.2 Land Utilization in DKI Jakarta, 2004

No	Municipality	Type of Land Utilization (Ha)					
		Housing	Industry	Office and Warehouse	Park	Others	Total
1	South Jakarta	10,428.43	236.08	1,757.50	190.91	1,960.07	14,573
2	East Jakarta	13,542.84	1,130.13	1,798.45	217.77	2,083.80	18,773
3	Central Jakarta	2,968.84	92.93	1,068.65	170.04	489.54	4,790
4	West Jakarta	9,032.34	512.17	1,253.93	209.41	1,607.15	12,615
5	North Jakarta	7,495.36	2,171.39	1,474.61	126.56	2,952.07	14,220
6	Kepulauan Seribu	320.76	275.17	92.71	-	491.77	1,180
	Total	**43,788.57**	**4,417.87**	**7,445.85**	**914.69**	**9,584.40**	**66,151**
	2003	44,052.27	4,259.60	7,342.88	800.91	9,696.23	66,151
	2002	44,414.00	3,764.98	7,174.63	1,009.56	9,788.81	66,151
	2001	43,475.09	3,228.21	7,898.54	1,270.11	10,280.02	66,151
	2000	41,331.32	4,988.53	6,812.75	1,314.23	11,705.17	66,151
	1999	43,230.00	3,970.00	6,955.00	1,328.00	10,669.00	66,151

Source: BPS-Statistics DKI Jakarta, 2004

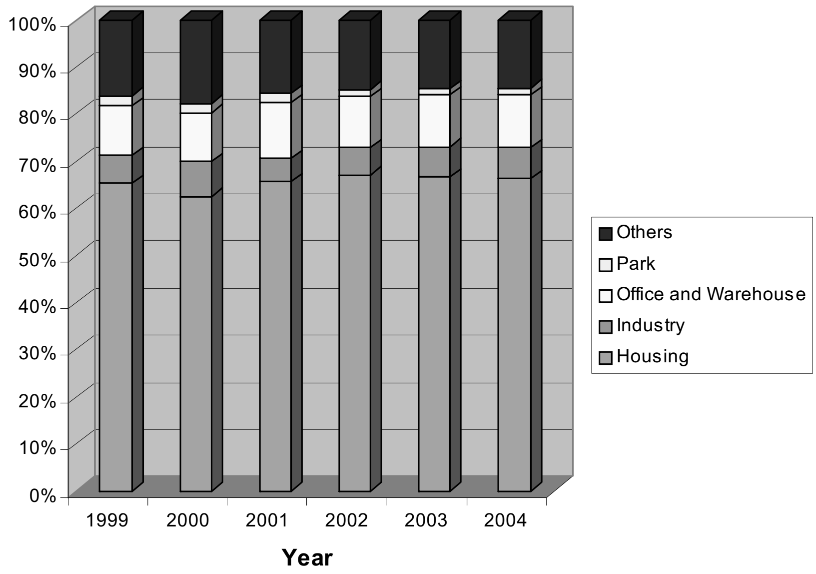

Figure 4.6.a.1 Area of Land Utilization by Municipality and Regency in DKI Jakarta, 1999 – 2004

Source: BPS-Statistics DKI Jakarta, 2004, processed

Table 4.6.a.3 Gross Regional Domestic Product (GRDP) at Current Market Prices by Industrial Origin (Rp)

No	Industrial Origin	1980	1985	1990	1995	2000	2001	2002	2003	2004
1	Agriculture		126,765			419,075	472,392	521,899	549,954	637,773
2	Manufacturing Industry (excluding oil)		2.925.821,9			43,425,463	49,299,787	54,759,870	60,593,297	65,922,237
3	Electricity, Gas and Water Supply		407,267			2,405,391	2,767,280	3,182,464	4,415,311	4,835,377
4	Construction		838,036			23,400,649	27,132,260	31,479,904	34,524,116	38,205,927
5	Trade, Hotel and Restaurant		2,468,559			43,802,039	51,184,911	59,969,474	66,022,605	75,331,308
6	Transportation and Communication		1,081,819			13,642,347	17,023,502	20,035,771	23,947,730	28,596,199
7	Financial, Ownership of Dwelling		2,184,542			43,062,012	49,857,289	57,971,037	64,470,720	72,125,158
8	Services		849,447			18,958,995	22,197,012	25,514,821	30,192,147	34,717,161
	Total GRDP		**10,882,256**			**189,115,971**	**219,934,433**	**253,435,240**	**284,715,880**	**320,371,140**

Source: BPS-Statistics DKI Jakarta, 1985, 2000, 2004

Table 4.6.a.4 Gross Regional Domestic Product (GRDP) at Constant 1993 Prices by Industrial Origin

No	Industrial Origin	1980	1985	1990	1995	2000	2001	2002	2003	2004
1	Agriculture		125,871			115,742	113,408	111,151	106,568	106,142
2	Manufacturing Industry (excluding oil)		1.680,403			12,875,191	13,320,467	13,756,925	14,267,353	14,714,776
3	Electricity, Gas and Water Supply		349,158			1,245,846	1,299,449	1,366,260	1,451,095	1,528,383
4	Construction		744,822			6,535,392	6,639,223	6,834,029	7,114,936	7,442,413
5	Trade, Hotel and Restaurant		2,100,336			14,166,037	14,799,488	15,549,392	16,333,552	17,232,719
6	Transportation and Communication		916,756			5,736,012	6,047,202	6,391,477	6,761,689	7,348,111
7	Financial, Ownership of Dwelling		1.918,663			13,285,022	13,740,441	14,245,887	14,931,969	15,798,322
8	Services		676,166			5,735,176	5,908,579	6,083,709	6,347,039	6,671,799
	Total GRDP		**8,512,275**			**59,694,418**	**61,868,257**	**64,338,830**	**67,314,201**	**70,842,665**

Source: BPS-Statistics DKI Jakarta, 1985, 2000, 2004

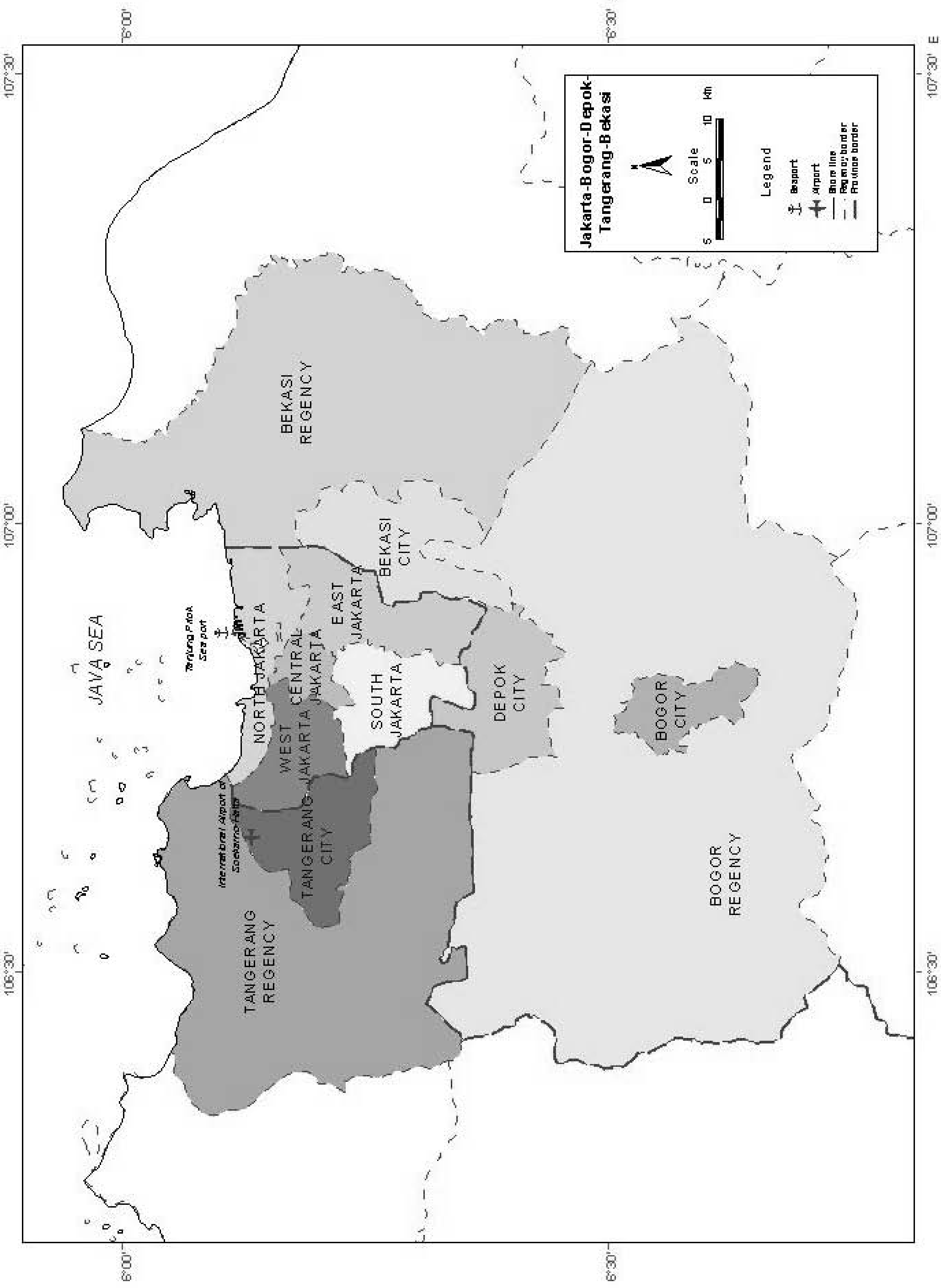

Figure 4.6.a.2 Administrative Map of DKI Jakarta

Source: PUSTRAL archives, 2006

2. Transport infrastructure: Road/rail/subway length and respective amount of investments if available

Table 4.6.a.5 Road Length by Function

Function	Length (m)								
	1980	1985	1990	1995	2000	2001	2002	2003	2004
1. Tol	NA	NA	NA	NA	NA	112.96	94.18	NA	94.18
2. Primary Arterial	NA	NA	NA	NA	NA	101.87	102.14	NA	102.14
3. Primary Collector	NA	NA	NA	NA	NA	51.63	55.13	NA	55.13
4. Secondary Arterial	NA	NA	NA	NA	NA	501.18	514.01	NA	514.01
5. Secondary Collector	NA	NA	NA	NA	NA	823.91	963.82	NA	966.60
6. City	NA	NA	NA	NA	NA	4,936.93	5,902.10	NA	5,884.20
Total	NA	NA	NA	NA	NA	6,528.48	7,631.38	NA	7,616.27

Source: BPS-Statistics DKI Jakarta, 1985, 2000, 2004

Table 4.6.a.6 Jabotabek Railway Service Line

Line	Relation	Length (km)	Single/Double Track	Signal System
North	Jakarta Kota-Jatinegara	11.8	double	electrification
	Jakarta Kota-Tanjung Priok	8.1	double	electrification
	Jakarta Kota-Kemayoran	4.2	double	electrification
Central	Jakarta Kota-Manggarai	9.7	double	electrification
West	Jakarta Kota-Kampung Bandan	2.7	double	electrification
Tangerang	Duri-Tangerang	19.3	single	non-electrification
Merak	Tanah Abang-Serpong	23.3	single	non-electrification
	Parung Panjang-Rangkas Bitung	49.5	single	non-electrification
Bogor	Manggarai-Depok	22.7	double	electrification
	Depok-Bogor	22.3	double	electrification
Bekasi	Jatinegara-Bekasi	14.8	double	electrification
	Karawang-Bekasi-Purwakarta	76.2	double	non-electrification

Source: SITRAMP, 2000

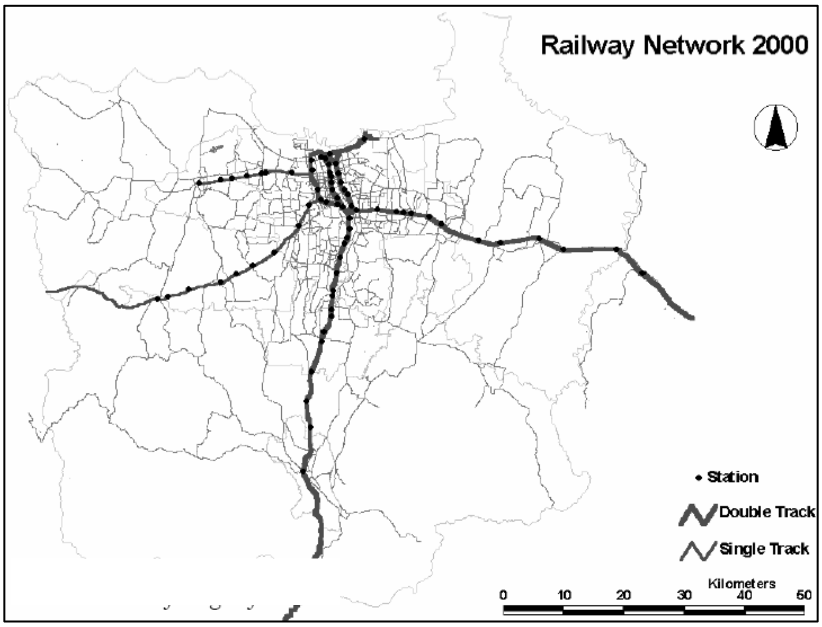

Figure 4.6.a.3 Railway Network in Jabotabek

Source: Macro Transport Pattern of Jakarta, 2004

3. BRT related map, facts and figures in Jakarta

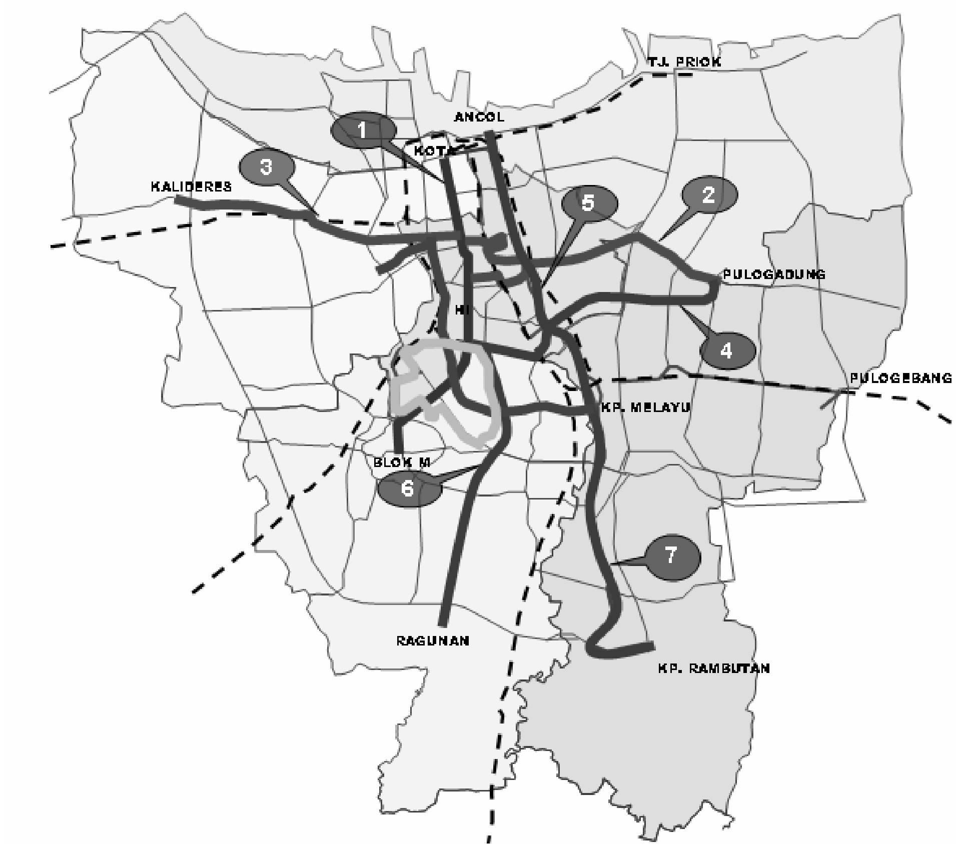

Figure 4.6.a.4 The Existing and Plan of BRT Corridors until 2007

Source: DKI Jakarta Transportation Office, 2006

4. Travel activity characteristics: Share of various modes of travel (road, rail, public, private, non-motorised)

Table 4.6.a.7 Modal Share: Public Transport vs Private Transport

Modal Share	1985	1990	1995	2000
Public Transport	57%	52,5%	49,5%	45%
Private Transport	43%	47,5%	50,5%	55%

Source: SITRAMP, 2002

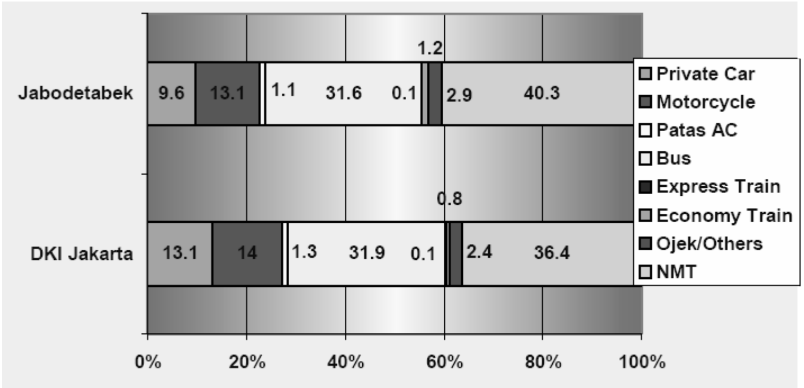

Figure 4.6.a.5 Modal Share in Jabodetabek and DKI Jakarta

Source: Macro Transport Pattern of Jakarta, 2004

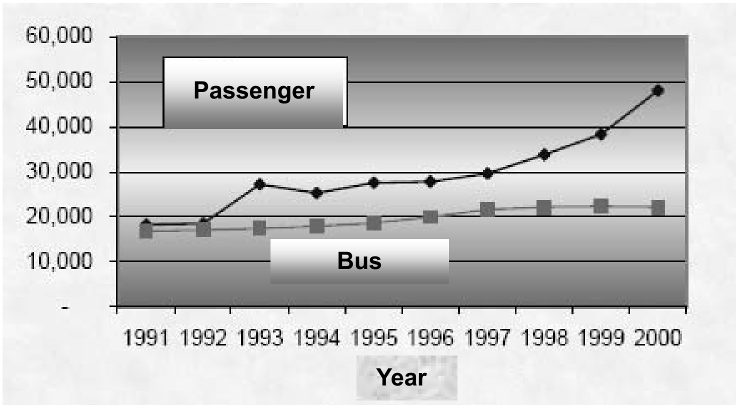

Figure 4.6.a.6 The growth of Passenger and Bus Fleets in DKI Jakarta from 1991-2000

Source: Macro Transportation Pattern of Jakarta, 2004

5. Vehicle population (total, by type), car population, buses serving public transportation, taxies

Table 4.6.a.8 Number of Registered Motor Vehicles

Year	Motor Cycles	Passenger Cars	Cargo Cars (Pick Up not Truck)	Buses	Total
1999	1,543,603	965,058	320,438	253,574	3,084,672
2000	1,619,516	1,052,802	334,013	253,593	3,261,924
2001	1,813,136	1,130,496	347,443	253,648	3,546,724
2002	2,257,194	1,195,871	366,221	254,849	4,076,137
2003	3,516,900	1,529,824	464,748	315,652	5,829,127
2004	2,534,480	1,361,239	399,691	255,307	4,552,721

Source: BPS-Statistics DKI Jakarta, 2004

Table 4.6.a.9 Number Urban Bus in Jakarta, 2004

Name of Company		Number of Bus	Routes
I. Large Bus		**4,676**	**365**
1	Perum PPD	1,815	116
2	PT. Mayasari Bakti	1,595	123
3	PT. Ikawati Pusaka J	29	1
4	PT. Pahala Kencana	62	6
5	PT. Bianglala	176	16
6	PT. Steady Safe	599	59
7	PT. Giri Indah Andalan	79	11
8	PT. Agung Bhakti	20	3
9	Koperasi ARH	25	2
10	PT. Koda Jaya	100	7
11	PT. Jasa Utama	20	2
12	Koperasi Himpurna	85	7
13	PT. Metro Mini	64	4
14	Kopaja	7	8
15	BP. Trans Jakarta	91	1
II. Medium Bus		**4,981**	**123**
16	PT. Metro Mini	3,106	70
17	Kopaja	1,481	38
18	Koantas Bima	185	7
19	Kopami Jaya	163	3
20	PT. Jewa Dian Mitra	46	5
III. Mini Bus		**12,984**	**145**
21	Micro bus	6,746	60
22	APK/KWK	6,238	85

Source: BPS-Statistics DKI Jakarta, 2004

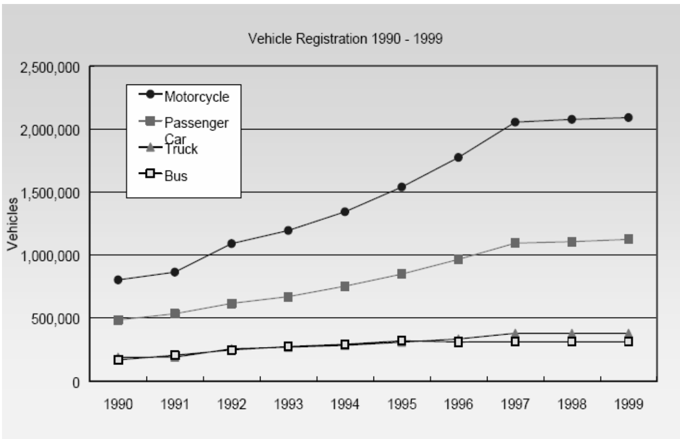

Figure 4.6.a.7 The Growth of Motorized Vehicles in 1990-1999

Source: Macro Transport Pattern of Jakarta, 2004

Table 4.6.a.10 Number of Taxi in Jakarta (in January 2000)

No	Company	Logo	Total
Regular Taxi			
1	PT President Taxi	Prestasi	6.759
2	PT Steady Safe	Steady Safe	700
	"Koperasi Pembela Tanah Air"	Steady Safe	100
3	PT Buana Metropolitan Taksi	Buana	500
4	PT Sembada Prakarsa Permai Sejati	JIT	500
5	PT Hasmuda Internusa	Rajawali	364
6	PT Wahana Artha Sentosa	Spirit	700
7	PT Luhur Satria Dwiraya	Transit Cab	100
8	PT Citra Pancakabraja	Swadarma	100
9	PT Primajasa Perdanaraya	Primajasa	100
10	PT Blue Bird	Blue Bird	1.600
11	"Cendrawasih Pertiwijaya"	Cendrawasih	250
12	PT Morante Jaya	Morante	500
13	PT Gamya	Gamya	482
14	PT Dian Taksi	Dian	800
15	PT Bhakti Dian Sardo	BDS	400
16	PT Sriyaniasti	A Taksi	200
17	"PT Sriyaniasti"	Liberty	300
18	PT Ratax Armada	Ratax	800
19	PT Centris Wahana Taksi	Centris	100
20	PT Sri Medali	Srimedali	500
21	PT Express Transindo Utama	Express	1.000
22	PT Royal City Taxi	Royal City	673
23	PT Irdawan Multitrans	Queen	200
24	PT Lintas Buana Taksi	Lintas Buana	200
25	PT Mastertaxi Indonesia	Tiffani	800
26	PT Luhursatria Sejati Kencana	-	500
27	PT Citra Transpor Nusantara	Citra	1.000
28	PT Koperasi Taksi Indonesia	KTI	999
29	"Yayasan Gotong Royong"	KTI	50
30	Kosti Jaya	Kosti Jaya	1.350
31	Koperasi Bima Sakti	Bima Sakti	200
32	Koperasi Taksi Sepakat	Kotas	261
33	Transkoveri DKI	Transkoveri	145
	Sub Total		**23.233**
Exclusive Taxi			
34	PT Ratax Armada	Ratax	75
35	PT Silverinda Nusabird	Silver	740
	Sub Total		**815**
Total			**24.048**

Source: Transport Authority of DKI Jakarta Province, 2000

6. Fuel consumption by road transportation by fuel type

Table 4.6.a.11 Fuel Consumption

No	Fuel Type	Year			
		2001	2002	2003	2004
1	Avgas	613	687	NA	589
2	Avtur	37,121	303,233	NA	970337
3	Premium	1,999,624	3,622,722	NA	5792476
4	Kerosene	1,538,984	2,777,408	NA	3,885,610
	a. House hold	1,526,439	2,756,901	NA	3859130
	b. Industry	12,545	20,507	NA	26480
5	Diesel Fuel	2,205,630	4,039,603	NA	6,052,463
	a. Transportation	1,412,511	2,418,116	NA	3255969
	b. Industry	736,670	1,376,874	NA	1983739
	c. Electricity	56,449	244,613	NA	812755
6	Diesel Oil	171,805	570,999	NA	674,617
	a. Transportation	13,882	39,440	NA	33140
	b. Industry	155,936	528,125	NA	635820
	c. Electricity	1,987	3,434	NA	5657
7	Feul Oil	977,549	1,774,947	NA	2,162,268
	a. Transportation	203,165	156,090	NA	90293
	b. Industry	364,123	1,347,073	NA	1318073
	c. Electricity	410,261	271,784	NA	753902
	Total	**6,931,326**	**13,089,599**	**NA**	**19,538,360**

Source: BPS-Statistics DKI Jakarta, 2004

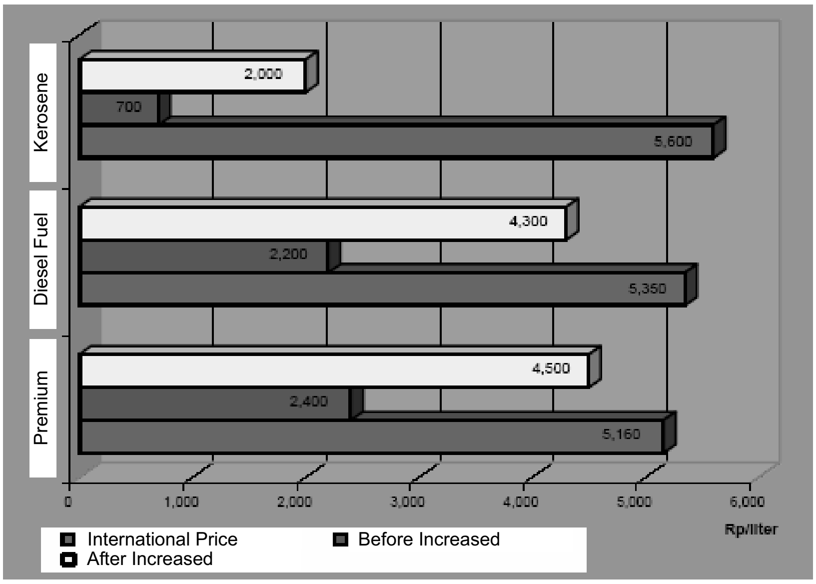

Figure 4.6.a.8 Fuel Price (International, Before and After Increased)

Source: www.kompas.com

7. Information on level of road congestion

Table 4.6.a.12

Description	2001	2002	2004	Average Growth
Road Length (meter)	6,528,481	7,636,758.77	7,616,269.24	8%
Number of vehicles	3,544,723	4,074,135	4,552,721	13%

Source: BPS-Statistics DKI Jakarta, 2001, 2002, 2004

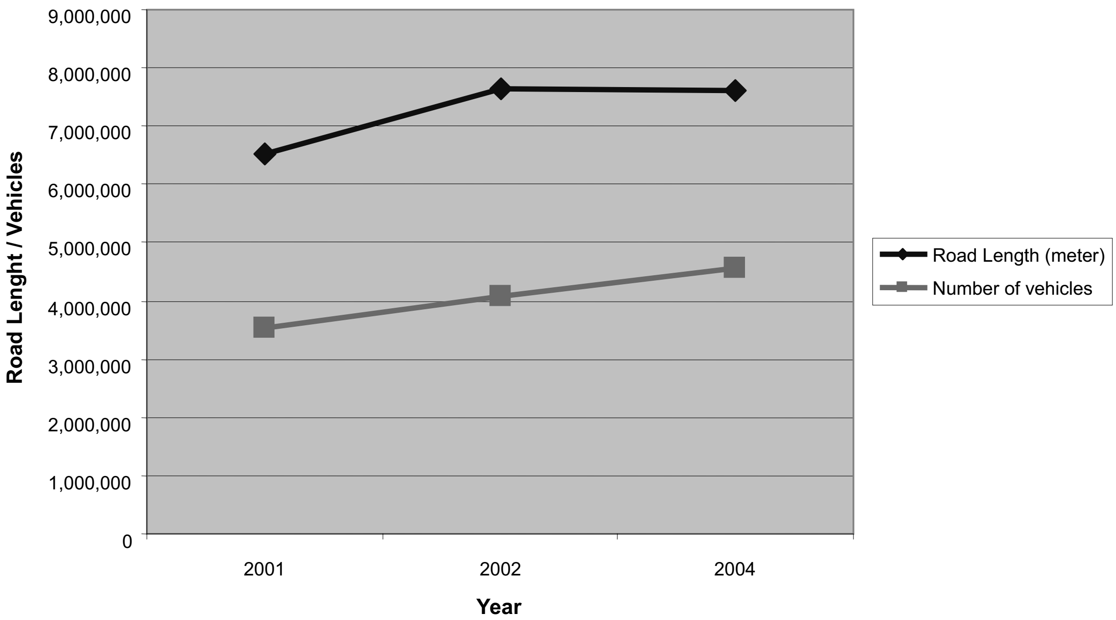

Figure 4.6.a.9 Comparison between Road Length Growth and Number of Vehicles Growth

8. Others as appropriate

Table 4.6.a.13 Urban agglomeration some countries with the number population

Rank of the most polluted city	Agglomeration	Country	Population (million)
1	Tokyo	Japan	25
16	Jakarta	Indonesia	9
18	Metro Manila	Philippines	9
24	Bangkok	Thailand	7

Source: First ASEAN Ministry of Environment Report, 1999 quoted in Swisscontact – Clean Air Project, 2002

Table 4.6.a.14 Commuter's Movement between Jakarta – BODETABEK in 2000

Movement Direction	Movement Volume (vehicles/day)	Movement Volume (persons/day)
DKI Jakarta-Tangerang	412,543	1,221,079
DKI Jakarta-Bekasi	499,198	1,503,654
DKI Jakarta-Bogor/Depok	424,219	1,369,626

Source: Jakarta Macro Transport Pattern, 2004

Table 4.6.a.15 Estimation of Daily Average City Bus Passengers in DKI Jakarta (1991-2000)

Year	Passenger	Bus (registered)	Passengers Growth	Bus Growth
1991	1,826,827	16,773		
1992	1,850,640	16,962	1.3%	1.1%
1993	2,720,540	17,423	47.0%	2.7%
1994	2,522,170	17,920	-7.3%	2.9%
1995	2,751,750	18,610	9.1%	3.9%
1996	2,771,470	19,878	0.7%	6.8%
1997	2,962,570	21,619	6.9%	8.8%
1998	3,382,621	22,071	14.2%	2.1%
1999	3,822,362	22,247	13.0%	0.8%
2000	4,803,518*	22,089	25.7%	-0.7%

Source: Macro Transportation Pattern of Jakarta, 2004

Table 4.6.a.16 Existing Urban Centers in Hierarchical Order

Hierarchy	Name	Population (1996)	Urban Functions
I	DKI Jakarta	7,678,273	Administration, Trade, Service, Industry, Residence
II	Kota Tangerang	1,417,550	Administration, Service, Industry, Residence
II	Kota Bekasi	1,362,900	Administration, Service, Industry, Residence
II	Kota Bogor	671,405	Service, Industry, Residence
II	Kota Depok	453,502	Service, Education, Residence
III	Ciputat	270,785	Service, Residence
III	Tambun	221,673	Industry, Residence
III	Cibitung	183,674	Industry, Residence
III	Serpong	182,047	Residence
III	Cikupoa	164,092	Industry, Residence
III	Mauk	162,055	Residence
III	Lemahabang	161,424	Residence
III	Cikarang	143,528	Industry, Residence
III	Balaraja	138,568	Industry, Residence
III	Leuwiliang	137,773	Residence
III	Parung	131,532	Service, Residence
III	Cileungsi	130,491	Service, Residence
III	Pasar Kemis	126,562	Residence
III	Cibinong	121,267	Service, Residence

Source: Jabotabek 2005 (Draft)

Table 4.6.a.17 Development Progress of New Towns

	New Town	Ultimate Development Area2 (ha)	Land Procured (ha)	Year of Project Mobilized	Planned Housing Mobilized	Constructed Housing Units
Tangerang	Kedaton	500	100	NA	10,000	
	Villa Melati Mas	600	NA	NA	16,000	8,600
	Alam Sutera	700	650	1993	15,000	1,200
	Lippo Village Karawaci	2,600	900	1992	47,000	2,000
	Modern Land	770	445	1991	20,000	1,300
	Citra Jaya	2,000	600	1994	20,000	1,500
	Pantai Indah Kapuk	800	NA	1990	8,000	800
	Gading Serpong	1,700	900	1993	35,000	4,000
	Jaya Garden Polis	1,590	600	0	30,000	NA
	Puri Jaya Pasar Kemis	2,000	NA	1996	61,000	1,500
	Bintaro Jaya	3,111	940	1992	25,000	14,300
	Kota Baru Tigaraksa	3,000	552	1990	11,000	5,500
	Bumi Serpong Damai	6,000	3,600	1993	140,000	11,000
	Griya Tangerang Estetika	1,700	200	NA	NA	NA
Bekasi	Kota Legenda	2,000	1,200	1994	45,000	2,300
	Lippo City Cikarang	5,000	1,450	1992	16,000	2,000
	Cikarang Baru	5,400	900	1991	37,000	3,950
	Delta Mas	3,000	NA	2000	30,000	0
Bogor	Royal Sentul Highlands	2,000	NA	1993	20,000	1,000
	Rancamaya	550	NA	1992	10,000	400
	Lido Lakas Resort	1,700	NA	1994	8,000	200
	Kota Citra Indah	1,200	NA	1996	25,000	300

Note: New town is defined as integrated urban development with more than 500 ha

Source: BSKP Jabotabek 1996 and others compiled by the JICA Study Team

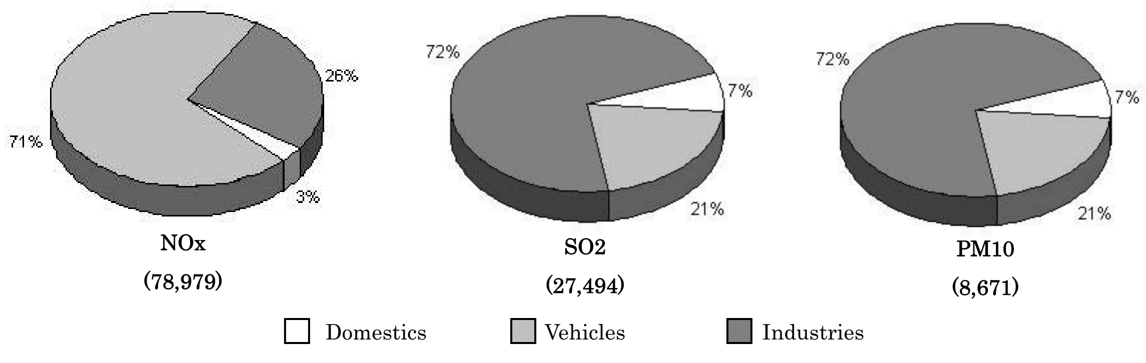

Figure 4.6.a.10 Emission Shares by Source Type in Jakarta in 1998

Note: The figures in the brackets are estimated total emission load in tons/year.

All CO and THC only emitted from vehicle as much as 942,840 and 187,545 tons/year, respectively.

Source: Shanty Syahril et al, 2002

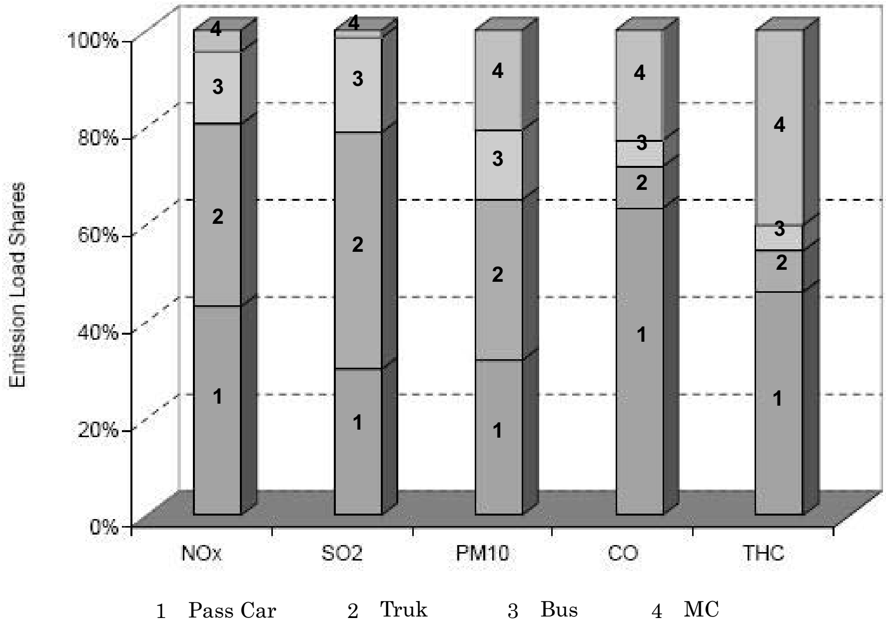

Figure 4.6.a.11 Emission Load Shares by Vehicle Category in Jakarta in 1998

Source: Shanty Syahril et al, 2002

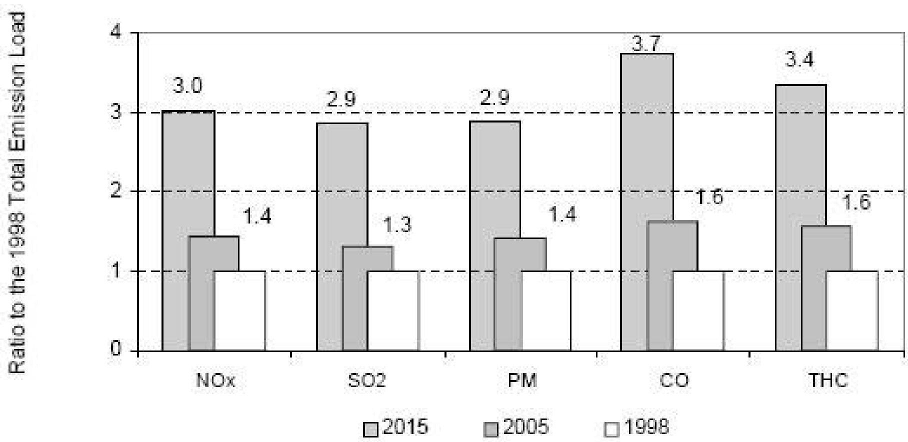

Figure 4.6.a.12 Prediction of Total Emission Load in Jakarta for Baseline Case

Source: Shanty Syahril et al, 2002

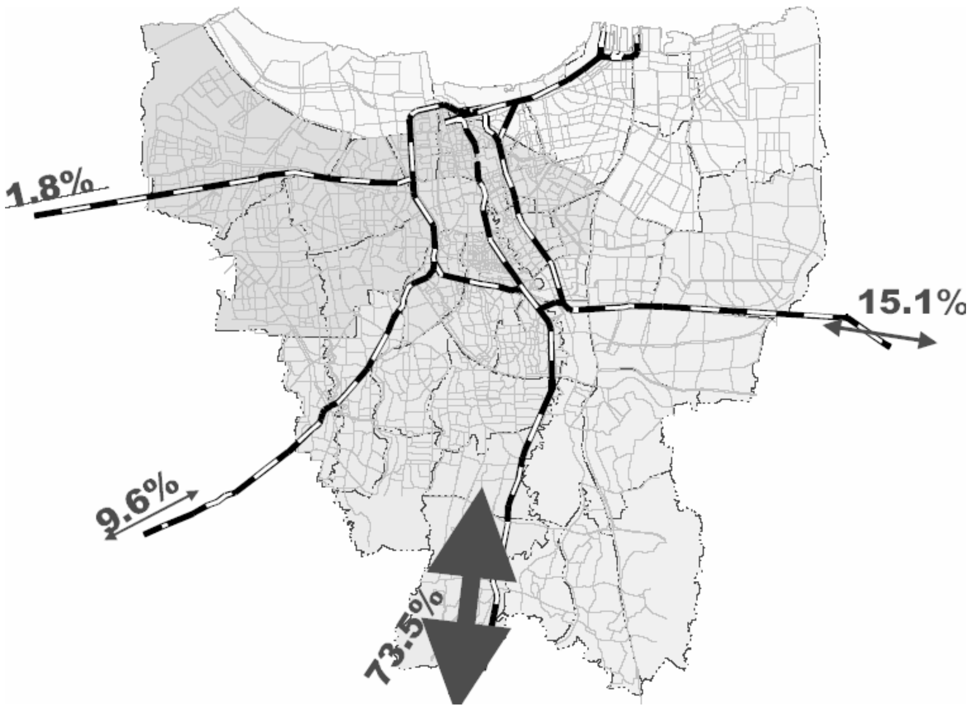

Figure 4.6.a.13 Proportion of Jabotabek Railway Passengers

Source: Macro Transport Pattern of Jakarta, 2004

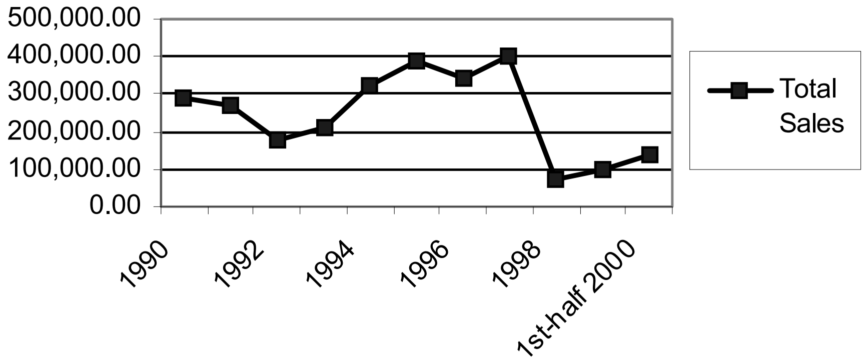

Figure 4.6.a.14 Indonesia Total Vehicle Domestic Sales

Source: Swisscontact, 2002

Table 4.6.a.18 June 1999 Deregulation Changes in Tariff A-Structure (%)

Vehicle Classification	Completely Build Up		Completely Knocked Down	
	New	Old	New	Old
Sedan less than 1500 cc	65	200	35	65
Sedan 1500-3000 cc	70	200	40	65
Sedan higher than 3000 cc	80	200	50	65
Minibus	45	105	25	25
Jeep	45	105	45	25
Bus	40	70	25	25
Truck with GVW less than 24 tones	40	70	25	25
Truck with GVW higher than 24 tones	5	5	0	0

Source: Ministry of Trade and Industry, 2001

Table 4.6.a.19 June 1999 Deregulation Package: New Schedule of Luxury Taxes

Type of Vehicles	Taxes (%)
Sedan less than 1500 cc	30
Sedan 1500-3000 cc	40
Sedan higher than 3000 cc	50
Minibus less than 1500 cc	10
Minibus 1500-3000 cc	20
Truck and Pick up	0
Bus	10

Source: Ministry of Trade and Industry, 2001

IV.7 Analysis of Policy Processes to Introduce Bus Rapid Transit Systems in Asian Cities from the Perspective of Lesson-drawing: Cases of Jakarta, Seoul, and Beijing

Naoko Matsumoto[1]

1. Introduction

Bus Rapid Transit (BRT) is commonly understood to mean a system that emphasises priority for and rapid movement of buses by securing segregated busways, although there is no precise definition of what constitutes a BRT system (International Energy Agency (IEA) 2002; Wright 2005). From an environmental perspective, BRTs have the potential to reduce emissions of GHGs at a lower cost than rail systems, while carrying more passengers with higher speed than normal bus services, in both developing and developed countries.

Policy makers in some of the large cities in Asia recently started to consider BRT as an option for their urban transport. On 15 January 2004, the TransJakarta busway was started along a 12.9 km corridor through the city centre. On 1 July 2004, BRT corridors were installed as part of Seoul's reform of its public transport system. On 25 December 2004, the first stage commercial operation of BRT was started in Beijing. In these new BRT systems in Asia, the influences of existing BRT systems such as those in Curitiba and Bogotá show that those Asian cities actually learned lessons from the Latin American countries.

This research aims to uncover the reason why introduction of BRTs in Asia accelerated around 2004 from the perspective of lesson-drawing. Specifically, through comparative study of three Asian cities, this study examines who played important roles in lesson-drawing processes on BRTs and what their roles were, and what factors motivated those actors to draw lessons on BRT. Case studies are conducted in Jakarta, Seoul, and Beijing, the three pioneering cities of BRT in Asia. The hypotheses of this study are developed on the roles of actors in lesson-drawing processes specifically focusing on international organisations and political leaders, and influence of the Asian economic crisis on the preferences of policy makers. The hypotheses are tested through review of newspaper articles on BRT in those cities, and a questionnaire survey with key individuals who were involved in the adoption processes of those BRT systems.

2. Background

2.1 Historical development of BRT world-wide

The first wide-scale development of BRTs started in Curitiba (Brazil) in 1974, although there were several smaller-scale projects prior to its development there. Since then, Curitiba's experience has inspired other cities to develop similar systems. In the 1970s, development of BRT systems was limited to the North and South American continent: Sao Paulo, Brazil (1975); Arlington, USA (1975); Goiania, Brazil (1976); Porte Alegre, Brazil (1977) and Pittsburgh, USA (1977). In the late 1990s, the replication of the BRT concept gained

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momentum and BRT systems were opened in Quito, Ecuador (1996), Los Angeles, USA (1999) and Bogotá, Columbia (2000). Specifically, the TransMilenio project in Bogotá started operation in 2000 and its success drew attention from the global community as a state of the art example of a BRT system. As of 2005, there may be up to 70 systems around the world, depending on one's definition of BRT, including Ottawa in Canada, Honolulu in the United States, Brisbane and Adelaide in Australia, Leeds in the United Kingdom, and Rouen in France (Levinson et al. 2003; Ernst 2005; Wright 2005).

2.2 BRT introduction in Asia

In Asia, prior to 2000, experience of BRTs was very limited in terms of number and scope of these schemes. The systems in Nagoya, Japan, and Taipei were regarded as relatively complete systems in the Asian region (Wright 2005). The system in Nagoya was opened as early as 1982, adopting the median bus lane system using colour-marked designated lanes rather than physically separated lanes (Nagoya City Transport Department 2006). In Taipei, the first BRT was adopted in 1989 in the form of 'Bus Exclusive Lanes' (National Taiwan University and THI Consultants 2004). In 1999, Kunming developed the first median busway in China (Fjellstrom 2005).

The spread of BRT in Asia has become more conspicuous since 2004. In 2004, the TransJakarta busway was started through the city centre (Hook and Ernst 2005). On 1 July 2004, three BRT corridors totalling around 37 km were installed as part of Seoul's reforms of its public transport system (Pucher et al. 2005). On 25 December 2004, the first stage commercial operation of BRT was started in Beijing as a 5 km pilot line (Chang 2005). In Bangkok, the plan for BRT was declared in 2004 by the newly elected Governor of Bangkok Metropolitan Administration (BMA), indicating that the first BRT lines would be opened in October 2005.

Although there was some confusion in Indonesia and Seoul when those lines were first introduced, the BRTs in Jakarta, Seoul, and Beijing have shown some success. The TransJakarta financially broke even six months after its adoption. According to a survey, 14% of a total of about 4.8 million private car owners have switched to the busway (The Jakarta Post 2006a). Two additional corridors were launched in January 2006, two years after the initial adoption. The system in Seoul dramatically increased bus speeds and customer dissatisfaction dropped from 56% to 13% within four months of the implementation. Daily bus ridership reached 4.49 million passengers on a daily average in September 2005, which is a significant increase by 522,000 (13.2%) from 3.96 million in the previous year (Seoul Metropolitan Government (SMG) 2006a). These systems are undergoing expansion and upgrading. In Jakarta, two more busway corridors were launched in January 2006 (The Jakarta Post 2006a). In Seoul, two more Median Bus Lanes were opened on 1 July 2005, a year after the first phase, and another line was opened in December of the same year. The Seoul Government plans to open median bus lanes on 10 of the remaining 16 trunk and feeder lines (191.1 km) by 2008 (SMG 2006a). The pilot line in Beijing was extended to the whole 16 km line on 30 December 2005 and a second line was under construction as of July 2006 (Xu 2005; Liu 2006). In contrast, the plan for BRT in Bangkok has been delayed and has not been introduced yet, although rail expansion is underway.

The number of cities looking into BRT is rapidly increasing. In China, a BRT longer than that introduced in Beijing was officially opened in Hangzou in April 2006 (CAI-Asia 2006b). The cities planning or constructing BRTs include: Bangalore (India), Chengdu (China), Chongquing (China), Delhi (India), Ha Noi (Viet Nam), Hangzhou (China), Huai'an (China), Jinan (China), Pune (India), Shanghai (China), Shengyan (China), T'aichung (China), T'ainan (China), Tienjing (China), Wuhan (China), Xi'an (China), and Xiamen (China). Also, introduction of BRTs is being considered in Ahmedabad (India), Dhaka (Bangladesh), Hyderabad (India), Manila (Philippines) and Shenzhen (China) (CAI-Asia 2006a).

Thus, policy makers in many large cities in Asia have recently started to consider BRT as an option for their urban transport, thirty years after the initial introduction of a comprehensive BRT system in Curitiba. In the new

BRT systems in Asia, some similarities can be observed with existing BRT systems such as Curitiba and Bogotá. In fact, there are records detailing communication between those Asian cities and Latin American cities, such as the visit of Jakarta's Governor to Bogotá in May 2003 (Institute for Transportation and Development Policy (ITDP) 2003a).

2.3 Potential for BRT to address both local and global environmental problems in Asia

In Asia, a growing motorisation trend is observed in most countries and the number of vehicles is forecasted to continue to grow with the possible exception of Singapore and Hong Kong, China. Although the growth in mobility helps Asian countries in their economic development, it is causing adverse impacts such as congestion, noise, accidents, and air pollution. In the majority of Asian cities, mobile sources are the most significant contributor to air pollution, especially for particulate matter (PM), carbon monoxide (CO) and nitrogen oxides (NOx), and are expected to continue to be the main source of pollution in the future. Statistics show that air pollution levels in many cities in Asia still exceed the standards of the World Health Organisation (Asian Development Bank 2003).

The transport sector also contributes to greenhouse gas (GHG) emissions. In 1994, it accounted for 20% of carbon dioxide (CO_2) emissions in Japan, 25% in Indonesia, 28% in Thailand, 27% in the Philippines, and 15% in Singapore (United Nations Framework Convention on Climate Change (UNFCCC) 2002). The share of world carbon emissions from Asia is on an upward trend: it grew from about 10% in 1971 to 23% in 1997 (Schipper, Marie-Lilliu, and Gorham 2000).

It is necessary for Asian policy makers to develop policies to mitigate emissions from transportation without reducing the accessibility to goods and services. One of the key elements is public transport, which can reduce the use of automobiles. Energy consumption and emissions from public transport are lower for each passenger kilometre than private vehicle use, if load factors are sufficient (World Conference on Transport Research Society and Institute for Transport Policy Studies 2004). In addition, public transport can provide wider consumer options and greater equity, more efficient land use, greater resilience and security, and the fostering of community development (Litman 2006).

Rail-based public transport systems have larger passenger capacities, higher speeds and emit smaller amounts of air pollutants than bus systems (Litman 2006). However, the investment cost of rail-based public transport is significant and many Asian cities have not been able to afford to construct rail-based systems. Even in the cities with rail-based systems, many of them cannot raise the operating costs and only operate by receiving subsidies from the government (Matsumoto 2004).

The infrastructure costs of BRT systems are far less than for rail-based systems. Existing BRT systems were constructed with costs in the range of US$1-15 million/km, depending on the capacity requirements and complexity of the project, while elevated rail systems and underground systems can cost from US$50 million to over US$200 million /km (Wright 2004 cited in Wright and Fulton 2005).

There have been some attempts to calculate the actual or potential effects of BRT projects for emission reductions. One estimate showed that the combined BRT, traffic demand management (TDM), and non-motorised transport (NMT) projects in Bogotá reduced CO_2 emissions by 318 metric tons per day from 1997. Approximately 90% of this reduction is the result of the modal shift from private car and taxi to bus and bicycle (Hook 2005).

Wright and Fulton (2005) conducted an analysis of potential reduction of CO_2 and cost effectiveness of several transport scenarios in a city in a large developing nation. In the scenario of BRT introduction having a modal share of 5%, it was estimated that CO_2 would be reduced by 1.9 million tonnes compared with the non-action case over 20 years at a cost of approximately US$66 per tonne. If the BRT mode share is increased to 10%, the reduction would be 4.2 million tonnes at US$59 per tonne. If BRT is combined with pedestrian upgrades and cycleway investment, the package would produce over 12 million tonnes of CO_2 reduction at US$30 per tonne. On the other hand, the estimates for scenarios with fuel-based measures only resulted in cost effectiveness ranges of approximately US$148 to over US$3,500 per tonne. Those figures indicate that BRT can be a cost-effective measure to reduce CO_2 from the transport sector (Wright and Fulton 2005) .

Vincent (2006) compared the expected CO_2 emissions in a typical medium-sized city in the United States for BRT and Light Rail Transit (LRT). Emission reduction of CO_2 by BRT systems was estimated for three kinds of bus fleet: BRT with 40-feet CNG buses; BRT with 40-feet Hybrid Diesel Buses; and 60-feet Hybrid-Diesel Buses. The estimates were approximately 654,000, 602,000, and 508,000 tonnes of CO_2, respectively, over 20 years. Those were found to be higher than light rail, which was calculated to reduce CO_2 emissions by 227,000 tonnes (Vincent 2006).

In late July 2006, the Executive Board of the Clean Development Mechanism (CDM) of the United Nations Framework Convention on Climate Change (UNFCCC) agreed to approve the baseline and monitoring methodologies in the proposal 'Bus Rapid Transit System for Bogotá, Colombia: TransMilenio Phase II to IV' (UNFCCC 2006). The CDM is a market mechanism established under the Kyoto Protocol to assist developing countries in achieving sustainable development by providing incentives for developed countries to invest in environmentally friendly infrastructure. Under CDM, developed countries which invest in projects leading to GHG reduction in developing countries may use the certified emissions reductions (CER) accrued from such project activities to contribute towards compliance as part of their quantified emission limitation and reduction commitments under Kyoto Protocol. The number of approved CDM projects related to transport has been relatively small due to the difficulty in proposing methodologies for baseline and monitoring. This approval indicates that the potential for GHG reduction by BRT is recognised by the market and the global community in climate change policy. The approved methodology can be applied to all mass transport systems based on BRT and widens the potential for BRT projects to raise funds from the sale of the environmental service of emission reductions (Andean Development Corporation (CAF) 2006).

Therefore, BRT has the potential to reduce emissions of GHGs at a lower cost than rail systems, while carrying more passengers at higher speeds than normal bus services, in both developing and developed countries.

2.4 Limitations of BRT

However, the effectiveness of BRT is not always permanent. Vuchic (2005) pointed out that BRTs cannot succeed if police enforcement is not strict, citing the examples of Philadelphia and Mexico. Experiences from U.S. cities such as Shirley Busway in Washington and El Monte Busway in Los Angeles show that pressure from automobile interests is a threat to the existence of BRT. The relationship between BRT and other modes is a crucial factor for the success of BRT: BRT cannot bring success as a stand-alone policy and effectiveness depends on the presence of complementary transport options, such as the promotion of NMT and integrated feeder services (Wright 2001). Another important factor for success is a thorough understanding of planning and design elements, based on experiences in real-world conditions (Vuchic 2005).

3. Research framework

3.1 Definitions and scope

Bus Rapid Transit (BRT)

There is no precise definition of BRT. Wright (2005) defines it as a *'bus-based mass transit system that delivers fast, comfortable, and cost-effective urban mobility'*. In Levinson et al. (2003), it is defined as *'a flexible,* *rubber-tired rapid-transit mode that combines stations, vehicles, services, running ways, and Intelligent Transportation System (ITS) elements into an integrated system with a strong positive identity that evokes a unique image'.*

Components or features of BRT in these two references are summarised in Table 4.7.1 in terms of running ways, stations, vehicles, services, route structure, fare collection, ITS, integration, and institutional setup.

Table 4.7.2 lists the details of the BRT systems in Jakarta, Seoul, and Beijing according to the components described in Table 4.7.1. It shows that while all three systems meet the basic components of BRT to some degree, each system is different. Moreover, the system in Seoul is quite different in terms of penetration of advanced IT technology and integration with other modes.

This research does not intend to compare the differences in those systems themselves, although the importance of that kind of information as background knowledge is acknowledged. Rather, the focus of this research is on the policy processes that resulted in decisions to change the transport system by taking some road space from automobiles to give priority to public transport, and how and why the lessons from other cities are reflected in the decision-making process. Although the BRT development processes are still ongoing in those cities, this study examines the process up to the point when the first line of the BRT was opened in each city.

Table 4.7.1 Components or features of BRT system from literature[2]

Components	Levinson et al. (p13)	Wright (p2)
Running ways	BRT vehicles operate primarily in fast and easily identifiable exclusive transit-ways or dedicated bus lanes. Vehicles may also operate in general traffic.	Exclusive right-of-way lanes.
Stations	BRT stations, ranging from enhanced shelters to large transit centres, are attractive and easily accessible. They are also conveniently located and integrated into the community they serve.	Rapid boarding and alighting. Enclosed stations that are safe and comfortable.
Vehicles	BRT uses rubber-tired vehicles that are easy to board and comfortable to ride. Quiet, high-capacity vehicles carry many people and use clean fuels to protect the environment.	Clean vehicle technologies
Services	BRT's high-frequency, all-day service means less waiting and no need to consult schedules. The integration of local and express services can reduce long-distance travel times.	Excellence in marketing and customer service.
Route Structure	BRT uses simple, often colour-coded routes. They can be laid out to provide direct, no-transfer rides to multiple destinations.	
Fare Collection	Simple BRT fare collection systems make it fast and easy to pay, often before you even get on the bus. They allow multiple door boarding, reducing time in stations.	Pre-board fare collection and fare verification.
ITS	BRT uses advanced digital technologies that improve customer convenience, speed, reliability, and operations safety.	Clear route maps, signage, and real-time information displays. Automatic vehicle location technology to manage vehicle movements.
Integration		Free transfers between lines. Modal integration at stations and terminals.
Institutional setup		Competitively-bid concessions for operations. Effective reform of the existing institutional structures for public transit.

2. The layout of this table was inspired by Ernst (2005).

Table 4.7.2 Features of BRT in Jakarta, Seoul, and Beijing[3]

Components	**TransJakarta busway** (1st line, opened in January 2004)	**Median Bus Lanes in Seoul** (Bus system reform in July 2004)	**Southern Axis BRT Line One in Beijing** (1st line: 5.5 km segment opened in December 2004, 16-kilometre line opened in December 2005)
Running ways	12.9-km fully physically segregated busway corridor in the median of the roadway from Blok M, South Jakarta, to Kota, West Jakarta.	In May 2004, a 1.1 km median bus lane was opened on Samilro. Three more lines were opened 1 July in the first phase of the project: Dobong-Miaro (15.8 km), Susaek-Seongsanro (9.9km), and Gangnamdaero (10.4km) (SMG 2006a). The lanes are highlighted with colour but not physically segregated.	16 km from Qianmen in the city centre to the South. The lanes are physically segregated and placed in the median of the roadway, except for the first 2 km from Qianmen to Tiantan (Fjellstrom 2005).
Stations	Stations provide an elevated platform for rapid boarding and alighting. In most cases, the stations are connected to the sidewalk by a pedestrian bridge and ramps suitable for wheelchairs (Ernst 2005). There are 20 busway shelters (Hudiono and Harsanto 2004).	Bus shelters are installed at stops in the middle of the road. Construction of shelters is funded by advertisement (SMG 2006a).	The stops are located in the median of the road. The bus stops are connected to the pedestrian lanes of both sides of the roads by crossroads or pedestrian overpasses. There are 17 stations.
Vehicles	56 air-conditioned orange and yellow buses (Hudiono and Harsanto 2004). Euro II compliant buses (The Jakarta Post 2002).	Low-floor buses and articulated buses and CNG buses are being introduced on an annual basis (SMG 2006a).	A fleet of 15 articulated CNG buses for a 5.5 km line (Fjellstrom 2005). 40 BRT buses were operated right after the opening of the full line and another 50 regular buses were planned to start operation on BRT lanes by April. The buses are air-conditioned, 18.3m low floor buses (Liu 2006; Fjellstrom 2006).
Services	Service headway is 2 to 3 min at peak period and 3 to 4 min at off-peak periods. Service hours are from 5:00 a.m. until 10:00 p.m. (Ernst 2005)	Seoul's system is different from other systems in that it adopts 'area wide networks' instead of 'line based networks'. More than 20 routes run on the Medium Bus Lanes. Average bus frequency in Seoul is 7.6 minutes/day, 3-5 min at peak time, 10-15 min at off peak time (Kim 2006).	For the pilot project, the peak service frequency was around 4 buses per hour (Fjellstrom 2005). After the opening of the full line, the service frequency became around 2 to 3 min.

3. Based on the information as of June 2006

Table 4.7.2 Features of BRT in Jakarta, Seoul, and Beijing (cont'd)

Components	**TransJakarta busway** (1st line, opened in January 2004)	**Median Bus Lanes in Seoul** (Bus system reform in July 2004)	**Southern Axis BRT Line One in Beijing** (1st line: 5.5 km segment opened in December 2004, 16-kilometre line opened in December 2005)
Route Structure	Thus far, the route structure is simple (one dedicated bus lane).	The routes are divided into a system of trunk lines and feeder lines. The buses are colour-coded according to the lines they travel, and are numbered in such a way that passengers can easily regognise where a bus has departed from and where it is going to (SMG 2006a).	Thus far, the route structure is simple (one dedicated bus lane).
Fare Collection	Fare is collected using a 'contactless' fare card system in advance in stations. Problems with the cards and readers have made their use unreliable, with bypass gates being used when a problem occurs (Ernst 2005). The fare structure is a flat fare of 2,500 rupiah (Rp) (30 cents). A discounted flat fare of 1,500 Rp is offered for trips from 5 to 6 pm.	Fare collection is done using a card embedded with an IC micro-chip (T-money), which enables implementation of various policies such as distance-based fares and free transfers. The flat rate (800 won: approx. 85 cents) is charged on a single bus service, but when transferring to another bus the basic rate is charged once within 10 km of travel and an extra 100 won for every additional 5km. Passengers place the T-money cards on the terminal installed in buses when they get on and off the buses (SMG 2006a).	Fare collection is done at the ticket counter at the entrance of bus stops. Tickets are sold by salesclerks, not by using vending machines. One ticket is 2 yuan (approx. 25 cents), no matter where a passenger gets on or off (Fjellstrom 2005). The fee is two-thirds that of a subway ticket.
ITS	On-board variable message sign at the front of the bus and audio, manually operated by the driver, announce the next station in Indonesian and English (Ernst 2005).	Seoul Transport Operation and Information Service (TOPIS) informs passengers waiting at bus stops of when to expect the next bus, based on real-time positioning of buses and traffic flow on the roads, and makes automatic announcements about the next stop for passengers on board (SMG 2006a).	Bus is equipped with an electric stop announcement system (Liu 2006).

Table 4.7.2 Features of BRT in Jakarta, Seoul, and Beijing (cont'd)

Components	**TransJakarta busway** (1st line, opened in January 2004)	**Median Bus Lanes in Seoul** (Bus system reform in July 2004)	**Southern Axis BRT Line One in Beijing** (1st line: 5.5 km segment opened in December 2004, 16-kilometre line opened in December 2005)
Integration	The system is not officially integrated with other modes. However, some informal connecting services, such as bicycle taxis, have emerged at BRT stations. TransJakarta has contracted eight private bus operators whose existing bus routes cross the corridor, in an effort to establish feeder services for the BRT. A paper ticket offering integrated feeder and BRT service is sold. This effort has largely failed because of difficulties in getting the bus drivers, who must pay daily cash rental for the buses, to accept the printed tickets (Ernst 2005).	Inter-modal transfers of fees were made possible with smartcards. When transferring between different modes of transport, that is, from subway to bus or vice versa, only the basic rate is charged for up to 10 km and transfers are free. When the travel distance exceeds 10 km, an extra 100 won is charged for every additional 5 km (SMG 2006a).	The BRT terminal is situated near the metro station. There is no integration of fares between the metro and BRT.
Institutional setup	TransJakarta BP, a public managing company is in charge of running and planning the BRT system. It contracts services including: (1) bus operation to an operators' consortium; (2) ticketing operations to a private company made up of private and government operators; (3) revenue handling to a bank acting as trustee, and (4) feeder service operation to eight private bus operators (Ernst 2005).	A quasi-public operation system was introduced to increase public responsibility for the system. The methods chosen to make this work included a tender system for routes, and a revenue pool management including subsidies for bus companies. The companies selected through a tender to run the trunk lines were granted a one-time, six-year operating license to prevent privatisation of bus routes (SMG 2006a).	The BRT company is majority owned by the state-owned and subsidised Beijing General Bus Company. Other shareholders include two private companies and two government agencies. The revenue is collected by the BRT company. The city government is assuming the project's entire financial risk. The BRT is not required to meet any documented service standard or profitability goals (Hook, Fjellstrom, and Diaz 2006).

Lesson-drawing

Lesson-drawing is one of the terms used to describe 'the process by which knowledge about policies, administrative arrangements, institutions and ideas in one political system (past or present) is used in the development of policies, administrative arrangements, institutions and ideas in another political system' (Dolowitz and Marsh 2000). Other terminologies used to describe the same or similar processes include 'policy transfer', 'policy diffusion', and 'policy convergence'. According to Rose (1993), the term 'lesson-drawing' describes the overall transfer process of policy and institutions, while some argue that it is a narrower concept than 'policy transfer' in that it focuses on voluntary lesson-drawing while the latter encompasses diffusion and coercion (Dolowitz and Marsh 1996; Stone 1999). Rose defines a 'lesson' in the policy process as '*a program for action based on a program or programs undertaken in another city, state, or nation, or by the same organisation in its own past*'. Lessons can be drawn across time and/or space. In the latter case, lesson-drawing can occur at and between any of the following levels: trans-national, international, national, regional, and local (Evans 2004).

This notion of 'lesson-drawing' can be applied to analyse the adoption of BRT systems worldwide. It is documented that visits by technical and political teams from Bogotá to Curitiba facilitated the introduction of BRT in Bogotá and the system in Bogotá was designed referring to Curitiba's system (Lee 2003; Wright 2005). In the United States, the Federal Transit Administration (FTA) has undertaken a BRT initiative using Curitiba's BRT system as a model (Levinson et al. 2003). Wright and Fulton (2005) pointed out that some influence of Bogotá and/or Curitiba can be found in the new BRT systems examined in the case study cities of this research: Beijing, Jakarta, and Seoul.

3.2 Research questions and hypotheses

This research aims to uncover the reason why introduction of BRTs in Asia accelerated around 2004 from the perspective of lesson-drawing. Specifically, through comparative study of three Asian cities, this study examines: (1) who played important roles in lesson-drawing processes on BRTs and what their roles were; and (2) what factors motivated those actors to draw lessons on BRT. Case studies are conducted on Jakarta, Seoul, and Beijing, which have adopted the BRT system in one way or another since 2004.

Actors in lesson-drawing

Previous studies identified the important roles of actors such as international organisations or transnational actor networks regularly acting as 'agents of diffusion' (Evans 2004; Jörgens 2001; Tews et al. 2003). Rose (1993) stated 'intergovernmental and international organisations encourage exchanges of ideas between countries with similar levels of economic resources', mentioning examples of the European Community and OECD. Rose also mentioned that international organisations such as the World Bank and many United Nations agencies focus on programmes of concern to developing countries. Lana and Evans (2004) argued that international organisations open up channels for lesson-drawing and policy transfer between developing countries by encouraging the emulation of 'best practice' and even finance implementation of best practice projects.

Matsumoto, King, and Mori (2007) found that international organisations played important roles in the transfer of BRT programmes to Bogotá and Quito in terms of funding. In Bogotá, the World Bank was one of the funding sources for infrastructure of the BRT system, and the Spanish Development Fund and the Spanish Banco de Bilbao Vyzcaya funded the total cost of the first 11.2 km trolleybus line (US$57.6 million) in Quito.

Thus, this paper first examines the role of international organisations in lesson-drawing processes for BRT introduction.

Hypothesis 1: International organisations play important roles in lesson-drawing.

Another important actor is the government. Elected officials are important actors in lesson-drawing processes because their values give direction to public policy and their endorsement is needed to legitimise the adoption of programmes, while non-elected officials provide substantive expertise to formulate programmes (Rose 1993). Matsumoto, King, and Mori (2007) examined the case studies and discussed the notion that political leaders played prominent roles in adoption of BRT in Bogotá and Los Angeles, both of which drew lessons from Curitiba, and in the transfer of road pricing from Singapore to London. They pointed out that a common thread between those three leaderships is the institutional arrangement of local transportation bodies. Also, Wright (2005) identified 'political will' as the most important ingredient in making BRT work. This paper tests whether the importance of political will also applies to the adoption of BRTs in Asia.

Hypothesis 2: Political will provides an opportunity structure for lesson-drawing to occur.

Factors affecting values of the actors

If the above actors played key roles in the lesson-drawing processes, a question arises as to why Asian cities only start to pay attention to BRT in early 2000. Given that Curitiba's BRT was already in place by 1974 and became famous worldwide in the 1990s, the reason those Asian cities did not introduce BRTs is unlikely to be simple ignorance of such systems. There might have been some changes in the values of decision makers who later favoured BRTs. In fact, the political values of policymakers are one of the important influences on the process of lesson-drawing from beginning to end (Rose 1993).

One possible explanation is the worldwide change in the image of BRT as a replicable option for public transport. It has been argued that the success of Bogotá's TransMilenio system, drawing lessons from Curitiba, transformed the perception on BRT around the world (Wright 2005). This may certainly be one of the reasons why BRT started to be introduced or considered in Asian cities in the 2000s.

There might have been some changes in the situation in Asia that made BRTs a more attractive option. One of the features of BRTs is lower cost compared to rail-based systems. Coyle (1994) argued that 'in times of fiscal crisis local government tends to bear more than its fair share of the burden as the central state seeks to export or devolve its financial problems to the local level'. While Coyle's argument was made in a European context, it should be noted that Asian countries went through financial crisis in the late 1990s, with effects more severe than any period since the great depression of the 1930s. The impact in Indonesia was shattering and the economy contracted by nearly 14%. In Korea, economic reversals surpassed anything since the early 1950s when the Korean War took place. China managed to maintain growth, although it was diminished (Noble and Ravenhill 2000). It is worth examining if this financial crisis in Asia affected the values of policy makers in favour of cost-effective alternatives such as BRT, departing from a prior preference for more expensive rail-based public transport.

Hypothesis 3: Economic crisis changes the preference of policy makers to turn to lower cost options.

3.3 Data sources

Information on the introduction processes of BRT in the three cities was obtained from review of newspaper articles, literature review, and expert survey.

(1) Newspaper article review

The histories of the introduction of BRTs in the four cities were examined by collecting local newspaper articles including those from *the Jakarta Post, the Chosun Ilbo, the Korea Times, Xinhua, and the China Daily*. *SustainableTransport*, a newsletter issued by the Institute for Transportation and Development Policy (ITDP), was also referred to.

(2) Literature review

Literature was available on the introduction of BRTs in various forms including journal papers, papers for conferences, documentation by local governments, reports by international institutions, and internet sources.

(3) Expert surveys

Expert surveys were conducted with individuals who were involved in the adoption processes of BRT in Jakarta, Seoul, and Beijing.

The survey consisted of questions regarding: (1) the role of international organisations, (2) the role of political leaders, (3) sources of lesson-drawing, and (4) opinions on the relationship between economic crisis in the 1990s and BRT adoption. Although all questionnaires shared this common structure, details of questionnaires were modified for each city to accommodate the facts obtained through newspapers and other literature.

Questionnaires were sent out via e-mail in June 2006 to the experts identified through literature survey and expert consultation.[4] The list of respondents is attached as Appendix I.

4. BRT introduction in three cities

4.1 Jakarta

Jakarta is the capital of Indonesia and located on the island of Java. The total area of DKI Jakarta[5] is 661.52 km^2 and total population was approximately 8.7 million in 2005, with a population density of 13,150 persons/km^2 (BPS Propinsi DKI Jakarta 2005). From 1985 to 2000, despite a significant reduction in car ownership after the economic crises, travel time measured on four principal routes increased by an average of 50% (Pacific Consultants International and Almec Corp. 2003 cited in Ernst 2005). The air pollution was quite serious: in the 1980s, total suspended particulate (TSP) concentration exceeded 600 $\mu g/m^3$ (Shah and Nagpal 1997 cited in Ernst 2005) and 35% to 40% of TSPs were estimated to have originated from the transportation sector (Heuberger 2000 cited in Ernst 2005).

Process of BRT introduction

Although many studies and plans for Jakarta's mass transit systems were developed during the previous several decades, little progress was made towards implementation. Before the economic crisis in 1997, the delay was mainly due to the centralised and segregated government structure. After the economic crisis, neither the national government, the municipal government nor the private toll road company had the funds to implement an expensive railroad plan. Although a very low-interest loan from JBIC (Japanese Bank for International Cooperation) was offered for an underground metro in the Blok M – Kota area, DKI Jakarta was unwilling to move forward, since it would have been responsible for repaying at least 30% of the loan (ITDP 2003d). As a result, local public transit was mainly dependent on road-based modes of buses and para-transit (Ernst 2005).

In December 2001, DKI Jakarta's Governor Sutiyoso, while never ruling out a metro in the corridor, decided to introduce a Bus Rapid Transit System.[6] Partially on the strength of his promise to implement this tentative plan, he was re-elected as Governor of DKI Jakarta by the Regional Parliament (DPRD) with the support of President Megawati (ITDP 2003d).

In April 2002, the city administration announced that the busway system connecting Blok M in South Jakarta with downtown Kota in West Jakarta would start operating in December 2002 (Nurbianto 2002). An allocation of Rp 54 billion (US$6 million) from the 2002 city budget was approved by the City Council in June (Hartanto and Thilramani 2002). However, the delay to the plan was made public in early October 2002 due to lack of public consultation and financial preparation (The Jakarta Post 2002). In February 2003, another announcement of delay in the opening of the busway was made by Governor Sutiyoso, who revealed that he and city officials were planning to visit Bogotá, Columbia, to conduct a study of a similar busway system (Junaidi 2003a).

In February 2003, a delegation of 15 Indonesian government, local parliament, private sector, press, and non-governmental organisation (NGO) representatives attended the International Seminar on Human Mobility in Bogotá (ITDP 2003b). In May 2003, Governor Sutiyoso himself visited Bogotá's TransMilenio bus system. After the return of the Governor, a task force was formed to implement the BRT system, officially consisting of five Jakarta agencies – Transportation, Public Works, Parks, Utilities, and Planning – plus the three affected local municipalities within Jakarta (Ernst 2005; ITDP 2003a).

4. One respondent provided the answers through personal interview.
5. DKI stands for Daerah Khusus Ibukota, a province with special status as the capital of Indonesia.
6. A monorail system intersecting the corridor is now under development (Ernst 2005).

On 15 January 2004, the 12.9 km trunk corridor busway was finally opened on the main corridor through the city centre, in line with the extension and expansion of the three-in-one traffic policy to the evening period (Hook and Ernst 2005).[7] The construction of the first BRT cost 240 billion Rp (US$29 million), funded by the city budget (Harsanto 2005).

Evaluation of the system

According to a survey of 320 BRT passengers undertaken by JICA in the first month of TransJakarta's operation, 20% of TransJakarta busway passengers had switched from private motorised vehicles for the same trip (Ernst 2005). In July 2004, six months after the inauguration, the TransJakarta Busway recorded an average 46,000 passenger a day, which exceeded its estimated target of 20,000 passengers out of the 60,000 people who commute between Blok M and Kota daily (Nurbianto 2004). The total passengers during the first two years of operation, was estimated to be 40 million (The Jakarta Post 2006a).

An estimate indicates that the modal shift to TransJakarta busway reduced the emission of nitrogen oxide by 212 kg/day and PM_{10} by 30 kg/day (Ernst 2005).

Shortcomings of the system included: inadequate improvement of road surfaces for BRT lanes; terminal station capacities below passenger demand level; having only one platform-level door on the platform side; ineffective feeder services; and the absence of in-route headway control. In addition, under the current administrative structure, the TransJakarta public company cannot directly manage the BRT revenue and is unable to provide fiscal controls or to have resources available for planning the system's expansion (Ernst 2005).[8]

Expansion of the system

Two more busway corridors were opened two years after the launch of the first line. The first additional corridor, covering 14.3 kilometres, begins in Pulogadung bus station in East Jakarta and ends at Harmoni in Central Jakarta. The second new one, spanning a distance of 18.7 kilometres, stretches from Harmoni to Kalideres bus station in West Jakarta (The Jakarta Post 2006a). As of November 2005, the city administration was planning to develop four new busway corridors in 2006 to bring the total to seven by the end of the year (The Jakarta Post 2005).

4.2 Seoul

Seoul, the capital city of Korea, has a population of more than 10 million residents in an area of 605.39 km^2 and is now one of the world's largest and fastest growing megacities. The city's population density was 17,009 persons/km^2 in 2005 (SMG 2006b; Pucher et al. 2005). As the city grew, the total number of daily trips increased from 5.7 million to 29.6 million between 1970 and 2002. Private vehicles gained popularity as a means to meet the travel demand and increased from the 1980s onwards. Although the increase in the use of private vehicles slowed during the Korean economic crisis in 1997, it started to increase unabated after economic recovery. Vehicle ownership in 2003 became 215 vehicles per 1000 population, whereas only 0.2% of the population owned personal vehicles thirty years ago. The modal split of cars increased from 25% in 1996 to 27% in 2002 (Kim and Kang 2005).

The increase in private car use overwhelmed the capacity of the existing infrastructure and resulted in serious traffic congestion, air pollution, noise, traffic accidents as well as excessive use of scarce land for

7. For the details of the system, please refer to Table 4.7.2.
8. In May 2006, the city administration decided to take over the running of the busway, although current manager BP TransJakarta will still control the day-to-day handling of the successful bus line (The Jakarta Post 2006b).

roadways and parking facilities. Economic loss due to congestion was estimated to exceed $8 billion a year, amounting to 4% of GDP by 2003 (Kim and Kang 2005).

Process of BRT introduction

From the 1960s until the mid-1980s, the bus sector served as the main mode of public transport (Kim and Dickey 2006). The first metro line started operation in 1974 and the metro network has been expanded since then to become the most popular mode of public transport. By 2004, the total rail network included eight subway lines totalling 487 km, and servicing more than 2.1 billion people yearly. The share of buses began to fall sharply as subway lines expanded, but much of the drop is attributed to the rise in private car use and the low quality of bus services (Kim and Kang 2005).

The extensive development of the metro system put fiscal pressure on both the central and municipal governments. The construction debt from the metro system expansion reached $6 billion. In addition, since passenger fares cover only 75% of the operating costs, the annual operating deficit was estimated at $634 million in 2004. The central government covered 40% of the construction cost, while the Seoul Metropolitan Government (SMG) financed the rest of the construction costs and operating deficits that represented 82% of the SMG's total debt. The local government also needed to spend $65 million to cover the operating deficit and $66 million to cover capital deficit of the inefficient bus services (Kim and Kang 2005). Facing such great financial burdens, both central and local government officials sought more affordable ways to expand urban public transport services to meet the rising travel demands of a growing megacity (Pucher et al. 2005).

In June 2002, Myung-Bak Lee, promising to improve the problem-ridden public transport system, was elected by the popular vote. Prior to his reform, attempts to reform the bus sectors were made several times over four decades but all failed in the face of opposition from the bus industry and users (Kim and Dickey 2006). In August 2002, the public transport promotion task force was formed with the head of Seoul Traffic Information Centre in charge. The overhaul of Seoul's traffic system was announced by the Seoul City government in early September 2002 and the 'public transport reform support team' based around researchers at the Seoul Development Institute (SDI) was formed in October. While assigning research to the SDI, the Mayor himself visited Brazil, Sao Paulo, and Los Angeles to see the existing BRT systems.

The proposal for the trial BRT along Cheonggyecheon corridor in the northeastern district was developed in May 2003. However, the plan faced opposition from the bus operators' union, which invoked an all-out strike across Seoul. The Mayor decided to postpone the trial service plan and changed the decision making approach. The BSRCC (Bus System Reform Citizen Committee) was formed as an independent committee bringing together all those most directly involved in the bus system reform. The members included twenty representatives from the SMG, the Seoul Metropolitan Police Agency, the bus industry, citizen groups, and professionals. The first meeting of BSRCC was held on 26 August 2003.

The SDI, in December 2003, published detailed reports recommending coordination and modernisation of the metro and bus fare structures and payment systems, better integration of bus and metro services, an expanded network of reserved bus lanes, and a complete overhaul of the organisation and operation of bus services. In January 2004, the start date for implementation of the reforms was announced and a public relations campaign started. An agreement was signed between the SMG and bus operators on the implementation of the bus system reform in February 2004. This was achieved through the efforts of the city government to address the concerns of bus operators by communication through letters, special briefings and a joint workshop (SMG 2006a; Kim and Dickey 2006; Pucher et al. 2005).

Thus, the public transportation reform came into effect on 1 July 2004: bus services were completely reorganised and BRTs in the form of median bus lanes were installed along three corridors.[9]

Evaluation of the system

The new system turned out to cause great confusion among citizens initially. The traffic card did not work properly due to the omission of computer data on the new transportation programme. People were confused by changes in bus routes and the colour-coding systems of buses (Youn-hee 2004). Complaints poured in from passengers and a lawsuit against Seoul City and Mayor Lee Myung-bak was filed by 53 residents of Seoul demanding a combined 53 million won in compensation for damage caused by Seoul's new traffic system (Na 2004). However, as the situation settled, passengers started to recognise the benefit of cheap transfers between different vehicles, and reduced transportation time due to bus-only lanes (The Korea Herald 2004). Based on figures provided by the civic group Network for Green Transport, the dissatisfaction rate was 47.2% on the first day and hit a peak of 56.0% on 8 July. On the other hand, satisfied citizens were 15.4% on the starting day and went down to 10.9% on 5 July. Satisfaction increased after the end of July and it exceeded the dissatisfaction rate on 23 September. On 28 October 2004, 27% of the citizens were satisfied with the system while 13.2% were still dissatisfied (SMG 2006a).

One of the achievements of the transport reform is the increase in ridership. The daily average number of public transport passengers rose from 9.32 million to 9.83 million. Specifically, bus passengers increased significantly: city bus passengers have risen by as much as 13.2 % on a daily average. Secondly, improvement in air quality was observed: the ambient concentration of pollution particles was reduced to 58 $\mu g/m^3$ in 2005, which is the lowest level since 1995 when such measurements started. Other achievements of the transportation reform in Seoul include: increase in operating speed of bus and car traffic; establishment of the foundations for scientific public transport management; improvement in fairness in terms of fare payment; increase in social benefits and hidden economic benefits such as reduced running time and traffic accidents (SMG 2006a).

In terms of reduction of the government's budgetary burden, the reform has failed to curtail subsidy needs. The SMG government is obliged to cover the full operating deficits of private bus firms based on the agreement with the bus operators (Pucher et al. 2005). However, the budget for public transport in total is getting better since the deficit in the subway sector is now reduced (Fujita 2006).

The world community started to recognise the transport reform in Korea. Seoul was awarded the Metropolis Award for outstanding urban project in May 2005; a certificate of recognition from the International Association of Public Transport (UITP) in July 2005; the Special Award for Social Contribution by the Association for the Research of Transportation Problems and Human Rights in Japan in August 2005; the 2005 World Technology Environment Award in November 2005; and the 2006 Sustainable Transportation Award by the ITDP.

Expansion of the system

The Seoul Government plans to open median bus lanes on 10 of the remaining 16 trunk and feeder lines (191 km) by 2008. All buses in Seoul will be replaced with premium buses: articulated buses, low-floor buses, and CNG buses.

4.3 Beijing

In the city of Beijing, a population of 15.38 million live in an area of 16,410 km^2 (Jiang and Huang 2007). Rapid economic growth during the last two decades has resulted in a significant increase in travel demand and car ownership. In 2003, the number of trips made by Beijing residents amounted to 21 million, an 80% increase

9. The details of this system are described in Table 4.7.2.

compared to 1986 (Zhenjiang 2004). In early 2006, there were around 2.8 million cars in the city, meaning that about 20% of the citizens own private vehicles (Liu 2006). The growing motorisation trend has caused serious congestion. According to statistics, 87 areas were seriously congested and the average speed of traffic is as low as 12 km per hour, meaning 40% of passengers spend over one hour in traffic (Zhenjiang 2004). The traffic also causes air pollution and enormous increases in gasoline consumption (Hossain 2006).

Under the Ninth Five-Year Plan (1996-2000), there was rapid development of the public transport system in Beijing. The number of buses increased from 4,452 to 10,077 from 1995 to 2000 and the number of bus routes grew from 260 to 422 (Zhu, Yu, and Jiang 2003). Bus lanes were introduced in Beijing in 1997 in Chang'An Street. As of 2006, there are 45 roads with bus lanes, with a total length of 105.4 km. These bus lanes normally operate during rush hours: from 7 am to 9 am and from 5 pm to 7 pm. The expansion of bus lanes is planned and the total length will reach 200 km by 2008 (Jiang and Huang 2007).

Regarding the rail-based system, Beijing Subway Line 1 was constructed in 1969 as the first subway in China over 30 km with 23 stations. The second line (23 km-long Loop Line) was opened in 1982 (Hook, Fjellstrom, and Diaz 2006). Subway construction has gained momentum in the 2000s and it was planned to extend subway lines by 40 kilometres per year and complete the network of around 250 km of lines (Zhu, Yu, and Jiang 2003). However, this extensive metro network will be able to deal with only 20 per cent of total public transport trips, and most parts of the city will be left uncovered (Xu 2004).

Process of BRT introduction

In China, there has been a national level initiative by international organisations promoting BRT. In November 2001, the China Bus Rapid Transit Programme was started as part of the Energy Foundation's China Sustainable Energy Program (CSEP), funded by Hewlett Packard and Blue Moon foundations. The mission of CSEP is to assist in China's transition to a sustainable energy future by promoting energy efficiency and renewable energy, and transport was a focus as it is one of the major oil consuming sectors (Hossain 2006). The programme targets eight project cities, including Beijing (Xu 2005).

In Beijing, conventional bus services were not attractive to passengers because of slow and poor quality service. Faced with growing traffic demands and considering the upcoming 2008 Olympic Games, the Beijing Government found it essential to build the BRT and took the lead in the BRT project. BRT was considered as a supplement to railways while expanding the rail network to increase its coverage (Zhenjiang 2004).

Thus, construction of BRT became one of the projects to which the Beijing municipal government was most committed in 2004 and a task force was formed with representatives from many government agencies in October 2004 (Beijing Changdatong Transit Ltd. 2006). The first line was planned along the southern axis from Qianmen, for which subway line 8 was originally planned. This corridor was chosen because the planned subway construction could not be expected in the short term while traffic problems continued to worsen (Zhenjiang 2004).

The first BRT line was implemented in two phases. The first stage line for 5 km, from Qianmen in the city centre southward to Muxiyuan, started operation on 25 December 2004. This line was deemed to have 'passed' the test phase and, as the second phase, the corridor for 16 km, called the Southern Axis BRT Line One in Beijing, was opened on 30 December 2005 (Liu 2006; Fjellstrom 2005).

Evaluation of the system

The full BRT line achieved a large ridership within the first two months of operation. Daily passenger flows averaged around 80,000 commuters. On the third day, the service recorded a peak flow of nearly 130,000 passengers per day, which is only 20,000 less than the figure expected by 2007 (Liu 2006).

The operational speed during the peak period was around 22km/hr as of May 2006, which is slightly faster than the speed of regular buses in the same corridor. Although the corridor is not currently congested,[10] congestion can be expected to increase in the future and the BRT will bring more significant travel time savings for passengers compared to regular buses (Hook, Fjellstrom, and Diaz 2006).

Expansion of the system

Just after launching the first BRT line, the plan to open the second BRT line by the end of 2006 was announced by a spokesman for the capital's traffic commission. He further indicated the plan to open more BRTs (Shanghai Daily 2006). As of March 2006, the second line (Chaoyanglu Line) was under construction in Beijing's eastern districts, and two more lines cutting across the north and the west were in the planning stages (Liu 2006). The BRT network is planned to be extended to a length of 60 km by the year 2008 (Xu 2005; Beijing Changdatong Transit Ltd. 2006).

5. Comparison and discussion

5.1 Origins and contents of lessons

Literature and responses to the expert survey provided information supporting the assumption that lesson-drawing was observed in the introduction of BRT in all three case cities.

In Jakarta, policy makers expressed their interest in learning from other cities, especially from Bogotá, during the planning process of the TransJakarta BRT. For example, Governor Sutiyoso stated that 'Bogotá has been applying the busway system and it runs well. The Bogotá Mayor has invited us (for the visit)' when he revealed the plan for the city officials and him to visit Bogotá to conduct a study on the BRT system in early 2003 (Junaidi 2003a). D.A.Rini of Jakarta Transport Authority, who was also a member of the busway team of experts, also said that 'Bogotá has been successful in implementing the busway project. We want to learn how they solve technical problems to ensure the busway system is running smoothly' (Harsanto, 2003b).

According to responses from experts, the elements specifically imported to TransJakarta from Bogotá's TransMilenio include: physically separated bus lanes in the median of the roadway; high floor bus stations and wheelchair-usable pedestrian ramps; high-floor buses; pre-board fare payment with turnstiles using electronic smart-cards. Thus, Jakarta imported the components from TransMilenio which it thought feasible but did not adopt the holistic system approach found in Bogotá. Regarding Curitiba, both experts answered that Jakarta drew few lessons directly from Curitiba.[11] Expert survey also revealed that TransJakarta drew lessons from Quito, in terms of the concept of using BRT in narrow streets and the factors causing the failure of BRT systems. Information sources from which the experts found most useful to draw lessons included: the visit by the former Mayor of Bogotá to Jakarta; visit to Bogotá; visit to Quito; and technical support by experts.

In contrast, the Bogotá system was found to be only marginally useful in Seoul. One expert explained this is because Bogotá's system is based on a trunk concept or corridor approach, while Seoul wanted to address not only one corridor but the total system. Instead, Seoul did adopt the Quasi-Operational system of Curitiba, in which private bus companies earn revenue by service distance and not by the number of passengers. Components such as physical busway segregation, bus station design, and vehicle design were not imported mainly because of the difference in weather and in order to utilise the existing bus system to the maximum extent possible. While studies were conducted on many cities including Paris, London, and Osaka, there were not enough lessons on 'integration' from which Seoul really wanted to draw guidance. In learning from Curitiba,

10. Exception is the northern section, which does not have segregated bus lanes.

11. However, a response from one of the experts indicated that there was an indirect lesson-drawing: some elements that Bogotá adopted from Curitiba's lesson were reflected in TransJakarta.

useful information was obtained through the visit by the former Mayor of Curitiba to Seoul, research conducted by the SDI, and international conferences held by organisations such as the Transportation Research Board (TRB), and the UITP.

In the case of Beijing, the experts replied that both the Bogotá and Curitiba systems were referred to and some elements were incorporated into the system design in Beijing. Beijing BRT adopted the off-boarding ticketing system from Curitiba and left-side door BRT operation from Bogotá. The Beijing BRT system drew those lessons by sending decision makers to Curitiba, inviting the former Mayor of Curitiba to Beijing, and conducting studies on technical elements of BRT systems.

5.2 Actors

International organisations

For the TransJakarta project, the ITDP provided technical assistance based on a grant from the United States Agency for International Development (USAID) (ITDP 2003d). This assistance included support of civil groups (particularly NGOs and the media), private bus operators, and the government, primarily in the form of visits to the BRT systems in Bogotá, Columbia, and Quito, Ecuador, and visits to Jakarta by key consultants who developed the Bogotá system, including the former Mayor, Enrique Peñalosa (Ernst 2005). It also facilitated the involvement of NGOs in coordinating civil input into the planning process. During the period June 2003 to June 2005, ITDP sent a series of technical experts to analyse and provide recommendations on BRT design and operation (Global Environmental Facility 2006). A technical report summarising BRT technical recommendations was issued in December 2003.

Close examination indicates that the visits assisted by ITDP preceded key turning points and seem to have triggered the changes. First, the decision to develop BRT was made in December 2001, right after the ITDP-sponsored visit by former Mayor of Bogotá, Enrique Peñalosa to Jakarta (ITDP 2003d; Ernst 2005). The second turning point was February 2003, when the BRT plan was facing deadlock and had already been postponed several times, mainly due to the lack of in-depth study and public dissemination. A delegation of 15 Indonesian government, local parliament, private sector, press, and NGO representatives attended the International Seminar on Human Mobility in Bogotá, supported by ITDP.[12] After that, activists and urban transportation experts asked for the involvement of the public in the process to fix the transportation problems in the capital, noting the importance of public involvement in Bogotá's case. The head of the City Transportation Agency admitted that more public information was necessary (Junaidi 2003b, 2003c; Harsanto 2003a; Junaidi 2002).

In Beijing, the Beijing office of the Energy Foundation contributed to the BRT project by: initiating the China Bus Rapid Transit Programme together with the Hewlett Packard and Blue Moon Foundations in 2001 (Xu 2005); providing grants to the study team and technical support (He, Xu, and Chang 2004); supporting the Beijing BRT Development Symposium in 2003 (Beijing Changdatong Transit Ltd. 2006); and providing continuous technical support to Beijing BRT development through the provision of a full-time consultant.[13] The contribution of international organisations was noted as one of the key factors in the successful introduction of BRT in China (Chang 2005; Hossain 2006). An Assistant Secretary General of Beijing Municipal Government noted the contributions from international experts stating that 'experts from the US provided useful technical guidance that we appreciate very much' (Zhenjiang 2004).[14]

12. Roughly half of these visits were paid for by DKI Jakarta and operators, and the other half under the auspices of ITDP (ITDP 2003d) .
13. Based on the expert survey
14. In other cities in China, other international organisations played roles. In Kunming, technical support for the first median busway system came originally from the Swiss Government via the Zurich Sister City Project, with matching funds from general municipal government budget revenues. For Shijiazhuang project, technical support came from municipal general budget revenues, with some loan funds from the World Bank (Hook, Fjellstrom, and Diaz 2006).

By contrast, in the case of Seoul, there was no record of involvement of international organisations. Answers from two experts confirmed that there was no substantial involvement of any international organisation in the planning process of the BRT. The planning for the transport reform in Seoul was technically supported by Korean specialists, specifically the transport specialists at the SDI, a research group funded by the municipality (ITDP 2003c; Pucher et al. 2005).

It should be noted that neither Jakarta nor Beijing received any financial support for construction or operation of the bus systems. While in Bogotá's case the involvement of international organisations included funding, support from international organisations for Jakarta and Beijing was mainly in the planning and engineering phases (Hook 2004).

Political will

In Jakarta**,** Governor Sutiyoso of DKI pushed the BRT project through implementation using his budget and staff (Ernst 2005). He decided to introduce a BRT system in December 2001 and was re-elected as the Governor by the Regional Parliament partly due to this promise. Therefore, the busway became 'something of a litmus test' for his administration, and its success was a political priority for him (ITDP 2003d).

The Governor reconfirmed his commitment to opening the TransJakarta busway by the end of 2003, when he returned from the visit to Bogotá in May 2003. He set up a task force consisting of five Jakarta agencies in charge of transportation, public works, parks, utilities, and planning. Three affected local municipalities within Jakarta were also part of it (Ernst 2005). The Governor also made a commitment to improved pedestrian access facilities and nicer, more comfortable stations (ITDP 2003a).

After the inauguration of the system, the Governor defended the reserved right-of-way for the TransJakarta BRT. He publicly criticised the misuse of the BRT lane by the Vice President of Indonesia for his motorcade (Ernst 2005).

The conviction of the Governor was influenced by actors such as the former mayor of Bogotá. As indicated above, Bogotá's former mayor Peñalosa visited Jakarta in November 2001 to present the Bogotá Transmilenio BRT system and that information was relayed to Governor Sutiyoso by the Vice Governor (Ernst 2005). One of the Mayors[15] also made a presentation on the reasons that led Bogotá to develop a BRT system instead of mass rapid transit (MRT) in front of Governor Sutiyoso and the local parliament before the local parliament approved the budget to develop the BRT demonstration project in Jakarta in February 2002.[16]

The Mayor in Seoul shared a similar political commitment to Jakarta's Governor: Mayor Lee Myong-bak promised to improve the problem-ridden public transportation system when he ran for election in 2002.[17] He held a weekly transport policy meeting until implementation of the reform in 2004 (SMG 2006a). A transport expert was invited by the Mayor to take the top position in the SMG. Mayor Lee and his staff charged the transport specialists at the SDI to lead the Transit Report Task Force Team and then provided the necessary political support (Pucher et al. 2005).[18]

What is notable in the leadership of the Mayor of Seoul was his change in approach when the first plan for BRT failed due to opposition from the bus drivers' union and the bus operators' association (SMG 2006a). The previous top-down approach by the central government and SMG was changed into a participatory process headed by a committee supported by citizen groups and collaborative organisations by establishing the BSRCC (Kim and Kang 2005).

15. Jakarta is a special district incorporating several municipalities, each with a mayor. The district has roughly the status of a province and is headed by a governor (Ernst 2005).

16. According to the expert survey

17. Mr. Lee retired from office at the end of June 2006.

18. According to the expert survey

After the confusion with the opening of the new system, the Mayor also took public actions such as visiting Gangnamdaero (one of the corridors for Median Bus Lanes) and Korea Smart Card Co., expanded daily transport policy meetings, and received issues for the day (SMG 2006a).

Behind the strong commitment to the transport reform, there was also the influence of experiences drawn from foreign cities. During his first two months in the Mayor's office, Mr. Lee conducted fact-finding trips to investigate the BRT systems in Curitiba, Sao Paulo and Los Angeles (ITDP 2003c). When he visited Brazil, he asked former Mayor Lerner, who pioneered the Curitiba BRT, from 1971 to 1998, to visit Seoul. Mayor Lerner made a visit to Seoul in March 2003 and received an honorary citizenship (Hong-ryul 2003).

The major role taken by the Mayor of Beijing was to support the plans proposed by the Director of Beijing Transportation Commission.[19] Both Xu (2005) and Chang (2005) pointed out that this support from the Mayor was one of the key factors in the BRT success in Beijing. In China, such support is crucial since Mayors in China have enormous discretion in terms of transportation planning and budgets by international standards. Municipal budgets are largely under the control of the Mayors and approval from the national government is necessary only for rail projects. Therefore, BRT projects can be planned, financed, and implemented without national government approval or legislative approval as long as they have the support of the Mayor and local Party leadership (Hook, Fjellstrom, and Diaz 2006).

Not much documentation is available on why the Mayor of Beijing expressed strong support for BRT. One reason could be that capital-intensive solutions like road infrastructure expansion and metro systems have been found incapable of solving the growing problems of congestion and air pollution, while creating their own problems of rapidly growing public debt, urban sprawl, and the rapid loss of state land assets. Mayors in China are responsible for the performance of the urban economy, including reforming the state-owned enterprises, and running indirectly a host of municipally owned companies in banking, transportation, real estate, and other sectors (Hook, Fjellstrom, and Diaz 2006).

5.3 Factors affecting values of the actors

Economic crisis

In the expert surveys, the respondents were asked how far they agree with the following statement on the linkage between the Asian economic crisis and the introduction of BRTs:

'Policy makers <u>in the city</u>[20] were long prioritising the introduction of rail-based systems as the most effective mode of public transport and were developing plans for subway construction. However, the economic crisis in Asia in the late 1990s affected the budget of the city government and the policy makers started to seek lower cost solutions to provide public transport. In this context, BRT started to draw attention from the policy makers <u>in the city</u>.'

One respondent in Jakarta strongly agreed with this statement. The report by ITDP (2003d) concurs with this statement: 'neither the national government nor the municipal government nor the private toll road company had the funds to pursue plans for rail-based transit, with the economic crisis and transition to democracy'. However, another respondent somewhat disagreed and responded that although the economic crisis severely impacted the national budget, the impact on local government was mitigated by decentralisation of funds after the Suharto regime ended. According to this expert, the Jakarta provincial-level government budget was substantially higher than it was during the previous decade by the time BRT was considered. It was pointed out that BRT was implemented not as a substitute for MRT, but as a public transport system which could be implemented in the

19. According to the expert survey
20. For the underlined parts of the statement, names of cities, namely, Jakarta, Seoul, or Beijing were used on the actual questionnaire sheet sent to the experts.

short term since the involvement of the national government was not necessary while it was required for MRT. The plan for Jakarta MRT was not stopped and it is currently under development.

One expert deeply involved in Seoul's transport reform also strongly agreed with the statement, noting that the crisis changed the thinking of the policy makers on costs. However, another expert involved in the Seoul master plan said that the impact of economic crisis on the transport reform was limited. Although 'the looming financial crisis of Seoul's public transport system due to deficits from the subway construction and operation' was the driving force behind the drastic reforms of July 2004 (Pucher et al. 2005), this financial burden is not only due to the economic crisis in 1997 but also due to other structural reasons associated with the public transport system in Seoul.

With a contrary view, the Chinese experts strongly disagreed with the statement. This is not surprising since the economic crisis had less impact on China than other Asian countries (Noble and Ravenhill 2000).

The literature shows that notable aggravation of congestion was observed after the recovery from economic crisis in both Jakarta and Seoul. In Jakarta, there was a rapid development of motorisation after the economic recovery, which led to severe congestion, air pollution, and noise (Yabe 2006). Similarly, in Korea, although the use of private vehicles decreased and public transportation increased during the economic crisis, the number of private vehicle users has continuously increased along with a decrease in public transportation ridership after the Korean economy showed some signs of recovery (Kim and Kang 2005). Those rapid changes in traffic after the recovery from economic crisis might have pressed the policy makers to seek a relatively quick solution in developing public transportation.

In addition, in the case of Jakarta, the economic crisis affected the bus sector severely and put pressure on the government to take rapid action. After the economic crisis there was a serious decline in bus patronage threatening the sustainability of the bus industry. Consequently, bus frequency became significantly lower and public complaints about the poor service quality grew. Those situations acted as a catalyst for preparation of the new bus system (Sutomo, Saumatmaji, and Djarwoningrum 2007).

6. Conclusion

Three pioneering cases of BRT introduction in Asia have been examined, namely, the TransJakarta busway, the Median Bus Lanes in Seoul, and the Southern Axis BRT Line One in Beijing, from the perspective of lesson-drawing focusing on important actors and factors that motivated them to introduce BRTs.

First, it was found that during the process of BRT introduction in the three cities, lessons were drawn from the Latin American good practice cases: Curitiba and Bogotá. Interestingly, however, the major origins and contents of lessons differed from city to city. Jakarta drew lessons mainly from Bogotá on the specification of running ways, stations, vehicles, and fare collection. Seoul looked into Curitiba's system and adopted the institutional arrangements for payment to bus operators, but not the technical specifications such as vehicles and stations. Beijing referred to both Bogotá and Curitiba and imported the factors related to vehicles, stations, and ticketing.

Second, it was found that different international organisations played important roles in technical assistance in Jakarta and Beijing. ITDP's assistance in facilitating the visits of stakeholders to Bogotá and vice versa catalysed the lesson-drawing and led to visible changes in the process. The technical support provided by the Energy Foundation to Beijing seems to have been more continuous technical assistance. On the other hand, Seoul's transport reform was supported by domestic experts.

Third, strong political will was found to be a common thread in the adoption of BRTs in the three cities. The Governor of DKI Jakarta and the Mayor of Seoul actively led the BRT projects. They placed BRT introduction as one of their major political commitments and made important decisions to change the setup of the teams when faced with planning gridlocks. They both took action when problems arose after the inaugurations of the systems. The influence of the former Mayors in Latin American cities could be tracked as one of the driving forces behind the commitment of those political leaders. There were interactions and visits between the former Mayor of Bogotá and the Jakarta Governor, and between the former Mayor of Curitiba and the Mayor of Seoul. The role of the Mayor in Beijing in BRT introduction was different from the other two cities. He provided his support to the plans proposed by the Director of Beijing Transportation Commission. This does not mean his role was less important than other cases since the Mayors have strong discretionary powers in Chinese cities.

Fourth, the Asian economic crisis in the late 1990s seems to have effected the shift in values of the policy makers in Jakarta and Seoul to some extent in motivating them to seek lower cost solutions to provide public transport, thus focusing attention on BRT systems. However, the impact of the economic crisis on the change in values seems to have mitigated by the decentralising trend in Jakarta. In Seoul, the economic crisis was not the only factor and the accumulated debts due to public transport seem to have been a more important factor in the decision of policy makers to turn to the lower cost options. It was also shown that rapid change in traffic volume after the economic recovery might have added to the momentum to urgently address the transport issue in those two cities. In addition, in Jakarta, the economic crisis pushed the government to take action to rescue the severely affected bus sector. No such linkage between economic crisis and BRT introduction was identified in Beijing.

Further research potential

This research shows how Asian cities learned from the experiences of Latin American countries. It should be noted that the lesson-drawing on BRT among Asian countries has now been initiated between Seoul and Beijing through an agreement in 2005 (JoongAug Daily 2005; SMG 2005). How the lesson-drawing interaction on BRT within the Asian region will evolve may be a rich topic for future research.

This study also addressed the importance of political will of local leaders. However, the background which enabled strong political leadership has not yet been examined. Through analysis of the impact of economic crisis, it was found that that decentralisation in Indonesia affected the introduction of BRT. Decentralisation is a trend generally ongoing in Asian countries and linkage between decentralisation and movement towards BRT introduction should be further analysed.

In addition, the cases of Jakarta and Seoul showed that not only international organisations and political leaders but also citizen groups played important roles in BRT planning. Jakarta's citizen participation was facilitated by IHDP and inspired by Bogotá's experience, while the participation system in Seoul emerged as a result of failure in the top-down approach. Further examination of the roles of citizen groups in BRT development should provide important policy implications for other Asian cities which are considering the introduction of BRTs.

Finally, while this study focused on the 'successful' cases of BRT implementation, some attempts to introduce BRT have been stagnated or failed including the cases of Bangkok, Delhi, and Bangalore. Studies on those cases should be conducted in the future from the perspective of the barriers to lesson-drawing.

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Appendix: List of Respondents to Expert Surveys

Jakarta

Mr. John Ernst, Asia Regional Director, Institute for Transportation and Development Policy

Ms. Andi Rahmah, Policy analyst, Pelangi Indonesia

Seoul

Dr. Gyung-Chul Kim, Director, Department of Urban Transit, Seoul Development Institute[21]

Beijing

Mr. Fan Jin, Executive Director, China Sustainable Transportation Centre[22]

21. Informal hearings were made with two other experts on the questions during international conferences such as the International Conference on Environment and Transport in Aichi (2005) and the 5th UITP Asia-Pacific Congress and IPTS Conference.
22. Mr. Kangming Xu, China BRT Consultant, provided information for Mr. Jin to complete the survey.

V. Conclusion

1. Summary of findings

Chapter Four presented case studies in Asian cities that were carried out by the Urban Environmental Management Project (UE Project) and research partners on the policies related to non-motorised transport (NMT), land use, restraint of car use and promotion of public transport. Below are some of the major findings from those case studies.

Non-motorised Modes of Transportation for Sustainable Mobility: Strategies for its Adaptation in Mumbai, India by Sudhakar Yedla (Section IV.1) tested the hypothesis that non-motorised transportation modes in Mumbai face certain barriers such as lack of infrastructure and low affordability by means of multi-stakeholder participation. The findings of this study shows that contrary to popular perception, neither a lack of awareness, possibility of theft or adverse climatic conditions were major barriers to NMT in Mumbai. It found that the lack of affordability of bicycles on one side and affordability of motorcycles on the other side are among the major dominant factors. It also suggests that, in the context of Mumbai, promotion of NMT has substantial benefits both in the form of greenhouse gas (GHG) and local emissions control. Through multi-criteria analysis and examination of various policy alternatives, the study suggested short-term and long-term strategies. In the short-term, the study proposes policies to provide separate bicycle lanes and parking places at all metro and bus stations. This should be accompanied with inter-modal integration of transport infrastructure in the city so that NMT's niche can be ascertained and fully developed in the long term. Together with this, strong promotional/awareness campaigns and capacity-building programmes are needed in the short-term. In the longer term, the study highlights the need for fully integrating NMT into multi-modal public transportation system and developing a robust system of making bicycles easily affordable such as a bicycle lending system, with the necessary financial mechanisms in place so that better uses of bicycles can be ascertained alongside the improvements in physical infrastructure.

Promoting Reduction in Travel Demand in Transport Sector of Asian Cities: Case of Bangkok, Thailand by Ranjith Perera et al. (Section IV.2) studied and discussed the reductions of travel demand by examining various possible interventions that are presently being undertaken as well as planned for Bangkok. It showed that the air quality in Bangkok has been improving since the end of 1990 due to the presence of political willingness of the authority on air pollution issues, which created synergistic policies and strategies. On the other hand, it found that car dependency in Bangkok is significantly increasing as a result of a rise in income of Bangkok residents, and the policy of the Bangkok Metropolitan Administration that gives priority to road development rather than damping travel demand or shifting to efficient modes. It suggests that Bangkok has potentials to reduce travel demands through further promotion of mixed land use and promotion of a pedestrian-friendly urban environment. These two issues are addressed to a certain extent in the current Bangkok Comprehensive Plan but further promotion is necessary. It was noted, however, that the impacts of this plan would not influence the present situation in Bangkok right away.

Promoting Reduction in Travel Demand in Transport Sector of Asian Cities: Case of Shanghai, China by Haixiao Pan (Section IV.3) reviewed various information on urban transportation in Shanghai in relation to urban planning, and conducted a survey on pedestrian-friendly urban design in four blocks in Shanghai. The studies major findings suggest that the air pollution in the central part of the city is mainly derived from urban planning as well as vehicular emissions and factories for particles. However, it has some potential to influence the rate of motorisation. As of yet, Shanghai's urban planning framework is highly controlled by the municipal government. The policies related to dense and mixed land use, car control on parking and license, introduction of a large scale metro system, that potentially help to make carbon friendly city, are already in place in Shanghai. These policies also put restrictions on new large-scale developments, ensure adequate dispersion, and envision open spaces and necessary urban infrastructures. The study also concludes that Shanghai still has a great possibility of becoming a pedestrian-friendly metropolis because NMT (including walking) accounted for about 60 percent of travel demand in 2004. Analysis of the current socio-economic status in Shanghai shows that pedestrian facilities are increasingly drawing attention from developers, the government and citizens as the economy is further developing. The study emphasises the need for sound implementation of such policies and planning efforts in the City.

Promoting Reduction in Travel Demand in Transport Sector of Asian Cities: Case of Yokohama by Noriko Kono and Tomomi Hoshiko (Section IV.4) described the state-of-the-art transportation and environmental situation in Yokohama in relation to urban planning. The study has reviewed the policies on some of the urban planning measures that are important to make carbon-friendly city such as urban density, mixed use and pedestrian friendly urban design. The major findings of the study highlight that the air quality and greenhouse gas emissions in Yokohama have been more influenced over time (especially after 1960s) by the transportation sector due to a reduction in industry-related emissions and a rise in car-dependent lifestyle. It shows that the urban planning of Japan is largely a top-down endeavour with strong administrative and legislative arrangements but lately the city is trying to be more flexible by using agreements. The study suggests that mixed and dense land use is promising. The city has already pursued policies for both site-specific and neighbourhood-level mixed land use in the central business district as well as Transit Oriented Development (TOD) to keep certain levels of density in suburban areas. The study notes that much attention is paid to the pedestrian and NMT- friendly urban design by related authorities and that interest among the public remains high on such developments. Some of the examples of public involvement cited in the study are Yokohama's bike rental system and Car Free Day movements initiated by non-profit organisations and community-based organisations. Finally, it highlight importance for the city to put more emphasis into creating several self-sufficient TOD cores and promote a multi-core metropolis which not only addresses the need for local urban planning but also potentially helps to design a carbon-friendly city.

Car restraining in Beijing: Evaluating the factors that impede or facilitate by Kejun Jiang and Liya (Section IV.5) Huang reviewed the current motorising trends, environmental problems and future scenarios. It further analysed the potential for the implementation of vehicle restraining policies in Beijing. The major findings of this study highlight several important points. It shows that an increase in motor vehicles is a major factor for a number of negative effects that include air pollution, congestion and noise pollution in Beijing. Various policies have in fact been implemented by the Beijing government to address those issues, and indeed the city has been effective in controlling air quality. It has been less successful in reducing congestion and noise. Car restraining, which can simultaneously address pollution, congestion and greenhouse gas emissions as well as reduce the need to develop massive road developments, is implemented in Beijing in the form of limiting car-use through increase in parking fees and increase in consumption tax for larger engine passenger vehicles. The study suggests that parking pricing policy has been successful in Beijing and the government is planning to further extend the pricing policy by increasing the parking tariff and expanding it to a larger area. The major barriers that this policy is facing are public acceptance and lack of adequate public transport system. Finally, the study suggests that further options should be sought to reduce the utilisation of cars, given the growing motorisation and high rate of private car ownership in Beijing.

Bus Rapid Transit in Jakarta: Evaluating the Factors that Impede or Facilitate by Heru Sutomo et al. (Section IV.6) studied the Bus Rapid Transit (BRT) in Jakarta, which was the first dedicated bus lane system introduced in Asia and that is now being expanded. The major findings of this study suggest that the poor state of public transport due to economic crisis in 1998-2001 has given opportunities for adopting a new bus system in

Jakarta. The rising interest in BRT from 2002 onwards was very timely considering the urgent need to save public transport from bankruptcy. The adoption of the plan by the Governor who is strongly committed, has paved the way for political support from parliament and the general public. In addition, the strong financial capacity of the Provincial Government of Jakarta has made the speedy implementation of BRT possible in Jakarta. The study also highlighted the substantial role of the international community such as the Institute for Transport and Development Policy in the USA, especially in providing Jakarta with BRT information from Latin American countries such as Columbia (Bogotá). The success of the BRT is also attributed to the participative planning process that created a strong ownership among government officials and the public in Jakarta. However, the study notes that the ambitious implementation of the new BRT has focussed more on physical infrastructures and less on operational, financial, management or institutional aspects, all of which should not be discounted. Finally, the study concludes that the BRT system seems successful in the short term in Jakarta. However, unless a clear and longer term development perspective is formulated, the sustainability of the BRT service in conjunction with other modes of public transport may be impaired in the future.

Analysis of policy processes to introduce Bus Rapid Transit systems in Asian cities from the perspective of lesson-drawing: Cases of Jakarta, Seoul, and Beijing by Naoko Matsumoto (Section IV.7) reviewed the three pioneering cases of BRT introduction in Asia from the perspective of "lesson-drawing" theory. The major findings of the study suggest a few key points. It shows that lessons about BRT systems were heavily drawn from the Latin American good practice cases of Curitiba and Bogotá when Jakarta, Seoul and Beijing adopted the BRTs. Interestingly, however, cities differ in where they draw lessons from, and the components of the lesson that they reflect in their own policies. This study highlights three major determinants: economic rationale, political-will and the role of the international community. Firstly, the Asian economic crisis in the late 1990s seems to have affected the traditional thinking of the policy makers in Jakarta and Seoul to some extent and motivated them to seek lower cost solutions to provide public transport which thus focused their attention on BRT systems. Secondly, a strong political-will is a common thread in the adoption of BRTs in these three cities. The strong leadership of former mayors in Latin American cities was a key influencing factor behind the commitment of political leaders in these three Asian cities. The interactions and visits between the former mayor of Bogotá and the Jakarta Governor and between the former mayor of Curitiba and the mayor of Seoul further promoted this. Finally, different international organisations played important roles in technical assistance in Jakarta and Beijing while Seoul's transport reform was supported by domestic experts.

2. Discussion: barriers and opportunities

As shown in Chapter Three, one of the overarching research questions of the UE Project was "What are the opportunities created by bringing 'the global to the local' and what are the barriers (technical, financial, institutional etc.,)?". This section analyses those case studies on the strategic factors that facilitate and impede promotion of transportation policies which can reduce air pollutants and GHG emissions following the list of the key factors listed in Chapter Three. Those key factors included: (1) the role of actors and their engagement in policy making and implementation; (2) timing from the viewpoint of political developments, political cycles, short and long term impact of measure, state of the problems and others; (3) air pollutant reduction potential and their uncertainties; (4) the level of uncertainties in basic assumptions that underpin the effectiveness of measures; (5) implementation issues such as strategic compatibility between national and local policies; and (6) likely cross-sectoral impacts and social issues such as equity.

Reviewing studies in Chapter Four, three factors were found to be playing important roles. Those include the role of actors, timing, and implementation issues. Two additional factors were found to be important.

The role of actors and their engagement in policy making and implementation

The role of actors was found to be one of the best facilitating factors in the Jakarta case study. The study showed that various actors, including local government, academics, international organisations and political leaders, played significant roles in the implementation of the TransJakarta busway.

Political leadership was found to be a common driver to the pioneering BRT introductions in Asia. The comparative analysis and Jakarta case study revealed that both the Governor of Jakarta DKI and the Mayor of Seoul placed BRT introduction as one of their major political commitments and made important decisions to change the setup for decision-making to a more participatory approach when faced with strong opposition. On the other hand, weakened leadership in urban planning and a lack of long-term goals was pointed out as an issue in the Yokohama case study: the Planning Bureau used to be famous for innovations and excellent leadership but seems to have lost its enterprising qualities.

The role of international organisations was emphasised by the Jakarta case study and the comparative analysis. In Jakarta and Beijing, international organisations played important roles not in financing the project but in technical assistance and facilitation of learning from the other cities' experiences. With the increased attention to the global warming issue, it is expected that international organisations will be more actively involved or support the local policies towards emission reduction of GHG from transport sector, for example, through the Clean Development Mechanism and Global Environmental Facilities.

Timing from the viewpoint of political developments, political cycles, short and long term impact of measure, state of the problems and others

The Jakarta case study also found that good timing was one of the key success factors. According to the study, the new system was introduced right in the era of government reforms and at the time of the worst condition of the bus system when bus operators were facing a danger of bankruptcy as a result of economic crisis starting in 1997. The report further discussed that the timing of the political cycle was important, pointing out that the governor could make important decisions with a feeling of "nothing to lose" because he was in his last term of office.

Case studies for Shanghai and Beijing clearly indicated the timing of international events, such as the World Expo and the Olympic Games, can promote proactive and quick transport policies and short-term urban planning measures. Key urban planning measures usually take time to implement and more importantly take time to show the outcome. The failure of many cities to advance much on the urban planning front may underscore the fact that the term of political leaders in office do not often match with prospects to show the outcome of planning measures.

Implementation issues

The importance of "strategic compatibility between national and local policies, on development goals, and on other existing policies", closely related to implementation, was emphasised in many of the case studies. For example, according to the Bangkok case study, commendable efforts towards better air quality were made possible due to appropriate compatibility between Thai National policies and Bangkok Metropolitan Administration policies. The Beijing case study reported that the energy intensity target in the 11^{th} Five Year Plan facilitated the promotion of fuel tax as a future option.

On the other hand, in reality, there are many cases where the national government's policies do not support local government's environmental transport policies or even conflict with them. The Mumbai case study identified a lack of integration of NMT in national transportation plans and frameworks as one of the major barriers for the promotion of NMT. In Shanghai, the city government is not allowed to increase parking fees in the congested areas, so as to comply with the fair trade principle. The Beijing study emphasised the importance of seeking options to reduce utilisation of vehicles even while ownership of vehicles increases backed up by the national policies supporting the automobile industries.

Jakarta's case implies that it is also important to seek strategic compatibility not only between national and municipal governments but also among national, regional and municipal governments, especially in large scale cities.

Another key issue related to implementation is feasibility in terms of various aspects such as political, administrative and financial dimensions. Political feasibility increases if a policy wins support from public. The policies in Yokohama, Jakarta and Seoul were examples of importance of public acceptance. Jakarta and Seoul first faced strong opposition but public acceptance increased as the consultation processes were elaborated, as described in the comparative analysis. In this context, it is imperative to address the culture that sees vehicles as "status symbols", an attitude commonly observed in Asian cities.

Other key factors

In addition to the above key factors, findings from case studies indicated the importance of two other factors, namely, integration between various policy measures and political decentralisation.

Although the case studies in Chapter Four focused on different kinds of policies such as NMT promotion, land use planning, vehicle restraining policy and public transport, it was commonly found that integration with other policies is a crucial factor for the success of policies. Lack of institutional arrangement to integrate NMT in transportation planning at the city/municipal level was found to be one of the major barriers for the promotion of NMT in Mumbai. Jakarta learned from its experience in a policy to prevent private vehicles from entering a restricted area in peak hours. The city then understood that mere traffic control does not solve the problems by itself and it took further steps to bolster public transport. Similarly, the effort in Bangkok to control air pollution was integrated with the promotion of mass rapid transport which is supported by an outstanding inter-modal transit system.

The findings from Jakarta show that the trend of political decentralisation had a positive impact by allowing strong local leadership and providing sound financial basis for a new bus system. However, it is necessary to note that decentralisation without adequately providing opportunities to build human resources or institutional and financial capacities locally, often results in a deflection and diffusion of responsibility and a lessening of policy effectiveness; it may not be helpful to solve problems (IGES 2005).

3. Ways forward

The papers contained in this report were written with the aim to contribute towards better management of the urban environment in Asian cities when developing new ideas and tools. In this quest, case studies analysed various factors that facilitated the formulation and implementation of policies and evaluated their limitations and advantages (Chapter Four). These studies provided new insights based on analysis of up-to-date information from each case study city. However, it has to be admitted and recognised that there is a long way to go before Asian cities can achieve sustainability in the area of air pollution and GHG emission control, and more strategic research is necessary to assist decision-makers in making sound decisions. This study is one of the early steps and should certainly be pursued further.

Firstly, the Third Phase of the UE Project successfully highlighted the linkages between the reduction of travel activities and reduction of emissions of both air pollutants and GHGs with case studies on Bangkok, Shanghai and Yokohama. Those case studies clarified this linkage by close examination of local information. It would have been more convincing for decision-makers if the attribution of land use was quantitatively backed. Further efforts are necessary along that line in the future.

Secondly, the studies in Beijing and the comparative analysis showed the potentials and importance of public transport and vehicle restraining policies in Asian medium and mega-cities now and in the future. The emergence of new policies and complexity related to political and economic background in each city indicates that it is necessary to further develop theories and approaches in this area that fit the individual context of each of these Asian cities. Those theories or approaches should not only be based on the traditional engineering approach, which is still prevalent in Asian cities, but also comprehend the fact that the appropriate public transport mode or policy mix of public transport and vehicle restraining policy depends on the historical and political context, financial situation, stakeholders and other socio-economic realities.

The relevance of new theories and approaches applicable to the Asian situation needs further illustration and testing, particularly in the context of the land use and urban transport linkages. Our experience in this study shows that it is very difficult to analyse Asian cities using the framework such as “compact city” or “smart growth” which are very much propounded in the case of European and North American Cities.

Finally, those studies focused only on the *Travel Activities* and *Modal Structure* for the Third Phase among the four major drivers shown in Chapter Three. This does not mean other two factors, namely, *Energy Intensity* and *Fuel Quality*, are less important. The UE Project simply attempted to address some of the up-stream issues that have great potentials to set the right initial conditions for bottom-up issues to play. It is acknowledged that the world is moving fast on bottom-up issues for various reasons, such as energy intensity and fuel quality. However, up-stream issues and studies to guide Asian policy makers are urgently needed there too.

The Institute for Global Environmental Strategies (IGES) is starting three research projects for its Fourth Phase which follow up the following studies: *Co-benefits of GHG mitigation and energy conservation in transportatio*n; *Promotion of urban/local initiatives for sustainable society*, and *Sustainable use of biofuels in transport in Asia.* It is our hope that those new projects will be able to fill some of the above mentioned needs and gaps in empowering decision makers. IGES is looking forward to further collaboration with stakeholders in Asia through those research activities and hopes to make further contributions to sustainability in Asia.

(This chapter was written by Naoko Matsumoto in consultation with Prof. Akio Morishima)

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