The Research on Practical Approach for Urban Transport Planning

Final Report

December 2011

Japan International Cooperation Agency
ALMEC Corporation

PREFACE

The Japan International Cooperation Agency has supported urban transportation planning activities in more than 60 cities mainly in Asian countries by conducting studies on master plan formulation and feasibility studies. Many of the proposals suggested in these studies have been implemented through Japanese yen loans and grant aid, as well as by the respective countries, the private sector, and other donor agencies.

Now, Japan is highly expected to participate in urban planning with more strategies to develop proposals into projects for the promotion of infrastructure through international cooperation as indicated in the government's *Plan for Growth* which started in 2010. For this purpose, this study was designed to review cross-sectoral information which are available from existing studies and documents, thereby contributing to the formulation of medium- and long-term development strategies in urban transportation which are in accordance with prevailing urban socio-economic conditions in subject cities.

The team headed by Mr. Tetsuo Wakui of ALMEC Corporation conducted the study on cities in Japan, India, Indonesia, and Vietnam. Besides the field work, discussions were held four times with study advisors, Dr. Tetsuro Hyodo, professor at the Tokyo University of Marine Science and Technology, and Dr. Sinya Hanaoka, associate professor at the Graduate School of Science and Engineering of the Tokyo Institute of Technology.

I hope that this report will contribute to the promotion of development assistance in urban transportation planning worldwide.

Finally, I wish to express my sincere appreciation to the concerned agencies and their personnel for their cooperation and the support they extended to the study.

December 2011

KONISHI Atsufumi
Director, Economic Infrastructure Department
Japan International Cooperation Agency

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Acronym

AF	**Africa**
AFC	**Automatic Fare Collection system**
AGT	**Automated Guideway Transit**
ATS	**Automatic Train Stop**
BRT	**Bus Rapid Transit**
CA	**Central Asia**
CBD	**central business district**
CCTV	**Closed-circuit Television**
CTC	**Centralized Train Control**
EA	**East Asia**
ERP	**Electronic Road Pricing**
EU	**European Union**
GDP	**Gross Domestic Product**
GRDP	**Gross Regional Domestic Product**
GRP	**Gross Regional Product**
HDI	**Human Development Index**
HOV	**High-Occupancy Vehicles**
HPI	**Human Poverty Index**
ITS	**Intelligent Transport Systems**
JICA	**Japan International Cooperation Agency**
JPY	**Japanese Yen**
JR	**Japan Railway Company**
LA	**Latin America**
LRT	**Light Rail Transit**
ME	**Middle East**
MP	**Master Plan**
MRT	**Mass Rapid Transit**
NA	**North America**
NMT	**Non-Motorized Transport**
PM	**particulate matter**
PPHPD	**passengers per hour per direction**
PPP	**Public Private Partnership**
PT	**Person Trip**
SA	**South Asia**
SEA	**South East Asia**
TDM	**Transportation Demand Management**
TOD	**Transit Oriented Development**
UITP	**Union Internationale de Transports Publics**

UN	**United Nations**
USD	**United States dollar**
VMS	**variable message sign**
VND	**Vietnam Dong**
WDI	**World Development Indicators**

1. Outline of the Study

1.1 Backgrounds

JICA has supported urban transport planning activities mainly in Asian developing countries by conducting studies for master plan formulation on urban transport development and often followed them up with feasibility studies. More specifically, JICA studies examined and proposed the physical, or hardware, development of urban transport infrastructure such as railway and bus transits and road networks. At the same time, these studies contained a set of proposals about the institutional, or software, development such as traffic demand management and tariff policy (e.g. certain restrictions on motorized traffic to enter the CBD, like the high-occupancy vehicle control in the United States, the electronic road pricing system in Singapore and the 3in 1 scheme in Jakarta), urban land use planning and so on. The proposals of JICA studies have been sometimes acted upon partly financed by the Yen Credit Program or the Grant Program of Japanese Government. Or else, the respective governments of the developing countries invested in the development along the direction proposed by JICA studies, occasionally with participation of private investors and/or some external donors.

It is crucial to formulate a hardware and software development plan for a given city suitably based on the phase of the city's socio-economic development and to implement the proposed projects and policy measures in steady and purposeful steps. On occasions, however, Japanese financial and technical supports after the completion of JICA studies missed the best timing and should have been provided much earlier. It is now increasingly important to support the infrastructure development in developing countries in a comprehensive package. Furthermore, the packaged supports need to include capacity development components of organizational and institutional nature and human resource empowerment. To pursue this direction of thought and action, it is useful to review across all master plan studies conducted by JICA on urban transport development and thereby clarify the strategic approach to project formulation and implementation.

The present study project is organized by a group of interested JICA staff and outside specialists to discuss and analyze the issues involved in strategy formulation for urban transport development in the developing countries.

1.2 Purpose of the Study

The present study project aims to review the available basic information and thereby to contribute to the formulation of medium- to long-term development strategy for urban transportation in suitable accordance with phases of urban socio-economic development. Specifically, the study undertakes (i) the collection and typological analysis of basic data on urban agglomerations or cities and the review of proposed and implemented urban transport projects and (ii) the examination of hardware and software development needs in urban transport infrastructure and the related institutional capacity building vis-à-vis phases of socio-economic development and the proposal on urban transport strategy formulation.

1.3 Scope of the Study

1) Study Area

The present study covers the entire developing countries and conducts a field survey of two cities each in India, Indonesia and Vietnam. Cities selected for the present study are large cities with more than one million in population, where a railway transit system is not yet in operation or in the midst of planning its introduction.

2) Selection of Cities for the Study

The study requires a wide range of information on cities or urban agglomerations. In addition to the basic urban statistics, the information is needed on intra-city traffic situations for review, and various supportive data are necessary for the typological analysis of urban agglomerations and the evaluation of urban transport strategies in these agglomerations. In contrast to nationally aggregated data and information, however, cities in developing countries are very poorly profiled by statistical documentation. Moreover, the available data on urban transportation is often too scarce or sporadic to satisfy the needs of wide-ranged and detailed examination. In the cities where JICA once undertook traffic surveys, it is possible to know trip attributes in detail but only about the year when the surveys were conducted. In many cases, such information is long outdated. To carry out the analysis as efficiently as possible under such limitations, the present study adopts a step-wise approach to the selection of cities for review. It is thought important to clarify the nature of the output obtained at each step of selection. Table 1.1 shows the expected output per step of selection and the sources of information.

Table 1.1 Steps of Selecting Cities and Expected Outputs

<table>
<tr><th>Expected Output</th><th>Selected Cities</th><th>Source of Information</th></tr>
<tr><td>【2.1】 Global trends of urban agglomerations</td><td>398 cities (urban agglomerations) with one million or more in population</td><td>・Demographia,
・UN, World Urbanization Prospect
・World Bank, World Development Indicators 2008</td></tr>
<tr><td>【2.2】 Urban transportation and city types</td><td rowspan="2">69 cities selected for strategy formulation (cities with basic data available)
Aid recipient countries;
Cities with one million or more in population;
Cities where JICA master plan studies were conducted</td><td rowspan="3">・Same sources as above
・UITP, Millennium Cities Database for Sustainable Transport
・Reports of JICA master plan studies
・Other available sources (including relevant web sites)</td></tr>
<tr><td>【2.3】 Conditions for introducing a Mass Transit System</td></tr>
<tr><td>【3】 Review on urban transport strategies</td><td>18 cities where JICA master plan studies were conducted after 2000</td></tr>
<tr><td>【4】 Guidelines for urban transport strategy formulation (Urban transport strategy for model cities)</td><td>6 model cities with one million or more in population where rail transit is not introduced or being introduced.</td><td>・Field survey</td></tr>
</table>

(1) Cities Selected for Strategy Formulation

Step【2.2】of the table above is meant to collect detailed information on urban transportation, such as traffic demand and conditions of transport infrastructure, in addition to urban socio-economic indices. Judging by the availability of necessary data within the limited time frame for the present study[1], cities are selected from among those with

[1] In China, for example, there are as many as 72 cities with population of 1 million or more and it is obviously time-consuming, if not impossible, to collect the necessary data on all of them. Accordingly, three cities of Beijing, Guangzhou and Shanghai are selected from

population of 1 million or more, which are located in aid recipient countries and were studied by JICA for master plan formulation in the past. The national capitals are added to the selection even when their respective population is less than 1 million. Countries such as Singapore and Korea are no longer aid recipients, but two cities of Singapore and Seoul are included in the selection because their presence is informative of the relationship between the takeoff process and urban transportation. Kolkata is the only JICA-studied city in India, but three more cities (Mumbai, Hyderabad and Pune) are added to the selection. In all, 69 cities are selected to collect basic urban and transport data. The list of these cities is attached in the Appendix.

(2) Utilization of Available Sources of Information

Regarding urban statistics, the databases in the following list are utilized to the fullest possible extent.

Table 1.2 List of Urban Databases

Database	Compiler	Cities Selected for the Study[1)]	index	Year
World Urbanization Prospect 2009	UN	Global urban agglomerations with population of 750,000 or more ● 64 JICA-studied cities included	Population of urban agglomerations	Every 5 years during 1950-2025
Demographia	Wendell Cox Consultancy	Global urban agglomerations with population of 600,000 or more ● 65 JICA-studied cities included	Urban Area (population, area size, population density)	Base Year: 2010
		Global urban agglomerations with population of 2 million or more ● 52 JICA-studied cities included	Urban Area Population projections	2010, 2025, 2030
		Global urban agglomerations with population of 5 million or more ● 24 JICA-studied cities included	Metropolitan population, Core & Suburb	1965, 2000 (the latest year)
		Bangkok, Manila and Singapore only	Employment in CBD	1990
Millennium Cities Database for Sustainable Transport	UITP	100 global cities ● 23 JICA-studied cities included	Transport-related indices	1995

Note: In all, JICA conducted master plan studies on 69 cities.
Source: Study Team

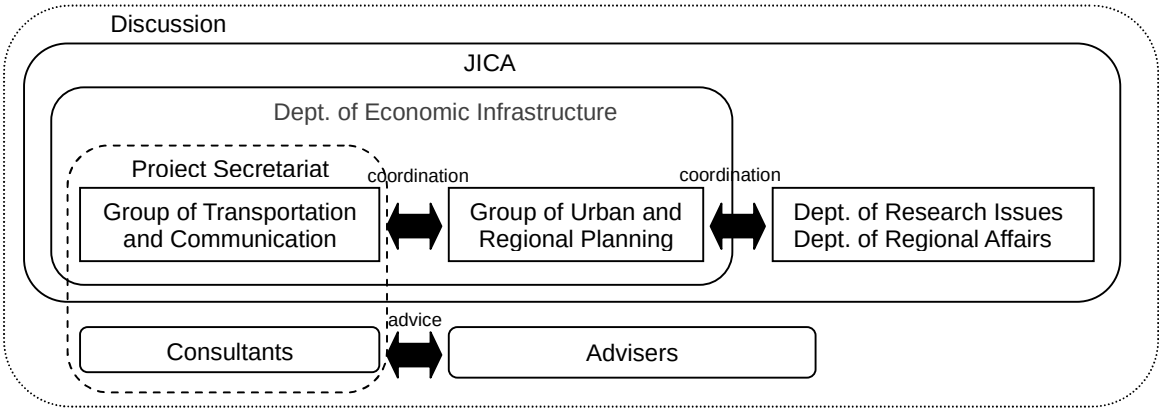
1.4 Organization for the Study

The present study is carried out through a series of discussion sessions with the backup by the Project Secretariat manned by the JICA staff and the consultants. The following two experts in the field of urban transport planning are invited to sit in the Technical Advisory Committee to give advice at appropriate points during the implementation of the study.

HYODO, Tetsuo (Dr.Eng.)	Professor of Marketing Information Engineering, Tokyo University of Marine Science and Technology
HANAOKA, Shinya (Dr.of Info. Sci.)	Associate Professor of International Development Engineering, Div. of Science and Technology, Graduate School, Tokyo Institute of Technology

China for the present study.

Figure 1.1 Organizational Setup for the Study Project



1.5 Cautionary Notes on the Study Findings

The present study deals with statistics and transport indices that pertain to individual cities. As mentioned earlier in Section 1.3, it is hardly possible to use the same database uniformly for the entire selected cities. Nationally aggregated statistics have to be used for some part of the analysis, or necessary data must be extrapolated from the available growth rates. Quite a few cities have changed radically by economic growth after the compilation of the respective databases. Therefore, it is necessary to take cautious note of such disparities when the findings of the present study are perused for some purpose.

(1) Disparity of Current Situations from Available Compiled Database

Automobile ownerships (passenger cars and freight vehicles) in China have been rapidly increasing in recent years. For example, automobile ownerships totaled 10,033 vehicles in 1995, and increased to 15,700 in 2000, 30,871 in 2005 and 61,180 in 2009, doubling every five years and in four years during 2005 – 2009 (Shinya Hanaoka, 2011).The database compiled for the year 1995 is obviously too outdated to analyze the current situations of urban transportation in Chinese cities. The analysis of urban transport conditions in individual cities must be carried out with due caution, especially regarding Chinese cities.

(2) Data Limitations

When GRP[1] estimates on individual cities (not as administrative units but as urban agglomerations, to be exact) are not available from the existing database (as required, for example, for the analysis in Section 2.3), the present study uses the UN population database on urban agglomerations and per capita GDP estimates (in constant 2000 US dollars[2]) in the World Development Indicators of the World Bank (hereafter referred to as WDI). It has been found in many cases that per capita GRPs of large urban agglomerations are worth 200% to 500% of per capita GDPs of the countries where such cities are located. The disparity between per capita GRP and per capita GDP is larger, it has been observed, in low-income countries of the developing world. Accordingly, the present study provides a wider range of interpretation to the findings of quantitative analyses.

[1] Gross regional product (GRP) is conceptually equivalent to gross domestic product (GDP); the latter measures newly created value through production by resident production units (or residents in short) in the domestic economy, while for the former measures newly created value through production by regional production units (or regional residents in short) in the regional economy, be it a state, province or a district.
[2] Dollar figures for nominal GDP converted by domestic currencies using 2000 official exchange rates.

2. Typological Analysis of Cities

This chapter analyzes the characteristics of cities and discusses the trends in urban transport problems in accordance with the typology of cities. Section 2.1 examines the global database of cities, or urban agglomerations to be exact, to clarify the relative profiles of the cities that have been studied by JICA for strategic transport master plan formulation. Section 2.2 analyzes the relationships between city types and urban traffic patterns by referring to two transport indices, namely, the share of public transit and the ratio of automobile ownerships. Sections 2.3 and 24 discuss the focal issue of any urban transport strategy, namely, the timing for starting the development and operation of a mass transit system, by analyzing urban transport problems and phases of socio-economic development in the respective cities.

2.1 Global Trends of Urban Agglomerations

1) Indices and Distribution of Urban Agglomerations

There is no universally accepted definition of “cities.” Cities can be analyzed by their demographic attributes such as population size and density, by economic profiles featuring the pre-dominance of non-agricultural activities, or by administrative characteristics as municipalities. In dynamic terms, a city embodies a collectivity of urban functions that range from basic characteristics evinced in residential and community patterns to concentrations of diverse and advanced economic and commercial undertakings. Accordingly, they serve as integrative nodes that generate and attract such diverse functions and activities. In this section, cities and their growths are examined by analyzing the following indices.

(1) Population: Indicator of the scale of a city, implying its agglomerating potentials of urban functions

(2) GDP per capita: Indicator of the agglomerated level of advanced urban functions and activities

(3) Residential Population Density: Indices showing the nature of living environments and the accessibility (proximity) to basic functions and services

(4) Growth Rate (trend and future): Indicator of the past development and the future prospects

Based on the informed judgment about general situations of the cities selected for the present study, three ranks are distinguished on each of the four indices mentioned above for typological analyses of the cities (=urban agglomerations). Due attention is paid to keep some numerical balance among city types when individual cities are classified according to the three-hold ranks of the indices.

Table 2.1 Classificatory Categories for Typological Analysis of Urban Agglomerations

Present Population (mil)		Population Growth Potential[2] (%/year)		Present Density (persons/ha)		Per Capita GDP [3] (const. 2000 US$)	
Large	>10mil	High	>2%	Overcrowded	>100	Late-development	>4,000
Medium	3-10 mil	Medium	1-2%	High	60-100	Mid-development	1,000 -4,000
Small	< 3mil	Low	<1%	Medium	<60	Early-development	<1,000

In the present study, cities are analyzed not as administrative units but as spatially continuous urban agglomerations above a certain level of population density. The word “city” is frequently used in this report for its brevity, but it means an urban agglomeration as defined above, unless otherwise specified.

According to the available database on urban population listed in Table 1.3 of Chapter 1, there are 398 cities, or urban agglomerations, with population of one million or more in the world. The trends among these cities are examined in terms of four indices mentioned above and regional distribution. Major findings can be summarized as follows. The typological analysis of the trends discernible from the indices is discussed in the next section.

- Among 398 cities, 106 are distributed in East and Southeast Asia, 61 in South and Central Asia. 26 cities have a population over 10 million, and 11 of them are found in East and Southeast Asia and 5 in South and Central Asia. Most of these mega cities are distributed in Asia.
- 112 cities have population growth potential exceeding 2% per annum. 80 of them are small cities of less than 3 million in population and 27 are medium-size cities of less than 10 million. The remaining 5 are mega cities of more than 10 million in population. The regional distribution is 33 in East and Southeast Asia, 35 in South and Central Asia and 30 in Africa. There are a total of 34 cities with population of 1 million or more in Africa, and 30 of them have the high growth potential of over 2% per annum during 2010 - 2025, suggesting explosive urbanization in the future. In contrast, all cities except one have the low population growth potential in Europe.
- 99 cities have population density exceeding 100 persons per hectare. 22 of these cities are distributed in East and Southeast Asia, 15 in Middle East and 45 in South and Central Asia. No city in Europe and North America reaches this high density level.
- Among 87 cities in the early development phase with GDP per capita of less than US$1,000 (in constant US$ of 2000), 60%, or 55 cities, are found in South and Central Asia. 80% of the cities in Africa are classified to the early development phase. In East and Southeast Asia, most of the cities are in the middle phase of development (GDP per capita of less than US$4,000).

Table 2.2 Cities of 1 Million or more in Population (398 cities)

Index	Year	Classificatiob		Total No. of Cities	Reginal Distribution[1]						
					EA& SEA	SA& CA	ME	LA	AF	EU	NA
				398	106	61	38	53	36	56	48
Present Population (mil)	2010	Large	>10mil	26	11	5	2	4	-	2	2
		Medium	3-10mil	89	23	10	7	12	12	9	16
		Small	< 3mil	283	72	46	29	37	24	45	30
Total				398	106	61	38	53	36	56	48
Population Growth Potential[2] (%/year)	2010-2025	High	> 2%	121	33	35	10	4	30	1	8
		Medium	1-2%	83	29	4	15	25	1	-	9
		Low	< 1%	61	13	-	1	6	3	23	15
合計				265	75	39	26	35	34	24	32
Present Density (person/ha)	2010	Overcrowded	> 100	99	22	45	15	10	7	-	-
		High	60 – 100	110	50	12	13	16	15	4	-
		Medium	< 60	189	34	4	10	27	14	52	48
合計				398	106	61	38	53	36	56	48
Per Capita GDP [3] (const. 2000 USD)	2008	Early-development	<1,000	87	3	55	1	1	27		
		Mid-development	<4,000	139	79	5	18	13	6	18	-
		Late-development	> 4,000	155	17	-	14	38	-	38	48
Total				381	99	60	33	52	33	56	48

Cities vary in the degree of data availability. Therefore, regional totals do not add up to the grand total of cities.

Notes: 1) EA &SEA stands for East and Southeast Asia, SA & CA for South and Central Asia, ME for Middle East, LA for Latin America, AF for Africa, EU for Europe including Russia, and NA for North America including Australia.
2) Only 265 cities are covered.
3) Only 381 cities are covered

Sources: Urban population, density and population growth from *Demographia 2010* (UN 2010); per capita GDP from *World Development Indicators* 2008 (World Bank).

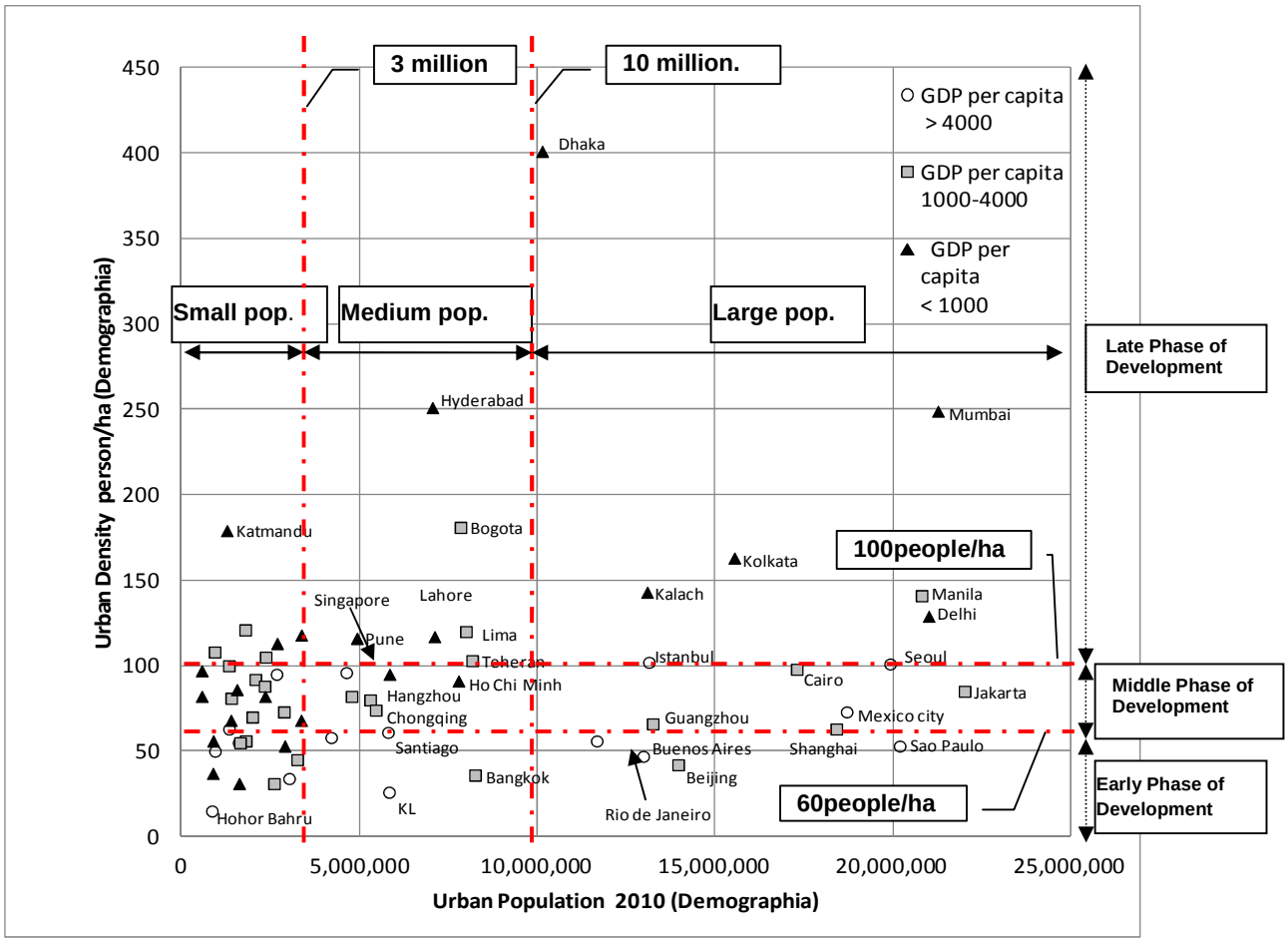
2) Urbanization Trends Relevant to Strategy Formulation

Figure 2.1 and Table 2.3 summarize the conditions of 65 cities selected for the present study for urban transport strategy formulation. The selected cities are basically those on which JICA once conducted master plan studies. The total number of cities comes to 65 after excluding a few cities that are not included in the available databases on urban agglomerations (see Table 1.2).

Many of the cities selected for the present analysis are the ones with small population (less than 3 million) and high population growth potentials (2% or more per annum) and in the middle phase of development (per capita GDP from US$1,000 to US$4,000). They are expected to continue their growth and expansion for a long time to come.

Figure 2.1 Typology of JICA-studied Cities

(Population, Density and Per Capita GDP)



Source: Demographia 2010, WDI 2008, UN 2010

Table 2.3 Situations in 65 JICA-studied Cities

Index	Unit	Year	Data Source	Classification		No. of Cities
Present Urban Population	Million	2010	*Demographia*	Large	>10mil	17
				Medium	3-10 mil	20
				Small	< 3mil	28
Population Growth Potential	%/year	2010 – 2025	*Demographia*,	High	> 2%	27
				Medium	1-2%	26
				Low	< 1%	11
Present Population Density	2010	2010	*Demographia*	Overcrowded	> 100	20
				High	60 – 100	25
				Medium	< 60	19
Per Capita GDP	Constant 2000 US$	2008	*World Development Indicators*	Early-development	<1000	17
				Mid-development	<4,000	26
				Late-development	> 4,000	21
Regional Distribution	-	-	-	East & Southeast Asia	(EA&SEA)	23
				South &Central Asia	(SA&CA)	12
				Middle East	(ME)	4
				Latin America	(LA)	18
				Africa	(AF)	6
				Europe	(EU)	2
				North America	(NA)	0

Note: 65 cities are the ones where JICA have so far conducted studies to formulate urban transport master plans, but excluding those which are not found in the Demographia database.
Sources: *Demographia 2010*, and *World Development Indicators 2008*

2.2 Urban Transportation and City Types

1) Current Urban Situations and Traffic Patterns

To ascertain the similarities of urban transport problems per city type, the available transport data are examined in relation to the ranked indices already mentioned. The results of examination are summed up in Table 2.4.

Each urban transport indicator shows strong enough correlation with socio-economic indices of cities after their per capita GDP exceeds US$10,000. It is recommendable to start city planning which aims to raise urban density when per capita GDP is in the range of US$1,000 and US$10,000. Two-wheeler cities are classifiable as the pre-motorization city type with per capita GDP of less than US$1,000.

Table 2.4 Relationships between Urban Transport and Three Indices

	(1) Density and Public Transit Share	(2) Density and Car Ownerships	(3) Car Ownerships and Public Transit Share	(4) Public Transit Share and Per Capita GDP
(A) 100 Global Cities[1]	・Higher public transit share found in higher-density cities ・Correlation is weak (R^2＝0.24), but becomes strong when per capita GDP exceeds US$10,000	・Lower ratios of car ownerships found in higher-density cities ・Correlation is moderate (R^2＝0.54), but becomes strong when per capita GDP exceeds US$10,000	・Higher ratios of car ownerships associated with lower public transit share ・Correlation is weak (R^2＝0.38), but becomes strong when per capita GDP exceeds US$10,000	・Lower public transit share associated with higher per capita GDP ・Correlation is weak (R^2＝0.16)
(i) Pop. Size	・No variation in correlation by population size		・Correlation gets stronger among cities of large pop. (R^2＝0.56)	
(ii) Per Capita GDP	・Stronger correlation among high-income cities ・Weaker correlation among medium- and low-income cities	・The ratio of car ownerships becomes higher among high-income cities ・Correlation is very weak among medium- and low-income cities	・Correlation becomes stronger among high-income countries ・Correlation is weak among medium- and low-income cities	・Correlation becomes stronger among high-income cities
(iii) Region	・North American and European cities are respectively found concentrated in a certain narrow range ・No discernible correlation among cities in Southeast Asia, Middle East and Latin America	・North American and European cities are respectively found concentrated in a certain narrow range ・No discernible correlation among cities in Southeast Asia, Middle East and Latin America	・North American and European cities are respectively found concentrated in a certain narrow range ・No discernible correlation among cities in Southeast Asia, Middle East and Latin America	
(B) 57 Strategy -studied Cities[2]	・General correlation is absent ・Low density and large public transit share in Africa ・Large public transit share irrespective of density level in Latin America ・Large public transit share correlated with high density in Asian cities with 5 million or more population	・Higher ratios of car ownerships found in low-density cities ・Low ratios of car ownerships irrespective of density level in Africa and Latin America	・Inverse correlation found in many cities except those in Asia Some cities in Asia have a low ratio of car ownerships and a low public transit share（e.g. Beijing, Guangzhou, Hanoi, Ho Chi Minh, Phnom Penh, Vientiane, etc. See remarks on two-wheeler cities below）	・No discernible tendency of association between high income and low public transit share ・Cities of East & Southeast Asia deviate greatly from the general tendency of correlation ・No discernible correlation of income level and public transit share in Latin American cities ・Heavy dependence on walk in cities of Central & South Asia and Africa. When trips on foot are excluded, public transit has a large modal share.
(C)Two-wheeler Cities[3]		・Low density and low ratio of car ownerships	・Low car ownerships and low public transit share	

Notes: 1) Regional distribution is as follows: 15 cities in East & Southeast Asia, 3 in Central & South Asia, 10 in Latin America, 6 in Middle East, 20 in North America and Australia, 5 in Africa and 41 in Europe. The database pertains to 100 cities as of 1995.
2) Data on 57 cities are obtained from the reports of JICA master plan studies. The years of JICA studies are various. For more details, see (2) of Section 2.2 in Chapter 2.
3) Cities where the two-wheeler mode has the largest share in the total traffic volume. For more details, see 4) of Section 2.2 in Chapter 2.
Sources: UITP, *Millennium Cities Database for Sustainable Transport*, 2010, and various reports of JICA master plan studies.

Figure 2.2 Urban Density and Modal Share of Public Transit (100 Cities in 1995)

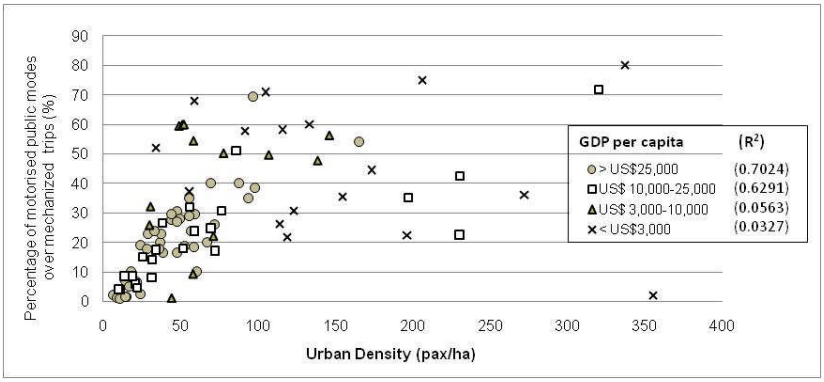


Figure 2.3 Urban Density and Passenger Car Ownerships (100 Cities in 1995)

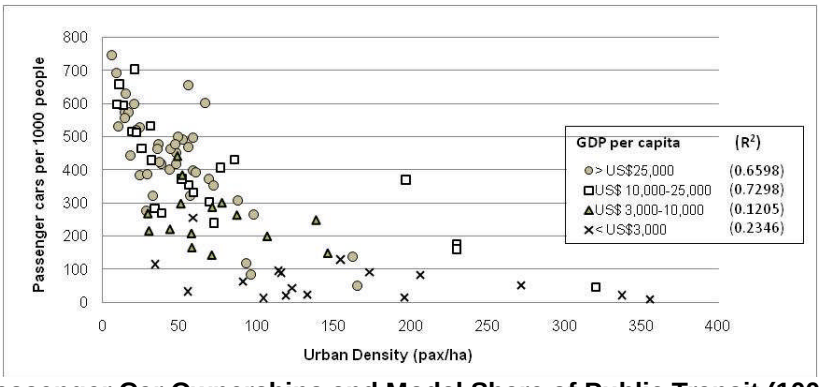


Figure 2.4 Passenger Car Ownerships and Modal Share of Public Transit (100 Cities in 1995)

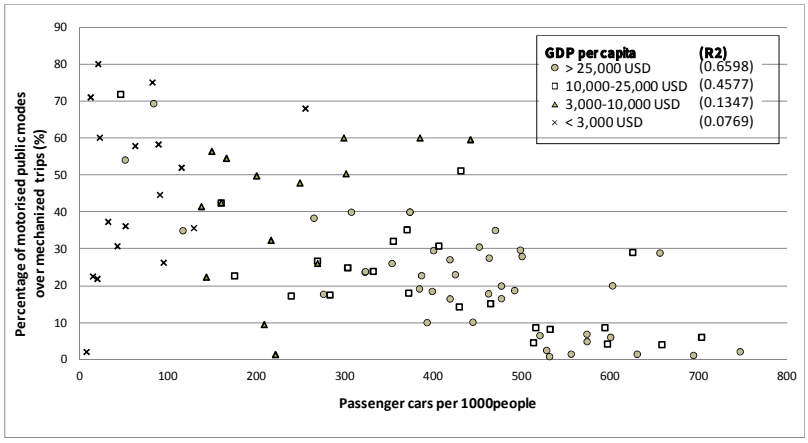
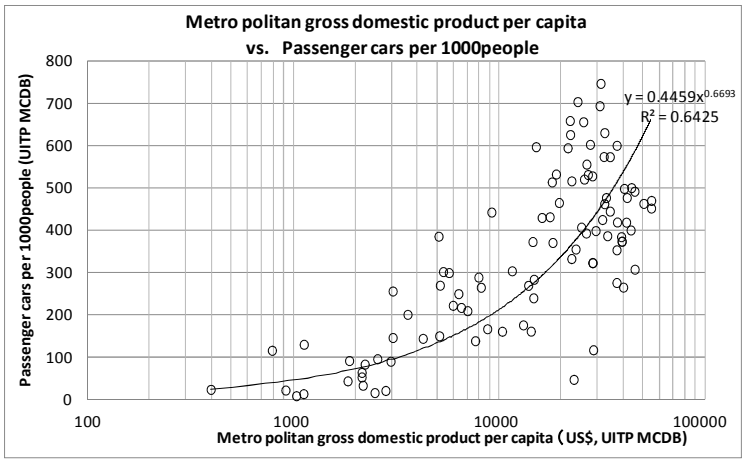


Figure 2.5 Per Capita GDP and Passenger Car Ownerships (100 Cities in 1995)



2.3 Conditions for Introducing a Mass Transit System

It is now generally acknowledged regarding large cities in the world that it would be no longer possible to continue servicing the growing motorized traffic by constructing more and more roads. It is no exaggeration to say that the most fundamental issue shared by global urban policymakers is how to facilitate a shift in transport demand from the private use of passenger cars to public transport means.

In order to improve the level of services in punctuality and speed for public transit, it is necessary to develop Mass Rapid Transit System (MRT), such as Metro[1] or BRT[2] (Bus Rapid transit), corresponding to the growing traffic demand. The city must have the financial capability for MRT development. As the urban GDP is growing, the financial capability of the city is also enlarging. Therefore, the following clause analyzes timing for Metro and/or BRT operation in the social and economical developmental process of the city.

1) Development Phase of Urban Economy and Metro and/or BRT Operation

(1) Analysis of the Timing for Metro Operation

Figure 2.6 is prepared to show how the development phases of the cities are related to the timing to start operating their metro systems in East and Southeast Asia.[3] The trends of urban population (data from UN Population Dept.) and GDP per capita of every 5 years during the period of 1960 -2010 (constant 2000 US$, taken from World Bank's World Development Indicators) are plotted in the figure. The time when each metro system was opened for operation is marked by a circle. Two parallel lines in red signify the same levels of urban GDP among the cities. Urban GDP of a given city in this context is obtained as the product of the city's population and GDP per capita. The solid red line (the start line or S-line) means the urban GDP level of US$3 billion, and the dotted line (the end line or E-line) shows the level of US$30 billion. The time to start the metro operation in the respective cities mostly falls between two Urban GDP lines.[4]

(2) Time to Start BRT Operation

The year when the BRT system started operation in each city is marked by a blue circle in the graph in which are plotted the trends of urban population (from the UN database on urban agglomerations) during the period of 1960 – 2010 and per capita GDP (from WDI, in constant 2000 US dollars) of every 5 years over the same period. Figure 2.7 pertains to the cities in East and Southeast Asia only.[5] Two parallel lines in blue show the range of per

[1] A metro system is defined as an urban electric passenger transport system with high capacity and high frequency of services, which is totally independent from other traffic, road or pedestrian. The terms heavy rail (mainly in North America) and heavy urban rail often have similar definitions.

[2] The term BRT is applied to a variety of public transportation systems using buses to provide faster, more efficient service than conventional bus services. Often this is achieved by making improvements to existing infrastructure, vehicles and scheduling. The goal of BRT system is to achieve the service quality comparable to rail transits, while taking advantage of the low cost and the flexibility of bus transit.

[3] For other regions, see Figure 2.22 in Chapter 2, Main Report.

[4] The urban GDP of a city is calculated by multiplying the city's population (from UN population database) by GDP per capita (from WDI in constant 2000 USD), because the actual GRP of the city is not available on most of the cities. By the informed judgment over various data sources, GRP per capita in large cities could be worth 300% of GDP per capita in the developing world. It is reasonably arguable that the GRP range of US$9-90 billion makes the opening of a metro system economically possible and its operation sustainable.

[5] For other regions, see Figure 2.24 in Chapter 2, Main Report.

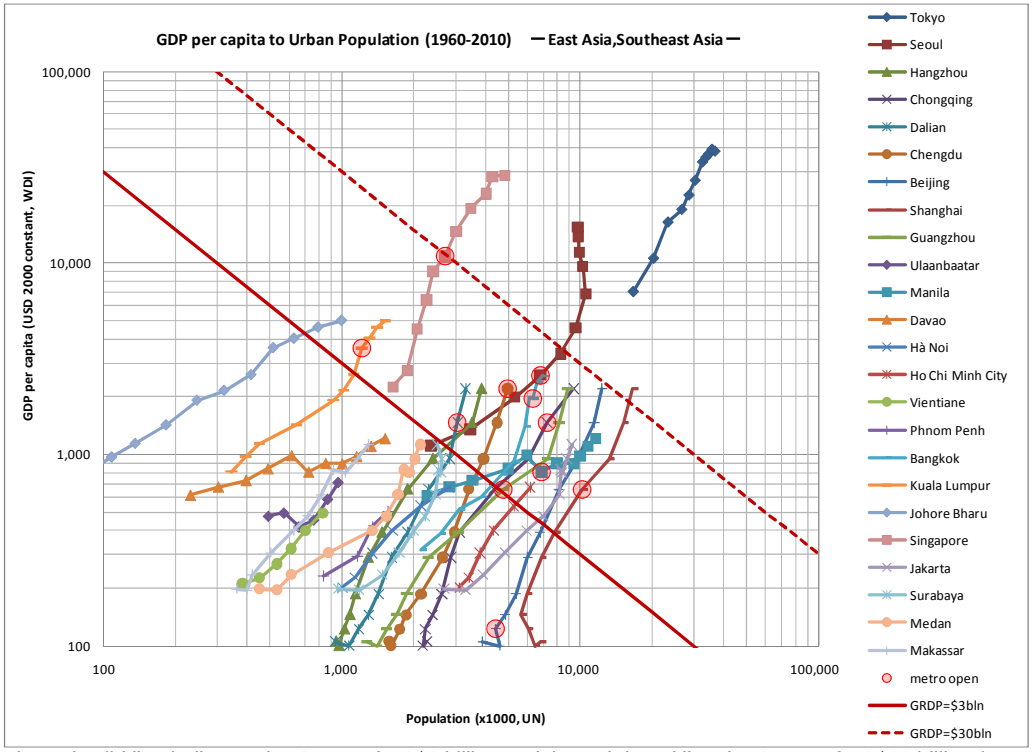
capita GDP between US$700 and US$3,000. Most of the cities in the region started their respective BRT operation within the range.

The relationship between the development phase and the time of starting a BRT system is analyzed by using the cities which now operate BRT systems. The population size of the cities and per capita GDP are plotted in Figure 2.7.

As seen in the figure, no clear picture emerges in the plotting. Beginning from the world's first subways of London opened in 1863, metro systems have the history spanning some 150 years, much longer than BRT operation. The first BRT system was opened in Curitiba, Brazil, in 1972, but its importance as a viable alternative of public transit was widely acknowledged only recently in the 2000s. This might be one of the reasons why the analysis falls short of offering a clear picture of the timing of BRT operation.

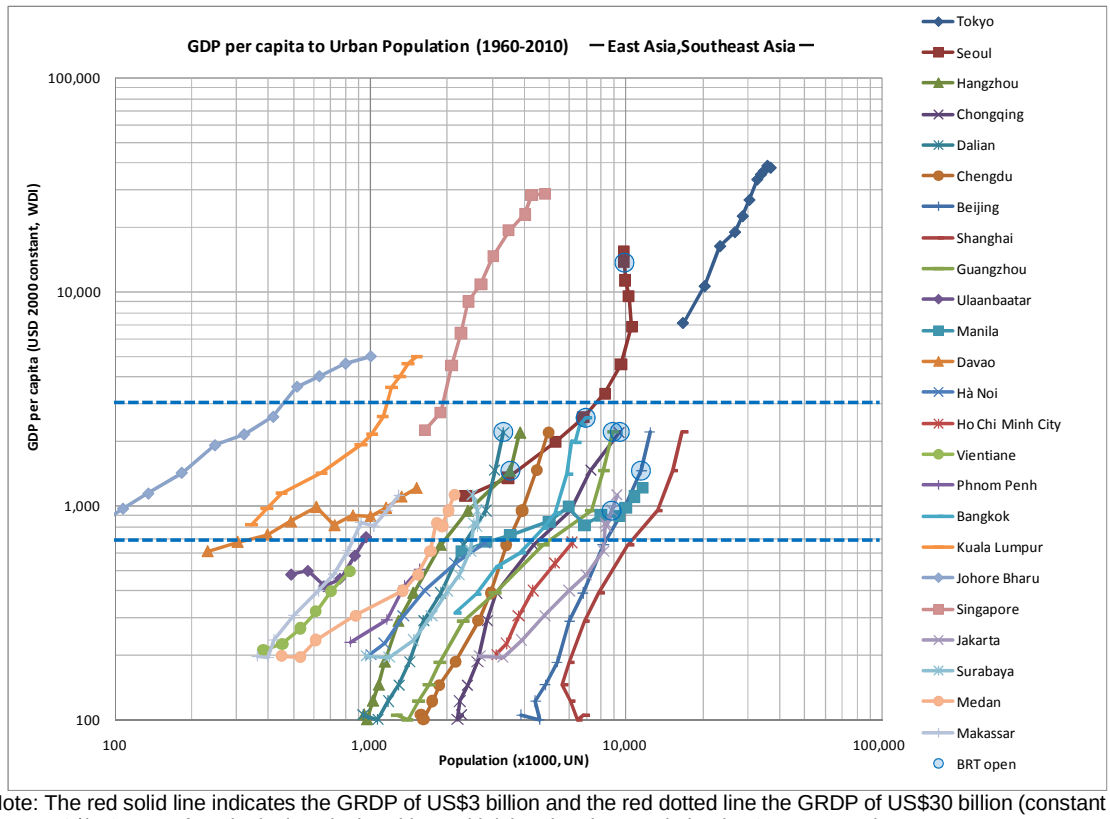
The cost of developing a BRT system is one-tenth of the capital outlay needed for a metro system. The initial investment requirement is not as prohibitive as a subway system. Therefore, cities facing severe congestion problems by rapid motorization begin to consider the alternative of introducing a BRT system. Excluding the cities which have both metro and BRT systems, the timing for BRT introduction roughly corresponds to the range of US$700 – 3,000 in per capita GDP. After per capita GDP exceeds US$1,000, economic growth accelerates and an increased proportion of the population purchases durable consumer goods like household electric appliances and automobiles. The diffusion of these goods is reported to be especially rapid when economic growth achieves the per capita GDP range of US$1,000 – 3,000. In other words, the BRT system functions as focal urban mass transit in an urban economy about to take off with full-scale motorization imminent.

Figure 2.6 Metro Operation Relative to GDP per capita and Urban Population Size (East Asia & South East Asia)



Note: The red solid line indicates the GRDP of US$3 billion and the red dotted line the GRDP of US$30 billion (constant 2000 US$). GRDP of each city is calculated by multiplying the city population by GDP per capita

Figure 2.7 Per Capita GDP and Urban Population at the Time of BRT Introduction (East Asia & South East Asia)



Note: The red solid line indicates the GRDP of US$3 billion and the red dotted line the GRDP of US$30 billion (constant 2000 US$). GRDP of each city is calculated by multiplying the city population by GDP per capita

2) Estimating Future Prospects for Starting Metro or BRT Operation

Table 2.5 and 2.6 summarizes the present situations and the estimated prospects of metro-system or BRT system development in the JICA-studied cities. The development of a metro system takes long time to complete the project cycle of planning, design, construction and operation. For example, when a city is expected to reach the stage of operating a metro system by 2025, the lead time requires starting initial preparations now.

Table 2.5 Strategic Timing for Introducing a Metro System

Region	City with Metro System as of 2010	City without Metro System as of 2010		
		City Ready for Metro System as of 2010	City Ready for Metro System by 2025	City not Ready for Metro System before 2025
East Asia Southeast Asia	・Seoul ・Chongqing ・Dalian ・Chengdu ・Beijing ・Shanghai ・Guangzhou ・Manila ・Bangkok ・Kuala Lumpur ・Singapore	・Hangzhou ・Ho Chi Minh City (under construction) ・Johore Bharu ・Jakarta (under construction)	・Davao[1)] ・Hà Noi (under construction) ・Surabaya ・Medan	・Ulaanbaatar ・Vientiane ・Phnom Penh ・Makassar
South Asia Central Asia	・Kolkata/Calcutta ・Delhi ・Baku	・Dhaka ・Mumbai /Bombay ・Hyderabad ・Pune/Poona ・Lahore ・Karachi	―	・Kathmandu
Middle East	・Tehran ・Cairo	・Baghdad ・Damascus	―	―
Central and South America	・Mexico City ・Caracas ・Lima ・Santiago ・São Paulo ・Rio de Janeiro ・Buenos Aires	・Guadalajara ・Panama City ・Barranquilla ・Bogotá ・Guayaquil ・Belém ・Curitiba	・Cartagena ・Asunción	・Guatemala City ・Managua
Africa	―	―	・Nairobi (2020)[2)] ・Dar es Salaam (2025)[2)]	・Kampala ・Lusaka ・Lilongwe
Europe	・Istanbul ・Bucharest	―	―	―

Notes: 1) Shaded cities do not have GRDP estimates in the available publications. Their GRDPs are estimated by the present study team from the recent growth rates of the respective per capita GDP and city population. These cities are not included in Figure 2.10 on 100 global cities
2) Forecast from the available GRDP estimates.
3) Colombo, Kabul, Juba, Monrovia and Bujumbura are excluded from the table, because either their respective population or per capita GDP is not available.

Sources: Demographia and the estimation by the study team on the basis of available sources

Table 2.6 Strategic Timing for Starting BRT Operation

	City with BRT System	City without BRT System		
		City Ready for BRT System as of 2010	City Ready for BRT System by 2025	City not Ready for BRT System before 2025
City without Mass Rapid Transit (MRT)				
East Asia Southeast Asia	・Hangzhou ・Jakarta	・Ulaanbaatar ・Davao ・Johore Bharu ・Surabaya (planning) ・Medan (planning) ・Makassar	・Hà Noi[1)] (planning) ・Ho Chi Minh City ・Vientiane ・Phnom Penh	―
South Asia Central Asia	・Mumbai (Bombay) ・Pune (Poona)	・Hyderabad (under construction) ・Baku	・Dhaka (2010)[2)] ・Lahore (2015)[2)] ・Karachi (2015)[2)]	・Kathmandu
Middle East		・Baghdad ・Damascus	―	―
Central and South America	・Guatemala City ・Barranquilla ・Bogotá ・Guayaquil ・Curitiba	・Guadalajara ・Managua ・Panama City ・Cartagena (under construction) ・Belém ・Asunción	―	―
Africa	―	―	―	・Kampala ・Nairobi ・Lusaka ・Dar es Salaam ・Lilongwe

Notes: 1) Shaded cities do not have GRDP estimates in the available publications. Their GRDPs are estimated by the present study team from the recent growth rates of the respective per capita GDP and city population. These cities are not included in Figure 2.10 on 100 global cities.
2) Forecast from the available GRDP estimates.
3) Colombo, Kabul, Juba, Monrovia and Bujumbura are excluded from the table, because either their respective population or per capita GDP is not available.

Sources: Demographia and the estimation by the study team

3. Review on Urban Transport Strategy

This chapter reviews urban transport strategies in the selected cities on the basis of the JICA master plan studies conducted since 2000. The review examines the urban transport problems in the JICA-studied cities and the projects and measures proposed in the respective master plans to cope with such problems. Section 3.1 defines what is meant by urban transport strategy and Section 3.2 discusses the significance of the strategy in urban transport development and ascertains important components of the master plans proposed in the JICA studies. Section 3.3 clarifies salient characteristics of urban transport problems and discusses the relationships between such characteristics and the respective development phases of the cities under study.

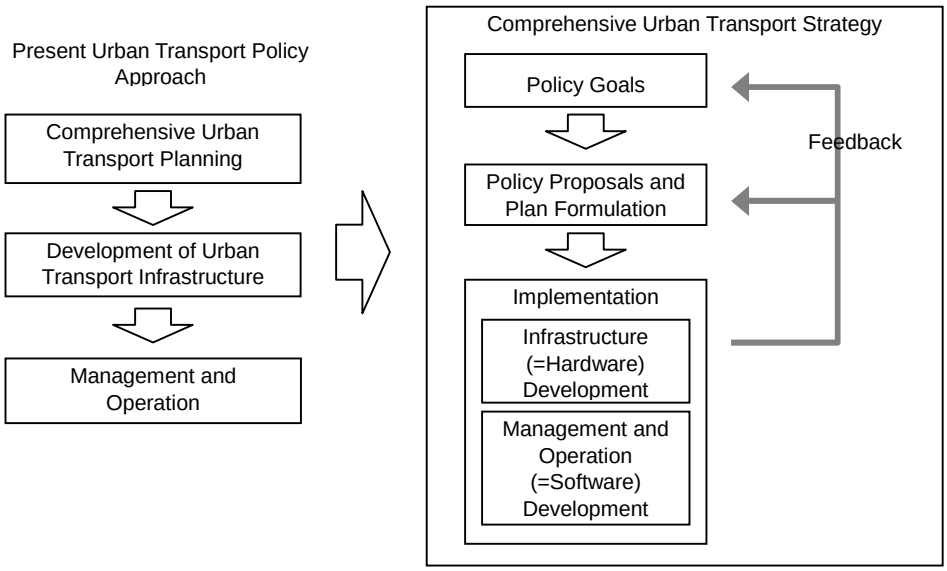
3.1 Definition of Urban Transport Strategy

Prior to the review on urban transport strategy, urban transport starategy should be clearly defined. According to the Council on the Development of Social Capital, Ministry of National Land and Transport, a comprehensive urban transport strategy is defined as follows.

> …in addition to formulating an urban transport development plan, (a strategy) explicitly announces a set of policy goals, proposes a number of policy measures and a program of specific projects that are identified to achieve such goals and indicates the procedure to implement, operate and manage the proposed measures and projects……

In other words, a strategy comprises a set of long-term policy objectives, or an actionable vision of some 20 years ahead and a set of policy measures that are feasible during the coming 5 to 10 years. Importantly, it also includes a description of how to implement and manage the proposals.

Figure 3.1 Present Transport Policy Approach and Proposed Comprehensive Strategy



Source: The Subcommittee on Urban Transport and Built-up Area Development, the Committee on Urban Planning, the Division of Urban Planning and Historic Heritage, the Council for Social Capital Development, 2007.

3.2 Review on Urban Transport Strategy

The present study discusses large cities in developing countries that possess their respective transport strategies as formulated in the proposed master plans. The subjects of the present review are those cities on which JICA conducted master plan studies since 2000.

1) Compilation of Database from JICA Master Plan Studies

Urban statistical information (population, economic indicators, traffic volume and pattern, etc.), major issues troubling urban transportation and major proposals (projects and policy instrumentation) are compiled in compact format by using the data on 18 cities where the JICA master plan studies have been conducted. The said database is compiled from the JICA master plan studies conducted since 2000 on 18 cities (Table 3.1). The data items are listed in Table 3.2. For more details, the Appendix A of the main report contains the data sheets on the JICA-studied cities.

Table 3.1 18 JICA-studied Cities for Database Compilation

	City	Country	Population(000)	JICA M/P year
1	Chenngdu	China	4,785	2001
2	Ulaanbaatar	Mongolia	885	2009
3	Jakarta	Indonesia	22,000	1987,1990,2001,2004
4	Bangkok	Thailand	8,250	1979,1988,1990
5	Manila	Philippines	20,795	1972,1973,1985,1999
6	Hanoi	Vietnam	2,355	1997,2007,
7	Ho Chi Minh	Vietnam	7,785	2004
8	Phnom Penh	Cambodia	1,560	2001
9	Dhaka	Bangladesh	10,135	2010
10	Colombo	Sri Lanka	2,080	1984,2006
11	Baku	Azerbaijan	1,650	2002
12	Damascus	Syria	2,370	1999,2008
13	Bogota	Colombia	7,845	1996
14	Lima	Peru	7,995	2005
15	Nairobi	Kenya	3,365	2006
16	Lusaka	Zanbia	1,395	2009
17	Istanbul	Turkey	13,135	2009
18	Bucuresti	Romania	1,995	2000

Table 3.2 Data Items for Compilation

large category	middle category
Urban Indicator	・City Information(Population, Population Growth Rate, Population Density, etc) ・Economy(GRDP, GRDP Structure) ・Social Development (HDI,HPI) ・Urban Development(Greenery Ration, Land use, etc), ・Urban Environment(CO2 emission, etc) ・Transportation Master plan, Traffic Demand(Modalshare, etc) ・Vehicle Ownership ・Public Transport Demand & Supply(Urban Railway, Freight Railway, Bus, Para-tra, etc) ・Road Infrastructure(Road Network, etc) ・Traffic Management ・Traffic Accident/Safety, Financing, Traffic Condition
Issues & Projects	・Current Problems on Urban Transport ・Current Conditions and Problems of Each Sector（Urban Structure/Land use, Road Infrastructure, Public transportation, Traffic Management for Road Traffic, Traffic Demand Management, Traffic Safety, Environment, Social Environment, Institutions） ・Transportation planning and propsed projects
MP Investment	・Master Plan Investment Composition

2) Review on Urban Transport Strategy

The relative significance of a transport strategy in a master plan and the composition of each master plan vary from one city to another. For example, JICA master plan studies on comprehensive city development deal with urban transport as one of the sectoral issues. Their primary emphasis is usually placed on how to integrate the transport program into the comprehensive picture of urban development. Some master plan studies propose a strategy that specifically focuses on the transport sector or specific transport projects.

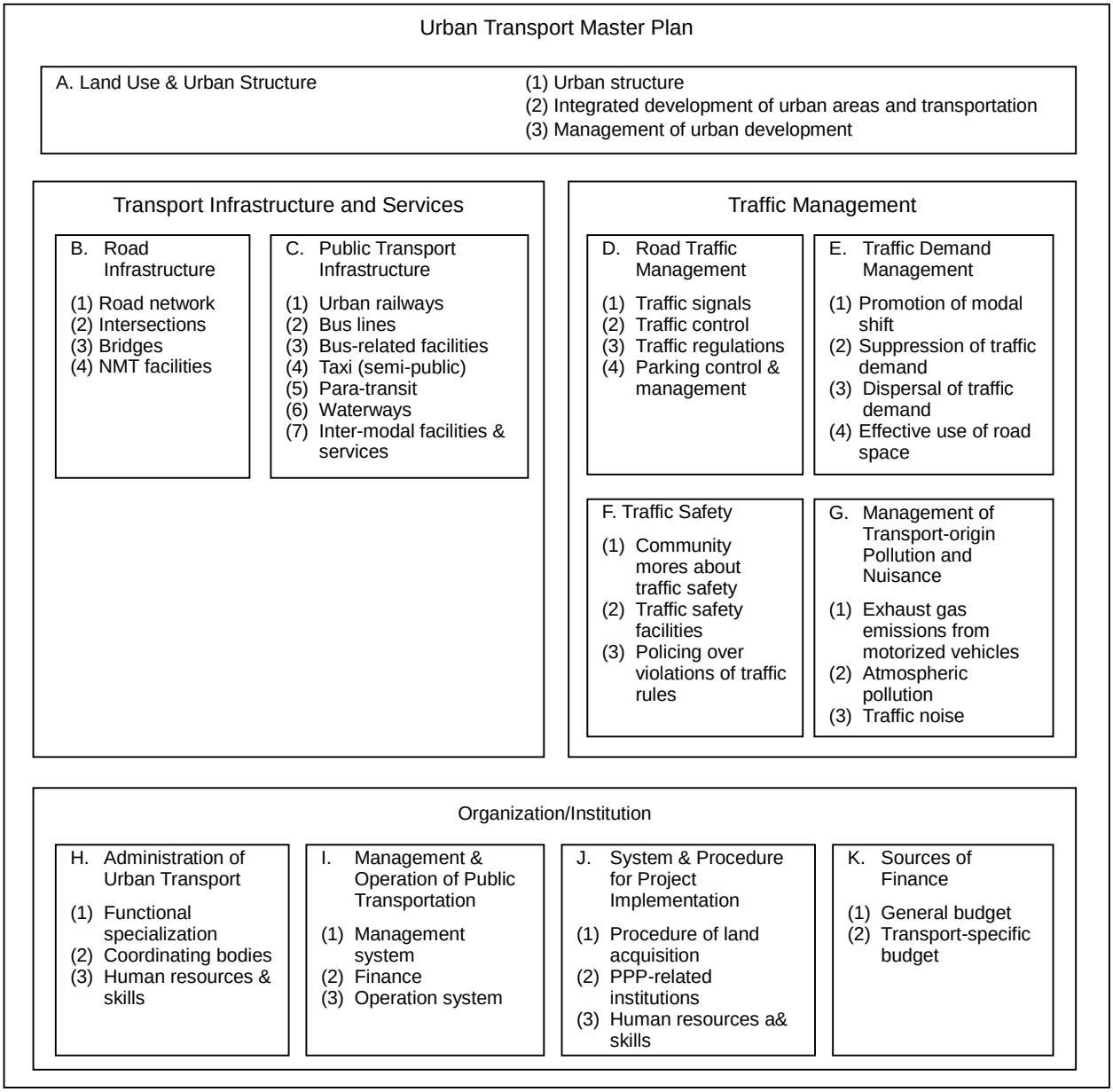
Although the emphasis and the composition vary, most of the formulated master plans make the presentation of the vision, the objective (challenge), the strategy (planning policy or concept) and the specific action (program or project). If “Comprehensive Urban Transport Strategy” in Figure 3.1 is analogous to a master plan, a strategy corresponds to “Policy Proposals and Plan Formulation” in the figure. In other words, a strategy is needed to achieve an objective and a program of projects need be proposed to put the strategy into action (Figure 3.2).The components of the proposed urban transport strategy, it must be admitted, vary a great deal in substance and level of importance from one master plan to another. A considerable number of master plans fail to bridge between upper-level objectives and proposed specific actions. In such a master plan, a strategy is formulated supposedly in reference to the announced policy objectives but the list of development projects (both physical and institutional proposals) are not necessarily linked to what is stated in the strategy.

3.3 Urban Transport Projects Proposed in the Master Plans

In the JICA studies, individual projects are identified in accordance with the framework of an urban transport strategy. Details of the project lists differ among the JICA-studied cities but the master plans consist of the sectors and the projects as shown in Figure 3.2.

In recent years, promising projects identified in the JICA master plan studies were more and more often proposed as urgent projects in such a way to be suitable for immediate application to the Yen Credit Program or for the participation of private investors. Some master plan studies propose infrastructure development programs to suit the implementation by some PPP scheme. However, it is generally observed in the developing countries that the related laws and regulations and the administrative capacity and capability are not adequately developed and that such deficiencies tend to impede the smooth implementation of the proposed programs. Therefore, it is essential, more than ever, to examine and propose the details of institutional and organizational development requirements in the master plans.

Figure 3.2 Master Plan Components



3.4 Classification of Urban Transport Problems

The compiled database is useful to clarify the salient aspects of urban transport problems in relation to the typology of cities.

On the whole, urban transportation is accompanied by traffic congestions and accidents and other problems affecting user convenience and accessibility. Specific sets of problems might vary from one city to another, but salient manifestations of urban transport problems can be summed up in relation to the city types (Table 3.3).

Table 3.3 Classified Urban Transport Problems in JICA-studied Cities (1/2)

Primary Classification	Classification	Urban Transport Problems
(A) Traffic Congestion	Absence of efficiency in the provision and operation of transportation: Examples: congestions on public transport means during morning and evening rush hours; motorized traffic congestions in the central built-up areas.	In terms of population size, traffic congestions are found in limited locations in many cities of less than 3 million in population. Along with demographic growth, congestions become increasingly extensive. In cities of more than 10 million, chronic congestions are usually found over the entire city area. In terms of economic development, congestions of the cities in the early phase of development are attributable to the shortage and the inadequacy of basic transport infrastructure, such as underdeveloped arterials, presence of missing links in the network and absence of properly paved road surfaces. At the same time, some problems are found in most of the cities under study, regardless of their respective population size and development phase. They concern road traffic management: namely, inappropriate posting or absence of traffic signals and absence of left- or right-turn lanes.
(B) Inconvenience	Inadequate accessibility and poor usability: Examples: bad access to transfer stations; station buildings full of bumps and barriers; low service levels	Along with the growth of urban economy, the urbanized area expands outward and commuters have to travel ever-extending distance on every weekday. The development of necessary road infrastructure falls behind the pace of such urban sprawl. Urban public transport during the early development phase is mainly provided by bus services, but bus lines are often inadequately laid down to meet the needs of users and/or the bus fleet is insufficient relative to the demand. Meanwhile, the issue of transfer between different transport modes is yet to emerge because the available means of travel are very limited in the cities in the early development phase. During the middle and the late phase of economic development, however, many cities come to offer BRT and/or railway transit services and the inadequacy of transfer between them jeopardizes the convenience of public transport to city dwellers. In addition, as urban population grows, the existing capacities of bus terminals and inter-modal facilities fail to handle a massive flow of passengers.
(C) Decline of Traffic Safety	Poor user safety: Examples: frequent traffic accidents; poor public peace on trains and buses and other means of travel	During the early phase of economic development, the issue of traffic safety mostly exists in various inadequacies of basic road infrastructure, such as absence of surface pavement and pedestrian sidewalks Urban economic growth spurs the increase of motorized traffic, resulting in the increase of fatal traffic accidents. Some problems persist regardless of development phase: namely, ill-mannered driving, drunken driving and speeding.

Table 3.3 Classified Urban Transport Problems in JICA-studied Cities (2/2)

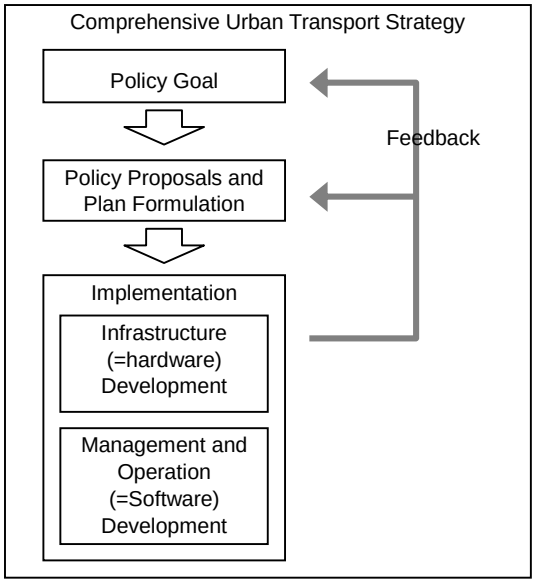
Primary Classification	Classification	Urban Transport Problems
(D) Pollution and Nuisance	Reduced sustainability of cities: Examples: air pollution by exhaust emissions of automobiles; noises and vibrations caused by motorized traffic; landscape damages and sunlight obstructions by elevated transport structures	Along with the growth of urban economy, rapidly increased motorized traffic and the continued use of outdated motor vehicles become major sources of atmospheric deterioration.
(E) Social Injustice and Inequality	Biased accessibility and unfair victimization Examples: rampant corruption and injustice; increase of the transportation-poor among city population; increase of those more liable to suffer transportation-caused pollution and nuisance as well as traffic accidents	The cities under study show, regardless of their respective development phase and population size, that urban low income classes are heavily dependent on non-motorized transport and lack the access to affordable transport means. The absolute number of the elderly and the handicapped would rise along with population growth, calling attention to the poor provision of barrier-free transport infrastructure and passenger- and pedestrian-friendly facilities.

4. Guidelines for Urban Transport Strategy Formulation

This chapter discusses two components to be included in the guidelines for formulating urban transport strategy, namely, how to diagnose transport problems and identify effective prescriptions to solve them and how to choose a most suitable transit mode from the available investment alternatives. In addition to devising the methods to clarify the said two issues in the strategy formulation, the present study would apply the methods in the case study of cities.

As discussed in Section 3.1 of Chapter 3, an urban transport strategy has to be formulated with a long-term policy goal or vision over two decades to come. In addition to a number of strategic policy proposals to achieve the long-term goal, a set of feasible projects and measures must be proposed for implementation during the coming five to ten years, accompanied by operation and management requirements.

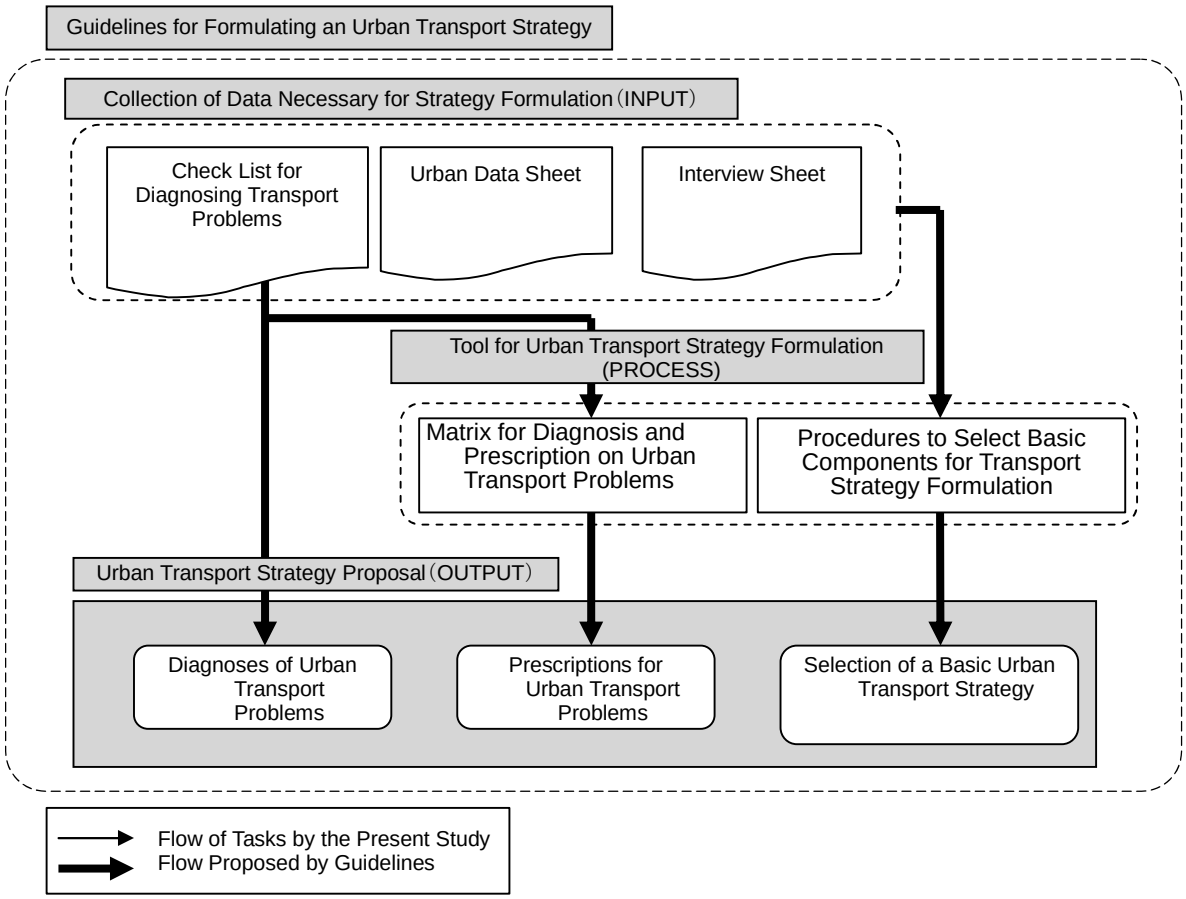
Figure 4.1 Proposed Approach to Comprehensive Urban Transport Strategy



Note: Partly replicated from Figure 3.1 of Chapter 3

Two different approaches are necessary for strategy formulation. One approach seeks best possible ways to solve or alleviate the immediate transport problems that vex the day-to-day life of city dwellers, and might be called “the individual issue approach.” The other selects a public transport mode which is to play the central role in urban transportation in the medium- to long-term perspective. This might be called “the basic strategy approach.” The last step is to decide what to do on the basis of the conclusions from two approaches, or to identify “the actions to put into effect.” The flow of the procedure is shown in Figure 4.2.

Figure 4.2 Composition of Guidelines for Formulating an Urban Transport Strategy Proposal



4.1 Collection of Data for Strategy Formulation

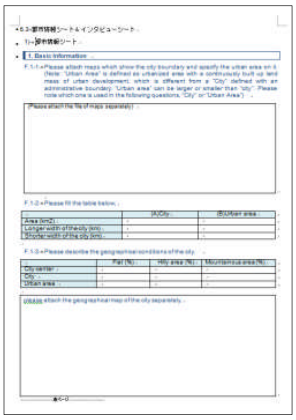
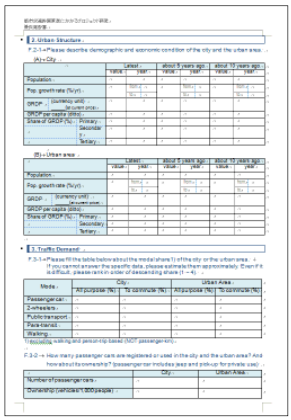
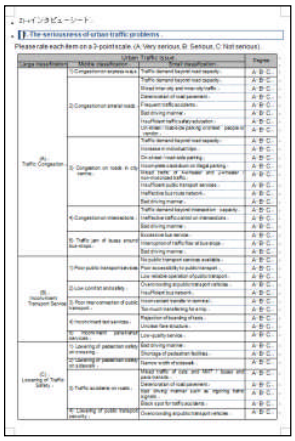
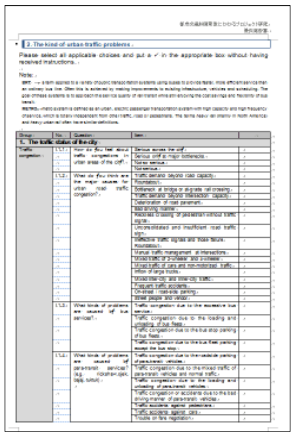
Data must be collected as required by the urban data sheet, the check list for diagnosing urban transport conditions and the interview sheet, all of which are necessary inputs to the tools devised for formulating an urban transport strategy.

1) How to Compile Necessary Information

Formulation of an urban transport strategy needs a broad range of information, such as socio-economic indicators needed to classify city types, the volume and modal patterns of transport demand, the extent and intensity of traffic problems and causes thereof, and the availability of effective measures to solve or alleviate such problems. The necessary information is grouped into two categories: namely, objective data like socio-economic indicators and characteristics of traffic demand and subjective data consisting of informed judgments about the intensity and causes of problems and effective alternatives available for solving the problems. The methods to collect information naturally differ by category of data. To collect subjective types of information, two data sheets are devised: namely, the check sheet for diagnosing and understanding urban transport conditions and the interview sheet for collecting detailed information needed to choose basic elements for formulating urban transport strategy proposals.

Two sheets are not prepared with a particular city in mind and accordingly might contain some data items that do not suit the conditions of a given city or require additional items for another city.

Table 4.1 Data Sheets and Procedure for Data Collection

Data Sheet	Procedure	Sheet Image
Urban Data Sheet	・ Collect information via transport consultants who have access to available sources of transport statistics	 
Check List for Diagnosis on Urban Transport Conditions	・ Because the list is simplified, collection of data can be made not only from experts and government officials but also from ordinary citizens. ・ It is desirable to gather information from as many samples as possible so as to avoid undue effects of idiosyncratic opinions on the statistical significance of the collected data.	
Interview Sheet	・ Interviews are conducted with a number of experts (10 to 15) who are knowledgeable in urban transport problems and policy measures. ・ Pre-interviews need be carried out prior to final interviews so as to finalize the questions for interviewees.	

4.2 Diagnosis of Urban Traffic Problems

Regarding the individual issue approach to transport problems that exasperate daily lives of city dwellers, it is essential to grasp the seriousness of the respective problems before proposing measures to solve or alleviate them. The diagnosis for a given city is to identify what are the specific problems that vex the city and how serious they are perceived by the citizens. The check list is used to obtain answers from selected samples and individual urban transport problems are diagnosed by aggregating the questionnaire results.

1) Diagnoses of Urban Traffic Problems

The diagnosis of an urban traffic problem is to observe the incidents of the problem and rate the extent of seriousness thereof. This can be done by checking the items in the tertiary classification level of urban transport problems as listed in Table 4.2.

The rating of the listed tertiary classifications is done according to the following scales of seriousness and urgency. After the rating on tertiary classifications, the results are added up respectively for the secondary and the primary classification levels. If all tertiary items of a given primary classification are rated very serious, for example, the points added up for the primary classification (the number of tertiary items multiplied by 3 points) would be the maximum possible. For each primary classification level, the ratio of the rated points to the maximum is calculated for the radar chart presentation. If all tertiary items are rated as very serious (3 points), the ratio would be 100, and if rated not serious (0 point), the ratio would be zero.

Rating of Seriousness and Urgency:	Rating Scale
A: Very serious / Immediate actions needed	(3 points)
B: Serious / Actions needed	(2 points)
C: Not serious	(0 point)

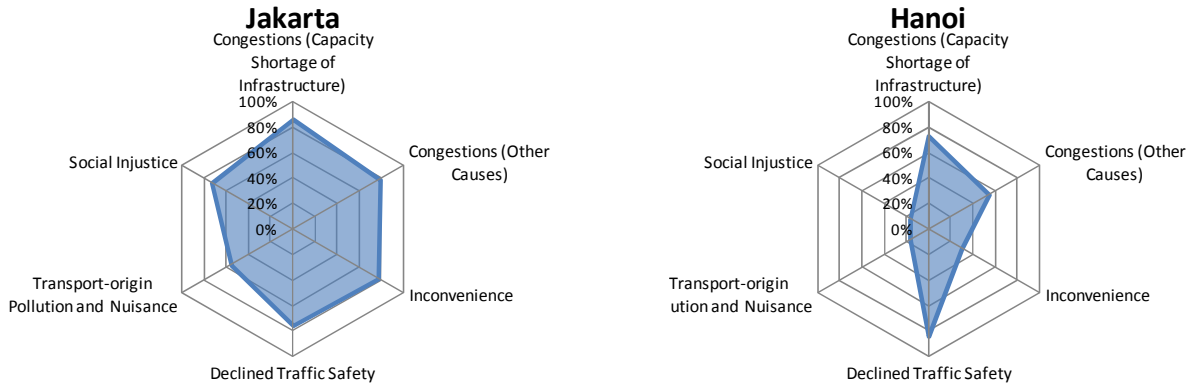
2) Examples of Rating Application

The rating scales are applied to Jakarta and Ha Noi where the respective JICA master plan study has been underway including traffic surveys. The participants in the respective study are asked to rate the urban transport problems in two cities. The results are shown in Table 4.2.

Table 4.2 Diagnoses of Urban Transport Problems in Jakarta and Ha Noi

Transport Problems	No. of Tertiary Items	Maximum Points	Jakarta		Ha Noi	
			Points	Ratio to Maximum	Points	Ratio to Maximum
Congestions (Capacity Shortage of Infrastructure)	5	15	13	87 %	11	73 %
Congestions (Other Causes)	17	51	40	78 %	28	55 %
Inconvenience	10	30	23	77 %	9	30 %
Declined Traffic Safety	8	24	18	75 %	20	83 %
Transport-origin Pollution and Nuisance	6	18	10	56 %	3	17 %
Social Injustice	10	30	22	73 %	5	17 %
Total	56	168	126	75 %	76	45 %

Figure 4.3 Diagnoses of Urban Transport Problems in Jakarta and Ha Noi



4.3 Prescriptions for Urban Transport Problems

Necessary prescriptions (countermeasures and development projects) are listed up in the matrix format vis-a-vis the diagnostic ratings of urban transport problems. The prepared matrix format can be used to identify how to deal with problems and issues of urban transportation in individual cities.

1) Prescribed Measures for Transport Problems: Relative Importance of Subsectors

On each matrix component (=cell), the members of the study team judge whether or not the measure indicated in the column is effective to solve the problem in the row and thereby eliminate the irrelevant components from the matrix. The remaining components are then rated by assigning 1 to 3 points to three levels of their effectiveness as shown below.

3 points: The measure contributes decisively to the solution of the problem and its effect lasts a long time.

2 points: The measure either contributes decisively to the solution of the problem or its effect lasts a long time.

1 point: The measure to some degree contributes to the solution of the problem, but its effect is not necessarily long-lasting.

2) Examples of Application

On the basis of the diagnoses shown in Table 4.2, prescribed measures are rated for Jakarta and Ha Noi where, as mentioned earlier, the respective JICA master plan study has been underway including traffic surveys. Prescribed measures are rated per category of transport problems and the assigned points are added up to see the relative importance of subsectors (Tables 4.3). The results are shown in radar charts (Figures 4.4).

In the rating, development and improvement of infrastructure is more important than traffic management in Jakarta. Road and railway infrastructure show comparable importance in the infrastructure subsector. In contrast, traffic management is more important than infrastructure development in Ha Noi. In the infrastructure subsector, road development is more important than railway and bus transit development. In the traffic management subsector in Ha Noi, higher priority is traffic safety. This seems to reflect the overwhelming predominance of private two-wheelers (motorbikes) in the intra-city traffic.

Table 4.3 Relative Importance of Prescribed Measures: Jakarta and Ha Noi

Development Strategy (Prescribed Measures for Transport Problems)		Judged Points				Relative Importance			
		Jakarta		Ha Noi		Jakarta		Ha Noi	
Primary Classification	Secondary Classification	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
Land Use / Urban Structure		23	23	14	14	96 %	96 %	58 %	58 %
Infrastructure	Road Infrastructure	264	136	142	97	85 %	89 %	46 %	63 %
	Public Transport Infrastructure		128		45		82 %		29 %
Traffic Management	Road Traffic Management	227	72	178	58	80 %	75 %	62 %	60 %
	Traffic Demand Management		87		58		94 %		62 %
	Traffic Safety		68		62		71 %		65 %
Organization / Institution	Transport Planning and Administration	111	36	81	30	76 %	75 %	55 %	63 %
	Transit Management and Operation		17		9		63 %		33 %
	Institutions for project and program Implementation		23		13		77 %		43 %
	Finance		35		29		83 %		69 %
Total		625	521	415	287	82 %	68 %	54 %	38 %

Figure 4.4 Relative Importance of Prescribed Measures: Jakarta and Ha Noi

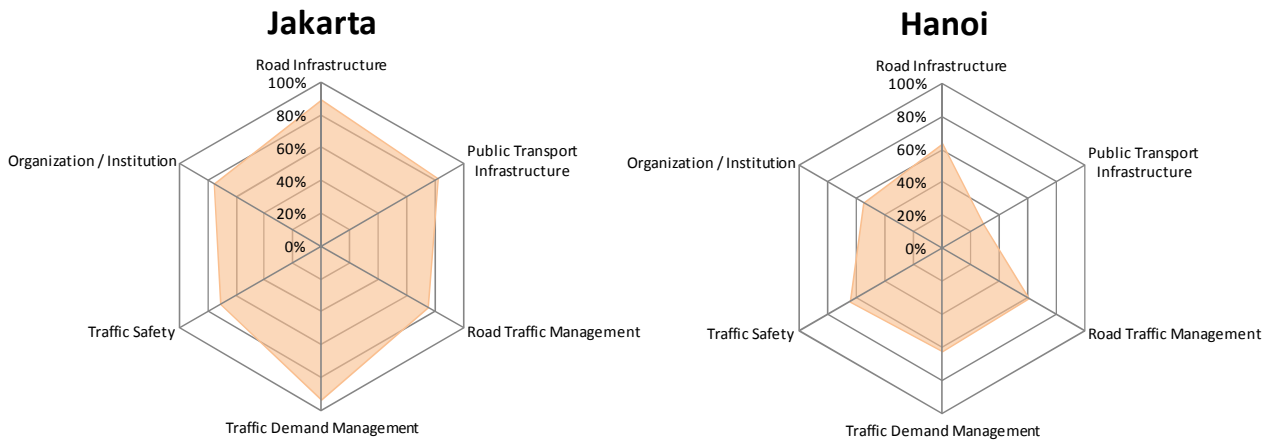


Table 4.4 Matrix Preparation for Diagnoses and Prescriptions

Urban Transport Problems		Prescribed Measures for Transport	Land Use / Urban St	Infrastructure																Traffic Management													Organization / Institution										
				Road Infrastructure									Transit Infrastructure							Road Traffic Management						Traffic Demand Management				Traffic Safety			Transport Planning and Administration			Management and Operation of Transit Systems			Institutions for Project and Program Implementation			Shortage of Finance	
Primary Classification	Secondary Classification	Tertiary Classification	・Compact multi-core urban structure	・Construction of urban highways and arterial roads	・Construction of missing links in the network	・Establishment of grade-separated network	・Development of feeder roads and local roads	・Strengthening of road maintenance system (improvement of pavement)	・Grade separation at major intersections	・Improved designs for intersections at grade with traffic	・Removal of roundabouts	・Construction and widening of bridges	・Construction and improvement of urban railways	・Restructuring of bus network	・Construction and improvement of bus stops	・Construction and improvement of bus terminals	・Diversification and replacement of vehicles	・Modernization of bus services	・Integrated separation of bus, minibus and para-transit services	・Installation of traffic signals	・Improvement of signal control (green phases for left- and right-turn	・Introduction of zone traffic control	・Efficiency improvement of traffic control	・Development of roadside and off-road parking space	・Strict policing on illegal parking	・Suppression on ownership and use of private automobiles	・Facilitation of modal shift	・Transit-oriented development policy	・Demand dispersing measures	・Public education on traffic safety	・Construction and improvement of traffic safety facilities	・Strengthening of policing on traffic rule violations	・Clear definitions of administrative jurisdiction between related	・Establishment of an administrative coordinating body for urban	・Capacity development of personnel	・Efficiency improvement of management systems (licensing and	・Establishment of fiscal independence and abolition of subsidies	・Modernization of operating systems	・Improvement of the procedure for land acquisition or appropriation	・Development of PPP schemes	・Capacity development of personnel	・Increase of revenue sources	・Creation of transport-specific revenue sources
(A) Traffic Congestions	1) Congestions on urban highways	Shortage of road capacity＊	2	3	2	1	2	1	1			2														2	2	1	1				1		1					2	1	1	2
	2) Congestions on single-lane sections of arterial motorways	Shortage of road capacity＊	3	3	3	2	2	1	2	1	1	2	1	1						1	1	1	1	1	1	2	2	1	1	1		1	1	1	1						1	2	2
		Mingling of intra-city and inter-city traffic	1	1	1	2	1	1	1											1	1	1																					
		Poor road surface pavement＊					1	3	1	1		1																					1		1							1	1
		Abandoned cars after accidents and																1	1					1																				
		Ill-mannered driving																					1								1												
		Inadequate public education on traffic																													1		1										
		Roadside parking and vending stalls																														1	1										
	3) Congestions on roads in the CBD	Excessive traffic demand	2	1																						2	1	1	1														
		Increase of private traffic volume																								2	2	1															
		Roadside parking＊																						3	2	1	1	1				1											
		Negligent policing over illegal parking																							3	1																	
		Mingling of automobiles, two-wheelers																					1							1													
		Shortage of public transit services											3	2	1	1	1	1	1									1							1	1							
		Inefficient bus network												3	1	1	1	1	1									1							1	1							
		Ill-mannered driving																												1		2			1								
	4) Congestions at intersections	Shortage of capacity＊							2	1	1																																
		Inefficient traffic control at intersections																		2	1	1	1																				
		Ill-mannered driving																												1		2			1								
	5) Congestions of bus traffic and at bus stops	Excessive bus services																1	1																						1		
		Obstruction of through traffic by parked													2																	1											
		Ill-mannered driving																												1		2			1								
(B) Inconvenience in Transportation	1) Low passenger convenience of public transit	Absence of affordable public transit												1					1																								
		Poor access to public transit services												1					1																								
		Unpredictability of travel time												1		1		1																									
	2) Low passenger comfort and safety	High occupancy ratio on public transit																1																									
		Inefficient bus network												1				1																									
	3) Inconvenience to transfer passengers	Inconvenience of transfer at transport													1	1																											
		Too frequent transfers												1																													
	4) Low user convenience of taxi services	Dishonest taxi drivers wilfully refusing																	1													1											
		Poor transparency of taxi fare																	1																			1					
	5) Low user convenience of para-	Lowered service level due to															1	1																1	1		1					
(C) Declined Traffic Safety	1) Lowered pedestrian safety (crosswalks)	Ill-mannered driving																												1		2			1								
		Shortage of pedestrian facilities																																									
	2) Lowered pedestrian safety	Capacity shortage of sidewalks					1																		1																		
	3) Traffic accidents on motorways	Mixed traffic of automobiles and NMT																					1																				
		Poor road surface pavement					1																																			1	
		Traffic signal violations and ill-																												1		1											
		Presence of locations prone to cause																												1	1												
	4) Declined law and order on	High occupancy ratio of public transit															1	1																									
(D) Transport-originating Air Pollution and Nuisance	1) Atmospheric pollution by exhaust gases	Entry of trucks to the CBD																					1									1											
		Increase of private automobiles											1					1								1	1																
	2) Noises and vibrations caused by motorized traffic	Increase of night traffic																					1									1											
		Increase of ill-maintained vehicles																					1																				
		Poor road surface pavement						1																																		1	
	3) Landscape and sunlight	Damages by the construction of																																							1		
(E) Social Injustice	1) Presence of the transportation-poor	Presence of areas not serviced by												1					1																								
		Presence of disaster-prone areas																					1								1												
		Low mobility of pedestrians and NMT															1		1																								
		Shortage of barrier-free facilities																													1										1	
		Gender-related disparity in mobility																	1									1															
	2) Adverse impact on local	Inadequate relocation compensation																																					1			1	
	3) Deficient compensation system	Absence of insurance policies																												1								1					
	4) Negligent policing on violations	Police corruption																					1																		1		
	5) Disadvantage of fare scales	Biased subsidization																																				1			1	1	
		Inappropriate fare scales for the poor																																		1		1			1		

4.4 Choices on Basic Components of Urban Transport Strategy

Large cities in the development countries selected for the present study are mostly in the early phase of motorization. This implies that automobile ownerships and use will increase at accelerating speed from now on and accordingly that the problem of traffic congestions will quickly go from bad to worse or even from worse to the worst ever. It is expected that the road network will extend its reach to catch up with ever-expanding urban sprawl spurred by the new town development in the suburbs and the construction of outer ring roads, among others.

It is now generally acknowledged regarding mega cities in the world that it would be no longer possible to continue catching up with the pace of motorization by constructing more and more roads to maintain a favorable service standard for motorized traffic. It is no exaggeration to say that the most fundamental issue shared by global urban policymakers is how to facilitate a shift in traffic demand from the private use of passenger cars to some public transit systems. However, in many large cities of the developing world, such modal shift is a vain issue because transit systems are either not available, or not up to the standard to take on the shift of passengers from private automobiles.

It is, therefore, urgently necessary for the respective cities in the developing world to construct and operate a transit system. Basic questions that must be addressed to in formulating an urban transport strategy for a given city is to decide on the type of public transits suited to the city. Concurrently, it is necessary to select and put into effect a set of traffic management measures which will help achieve efficient and effective utilization of the proposed transit system. The study team prepared a number of flow charts to show the procedures for selecting a transit alternative and applicable TDM measures. This section explains how to use the flow charts in application.

1) Public Transport Modes and Their Characteristics

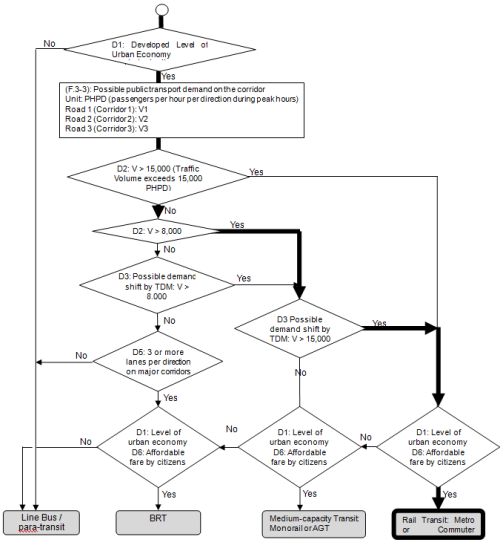
Before trying out the procedures for making strategic judgments concerning the selection of a suitable public transport mode, salient characteristics of several public transport modes are briefly summarized in Table 4.5.

Table 4.5 General Specifications of Public Transport Modes

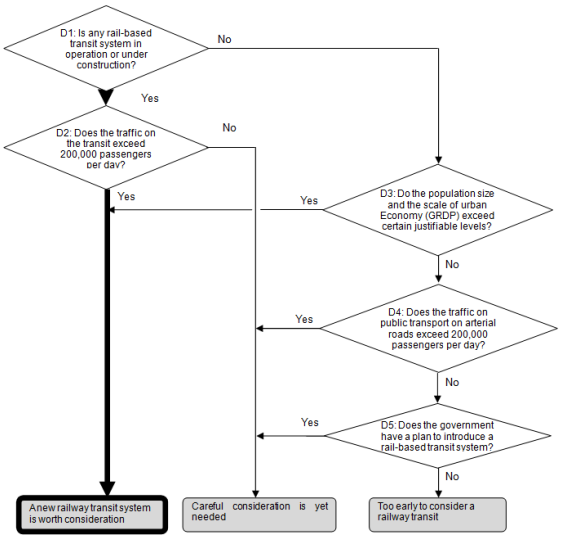
	Metro (MRT)	LRT	Existing Railways	Monorail and AGT	BRT	Conventional Bus
Exclusiveness	- Operated on exclusive rails - Grade separation from other transport modes	- Operated mainly on exclusive rails - Sometimes mixed with other traffic	- Commuter trains mixed with Inter-city long distance trains	- Operated on exclusive rails or guideways - Grade separation from other transport modes	- Use exclusive lanes - Occasionally share certain sections of roads with other motorized vehicles	- Mixed with other motorized traffic
Interval between stations / bus stops km	1.5	0.8-1.5	3-15	0.8-1.5	0.4-1.0	0.2-0.4
Vehicles	Electric trains	- Electric motor cars - Articulated cars - Low-floor cars	Electric trains Rolling stock	- Electric motorcars	Conventional bus, articulated bus, low-floor bus, high-floor bus (to fit the high platform), diesel bus and hybrid bus	Conventional bus, articulated bus, low-floor bus, diesel bus and hybrid bus
Number of seating	50-80 per car	65-85 per car	60-90 per car	30-75 per car	- 40 per standard bus - 65-85 per articulated bus	- 40 per standard bus - 65 per articulated bus
Average Speed (km/hr)	25-55	20-30	40-60	25-40	15-35	15-35
Transport Capacity (PPHPD)	～60,000	～30,000	～30,000	～15,000	～8,000	～6,000
Minimum Radius Maximum Gradient	50m 8% (Linear Metro) 160m 3%	20m 8%	300m 3%	100m 6%		
Investment (US$ million /km)	60-100 (under ground) 30-50 (viaduct)	30-50	10-20	30-50	6-13	-

2) Case Study

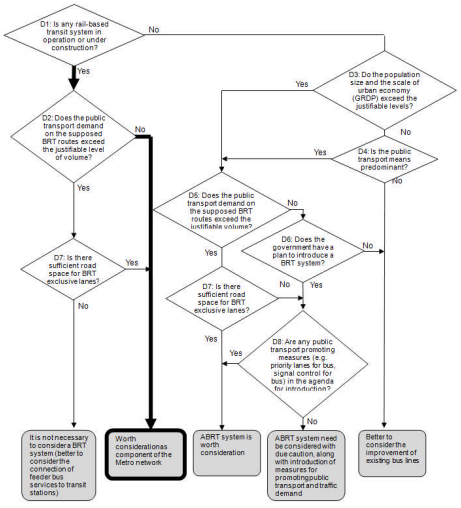
Judgments about Suitable Public Transport Mode



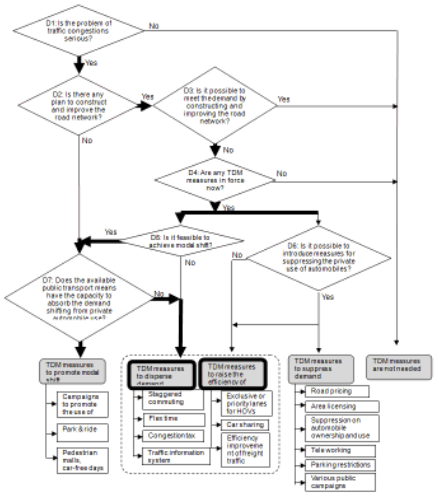
Judgments about Railway Transit



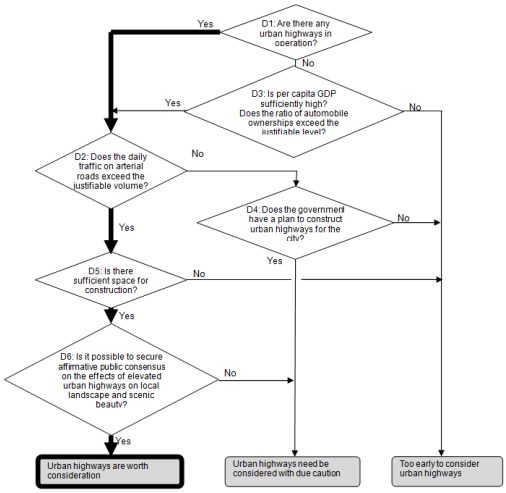
Judgments about BRT System



Judgments about TDM Measures



Judgments about Urban Highways



3) Verification of Guidelines for Formulating Urban Transport Strategy

The procedures discussed in the foregoing section are collectively called guidelines from here on. As mentioned earlier, the present study selected six cities or two cities each from India, Vietnam and Indonesia and collected information on current transport conditions, policies and programs. The collected data includes the types of data needed for the suggested procedures to make strategic judgments about urban transport development. The present study made a case study of six cities by using the collected data as inputs to the flow charts. The results of the case study are compared to the actual master plan strategies of six cities to verify the practical validity of the suggested guidelines.

Table 4.6 compares the strategic judgments according to the guidelines and the proposals in the respective transport master plans in six cities. Regarding the procedures (I), (II), (III) and (V), the results of the case study agree with the proposals of the master plans in most of six cities. The suggested procedures are judged wholly practicable to identify feasible prospects of urban transport development.

Regarding the procedure (IV), however, the agreement is rather weak. Part of the reason is that the feasibility of introducing a certain selection of TDM measures is liable to be affected by complex combinations in a given city of such factors as the degree of public awareness, income levels of city dwellers and the capacity of available alternative modes of travel.

The suggested guidelines do not claim to suggest specific locations for the strategic decisions they help to make. Judgments are based on the aggregate transport conditions taken as a whole concerning a given city. Take, for example, the traffic volume data collected on three transport corridors regarding six cities. It is possible to go on to the examination of investment prospects along these corridors, but one has to keep in mind that these corridors do not necessarily represent the true development axes in these cities.

Table 4.6 Comparison of Flow Chart Judgments and Master Plan Proposals

Country / City	Vietnam		India		Indonesia	
	Ha Noi	Ho Chi Minh	Hyderabad	Pune	Jakarta	Surabaya
(I) Judgment on a basic public transport mode	transport corridor is different	□	□	□	□	□
(II) Judgment on a railway transit	□	□	□	□	□	□
(III) Judgment on a BRT system	□	□	△	□	×	□
(IV) Judgment on feasible TDM measures	△	△	―	△	△	―
(V) Judgment on urban highways	×	□	―	―	□	×

Note: □ not much different from the master plan proposal; △ different in some part; × no congruity with MP;
― not possible to judge

4.5 How to Utilize the Proposed Guidelines

1) Application to JICA Technical Cooperation Program

Once the matrix methodology of diagnosis and prescription on urban transport problems and the procedures for making medium- to long-term strategic decisions are devised and verified reasonably practicable, the next step would be to ask how the devised guidelines could be put to best possible use, or what could be achieved now by the application of the guidelines. This section argues from the viewpoint of donors a logical extension that the guidelines could point to the possible courses for technical cooperation.

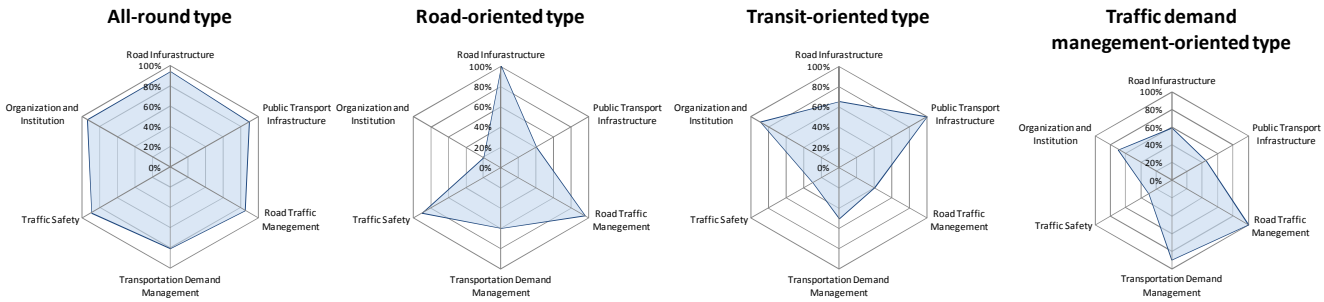
For a city of all-round type, it would be most suitable to conduct a master plan study that covers the entire subsectors. If such a master plan study has been undertaken for the said city in the recent past, it would be necessary to follow up the progress of the program proposed by the study. And if some delays should be found, it would be necessary to take some actions, e.g. updating the program components and scheduling, to expedite the progress of implementation. In such a case, it would be necessary as well to add alternative financing sources in the updated program, by proposing organizational and institutional development such as some scheme for private sector participation or application of some user-pay principle.

Cities of the other types would need subsector-specific studies for plan formulation. A city of road-oriented type, for example, would require a plan that covers not only physical road infrastructure but proposes appropriate projects and measures for road traffic management and safety along with the construction and improvement of roads.

If the application of the guidelines to a city of transit-oriented type indicates some justifiable degree of feasibility on a metro or BRT system, it might be better to conduct a full-scale feasibility study without going through subsector-wide plan formulation. In a similar vein, if the introduction of urban highways is justifiably indicated for a city of road-oriented type, it would be reasonable to conduct a feasibility study with due consideration of a PPP scheme for private sector participation.

There are few successful cases of full-scale traffic management in the cities of developing countries. Partly because of this, practically no subsector study of TDM orientation has been undertaken so far. However, it would be reasonably justified to formulate a TDM plan which would propose a selection of measures for inducing traffic demand towards the anticipated operation of a BRT or metro system.

Figure 4.5 Radar Patterns of Relative Subsectoral Importance of Transport Development



2) Useful Application in Other Types of JICA Projects

(1) Urgent Issues and Long-term Strategy

To recapitulate, the matrix format of diagnosis and prescription is explained and applied in Section 4.3 and the flow chart procedures for strategic judgments are described and applied in Section 4.4. The matrix and the flow chart methods are both developed out of the analyses in Chapters 2 and 3 and two of the important outputs of the present study. The matrix method is applied to manifested urban problems in a given city and helps ascertain the relative importance of the respectively prescribed measures.

The flow chart method is applied to identify a basic public transport mode for a given city. In other words, it deals with key issues in any long-term strategy for urban transport development: viz. how to select a most suitable alternative from the costly large-scale projects like a railway transit, a BRT system and/or urban highways and how to decide on a selection of TDM measures best suited or most acceptable to the conditions in a given city. The combined application of two methods will help identify urgent issues and see through the future course of medium- to long-term strategic issues.

(2) Quick Processing of Transport-related Requests from Developing Countries

With the aid of the guidelines, it is possible to judge quickly whether or not to accept the official requests for a study project on urban transport development.

(3) Checklist for Preliminary Studies

Preliminary studies not only on urban transportation but also on any other sectors and subsectors must collect many relevant data and information within a short time limit. The urban data sheet and the interview sheet prepared by the present study could be used as a manual for collecting data and interviewing experts. Moreover, the matrix method is useable as a checklist for collecting data on urban transport conditions.

(4) Application of the Guidelines in Master Plan Studies

The analytical findings and the devised methods of the present study could be usefully consulted during the early stage of a JICA master plan study on urban transport. The review of sixty some JICA master plan studies conducted in the past would give insightful hints to a team about to embark on a similar study on urban transportation.

(5) Guidelines as Materials for Training

JICA has a sizable training program for capacity development in diverse fields. The matrix method and the flow chart method could be used as exercise materials for group seminars on urban transportation issues or for the counterpart training during the implementation of a JICA urban transport study project. When the two methods are applied in exercise to the actual city the trainees live or know at first hand, the outcome of training would be substantial in impact.

3) Next Steps

The present study has developed three tools to deal with urban transport development: namely, the tool to diagnose problems and subsectoral priorities, the tool to prescribe appropriate measures to solve or alleviate the problems, and lastly the tool to select a most strategically suitable alternative for transport development. The tools are simple and

compact in design to provide quickly whatever answers they are meant to provide, but there is no denying that the logic employed in the process of devising these tools is sometimes too crude to stand up to well-intentioned scrutiny. It will be necessary to improve their designs and raise their practicability. The following efforts will be needed for future improvements.

(1) Diagnosis

Individual urban transport problems are rated to three ranks of “very serious”, “serious” and “not serious.” However, the present study failed to provide a clear definition of what constitutes the seriousness or the lack thereof. The individual transport problems themselves are heavily dependent on the subjective judgment on what is “problematic.” To introduce the element of objectivity into such judgments, there are possibly two courses to take as shown below.

- It is possible to define three ranks in quantitative terms for certain types of transport problems.
- Each individual problem is broke down to 5 to 10 descriptions of its concrete manifestations, and the rating into one of three ranks is done by counting the number of descriptions judged serious.

(2) Prescription

The elements (= cells in the matrix) of prescriptions as per problems are rated for their respective effectiveness by taking into consideration the possible size of investment requirements and the possible size of passengers who are either affected by or benefit from a given prescription, but it must be admitted that the large part of the rating is philosophical. It might be necessary to accumulate case studies to improve the rating towards a more tangible approach.

It would be useful to determine the average unit cost for each prescribed project or measure. Then, the total cost of a project or measure prescribed for a given city can be obtained by an input of the required scale of investment.

(3) Strategic Judgment

The flow charts for making strategic judgments are extremely simplified. Inadequacies will become immediately apparent when they are applied to a real city. Paths for judgment will have to be increased in the flow charts to ensure more general applicability.

The tools devised by the present study, however simple and compact both in design and original intention, must be continuously modified by feeding back the inadequacies found during the repeated application trials, just like all-purpose computer programs or any types of manuals.

Appendix

Table1 Cities selected for strategy formulation (1/2)

	City	Country	Population(000), 2010[1)]	JICA M/P year
	Asia			
1	Hangzhou	China	5,305	1994
2	Chongqing	China	5,460	1994
3	Dalian	China	3,255	1996
4	Chengdu	China	4,785	2001
5	Ulaanbaatar	Mongolia	885	2009
6	Jakarta	Indonesia	22,000	1987, 1990, 2004
7	Surabaya	Indonesia	2,885	1983, 1997
8	Medan	Indonesia	2,340	1980
9	Ujung Pandang (Makassar)	Indonesia	1,405	1989
10	Bangkok	Thailand	8,250	1979, 1988, 1990
11	Manila	Philippines	20,795	1972, 1973, 1985, 1999
12	Davao	Philippines	1,335	1981
13	Hà Noi	Vietnam	2,355	1997, 2007
14	Ho Chi Minh City	Vietnam	7,785	2004
15	Kuala Lumpur	Malaysia	5,835	1999
16	Johore Bharu	Malaysia	860	1984
17	Klang	Malaysia	n.a. [2)]	1987
18	Vientiane	Laos	575	2008
19	Phnom Penh	Cambodia	1,560	2001
20	Kolkata (Calcutta)	India	15,535	1992
21	Dhaka	Bangladesh	10,135	2010
22	Seoul	Koria	19,910	1970
23	Singapore	Singapore	4,635	1988
24	Colombo	Sri Lanka	2,080	1984, 2006
25	Kathmandu	Nepal	1,280	1993
26	Lahore	Pakistan	7,110	1991, drawing up
27	Karachi	Pakistan	13,085	Drawing up
28	Baku	Azerbaijan	1,650	2002
29	Kabul	Afghanistan	3,370	2009
	Middle East			
30	Cairo	Egypt	17,290	1966,2002、2008
31	Baghdad	Iraq	5,850	1988
32	Tehran	Iran	8,170	1977
33	Damascus	Syria	2,370	1999, 2008
34	Tarabulus (Tripoli)	Lebanon	n.a. [2)]	1966, 2001
	Latin America			
35	Caracas	Venezuela	2,675	1965
36	Guayaquil	Ecuador	2,690	1983
37	Guatemala City	Guatemala	1,810	1992
38	Barranquilla	Colombia	1,795	1985
39	Cartagena	Colombia	935	1992
40	Bogotá	Colombia	7,845	1996
41	Santiago	Chile	5,805	1967
42	Managua	Nicaragua	895	1999
43	Panama City	Panama	945	1982
44	Asunción	Paraguay	2,605	1986, 1992
45	Belém	Brazil	1,610	1991, 2002
46	Lima	Peru	7,995	2005
47	Guadalajara	Mexico	4,210	1969

Table1 Cities selected for strategy formulation (2/2)

	City	Country	Population(000), 2010[1)]	JICA M/P year
	Africa			
48	Kampala	Uganda	1,625	2009, 2010
49	Nairobi	Kenya	3,365	2006
50	Lusaka	Zanbia	1,395	2009
51	Juba	Sudan	n.a. [2)]	Drawing up
52	Dar es Salaam	Tanzania	2,905	1995, 2008
53	Lilongwe	Malawi	575	2008
54	Monrovia	Liveria	500	2009
55	Bujumbura	Burundi	n.a. [2)]	2008
	EU			
56	Istanbul	Turkey	13,135	2009
57	Bucuresti (Bucharest)	Romania	1,995	2000
	Cities which don't have JICA master plans			
58	Beijing	China	13,955	None
59	Shanghai	China	18,400	None
60	Guangzhou, Guangdong	China	13,245	None
61	Mumbai (Bombay)	India	21,255	None
62	Delhi	India	20,995	None
63	Hyderabad	India	6,720	None
64	Pune (Poona)	India	4,935	None
65	São Paulo	Brazil	20,180	None
66	Curitiba	Brazil	3,030	None
67	Rio de Janeiro	Brazil	11,670	None
68	Buenos Aires	Argentina	12,975	None
69	Mexico City	Mexico	18,690	None

1) Demographia, and refer to UN World Urbanization Prospect 2010 for cities NOT including in this list.
2) Not coverd in Typological Analysis of Cities.

Appendix

Figure1 Diagnosis of Urban Transportation Problems in Cities Worldwide (1/2)

Note: To come up with these figures, trainees from various countries evaluated their own cities by using the Checklist for Urban Transportation Diagnosis in the Comprehensive Urban Transportation Planning and Project by JICA in October 2011.

Figure1 Diagnosis of Urban Transportation Problems in Cities Worldwide (2/2)

Appendix

Figure2 Prescriptions of Urban Transportation Problems in Cities Worldwide (1/2)

Note: To come up with these figures, trainees from various countries evaluated their own cities by using the Checklist for Urban Transportation Diagnosis in the Comprehensive Urban Transportation Planning and Project by JICA in October 2011.

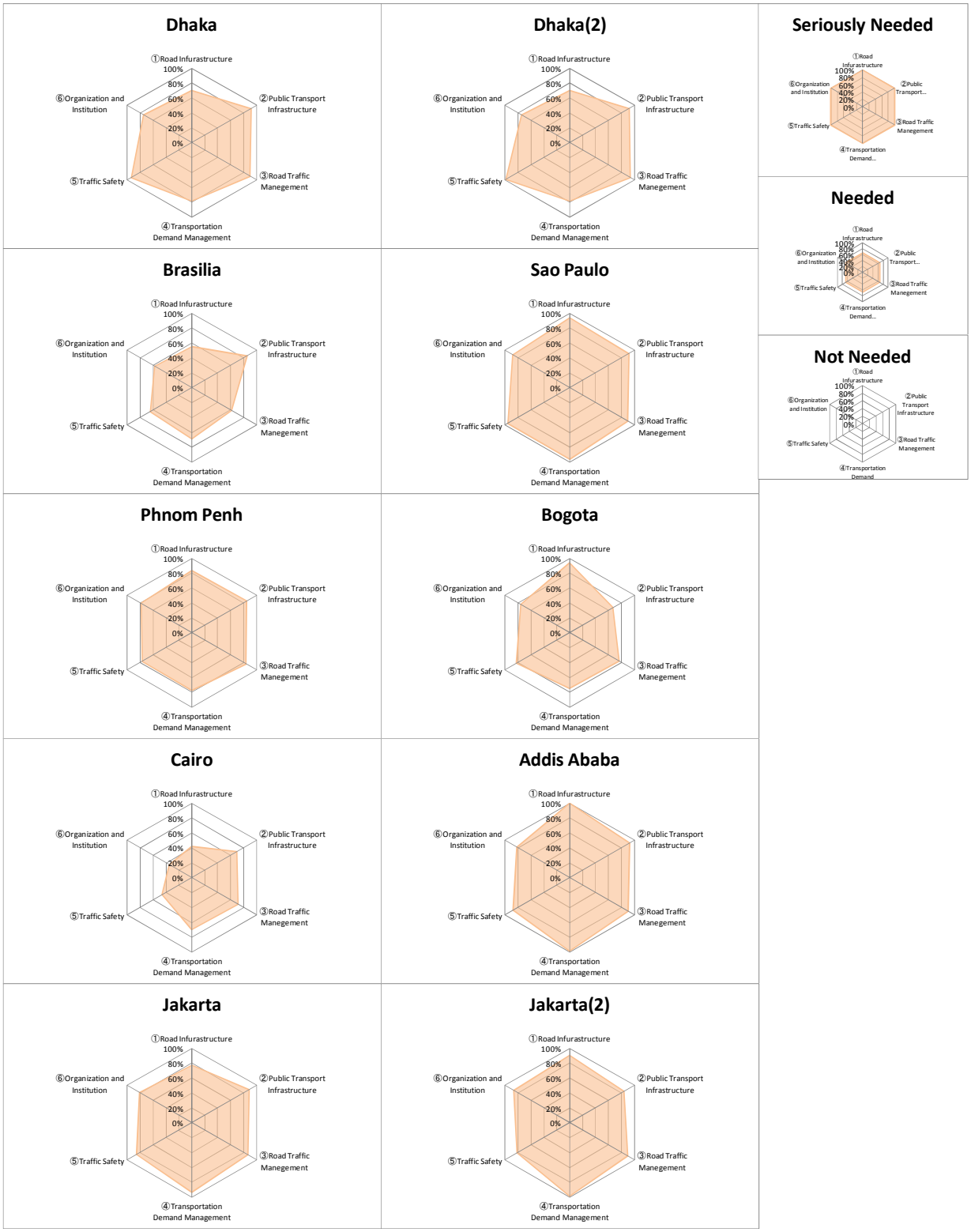


Figure2 Prescriptions of Urban Transportation Problems in Cities Worldwide (2/2)

The Research on Practical Approach for Urban Transport Planning

Final Report

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Acronym

AF	**Africa**
AFC	**Automatic Fare Collection system**
AGT	**Automated Guideway Transit**
ATS	**Automatic Train Stop**
BRT	**Bus Rapid Transit**
CA	**Central Asia**
CBD	**Central Business District**
CCTV	**Closed-circuit Television**
CTC	**Centralized Train Control**
EA	**East Asia**
ERP	**Electronic Road Pricing**
EU	**European Union**
GDP	**Gross Domestic Product**
GRDP	**Gross Regional Domestic Product**
GRP	**Gross Regional Product**
HDI	**Human Development Index**
HOV	**High-Occupancy Vehicles**
HPI	**Human Poverty Index**
ITS	**Intelligent Transport Systems**
JICA	**Japan International Cooperation Agency**
JPY	**Japanese Yen**
JR	**Japan Railway Company**
LA	**Latin America**
LRT	**Light Rail Transit**
ME	**Middle East**
MP	**Master Plan**
MRT	**Mass Rapid Transit**
NA	**North America**
NMT	**Non-Motorized Transport**
PM	**Particulate Matter**
PPHPD	**Passengers Per Hour Per Direction**
PPP	**Public Private Partnership**
PT	**Person Trip**
SA	**South Asia**
SEA	**South East Asia**
TDM	**Transportation Demand Management**
TOD	**Transit Oriented Development**
UITP	**Union Internationale de Transports Publics**
UN	**United Nations**
USD	**United States Dollar**
VMS	**Variable Bessage Sign**
VND	**Vietnam Dong**
WDI	**World Development Indicators**

1. Outline of the Study

1.1 Backgrounds

JICA has supported urban transport planning activities mainly in Asian developing countries by conducting studies for master plan formulation on urban transport development and often followed them up with feasibility studies. More specifically, JICA studies examined and proposed the physical, or hardware, development of urban transport infrastructure such as railway and bus transits and road networks. At the same time, these studies contained a set of proposals about the institutional, or software, development such as traffic demand management and tariff policy (e.g. certain restrictions on motorized traffic to enter the CBD, like the high-occupancy vehicle control in the United States, the electronic road pricing system in Singapore and the 3in 1 scheme in Jakarta), urban land use planning and so on. The proposals of JICA studies have been sometimes acted upon partly financed by the Yen Credit Program or the Grant Program of Japanese Government. Or else, the respective governments of the developing countries invested in the development along the direction proposed by JICA studies, occasionally with participation of private investors and/or some external donors.

It is crucial to formulate a hardware and software development plan for a given city suitably based on the phase of the city's socio-economic development and to implement the proposed projects and policy measures in steady and purposeful steps. On occasions, however, Japanese financial and technical supports after the completion of JICA studies missed the best timing and should have been provided much earlier. It is now increasingly important to support the infrastructure development in developing countries in a comprehensive package. Furthermore, the packaged supports need to include capacity development components of organizational and institutional nature and human resource empowerment. To pursue this direction of thought and action, it is useful to review across all master plan studies conducted by JICA on urban transport development and thereby clarify the strategic approach to project formulation and implementation.

The present study project is organized by a group of interested JICA staff and outside specialists to discuss and analyze the issues involved in strategy formulation for urban transport development in the developing countries.

1.2 Purpose of the Study

The present study project aims to review the available basic information and thereby to contribute to the formulation of medium- to long-term development strategy for urban transportation in suitable accordance with phases of urban socio-economic development. Specifically, the study undertakes (i) the collection and typological analysis of basic data on urban agglomerations or cities and the review of proposed and implemented urban transport projects and (ii) the examination of hardware and software development needs in urban transport infrastructure and the related institutional capacity building vis-à-vis phases of socio-economic development and the proposal on urban transport strategy formulation.

1.3 Scope of the Study

1) Study Area

The present study covers the entire developing countries and conducts a field survey of two cities each in India, Indonesia and Vietnam. Cities selected for the present study are large cities with more than one million in population, where a railway transit system is not yet in operation or in the midst of planning its introduction.

2) Selection of Cities for the Study

The study requires a wide range of information on cities or urban agglomerations. In addition to the basic urban statistics, the information is needed on intra-city traffic situations for review, and various supportive data are necessary for the typological analysis of urban agglomerations and the evaluation of urban transport strategies in these agglomerations. In contrast to nationally aggregated data and information, however, cities in developing countries are very poorly profiled by statistical documentation. Moreover, the available data on urban transportation is often too scarce or sporadic to satisfy the needs of wide-ranged and detailed examination. In the cities where JICA once undertook traffic surveys, it is possible to know trip attributes in detail but only about the year when the surveys were conducted. In many cases, such information is long outdated. To carry out the analysis as efficiently as possible under such limitations, the present study adopts a step-wise approach to the selection of cities for review. It is thought important to clarify the nature of the output obtained at each step of selection. Table 1.1 shows the expected output per step of selection and the sources of information.

Table 1.1 Steps of Selecting Cities and Expected Outputs

Expected Output	Selected Cities	Source of Information
【1】 Typology of cities (first selection)	Cities (urban agglomerations) with one million or more in population	・Demographia, ・UN, *World Urbanization Prospect* ・World Bank, *World Development Indicators 2008*
【2】 Collection of basic urban data	Cities selected for strategy formulation (cities with basic data available) Aid recipient countries; Cities with one million or more in population; Cities where JICA master plan studies were conducted	・Same sources as above ・UITP, *Millennium Cities Database for Sustainable Transport* ・Reports of JICA master plan studies ・Other available sources (including relevant web sites)
【3】 Current urban traffic situations		
【4】 Outline of urban transport strategies		
【5】 Urban transport strategy for model cities	Model cities	・Field survey

(1) Cities Selected for Strategy Formulation

Step【2】of the table above is meant to collect detailed information on urban transportation, such as traffic demand and conditions of transport infrastructure, in addition to urban socio-economic indices. Judging by the availability of necessary data within the limited time frame for the present study1, cities are selected from among those with population of 1 million or more, which are located in aid recipient countries and were studied by JICA for

[1] In China, for example, there are as many as 72 cities with population of 1 million or more and it is obviously time-consuming, if not impossible, to collect the necessary data on all of them. Accordingly, three cities of Beijing, Guangzhou and Shanghai are selected from China for the present study.

master plan formulation in the past. The national capitals are added to the selection even when their respective population is less than 1 million. Countries such as Singapore and Korea are no longer aid recipients, but two cities of Singapore and Seoul are included in the selection because their presence is informative of the relationship between the takeoff process and urban transportation. Kolkata is the only JICA-studied city in India, but three more cities (Mumbai, Hyderabad and Pune) are added to the selection. In all, 69 cities are selected to collect basic urban and transport data. The list of these cities is Table 1.1.

Table 1.2 Cities selected for strategy formulation (1/2)

	City	Country	Population(000), 2010[1)]	JICA M/P year
	Asia			
1	Hangzhou	China	5,305	1994
2	Chongqing	China	5,460	1994
3	Dalian	China	3,255	1996
4	Chengdu	China	4,785	2001
5	Ulaanbaatar	Mongolia	885	2009
6	Jakarta	Indonesia	22,000	1987, 1990, 2004
7	Surabaya	Indonesia	2,885	1983, 1997
8	Medan	Indonesia	2,340	1980
9	Ujung Pandang (Makassar)	Indonesia	1,405	1989
10	Bangkok	Thailand	8,250	1979, 1988, 1990
11	Manila	Philippines	20,795	1972, 1973, 1985, 1999
12	Davao	Philippines	1,335	1981
13	Hà Noi	Vietnam	2,355	1997, 2007
14	Ho Chi Minh City	Vietnam	7,785	2004
15	Kuala Lumpur	Malaysia	5,835	1999
16	Johore Bharu	Malaysia	860	1984
17	Klang	Malaysia	n.a. [2)]	1987
18	Vientiane	Laos	575	2008
19	Phnom Penh	Cambodia	1,560	2001
20	Kolkata (Calcutta)	India	15,535	1992
21	Dhaka	Bangladesh	10,135	2010
22	Seoul	Koria	19,910	1970
23	Singapore	Singapore	4,635	1988
24	Colombo	Sri Lanka	2,080	1984, 2006
25	Kathmandu	Nepal	1,280	1993
26	Lahore	Pakistan	7,110	1991, drawing up
27	Karachi	Pakistan	13,085	Drawing up
28	Baku	Azerbaijan	1,650	2002
29	Kabul	Afghanistan	3,370	2009
	Middle East			
30	Cairo	Egypt	17,290	1966,2002、2008
31	Baghdad	Iraq	5,850	1988
32	Tehran	Iran	8,170	1977
33	Damascus	Syria	2,370	1999, 2008
34	Tarabulus (Tripoli)	Lebanon	n.a. [2)]	1966, 2001
	Latin America			
35	Caracas	Venezuela	2,675	1965
36	Guayaquil	Ecuador	2,690	1983
37	Guatemala City	Guatemala	1,810	1992
38	Barranquilla	Colombia	1,795	1985
39	Cartagena	Colombia	935	1992
40	Bogotá	Colombia	7,845	1996
41	Santiago	Chile	5,805	1967
42	Managua	Nicaragua	895	1999
43	Panama City	Panama	945	1982
44	Asunción	Paraguay	2,605	1986, 1992
45	Belém	Brazil	1,610	1991, 2002
46	Lima	Peru	7,995	2005
47	Guadalajara	Mexico	4,210	1969
	Africa (1/2)			
48	Kampala	Uganda	1,625	2009, 2010
49	Nairobi	Kenya	3,365	2006

Table1.2 Cities selected for strategy formulation (2/2)

	City	Country	Population(000), 2010[1)]	JICA M/P year
	Africa (2/2)			
50	Lusaka	Zanbia	1,395	2009
51	Juba	Sudan	n.a. [2)]	Drawing up
52	Dar es Salaam	Tanzania	2,905	1995, 2008
53	Lilongwe	Malawi	575	2008
54	Monrovia	Liveria	500	2009
55	Bujumbura	Burundi	n.a. [2)]	2008
	EU			
56	Istanbul	Turkey	13,135	2009
57	Bucuresti (Bucharest)	Romania	1,995	2000
	Cities which don't have JICA master plans			
58	Beijing	China	13,955	None
59	Shanghai	China	18,400	None
60	Guangzhou, Guangdong	China	13,245	None
61	Mumbai (Bombay)	India	21,255	None
62	Delhi	India	20,995	None
63	Hyderabad	India	6,720	None
64	Pune (Poona)	India	4,935	None
65	São Paulo	Brazil	20,180	None
66	Curitiba	Brazil	3,030	None
67	Rio de Janeiro	Brazil	11,670	None
68	Buenos Aires	Argentina	12,975	None
69	Mexico City	Mexico	18,690	None

1) Demographia, and refer to UN World Urbanization Prospect 2010 for cities NOT including in this list.
2) Not coverd in Typological Analysis of Cities.

(2) Utilization of Available Sources of Information

Regarding urban statistics, the databases in the following list are utilized to the fullest possible extent.

Table 1.3 List of Urban Databases

Database	Compiler	Cities Selected for the Study[1)]	index	Year
World Urbanization Prospect 2009	UN	Global urban agglomerations with population of 750,000 or more ● 64 JICA-studied cities included	Population of urban agglomerations	Every 5 years during 1950-2025
Demographia	Wendell Cox Consultancy	Global urban agglomerations with population of 600,000 or more ● 65 JICA-studied cities included	Urban Area (population, area size, population density)	Base Year: 2010
		Global urban agglomerations with population of 2 million or more ● 52 JICA-studied cities included	Urban Area Population projections	2010, 2025, 2030
		Global urban agglomerations with population of 5 million or more ● 24 JICA-studied cities included	Metropolitan population, Core & Suburb	1965, 2000 (the latest year)
		Bangkok, Manila and Singapore only	Employment in CBD	1990
Millennium Cities Database for Sustainable Transport	UITP	100 global cities ● 23 JICA-studied cities included	Transport-related indices	1995

Note: In all, JICA conducted master plan studies on 69 cities.
Source: Study Team

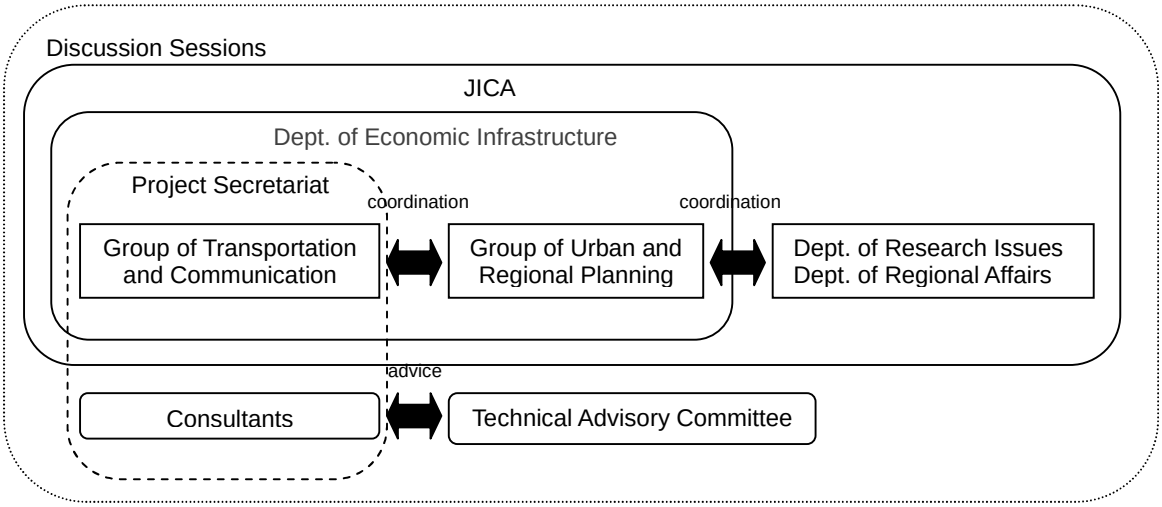
1.4 Organization for the Study

The present study is carried out through a series of discussion sessions with the backup by the Project Secretariat manned by the JICA staff and the consultants. The following two experts in the field of urban transport planning are invited to sit in the Technical Advisory Committee to give advice at appropriate points during the implementation of the study.

HYODO, Tetsuo — Professor of Marketing Information Engineering, Tokyo University of Marine Science and Technology

HANAOKA, Shinya — Associate Professor of International Development Engineering, Div. of Science and Technology, Graduate School, Tokyo Institute of Technology

Figure 1.1 Organizational Setup for the Study Project



1.5 Cautionary Notes on the Study Findings

The present study deals with statistics and transport indices that pertain to individual cities. As mentioned earlier in Section 1.3, it is hardly possible to use the same database uniformly for the entire selected cities. Nationally aggregated statistics have to be used for some part of the analysis, or necessary data must be extrapolated from the available growth rates. Quite a few cities have changed radically by economic growth after the compilation of the respective databases. Therefore, it is necessary to take cautious note of such disparities when the findings of the present study are perused for some purpose.

1) Disparity of Current Situations from Available Compiled Database

Automobile ownerships (passenger cars and freight vehicles) in China have been rapidly increasing in recent years. For example, automobile ownerships totaled 10,033,000 vehicles in 1995, and increased to 15,700,000 in 2000, 30,871,000 in 2005 and 61,180,000 in 2009, doubling every five years and in four years during 2005 – 2009 (Shinya Hanaoka, 2011). The database compiled for the year 1995 is obviously too outdated to analyze the current situations of urban transportation in Chinese cities. The analysis of urban transport conditions in individual cities must be carried out with due caution, especially regarding Chinese cities.

2) Data Limitations

When GRP[1] estimates on individual cities (not as administrative units but as urban agglomerations, to be exact) are not available from the existing database (as required, for example, for the analysis in Section 2.3), the present study uses the UN population database on urban agglomerations and per capita GDP estimates (in constant 2000 US dollars[2]) in the World Development Indicators of the World Bank (hereafter referred to as WDI). It has been found in many cases that per capita GRPs of large urban agglomerations are worth 200% to 500% of per capita GDPs of the countries where such cities are located. The disparity between per capita GRP and per capita GDP is larger, it has been observed, in low-income countries of the developing world. Accordingly, the present study provides a wider range of interpretation to the findings of quantitative analyses.

[1] Gross regional product (GRP) is conceptually equivalent to gross domestic product (GDP); the latter measures newly created value through production by resident production units (or residents in short) in the domestic economy, while for the former measures newly created value through production by regional production units (or regional residents in short) in the regional economy, be it a state, province or a district.

[2] Dollar figures for nominal GDP converted by domestic currencies using 2000 official exchange rates.

2. Typological Analysis of Cities

This chapter analyzes the characteristics of cities and discusses the trends in urban transport problems in accordance with the typology of cities. Section 2.1 examines the global database of cities or urbanized areas to clarify the relative positions of those cities that have been studied by JICA for strategic transport master plan formulation (hereafter referred to as strategy-studied cities). Section 2.2 analyzes the relationships between city types and urban transport patterns by referring to such indices as the share of public transit and the ratio of passenger car ownerships. Section 2.3 argues the interrelationships between different phases of urban development, city types and urban transport problems on the basis of the findings by the JICA master plan studies mentioned above.

2.1 Global Trends of Urban Agglomerations

1) Indices and Distribution of Urban Agglomerations

There is no universally accepted definition of “cities.” Cities can be analyzed by their demographic attributes such as population size and density, by economic profiles featuring the pre-dominance of non-agricultural activities, or by administrative characteristics as municipalities. In dynamic terms, a city embodies a collectivity of urban functions that range from basic characteristics evinced in residential and community patterns to concentrations of diverse and advanced economic and commercial undertakings. Accordingly, they serve as integrative nodes that generate and attract such diverse functions and activities. In this section, cities and their growths are examined by analyzing the following indices.

(1) Population: Indicator of the scale of a city, implying its agglomerating potentials of urban functions

(2) GDP per capita: Indicator of the agglomerated level of advanced urban functions and activities1

(3) Residential Population Density: Indices showing the nature of living environments and the accessibility (proximity) to basic functions and services

(4) Growth Rate (trend and future): Indicator of the past development and the future prospects

In the present study, cities are analyzed not as administrative units but as spatially continuous urban agglomerations above a certain level of population density. The word “city” is frequently used in this report for its brevity, but it means an urban agglomeration as defined above, unless otherwise specified.

According to the available database on urban population listed in Table 1.3 of Chapter 1, there are 398 cities, or urban agglomerations, with population of one million or more in the world. The trends among these cities are examined in terms of four indices mentioned above and regional distribution. Major findings can be summarized as follows. The typological analysis of the trends discernible from the indices is discussed in the next section.

[1] GRP (gross regional product) of a city is a much better indicator of the level of agglomerated urban functions, but such data are hardly available on urban agglomerations, least of all as time series estimated on the uniform or comparable basis.

- Among 398 cities, 106 are distributed in East and Southeast Asia, 61 in South and Central Asia. 26 cities have a population over 10 million, and 11 of them are found in East and Southeast Asia and 5 in South and Central Asia. Most of these mega cities are distributed in Asia.
- 112 cities have population growth potential exceeding 2% per annum. 80 of them are small cities of less than 3 million in population and 27 are medium-size cities of less than 10 million. The remaining 5 are mega cities of more than 10 million in population. The regional distribution is 33 in East and Southeast Asia, 35 in South and Central Asia and 30 in Africa. There are a total of 34 cities with population of 1 million or more in Africa, and 30 of them have the high growth potential of over 2% per annum during 2010 - 2025, suggesting explosive urbanization in the future. In contrast, all cities except one have the low population growth potential in Europe.
- 99 cities have population density exceeding 100 persons per hectare. 22 of these cities are distributed in East and Southeast Asia, 15 in Middle East and 45 in South and Central Asia. No city in Europe and North America reaches this high density level.
- Among 87 cities in the early development phase with GDP per capita of less than US$1,000 (in constant US$ of 2000), 60%, or 55 cities, are found in South and Central Asia. 80% of the cities in Africa are classified to the early development phase. In East and Southeast Asia, most of the cities are in the middle phase of development (GDP per capita of less than US$4,000).

Table 2.1 Cities of 1 Million or more in Population (398 cities)

Index	Year	Classificatiob		Total No. of Cities	Reginal Distribution[1)]						
					EA& SEA	SA& CA	ME	LA	AF	EU	NA
				398	106	61	38	53	36	56	48
Present Population (mil)	2010	Large	>10mil	26	11	5	2	4	-	2	2
		Medium	3-10mil	89	23	10	7	12	12	9	16
		Small	< 3mil	283	72	46	29	37	24	45	30
Total				398	106	61	38	53	36	56	48
Population Growth Potential[2)] (%/year)	2010-2025	High	> 2%	121	33	35	10	4	30	1	8
		Medium	1-2%	83	29	4	15	25	1	-	9
		Low	< 1%	61	13	-	1	6	3	23	15
合計				265	75	39	26	35	34	24	32
Present Density (person/ha)	2010	Overcrowded	> 100	99	22	45	15	10	7	-	-
		High	60 − 100	110	50	12	13	16	15	4	-
		Medium	< 60	189	34	4	10	27	14	52	48
合計				398	106	61	38	53	36	56	48
Per Capita GDP [3)] (const. 2000 USD)	2008	Early-development	<1,000	87	3	55	1	1	27		
		Mid-development	<4,000	139	79	5	18	13	6	18	-
		Late-development	> 4,000	155	17	-	14	38	-	38	48
Total				381	99	60	33	52	33	56	48

Cities vary in the degree of data availability. Therefore, regional totals do not add up to the grand total of cities.

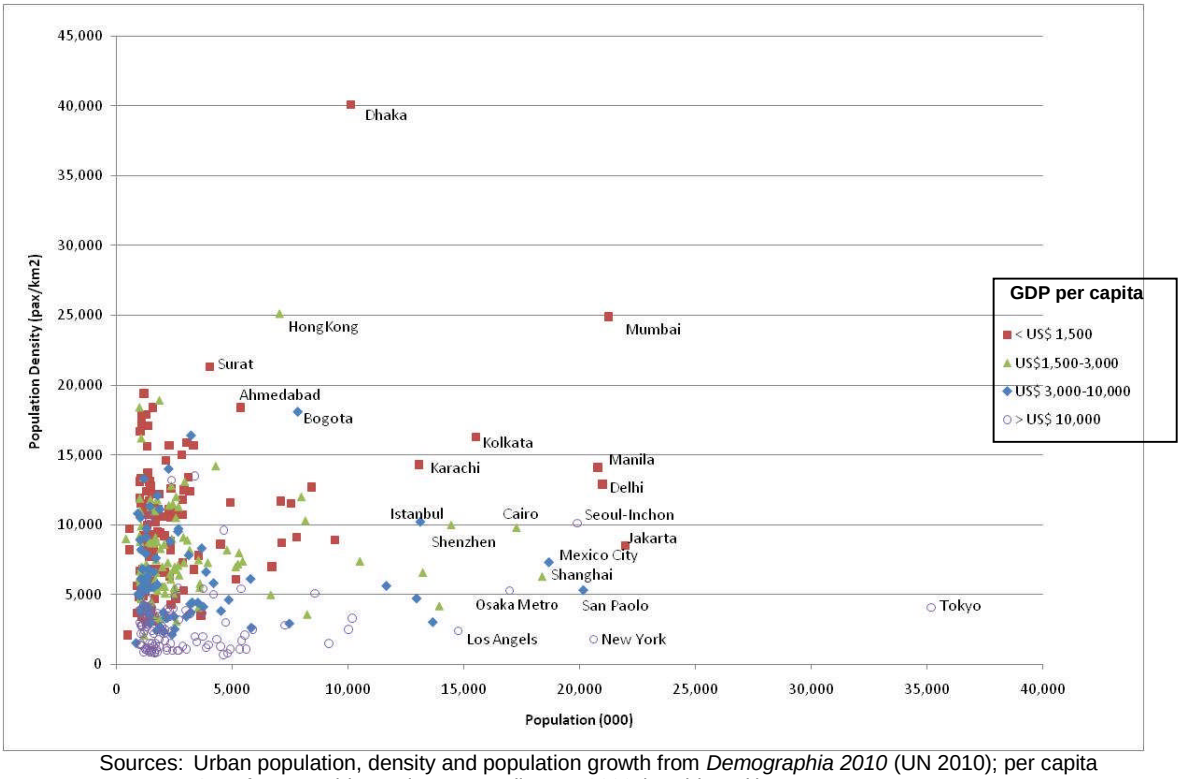
Notes:1) EA &SEA stands for East and Southeast Asia, SA & CA for South and Central Asia, ME for Middle East, LA for Latin America, AF for Africa, EU for Europe including Russia, and NA for North America including Australia.
2) Only 265 cities are covered.
3) Only 381 cities are covered

Sources: Urban population, density and population growth from *Demographia 2010* (UN 2010); per capita GDP from *World Development Indicators* 2008 (World Bank).

2) Population Size and Density

There is no apparent correlation between population size and density as shown in the figure below. High density cities are mostly concentrated in low-income countries. High-density mega cities are also found mostly in low-income countries excepting Japan and the United States.

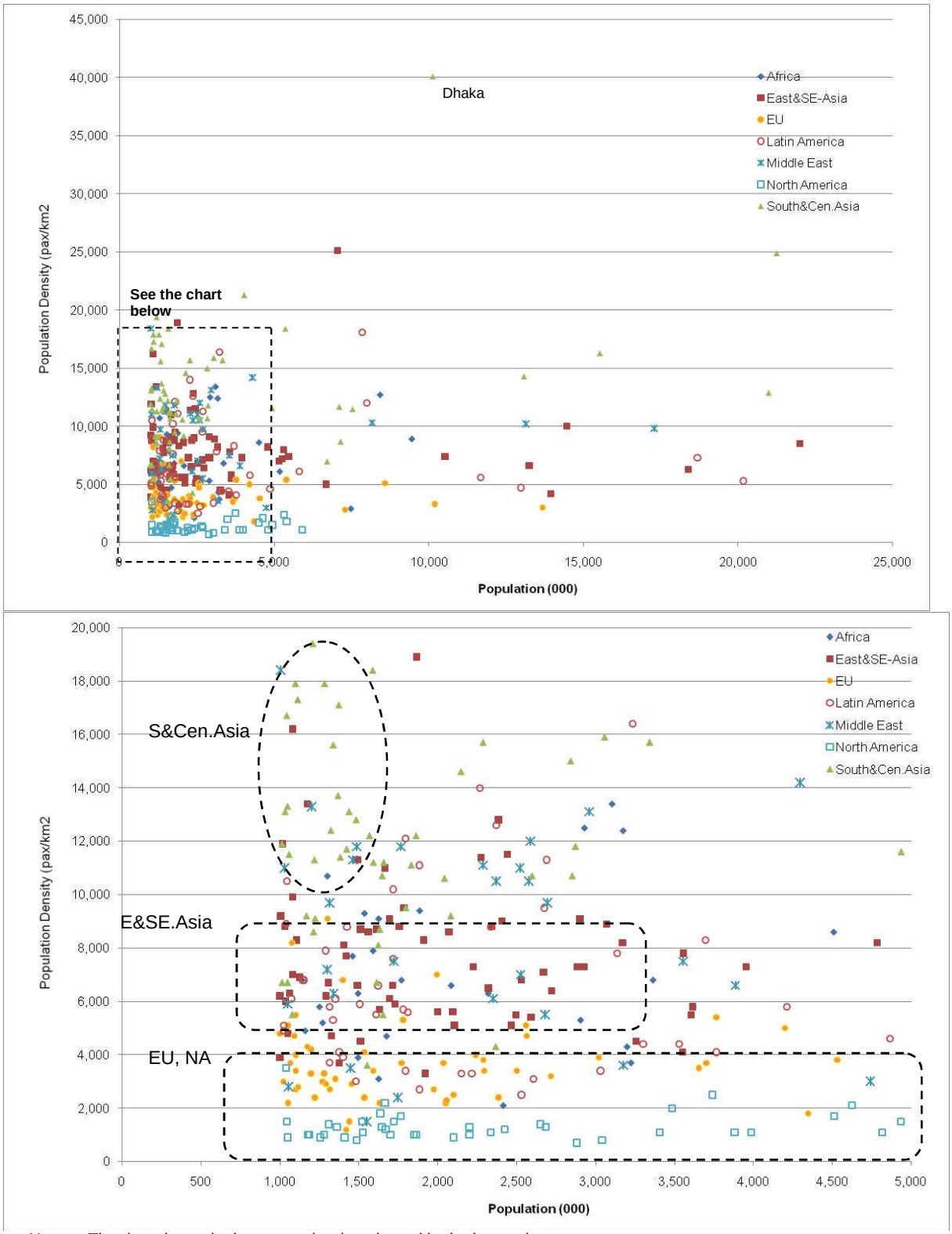
Figure 2.1 Population Size and Density by Per Capita GDP Level (381 Cities of over 1 million in Population)



Sources: Urban population, density and population growth from *Demographia 2010* (UN 2010); per capita GDP from *World Development Indicators* 2008 (World Bank).

The regional distribution of population size and density in Figure 2.2 indicates that the density is lower than 50 pax/ha in the cities of North America and Europe. The density is especially low in North America, where the bulk of the cities are around 20 pax/ha. Most of the mega cities in South and Central Asia have high population density, but it must be noted at the same time that many smaller cities have very high density in this region. In terms of population size and density, the cities in East and Southeast Asia are roughly distributed between those in South and Central Asia and those in Europe and North America. The cities of Middle East show a large variation in population size and density.

Figure 2.2 Population Size and Density by Region (381 Cities of over 1 million in Population)

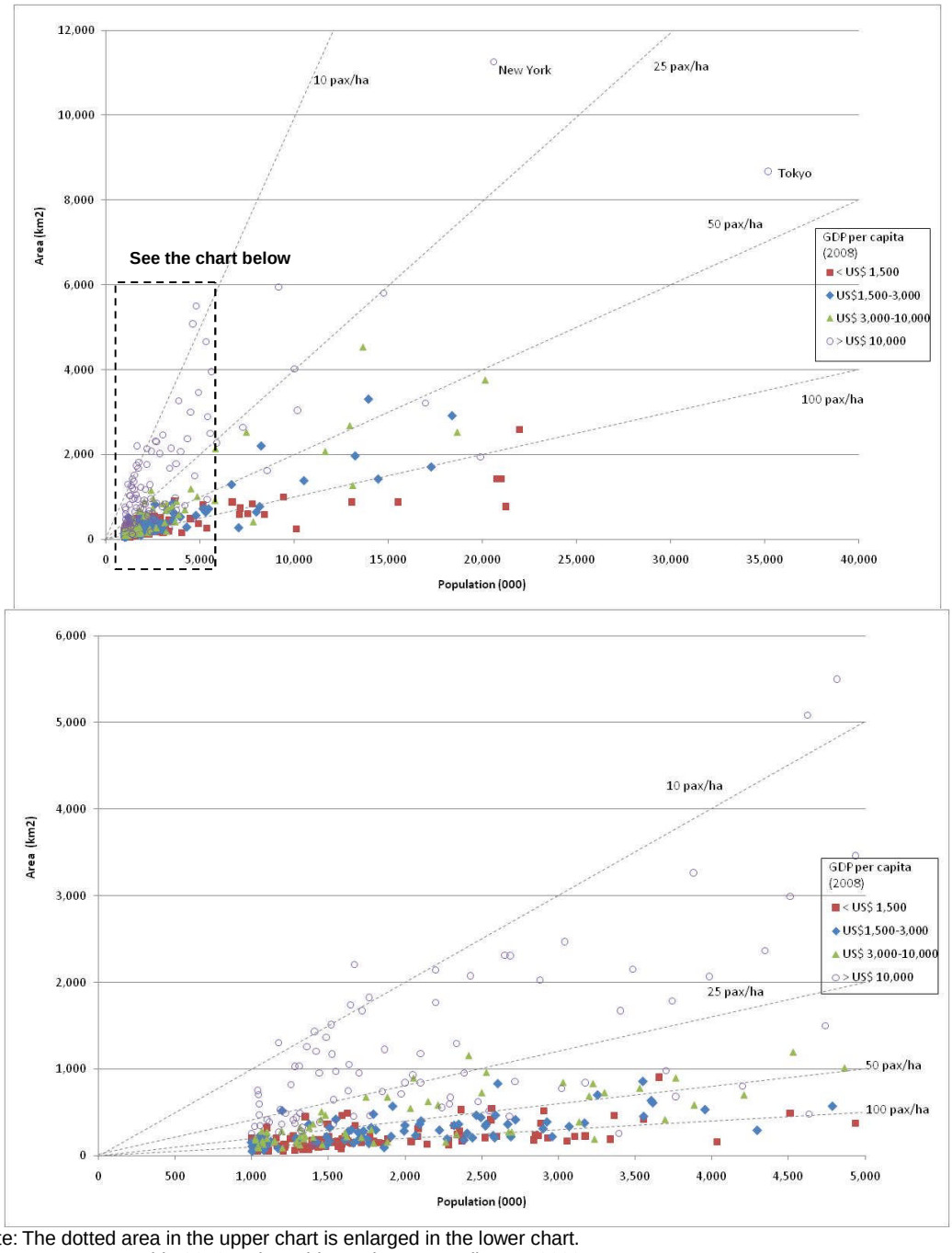


Note: The dotted area in the upper char is enlarged in the lower chart.
Source: *Demographia 2010*

As shown in Figure 2.3, the distribution of population size and city area indicates two notable characteristics in terms of per capita GDP. In high-income countries of over US$10,000, many cities have the population density of more or less 10 persons/ha, whereas the bulk of cities in low-income countries have the density of around 100 persons/ha. Regarding cities with the population ranging from one to five million, the density is higher as per capita GDP gets lower. Most of the cities in high-income countries fall in the range of 10 to 25 persons/ha in density, whereas the cities of around 100 persons/ha in density increase their share as per capita income gets lower.

Figure 2.3 Population Size and City Area by GDP Level

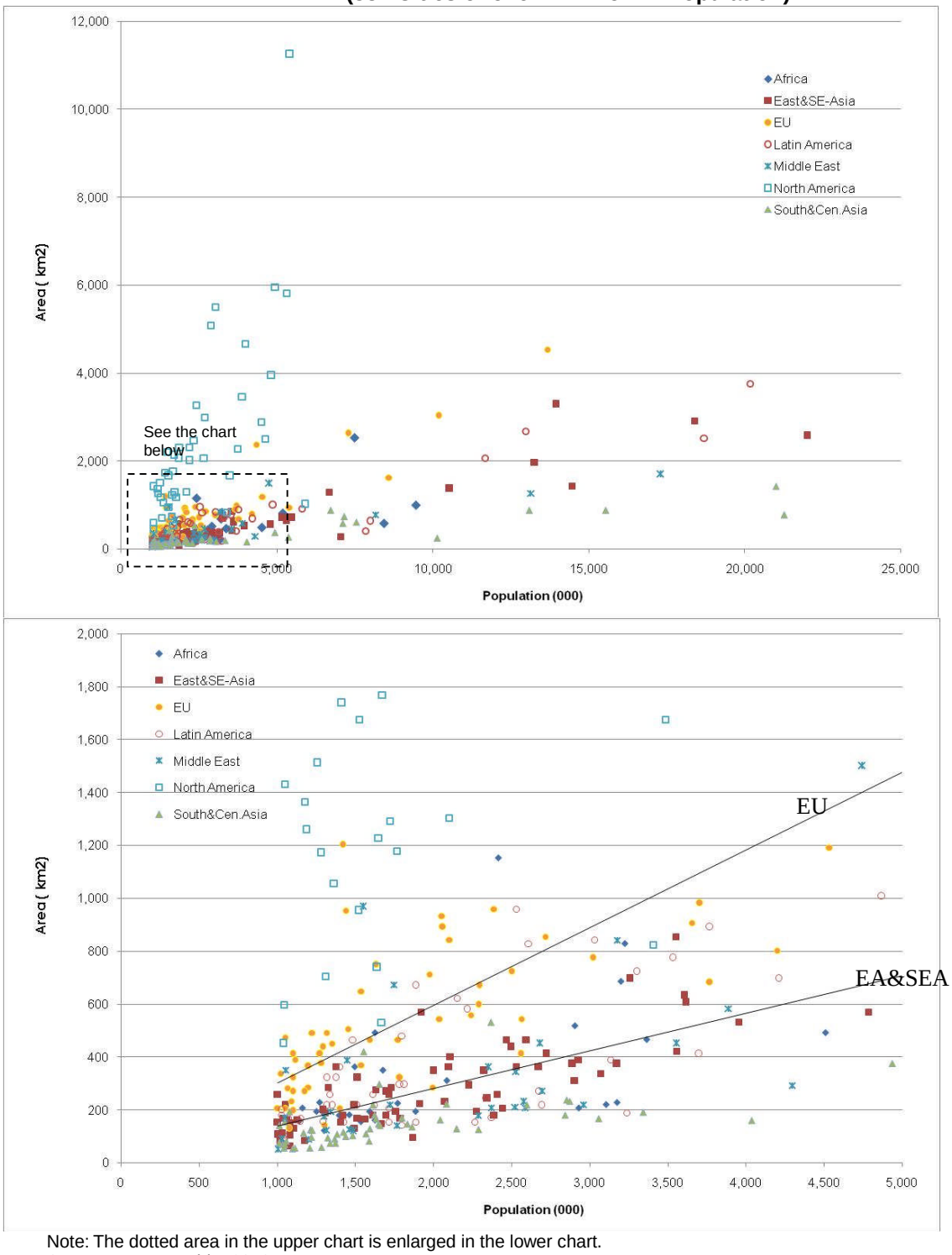
(381 Cities of over 1 million in Population)



Note: The dotted area in the upper chart is enlarged in the lower chart.
Sources: *Demographia 2010* and *World Development Indicators 2008*.

When the same distribution is examined in terms of regions as shown in Figure 2.4, the contrast is sharp between the cities in North America which stand out by their large city area and those in South and Central Asia where their respective areas are especially small. In East and Southeast Asia and Europe, a notable positive correlation exists between population size and city area, but no such relationship is detectable in other regions.

Figure 2.4 Population Size and City Area by Region (381 Cities of over 1 million in Population)

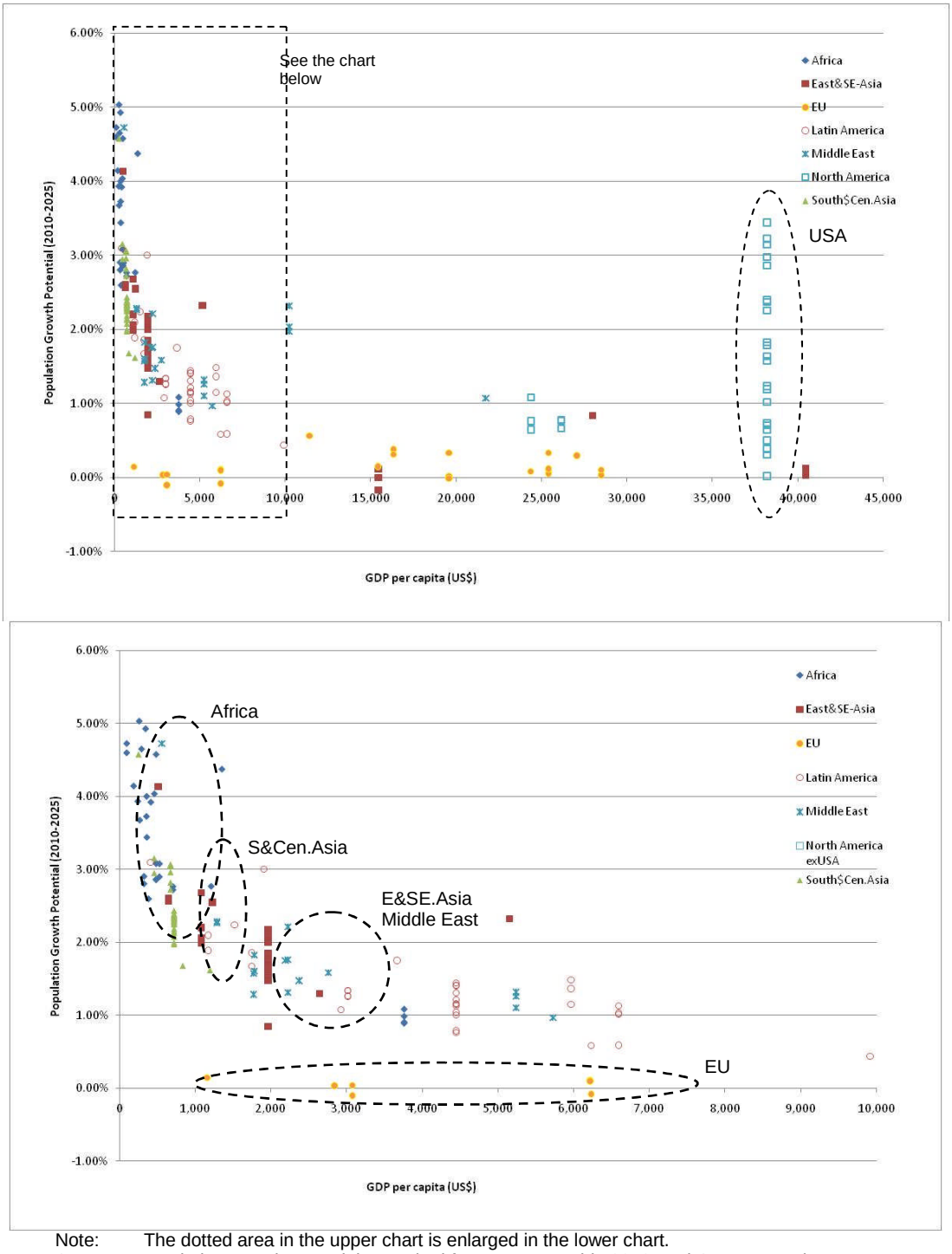


Note: The dotted area in the upper chart is enlarged in the lower chart.
Source: Demographia, 2010

3) Urban Population Growth Potentials and Per Capita GDP

The potential of urban population growth is inversely correlated to the level of per capita GDP, as shown in Figure 2.5. The projected growth rates of urban population are higher in the cities of low income countries. In terms of regional distribution, the combination of low per capita GDP and high population growth potential is pronounced in the cities of Africa and South and Central Asia. The cities in East and Southeast Asia and Middle East are grouped by higher income and lower population growth potential than those cities. The cities in Europe invariably show low population growth potentials irrespective of per capita GDP levels.

Figure 2.5 Per Capita GDP and Urban Population Growth Potentials (250 Cities)



Note: The dotted area in the upper chart is enlarged in the lower chart.
Sources: Population growth potentials are cited from *Demographia 2010*, and GDP per capita from World Development Indicators 2008

4) Salient Characteristics of Cities Studied for Strategy Formulation

The situations in 2010 are summarized in Table 1.2, regarding 65 cities selected for the present analysis from the cities studied by JICA for strategy formulation (see Section 1.3, Chapter 1).

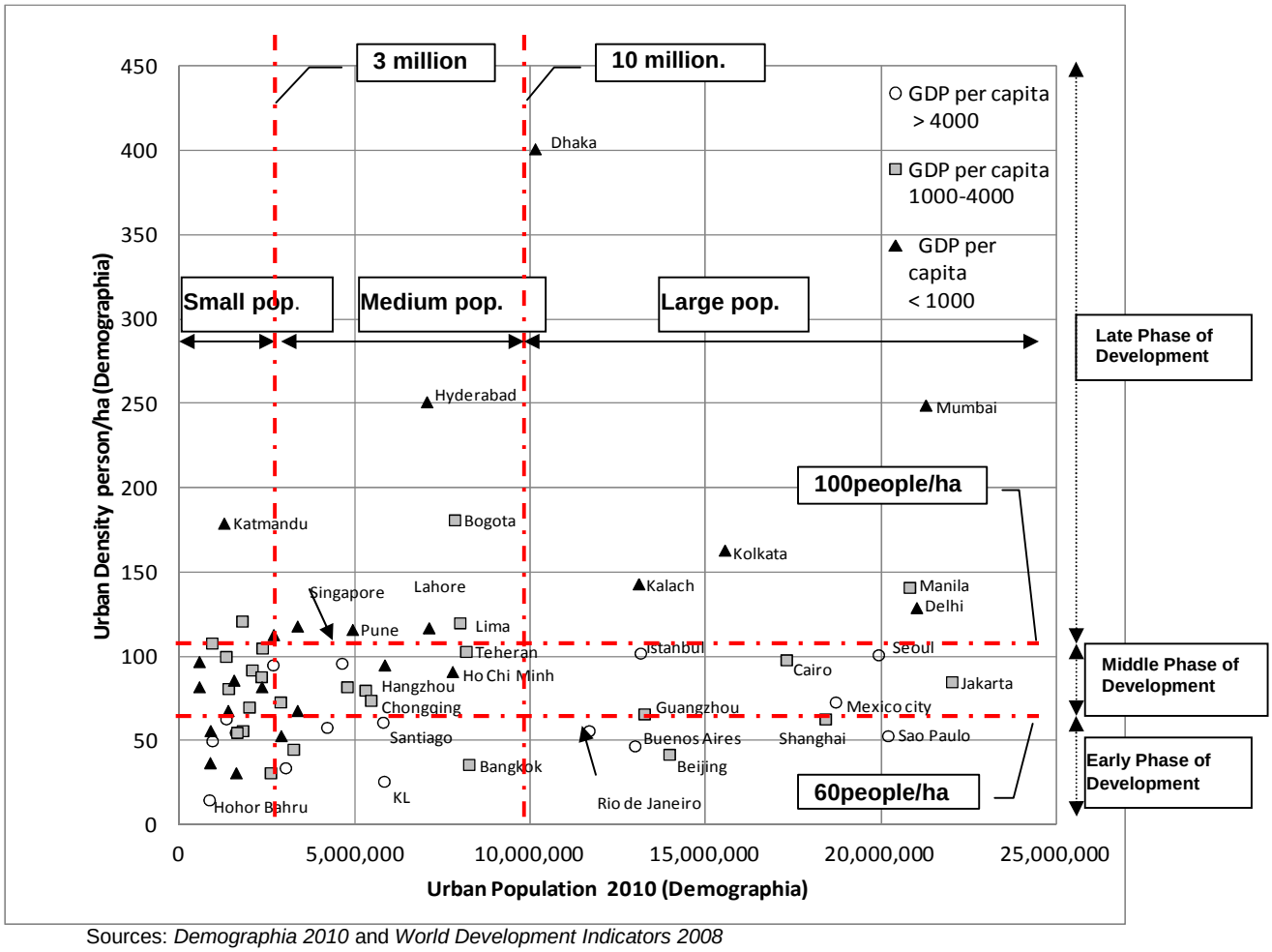
Many of the cities selected for the present analysis are the ones with small population (less than 3 million) and high population growth potentials (2% or more per annum) and in the middle phase of development (per capita GDP from US$1,000 to US$4,000). They are expected to continue their growth and expansion for a long time to come.

Table 2.2 Situations in 65 JICA-studied Cities

Index	Unit	Year	Data Source	Classification		No. of Cities
Present Urban Population	Million	2010	*Demographia*	Large	>10mil	17
				Medium	3-10 mil	20
				Small	< 3mil	28
Population Growth Potential	%/year	2010 – 2025	*Demographia*,	High	> 2%	27
				Medium	1-2%	26
				Low	< 1%	11
Present Population Density	2010	2010	*Demographia*	Overcrowded	> 100	20
				High	60 – 100	25
				Medium	< 60	19
Per Capita GDP	Constant 2000 US$	2008	*World Development Indicators*	Early-development	<1000	17
				Mid-development	<4,000	26
				Late-development	> 4,000	21
Regional Distribution	-	-	-	East & Southeast Asia	(EA&SEA)	23
				South &Central Asia	(SA&CA)	12
				Middle East	(ME)	4
				Latin America	(LA)	18
				Africa	(AF)	6
				Europe	(EU)	2
				North America	(NA)	0

Note: 65 cities are the ones where JICA have so far conducted studies to formulate urban transport master plans, but excluding those which are not found in the Demographia database.
Sources: *Demographia 2010*, and *World Development Indicators 2008*

Figure 2.6 Typology of JICA-studied Cities (Population, Density and Per Capita GDP)



Sources: *Demographia 2010* and *World Development Indicators 2008*

Table 2.3 Typology of JICA-studied Cities (Population, Density and Per Capita GDP)

		Urban Population Density		
		A. Overcrowded: > 100 prs/ha	B. High Density: 60- 100 prs/ha	C. Medium Density: < 60 prs/ha
Urban Pop.	A. Large City: >10 mil	A. Late Phase of Development: GDP/capita > US$4,000 Istanbul Seoul	A. Late Phase of Development: GDP/capita > US$4,000 Mexico City	A. Late Phase of Development: GDP/capita > US$4,000 Rio de Janeiro Sao Paolo Buenos Aires
		B. Middle Phase of Development: GDP/capita US$1,000-4000 Manila	B. Middle Phase of Development: GDP/capita US$1,000-4000 Cairo Jakarta Guangzhou Shanghai	B. Middle Phase of Development: GDP/capita US$1,000-4000 Beijing
		C. Early Phase of Development: GDP/capita < US$1,000 Dhaka Mumbai Kolkata Karachi Delhi	C. Early Phase of Development: GDP/capita < US$1,000	C. Early Phase of Development: GDP/capita < US$1,000
	B. Medium City: 3 mil -10 mil	A. Late Phase of Development: GDP/capita > 4,000	A. Late Phase of Development: GDP/capita > 4,000 Singapore Santiago	A. Late Phase of Development: GDP/capita > 4,000 Guadalajara Curitiba Kuala Lumpur
		B. Middle Phase of Development: GDP/capita US$1,000-4000 Bogota Lima Teheran	B. Middle Phase of Development: GDP/capita US$1,000-4000 Chengdu, Sichuan Province Hangzhou, Zhejiang Province Chongqing	B. Middle Phase of Development: GDP/capita US$1,000-4000 Dalian Bangkok
		C. Early Phase of Development: GDP/capita < US$1,000 Hyderabad Lahore Pune Kabul	C. Early Phase of Development: GDP/capita < US$1,000 Ho Chi Minh Nairobi Bagdad	C. Early Phase of Development: GDP/capita < US$1,000
	C. Small City < 3 mil	A. Late Phase of Development: GDP/capita > 4,000	A. Late Phase of Development: GDP/capita > 4,000 Caracas	A. Late Phase of Development: GDP/capita > 4,000 Belem Panama Johor Bahru
		B. Middle Phase of Development: GDP/capita US$1,000-4000 Barranquilla Cartagena Damascus Davao	B. Middle Phase of Development: GDP/capita US$1,000-4000 Colombo Medan Ujung Pandang Surabaya Bucharest	B. Middle Phase of Development: GDP/capita US$1,000-4000 Baku Asuncion
		C. Early Phase of Development: GDP/capita < US$1,000 Katmandu Guayaquil	C. Early Phase of Development: GDP/capita < US$1,000 Vientiane Phnom Penh Lilongwe Hanoi Lusaka	C. Early Phase of Development: GDP/capita < US$1,000 Managua Dar es Salam Ulan Bator Kampala

Sources: *Demographia 2010, WDI 2008* and UN 2010

2.2 Urban Transportation and City Types

1) Role of Transportation in Urban Agglomerations

The general inter-relationships between urban traffic patterns and city types can be summed up in the following descriptions.

(1) An urban transport network is related to the urban structure or the distribution of population density. More compactly structured a given city is, higher would be the convenience provided by public transits. The modal share of public transit tends to be larger in more densely populated cities.

(2) The ratio of passenger car ownerships among urban population is closely related to the level and distribution of density. More compactly structured distribution of high density is correlated with a lower ratio of car ownerships among urban population, whereas lower density cities have the higher ratio of car ownerships.

(3) Passenger car ownerships influence the modal composition of urban traffic. The higher the ratio of car ownerships among city population, the larger would be the share of passenger car trips, or to put it differently, the lower would be the share of public transit in the total traffic demand.

(4) Cities of high economic performance tend to have a high ratio of car ownerships among their population. As mentioned in (2), the modal share of public transit tends to be low in such cities, as shown in Figure 2.7.

(5) The higher the modal share of public transit is in a given city, the lower the transport-related energy consumption. In other words, more compactly structured cities tend to require less energy for the provision of urban transportation, as shown in Figure 2.8.

Figure 2.7 Per Capita GDP and Passenger Car Ownerships (100 Cities in 1995)

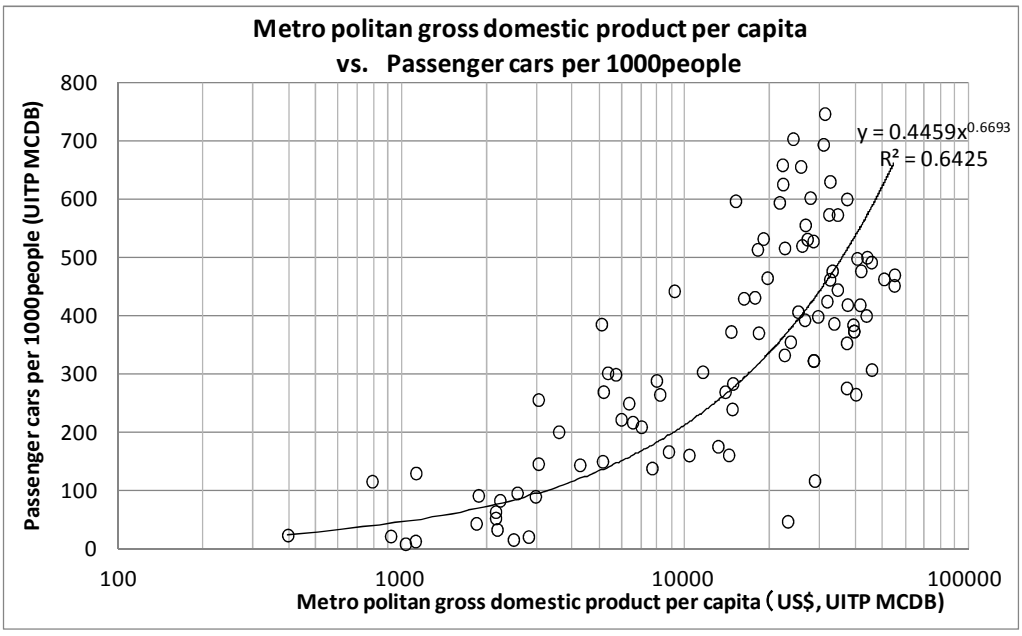
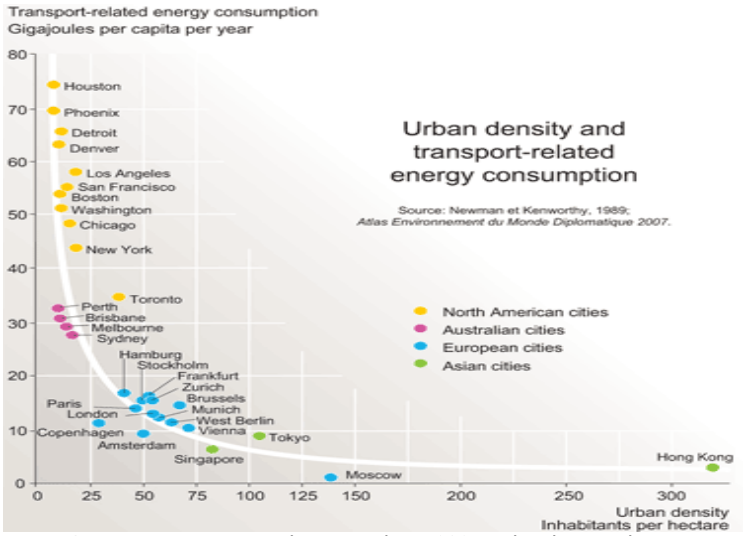


Figure 2.8 Urban Density and Transport-originating Energy Consumption



Sources: Newman and Kenworthy, 1989 and *Atlas Environnement du Monde Diplomatique,* 2007.

In this section, the relationships between city types and urban traffic patterns are analyzed by utilizing such data as the modal share of public transit and the ratio of automobile ownerships. The necessary data are obtained from the following databases.

(1) UITP, *Millennium Cities Database for Sustainable Transport*

Compiled cities: 100 cities
Surveyed year: 1995
Regional distribution: East & Southeast Asia (15 cities), South Asia (3 cities), Central and South America (10 cities), Middle East (6 cities), North America and Oceania (20 cities), Africa (5 cities) and Europe (41 cities)

(2) Reports of the JICA Master Plan Studies on Urban Transport

Studied cities: 57 cities (see Table 1.2 for more details)
Studied year: various

2) Indices Related to Urban Transportation

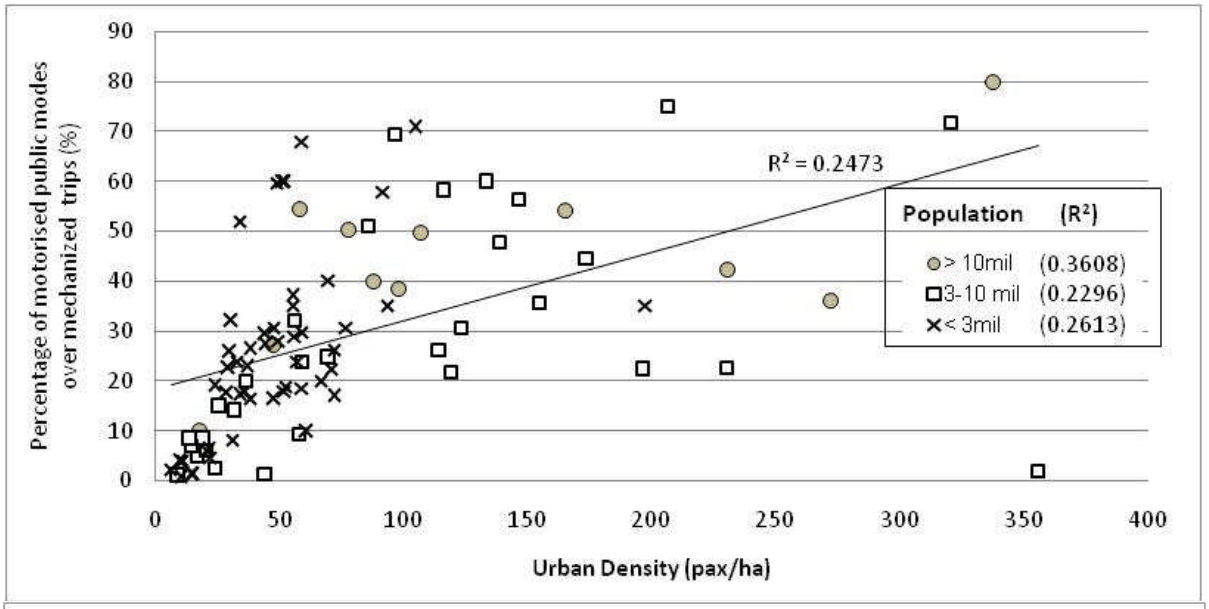
(1) Population Density and Modal Share

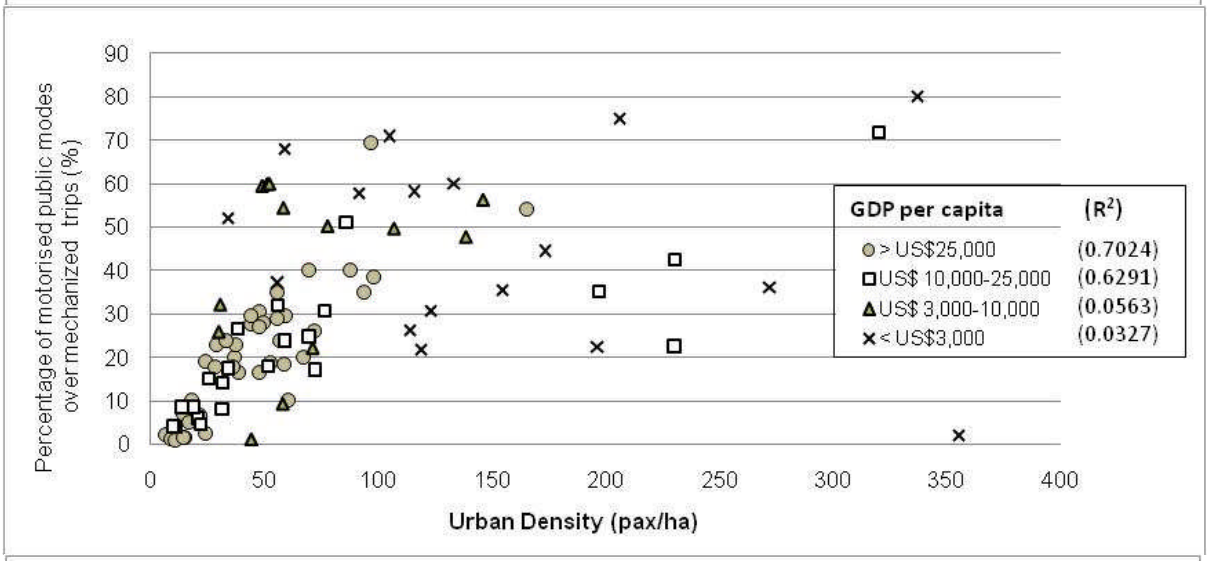
The relationships between urban population density and the modal share of public transit are plotted in Figure 2.9 in terms of population size, per capita GDP and regional distribution. An appreciable tendency of correlation can be read between the higher urban density and the larger share of public transit, but the correlation coefficient itself (R^2 =0.2473) of 100 cities is not sufficiently strong. The same applies to three different classes of population size.

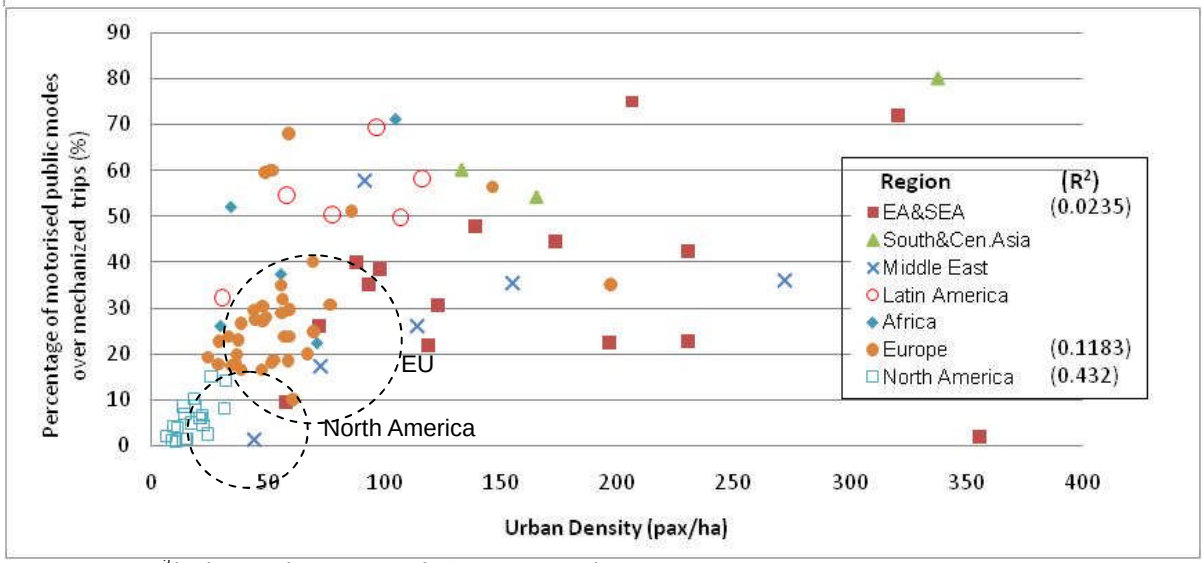
In terms of per capita GDP, there is a strong correlation in high-income countries between the higher urban density and the larger share of public transit. The correlation becomes weaker progressively from high-income countries to medium-income countries and then to low-income countries.

The correlation by region is generally weak, except that the cities in Europe and North America are found concentrated in a certain range of urban density and modal share. There is no distinct correlation in Southeast Asia, Middle East and Central and South America, suggesting the diversity of cities in these regions.

Figure 2.9 Urban Density and Modal Share of Public Transit (100 Cities in 1995)







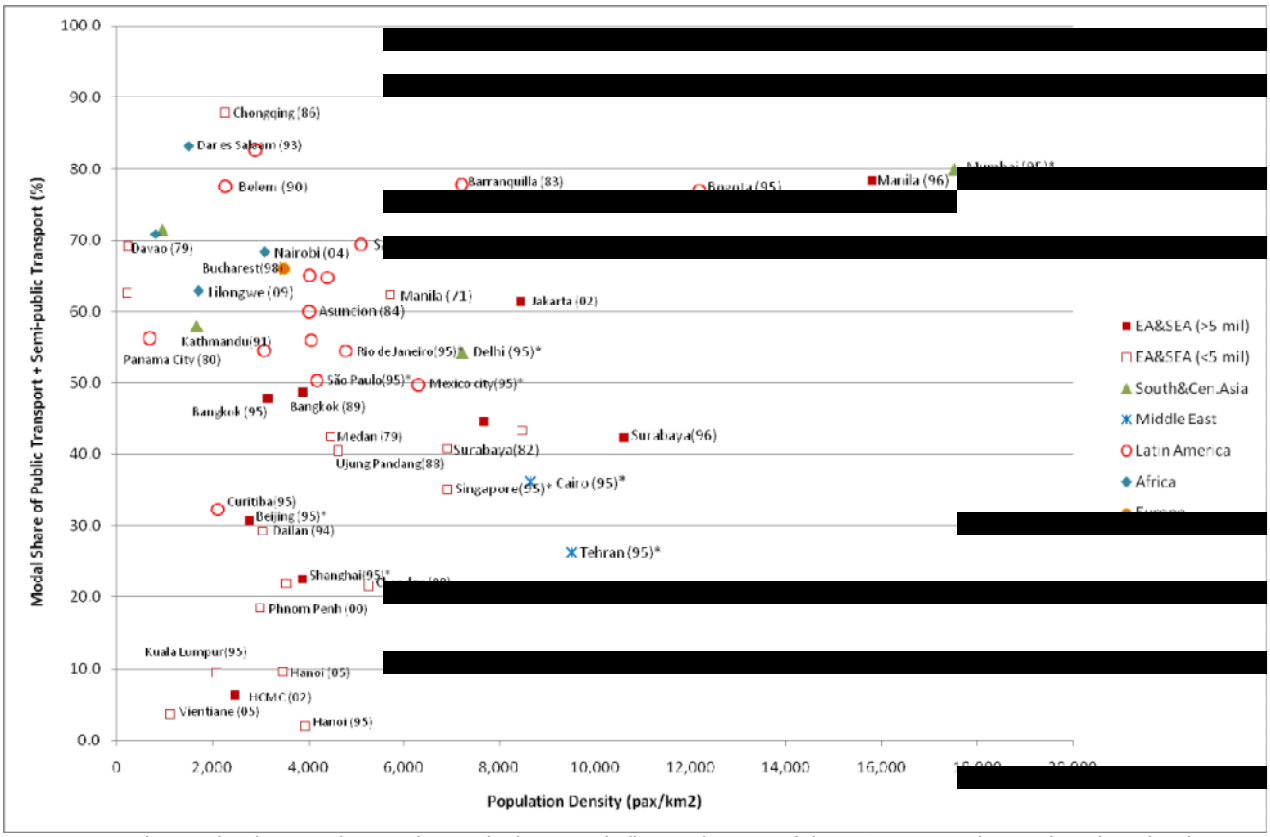
Note: R^2 is shown only on groups of 10 or more samples.
Source: UITP, *The Millennium Cities Database for Sustainable Transport*, 2000.

Figure 2.10 shows population density and the modal share of public transit in those cities studied by JICA for master plan formulation. There is no apparent indication of the correlation in the plotting. This is probably because the JICA-studied cities are found in developing countries, accordingly with no reflection of the correlation found in developed countries.

The cities of Africa in the early phase of development are plotted in the area of low density and high public transit share in the chart, whereas the cities in Latin America show a relatively high share of public transit regardless of the level of urban density.

The cities in Asia, on the contrary, show an appreciable tendency of correlation. The population size varies a great deal, but in the cities of over 5 million in population, the higher urban density is correlated with the higher share of public transit in the similar manner found among 100 global cities in Figure 2.9.

Figure 2.10 Urban Density and Modal Share of Public Transit (65 JICA-studied Cities)

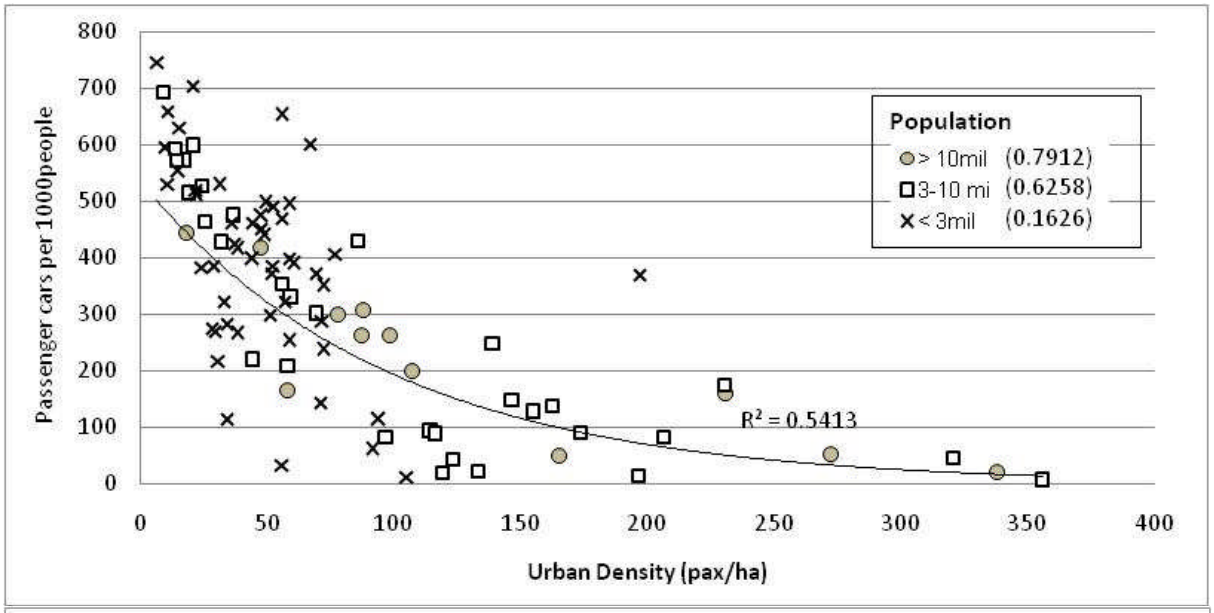


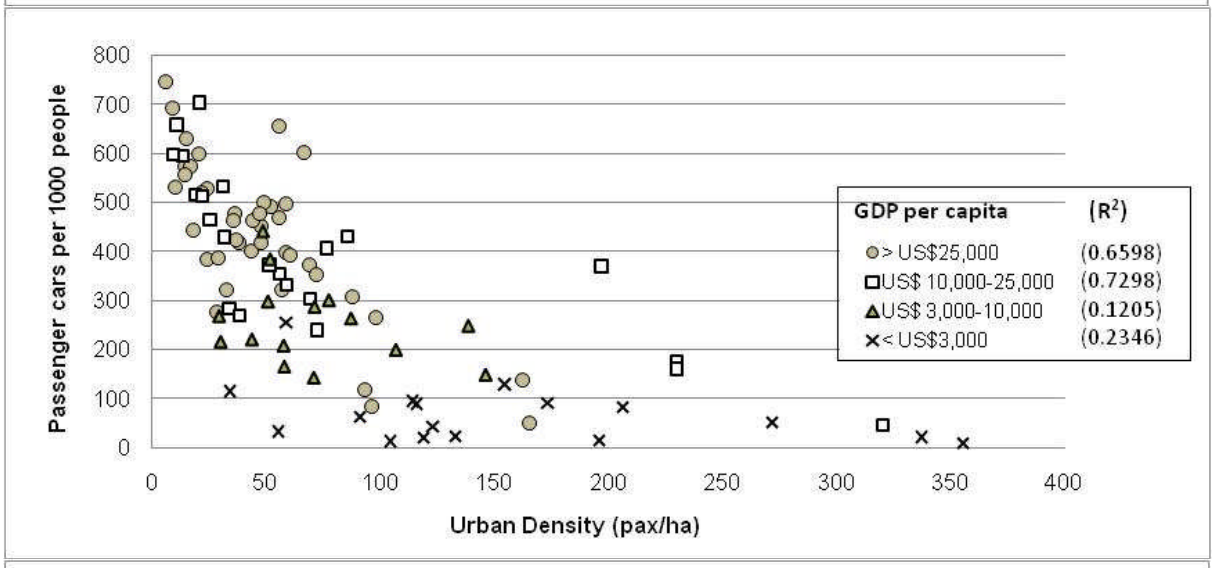
Note: The number in parentheses after each city name indicates the year of the JICA master plan study. Urban density and the modal share of public transit pertain to the year when each JICA study was conducted.
Sources: Various JICA Study Reports and UITP, *the Millennium Cities Database for Sustainable Transport*.

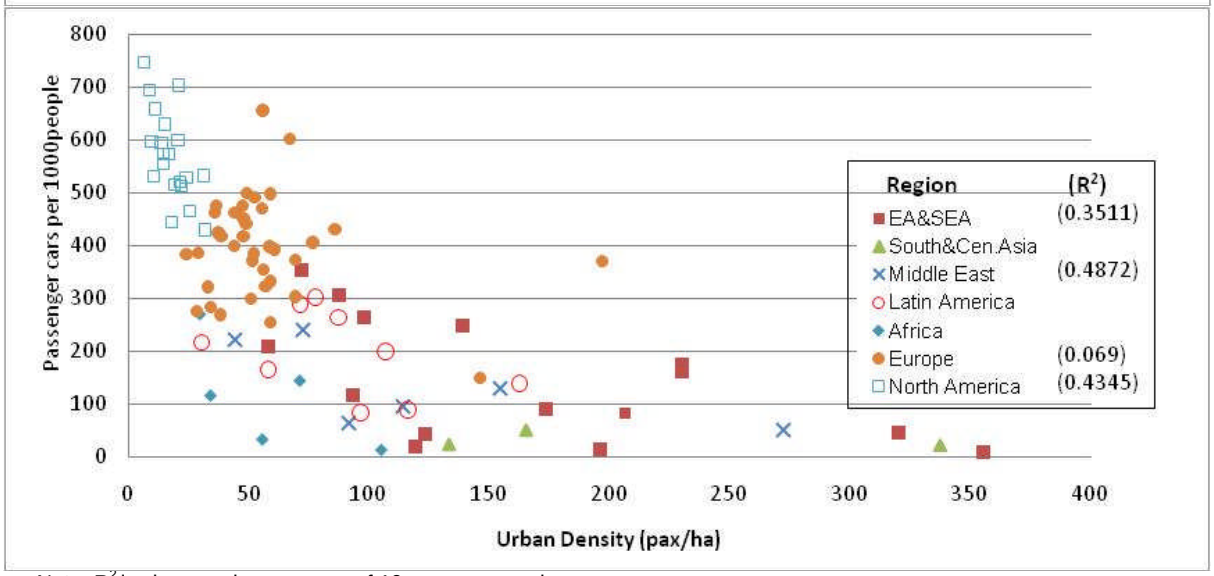
(2) Population Density and Passenger Car Ownerships

Figure 2.11 plots the relationships between urban population density and the ratio of passenger car ownerships in terms of population size, per capita GDP and regional distribution. An appreciable correlation (R^2 =0.5413) exists between the higher density and the lower ratio of car ownerships among city population. The correlation is stronger in high-income countries but weaker in medium- to low-income countries. In terms of regional distribution, the cities respectively of Europe and North America are found concentrated in a certain range of urban density and car ownership ratio, although the correlation coefficient is not sufficiently high in these regions. There is no distinct correlation found in other regions.

Figure 2.11 Urban Density and Passenger Car Ownerships (100 Cities in 1995)



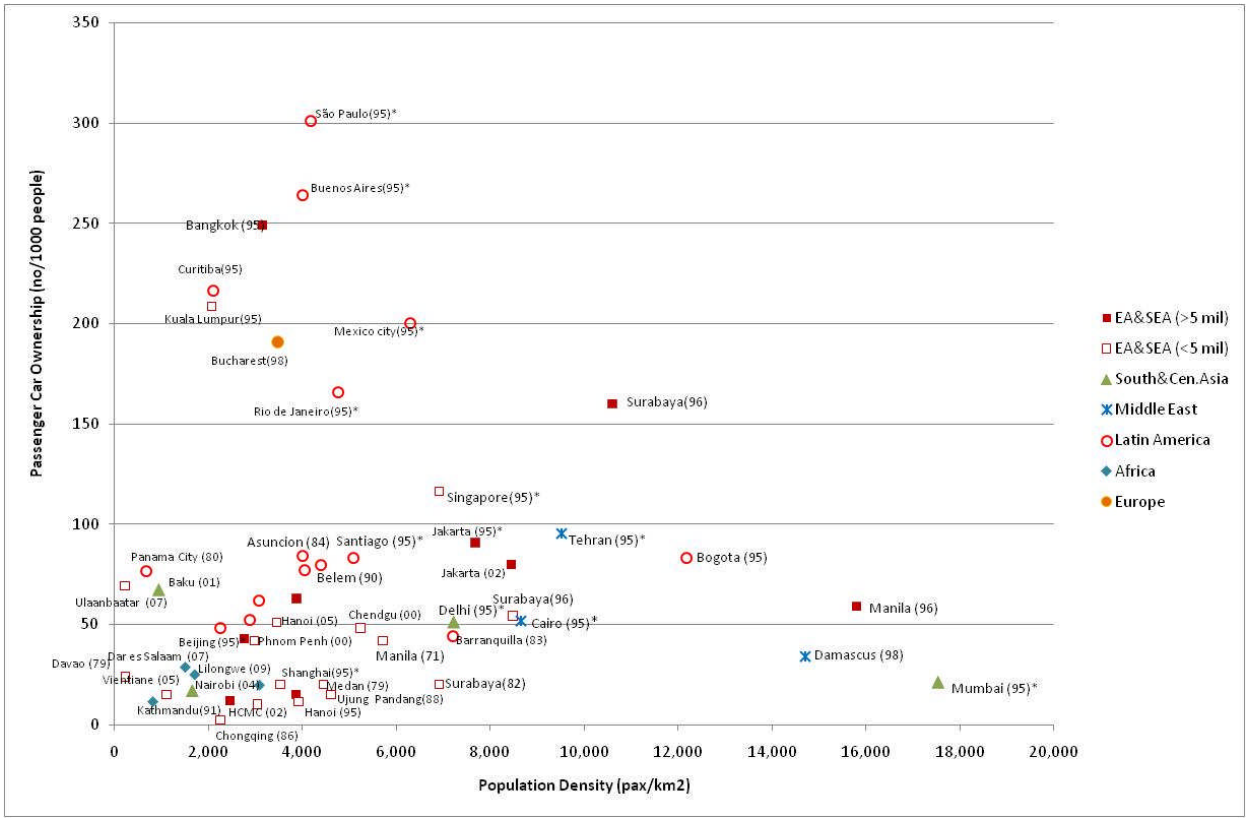




Note: R^2 is shown only on groups of 10 or more samples.
Source: UITP, *The Millennium Cities Database for Sustainable Transport*, 2000.

Among the JICA-studied cities, there is a tendency of correlation between lower density and higher car ownerships as shown in Figure 2.12. However, many low-density cities in Africa and Latin America have a low ratio of private car ownerships.

Figure 2.12 Urban Density and Passenger Car Ownerships (65 JICA-studied Cities)



Note: The number in parentheses after each city name indicates the year of the JICA master plan study. Urban density and the ratio of passenger car ownerships pertain to the year when each JICA study was conducted.

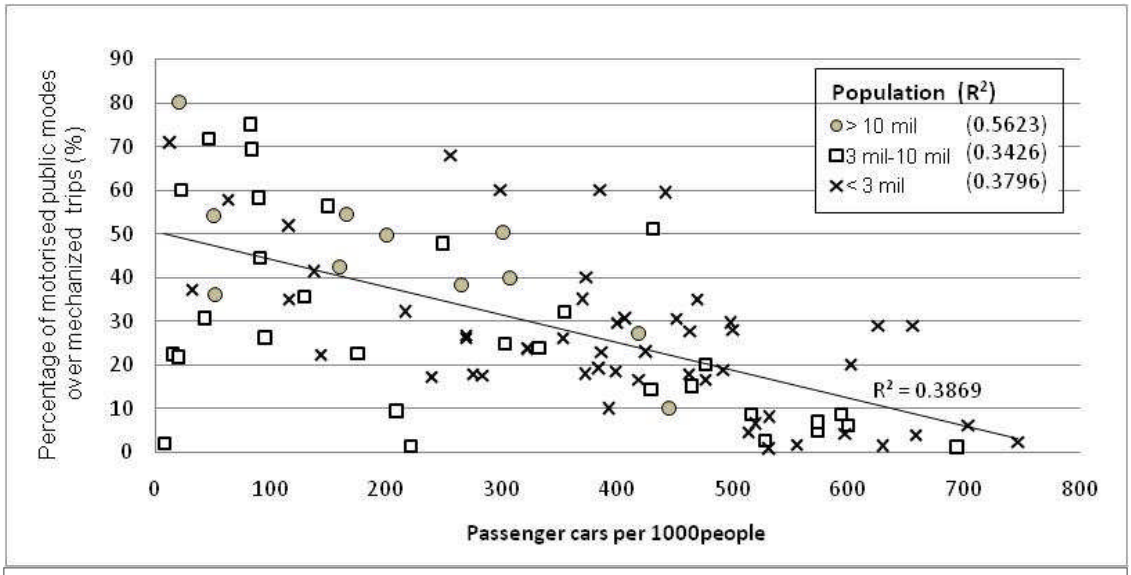
Sources: Various JICA Study Reports and *the Millennium Cities Database for Sustainable Transport*.

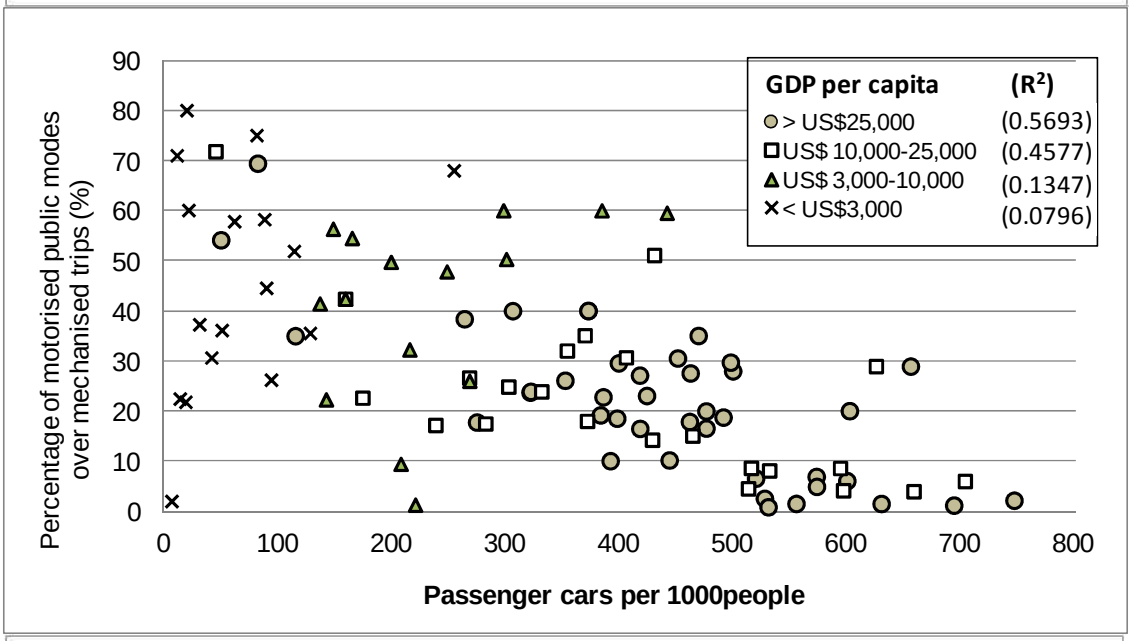
(3) Passenger Car Ownerships and Modal Share of Public Transit

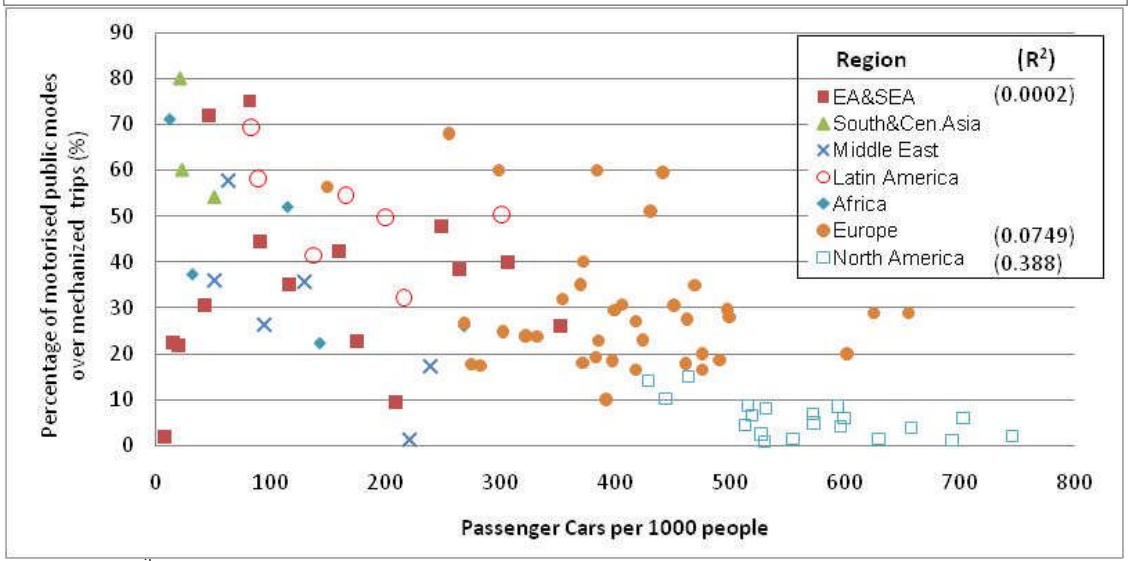
Figure 2.13 plots the relationships between the ratio of passenger car ownerships and the modal share of public transit in terms of population size, per capita GDP and regional distribution. Some tendency of correlation can be read between the higher ratio of car ownerships and the lower share of public transit, but the coefficient (R^2 =0.3869) among 100 global cities is not strong enough.

The correlation is strong in high-income countries but diverges from this tendency in medium- to low-income countries. In terms of regional distribution, the cities of Europe and North America are respectively found concentrated in a certain range of car ownership ratios and public transit shares, although the correlation coefficient is not high in these regions. There is no distinct correlation in Southeast Asia, Middle East and Central and South America, indicating the diversity of cities in these regions.

Figure 2.13 Passenger Car Ownerships and Modal Share of Public Transit (100 Cities in 1995)





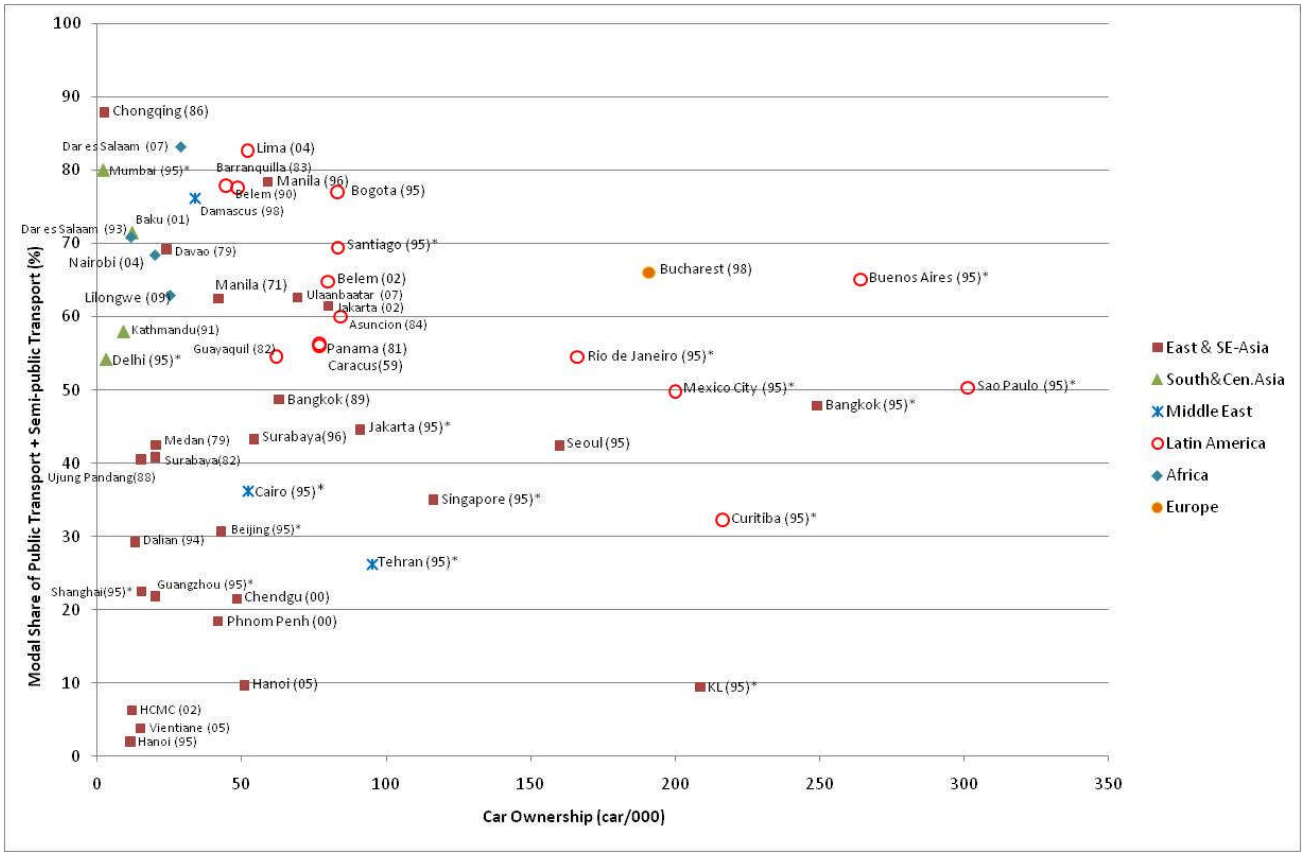


Note: R^2 is shown only on groups of 10 or more samples.
Source: UITP, *The Millennium Cities Database for Sustainable Transport*, 2000.

Among the JICA-studied cities in Figure 2.14, non-Asian cities indicate a general tendency of inverse correlation between the ratio of car ownerships and the share of public transit. Especially in Latin America, the cities of lower car ownerships have a higher public transit share in all cases (Figure 2.14).

The cities in Asia show somewhat idiosyncratic characteristics compared with those in other regions. Passenger car ownerships are on the whole low in Asian cities, reflecting the low level of economic development. And yet, some of them have a high public transit share, whereas others, like Ha Noi and Ho Chi Minh, have a pronouncedly low share of public transit. Such a divergence from the general tendency of inverse correlation is mostly found in those cities dependent on two-wheelers (two-wheeler cities such as Ha Noi, Ho Chi Minh, Phnom Penh, Vientiane and elsewhere are discussed later on in Section 4).

Figure 2.14 Passenger Car Ownerships and Modal Share of Public Transit (65 JICA-studied Cities)



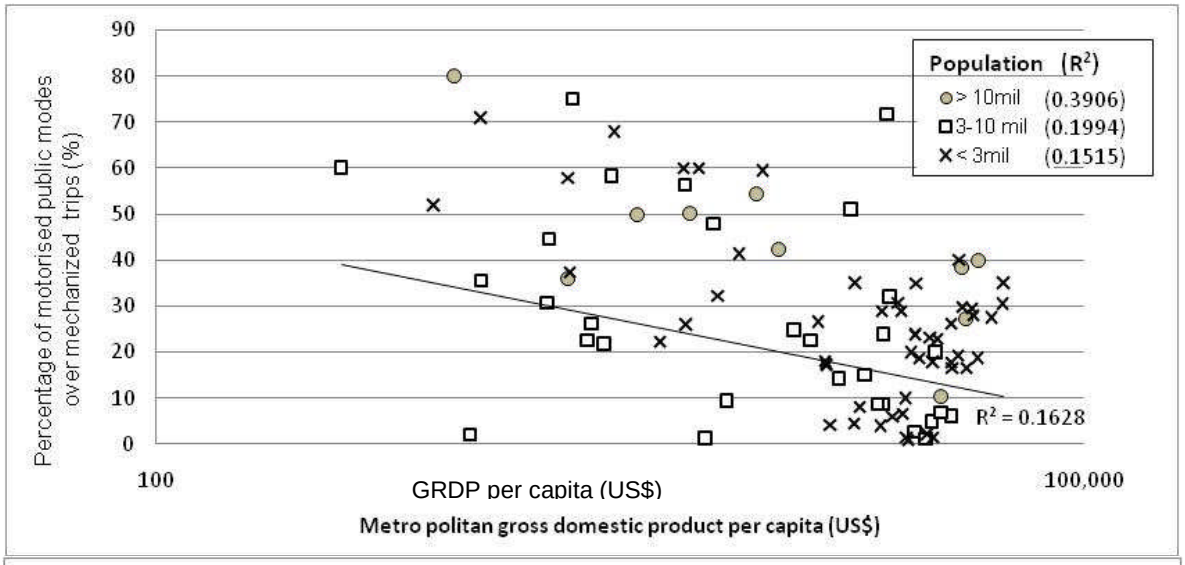
Note: The number in parentheses after each city name indicates the year of the JICA master plan study. The ratio of passenger car ownerships and the modal share of public transit pertain to the year when each JICA study was conducted.

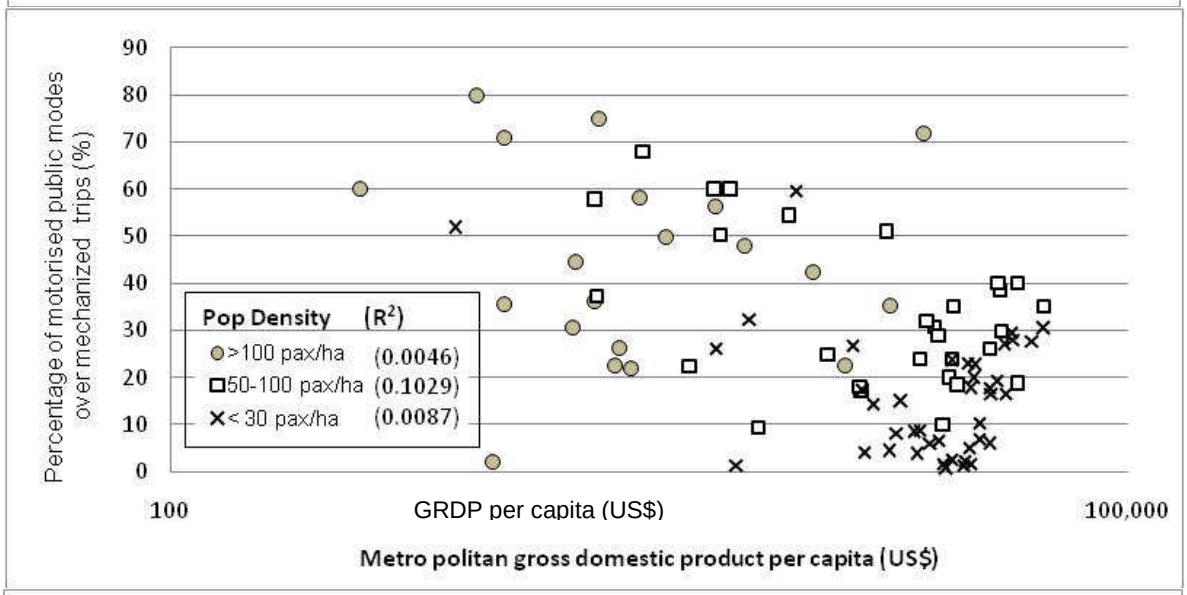
Sources: Various JICA Study Reports and *the Millennium Cities Database for Sustainable Transport*.

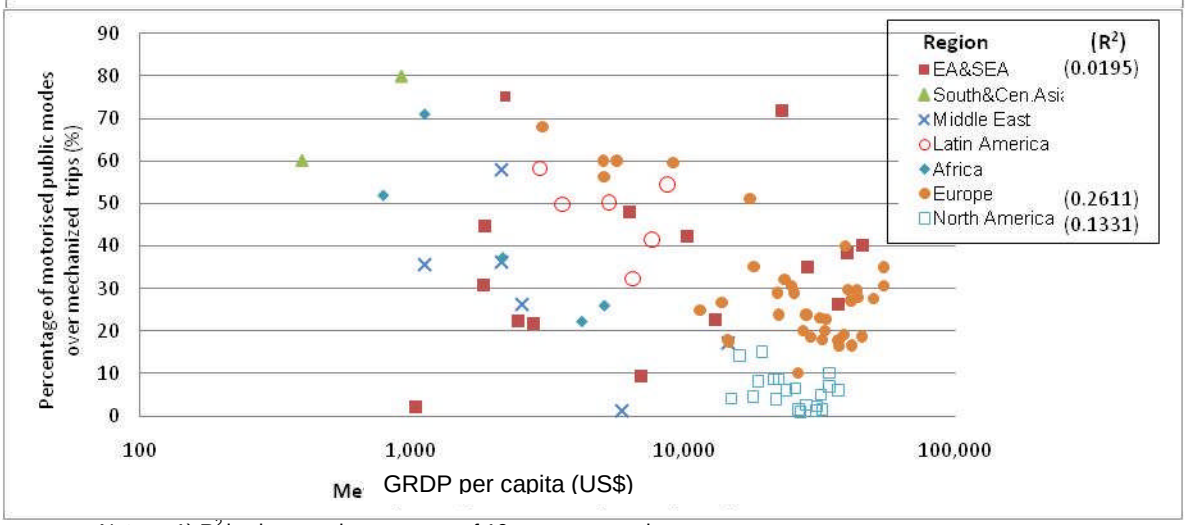
(4) Modal Share of Public Transit and Per Capita GDP

The relationships between the level of per capita GDP and the share of public transit are plotted in Figure 2.15 in terms of population size, urban density and regional distribution. The plotting shows a tendency of inverse correlation between the higher level of per capita income and the lower share of public transit. This general tendency is in agreement with the correlation between the higher economic level and the higher car ownerships.

Figure 2.15 Per Capita GDP and Modal Share of Public Transit (100 Cities in 1995)



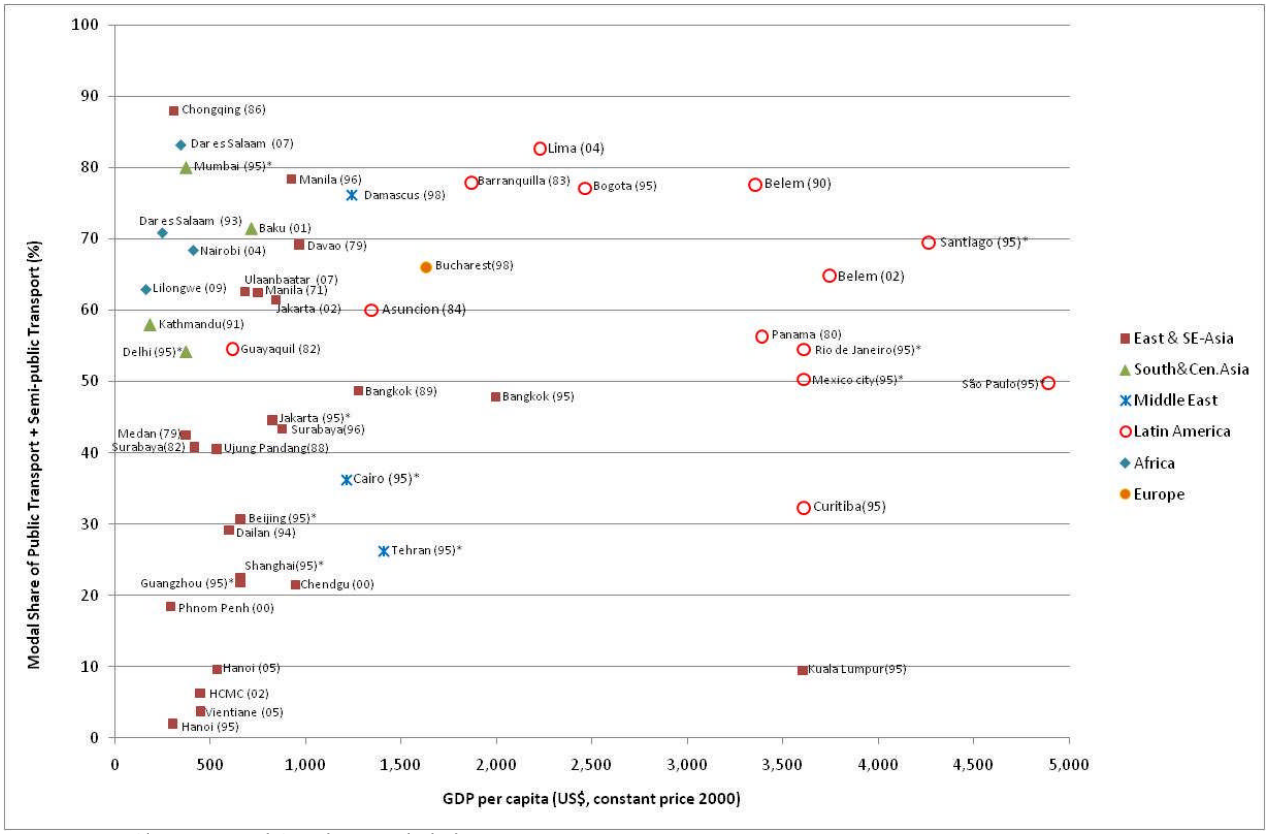




Notes: 1) R^2 is shown only on groups of 10 or more samples.
2) GRP is expressed as metropolitan gross domestic product in the UITP database.
Source: UITP, *The Millennium Cities Database for Sustainable Transport*, 2000.

The analysis of JICA-studied cities plotted in Figure 2.16 does not indicate a similar general tendency of inverse correlation between the higher per capita income and the lower share of public transit. The divergence is especially pronounced among the cities of East and Southeast Asia, many of which rely on two-wheelers for intra-city trips. There is no clear relationship between two indices in Latin American cities where the share of public transit ranges from 50 to 80%. Cities in South and Central Asia and Africa are very low in per capita GDP and accordingly low in passenger car ownerships. Intra-city travels are done mostly on foot. If such trips on foot are excluded from the total traffic, the share of public transit rises to a high level.

Figure 2.16 Per Capita GDP and Modal Share of Public Transit (65 JICA-studied Cities)

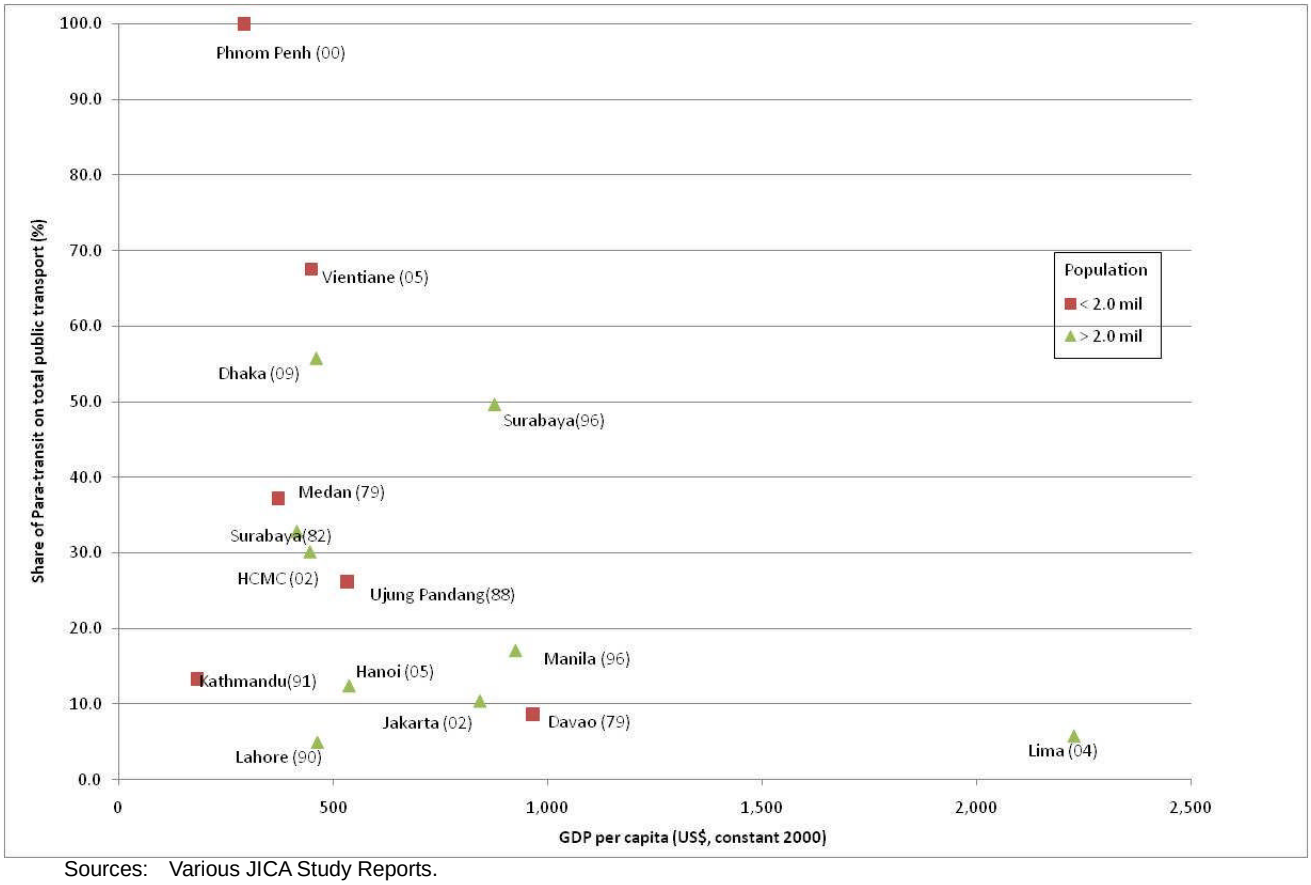


Note: Singapore and Seoul are excluded.
Sources: Various JICA study reports and *the Millennium Cities Database for Sustainable Transport*.

3) Characteristics of Para-transits in Developing Countries

Public transportation is treated as one collective category in the foregoing analysis. However, it consists of organized public transits like railways and buses that service fixed lines on schedule, so-called para-transits with no fixed schedule and service line, and semi-public transit by taxi and school bus. The relationships between per capita GDP and the share of para-transits in public transportation are plotted in Figure 2.17. Although the plotted cities are limited in number, the para-transits have a larger share in public transportation in low-income countries, especially pronounced in Asian cities.

Figure 2.17 Share of Para-transits in Public Transportation (JICA-studied Cities)



Sources: Various JICA Study Reports.

4) Patterns of Urban Two-wheeler Traffic

It has been made clear in the foregoing analysis that the cities of developing countries which rely more heavily on two-wheelers diverge distinctly from the general tendencies of correlation found elsewhere. Separate analysis is necessary on such cities with a higher share of two-wheelers in urban traffic in terms of modal split[1], as shown in Figure 2.18.

Of the JICA-studied cities where information is available on two-wheeler traffic, 7 cities fit the condition of having a high share of two-wheelers in urban traffic[2]. These two-wheeler cities are all found in Asian countries in the early phase of economic development, as summarized in Table 2.4.

Table 2.4 Summary Profiles of Ten Two-wheeler Cities

City	Year[1)]	Population (000)	Density (prs/km^2)[2)]	GDP Per Capita (US$)	Modal Share (%) [3)]		Car Ownership (vehicles/1000prs)
					Two-wheeler	Public Trans.	
Chengdu,	2000	3,068	5,240	949	67.1	14.7	48.3
Surabaya	1982	2,018	6,915	417	46.9	27.4	20.1
	1996	2,473	8,477	878	41.9	21.5	54.3
Ujung Pandang	1988	779	4,610	534	41.2	29.9	15.1
Hanoi	1995	2,292	3,915	305	96.9	2.0	11.5
	2005	3,183	3,456	539	86.7	6.2	51.0
Ho Chi Minh	1996	-	-	328	96.0	3.0	-
	2002	5,285	2,461	448	91.5	2.5	12.1
Vientiane	2007	422	1,110	450	82.5	1.2	14.9
Phnom Penh	2000	1,152	2,980	293	70.2	0.0	41.8
Beijing	1995	8,164	2,457	658	42.6	30.7	42.9
Shanghai	1995	9,570	3,277	658	67.1	22.5	15.2
Guangzhou	1995	3,854	1,920	658	52.8	21.8	20.2

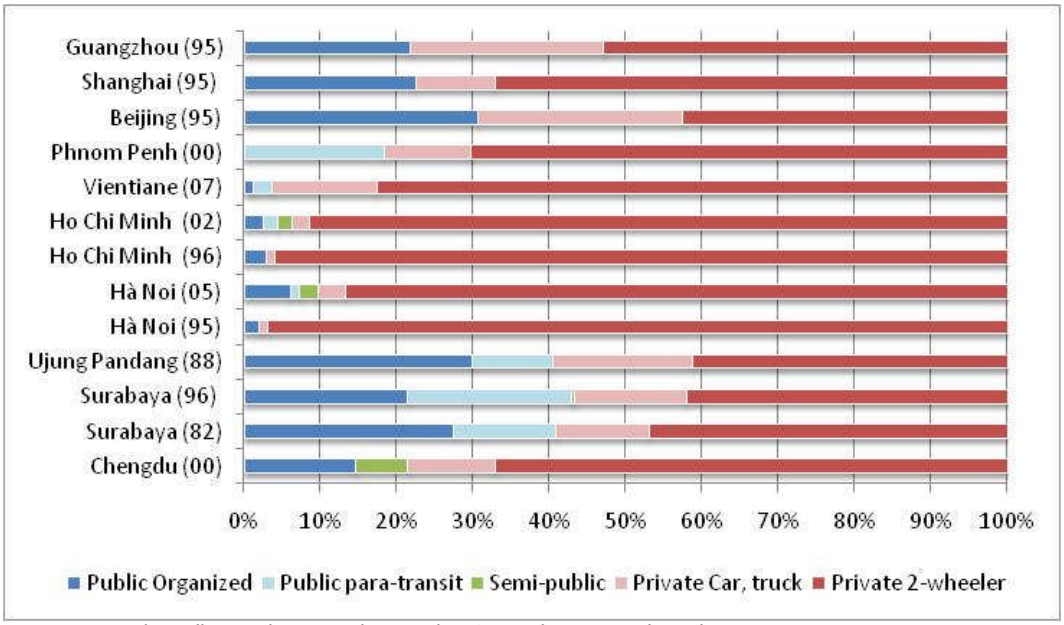
Notes: 1) Indicates the year when each JICA study was conducted
2) For Guangzhou, Shanghai and Beijing, the density is estimated on the basis of density figures in *Demographia 2010*, by using population estimates of *Demographia* and the UITP publication.
3) In Guangzhou, Shanghai and Beijing, bicycles are regarded as "mechanized non-motorized mode (NMT) and classified as two-wheelers, and thus motorbikes are not classified to two-wheelers. The available data do not distinguish " public (para-transit) "and "semi-public" modes.

Sources: Various JICA study reports, data on Guangzhou, Shanghai and Beijing taken from *the Millennium Cities Database for Sustainable Transport* (UITP 2000), and per capita GDP from *World Development Indicators 2008*.

[1] Urban transport modes are classified into public transport (consisting of organized, para-transit and semi-public) and private transport (consisting of passenger car and two-wheeler).

[2] 7 cities are those shown in Table 2.4, but excluding Beijing, Shanghai and Guangzhou. Three Chinese cities were two-wheeler cities at the time of the JICA study (1995), but are not included in the present study because of the rapid motorization since then that put them wide apart from 7 cities. (See Section 1.5 "Cautions on the Use of the Study Report" in Chapter 1)

Figure 2.18 Modal Split in Ten Two-wheeler Cities



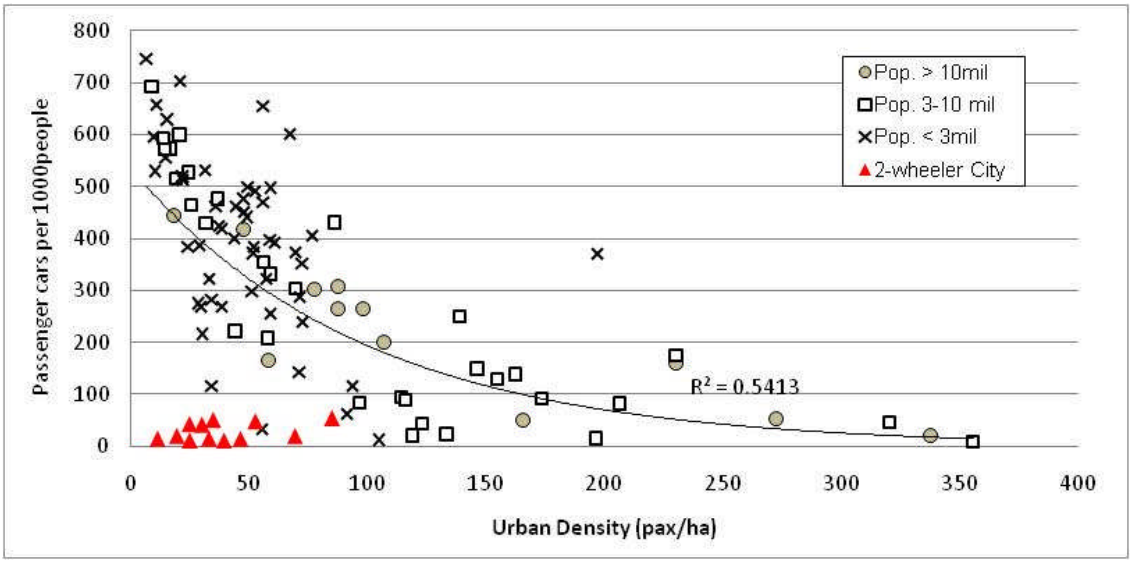
Notes: 1) Indicates the year when each JICA study was conducted
2) In Guangzhou, Shanghai and Beijing, bicycles are regarded as "mechanized non-motorized mode (NMT) and classified as two-wheelers, and thus motorbikes are not classified to two-wheelers. The available data do not distinguish "public (para-transit) "and "semi-public" modes.

Sources: Various JICA study reports, the data on Guangzhou, Shanghai and Beijing taken from *the Millennium Cities Database for Sustainable Transport* (UITP 2000).

Urban and transport indices of 10 Asian cities are examined in the comparative perspective with the findings about 100 global cities shown in Figures 2.19 and 2.20. Although the different data definitions do not warrant straightforward comparison[1], Asian cities heavily reliant on two-wheelers .distinctively diverges from the strong correlations found among 100 cities between urban density and passenger car ownerships and between car ownerships and the modal share of public transit.

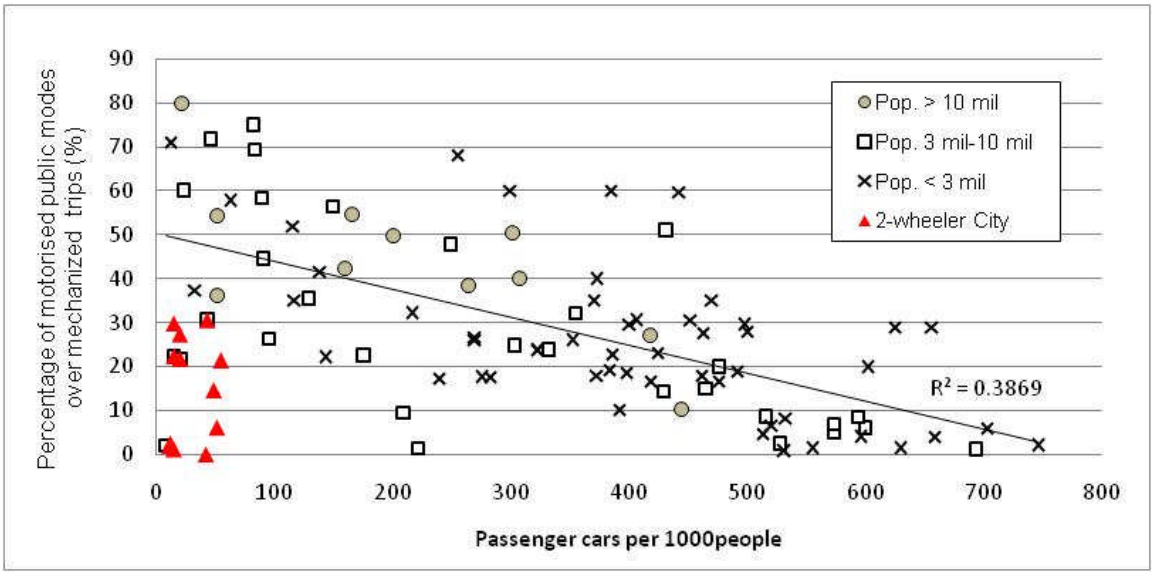
[1] For example, the urban density cited in the UITP-compiled database on 100 cities pertains to the central area of each city, whereas the equivalent figure available in JICA studies concerns the entire administrative area of a city.

Figure 2.19 Urban Density and Passenger Car Ownerships: Comparison between 100 Cities and Two-wheeler Cities



Sources: UITP, *The Millennium Cities Database for Sustainable Transport*, 2000, various JICA Study Reports and *Demographia 2010.*

Figure 2.20 Passenger Car Ownerships and Modal Share of Public Transit: Comparison between 100 Cities and Two-wheeler Cities



Sources: UITP, *The Millennium Cities Database for Sustainable Transport*, 2000, various JICA Study Reports and *Demographia 2010.*

5) Current Urban Situations and Traffic Patterns

In this section, three indices influencing urban traffic patterns, i.e. urban density, per capita GDP and passenger car ownerships, are graphically plotted to see the inter-relationships that exist between the present urban situations and the traffic patterns therein. The plotted cities are examined in terms of population size, per capita GDP level and regional distribution to clarify the inter-relationships. The findings of the analysis are summarized in Table 2.5.

Compared with 100 global cities taken from the UITP database, the cities that have been studied by JICA for urban transport strategy formulation are found to diverge somewhat from the global tendencies. Especially among JICA-studied Asian cities, the larger their modal share of two-wheelers, the more divergent they are from the global tendencies.

Table 2.5 Relationships between Urban Transport and Three Indices

	(1) Density and Public Transit Share	(2) Density and Car Ownerships	(3) Car Ownerships and Public Transit Share	(4) Public Transit Share and Per Capita GDP
(A) 100 Global Cities[1]	・Higher public transit share found in higher-density cities ・Correlation is weak (R^2＝0.24), but becomes strong when per capita GDP exceeds US$10,000	・Lower ratios of car ownerships found in higher-density cities ・Correlation is moderate (R^2＝0.54), but becomes strong when per capita GDP exceeds US$10,000	・Higher ratios of car ownerships associated with lower public transit share ・Correlation is weak (R^2＝0.38), but becomes strong when per capita GDP exceeds US$10,000	・Lower public transit share associated with higher per capita GDP ・Correlation is weak (R^2＝0.16)
(i) Pop. Size	・No variation in correlation by population size		・Correlation gets stronger among cities of large pop. (R^2＝0.56)	
(ii) Per Capita GDP	・Stronger correlation among high-income cities ・Weaker correlation among medium- and low-income cities	・The ratio of car ownerships becomes higher among high-income cities ・Correlation is very weak among medium- and low-income cities	・Correlation becomes stronger among high-income countries ・Correlation is weak among medium- and low-income cities	・Correlation becomes stronger among high-income cities
(iii) Region	・North American and European cities are respectively found concentrated in a certain narrow range ・No discernible correlation among cities in Southeast Asia, Middle East and Latin America	・North American and European cities are respectively found concentrated in a certain narrow range ・No discernible correlation among cities in Southeast Asia, Middle East and Latin America	・North American and European cities are respectively found concentrated in a certain narrow range ・No discernible correlation among cities in Southeast Asia, Middle East and Latin America	
(B) 57 Strategy -studied Cities[2]	・General correlation is absent ・Low density and large public transit share in Africa ・Large public transit share irrespective of density level in Latin America ・Large public transit share correlated with high density in Asian cities with 5 million or more population	・Higher ratios of car ownerships found in low-density cities ・Low ratios of car ownerships irrespective of density level in Africa and Latin America	・Inverse correlation found in many cities except those in Asia Some cities in Asia have a low ratio of car ownerships and a low public transit share（e.g. Beijing, Guangzhou, Hanoi, Ho Chi Minh, Phnom Penh, Vientiane, etc. See remarks on two-wheeler cities below）	・No discernible tendency of association between high income and low public transit share ・Cities of East & Southeast Asia deviate greatly from the general tendency of correlation ・No discernible correlation of income level and public transit share in Latin American cities ・Heavy dependence on walk in cities of Central $ South Asia and Africa When trips on foot are excluded, public transit has a large modal share.
(C)Two-wheeler Cities[3]		・Low density and low ratio of car ownerships	・Low car ownerships and low public transit share	

Notes: 1) Regional distribution is as follows: 15 cities in East & Southeast Asia, 3 in Central & South Asia, 10 in Latin America, 6 in Middle East, 20 in North America and Australia, 5 in Africa and 41 in Europe. The database pertains to 100 cities as of 1995.
2) Data on 57 cities are obtained from the reports of JICA master plan studies. The years of JICA studies are various. For more details, see (2) of Section 2.2 in Chapter 2.
3) Cities where the two-wheeler mode has the largest share in the total traffic volume. For more details, see 4) of Section 2.2 in Chapter 2.

Sources: UITP, *Millennium Cities Database for Sustainable Transport*, 2010, and various reports of JICA master plan studies.

2.3 Conditions for Introducing a Mass Transit System

It is now generally acknowledged regarding large cities in the world that it would be no longer possible to continue servicing the growing motorized traffic by constructing more and more roads. It is no exaggeration to say that the most fundamental issue shared by global urban policymakers is how to facilitate a shift in transport demand from the private use of passenger cars to public transport means.

However, many large cities in the developing world are poorly provided with public transport means. When the brake should be stepped on against the increasing trend in private car ownership and use, the available public transport means would not be capable of absorbing the shift of passenger traffic. Therefore, the most urgent issue in such cities is the development of urban public transport services. An urban transport strategy in such a context must deal with the issue of selecting a most suitable mode which will play a central role in public transportation over the medium to long time span. The present study clarifies the conditions for selecting a central public transport mode by examining the JICA-studied cities with regard to their different social and economic development phases, their choices of mass transits and/or urban highways.

1) Current Situations of Mass Transits in Operation

The time of starting the operation of a metro system[1] or a BRT system[2] is summarized in Table 2.6 regarding 67 cities. In the present study, metro systems mean subway, LRT and monorail systems.

[1] A metro system is defined as an urban electric passenger transportation system with high capacity and high frequency of service, which is totally independent from other traffic, road or pedestrian. The terms heavy rail (mainly in North America) and heavy urban rail often have similar definitions.

[2] The term BRT is applied to a variety of public transportation systems using buses to provide faster, more efficient service than conventional bus services. Often this is achieved by making improvements to existing infrastructure, vehicles and scheduling. The goal of BRT systems is to achieve the service quality comparable to railway transits, while taking advantage of the low cost and the flexibility of bus transits.

Table 2.6 Time of Starting Operation of Metro and/or BRT Systems (1/2)

City		Time of Starting Operation	
City	Country	Metro System	BRT System
Asia			
Seoul	Korea	1974	2005
Hangzhou	China	-	2006
Chongqing	China	2005 (Monorail)	2008
Dalian	China	2003	2008
Chengdu	China	2010	-
Beijing	China	1969	2004
Shanghai	China	1995	-
Guangzhou	China	1997	2010
Ulaanbaatar	Mongol	-	-
Manila	Philippines	1984 (LRT)	-
Davao	Philippines	-	-
Hà Noi	Vietnam	Under construction	Under planning
Ho Chi Minh City	Vietnam	Under construction	-
Vientiane	Laos	-	-
Phnom Penh	Cambodia	-	-
Bangkok	Thailand	1999	2010
Kuala Lumpur	Malaysia	1996 (LRT)	-
Johore Bharu	Malaysia	-	-
Singapore	Singapore	1987	-
Jakarta	Indonesia	Under construction	2004
Surabaya	Indonesia	-	Under planning
Medan	Indonesia	-	Under planning
Ujung Pandang (Makassar)	Indonesia	-	-
Dhaka	Bangladesh	-	-
Kolkata (Calcutta)	India	1984	Under planning
Mumbai (Bombay)	India	Under construction	2008
Delhi	India	2002	2008
Hyderabad	India	Under planning	Under construction
Pune (Poona)	India	Under construction	2008
Lahore	Pakistan	-	-
Karachi	Pakistan	-	-
Colombo	Sri Lanka	-	-
Kathmandu	Nepal	-	-
Kabul	Afghanistan	-	-
Baku	Azerbaijan	1967	-
Middle East			
Teheran	Iran	2000	2008
Baghdad	Iraq	-	-
Damascus	Syria	-	-
Cairo	Egypt	1987	2009
Central and South America (1/2)			
Guadalajara	Mexico	-	-
Mexico City	Mexico	1969	2005
Guatemala City	Guatemala	-	2007
Managua	Nicaragua	-	-
Panama City	Panama	-	-
Barranquilla	Colombia	-	2010
Cartagena	Colombia	-	Under construction

Table 2.6 Time of Starting Operation of Metro and/or BRT Systems (1/2)

City		Time of Starting Operation	
City	Country	Metro System	BRT System
Central and South America(2/2)			
Bogota	Colombia	-	2000
Caracas	Venezuela	1983	Under construction
Guayaquil	Ecuador	-	2006
Lima	Peru	2003	2010
Santiago	Chile	1975	2007
Belem	Brazil	-	-
Sao Paulo	Brazil	1974	2003
Rio de Janeiro	Brazil	1979	Under construction
Curitiba	Brazil	-	1972
Asuncion	Paraguay	-	-
Buenos Aires	Argentina	1923	-
Africa			
Kampala	Uganda	-	-
Nairobi	Kenya	-	-
Lusaka	Zambia	-	-
Juba	Sudan	-	-
Dar es Salaam	Tanzania	-	-
Lilongwe	Malawi	-	-
Monrovia	Liberia	-	-
Bujumbura	Burundi	-	-
Europe			
Istanbul	Turkey	2000	2007
Bucuresti (Bucharest)	Rumania	1979	-
For reference			
Tokyo	Japan	1927	-

Sources: Metro information from the Global List of Metro Systems, (home page of the Japan Association of Metro Companies), and BRT information from Wikipedia search on relevant sources.

Including those cities where a system is under construction, 11 cities chose the operation of a metro system only and 10 cities decided on a BRT system, while 17 cities chose both metro and BRT systems.

Table 2.7 Operation or Development of Metro and BRT Systems

	Metro System Only	BRT System Only	Metro and BRT Systems	
			Order of Operation BRT➔Metro	Order of Operation Metro➔BRT
Asia	・Chengdu (2010) ・Shanghai (1995) ・Manila (LRT) (1984) ・Ho Chi Minh City (under construction) ・Kuala Lumpur (LRT) (1996) ・Singapore (1987) ・Baku (1967)	・Hangzhou (2006)	・Jakarta (2004→ under construction) ・Mumbai/Bombay (2008→ under construction) ・Hyderabad (under construction→ under planning) ・Pune /Poona (2008→under construction)	・Seoul (1974→2005) ・Chongqing(monorail) (2005→2008) ・Dalian (2003→2008) ・Beijing (1969→2004) ・Guangzhou (1997→2010) ・Hà Noi (Metro under construction and BRT under planning) ・Bangkok (1999→2010) ・Delhi (2002→2008) ・Kolkata/Calcutta (1984→under planning)
Middle East	－	－	－	・Tehran (2000→2008) ・Cairo (1987→2009)
Central and South America	・Buenos Aires (1913)	・Guatemala City (2007) ・Barranquilla (2010) ・Cartagena (under construction) ・Bogotá (2000) ・Guayaquil (2006) ・Curitiba (1972)	－	・Mexico City (1969→2005) ・Caracas (1983→under construction) ・Lima (2003→2010) ・Santiago (1975→2007) ・São Paulo (1974→2003) ・Rio de Janeiro (1979→under construction)
Africa	－	－	－	－
Europe	・Bucuresti (1979)	－	－	・Istanbul (2000→2007)

Table 2.8 Characteristics of Metro and BRT Operation

Metro System Only	BRT System Only	Metro and BRT Systems	
		Order of Operation BRT➔Metro	Order of Operation Metro➔BRT
♦ Early introduction under socialist regimes ♦ Large-scale urbanization before the advent of motorization ♦ Cities with a metro system only have been decreasing. Many cities began to integrate the metro system with BRT services.	♦ Cities of this type are mainly found in Latin America ♦ A large-scale BRT system is an effective substitute to a metro system	♦ A BRT system is introduced as a precursor to a metro system ♦ The order of introduction is becoming a trend. ♦ Many cities of this type are found in India.	♦ A BRT system is complementary to a metro system. ♦ The order of introduction is found in many cities with metro systems of long standing.

2) Capacity of Basic Urban Public Transit Systems

The respective capacities of different public transit systems (line bus, BRT, monorail, LRT, subways, etc.) are examined by comparing the performances of the systems in operation in selected cities of Asia. The transport capacity of a given public transit system is measured in terms of passengers per hour per direction (PPHPD) during peak hour. The findings can be roughly summarized as shown in Figure 2.21.

Figure 2.21 Capacity of Urban Public Transit Systems

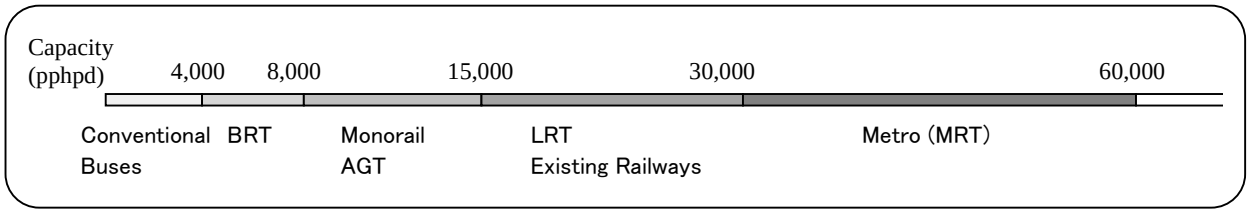


Table 2.9 Outlines of Selected Public Transit Systems in Asia

Mass Transit	1st Year of Operation; Total Length (km)	No. of Stations; Average Distance between Stations	Maximum Peak Hour (PPHPD)			Daily Passengers (persons/day)	Daily Passengers per Km (persons/ day/km)
			Frequency of Train Services (times)	Passenger Capacity (persons)	Through Passengers (persons)		
AGT, Tokyo Yurikamome Line	1995 14.7km	16 1.0km	15	5,152	5,032	103,177	7,019
Monorail, Tokyo Tokyo Monorail	1964 17.8km	10 2.0km	18	10,512	9,975	130,500	7,331
Mini Subways, Tokyo Oedo Line	1991 40.7km	38 1.1km	19	14,820	26,835	796,300	19,565
Subways, Tokyo Tokyo Metro East West Line	1966 30.8km	23 1.3km	27	38,448	76,606	1,335,200	43,351
Urban Railways, Tokyo JR Eastern Japan, Yamanote Line	1872 34.5km	29 1.2km	25	40,700	84,370	3,855,700[1]	187,171[1]
Monorail, Chongqing Chongqing Railways, Line No. 2	2005 19.15km	18 1.1km	17	14,000	—	383,562	20,029
LRT, Manila Line No. 1 (Yellow Line)	1984 17.2km	20 0.9km	12	19,536	—	409,000	23,779
LRT, Manila Line No. 2 (Purple Line)	2004 13.8km	11 1.3km	12	5,100	—	170,000	12,319
BRT, Jakarta TransJakarta Line No. 1	2004 13km	20 0.7km	60			230,000[2]	1,855

Notes: 1) Between Tabata and Shinagawa Stations
2) 8 lines with a total extension of 124km

Source: *Urban Transport Yearbook 2009* and *Regional Transport Yearbook 2009*; Wikipedia-searched home pages of the respective companies.

(a) Chongqing Monorail System (Chongqing Rail Transit)

The monorail system in Chongqing uses the same type of vehicles as Osaka Monorail and operates trains of 8 vehicles each. In Osaka, the transport capacity is 103 pphpd per vehicle unit during peak hours. The service headway is 3.5 minutes during morning peak hours. Supposing from this that the frequency of services comes to 17 trains per peak hour, the transport capacity would be 14,000pphpd. According to the Wikipedia search, the web site of Chongqing Rail Transit announces the maximum transport capacity of 30,000pphpd. At present, the system is reported to carry a total of 140 million passengers per year, or 20,000 passenger kilometers per day. The performance is roughly equivalent to Oedo Line of the Tokyo Metropolitan Subway System.

(b) Manila LRT

The urban mass transit in Manila is an elevated railway system which has the characteristics of a metro system as well. It is commonly called LRT because it initially used LRT vehicles. Passenger traffic is largest on Line One which operates 24 trains of 4 vehicles per peak hour. The train capacity of four newest models is reported to be 1,350pphpd. The passenger capacity per vehicle is said to be 340 persons, more than double the 150-person capacity of commuter vehicles (E231 series) operated in Japan. The vehicle size in Manila is 2.6m x 26m, not much different from the E231 size of 2.95m x 20m. The “passenger capacity” of 340 persons as such in Manila means the congestion ratio of some 200%, to apply the calculation practiced in Japan. This implies that the actual passengers in Manila should be lower than the reported figure.

Line Two (Purple Line) operates the same train formation of 4 vehicles with transport capacity of 1,628pphpd. The headway of two minutes is reported to be possible, with maximum capacity of 60,000pphpd. Judging from the comparison of actual performances in Manila and Japanese mega cities, a more realistic estimate of transport capacity would be 30,000pphpd.

(c) Jakarta BRT (TransJakarta)

TransJakarta is a bus rapid transit (BRT) system in Jakarta, Indonesia. It was the first BRT system in Southern and Southeast Asia. It started on January 15, 2004. As of March 2011, there were 10 corridors (or lines) in operation, with five more to be built. It was designed to provide Jakarta citizens with a fast public transportation system to help reduce rush hour traffic. It is used by approximately 280,000 people every day. The buses run in special lanes, and the ticket prices are subsidized by the regional government. Currently, TransJakarta has the world's longest BRT routes with 172 km system length and has more than 520 buses in Operation.

Capacity of TransJakarta buses are 30 seated and 55 standing passengers for standard, and 180 passengers for 23 numbers of articulated buses. The transport capacity in peak hour is probably in the range from 3,200 to 4,000 pphpd by 2 to 15 minutes operation interval.

3) Development Phases and Operation of Metro Systems

(1) Timing to Start Operation

Figure 2.22 is prepared to show how the development phases of the cities are related to the timing to start operating their metro systems. The trends of urban population (data from UN Population Dept.) and GDP per capita of every 5 years during the period of 1960 -2010 (constant 2000 US$, taken from World Bank’s World Development Indicators) are plotted in the figure. The time when each metro system was opened for operation is marked by a circle. Two parallel lines in red signify the same levels of GRP (gross regional product) among the cities. GRP of a given city in this context is obtained as the product of the city’s population and GDP per capita. The solid red line (the start line or S-line) means the GRP level of US$3 billion, and the dotted line (the end line or E-line) shows the level of US$30 billion. The time to start the metro operation in the respective cities mostly falls between two GRP lines.

In East and Southeast Asia, Seoul and Singapore are plotted around the E-line. Chengdu,

Bangkok and Chongqing are around the S-line, while Kuala Lumpur, Dalian, Shanghai and Manila are found between the two lines. The metro system in Beijing was officially opened in 1969, but the construction and operation as a mass transit system in the true sense of the word began in 2002. Thus, the city is almost on the E-line. Tokyo began the operation of its first metro system in 1927.

In South and Central Asia and Middle East, Teheran, Cairo and Delhi are found at midpoints between two GRP lines, with Kolkata on the S-line. The metro system in Kolkata began its operation in 1984 over a distance of 28km and no extension has been made ever since. A plan of new extension is currently being prepared. The metro system in Delhi started operation in 2002, currently with 6 lines totaling 190km.

In Latin America, Buenos Aires was the first city to introduce its metro system in 1913, and Mexico City, Rio de Janeiro, Sao Paulo and Lima are found around the E-line. Caracas and Santiago are found between two GRP lines.

In Africa, there is no city that operates a metro system. In Europe, Istanbul is near the E-line, whereas Bucharest is around the S-line, opening its metro system in 1979.

Figure 2.22 Metro Operation Relative to GDP per capita and Urban Population Size (1/2)

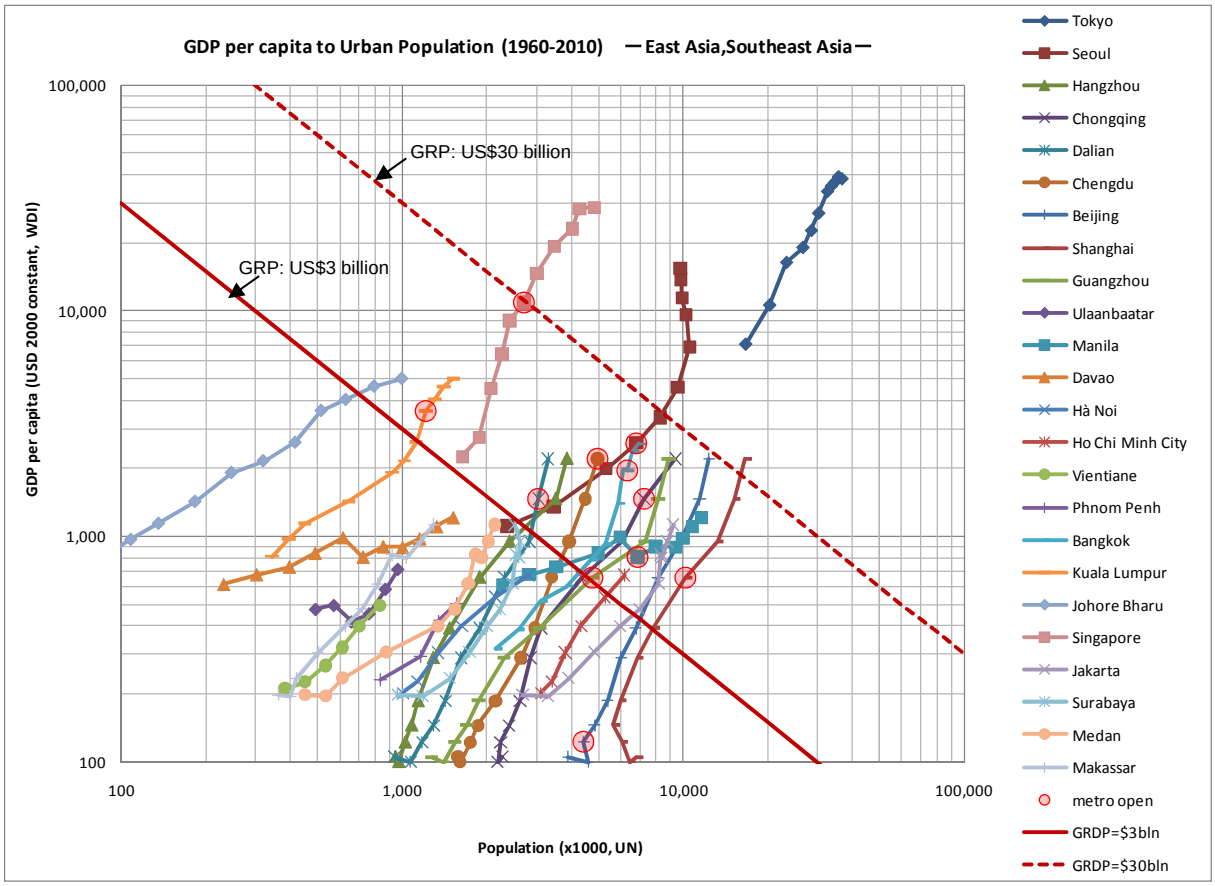
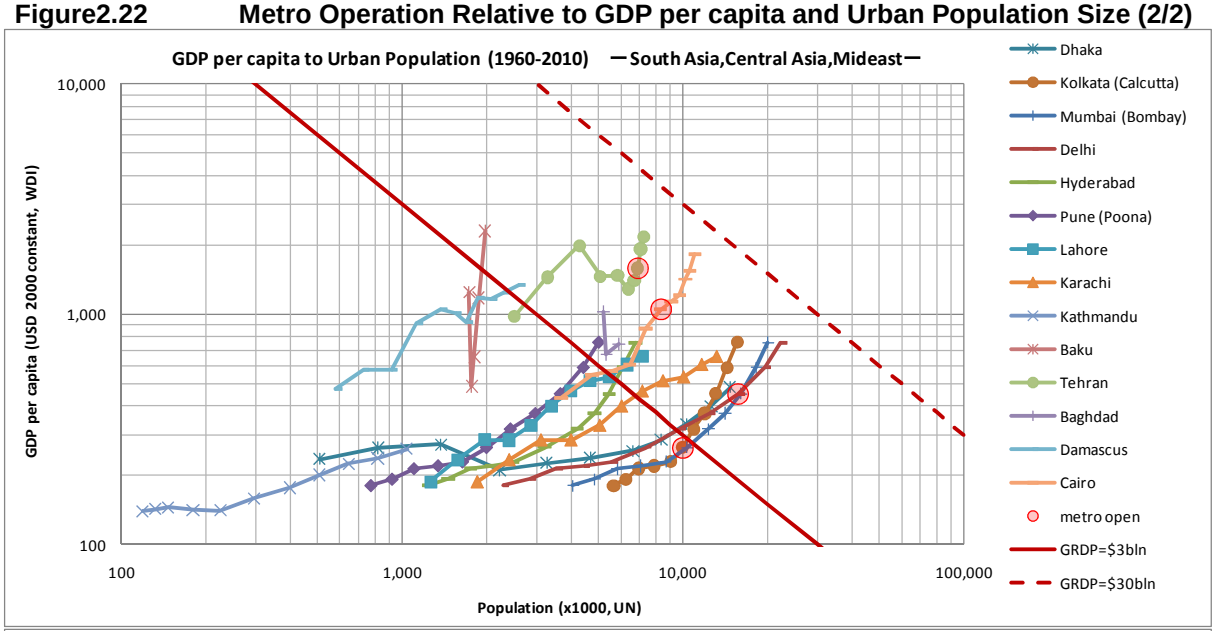
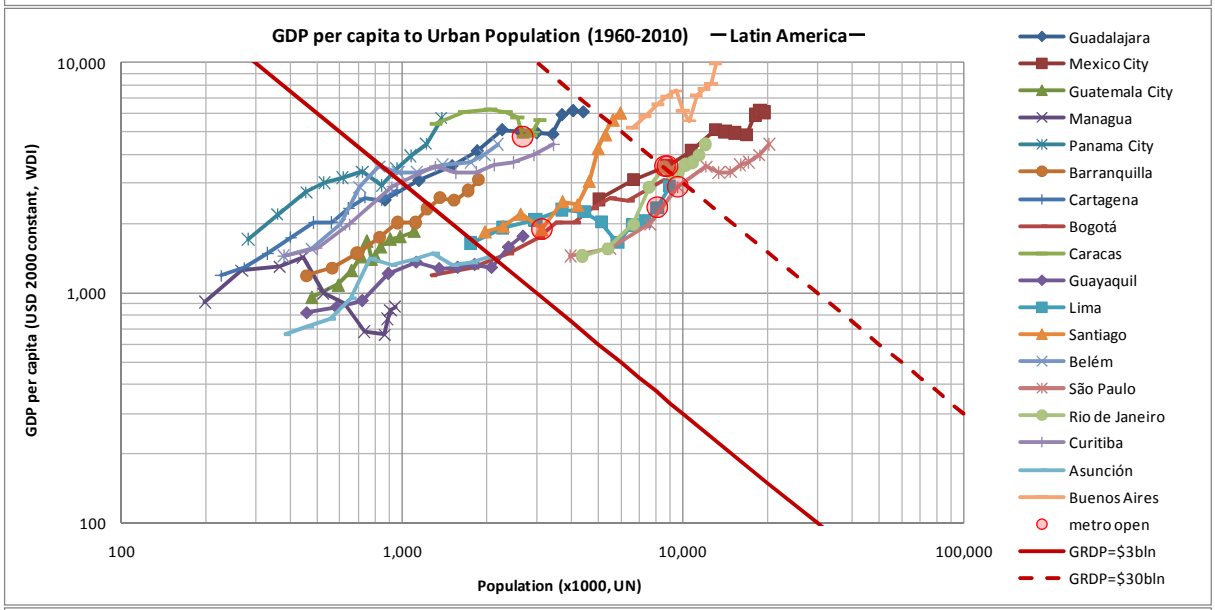
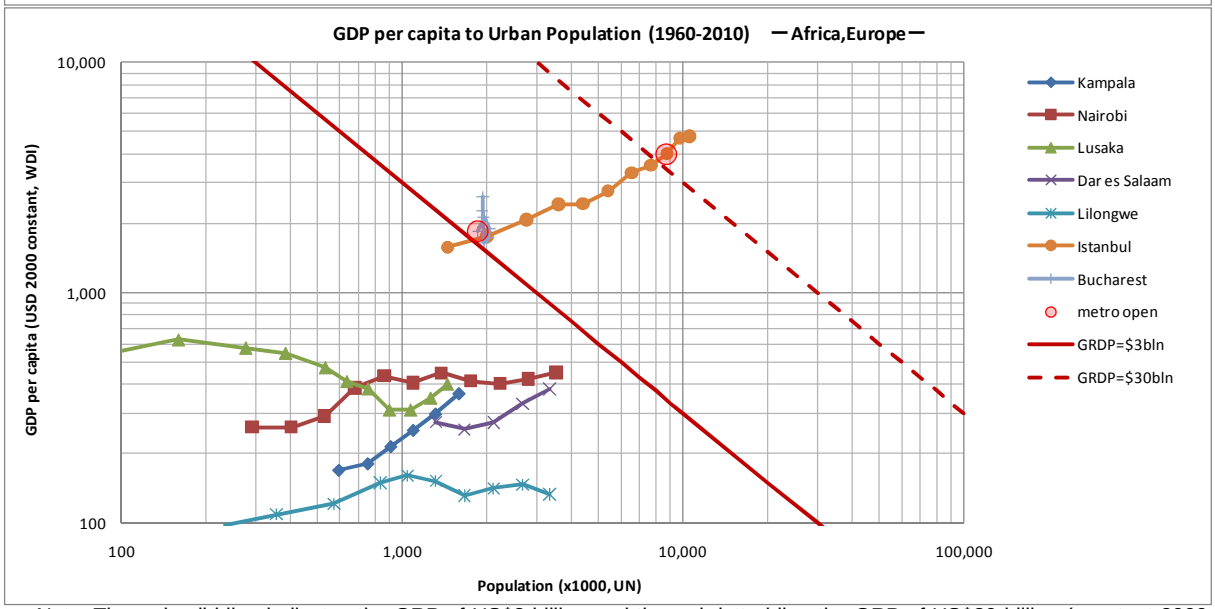


Figure2.22 Metro Operation Relative to GDP per capita and Urban Population Size (2/2)







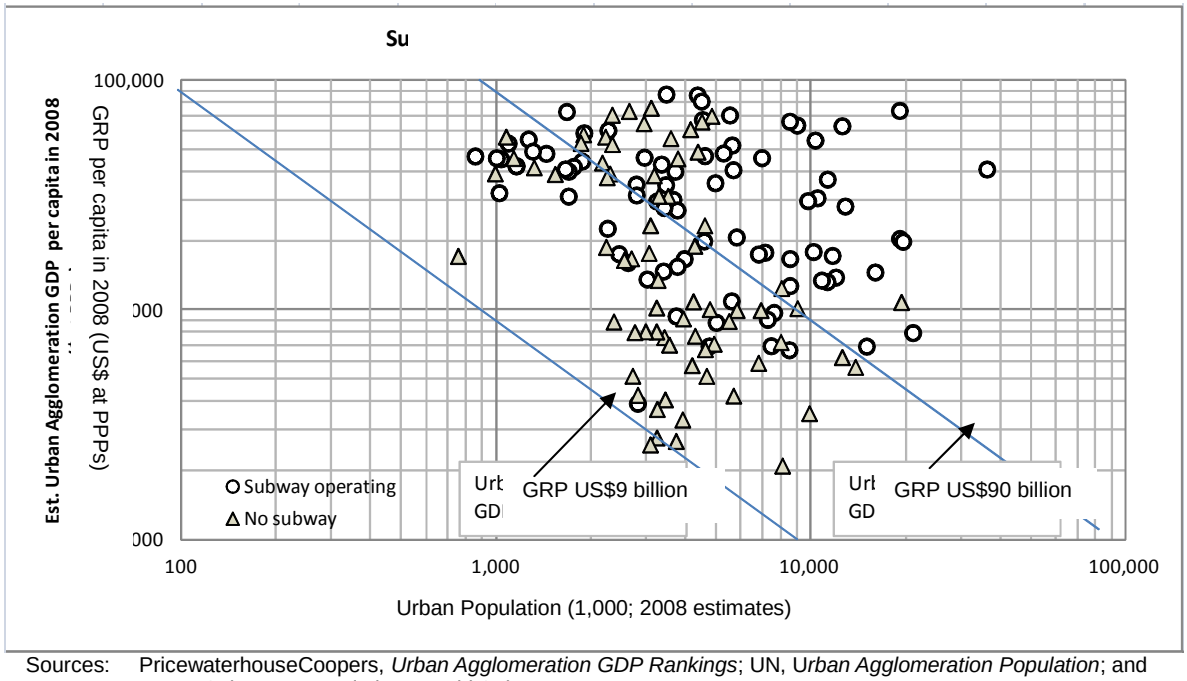
Note: The red solid line indicates the GRP of US$3 billion and the red dotted line the GRP of US$30 billion (constant 2000 US$). GRP of each city is calculated by multiplying the city population by GDP per capita

(2) Analysis of the Timing for Metro Operation

It is reasonable to argue that the timing for metro operation is closely related to the level of socio-economic development a city has achieved. The larger the city population, the more likely the city was to develop a metro system, even though GDP per capita was not high enough. As a corollary, cities blessed with higher levels of GDP per capita opened their metro systems, even if their population was yet small. It is possible to presume that the achievement of a certain level of GRP be the condition for a given city to introduce a metro system. Roughly speaking, the crucial level of GRP is around US$10 billion. As mentioned earlier, the GRP of a city is here calculated by multiplying the city's population (from UN population database) by GDP per capita (from WDI in constant 2000 US$), because the actual GRP estimate is not available on most of the cities. By the informed judgment over various data sources, GRP per capita in large cities could be worth 300% of GDP per capita in the developing world. It is reasonably arguable that the GRP range of US$9 – 90 billion makes the opening of a metro system economically possible and its operation sustainable.

Assume that a city with GRP of US$20 billion invest in a metro system, starting from the first 10km at the construction cost of US$80 million per km. The initial investment of US$0.8 billion would be equivalent to 4% of the city's GRP. Supposing the repayment in 40 years (interest rate of 0.3% per annum), the annual repayment would amount to 0.12% of GRP. Supposing further that the municipal government revenue be equivalent to 20% of the city's GRP, the initial investment would amount to about 0.6% of the annual revenue.

Figure 2.23 Subway Operation Relative to Urban Population and Per Capita GRP



Sources: PricewaterhouseCoopers, *Urban Agglomeration GDP Rankings*; UN, U*rban Agglomeration Population*; and Japan Subways Association, *World Subways.*

(3) Estimating Future Prospects of Metro System Development

Regarding those cities now without a metro system and short of the required level of economic development in 2010, the present study estimates their future possibility and timing of introducing a metro transit system. The future prospects are estimated only for those cities on which the available data sources provide GDP figures. Regarding the cities on which PricewaterhouseCoopers provides the GRP estimates, the GRP forecast is made for the period of 2015 – 2025. The GRP forecasts on each city are divided by the respective population projections and the growth rate of the resulting GRP per capita is then applied to GDP per capita of 2010.

The findings are shown in Figure 2.22. Among the cities which were not ready for a metro system in terms of GRP in 2010, Nairobi and Dar es Salaam would reach the launching point by 2025.

Among the cities on which the GRP estimates are not available, Davao, Ha Noi, Surabaya, Medan, Cartagena and Asuncion would be able to introduce a metro system by 2025, judging from the projected growth of urban population and per capita GDP.

Figure 2.24 Estimated Strategic Timing for Introducing Metro Systems(1/2)

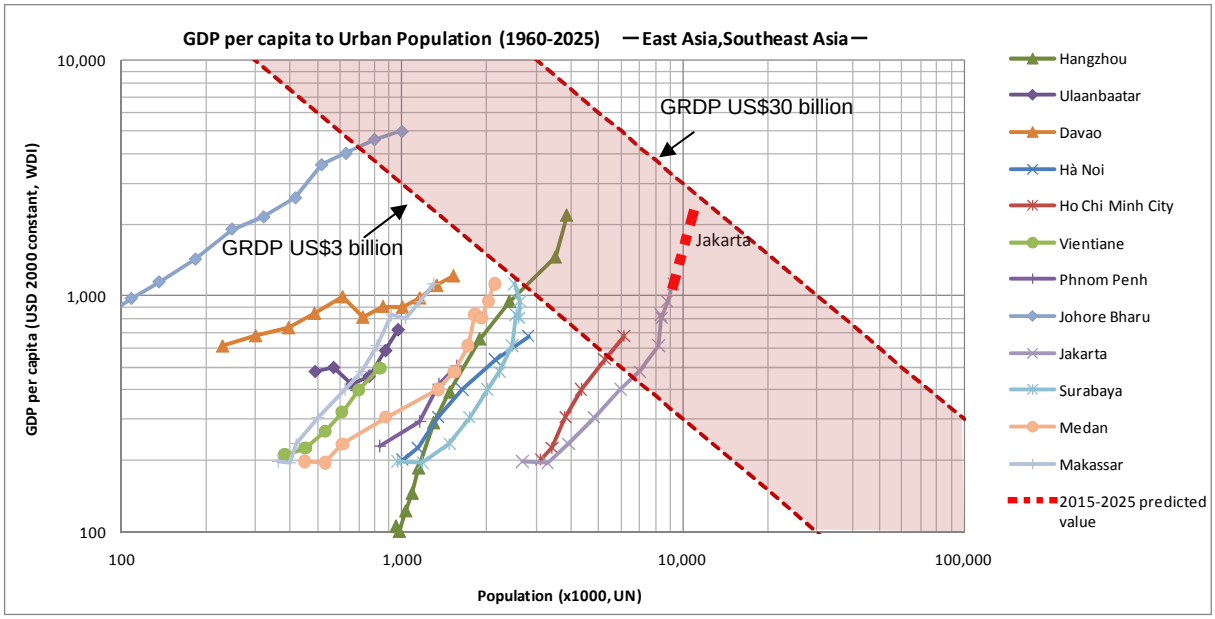
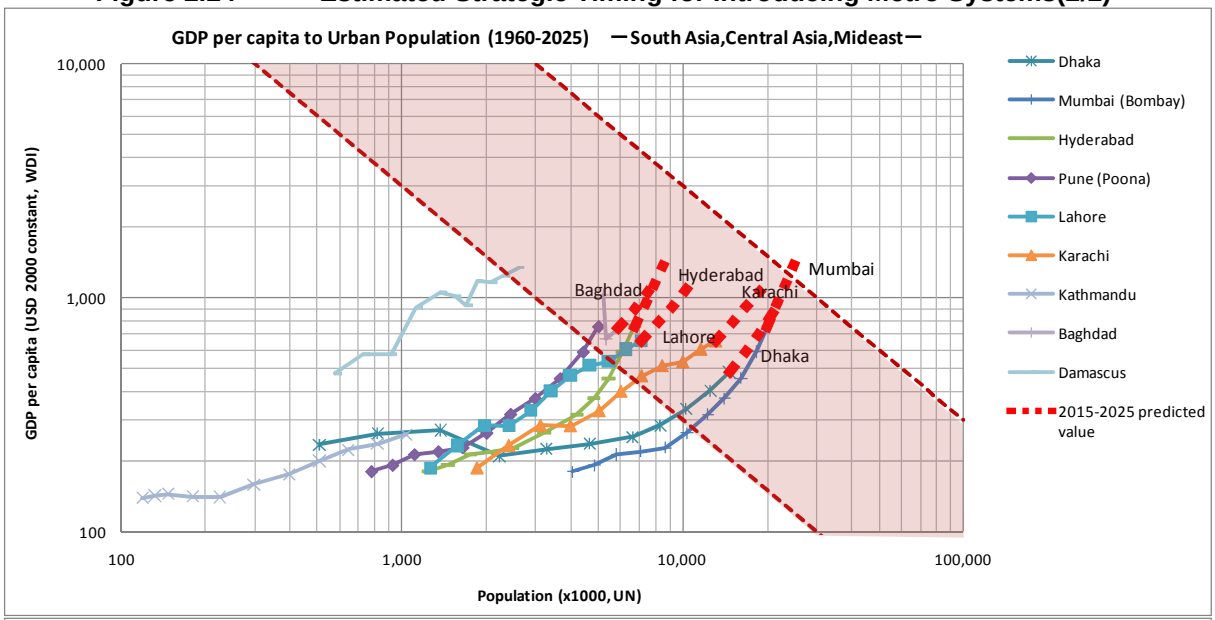
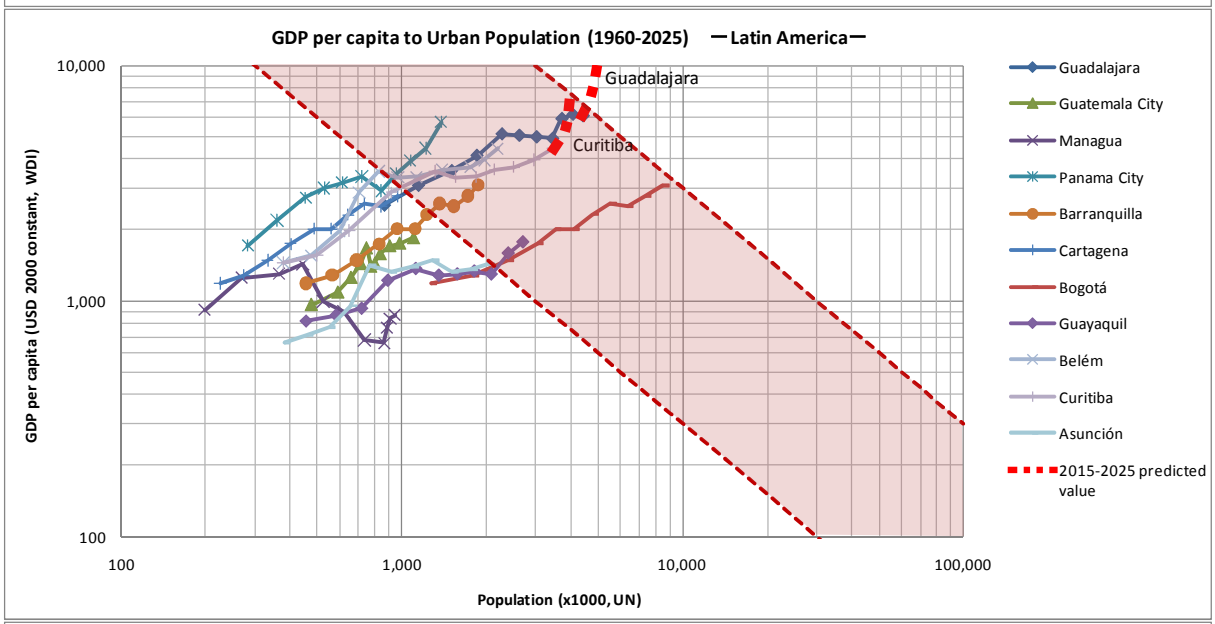


Figure 2.24 Estimated Strategic Timing for Introducing Metro Systems(2/2)





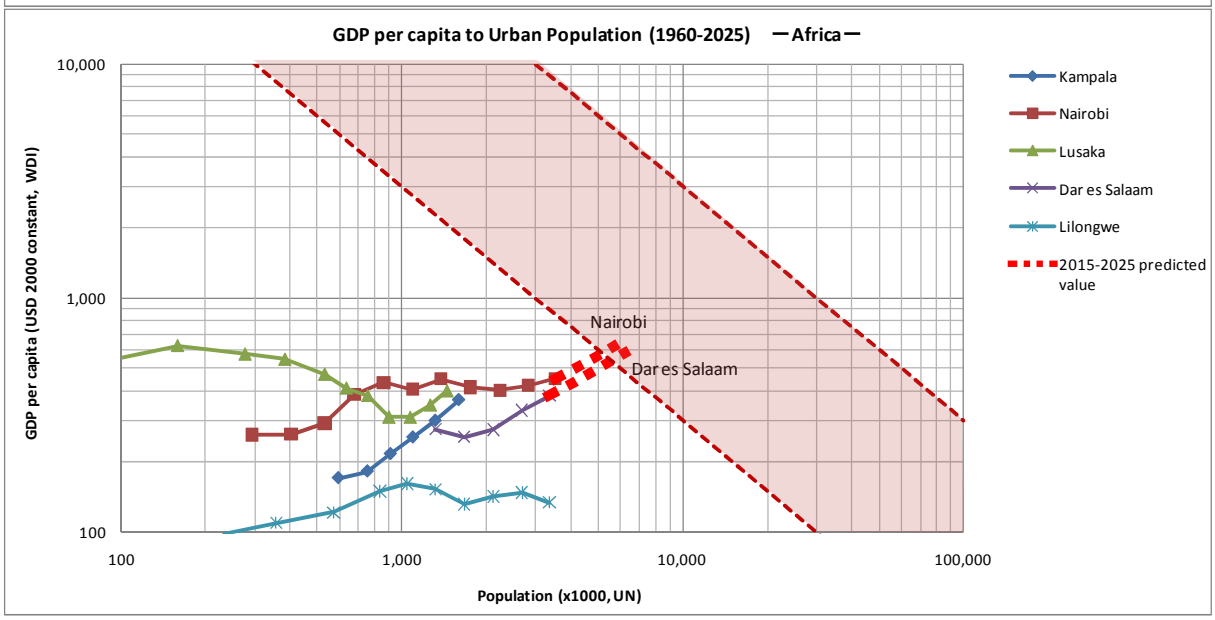


Table 2.10 summarizes the present situations and the estimated prospects of metro-system development in the JICA-studied cities. The development of a metro system takes long time to complete the project cycle of planning, design, construction and operation. For example, when a city is expected to reach the stage of operating a metro system by 2025, the lead time requires starting initial preparations now.

Table 2.10 Strategic Timing for Introducing a Metro System

Region	City with Metro System as of 2010	City without Metro System as of 2010		
		City Ready for Metro System as of 2010	City Ready for Metro System by 2025	City not Ready for Metro System before 2025
East Asia Southeast Asia	・Seoul ・Chongqing ・Dalian ・Chengdu ・Beijing ・Shanghai ・Guangzhou ・Manila ・Bangkok ・Kuala Lumpur ・Singapore	・Hangzhou ・Ho Chi Minh City (under construction) ・Johore Bharu ・Jakarta (under construction)	・Davao[1)] ・Hà Noi (under construction) ・Surabaya ・Medan	・Ulaanbaatar ・Vientiane ・Phnom Penh ・Makassar
South Asia Central Asia	・Kolkata/Calcutta ・Delhi ・Baku	・Dhaka ・Mumbai /Bombay ・Hyderabad ・Pune/Poona ・Lahore ・Karachi	―	・Kathmandu
Middle East	・Tehran ・Cairo	・Baghdad ・Damascus	―	―
Central and South America	・Mexico City ・Caracas ・Lima ・Santiago ・São Paulo ・Rio de Janeiro ・Buenos Aires	・Guadalajara ・Panama City ・Barranquilla ・Bogotá ・Guayaquil ・Belém ・Curitiba	・Cartagena ・Asunción	・Guatemala City ・Managua
Africa	―	―	・Nairobi (2020)[2)] ・Dar es Salaam (2025)[2)]	・Kampala ・Lusaka ・Lilongwe
Europe	・Istanbul ・Bucharest	―	―	―

Notes: 1) Shaded cities do not have GRP estimates in the available publications. Their GRPs are estimated by the present study team from the recent growth rates of the respective per capita GDP and city population These cities are not included in Figure 2.10 on 100 global cities
2) Forecast from the available GRP estimates.
3) Colombo, Kabul, Juba, Monrovia and Bujumbura are excluded from the table, because either their respective population or per capita GDP is not available.

Sources: Demographia and the estimation by the study team on the basis of available sources

4) Scales of Urban Economy and Metro System

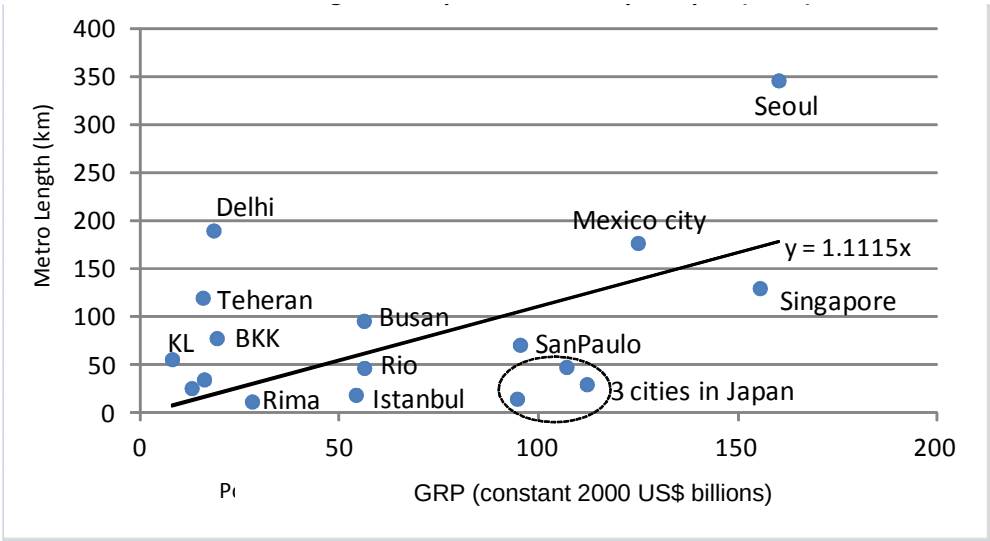
GRP of a given city is here calculated as the product of the city's population and GDP per capita. Figure 2.25 plots the relationship in 2010 of GRP and the service length of a metro system regarding 17 cities. The plots are somewhat dispersed but the relationship can be expressed by the following formula.

Metro Length (km)＝City Population×GDP per capita of 2010 (constant 2000 US$) / 1.0 billion

It can be argued that a city is capable of operating and maintaining a kilometer of the metro network when its GRP reaches the scale of US$1 billion.

Three cities in Japan (Sapporo, Sendai and Fukuoka) show shorter service length of their metro systems than other cities of developing countries. This is primarily because their population is much smaller, and given the same scale of urban economy, per capita income is high enough for urban dwellers to afford car ownerships. The modal share of private automobiles thus settles at a higher level and dampens an attempt to justify a further extension of metro service length. In mega cities like Tokyo and Osaka, the Japan Railways and a few private railway systems function as urban mass transits in addition to the metro systems, and thus cannot be analyzed on the same plane as 17 cities.

Figure 2.25 GRP and Metro Length (2010)



Note: GRP is calculated by multiplying GDP per capita by the population of a given city.
Source: UITP, *Millennium Cities Database for Sustainable Transport*.

5) Urban Economy and Public Transit Tariff

The relationship between the scale of urban economy and the tariff of a public transit system is examined by using the UITP database on per capita GRP (US$) and the average user cost per public transit trip (10-4% per capita GRP/trip) among global cities.1 The correlation is fairly strong as shown in the following logarithmic approximation.

$Y = 31.28\ln(X)+353$ where,

Y: 10^{-4}% per capita GRP per trip

X: per capita GRP (US$) of a given city

On the basis of the formula above, the average user cost per trip on public transit is calculated for eight levels of per capita GRP and shown in Table 2.11.

Table 2.11 Per Capita GRP and User Cost per Trip on Public Transit

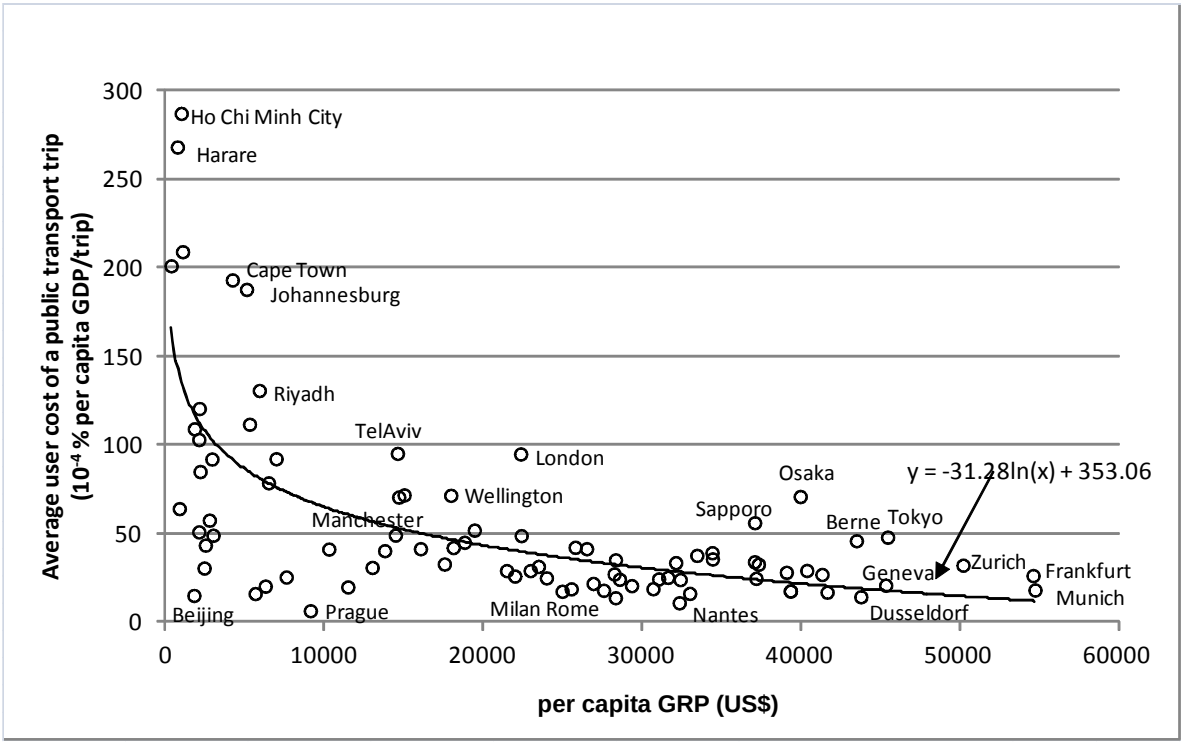
Per Capita GRP (US$)	1,000	3,000	5,000	10,000	20,000	30,000	40,000	50,000
Rate of Av. User Cost per Public Transit Trip (10^{-4}%)	137	103	87	65	43	31	22	15
Average User Cost per Public Transit Trip (US$)	0.14	0.31	0.43	0.65	0.87	0.92	0.86	0.73

In the case of Tokyo, for example, per capita GRP is US$45,000 and the rate of average user cost per trip on public transit is 48×10-4%. The average user cost per trip on public transit comes to US$2.16, which is reasonably close to the actual starting fares of the metro systems and bus lines in the city. However, given the same level of per capita GRP, Tokyo citizens pay more than twice as much for a ride on mass transits than in other cities. For example, citizens of Genève in Switzerland pay US$0.95 per trip, as calculated from the similar level of per capita GRP and the average user cost rate of 21×10-4%. In Zurich where high policy priority is placed on public transit, the tariff revenue accounted for 52% of the total annual revenue of Zurich United Regional Railways (ZVV) in 2000, with remaining 48% supplied by public subsidies. The presence of public subsidization is apparently the decisive factor to lower the tariff level.

Regarding the JICA-studied cities, GRP estimates are not available on many of them. Therefore, per capita GDP estimates are used to plot their relationship with the average user cost per trip on public transit, as shown in Figure 2.26.

[1] UITP, *Millennium Cities Database for Sustainable Transport*, Jan. 2001. Per capita GRDP is termed “metropolitan gross domestic product per capita” in this database.

Figure 2.26 Per Capita GRP and Average User Cost per Trip on Public Transit



Note: GDP per capita estimates are used on the JICA-studied cities lacking GRP data.
Source: UITP, *Millennium Cities Database for Sustainable Transport*.

6) Development Phases and Introduction of BRT Systems

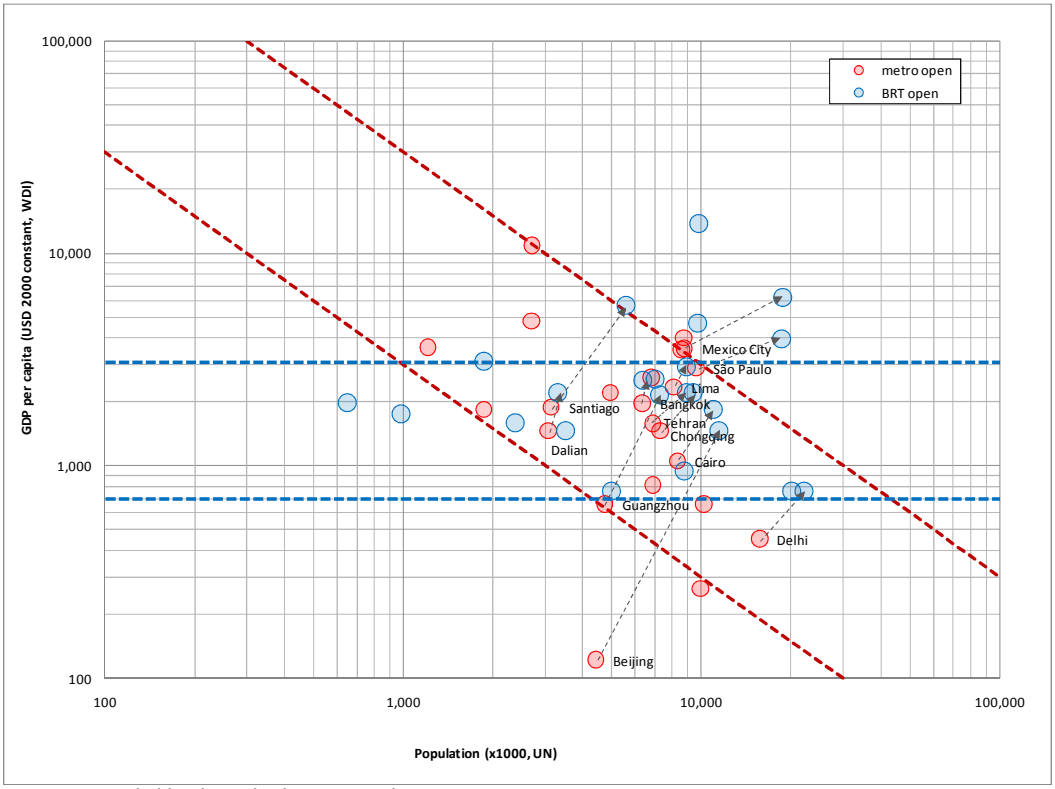
(1) Time to Start BRT Operation

The relationship between the development phase and the time of starting a BRT system is analyzed by using the cities which now operate BRT systems. The population size of the cities and per capita GDP are plotted in Figure 2.27.

As seen in the figure, no clear picture emerges in the plotting. Beginning from the world's first subways of London opened in 1863, metro systems have the history spanning some 150 years, much longer than BRT operation. The first BRT system was opened in Curitiba, Brazil, in 1972, but its importance as a viable alternative of public transit was widely acknowledged only recently in the 2000s. This might be one of the reasons why the analysis falls short of offering a clear picture of the timing of BRT operation.

The cost of developing a BRT system is one-tenth of the capital outlay needed for a metro system. The initial investment requirement is not as prohibitive as a subway system. Therefore, cities facing severe congestion problems by rapid motorization begin to consider the alternative of introducing a BRT system. Excluding the cities which have both metro and BRT systems, the timing for BRT introduction roughly corresponds to the range of US$700 – 3,000 in per capita GDP. After per capita GDP exceeds US$1,000, economic growth accelerates and an increased proportion of the population purchases durable consumer goods like household electric appliances and automobiles. The diffusion of these goods is reported to be especially rapid when economic growth achieves the per capita GDP range of US$1,000 – 3,000. In other words, the BRT system functions as focal urban mass transit in an urban economy about to take off with full-scale motorization imminent.

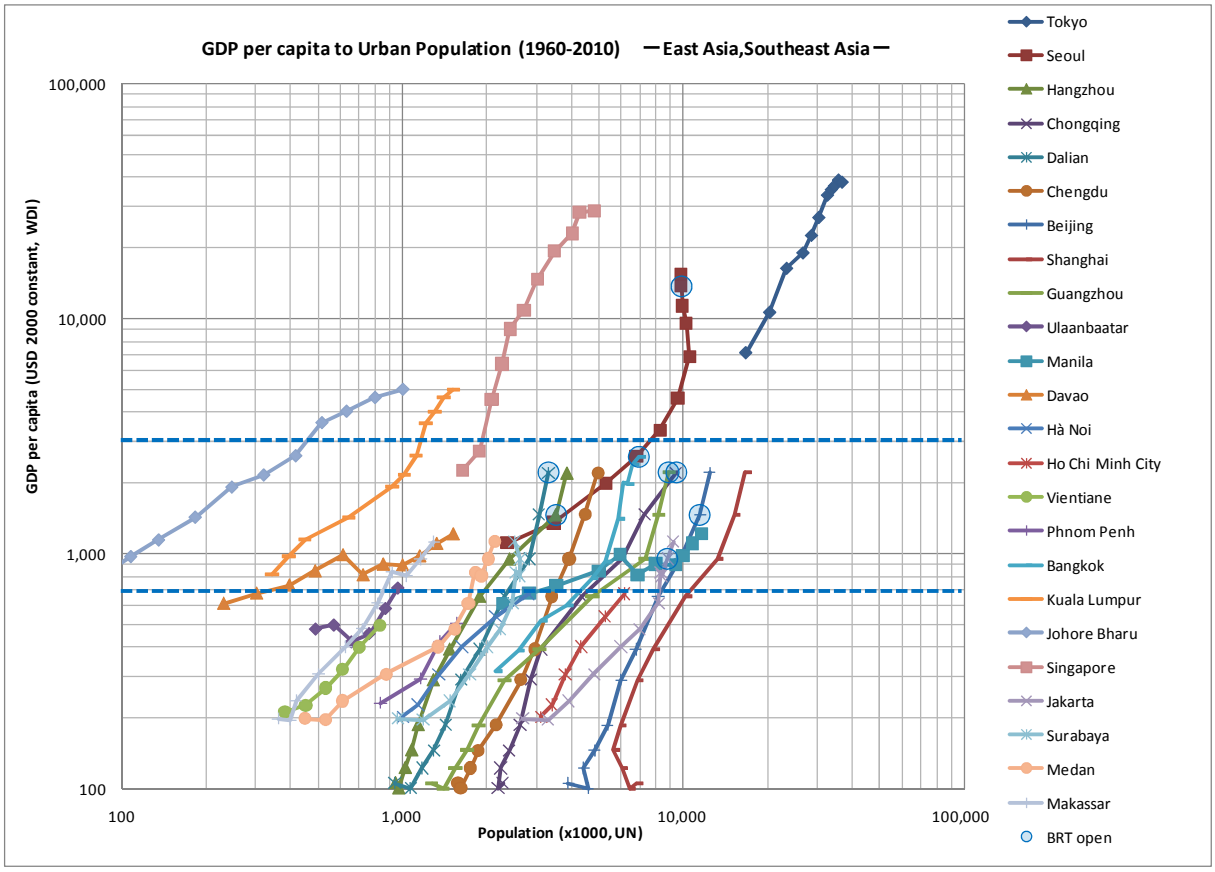
Figure 2.27 Per Capita GDP and Urban Population at the Time of Starting Metro and/or BRT Operation



Note: Named cities have both metro and BRT systems.
Sources: World Bank, *World Development Indicators 2008*; UN, *World Urbanization Prospect 2009*.

In the cities of Latin America, BRT systems serve as key mass transits overriding rail systems. Accordingly, the operation of a BRT system began at a higher level of per capita GDP than in other regions, as shown in Figure 2.28.

Figure 2.28 Per Capita GDP and Urban Population at the Time of BRT Introduction(1/2)



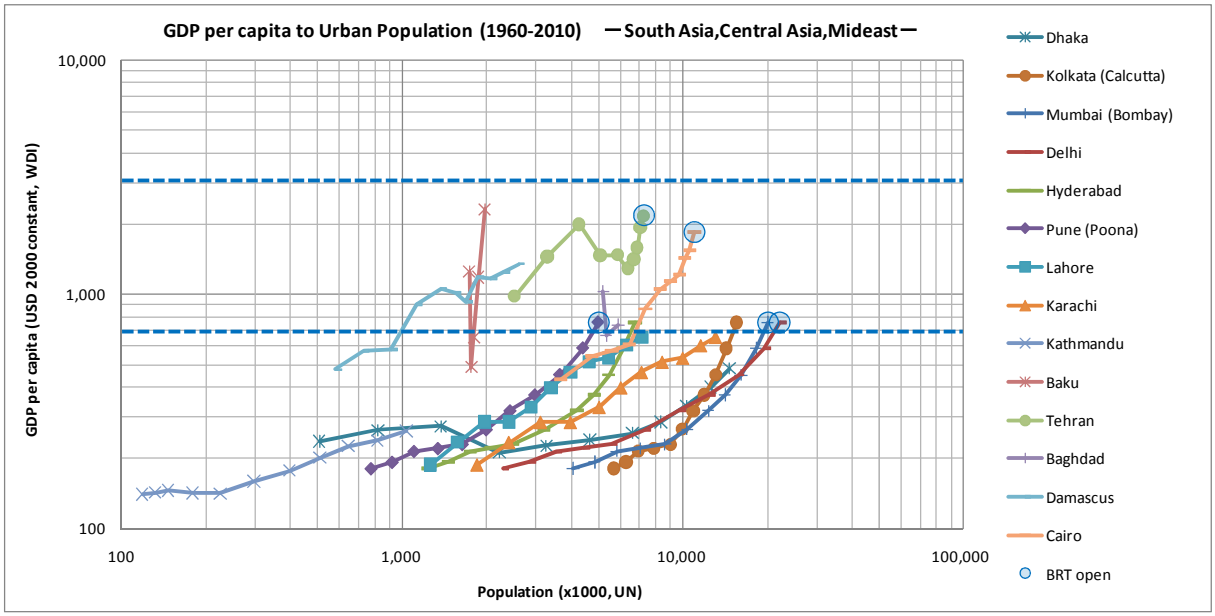
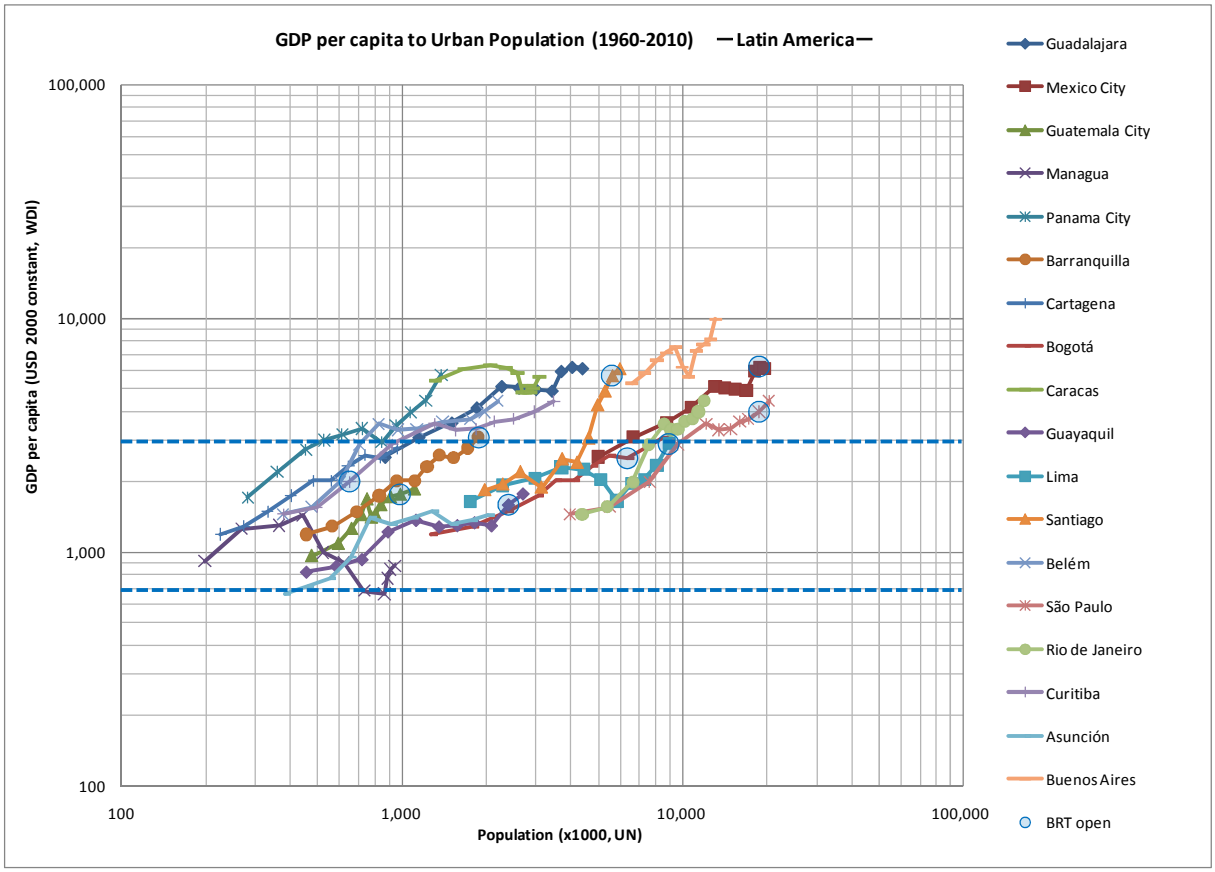
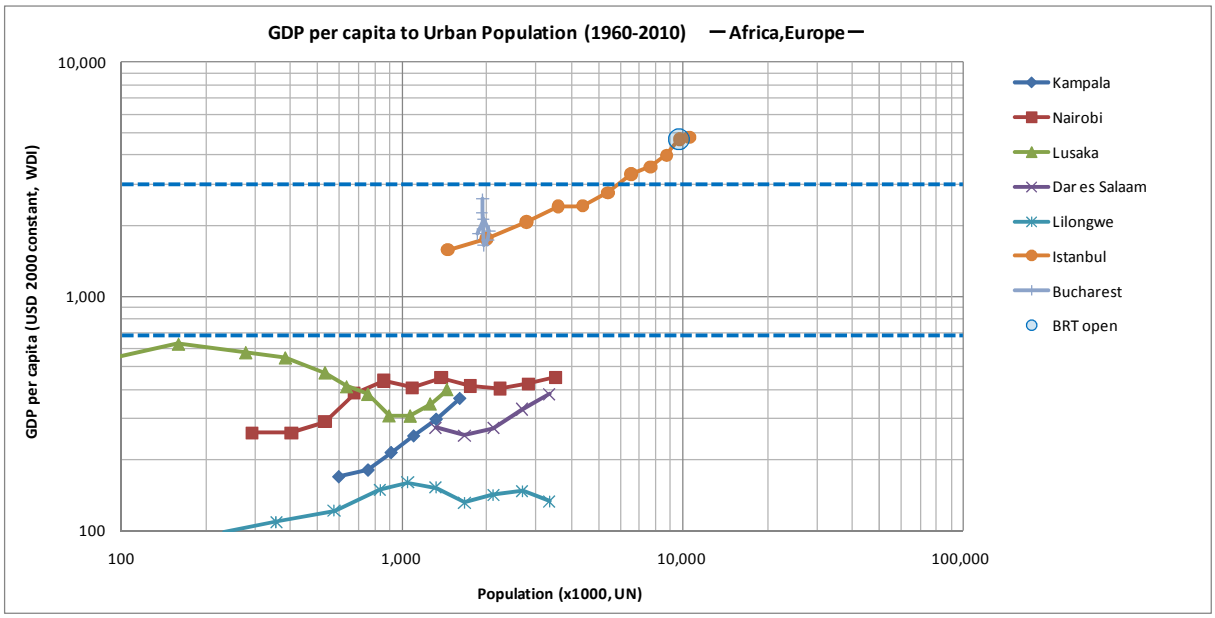


Figure2.28 Per Capita GDP and Urban Population at the Time of BRT Introduction(2/2)





Note: GDP per capita estimates are used on the JICA-studied cities lacking GRP data.

(2) Estimating Future Prospects of BRT Operation

Among the JICA-studied cities on which GDP estimates are not available, Ha Noi, Ho Chi Minh, Vientiane and Phnom Penh are likely to reach the strategic levels of population and per capita GDP for introducing a BRT system by 2025.

Although the required demographic and economic levels are yet to be achieved in 2010, Dhaka, Lahore and Karachi would be ready for the operation of a BRT system by 2025, as shown in Figure 2.29.

Figure 2.29 Strategic Timing and Future Prospects of BRT Operation (Cities without Metro System) (1/3)

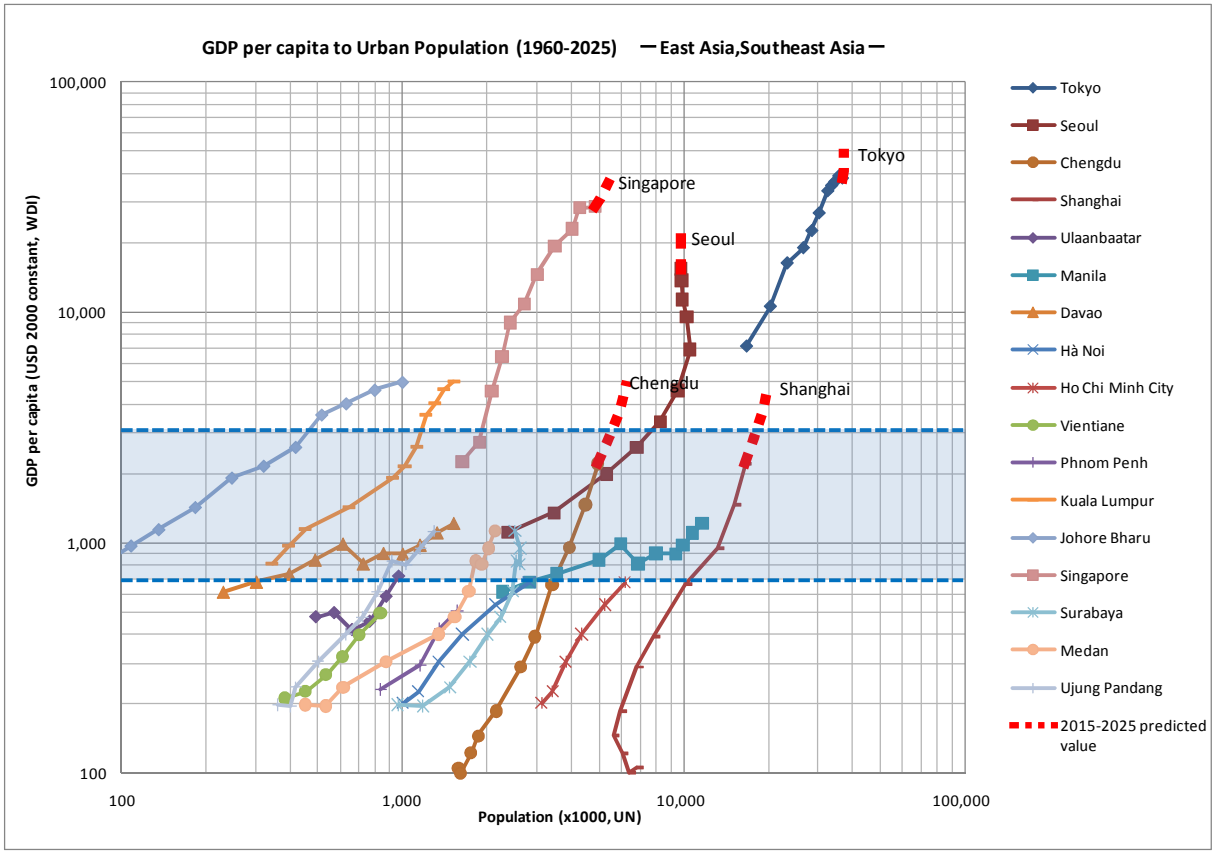
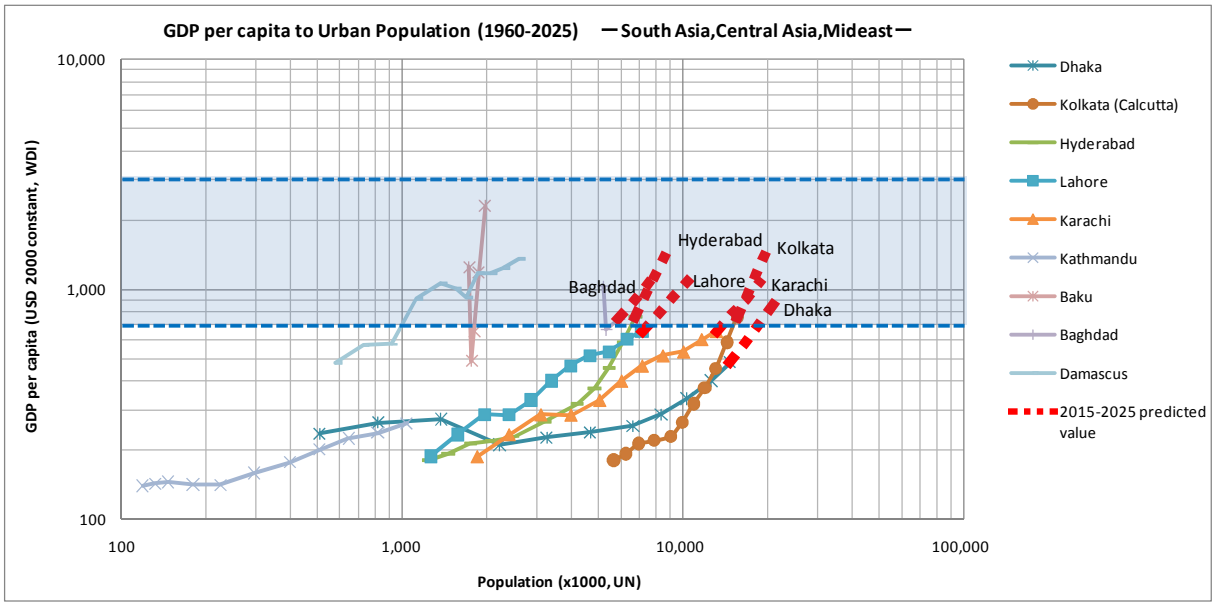


Figure 2.29 Strategic Timing and Future Prospects of BRT Operation (Cities without Metro System) (2/3)



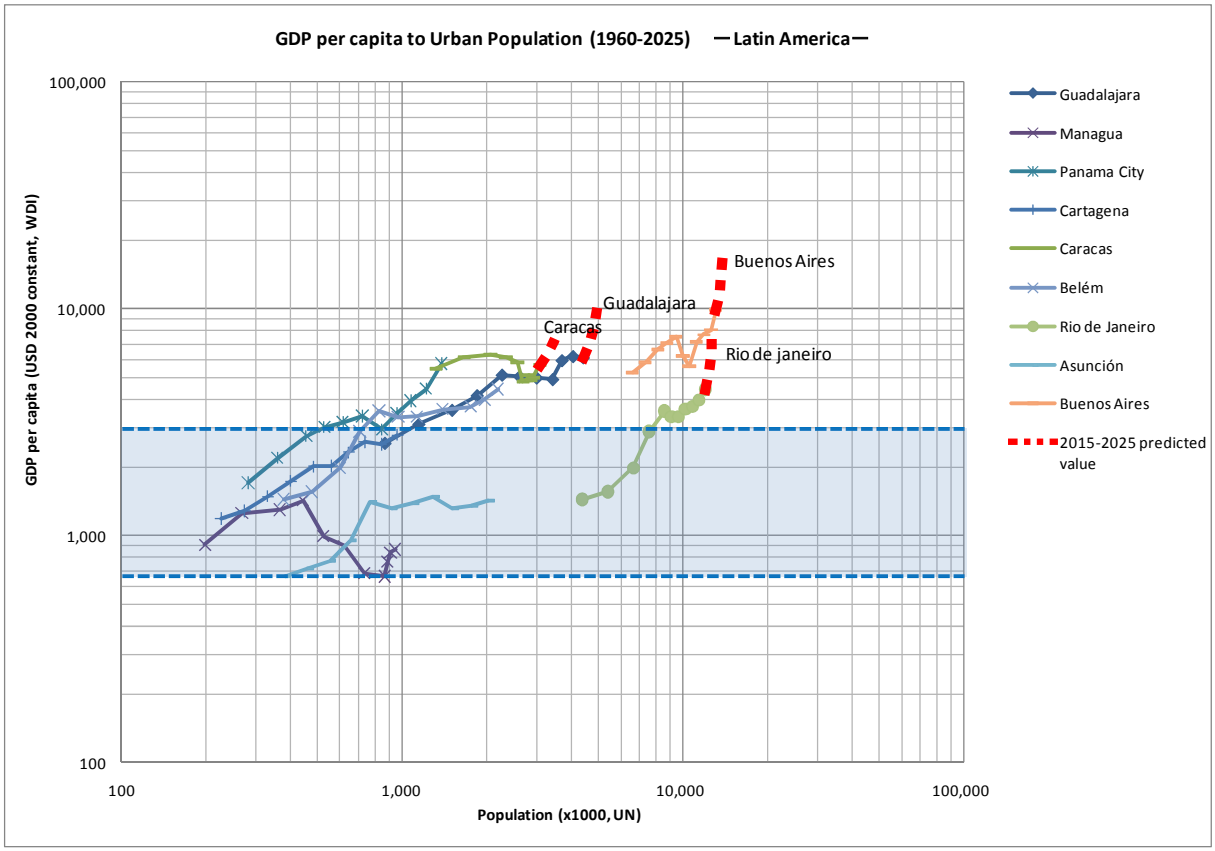
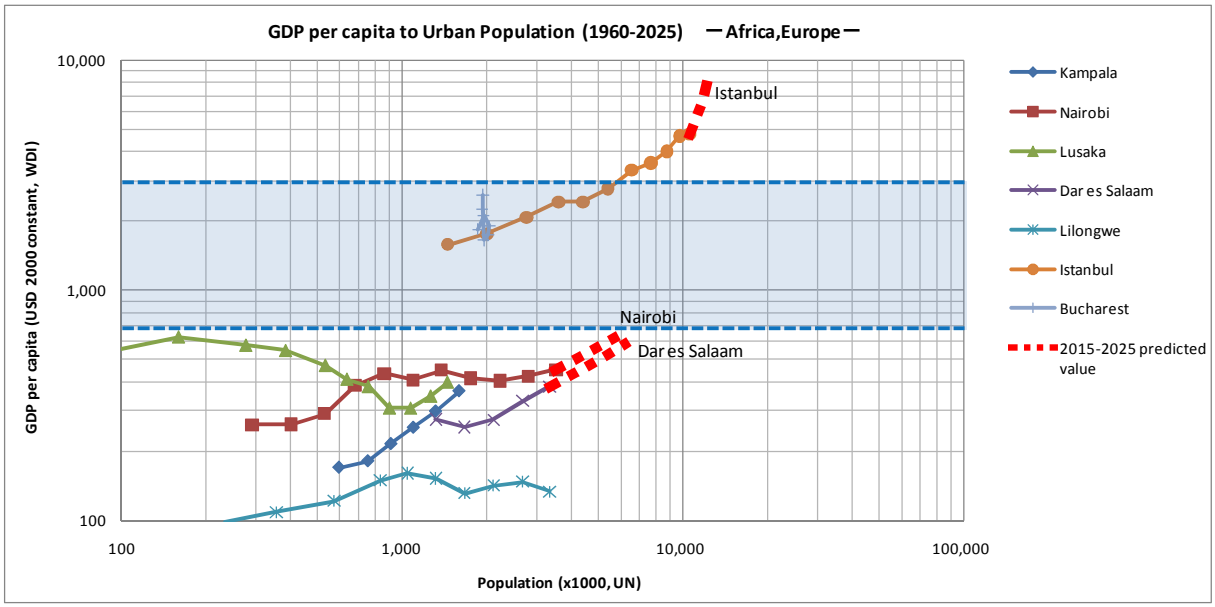


Figure 2.29 Strategic Timing and Future Prospects of BRT Operation (Cities without Metro System) (3/3)



Note: GDP per capita estimates are used on the JICA-studied cities lacking GRP data.

Table 2.12 summarizes the current situations and the strategic timing of BRT development and operation among the JICA-studied cities.

Table 2.12 Strategic Timing for Starting BRT Operation

	City with BRT System	City without BRT System		
		City Ready for BRT System as of 2010	City Ready for BRT System by 2025	City not Ready for BRT System before 2025
City without Mass Rapid Transit (MRT)				
East Asia Southeast Asia	・Hangzhou ・Jakarta	・Ulaanbaatar ・Davao ・Johore Bharu ・Surabaya (planning) ・Medan (planning) ・Makassar	・Hà Noi[1)] (planning) ・Ho Chi Minh City ・Vientiane ・Phnom Penh	―
South Asia Central Asia	・Mumbai (Bombay) ・Pune (Poona)	・Hyderabad (under construction) ・Baku	・Dhaka (2010)[2)] ・Lahore (2015)[2)] ・Karachi (2015)[2)]	・Kathmandu
Middle East		・Baghdad ・Damascus	―	―
Central and South America	・Guatemala City ・Barranquilla ・Bogotá ・Guayaquil ・Curitiba	・Guadalajara ・Managua ・Panama City ・Cartagena (under construction) ・Belém ・Asunción	―	―
Africa	―	―	―	・Kampala ・Nairobi ・Lusaka ・Dar es Salaam ・Lilongwe
Europe	―	―	―	―
City with Metro System (MRT)				
East Asia Southeast Asia	・Seoul ・Chongqing ・Dalian ・Beijing ・Guangzhou ・Bangkok	・Chengdu ・Shanghai ・Manila ・Kuala Lumpur ・Singapore		―
South Asia Central Asia	・Kolkata /Calcutta ・Delhi	・Baku		
Middle East	・Tehran ・Cairo		―	―
Central and South America	・Mexico City ・Lima ・Santiago ・São Paulo	・Caracas (under construction) ・Rio de Janeiro (under construction) ・Buenos Aires	―	―
Africa	―	―	―	
Europe	―	・Istanbul ・Bucharest	―	―

Notes: 1) Shaded cities do not have GRP estimates in the available publications. Their GRDPs are estimated by the present study team from the recent growth rates of the respective per capita GDP and city population. These cities are not included in Figure 2.10 on 100 global cities
2) Forecast from the available GRP estimates.
3) Colombo, Kabul, Juba, Monrovia and Bujumbura are excluded from the table, because either their respective population or per capita GDP is not available.

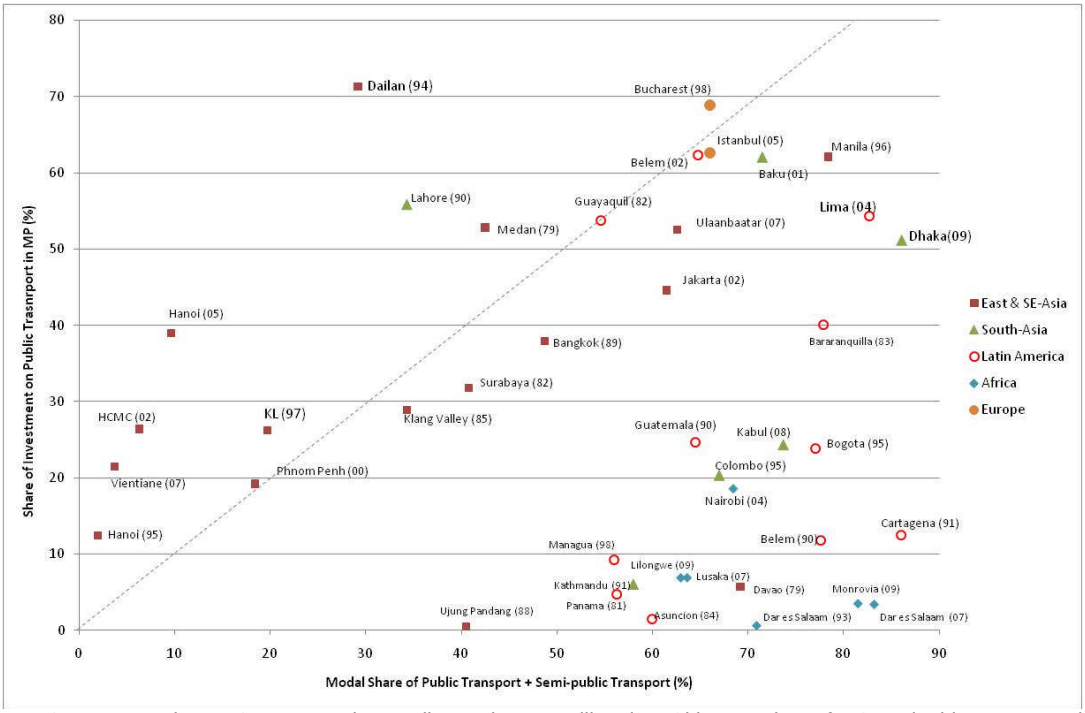
Sources: the estimation by the study team

7) Investment Patterns of JICA-studied Master Plans

One of the indices that would point the direction for formulating an urban transport strategy is the composition of investment proposed in a master plan. That is to say, the larger the share of public transit in the total investment, the more central the focus is on the public transport sector in the proposed urban transport strategy. The following is the results of the review on the JICA master plan studies. The proposed investment plans are classified into three sectors of roads, public transit and traffic management.

- *East Asia and Southeast Asia*: The larger the present modal share of public transit, the larger the investment allocation proposed for the public transport sector. However, this tendency does not apply to medium- and small-size cities.
- *South Asia*: The tendency similar to East and Southeast Asia is found in the region. It does not apply to medium- and small-size cities (i.e. Colombo and Kathmandu).
- *Central and South America*: The modal share of public transit is generally high in most of the cities. Because public transportation is provided by BRT systems in many cities, the share of public transit in the proposed investment is not as large as the modal share. However, the cities where a rail system is being planned, the public transport sector is allocated a large investment share. The allocation to the public transport sector is likely to increase its share in those cities where the introduction of an urban rail system is brought up for consideration in addition to the existing BRT system.
- *Africa*: The modal share of public transit is very high, because the motorization is yet to take off. Because of the obvious shortfalls in basic transport infrastructure, most of the investment is allocated to the road sector. Among the cities in this region, Nairobi and Dar es Salaam are expected to reach the economic level ready for introducing a metro system by 2025. The public transport sector will accordingly increase its share in investment in these cities.
- *Europe*: Samples are few, but the tendency appears to be similar to Asian cities.

Figure 2.30 Modal Share of Public Transit and Investment Allocation in JICA Master Plans



Sources: Various JICA master plan studies and UITP, *Millennium Cities Database for Sustainable Transport,* (2000).

2.4 Conditions for Introducing Urban Highways

1) Definition of Urban Highways

Urban highways are defined as toll roads that serve the intra-city traffic. If they function only as access roads to inter-city highways, they are not considered as urban highways.

2) Construction of Urban Highways in Various Cities

Urban highways as defined above have been constructed in the following cities, excluding those cities in which certain sections of the continuous elevated highways pass through or long access or exit ramps of inter-city highways are used by intra-city traffic.

Japan: Tokyo metropolitan area, Osaka metropolitan area, Chukyo (Nagoya) metropolitan area, Fukuoka, Kitakyushu and Hiroshima
Elsewhere: Singapore, Seoul, Manila, Kuala Lumpur, Bangkok, Jakarta, Istanbul, etc.

3) Urban Economy and Development of Urban Highways

Main factors that would occasion the construction of urban highways are severe congestions in the CBD, a large number of privately owned cars, low density of general roads per unit of urbanized area, fairly high income level among urban population and relative absence of landscape issues in areas of high-rise buildings, among others. Table 2.13 summarizes the features of the cities with urban highways on the basis of UITP database.

Table 2.13 Salient Features of Cities with Urban Highways in Asia

Metropolitan City with Urban Highways	2010 Urban Population[1] (million) (global ranking in parentheses)	UITP Database[2]					No. of Car Ownerships within a City (estimates in 1,000 units)
		Population Density (persons/ha)	GRP per Capita (US$)	Road Density (m/ha)	Car Ownerships (vehicles/ 1,000 paxs)	Traffic Volume per Road Length (1,000 vehicle km/km)	
Tokyo	35.20 (1)	88	45,425	352	307	676	10,806
Jakarta	22.00 (2)	173	1,861	115	91	979	2,002
Manila	20.80 (5)	206	2,217	107	82	1,825	1,706
Seoul	19.91 (8)	230	10,305	218	160	2,711	3,186
Osaka	17.00 (12)	98	39,937	383	264	699	4,488
Istanbul	13.14 (19)	N.A.	3,029	N.A.	N.A.	N.A.	
Bangkok	8.25 (31)	139	6,316	81	249	2,612	2,054
Kuala Lumpur	5.84 (47)	58	6,991	115	209	1,947	1,221
Singapore	4.64 (66)	94	28,578	92	116	2,196	538

Sources: 1) UN, *Demographia 2010*, (2010).
2) UITP, *Millennium Database for Sustainable Transport,* (2000).

Note on Urban Highways:

The planning concept of metropolitan highways in Tokyo has its roots in the idea of traffic management by grade separation learned from the United States and the attempt, a whiff of an attempt as it turned out, to develop highways in Manchuria. The network concept of urban highways grew out of the period when Japanese civil engineers and city planners vigorously absorbed the practices in Western cities, most notably Berlin and New York. Highways in Western countries have been constructed predominantly between the cities. They connect to the outer ring road surrounding a city and do not directly access the central part of the city. In some Western cities, the idea of developing urban highways primarily for intra-city traffic did come up for consideration at one point or another, but have not been acted upon to a full scale. The roads in Tokyo had been so poorly developed in the early days of motorization that Japanese civil engineers initially had to start from the urgent needs of developing inter-city highways. Nonetheless, by learning from the Western concepts and practices in highway development with foresight, Japanese engineers and planners came to focus on the concept of developing an urban highway network by continuous grade separation from the existing roads. The metropolitan highway network in Tokyo was the first example of urban highways constructed purely to serve intra-city traffic. The concept of urban highways in the Japanese sense has been spreading to other mega cities in Asia. Partly aided

by the technical cooperation program of Japan, an urban highway network of continuous grade separation reaching the CBD with compact access ramps are in the process of formation in such mega cities as Bangkok and Shanghai. (Excerpts from Hirotake Furukawa, *Study on the Formation of Tokyo Metropolitan Highway Network: its History and Planning Concept*,)

3. Review on Urban Transport Strategy

This chapter defines what is meant by urban transport strategy, and reviews the JICA master plan studies on urban transport since 2000 on the basis of the definition. The review clarifies the significance of the strategy in urban transport development and examines the basic components of the JICA-proposed master plans. Following the discussions in Chapter 2 on the correlation between urban transport problems and the social (population size) and economic (per capita GDP) development phases, this chapter focuses on a number of conditions necessary to identify projects in transport infrastructure and services and traffic demand management in accordance with three phases of social and economic development, and draws some conclusions on the direction to take towards urban transport strategy formulation.

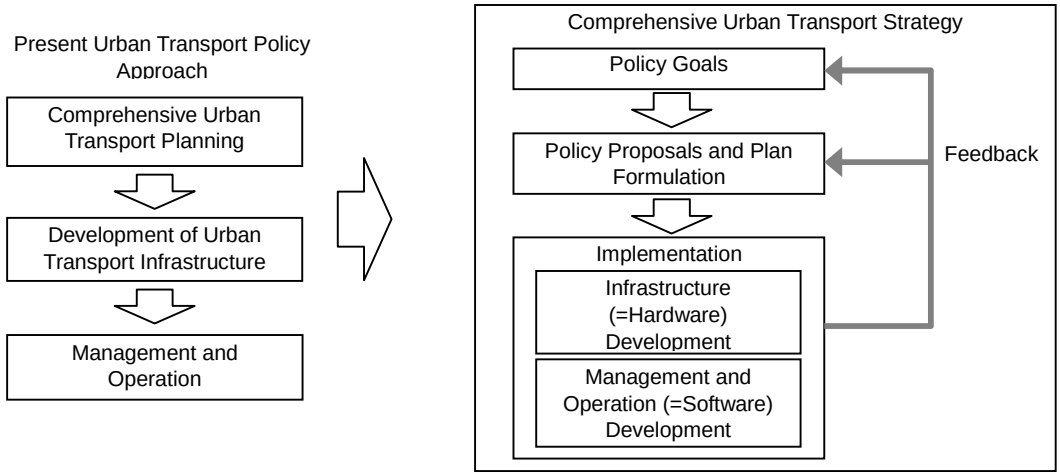
3.1 Significance of Urban Transport Strategy

According to the Council on the Development of Social Capital, Ministry of National Land and Transport, a comprehensive urban transport strategy is defined as follows.

> …in addition to formulating an urban transport development plan, (a strategy) explicitly announces a set of policy goals, proposes a number of policy measures and a program of specific projects that are identified to achieve such goals and indicates the procedure to implement, operate and manage the proposed measures and projects……

In other words, a strategy comprises a set of long-term policy objectives, or an actionable vision of some 20 years ahead and a set of policy measures that are feasible during the coming 5 to 10 years. Importantly, it also includes a description of how to implement and manage the proposals.

Figure 3.1 Present Transport Policy Approach and Proposed Comprehensive Strategy



Source: The Subcommittee on Urban Transport and Built-up Area Development, the Committee on Urban Planning, the Division of Urban Planning and Historic Heritage, the Council for Social Capital Development, 2007.

3.2 Review on Urban Transport Strategy

The present study discusses large cities in developing countries that possess their respective transport strategies as formulated in the proposed master plans. The subjects of the present review are those cities on which JICA conducted master plan studies since 2000 (see Appendix C).

1) 18 JICA-studied Cities for Database Compilation

Table 3.1 18 JICA-studied Cities for Database Compilation

	City	Country	Population(000)	JICA M/P year
1	Chengdu	China	4,785	2001
2	Ulaanbaatar	Mongolia	885	2009
3	Jakarta	Indonesia	22,000	1987,1990,2001,2004
4	Bangkok	Thailand	8,250	1979,1988,1990
5	Manila	Philippines	20,795	1972,1973,1985,1999
6	Hanoi	Vietnam	2,355	1997,2007,
7	Ho Chi Minh	Vietnam	7,785	2004
8	Phnom Penh	Cambodia	1,560	2001
9	Dhaka	Bangladesh	10,135	2010
10	Colombo	Sri Lanka	2,080	1984,2006
11	Baku	Azerbaijan	1,650	2002
12	Damascus	Syria	2,370	1999,2008
13	Bogota	Colombia	7,845	1996
14	Lima	Peru	7,995	2005
15	Nairobi	Kenya	3,365	2006
16	Lusaka	Zanbia	1,395	2009
17	Istanbul	Turkey	13,135	2009
18	Bucuresti	Romania	1,995	2000

Table 3.2 Data Items for Compilation

large category	middle category
Urban Indicator	・City Information(Population, Population Growth Rate, Population Density,etc) ・Economy(GRDP, GRDP Structure) ・Social Development (HDI,HPI) ・Urban Development(Greenery Ration, Land use,etc), ・Urban Environment(CO2 emission, etc) ・Transportation Masterplan, Traffic Demand(Modalshare, etc) ・Vehicle Ownership ・Public Transport Demand & Supply(Urban Railway, Freight Railway,Bus, Para-tra,etc) ・Road Infrastructure(Road Network, etc) ・Traffic Management ・Traffic Accident/Safety, Financing, Traffic Condition
Issues & Projects	・Current Problems on Urban Transport ・Current Conditions and Problems of Each Sector（Urban Structure/Land use, Road Infrastructure, Public transportation, Traffic Management for Road Traffic, Traffic Demand Management, Traffic Safety, Environment, Social Environment, Institutions）
MP Investment	・Master Plan Investment Composition

2) Urban Transport Projects Proposed in the JICA Master Plans

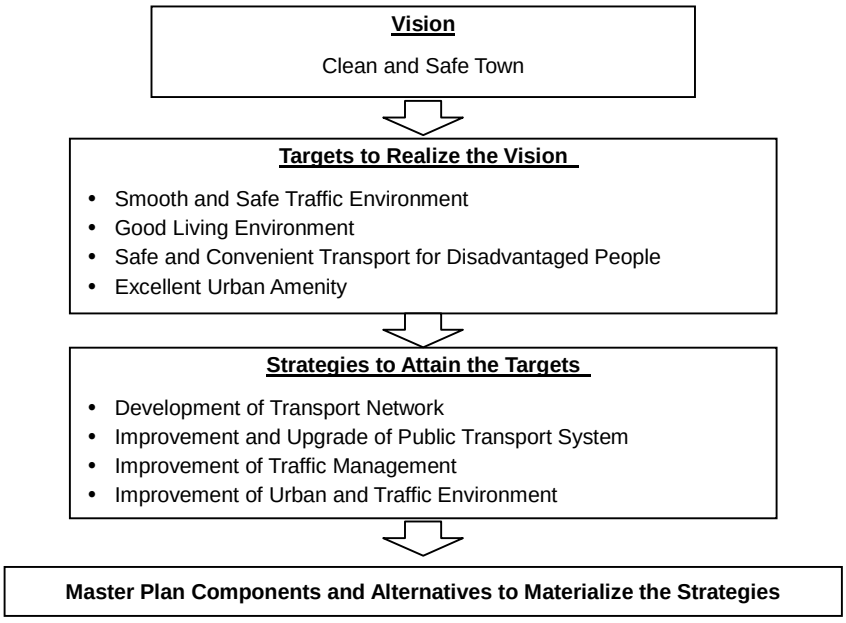
The present study discusses large cities in developing countries that possess their respective transport strategies as formulated in the proposed master plans. The subjects of the present review are those cities on which JICA conducted master plan studies since 2000 (see Appendix C).

The relative significance of a transport strategy in a master plan and the composition of each master plan vary from one city to another. For example, JICA master plan studies on comprehensive city development deal with urban transport as one of the sectoral issues. Their primary emphasis is usually placed on how to integrate the transport program into the comprehensive picture of urban development. Some master plan studies propose a strategy that specifically focuses on the transport sector or specific transport projects.

Although the emphasis and the composition vary, most of the formulated master plans make the presentation of the vision, the objective (challenge), the strategy (planning policy or concept) and the specific action (program or project). If “Comprehensive Urban Transport Strategy” in Figure 3.1 is analogous to a master plan, a strategy corresponds to “Policy Proposals and Plan Formulation” in the figure. In other words, a strategy is needed to achieve an objective and a program of projects need be proposed to put the strategy into action (Figure 3.2).

Some JICA studies try to ensure the feasibility of master plan proposals by indicating monitoring activities as integral part of the plan, by specifying items and indices for monitoring and evaluation to fulfill the plan objective. For instance, two JICA studies on comprehensive urban development planning (one for Ha Noi and the other for Metropolitan Jakarta) specify evaluation indices for each proposed transport policy. Another study conducted for urban transport improvement in Baku states evaluation indices and targets vis-à-vis the overall master plan objectives.

Figure 3.2 Basic Policy for Formulating the Urban Transport Development Plan:JICA Study on Comprehensive Urban Development Planning in Vientiane



Source: *The Study on Comprehensive Urban Development Planning in the Special City of Vientiane, Laos: Main Report,* JICA, 2008, p. 16-13.

Table 3.3 Urban Transport Policies and Evaluation Indices

Transport Policy	Evaluation Item	Evaluation Index
Alleviation of traffic congestion	Average running speed on ordinary roads	More than 25km/h
	Congestion ratio	Less than 1.0
	Commuting time	Less than 60 minutes
Promotion of public transport use	Coverage by railways	Population within the radius of 660m from a station
	Coverage by bus lines	Population within the radius of 660m from a bus shelter
	Frequency of transfers on public transport means	Average number of transfers per trip
	Transport expenditure	Appropriate % of household expenditure among different income groups
Mitigation of atmospheric pollution and noises	Emissions of NOx, CO2 and PM	Less than environmental standard
	Noise level	Less than environmental standard
Improvement of traffic safety and security	Number of fatal/casual traffic accidents	Reduction of traffic accidents
	Number of crimes such as robberies and snatches on public transport means	Reduction of crimes

Source: *The Study on Comprehensive Urban Transport Planning in the Metropolitan Area of Jakarta, Indonesia:* JICA, 2004.

The components of the proposed urban transport strategy, it must be admitted, vary a great deal in substance and level of importance from one master plan to another. A considerable number of master plans fail to bridge between upper-level objectives and proposed specific actions. In such a master plan, a strategy is formulated supposedly in reference to the announced policy objectives but the list of development projects (both physical and institutional proposals) are not necessarily linked to what is stated in the strategy.

3.3 Urban Transport Projects Proposed in the Master Plans

In the JICA studies, individual projects are identified in accordance with the framework of an urban transport strategy. Details of the project lists differ among the JICA-studied cities but the master plans consist of the sectors and the projects as shown in Figure 3.3 and Table 3.4.

Figure 3.3 Master Plan Components

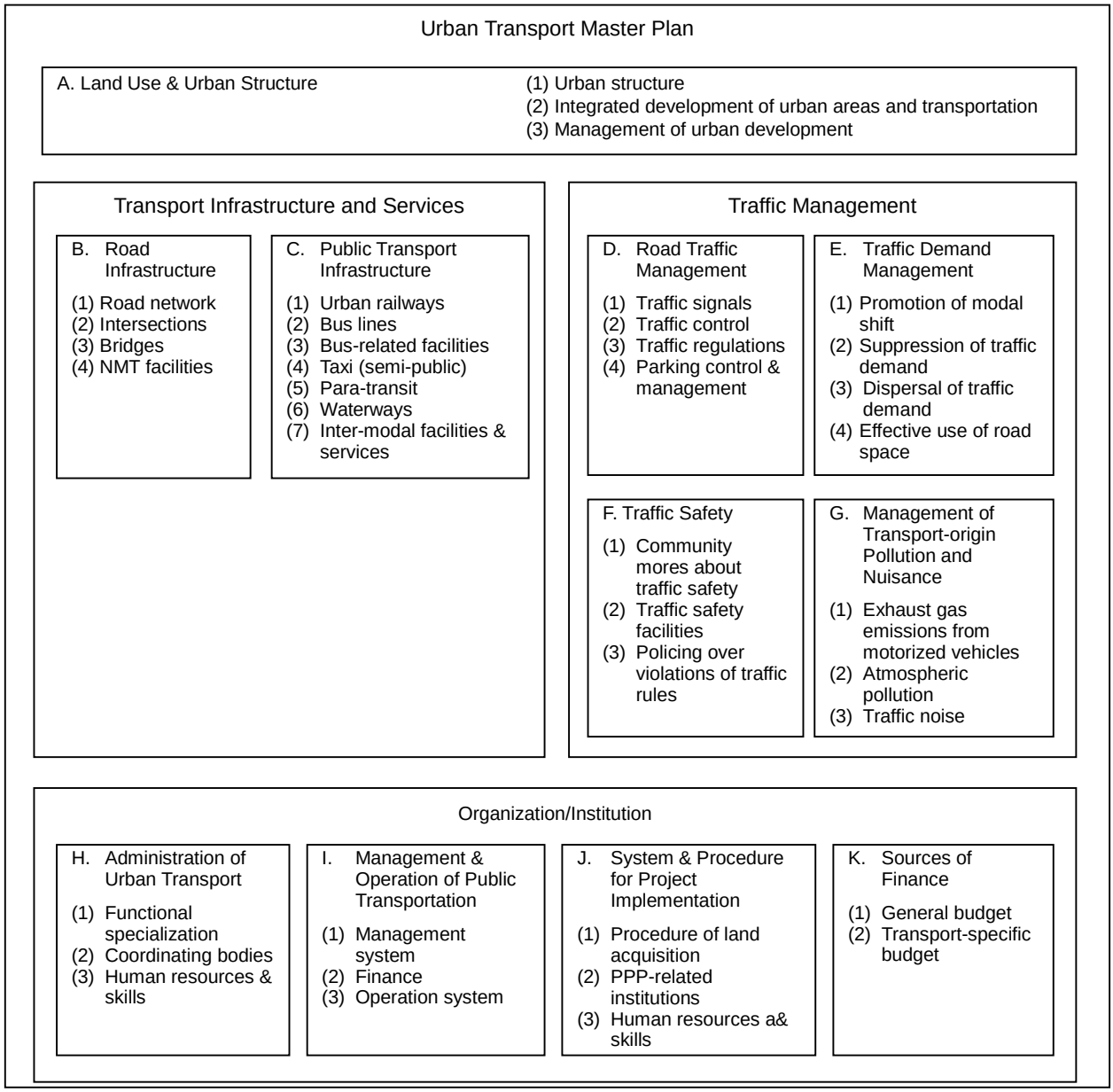


Table 3.4 Urban Transport Projects Listed in Master Plans (1/3)

A) Land Use and Urban Structure

(1) Urban structure
(2) Integrated development of urban areas and transportation

(3) Management of urban development

B) Road Infrastructure

(1) Road Network
1) Construction of urban highways
2) Construction of ordinary roads
3) Widening of ordinary roads
4) Solution of bottlenecks
5) Solution of missing links
6) Development of local roads
7) Road surface pavement and improvements
8) Construction of tunnels
(2) Intersections
1) Widening of intersections and layout improvement
2) Removal of roundabouts
3) Introduction of right- and left-turn lanes
4) Grade separation

(3) Bridges
1) Construction of bridges
2) Widening of bridges
(4) Non-motorized Transport (NMT) Facilities
1) Pedestrian footbridges
2) Sidewalks
3) Exclusive pedestrian paths
4) Cycling lanes
5) Cycling roads

C) Public Transport Infrastructure and Services

(1) Mass Transit Railway Systems
1) Construction of subways
2) Construction of monorails
3) Construction of LRT (light rail transit)
4) Construction of BRT (bus rapid transit)
5) Conversion of inter-city railways to urban railways
6) Linking up of different urban railway services
7) Strengthening of transport capacity (e.g. fleet increase)
8) Introduction of the ATS (automatic train stop) system
9) Introduction of CTC(centralized train control)
(2) Bus Lines
1) Introduction of bus and minibus services
2) Rationalization of bus routes
3) Introduction of large-size b uses and modernization thereof
4) Real time information service (e.g. bus locating systems)

(3) Bus-related Facilities
1) Construction and improvement of bus terminals
2) Installation of bus bays
3) Construction and Improvement of bus stops and shelters
4)
(4) Semi-public System
1) Strengthening of taxi services
2) Compulsory installation of taxi meters
3) Introduction of taxi sharing by users
4) Installation of taxi stands
(5) Para-transit
1) Consolidation of para-transit vehicles
2) Regulation of para-transit services
(6) Waterways
1) Introduction of large-size ferries
2) Rationalization of ferry routes
(7) Inter-modal Facilities and Services
1) Construction and improvement of inter-modal facilities
2) Introduction of discount transfers

Table 3.4 Urban Transport Projects Listed in Master Plans (2/3)

D) Road Traffic Management

(1) Traffic Signals
1) Installation of traffic signals
2) Systemic integration of traffic signals
3) Area-wise traffic control
4) Traffic control by sensors
5) Introduction of green phases for right- and left-turn traffic
(2) Traffic Regulation
1) Channelization at intersections
2) Introduction of right- and left-turn restrictions
3) Speed limits
4) Introduction of one-way roads
5) Prohibition of U-turns and jay walks
6) Provision of road signs and signposts
7) Traffic restrictions by mode

(3) Traffic Control
1) Installation of traffic information collecting devices
2) Establishment of the traffic control center
3) Installation of traffic information announcing devices
4) Strengthening of countermeasures against traffic accidents
(4) Parking Control and Management
1) Restrictions on roadside parking and waiting
2) Standards of compulsory provision of parking space
3) Regulations on parking space installation
4) Imposition of parking fees

E) Traffic Demand Management

(1) Promotion of Modal Shift
1) Promotion of public transport use
2) Park & ride
3) Car-free days/ hours and pedestrian malls
4) Provision of cycling roads
5) Campaigns
(2) Suppression on Traffic Demand
1) Road pricing and area licensing
2) Colour coding
3) Restrictions on automobile use (levy)
4) Restrictions on parking
5) Bans on trucks
6)) Restrictions on car registration (quota)
7) Campaigns

(3) Dispersal of Traffic Demand
1) Staggered commuting to offices and schools and flex time systems
2) Congestion tax
3) Traffic information systems
(4) Effective Use of Road Capacity
1) Exclusive or priority lanes for HOV vehicles
2) Car pooling systems
3) Efficiency improvement of freight transport

F) Traffic Safety

(1) Community Mores about Traffic Safety
1) Improvement of traffic safety organizations and systems
2) Traffic safety education
3) Traffic safety auditing
4) Compilation and analysis of traffic accidents database
5) Retraining of violators

(2) Traffic Safety Facilities
1) Improvement of accident-prone spots
2) Installation of guard rails
3) Separation of pedestrian and automobile traffic and introduction of mode-specific lanes
(3) Policing over Violations of Traffic Rules
1) Policing over violations of traffic rules
2) Increased penalties
3) Training of traffic policemen

G) Management of Transport-origin Pollution and Nuisance

(1) Exhaust Gas Emissions from Motorized Vehicles
1) Strengthening of automobile inspection systems
2) Promotion of eco-cars

(2) Traffic Noises
1) Roadside protection against noises

Table 3.4 Urban Transport Projects Listed in Master Plans (3/3)

H) Administration of Public Transportation

(1) Functional Specialization
1) Clarification of functional specialization among related administrative bodies
2) Elimination of overlapping functions
(2) Coordinating Authorities
1) Establishment of urban transport authorities
2) Establishment of an administrative body in charge of metropolitan coordination
3) Strengthening of collaboration between national provincial and municipal government organs

(3) Human Resources and Skills
1) Strengthening of transport planning capability
2) Strengthening of transport managing capability
3) Strengthening of traffic police capability
4) Manpower reinforcement in transport-related organizations

I) Management and Operation of Public Transportation

(1) Management System
1) Strengthening of bus service licensing institutions
2) Management and regulation of bus service operation
(2) Finance
1) Appropriate pricing of fares
2) Reforming subsidies to serve as incentives for operational efficiency improvement

(3) Operation System
1) Modernization of bus operation systems
2) Improvement of operational efficiency
3) Induced participation of private capital

J) System and Procedure for Project Implementation

(1) Procedure of Land Acquisition
1) Establishment of a scheme for compensating relocated people
2) Integration with urban area development

(2) PPP-related Institutions
1) Related institutional development
2) Clear role demarcation between public and private interests

K) Sources of Finance

(1) General Budget
1) Strengthening of local tax revenues
2) Promotion of private investors' participation in transport development
3) Urban developers required to invest in infrastructure

(2) Transport-specific Budget
1) Introduction of earmarked taxes (automobiles, gasoline)

Source: *Study Team*.

3.4 Urban Transport Problems

In this section, the urban transport issues and problems in the cities as reported by JICA master plan studies on urban transport strategy are reviewed and analyzed vis-à-vis the foregoing typology of cities and three phases of development.

1) Classification of Urban Transport Problems

Urban transportation is accompanied by traffic congestions and accidents and problems of user convenience and accessibility. Specific sets of problems may vary from one city to another, but general manifestations of urban transport problems might be summed up in four categories[1] as shown in Table 3.5.

Table 3.5 Transport Problems Generally Found in Cities

Problem	Remarks
Traffic Congestion	Congestions on public transport means during morning and evening rush hours; congestions of motorized traffic on roads in central built-up areas
Traffic Accidents	Incidents of traffic accidents soar along with the increase of automobiles, motorbikes, bicycles and other vehicles, involving pedestrians as well. Trains clash with one another and with motorized vehicles on the railway crossings.
Environmental Hazards Caused by Traffic	Atmospheric pollution by exhaust emissions of motorized vehicles and noise and vibration by motorized traffic; landscape and sunlight obstructions by elevated transport structures
Deterioration of Public Transport Operating Entities	The operation speed of bus services and street cars slows down by frequent traffic congestions; The regularity of scheduled services are lost and users lose their trust in public transport; Public transport users decrease in number as private car ownerships increase; It becomes increasingly difficult to sustain public transport services on sound financial basis; At the decline of public transport services, a certain proportion of city population becomes the transportation-poor who cannot afford to own and drive private automobiles; Urban transportation becomes inconvenient to such vulnerable dwellers.

Source: Paraphrased from Yoji Niitani, *Urban Transport Planning*, (Gihodo, 1993).

Starting from the four categories mentioned above and utilizing the results of the review on JICA master plan studies, urban transport problems are classified into five categories as presented in Table 3.6.

The problem of “traffic congestion” is divided into two categories: namely, congestions that are obstructions of efficient traffic flows, on the one hand, and user inconveniences that are caused by traffic obstructions, on the other. Inconveniences include the problem of accessibility to public transportation in addition to the decline or loss of predictable regularity in travel. The category of “traffic accidents” is rephrased as “Decline in Traffic Safety,” by adding overall traffic safety issues such as deterioration of road surfaces and law and order in urban transport management.

JICA reports under review did not mention the deterioration of public transport operating entities in the cities studied for master plan formulation. Regarding several cities, JICA reports referred to the issues of the transportation-poor. Namely, the fare scales of public transportation and/or the availability of affordable transport modes greatly influence the degree of mobility among the poor city dwellers who could not afford to own private cars. Specifically, the transportation-poor are discouraged from accessing social service providers and employment opportunities located in the central built-up areas[2]. The category of “social injustice and inequality” covers such issues. In addition, this category includes the problem of corruption found, for example, in the policing over violations of traffic rules or in the acquisition of driver’s licenses.

[1] Youji Niitani, *Urban Transport Planning*, (Tokyo: Gihodo Publishing, 1993).

[2] JICA, *Study on Integrated Transportation Master Plan for Jabodetabek: Phase II*, 2004, and several other JICA reports.

Table 3.6 Classified Urban Transport Problems in JICA-studied Cities

Classification	Details:
(1) Traffic Congestion	Absence of efficiency in the provision and operation of transportation: Examples: congestions on public transport means during morning and evening rush hours; motorized traffic congestions in the central built-up areas.
(2) Inconvenience	Inadequate accessibility and poor usability: Examples: bad access to transfer stations; station buildings full of bumps and barriers; low service levels
(3) Decline of Traffic Safety	Poor user safety: Examples: frequent traffic accidents; poor public peace on trains and buses and other means of travel
(4) Pollution and Nuisance	Reduced sustainability of cities: Examples: air pollution by exhaust emissions of automobiles; noises and vibrations caused by motorized traffic; landscape damages and sunlight obstructions by elevated transport structures
(5) Social Injustice and Inequality	Biased accessibility and unfair victimization Examples: rampant corruption and injustice; increase of the transportation-poor among city population; increase of those more liable to suffer transportation-caused pollution and nuisance as well as traffic accidents

Source: Study Team

2) Urban Economy and Population Size

As mentioned in Section 2.2 of Chapter 2, the bulk of the cities studied by JICA for master plan formulation are those of small population sizes (less than 3 million) and high population growth potentials (2% or more per annum) and in the middle phase of economic development (per capita GDP ranging fromUS$1,000 to US$4,000). They will continue to expand and grow for a long time to come.

The JICA-studied cities are classified by three phases of economic development and three classes of population size as shown in Table 3.7. The relationships between urban economic development and the nature of urban transport problems are examined in accordance with nine classified city types in the table.

Table 3.7 Nine City Types by Phase of Development and Population Size

	Late Phase of Development >GDP/capita US$4000	Middle Phase of Development GDP/capita US$1000-4000	Early Phase of Development GDP/capita US$1000<
Population Size: Large (more than 10 million)	Istanbul*	Manila* Jakarta	Dhaka*
Population Size: Medium (3 million - 10 million)	-	Bogota* Lima* Chengdu, Sichuan Province Bangkok	Ho Chi Minh Nairobi
Population Size: Small (less than 3 million)	-	Damascus* Colombo Bucharest Baku	Phnom Penh Hanoi Lusaka Ulan Bator

* The asterisk indicates a city with population density of 100 persons or more per hectare.

The following is the descriptions of five categories of transport problems in each of the nine classified types of cities that have been studied by JICA for transport master plan formulation.

3) In the early phase of development (per capita GDP of less than US$1,000)

(i) Small population size (less than 3 million)

Congestion	Traffic congestions arise from the basic inadequacies such as shortages of road infrastructure, poor provision of traffic control signals, roadside sign posts lacking standardization and so on. Congestions are frequent at roundabouts.
Inconvenience	The main mode of travel is bus, but serviced routes do not meet the demand distribution. The intra-city fleet of bus and minibus is insufficient in number. Because of the limited availability of public transport means, the transfer-related problem is yet to materialize.
Traffic Safety	Most of the roads are unpaved, but even where paved, the surface conditions are bad because of the absence of adequate drainage structures. Sidewalks are not provided
Pollution and Nuisance	The problems of air pollution and traffic noises are emerging but not serious enough to require immediate countermeasures.
Social Injustice	The para-transit mode provides sizable employment opportunities for low-income city dwellers. The introduction of organized public transport is often feared to wipe out their jobs. The government subsidization of public transport services is unequally distributed. Operators of large buses receive government subsidies, while minibus operators do without such financial supports.

(ii) Medium population size (3 to 10 million)

Congestion	Population is increasingly concentrated in central built-up areas where inadequate transport infrastructure such as the shortage of road capacity and the presence of missing links in the road network is causing chronic congestions. The available transport modes are diversified to include two-wheelers (motorcycles and bicycles), para-transit vehicles, buses and minibuses in addition to automobiles. The uncontrolled intermingling of these modes obstructs traffic flows on the road network. Furthermore, the absence of left-turn lanes, out-of-order traffic signals, the shortage and the lack of standardization in roadside sign posting, inappropriately linked arterials in the road network and many other inadequacies in urban transport infrastructure contribute to the deterioration of traffic conditions. Apace with the increase in traffic volume, traffic violations by drivers are prone to result in congestions and accidents.
Inconvenience	Bus operation is beset with the shortage of fleet and the low level of services. The competition between bus lines and minibus lines is one of the causes of traffic congestions, requiring effective coordination of their services. Compared to bus and minibus, the urban railways are usually characterized by infrequent operation and poor service even to the extent of being useless as a public transport mode.
Traffic Safety	As in the cities with less than 3 million in population mentioned above, few roads are paved, and in the rare cases of paved roads, conditions of surfaces are bad and deteriorating due to inadequate drainage and

	maintenance. Sidewalks are not provided. In the midst of urban population explosion, the frequency of traffic accidents is increasing because of unchecked roadside parking and ill-mannered driving of para-transit vehicles and decrepit buses.
Pollution and Nuisance	The increase in traffic volume is worsening atmospheric pollution and noise nuisance. Exhaust emissions by antiquated motorized vehicles and the traffic concentration on arterials are seriously affecting roadside communities and environment.
Social Injustice	As in the cities with less than 3 million in population mentioned above, financial resources are neither equitably allocated nor efficiently spent as seen in biased subsidization of public transport operators. Low income city dwellers are heavily dependent on non-motorized transport modes (NMT), and easily inconvenienced when the bus fare is raised. They are also liable to be victimized by atmospheric pollution and traffic accidents.

(iii) Large population size (more than 10 million)

Congestion	When the city population exceeds 10 million, congestion becomes chronic over the city area. In addition to traffic jams that occur at roundabouts, sub-capacity interchanges and other spots lacking adequate transport infrastructure, congestion crops up almost anywhere by irregular roadside parking, jaywalks by pedestrians and para-transit vehicles and other infractions of traffic regulations. Unruly mode-mixed traffic also adds to the worsening of congestion problems. As shown by the commonly-observed gaggles of para-transit vehicles vying for customers near bus stops and stations, lack of coordination between the available public transport modes is another cause of congestion.
Inconvenience	The convenience of bus operation depends on the passenger-handling capacities of bus terminals and other inter-modal facilities as well as on the frequency and the appropriate routing of services. Inadequacies and shortfalls in such aspects of bus operation are exacerbated by failures of meeting the needs of bus users with diverse socio-economic backgrounds, such as poor provision for easy pedestrian access and lack of barrier-free consideration in the designs of buildings and structures.
Traffic Safety	As in other cities in the early phase of development, few roads are paved and sidewalks are not provided for pedestrians. The conditions of paved surfaces are going from bad to worse due to inadequate drainage and maintenance. The frequency of traffic accidents is rising because of uncontrolled roadside parking and ill-mannered driving of para-transit vehicles.
Pollution and Nuisance	Air pollution and noise nuisance worsen with the increase of traffic volume. Exhaust emissions by antiquated motorized vehicles and extensive traffic congestion over the entire city area adversely affect the roadside living environment.
Social Injustice	People are hardly persuaded to keep traffic regulations because public education and campaigns on traffic safety are mostly ineffective and the literacy rate is low among population. In addition, driver's licenses are easily bought by bribery. Such factors contribute to the worsening of

	traffic congestions and accidents.

4) In the middle phase of development (per capita GDP from US$1,000 to US$4,000)

(i) Small population size (less than 3 million)

Congestion	This type of cities has the well-established public transportation by bus. Traffic congestions are neither too serious nor widespread. Contrary to the cities in the early phase of development, urban roads for motorized traffic are largely paved. There are, however, problems of shortage and inadequacy in the provision of traffic signals and roadside signs, while congestions take place at roundabouts and interchanges. In some cities, bus services are too frequent and cause traffic jams at bus stops. The ineffectively developed network of bus routes and the absence of schedules make matters worse. In port cities that have grown as centers of cargo distribution, the mixing of freight transport with local traffic is a major cause of congestion.
Inconvenience	Both bus and railways are operated in many cities of this type, but their services are not effectively utilized because of insufficient inter-linkage and competition between their respective routes. Terminals are not proportionally placed in the city area and their pedestrian access structures are sub-standard. Guide maps within the terminal are few and ill-placed. These factors combine to reduce the accessibility of public transport facilities.
Traffic Safety	Pedestrian facilities are in short supply on arterial roads, at bus terminals and train stations and in other locations where vehicles and passengers are found in concentration. Traffic lights for pedestrians are few in such locations. Outworn vehicles in use also threaten the safety of pedestrians.
Pollution and Nuisance	The problems of atmospheric pollution and noise nuisance are not yet apparent because of the smaller population size. However, the situation would not last long when demographic and economic urbanization picks up in these cities.
Social Injustice	It has been observed that bus and other public transport networks are failing to reach the steadily growing residential areas of low-income people in some cities of this type. When low-income city dwellers become increasingly dependent on NMT modes, their vulnerability to traffic accidents and polluted air is likely to rise.

(ii) Medium population size (3 to 10 million)

Congestion	During rush hours, the average speed of traffic slows down to less than 10km/h on some links in central built-up areas and on arterials. The major means of passenger travel is provided by bus. Bus services are one of the main causes of congestion, because bus lines of different operators overlap, the bus fleet in operation is in over supply with no effective management of service schedules. As is the case with the cities in the early phase of development, bus services lack efficient operation control, and block the through traffic when passengers board or alight at bus stops and in some cases at any place of their asking. Central built-up areas are growing in density apace with economic development, often making it increasingly difficult to acquire land needed for road construction and improvement.
Inconvenience	Commuting distance lengthens as the urbanization sprawls outward apace with economic development. However, the coordination with the outlying cities is slow to come by in the matter of extending the public transport network. As in the case of cities in the early phase of development, there are many problems in the operation and management of bus services. Namely, the integrated operation of trunk and feeder buses is absent or ill-developed, bus lines are inefficiently set up and bus stops are ill-placed from the viewpoint of users. The parking space shortage will soon become serious in the central built-up areas. In many cities of this type, urban railways, if they exist, are being prevented from developing and improving their services. In some cases, they are forced to stop the operation due to piling financial deficits, or operated mainly for freight transport.
Traffic Safety	Roadside parking becomes an issue in the cities where automobiles are increasing in number but policing over infractions of traffic and parking regulations is lax.
Pollution and Nuisance	In addition to traffic congestions, outdated vehicles in use are one of the major causes of atmospheric pollution.
Social Injustice	In Bogota, for example, owners often register their vehicles as buses or taxis for the sake of tax evasion. As in the case of cities in the early phase of development, bus services do not reach the residential areas of low-income citizens.

(iii) Large population size (more than 10 million)

Congestion	The motorized traffic volume is increasing along with the growth of urban population and income. This requires more advanced urban road management, but the roles of different road grades are not clearly defined, while the shortage of secondary and collector roads are causing congestions. The urban road network fails to keep pace with the progress of outlying residential development and urban renewals. This is another cause of congestions. The increase of para-transit vehicles and motor cycles makes the matters worse.
Inconvenience	Inter-modal linkages and transfers are not well taken care of to cause

	considerable user inconvenience. The preset licensing regulation is not functioning well in achieving efficient coordination and management of public transportation. For example, the existing system of licensing hampers the opening of new routes or the entry of new operators and discourages efforts to improve the level of service. The implementation of transport development projects often gets delayed by the difficulty of land acquisition. Buses and para-transit vehicles often block the traffic when their passengers board or alight.
Traffic Safety	Road conditions are liable to trigger traffic accidents because maintenance works on surfaces are not sufficient and roads are badly designed from the beginning. Accidents involving motorcycles or inadequately maintained vehicles are on the increase. Pedestrian sidewalks are relatively well provided in central built-up areas, but not yet developed on suburban roads.
Pollution and Nuisance	With activated growth of industries and urban activities, the problems of atmospheric pollution and noise nuisance are becoming increasingly serious, sometimes to the extent of exceeding local PPM standards.
Social Injustice	Low income citizens have to rely heavily on NMT modes and are more vulnerable to the adverse effects of air pollution and noise nuisance and victimized by traffic accidents. Even with relatively low public transport fares, low income people are often deprived of easy access to affordable means of travel and thus disadvantaged in accessing better earning opportunities and social services. With city population exceeding 10 million, the number of the elderly and the handicapped are increasing, but there is no established institution to meet their needs and help their predicaments.

5) In the late phase of development (per capita GDP of more than US$4,000)

(i) Large population size (more than 10 million)

Congestion	Chronic congestions spread extensively over the entire city area along with such trends as growth of personal disposable income, increase of passenger car ownerships, widespread roadside parking and insufficient network capacity and delayed development of transport infrastructure to reach new residential areas expanding in the outlying suburbs. The issue of mixed traffic as a cause of congestion is largely dealt with.
Inconvenience	New built-up areas are being development but the construction of roads and other transport infrastructure fails to catch up. The available means of travel are diversified. Public transport modes schedule frequent services, and yet their overdeveloped route extensions are sometimes too complicated for users to grasp the entire picture of. The interconnection between the road network and public transport is neither well planned nor well managed so that intra-city travels are rather hazardous.
Traffic Safety	As in other types of cities, ill-mannered driving causes many traffic accidents. Sidewalks are fairly well provided, but many of their designs are not free of barriers and inadequacies from the viewpoint of pedestrians.

Pollution and Nuisance	The problem of atmospheric pollution is grave.
Social Injustice	Measures to protect and support the handicapped are less developed.

6) Idiosyncratic Factors Affecting Urban Transport Problems

As discussed in the preceding paragraphs, the variations in economic development and population size influence the characteristics of urban transport problems that each city confronts and deals with. In addition, the respective characters of cities have been shaped and influenced by their unique natural environment, historical experiences and cultural backgrounds. Such idiosyncratic factors also affect the manifestations of urban transport problems. Table 3.8 summarizes the findings reported by the JICA transport master plan studies.

Table 3.8 Idiosyncratic Factors Affecting Urban Transport Problems

Natural Environment	Cities in riverine or lacustrine environment or cities straddling rivers, lakes or straits: rivers and such are bottlenecks in urban transportation. (e.g. Manila, Colombo, Bangkok, Hanoi and Istanbul)
History	Port cities and others that had grown as centers of freight distribution: the mixing of freight and local traffic leads to congestions. (e.g. Colombo and Damascus)
Physical Shaping	Cities with a dense and extensive mesh of alleys and aisles: people are heavily dependent on two-wheelers to get door-to-door transport. (e.g. Ho Chi Minh and Hanoi)
Culture and Religion	Generated trips vary between sexes under the influence of cultural or religious backgrounds.* (e.g. Damascus) Cities with separate residential areas for different ethnic or religious communities: it is sometimes difficult to provide acceptable places for relocation in compensation to the land appropriation for transport infrastructure development.(e.g. Damascus)

* JICA, *The Study on Urban Transportation Planning of Damascus City in the Syrian Arab Republic*, (1999).

7) Urban Economic Development and Transport Problems: Summation

Based on the foregoing review of the urban transport problems as reported in JICA master plan studies and the analysis thereof in relation to the phase of economic development and the size of population, the findings are summarized per category of transport problems.

(1) Traffic Congestion

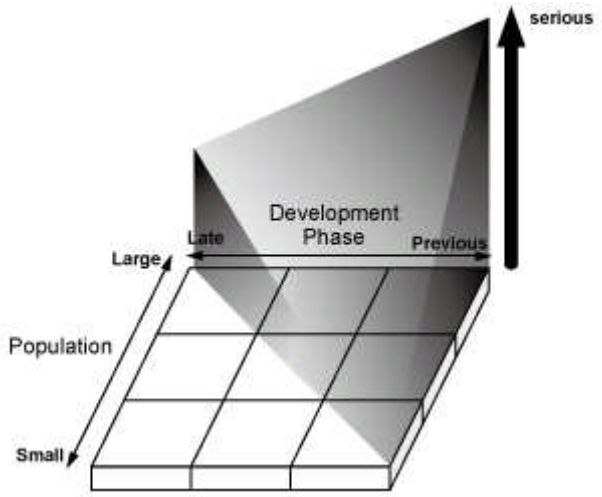
In terms of population size, traffic congestions are found in limited locations in many cities of less than 3 million in population. Along with demographic growth, congestions become increasingly extensive. In cities of more than 10 million, chronic congestions are usually found over the entire city area.

In terms of economic development, congestions of the cities in the early phase of development are attributable to the shortage and the inadequacy of basic transport infrastructure, such as underdeveloped arterials, presence of missing links in the network and absence of properly paved road surfaces. In the middle phase of development, cities find it difficult to acquire rights of way for new road construction because of rising land prices in increasingly densely built-up areas. Sometimes they can hardly propose relocation plans acceptable to local inhabitants. Moreover, the development of new residential communities in the suburbs goes ahead without concomitant network extension, creating new shortfalls of roads. The cities in the late phase of development are provided with a network of arterial roads adequately paved and maintained. City dwellers can avail themselves of diversified modes of travel including bus and railway services. However, a new problem arises in traffic management and transport service operation such as labyrinthine development of bus line networks and absence of easy transfer between public transport modes.

Moreover, the problem of traffic congestions worsens along with the growth of population size and urban economy. Traffic congestions in the early phase of development are no match in seriousness for those that emerge during the late phase (see Figure 3.4).

At the same time, some problems are found in most of the cities under study, regardless of their respective population size and development phase. They concern road traffic management: namely, inappropriate posting or absence of traffic signals and absence of left- or right-turn lanes.

Figure 3.4 Intensity of Congestions by Population Size and Development Phase



(2) Inconvenience

Along with the growth of urban economy, the urbanized area expands outward and commuters have to travel ever-extending distance on every weekday. The development of necessary road infrastructure falls behind the pace of such urban sprawl.

Urban public transport during the early development phase is mainly provided by bus services, but bus lines are often inadequately laid down to meet the needs of users and/or the bus fleet is insufficient relative to the demand. Meanwhile, the issue of transfer between different transport modes is yet to emerge because the available means of travel are very limited in the cities in the early development phase. During the middle and the late phase of economic development, however, many cities come to offer BRT and/or railway transit services and the inadequacy of transfer between them jeopardizes the convenience of public transport to city dwellers. In addition, as urban population grows, the existing capacities of bus terminals and inter-modal facilities fail to handle a massive flow of passengers.

(3) Decline of Traffic Safety

During the early phase of economic development, the issue of traffic safety mostly exists in various inadequacies of basic road infrastructure, such as absence of surface pavement and pedestrian sidewalks. By the middle development phase, cities are provided with basic road infrastructure, but the shortfalls of facilities for non-motorized traffic (NMT) become apparent. Some progress has been made in the central built-up areas but the provision of sidewalks and the maintenance and repair on road surfaces are slow to come by in the outlying areas. In the late development phase, urban roads are largely paved and provided with sidewalks, and the safety issue arises from bumps and barriers left in the poorly designed structures.

Urban economic growth spurs the increase of motorized traffic, resulting in the increase of fatal

traffic accidents. Some problems persist regardless of development phase: namely, ill-mannered driving, drunken driving and speeding.

(4) Pollution and Nuisance

Regardless of development phase, cities of small population size do not generally suffer atmospheric pollution and noise nuisance from motorization. As the population grows larger, roadside communities along arterial roads are first affected by serious air pollution and noise and then the entire living environment of cities comes under adverse hazards of widespread atmospheric deterioration. Along with the growth of urban economy, rapidly increased motorized traffic and the continued use of outdated motor vehicles become major sources of atmospheric deterioration.

(5) Social Injustice and Inequality

Continued growth of urban economy and concomitant expansion of urban residential areas tend to result in a shortfall of bus services reaching low-income communities. Low income classes among urban population are thus deprived of affordable access to employment opportunities and social services. The absolute number of the elderly and the handicapped would rise along with population growth, calling attention to the poor provision of barrier-free transport infrastructure and passenger- and pedestrian-friendly facilities.

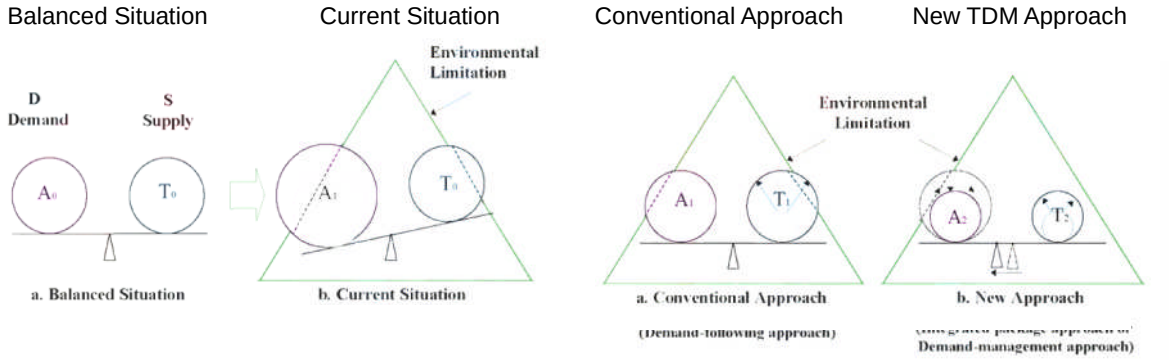
The cities under study show, regardless of their respective development phase and population size, that urban low income classes are heavily dependent on non-motorized transport and lack the access to affordable transport means. Illiterate drivers who obtained licenses by bribery are prone to cause traffic accidents because they are ignorant of traffic rules and regulations. Beside income levels, there are other disparities manifested in the patterns of trip generation and distribution that originate from cultural or religious backgrounds.

3.5 Traffic Demand Management in Developing Countries

1) Traffic Demand Management Scheme

A traffic demand management (TDM) scheme addresses a variety of issues such as mitigation of traffic congestions, reduction of energy consumption and exhaust gas emission in the transport sector and so forth which involve changes in people's attitudes towards mobility. TDM is a new concept that began to gain wide recognition in the later 1990s. In contrast to the then conventional approach that emphasized the supply side increase to meet the growing traffic demand, TDM focuses on the suppression of traffic demand vis-à-vis a given limited supply of transport infrastructure (Figure 3.5).

Figure 3.5 TDM Approach



Source: First Meeting of the Regional EST Forum in Asia, 2005.

2) Proposed TDM Measures and Examples of Introduction

Specific measures included in a TDM scheme vary from the hardware development of physical structures (e.g. park & ride facilities) to the software instrumentation (e.g. economic restraints or incentives). In the present study, TDM measures are classified into four categories in terms of the intended effects: namely, (i) promotion of modal shift, (ii) suppression on demand, (iii) dispersal of demand and (iv) efficient utilization of available road space. The discussion deals with TDM measures for each category and examines suitable conditions to introduce such measures (see Table 3.9).

The present situations of TDM introduction in the cities of developing countries are presented on the basis of JICA master plan studies. However, the studies conducted before the late 1990s when the concept and the approach of TDM were globally accepted paid no heed to TDM measures. Therefore, the present study limits the review to the cities on which JICA undertook master plan studies since 2000. Regarding other cities, relevant information is collected as much as possible from the available publications and databases.

Table 3.9 Proposed TDM Measures and Examples of Introduction (1/2)

TDM Classification	TDM Measure	Requirement	Example
Promotion of Modal Shift	・ Park & ride	・ Public transit routes from the suburbs to the CBD ・ Parking space near transit stations	・ Many examples in developed countries ・ Some examples in middle income countries (Istanbul under planning in 2008)
	・ Improvement of transit stations	・ Sufficient space for multimodal transit facilities	・ BRT network in Bogota ・ BRT network in Curitiba
	・ Development of pedestrian facilities (sidewalks, crosswalks, universal designs , car-free malls)	・ Road widening sufficient to provide sidewalks ・ Large-scale concentrations of commercial and business functions in the CBD	・ Many examples in developed countries ・ Development of public space, Bogota ・ Examples of mostly limited or partial application in developing countries
	・ Development of cycling facilities (bike lanes, bicycle parking space)	・ Road widening sufficient to provide cycling lanes	・ Bicycle lane, Seoul
	・ Integration of cycling and public transit	・ Bicycle-friendly environment (roads and parking space) ・ Provision of sufficient space for bicycles on public transport means	・ Bicycles allowed to ride on subways, Taipei
	・ Public bike system	・ Large-scale commercial and business centers with bicycle-friendly environment	・ Many examples in developed countries
	・ Financial l incentives to commuters by public transit (travel allowances)	・ Consensus and cooperation of the business sector	・ Japan
	・ Transit-oriented development (TOD), urban planning not dependent on automobile use	・ Close coordination between the urban sector (land use, urban renewals, etc.) and the transport sector	・ Many examples in developed countries ・ Integrated development of real estates and suburban railways, Japan
	・ Promotional campaigns for the use of public transit and non motorized transport (NMT)	・ Public consensus	・ Social experimentation and pilot projects (Phnom Penh, Ho Chi Minh, Ha Noi, etc.)
Demand Suppression (1/2)	・ Road pricing, area licensing	・ Cordon lines for policing ・ Public consensus	・ ERP (1998), Singapore ・ Congestion charging (2002), London ・ Similar examples in Stockholm, Milano and other small-size cities in Europe
	・ Restrictions on automobile use regarding particular areas or hours	・ Public consensus	・ Color coding, Manila ・ 3 in 1, Jakarta ・ Odd-even scheme, Surabaya
	・ Charges on automobile users (carbon tax, gasoline tax, pay-as-you-drive insurance polity)	・ Public consensus	・ Many examples in developed countries ・ Pay-as-you-drive automobile insurance policy, United Kingdom
	・ Ban on trucks	・ Consensus from the freight logistics sector	・ Introduced in many cities of developed and developing countries
	・ Restrictions on car ownerships (quota system)	・ Acceptance of car owners ・ Procedure for determining appropriate ceiling	・ Car plate quota system, Shanghai, Beijing
	・ Tele-working	・ Advancement of urban business functions (service sector)	・ Many examples in developed countries
	・ Parking management (parking pricing)	・ Consensus of car users	・ Very few examples of restrictions on automobile use in developing countries

Table 3.9 Proposed TDM Measures and Examples of Introduction (2/2)

TDM Classification	TDM Measure	Requirement	Example
Demand Suppression (2/2)	・ Campaigns to refrain from driving automobiles		・ Car-free day, Bogota
Demand Dispersal	・ Alternative work schedules (staggered commuting to offices and schools, flex time, compressed work week)	・ Introduction of advanced office management	・ Staggered commuting introduced in government offices and schools, Colombo ・ Flex time adopted by many private companies in many cities
	・ Congestion charging	・ Availability of appropriate alternatives of congestion pricing schedules (hours charged, appropriate rates of pricing)	・ Congestion Charging, Sao Paulo
	・ Intelligent traffic information system（ITS）	・ Roadside infrastructure for collecting traffic information (communication network, CCTV, vehicle detectors, etc.) ・ Variable message signs (VMS) provided along major corridors ・ Traffic control center	・ Increasing examples of introduction in the cities of middle income countries (Bangkok, Kuala Lumpur, Istanbul, etc.)
Efficient Use of Road Space	・ Lanes or roads for high-occupancy vehicles (HOV)	・ Traffic volume on HOV lanes are sufficiently large to get accepted by local communities ・ Smooth traffic arrangement at lane or road exits	・ 3 in 1, Jakarta
	・ Car sharing and pooling, efficient freight distribution system	・ Presence of commuters to the same direction during the same hours ・ An officially organized system requires a managing entity for coordination.	・ Impromptu examples in the cities of developing countries, but not officially supported
	・ Traffic calming (humps, median islands)	・ Consensus between local communities and road users	・ Many examples in developed countries
	・ Restrictions on para-transit vehicles	・	・ Restrictions on xichlos, Ha Noi and Ho Chi Minh ・ Restrictions on rickshaws, Dhaka

Source: Compiled by the study team from various JICA studies and other sources of information.

3) TDM Schemes Operated or Proposed in the Cities of Developing Countries

Partly taking note of the proposals in the JICA master plan studies, the present situations of TDM measures in developing countries are summed up as follows. The ban on trucks in the CBD is in force in many cities, but other measures for demand suppression (various means of economic control) and the promotion of modal shift are slow to come into practice. Notably, restrictions on car ownerships and driving have not been put in force in most of the cities, even though they were proposed in the urban transport master plans or discussed as an important issue of the transport sector strategy in the urban development master plans. The delay is largely due to local political obstacles and the difficulty of persuading wide acceptance among citizens.

In Bangkok, for example, such TDM measures as road pricing, parking restrictions, staggered commuting and introduction of bus lanes have been proposed repeatedly since the 1970s in a series of the National Social and Economic Development Plans. None of the proposals have been acted on. Sporadic half-hearted attempts, inefficient instrumentation, inadequate promotional campaigns and many other political, organizational and financial shortfalls contribute to such failings. It has been pointed out that the awareness and the understanding of the issue are yet too deficient to take actions.[1]

Economic measures for demand suppression, such as road pricing and taxation on car ownerships, have been more or less successfully implemented in the countries of strong administrative power like China and Singapore. They are practically absent in anywhere else. There are a few examples of demand suppression which involve only physical restrictions without any pricing or charging, such as color coding in Metropolitan Manila and 3 in 1 in Jakarta. Trucks are banned from entering the CBD in almost all cities.

Concerning TDM measures for demand dispersal, traffic information services by ITS have been started in some of the middle income countries.

The cities in Africa and in Asian low-income countries show no sign of planning or even considering a TDM scheme in their respective policy agenda. TDM-related proposals are mostly absent in the JICA master plan studies regarding many of these cities.

[1] AUN/SEED-Net, 2004.

Table 3.10 Urban TDM Measures Introduced or Proposed in Developing Countries(1/2)

City	Country	Modal Shift Promotion	Demand Suppression	Demand Dispersal	Efficient Use of Road Space
Asia					
Shanghai (2008)	China	○ Park & ride; bicycle parking space at transit stations	○ Car plate quota (by bidding); bans on entry of cars below exhaust emission standards	–	–
Ulaanbaatar (2009)	Mongol	▲ Transit-oriented Development (TOD)	▲ Number coding; parking restrictions; tax on car purchase	×	×
Jakarta	Indonesia	○ BRT operation; transit facilities	▲ Area Pricing	○ 3 in 1	×
Bangkok	Thailand	▲	▲ Road pricing; parking restrictions	▲ Staggered commuting	▲ Introduction of bus lanes
Manila (2011)	Philippines	▲ TOD	○ Color coding	×	○ Bud lanes
Ha Noi (2007)	Vietnam	▲ TOD	▲ Parking restrictions	×	○ Restrictions on xichlo traffic
Ho Chi Minh (2005)	Vietnam	▲ TOD	▲ Road pricing; parking restrictions	×	×
Kuala Lumpur	Malaysia	×	▲ Parking restrictions	○ Traffic information services	▲ Reversible lanes; exclusive bus lanes; car sharing
Vientiane (2009)	Laos	▲ Park & ride	▲ Parking restrictions	▲ Staggered commuting	×
Phnom Penh (2001)	Cambodia	×	×	×	×
Singapore		○ Park & ride	○ Electronic road pricing (ERP); taxation on automobiles (at purchase and registration)	○ ITS Off-peak car	–
Seoul	Korea	○ Bicycle lanes	○ Congestion charging (1996) Restrictions on total parking capacity	○ ITS	○ Car-free streets
Colombo	Sri Lanka	×	×	○ Staggered commuting (government offices and schools)	×
Dhaka (2010)	Bangladesh	×	▲ Parking management	×	○ Restrictions on rickshaw traffic
Middle East					
Damascus	Syria	×	×	×	×
Tripoli	Lebanon	×	×	×	×

Table 3.10 Urban TDM Measures Introduced or Proposed in Developing Countries(2/2)

City	Country	Modal Shift Promotion	Demand Suppression	Demand Dispersal	Efficient Use of Road Space
Central and South America					
Bogota	Columbia	○ BRT; transit facilities; bicycle lanes	○ Parking restrictions; car plate restrictions; car-free days	○ Peak hour restrictions	×
Lima	Peru	×	×	×	×
Sao Paulo	Brazil	－	－	○ Peak hour traffic restrictions	－
Curitiba	Brazil	○ TOD; BRT; transit facilities; bicycle lanes	○ Restrictions on constructing off-road parking lots in the CBD	×	○ Introduction of bus lanes
Mexico City (2008)	Mexico	－	○ Number coding	－	－
Africa					
Nairobi	Kenya	×	×	×	×
Lusaka	Zambia	×	×	×	×
Lilongwe	Malawi	▲ Sidewalk development	×	×	×
Europe					
Istanbul (2009)	Turkey	▲ Park & ride	▲ Traffic cells	×	×

Notes: ○: already in force; ▲: proposed in master plan studies; ×: not proposed; and －: information not available
Sources: Various reports of JICA master plan studies and the information collected by the study team elsewhere

Various TDM measures mentioned above are effective and sustainable when they are introduced as a package instead of being tried separately. For instance, road pricing or color coding to restrict the use of private automobiles must be accompanied by the adequately improved public transit services. Examples of cities which are implementing a comprehensive TDM scheme are Singapore, Curitiba in Brazil and Bogota in Columbia. Jakarta, Manila, Seoul and Beijing have put characteristic TDM measures into practice, although not in a comprehensive package. The following is a brief description of their TDM efforts.

(1) Comprehensive Public Transit Network in Curitiba, Brazil

Curitiba implemented the integrated development of urban land use and public transit (bus) with World Bank financing, a model case by far of the transit oriented development (TOD). By means of regulations and standards on urban land use, building height and floor area ratio, urban activities have been induced to locations along the development axes, where BRT services are provided for more efficient use. The public transit in the city has a stratified structure consisting of the trunk lines of triple-body articulated buses and the feeder bus lines, with appropriate positioning of terminals and other facilities for transit passengers. With its new tariff system that makes transfers between lines easy, the public transit system has substantially improved the convenience for users.

In addition to the public transit system, the city has tried to improve the environment for the non motorized traffic (NMT) by developing pedestrian spaces, bicycles lanes (total extension of 18 km) and restrictions on off-road construction of parking facilities in the CBD.

Other than the construction of exclusive trunk bus lanes and restrictions on off-road construction

of parking lots in the CBD, Curitiba has not introduced any TDM measure which aims to suppress, physically or economically, the use and ownership of private automobiles. Curitiba is an exemplary city which has successfully promoted the modal shift to public transit by upgrading the service level of bus lines.

(2) Car-free Day in Bogota, Columbia

Faced with severe atmospheric pollution and serious congestions spurred by rapid motorization, Bogota decided to reduce the use of private automobiles. For this purpose, the city formulated and implemented a comprehensive transport improvement program called Bogota Project, which combined supply- and demand-side approaches. The following is a brief description of the measures taken in Bogota.

Supply-side Development: a comprehensive public transit network that consists of a mass transit system to cover the entire city area, with appropriate provisions for alternative modes of travel

- TransMillenio: The BRT system started operation in December 2000 with a fleet of articulated trunk buses with capacity of 160 passengers per vehicle. User convenience was secured by the construction of transit facilities and the introduction of magnetic tickets, among others. In addition to the purchase of new fleet vehicles and the construction of exclusive trunk bus lanes, steps were taken to restructure the system of bus operation. The operation of the bus system is in the hands of private companies, including both trunk bus and feeder bus lines, services connecting residential areas to bus stations and the ticket system. The BRT system is expected to expand to a total of 22 lines by 2015, with a fleet increased to 6000 articulated buses.
- Cycle paths: A total extension of 120 km had been constructed and additional 180 km was in the pipeline. The objective was to increase bicycle users from 0.5% to 4% of city population in two years after the construction. It was expected that the percentage would grew to 6% in 2001 and reach as much as 30% by 2005.
- Public space: Over the entire city area, pedestrian facilities such as sidewalks and roofed promenades for recreational activities have been constructed to create pedestrian-friendly space for children, the elderly and the handicapped. The world longest roofed promenade of 15m wide has been constructed. New parks have been added along with rehabilitation of the existing parks.

Demand-side Development: a variety of schemes to promote public transportation by suppressing the use of private automobiles

- Fees and taxes: The city successfully managed to suppress the use of automobiles by doubling the fees at public parking lots and deregulating the fees of private-sector parking lots. In addition, the gasoline tax was raised by 20%. The resulting increase in the municipal revenue was spent on road maintenance and otherwise pooled as a fund for public transport development.
- Peak and license plate (Pico y Placa): The scheme was introduced to achieve a 40% reduction of motorized traffic during peak hours in the CBD of some 32,000ha, partly to promote the use of public transit and partly to alleviate road congestions. Specifically, the use of automobiles earmarked by the last digit of car plates is not allowed during rush hours (7:00 to 9:00 in the morning and 5:30 to 7:30 in the evening) from Monday through Friday.
- Cycleway: Intra-city highways (110km) are made free of automobiles on Sundays and

opened for cyclists, skaters and pedestrians. The measure has an important social impact by strengthening community ties in addition to alleviating the environmental problems.

- Public campaigns ("Without my car in Bogota. Let us imagine a new city"): The city has been mounting a variety of public campaigns to stimulate the awareness among citizens about the promotion of public transit. Of the largest scale so far was the car-free day campaign launched on Feb. 24th of 2000, the world's first attempt to ban the use of private automobiles over the entire area of the city. According to an opinion poll, 87% of the citizens favored the campaign and 89% answered that they suffered no significant difficulty of mobility on the campaign day.

Because various restrictions on the use of private automobiles were included in the program package, Bogota Project elicited voicing of pros and cons among the citizens in the beginning. The municipal referendum in October 2000 returned the result that 62% of the voters had answered yes to the project, indicating the favorable attitude among the population.

(3) Comprehensive Transport Demand Management in Singapore

Singapore has been implementing various TDM measures as part of its comprehensive transport strategy. By covering the whole gamut of measures from economic restrictions on the ownership and the use of private automobiles to the development of its public transit system, the city can benefit from the multiplier effect of the comprehensive transport program. For instance, the system of electronic road pricing (ERP) has been introduced to control motorized traffic volume, while the park & ride scheme has been expediting the modal shift from private automobiles to public transportation.

Restrictions on Car Ownerships:

- Vehicle quota system (VQS): The system was introduced in 1990 to control the number of new car registrations. An owner must obtain a certificate of enrolment (COE) to own a car and the government controls the number of certificates to be issued for new cars. There are five types of COEs and the Land Transport Authority (LTA) presides over public biddings for COEs twice a month.
- Additional registration fee (ARF): The additional registration fee on a new car is double the open market price (OMV) of the car. In addition to ARF, the new car owner pays import tariff (20% of OMV), consumption tax (7%), a vehicle registration fee (fixed fee per COE type), road tax and so on. The total cost of purchase and registration would amount to four or five times the open market price.

Restrictions on Car Use:

- Electronic road pricing (ERP): The ERT system succeeded in 1996 the earlier area licensing scheme (ALS) introduced in 1975. Motorized vehicles are tolled when they use the arterials and highways in the CBD during peak hours. The rates differ between arterials and other highways and between weekdays and Saturdays. LTA revises the rates four times a year.
- Off-peak car scheme: The scheme was introduced in 1994 by revising the earlier week-end car scheme that had been in force since 1991. It was meant to alleviate congestions during commuting hours on weekdays. The road charging was reduced for cars used at night (19:00 to 7:00). Off-peak cars were issued red number plates to distinguish from ordinary cars. They could be driven during day time by paying the fee of S$20 for a permit.
- Park & ride: The scheme has been making progress in congestion alleviation in the CBD. Commuters drive to a nearby MRT station or bus terminal and park their vehicles at public parking lots and then ride on public transit to the CBD.

Improvement of Public Transit Services:

- Efficient and affordable public transit system: The combined public transit network of MRT, bus and taxi covers the entire territory of Singapore and the fares are kept generally low. It is

now being planned to raise the modal share of public transit during commuting hours to 70% by 2020. For this purpose, improvements of bus services, two new MRT lines, and closer integration between MRT and bus lines are on the agenda.

The comprehensive TDM measures in Singapore are largely a reflection of the country's unique backgrounds: namely, it is a compact city-state with strong law and order commitment. At the same time, it is possible to list up a number of necessary conditions for TDM implementation from Singapore experiences.

- It is necessary to present TDM measures as integral part of the comprehensive transport strategy and have them accepted by citizens.
- The TDM demand suppression by raising the cost of private car ownership and use must be accompanied by the improved user convenience of public transit services as an effective alternative to automobiles.
- The TDM measures must be executed with fairness to gain the trust of citizens.
- It is necessary to heed the opinions of citizens and to revise or modify TDM measures accordingly.

(4) 3in 1 Policy in Jakarta, Indonesia

The scheme introduced HOV lanes to arterial roads in the CBD of Jakarta in the 1990s. Except for taxis and public transport means, motorized vehicles must carry three or more passengers to drive on the arterials during morning and evening peak hours. The measure has managed to alleviate to an appreciable degree the congestions on the roads with HOV lanes. At the same time, however, it caused the worsening of congestions elsewhere and even gave birth to "jockeys" who offer their service as temporary passengers. Moreover, the scheme itself has been faulted in its approach. Namely, the scheme is not flexible enough in design and application and brings no additional revenue to sustain itself.

(5) Color coding in Metropolitan Manila, Philippines

The Uniform Vehicular Volume Reduction Program (UVVRP), popularly known as "Color Coding", was introduced in 1996 to control the motorized traffic per weekday according to the last digit of number plates. Both private and public vehicles of number plates with the designated last digit are not allowed to run within metropolitan Manila on the designated weekday from 7:00 to 19:00 (private automobiles can be driven during the window hours from 10:00 to 15:00). Since its inception, the program has been repeatedly subjected to minor modifications. As a result, some municipalities in metropolitan Manila discontinued window hours, while others dropped the entire program. In some other municipalities, the scheme has devolved into the practice of applying "color coding" only exceptionally to some designated road sections or areas.

(6) Bicycle lanes in Seoul, Korea

The city government of Seoul announced on Oct. 21, 2008 its plan for expediting the use of bicycles and enabling commuters to cycle to their places of work in the city center. The gist of the plan was to develop a network of bicycle lanes totaling 207km in length by 2012 and to appropriate one lane off the existing roads for this purpose. It was predicted that the modal share of bicycles would increase from a mere 1.2% at the time of announcement to 4.4% in 2012 and 10.0% in 2020 by plan implementation. The increased use of bicycles would "kill five birds with one stone," as the announcement went, by easing the adverse impact of high petroleum prices, improving atmospheric pollution, reducing motorized traffic and thereby alleviating congestions, solving parking difficulties and reducing social costs by improving people's health. It was envisaged that the plan would generate the benefits worth estimated W574.5 billion (¥4.4 billion).

According to the plan, 4 radial axes (e.g. the axes from Cheonggyecheon to Cheonho and from City Government Buildings to Siheung)from suburbs to the city center (a total extension

of 70km) and 13 axes running either east to west or north to south (a total extension of 137km) would be provided with exclusive bicycle lanes. The exclusive bicycle lanes along River Hangang would be widened to 4m or more to allow high-speed cycling. To connect the Hangang lanes with the proposed city lanes, 19 elevators for bicycles would be constructed at bridges across River Hangang by the end of 2012. A circulating network of bicycle lanes would be established between Cheonggyecheon and Daehangno and between Gogoong and the city center where offices are found in concentration. The introduction of a public bicycle rental scheme would be considered regarding the CBD. In such areas as Nowon and Songpa where the bicycle traffic is sizeable, 12 bicycle-friendly towns would be developed with traffic signals for bicycles and other facilities to ensure convenience and safety for cyclists. At 16 subway stations where the daily parking demand would exceed 300 bicycles (e.g. Jamsil Station andSindorim Station), a multi-story parking building would be constructed exclusively for bicycles, including lockers and shower booths for cyclists (reported by Yonhap News Agency).

(7) Suppression on Motorized Traffic in Beijing, China

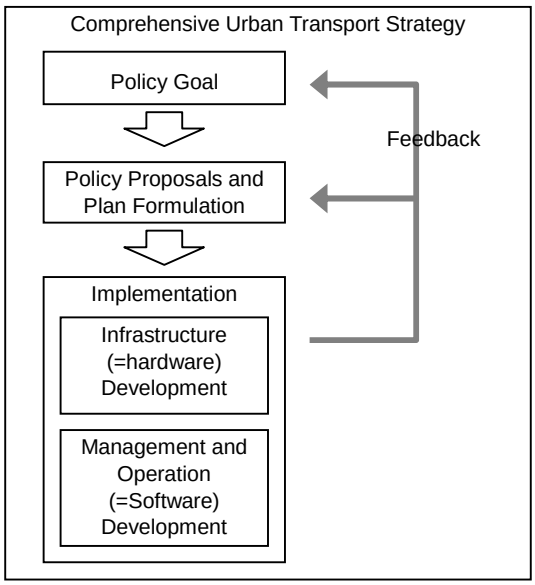
Congestions on arterial roads in Beijing have been worsening every year along with the increase of car ownerships and hence the vehicular traffic volume. Some TDM measures were introduced in the past, such as the five-shift scheme which allowed the use of motorized vehicles by the designation of the last digit of car plates or the ban on freight vehicles in the CBD. The population of Beijing has already reached 20 million, with an annual increase of 500,000. The number of registered car ownerships has easily exceeded 4.7 million, with a net increase of some 800,000 vehicles in a year. The city government of Beijing has initiated in 2011 a number of TDM measures. New car registrations for 2011 would be reduced to 30%, or 240,000 vehicles, of the total registrations in 2010, while the vehicles from outside Beijing would be banned from entering the CBD during 7:00 – 9:00AM and 5:00 – 8:00PM on weekdays. Regarding those areas in the city where congestions are especially pronounced on holidays, the motorized traffic would be restricted to enter, if need be, by designating the odd or the even last digit of number plates. In addition to such measures for demand suppression, the development of public transportation would be accelerated. The metro system is now being operated on 14 lines totaling 336km, of which 5 lines with a total extension of 108km was opened in 2010. The metro system will continue to expand with its total extension reaching 561km by 2015 and 1,050km with 30 lines by 2020.

4. Guidelines for Urban Transport Strategy Formulation

This chapter discusses two components to be included in the guidelines for formulating urban transport strategy, namely, how to diagnose transport problems and identify effective prescriptions to solve them and how to choose a most suitable transit mode from the available investment alternatives. In addition to devising the methods to clarify the said two issues in the strategy formulation, the present study would apply the methods in the case study of cities.

As discussed in Section 3.1 of Chapter 3, an urban transport strategy has to be formulated with a long-term policy goal or vision over two decades to come. In addition to a number of strategic policy proposals to achieve the long-term goal, a set of feasible projects and measures must be proposed for implementation during the coming five to ten years, accompanied by operation and management requirements.

Figure 4.1 Proposed Approach to Comprehensive Urban Transport Strategy



Note: Partly replicated from Figure 3.1 of Chapter 3

Formulation of a comprehensive strategy for urban transport in its genuine form, as shown in Figure 4.1, requires a series of tasks starting from compilation of necessary data, undertaking of a large-scale traffic survey to obtain the current trip patterns, forecasting future traffic demand based on the future frame of socio-economic conditions, and ending in the formulation of a future vision and a strategy for transport development, including identification and appraisal of specific projects based on the strategy. JICA has so far implemented master plan studies and thereby supported the strategy formulation regarding urban transport in many cities of the developing world. Such an accumulation of experiences could be usefully reviewed by taking careful note of the scales of the cities, the phases of their economic development and the geographical and geopolitical contexts. The resultant typology of the cities grouped by similarities could reveal a set of traffic problems commonly shared by each city type and accordingly indicate a similar approach to urban transport strategy formulation.

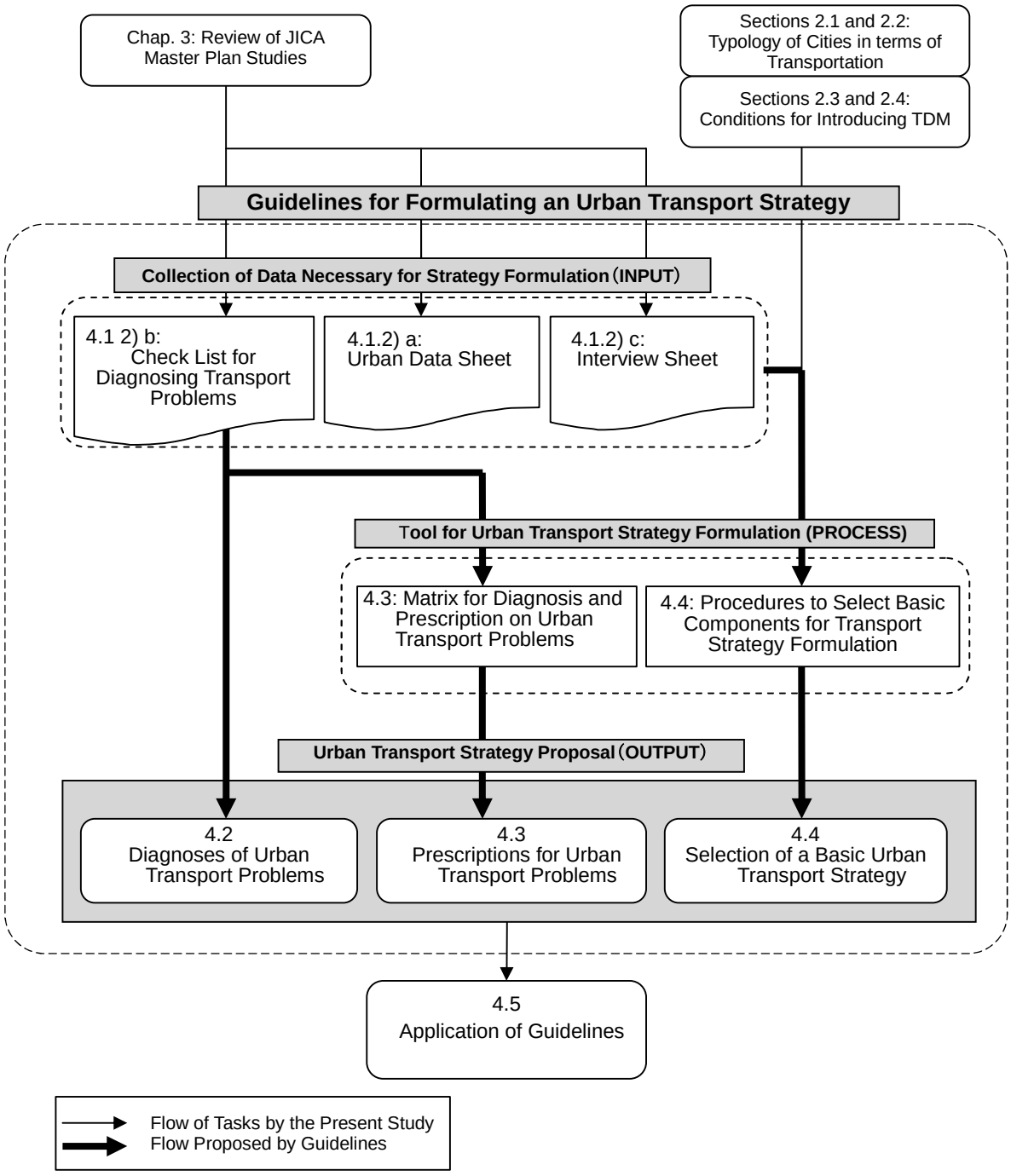
From the beginning, the present study intended to carry out a typological analysis of cities in the world (especially the developing world) and thereby ascertain the nature of urban transport problems and their remedies for each city type. It was expected moreover that the findings of the analysis could serve as important inputs to the drafting of guidelines for the future undertaking of urban transport planning. As seen in the argument of Chapter 2, the typological analysis of the

cities has yielded a certain set of conclusions as initially expected. However, many of such conclusions only suggest probable tendencies. The actual situations of urban transportation are so diverse that the findings of the analysis at this point could not be generalized as universally applicable to every city. The availability of relevant information is very limited in any city which the present study examined. However hard it is tried to combine the available pieces of information for the sake of analysis, the results from such efforts would fall short of giving definitive answers, or hints even, about the actual transport problems and needed development strategy in a given city. The spatial structure and the available modes of mobility vary from one city to another. Hasty judgments on inadequate grounds could amplify the risks of making mistakes in decision-making.

In the quandary, it was thought worthwhile to try some methodological development useful for the formulation of an urban transport strategy. Starting from the findings in Chapters 2 and 3, the present study asked what kinds of data would be the minimum necessary to arrive at a basic transport strategy and find some simple and compact way to collect and compile such information. Based on the compactly compiled data, the present study prepared a number of suitable procedures for strategy formulation. In place of the time-consuming and costly undertaking of an orthodox master plan study, in other words, the present study attempted to develop a simple method or methods which would require a minimum of data and simple formats of analysis for formulating an urban transport strategy.

Two different approaches are necessary for strategy formulation. One approach seeks best possible ways to solve or alleviate the immediate transport problems that vex the day-to-day life of city dwellers, and might be called “the individual issue approach.” The other selects a public transport mode which is to play the central role in urban transportation in the medium- to long-term perspective. This might be called “the basic strategy approach.” The last step is to decide what to do on the basis of the conclusions from two approaches, or to identify “the actions to put into effect.” The flow of the procedure is shown in Figure 4.2.

Figure 4.2 Composition of Guidelines for Formulating an Urban Transport Strategy Proposal



4.1 Collection of Data for Strategy Formulation

Data must be collected as required by the urban data sheet, the check list for diagnosing urban transport conditions and the interview sheet, all of which are necessary inputs to the tools devised for formulating an urban transport strategy.

1) How to Compile Necessary Information

Formulation of an urban transport strategy needs a broad range of information, such as socio-economic indicators needed to classify city types, the volume and modal patterns of transport demand, the extent and intensity of traffic problems and causes thereof, and the availability of effective measures to solve or alleviate such problems. The necessary information is grouped into two categories: namely, objective data like socio-economic indicators and characteristics of traffic demand and subjective data consisting of informed judgments about the intensity and causes of problems and effective alternatives available for solving the problems. The methods to collect information naturally differ by category of data. To collect subjective types of information, two data sheets are devised: namely, the check sheet for diagnosing and understanding urban transport conditions and the interview sheet for collecting detailed information needed to choose basic elements for formulating urban transport strategy proposals.

Two sheets are not prepared with a particular city in mind and accordingly might contain some data items that do not suit the conditions of a given city or require additional items for another city.

(1) Urban Data Sheet

The urban data sheet is used for collecting objective, or quantified, data with which to recognize the profile of current urban transport problems and thereby propose an urban transport strategy. It is presumed that such data be collected by some transport sector consultant who has access to necessary statistics on a given city.

- *Basic data:* maps; area size and geography of a city; mixed distribution of business and commercial establishments, residences and industrial activities in the CBD; and presence or absence of sub-CBDs
- Urban structure: trends of population and GRDP
- Traffic demand: modal split (all trip purposes and commuting trips); registered car ownerships; general conditions of arterial roads (number of lanes, cross-section structures, congested sections, traffic volume, public transport demand, development plans, etc.); and presence or absence of urban highways and general conditions thereof
- Public transport: Share of public transport in total traffic demand
- On-going measures of traffic demand management

(2) Check List for Diagnosing Urban Transport Conditions

The check list itemizes major issues of transport problems discussed in Section 3.3 of Chapter 3 and is used at interview sessions or questionnaire surveys to see whether such issues are already manifestly present or yet absent, and if present, to diagnose the degree of seriousness thereof. Interviewees or questionnaire respondents are asked to rate each issue in three levels (i.e. “very serious,” “serious” and “not serious”). Preferable targets for interviews and questionnaire surveys are transport planners and scholars well-versed in urban transport issues of a given city, because they are able to articulate their informed judgments in a comprehensive

manner. On some issues, however, citizens might be suitably asked their opinions. As will be discussed in the next section, furthermore, some issues can be clarified when transport operators or managers are interviewed or surveyed. It is desirable to collect samples as many as possible by interview or questionnaire to avoid too wide a variance among individual opinions and thereby ensure reasonable significance of the collected subjective data.

- Presence and seriousness of traffic congestions
- Inadequacies of available public transport services
- Defectiveness of traffic safety
- Presence and seriousness of transport-originated pollution and public nuisance
- Presence of social injustice manifested in transportation

(3) Interview Sheet

The interview sheet is used to collect informed opinions on causes of transport problems and feasible measures to overcome such problems for the purpose of understanding the issues to be considered for formulating urban transport strategy proposals. Targets for interviews are experts in academia, municipal administration and private sector consulting who participate in or contribute to the policy-making process about transport development.

- Conditions of Urban Transportation
- *Congestion:*levels and causes of traffic congestions; causes of bus traffic congestions; and para-transit traffic congestions
- *Traffic safety:* presence or absence of safety problems caused by parking behaviors, breakdowns and malfunctions of motorized vehicles, and/or mingling of freight vehicles
- Development Prospects of Urban Transport Infrastructure
- Road development: urgent issues in road network development; recognized limits to the prospects of alleviating congestions by road development; feasibility of introducing elevated highways or railways over road spaces from the viewpoint of roadside landscape; justifiability of developing urban highways; and experiences in and/or planning towards private-sector participation in transport infrastructure development
- *Public transport:* public awareness of economic sustainability of line bus services; measures necessary to improve bus operation and management; problems concerning the comfort and safety of bus trips; management issues of bus operating entities; problems in the convenience of bus services: feasibility of introducing a BRT or metro system; and experiences in and/or planning towards private-sector participation in public transport development
- *Availability of space:* limitations by the urban structure on further transport infrastructure development; and availability of space for introducing a BRT or metro system and/or urban highways
- Presence or Absence of Urban Transport Policy or Strategy
- *Transport subsectors that require improvements of administrative capability*
- *Presence or absence of urban transport policy or strategy*
- *Feasibility of TDM:* Public awareness of TDM; underutilized capacity (PPHPD) of public transport; policy measures to expand the capacity (PPHPD) of public transport; experiences in and/or planning towards the suppression on private automobile use; experiences in and/or planning towards the facilitation of increased public transport use; and presence or absence of policy discussions concerning the suppression on automobile ownership and use
- *Recognition of the presence of the transport-poor among citizens*

2) Urban Data Sheet and Interview Sheet

(1) Urban Data Sheet

1. Basic Information

F.1-1 Please attach maps which show the city boundary and specify the urban area on it. (Note: "Urban Area" is defined as urbanized area with a continuously built up land mass of urban development, which is different from a "City" defined with an administrative boundary. "Urban area" can be larger or smaller than "city". Please note which one is used in the following questions, "City" or "Urban Area")

(i) (Please attach the file of maps separately)

(ii)

F.1-2 Please fill the table below;

		(A)City	(B)Urban area
(iii)	Area (km2)		
(iv)	Longer width of the city (km)		
(v)	Shorter width of the city (km)		

F.1-3 Please describe the geographical conditions of the city.

		Flat (%)	Hilly area (%)	Mountainous area (%)
(vi)	City center			
(vii)	City			
(viii)	Urban area			

please attach the geographical map of the city separately.

F.1-4 What kinds of function does the city have? Please select all applicable to the city.

(i) Capital
(ii) Provincial Capital
(iii) Administrative, financial, and business center
(iv) Distribution center
(v) Industrial city
(vi) Tourism city
(vii) Academic city
(viii) Others (please specify, _____)

F.1-5 In the city center, is residential area or small-scale industrial sector mixed with business and commercial area?

(a) All of them are mixed.
(b) City center is specialized into business and commercial sector.

F.1-6 Is there any CBD (Central Business District) in the urban area?

(a) Yes.

Name of CBD	
Name of CBD	
Name of CBD	

(b) No.

2. Urban Structure

F.2-1 Please describe demographic and economic condition of the city and the urban area.

(A) City

		Latest		about 5 years ago		about 10 years ago	
		value	year	value	year	value	year
Population							
Pop. growth rate (%/yr)			from to		from to		from to
GRDP	(currency unit) _____(at current price)						
GRDP per capita (ditto)							
Share of GRDP (%)	Primary						
	Secondary						
	Tertiary						

(ix)

(B) Urban area

		Latest		about 5 years ago		about 10 years ago	
		value	year	value	year	value	year
Population							
Pop. growth rate (%/yr)			from to		from to		from to
GRDP	(currency unit) _____(at current price)						
GRDP per capita (ditto)							
Share of GRDP (%)	Primary						
	Secondary						
	Tertiary						

3. Traffic Demand

F.3-1 Please fill the table below about the modal share1) of the city or the urban area.
If you cannot answer the specific data, please estimate them approximately. Even if it is difficult, please rank in order of descending share (1 ~ 4).

Mode	City		Urban Area	
	All purpose (%)	To commute (%)	All purpose (%)	To commute (%)
Passenger car				
2-wheelers				
Public transport				
Para-transit				
Walking				

1) excluding walking and person-trip based (NOT passenger-km)

F.3-2 How many passenger cars are registered or used in the city and the urban area? And how about its ownership? (passenger car includes jeep and pick-up for private use)

	City	Urban Area
Number of passenger cars		
Ownership (vehicles/1,000 people)		

F.3-3 Please select the **major 3 trunk roads which form the core structure of the urban area** and fill the table below on the road structure, traffic demand, congestion, and improvement plan.

Name of the trunk road 1		
Road Structure	Number of lane per direction	_____ lanes / direction (if the number of lanes varies by section, please select that of major sections)
	Cross-section	Please roughly draw the cross-section of major sections (Please attach the file of drawing separately)
Congestion	Congested section	(a) name of the section or place: _____, (b) congested span: about _____km
	Major congested period	(a) Commuting hour in the morning and the afternoon (b) Weekday daytime (chronic traffic jam) (c) Holiday (d) Others (please specify _____)
Traffic Demand	Traffic volume	(a) 4-wheeler: _____vehicles/day (b) 2-wheeler: _____vehicles/day
	Peak traffic volume	(a) 4-wheeler: _____vehicles/hour/direction (b) 2-wheeler: _____vehicles/ hour/direction
	Public transport demand at peak hour	Approximately _____ passenger /hour/direction (if it is not available, _____vehicles /hour/direction)
Future Improvement	to widen the road	(a) planning, (b) no plan
	to develop bypass	(a) planning, (b) no plan
	to improve traffic management	(a) planning, (b) no plan

Name of the trunk road 2		
Road Structure	Number of lane per direction	_____ lanes / direction (if the number of lanes varies by section, please select that of major sections)
	Cross-section	Please roughly draw the cross-section of major sections (Please attach the file of drawing separately)
Congestion	Congested section	(c) name of the section or place: _____, (d) congested span: about _____km
	Major congested period	(e) Commuting hour in the morning and the afternoon (f) Weekday daytime (chronic traffic jam) (g) Holiday (h) Others (please specify _____)
Traffic Demand	Traffic volume	(c) 4-wheeler: _____vehicles/day (d) 2-wheeler: _____vehicles/day
	Peak traffic volume	(c) 4-wheeler: _____vehicles/hour/direction (d) 2-wheeler: _____vehicles/ hour/direction
	Public transport demand at peak hour	Approximately _____ passenger /hour/direction (if it is not available, _____vehicles /hour/direction)
Future Improvement	to widen the road	(a) planning, (b) no plan
	to develop bypass	(a) planning, (b) no plan
	to improve traffic management	(a) planning, (b) no plan

Name of the trunk road 3		
Road Structure	Number of lane per direction	_____ lanes / direction (if the number of lanes varies by section, please select that of major sections)
	Cross-section	Please roughly draw the cross-section of major sections (Please attach the file of drawing separately)
Congestion	Congested section	(e) name of the section or place: _____, (f) congested span: about _____km
	Major congested period	(i) Commuting hour in the morning and the afternoon (j) Weekday daytime (chronic traffic jam) (k) Holiday (l) Others (please specify _____)
Traffic Demand	Traffic volume	(e) 4-wheeler: _____vehicles/day (f) 2-wheeler: _____vehicles/day
	Peak traffic volume	(e) 4-wheeler: _____vehicles/hour/direction (f) 2-wheeler: _____vehicles/ hour/direction
	Public transport demand at peak hour	Approximately _____ passenger /hour/direction (if it is not available, _____vehicles /hour/direction)
Future Improvement	to widen the road	(a) planning, (b) no plan
	to develop bypass	(a) planning, (b) no plan
	to improve traffic management	(a) planning, (b) no plan

F.3-4 Please fill the table below about urban expressway

Availability of the urban expressway [1)]	(a) Yes, (b) No
Total length	_____km
Number of lanes (per direction)	_____ lanes / direction (if the number of lanes varies by section, please select that of major sections)
Connection with inter-city expressway	(a) connected, (b) not connected
Average daily traffic volume	(a) _____ vehicles /day ~(b) _____ vehicles /day

1) excluding intercity expressway or highway

4. Public Transport

F.4-1 Assuming that public transport services are classified into the following three types, please fill the table below about the share of each type of public transport in terms of the number of passenger (NOT passenger-km) in the city / urban area? (rough estimate is acceptable)

(x)	City	Urban Area
(a) Metro/ BRT	%	%
(b) Standard Bus, Minibus	%	%
(c) Para transit, others	%	%

F.4-2 Please select the public transport modes available in the urban area. (select all applicable)

(a) Metro *
(b) Subway
(c) Commuting railway
(d) Inter-city railway
(e) LRT/MRT
(f) Monorail
(g) Tram
(h) Cable-car
(i) BRT
(j) Bus
(k) Premium-bus with better services (air-con or all seated) than standard bus
(l) Minibus
(m) Shared taxi
(n) Motorcycle converted for passenger transport
(o) Man-powered vehicle for passenger transport (rickshaw)
(p) Motorcycle taxi
(q) Human-powered three-wheeler
(r) Auto three-wheeler / Auto-rickshaw
(s) Shared-taxi
(t) Others (please specify, _____)
(u) There are no para-transit services in the urban area.

* Metro system refers urban railway system which are operated on the tracks exclusively for it (tram car is not included). Inter-city railway, where some of rails are operated exclusively for urban transport is included.

< Bus / Minibus>

	(A) Bus	(B) Mini Bus
F.4-3 How many buses and minibuses are registered in the urban area?	vehicles	(xi) vehicles
F.4-4 Where are passengers loaded/unloaded from bus and minibus? (a) Only at bus stops (b) Basically at bus stops but passengers can be also loaded/ unloaded at any places. (c) There is no bus stop and passengers can be loaded/unloaded at any places.		
F.4-5 How is the bus operation in the city? (a) Almost individually operated (b) Buses are individually operated and most of them are organized by association or private /public bus company. (c) About half of buses are operated by individual and remaining half are operated by bus company. (d) Most of buses are operated by private bus company. (e) Most of buses are operated by public bus company. (f) Others (please specify, __)		
F.4-6 Is there hierarchical structure of bus network, namely trunk and feeder route? (a) Yes (b) No		
F.4-7 Is there any **government subsidy** provided? (a) Yes (b) No		
F.4-8 Are there any differences in services between bus and minibus? (a) Almost same. (b) Buses are operated relatively for longer route, while minibuses are for shorter route. (c) Others (please specify, ____)		

< BRT & Metro >

	(A)BRT	(B)Metro
F.4-9 Do you have any BRT system or metro lines * (see below for definitions of metro) in the urban area? (a) Yes, in services. (b) No, but plan to construct or under construction. (c) No.		

* Metro system refers urban railway system which are operated on the tracks exclusively for it (tram car is not included). Inter-city railway, where some of rails are operated exclusively for urban transport is included.

F.4-10 Please fill the table below about your BRT system and metro lines

	(A)BRT	(B)Metro
Number of planned routes	**routes**	**routes**
Among them, under construction.	routes	routes
Among them, in service.	routes	routes
Total length of planned network	**km**	**km**
Among them, under construction.	km	km
Among them, in service	km	km
Number of stations	stops	stations
Number of passenger per day (approx.)	_____passenger/day	_____passenger/day

	Bus	Mini bus	Taxi	Para-tra	BRT	Railways
F.4-11 How is the fare of set in the urban area? (a) It should be approved by the government. (b) It should be approved by the government, but it is not effectively regulated. (c) Private operators can decide the fare freely.						
F.4-12 Are these services restricted in the specific area or route? (a) Yes, restricted. (b) Yes, restricted but not effectively managed. (c) There is no restriction.					\	\

F.4-13 How much is the fare for one ride per person (adult)?

(xvi) Fare setting		(xvii) Bus	Premium bus	(xviii) Minibus	(xix) BRT	(xx) Railways	(xxi) Metro
(a) Flat rate _____ / ride							
(b) Fare (xxii) y zone	Base fare (for first ride)						
	For about 2km ride						
	For about 5km ride						
(c) Current Unit							

Please select the existing fare structure, (a)Flat rate or (b)Fare by zone.

< Overall public transport>

F.4-14 What kinds of discount system are available in the urban area?

(a) There is discount only when transferring to the lines operated by the same entity.
(b) There is discount even when transferring to the lines operated by different entities.
(c) There is no discount.

5. Traffic Management

F.5-1 Is there any Road Traffic Management below?

	(A) Yes	(B) No
(a) Area Traffic Control system		
(b) synchronized traffic signals		
(c) one-way control		
(d) lane divisions by type of vehicle		
(e) Bus priority lane		
(f) Bus priority signal		
(g) Vehicle inspection system for bus fleets and passenger cars		
(h) regulation on logistics traffic		

(2) Check List for Diagnosis on Urban Transport

1. The seriousness of urban traffic problems

Please rate each item on a 3-point scale. (A: Very serious, B: Serious, C: Not serious)

Urban Traffic Issue			Degree
Large classification	Middle classification	Small classification	
(A) Traffic Congestion	1) Congestion on express-ways	Traffic demand beyond road capacity	A・B・C
	2) Congestion on arterial roads	Traffic demand beyond road capacity	A・B・C
		Mixed inter-city and inner-city traffic	A・B・C
		Deterioration of road pavement	A・B・C
		Frequent traffic accidents	A・B・C
		Bad driving manner	A・B・C
		Insufficient traffic safety education	A・B・C
		On-street / road-side parking or street people or vendor	A・B・C
	3) Congestion on roads in city centre	Traffic demand beyond road capacity	A・B・C
		Increase in individual trips	A・B・C
		On-street / road-side parking	A・B・C
		Incomplete crackdown on illegal parking	A・B・C
		Mixed traffic of 4-wheeler and 2-wheeler / non-motorized traffic	A・B・C
		Insufficient public transport services	A・B・C
		Ineffective bus route network	A・B・C
		Bad driving manner	A・B・C
	4) Congestion on intersections	Traffic demand beyond intersection capacity	A・B・C
		Ineffective traffic control on intersections	A・B・C
		Bad driving manner	A・B・C
	5) Traffic jam of buses around bus-stops	Excessive bus service	A・B・C
		Interruption of traffic flow at bus-stops	A・B・C
		Bad driving manner	A・B・C
(B) Inconvinient Transport Service	(xxiii) 1) Poor public transport services	No public transport services available	A・B・C
		Poor accessibility to public transport	A・B・C
		Low reliable operation of public transport	A・B・C
	2) Low comfort and safety	Overcrowding at public transport vehicles	A・B・C
		Insufficient bus network	A・B・C
	3) Poor inter-connection of public transport	Inconvenient transfer in terminal	A・B・C
		Too much transferring for a trip	A・B・C
	4) Inconvinient taxi services	Rejection of boarding of taxis	A・B・C
		Unclear fare structure	A・B・C

Urban Traffic Issue			Degree
Large classification	Middle classification	Small classification	
	5) Inconvinient para-transit services	Low-quality service	A・B・C
(C) Lowering of Traffic Safety	1) Lowering of pedestrian safety on crossing	Bad driving manner	A・B・C
		Shortage of pedestrian facilities	A・B・C
	2) Lowering of pedestrian safety on sidewalk	Narrow width of sidewalk	A・B・C
	3) Traffic accidents on roads	Mixed traffic of cars and NMT / buses and para-transits	A・B・C
		Deterioration of road pavement	A・B・C
		Bad driving manner such as ingoring traffic signals	A・B・C
		Black spot for traffic accidents	A・B・C
	4) Lowering of public transport security	Overcrowding at public transport vehicles	A・B・C
(D) Environment Deterioration	1) Air pollution from automobile fumes	Inflow of large trucks	A・B・C
		Increasement of private vehicles	A・B・C
	2) Noise / Vibration problems	Increased volume of traffic at night	A・B・C
		Increased number of inappropriate vehicles (such as high gas emissions or decrepit cars)	A・B・C
		Deterioration of road pavement	A・B・C
	3) Landscape / insolation problems	Worsening by road construction or elevated structure for traffic	A・B・C
(E) Social Injustice	1) Vulnerable road users	Existence of no public transport service area	A・B・C
		Existence of disaster-prone area	A・B・C
		Low mobility of pedestrians or NMT users	A・B・C
		Shotage of barrier-free facilities for the elderly and the disabled	A・B・C
		The mobility disparity between men and women	A・B・C
	2) Bad influence on residents near the site of ongoing projects		A・B・C
	3) Undeveloped accident compensation system		A・B・C
	4) Incomplete crackdown on traffic violation		A・B・C
	5) Fare setup	Biased subsidy	A・B・C
		Improper pricing	A・B・C

(3) Interview Sheet

2. The kind of urban traffic problems

Please select all applicable choices and put a ✓ in the appropriate box without having received instructions.

Note:
BRT: a term applied to a variety of public transportation systems using buses to provide faster, more efficient service than an ordinary bus line. Often this is achieved by making improvements to existing infrastructure, vehicles and scheduling. The goal of these systems is to approach the service quality of rail transit while still enjoying the cost savings and flexibility of bus transit.

METRO : metro system is defined as an urban, electric passenger transportation system with high capacity and high frequency of service, which is totally independent from other traffic, road or pedestrians. The terms heavy rail (mainly in North America) and heavy urban rail often have similar definitions.

Group	No.	Question	Item	check
1. The traffic status of the city				
Traffic congestion	I.1-1	How do you feel about traffic congestions in urban areas of the city?	Serious across the city	
			Serious only at major bottlenecks	
			Not so serious	
			Not serious	
	I.1-2	What do you think are the major causes for urban road traffic congestion?	Traffic demand beyond road capacity	
			Roundabout	
			Bottleneck at bridge or at-grade rail crossing	
			Traffic demand beyond intersection capacity	
			Deterioration of road pavement	
			Bad driving manner	
			Reckless crossing of pedestrian without traffic signal	
			Unconsolidated and insufficient road traffic sign	
			Ineffective traffic signals and those failure Roundabout	
			Manual traffic management at intersections	
			Mixed traffic of 2-wheeler and 4-wheeler	
			Mixed traffic of cars and non-motorized traffic	
			Inflow of large trucks	
			Mixed inter-city and inner-city traffic	
			Frequent traffic accidents	
			On-street / road-side parking	
			Street people and vendor	
	I.1-3	What kinds of problems are caused by bus services?	Traffic congestion due to the excessive bus service	
			Traffic congestion due to the loading and unloading of bus fleets	
			Traffic congestion due to the bus stop parking of bus fleets	
			Traffic congestion due to the bus fleet parking except the bus stop	
	I.1-4	What kinds of problems are caused by para-transit services? (e.g. rickshaw,ojek, bajai, tuktuk)	Traffic congestion due to the roadside parking of para-transit vehicles	
			Traffic congestion due to the mixed traffic of para-transit vehicles and normal traffic	
			Traffic congestion due to the loading and unloading of para-transit vehicles	
			Traffic congestion or accidents due to the bad driving manner of para-transit vehicles	
			Traffic accidents against pedestrians	
			Traffic accidents against cars	
			Trouble on fare negotiation	

Group	No.	Question	Item	check
			Non-authorized operation of para-transit vehicles	
Traffic Safety	I.1-5	Are there any problems on roadside/on-street parking? (note: parking activities, not parking facilities)	There are no regulations.	
			There is regulation against roadside/on-street parking, which is not effectively enforced.	
			There are some cases of corruption, where policeman receive bribe and overlook illegal parking.	
	I.1-6	Are there any traffic problems due to vehicle faults such as poor maintenance and deterioration of vehicles?	It causes traffic problems.	
			It causes air pollution or noise.	
	I.1-7	Are there any problems on inflow of truck into the urban area?	It causes traffic congestion.	
			It reduces traffic safety.	
			It deteriorates road pavement.	
	I.1-8	What do you think about the situation of traffic accidents in urban areas of the city?	Serious, urgent actions are required.	
			Not so serious, but may become serious in the near future.	
			Not serious.	
	I.1-9	How do you feel about security conditions of the city?	Very good	
			Good	
			So - So	
			Bad	
			Very bad	
	I.1-10	Are there any problems on traffic pollution?	Air pollution due to exhaust fumes	
			noise pollution･vibration pollution	
			landscape disturbance･insolation problem	
	I.1-11	What is necessary to improve traffic safety? (please select **3** priority choices)	Strict enforcement against traffic violation (speed, parking, traffic signal, etc.)	
			Capacity development and corruption prevention of traffic police	
			Tightening of the standard to issue the driving license	
			Re-education for traffic violator and people who caused traffic accidents	
			Traffic safety program for pedestrians	
			Traffic safety education at school	
			Development of sidewalk and pedestrian crossing and bicycle lanes	
			tighten the speed limit	
2. The possibilities of urban infrastructure projects				
Road Construction	I.2-1	What are urgent issues on road network improvement?	Construction/ expansion of urban primary roads	
			Construction/ expansion of urban secondary roads	
			Construction/ expansion of rural roads	
			Improvement of road pavement	
			Grade separation of intersections	
			Improvement of traffic signals	
	I.2-2	If the road network is improved, do you think traffic congestion can be solved?	Yes, road network improvement alone can solve the traffic congestion.	
			No, road network improvement is not enough to solve the traffic congestion.	
	I.2-3	There is an argument that elevated urban expressway or urban railway on the arterial roads may destroy	It is easy to get people's consensus	

Group	No.	Question	Item	check
		urban landscape and damage natural environment. Do you think it is possible to make people's consensus on development of elevated urban expressway or urban railway on the arterial roads in your city?	It is difficult to get people's consensus but possible to persuade them.	
			Almost impossible.	
	I.2-4	What do you think about development / expansion of urban expressway network?	It is desirable to develop/expand urban expressway network.	
			It is not desirable to develop/expand urban expressway network.	
	I.2-5	Has the city introduced or will introduce private financing schemes for transport infrastructure development?	Yes, some private financing projects have been implemented or being implemented.	
			Yes, once tried but failed.	
			Yes, some private financing projects are in the planning stage.	
			No	
Public Transport	I.2-6	Do you think operation of bus / minibus in the city is financially sustainable?	Sustainable without subsidy.	
			Sustainable if subsidy is provided.	
			Not sustainable even if subsidy is provided.	
	I.2-7	What do you think should be improved in terms of operation and management of bus and minibus in the city?	Shortage of Number of times the bus is operated	
			Too complicated bus routes	
			Lack of the number of bus fleet	
			Deterioration or trouble of bus fleets	
			Inefficient bus route network	
			Unsatisfied size of bus fleet	
			Bad driving manner (e.g.traffic violations, rejection of boarding)	
			reliable bus service	
			Introduction of bus lane or bus priority lane	
			Installation of the bus stops	
			Introduction of barrier-free bus fleets	
	I.2-8	Is there any problems about comfort and safety of the passengers on the bus?	Deterioration in the security situation in vehicles	
			High rate of congestion	
			Lack or flaw of the air-conditioning equipment	
	I.2-9	Is there any problems about bus / minibus operation system ?	Low fare level	
			High fare level	
			Inefficient subsidy system provided for bus operators	
			Disapproval bus operating company	
			Difficulty in the entry of new businesses into the bus/minibus operation	
	I.2-10	What do you think about the convenience of public transportation as a whole?	Poor transportation to public transport service	
			Uncertain traveling time	
			Complicated transport fate system	
			Frequent change of trains, buses, and so far	
			Uncertain schedule (Trains or buses are often not going on time.)	
	I.2-12	If there is no BRT available in the city, do you think BRT can be operated and maintained with the	Possible	
			Difficult but gradually possible	
			Almost impossible	

Group	No.	Question	Item		check
		technological level of your country?			
		If there is no Metro available in the city, do you think Metro can be operated and maintained with the technological level of your country?	Possible		
			Difficult but gradually possible		
			Almost impossible		
	I.2-13	Do you plan to introduce private funds for urban transport development?	Yes, some private financing projects have been implemented or being implemented.		
			Yes, once tried but failed.		
			Yes, some private financing projects are in the planning stage.		
			No		
Site	I.2-14	Which of the following issues are observed in the city?	Population inflow into the urban center		
			Population outflow from the urban center		
			Traffic congestion in the urban center		
			Urban sprawl to suburban/ rural areas		
			There are no specific urban problems		
	I.2-15	If you want to develop urban expressway, metro, or BRT in the urban area, do you have enough space for them? (please select all applicable choices for each mode)	Metro	Arterial road spaces	
				River beds	
				Underground spaces	
			BRT	Arterial road spaces	
				River beds	
				Underground spaces	
			Expressway	Arterial road spaces	
				River beds	
				Underground spaces	
3. Urban transport strategy					
administrative organ	I.3-1	What kinds of capacity enhancements are needed for the transport sector? (please select 3 priority choices)	Transportation policies and planning		
			Road maintenance and management		
			Traffic engineering		
			Traffic control and management		
			Traffic enforcement		
			Public transportation management		
			Financing		
Policy and strategy for urban transport	I.3-2	Do you have the following? **Note:** Railway line includes all urban railway services such as MRT, monorail, subway which are operated on exclusive tracks.	Long-term master plan on urban railway development		Yes · No
			Plan to construct new railway line		Yes · No
			Long-term master plan on BRT development		Yes · No
			Plan to construct new BRT route		Yes · No
			Long-term master plan on urban expressway		Yes · No
			Plan to construct new expressway line		Yes · No
TDM	I.3-3	It is the common trend in the world to shift from the private transport modes to the public transport modes. Do people in the city commonly recognize such needs?	Yes, people recognize its needs and support policies and measures for it.		
			Yes, its needs are widely recognized, which is not enough for people to support policies and measures for it.		
			Some people recognize its needs but not common for general people.		
			Not recognized yet.		
	I.3-4	Please tell about the capacity of public transport system. Assuming that 10% of the current passenger car and motorcycle traffic is shifted to the public transport, can the current public transport system accommodate such converted demand?			Yes · No
	I.3-5	If you select "No" in	Introduction of large bus fleet		

Group	No.	Question	Item	check
		I.3-4, what is required to accommodate such demand converted from the passenger car and motorcycle traffic? (please select **3** priority choices)	Increase of frequency of bus / minibus operation	
			Development and expansion of bus / minibus routes	
			Introduction of large fleet for BRT services	
			Increase of frequency of BRT operation	
			Development and expansion of BRT routes	
			Improvement of metro fleet	
			Increase of frequency of metro operation	
			Development and expansion of metro routes	
			Improvement of inter-modal transit	
			Introduction of user-friendly ticketing system (e.g smart card,chip card, etc,.)	
			Inprove the public transportation connection	
	I.3-6	Has the city introduced any policies to reduce use of passenger cars?	Already implemented.	
			Planned but yet implemented.	
			No plan yet.	
	I.3-7	Has the city introduced any policies to promote public transport?	Already implemented.	
			Planned but yet implemented.	
			No plan yet.	
	I.3-8	Does the city consider introducing policies to restrict ownership and use of passenger car in future?	Increase car-related taxes	
			Increase fuel taxes	
			Restrict passenger car use during specific time/ date	
			Charge car traffic in the specific area/ route	
			Parking control (including both physical control and pricing)	
4. Social inequality and injustice				
	I.4-1	Who are vulnerable road users and facing difficulty to access public transport in your city? Do you have any policies to support for them?	Physically disabled	Yes · No
			Aged people	Yes · No
			Children	Yes · No
			Women	Yes · No
			Poor people	Yes · No
			Displaced person (relocated due to resettlements)	Yes · No
			Immigrant	Yes · No

3) Procedure for Data Collection

Table 4.1 shows the steps to collect information by using three data sheets. As mentioned earlier, the urban data sheet is not prepared to suit a particular city. The suggested data items may be irrelevant to a given city, or additional data items must be created for another city. Therefore, it is necessary to take the following steps prior to data collection.

Step 1 Data collection by the urban data sheet:

In addition to collecting regularly available statistics on transport conditions in a given city, it is necessary to identify the kinds of information which are difficult to obtain from the ordinary sources and also seek agencies or organizations which might be able to provide such information.

Step 2 Customizing the interview sheet:

It is necessary to modify the original sheet as required by the situations of an individual city, by striking out irrelevant data items and/or adding new data items pertaining to important issues in urban transport. It is essential to identify an important transport policy stance of a given city and accordingly specify what to ask during interviews.

Step 3 Pre-interviews:

Pre-interviews are carried out on a limited selection of targets and the findings are fed back to finalize the items to be included in the interview sheet.

Step 4 Final interviews:

Final interview sessions are held with selected experts who engage in transport strategy formulation. Approximately 15 experts are to be invited from among the following departments of municipal administration and other institutions.

City Administration:

- Head of the Transport Bureau (the top person in charge of practical affairs; hereafter the same qualification)
- Head of the Road Department
- Head of the Railway Department
- Head of the Public Transport Department
- Traffic Police (the top person in charge of the city)
- Head of the Environmental Department
- Head of the Urban Development Department

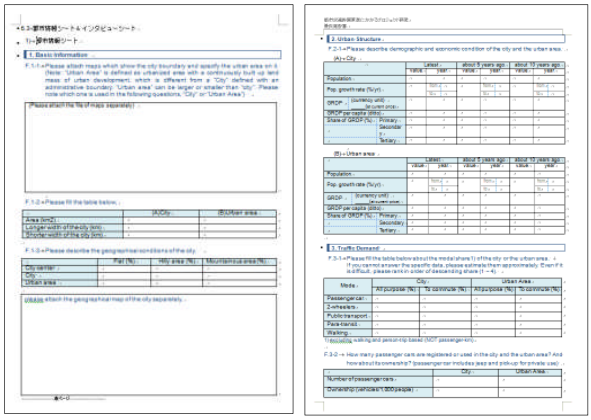
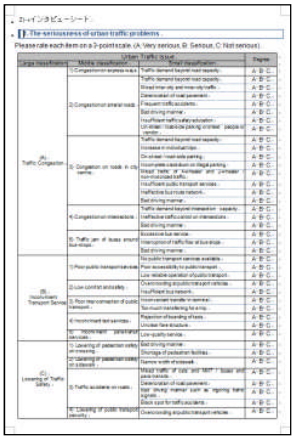
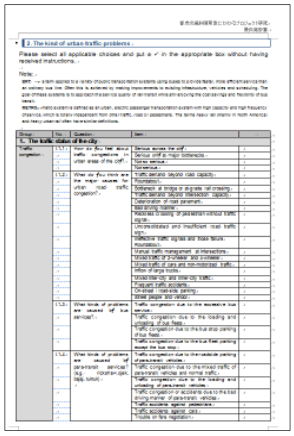
Other Institutions:

- Experienced scholars in academia
- Research institutes specializing in transportation
- Other transport specialists

Step 5 Completion of the urban data sheet:

During the interviews, it is necessary to ask for those data that are not obtainable from the standard statistical sources. When judged necessary, a field survey or surveys are conducted to obtain traffic and other data.

Table 4.1 Data Sheets and Procedure for Data Collection

Data Sheet	Procedure	Sheet Image
Urban Data Sheet	・ Collect information via transport consultants who have access to available sources of transport statistics	
Check List for Diagnosis on Urban Transport Conditions	・ Because the list is simplified, collection of data can be made not only from experts and government officials but also from ordinary citizens. ・ It is desirable to gather information from as many samples as possible so as to avoid undue effects of idiosyncratic opinions on the statistical significance of the collected data.	
Interview Sheet	・ Interviews are conducted with a number of experts (10 to 15) who are knowledgeable in urban transport problems and policy measures. ・ Pre-interviews need be carried out prior to final interviews so as to finalize the questions for interviewees.	

4.2 Diagnosis of Urban Traffic Problems

Regarding the individual issue approach to transport problems that exasperate daily lives of city dwellers, it is essential to grasp the seriousness of the respective problems before proposing measures to solve or alleviate them. The diagnosis for a given city is to identify what are the specific problems that vex the city and how serious they are perceived by the citizens. The check list is used to obtain answers from selected samples and individual urban transport problems are diagnosed by aggregating the questionnaire results.

1) Typological Classification of Urban Traffic Problems

Urban transport problems are typologically classified in Chapter 3 by reviewing the reports of JICA master plan studies. After deliberations within the present study team, the check list for diagnosis is prepared as shown in Table 4.2.

Transport problems and the factors that cause them are related in too ramified a way to decipher their straightforward relationships. Take the problem of traffic congestions, for example. An easily recognizable direct cause would be phrased as “the shortage of road capacity”, which is, in turn, a combined consequence from the delay in physical road development and the shortage of budget allocations. By perusing a chain of ramified factors that cause each transport problem, it is possible to arrive at a more comprehensive picture of the problems in question. As seen in the table, urban transport problems are compiled in three classificatory levels with breakdowns of causal factors.

The primary classification of urban transport problems as directly recognizable phenomena is five-hold, viz. traffic congestion, inconvenience in transportation, declined traffic safety, transport-originated pollution and nuisance and social injustice in transportation. Five primary categories are respectively divided into a number of secondary categories classified by affinity or proximity, which are in turn broken down into more specific factors as tertiary categories.

Table 4.2 Typological Classification of Urban Transport Problems

Primary Classification	Secondary Classification	Tertiary Classification	Cause
(A) Traffic Congestions	1) Congestions on urban highways and exclusive motorways	Shortage of road capacity	Underdeveloped urban highways Congestions at toll gates
	2) Congestions on single-lane sections of arterial motorways	Shortage of road capacity	Presence of missing links in the road network Shortage of the available arterial network
		Mingling of intra-city and inter-city traffic	Inadequate segregation in the road network Underdeveloped bypasses
		Poor surface pavement	Deficient maintenance due to inadequacies of the inspection system and shortage of budget allocations
		Abandoned cars after accidents and breakdowns	Inefficient handling of congestions caused by traffic accidents
			Inappropriate automobile inspection systems
		Ill-mannered driving	Negligent policing
		Inadequate public education on traffic safety	
		Roadside parking and vending stalls	In efficient road management
	3) Congestions on roads in the CBD	Excessive traffic demand	Mono-polar urban structure of concentration Underdeveloped arterial network of radials and ring roads
		Increase of private traffic volume	Absence of measures for traffic demand suppression
		Roadside parking	Shortage of parking lots
		Negligent policing over illegal parking	

Primary Classification	Secondary Classification	Tertiary Classification	Cause
		Mingling of automobiles, two-wheelers and non-motorized vehicles	Inefficient traffic control
		Shortage of public transit services	Shortage or absence of rail-based public transportation
		Inefficient network of bus lines	
		Ill-mannered driving	Negligent policing Inadequate public education on traffic safety
	4) Congestions at intersections	Shortage of capacity	Efficiency-poor designs
			Shortage of grade-separated intersections
			Presence of roundabouts (inefficient handling capacity at intersections)
			Mingling of through traffic with left- or right-turn traffic
		Inefficient traffic control at intersections	Traffic signal control inappropriate to the level of traffic demand
			Absence of traffic signals
			Manual traffic control at intersections
		Ill-mannered driving	Negligent policing Inadequate public education on traffic safety
	5) Congestions of bus traffic and at bus stops	Excessive bus services	Inadequate licensing system of bus operation
		Obstruction of through traffic by parked buses at bus stops	Inadequate supply of bus stops
			Buses waiting for passengers
		Ill-mannered driving	Negligent policing over violations Inadequate public education on traffic safety
(B) Inconvenience in Transportation	1) Low passenger convenience of public transit	Absence of affordable public transit services	No development of rail transit
			No development of bus network
		Poor access to public transit services	Low density of public transit development
			Poor development of access roads to transit stations
		Unpredictability of travel time	No development of rail transit
			Irregular off-schedule services by bus and para-transit due to traffic congestions
	2) Low passenger comfort and safety	High occupancy ratio on public transit services	Public transit capacity below demand
			Inefficient bus network
			Absence of bus operation control
	3) inconvenience to transfer passengers	Inconvenience of transfer at transport nodes	Poor connection between available public transits
			No clear distinction between trunk and feeder bus services
			Underdevelopment and inappropriate distribution of bus terminals
		Too frequent transfers	Poor connection between available public transits
			High cost of transfer
	4) Low user convenience of taxi services	Dishonest drivers wilfully refusing passengers	Mismatched supply and demand situation allowing taxi drivers wilful selection of passengers
			Uncontrolled licensing of taxis
		Poor transparency of taxi fare	Absence or unreliability of taxi meters
	5) Low user convenience of para-transit services	Lowered service level due to inadequate management	Inadequate system of taxi administration
(C) Declined Traffic Safety	1) Lowered pedestrian safety (crosswalks)	Ill-mannered driving	Negligent policing Inadequate public education on traffic safety
		Shortage of pedestrian facilities	Poor provision of pedestrian traffic signals Shortage of pedestrian footbridges
	2) Lowered pedestrian safety (sidewalks)	Capacity shortage of sidewalks	Poor availability of sidewalks Sidewalks occupied by parked cars and bicycles No segregation of sidewalks from motorways
	3) Traffic accidents on motorways	Mixed traffic of automobiles and NMT vehicles or of buses and private passenger cars	Inappropriate traffic control Shortage of road width
		Poor road surface pavement	Shortage of maintenance
		Traffic signal violations and ill-mannered driving	Negligent policing Inadequate public education on traffic safety
		Presence of locations prone to cause accidents	Road and intersection structures which are ill-designed in alignment, visibility, etc. Inadequate traffic safety measures
	4) Declined law and order on public transit services		Negligent policing
		High occupancy ratio of public transit services	Inefficient bus network
			Mismatched supply and demand

Primary Classification	Secondary Classification	Tertiary Classification	Cause
(D) Transport-originating Pollution and Nuisance	1) Atmospheric pollution by exhaust gases	Entry of trucks to the CBD	
		Increase of private automobiles	
		Increase of ill-maintained vehicles	Deficient vehicle inspection system
	2) Noises and vibrations caused by motorized traffic		Increase of night traffic
		Increase of ill-maintained vehicles	Deficient vehicle inspection system
		Poor road surface pavement	Shortage of maintenance
	3) Landscape and sunlight obstructions	Damages by the construction of transport facilities	Landscape and sunlight obstructions by the construction of elevated transport structures
（E） Social Injustice in Transportation	1) Presence of the transportation-poor	Presence of areas not serviced by public transit	
		Presence of disaster-prone areas	
		Low mobility of pedestrians and NMT users	
		Shortage of barrier-free facilities	
		Gender-related disparity in mobility	
	2) Adverse impact on local communities by the construction of transport facilities	Inadequate relocation compensation for local inhabitants	
	3) Deficient compensation system for victims of traffic accidents	Absence of insurance policies	
	4) Negligent policing on violations of traffic rules	Police corruption	
	5) Disadvantage of fare scales	Biased subsidization	
		Inappropriate fare scales for the poor	

Source: Compiled by the study team from the JICA master plan study reports.

2) Diagnoses of Urban Traffic Problems

The diagnosis of an urban traffic problem is to observe the incidents of the problem and rate the extent of seriousness thereof. This can be done by checking the items in the tertiary classification level of urban transport problems as listed in Table 4.2.

The rating of the listed tertiary classifications is done according to the following scales of seriousness and urgency.

Rating of Seriousness and Urgency:	Rating Scale 1	Rating Scale 2
A: Very serious / Immediate actions needed	(3 points)	(3 points)
B: Serious / Actions needed	(1 point)	(2 points)
C: Not serious	(0 point)	(0 point)

After the rating on tertiary classifications, the results are added up respectively for the secondary and the primary classification levels. If all tertiary items of a given primary classification are rated very serious, for example, the points added up for the primary classification (the number of tertiary items multiplied by 3 points) would be the maximum possible. For each primary classification level, the ratio of the rated points to the maximum is calculated for the radar chart presentation. If all tertiary items are rated as very serious (3 points), the ratio would be 100, and if rated not serious (0 point), the ratio would be zero.

3) Examples of Rating Application

The rating scales are applied to Jakarta and Ha Noi where the respective JICA master plan study has been underway including traffic surveys. The participants in the respective study are asked to rate the urban transport problems in two cities. The results are shown in Table 4.3.

Table 4.3 Examples of Diagnoses on Urban Transport Problems: Jakarta and Ha Noi (1/2)

Urban Transport Problems			Jakarta	Ha Noi
Primary Classification	Secondary Classification	Tertiary Classification		
(A) Traffic Congestions	1) Congestions on urban highways and exclusive motorways	Shortage of road capacity *	A	B
	2) Congestions on single-lane sections of arterial motorways	Shortage of road capacity *	A	B
		Mingling of intra-city and inter-city traffic	B	C
		Poor road surface pavement *	B	A
		Abandoned cars after accidents and breakdowns	B	B
		Ill-mannered driving	A	A
		Inadequate public education on traffic safety	B	C
		Roadside parking and vending stalls	B	C
	3) Congestions on roads in the CBD	Excessive traffic demand	A	B
		Increase of private traffic volume	A	B
		Roadside parking *	B	A
		Negligent policing over illegal parking	B	A
		Mingling of automobiles, two-wheelers and non-motorized vehicles	A	B
		Shortage of public transit services	B	C
		Inefficient bus network	A	B
		Ill-mannered driving	B	A
	4) Congestions at intersections	Shortage of capacity *	A	B
		Inefficient traffic control at intersections	B	B
		Ill-mannered driving	B	A
	5) Congestions of bus traffic and at bus stops	Excessive bus services	A	C
		Obstruction of through traffic by parked buses and at bus stops	B	C
		Ill-mannered driving	B	A
(B) Inconvenience in Transportation	1) Low passenger convenience of public transit	Absence of affordable public transit services	B	C
		Poor access to public transit services	A	B
		Unpredictability of travel time	B	B
	2) Low passenger comfort and safety	High occupancy ratio on public transit	B	A
		Inefficient bus network	A	B
	3) Inconvenience to transfer passengers	Inconvenience of transfer at transport nodes	A	C
		Too frequent transfers	A	C
	4) Low user convenience of taxi services	Dishonest taxi drivers wilfully refusing passengers	B	C
		Poor transparency of taxi fare	A	C
	5) Low user convenience of para-transit services	Lowered service level due to inadequate management	C	C
(C) Declined Traffic Safety	1) Lowered pedestrian safety (crosswalks)	Ill-mannered driving	B	A
		Shortage of pedestrian facilities	B	B
	2) Lowered pedestrian safety (sidewalks)	Capacity shortage of sidewalks	B	B
	3) Traffic accidents on motorways	Mixed traffic of automobiles and NMT vehicles or of buses and private passenger cars	B	A
		Poor road surface pavement	B	A
		Traffic signal violations and ill-mannered driving	A	A
		Presence of locations prone to cause accidents	B	B
	4) Declined law and order on public transit services	High occupancy ratio of public transit services	A	B
(D) Transport-originating Air Pollution and Nuisance	1) Atmospheric pollution by exhaust gases	Entry of trucks to the CBD	B	C
		Increase of private automobiles	A	C
	2) Noises and vibrations caused by motorized traffic	Increase of night traffic	C	C
		Increase of ill-maintained vehicles	A	C
		Poor road surface pavement	B	A
	3) Landscape and sunlight obstructions	Damages by the construction of transport facilities	C	C

Table4.3 Examples of Diagnoses on Urban Transport Problems: Jakarta and Ha Noi (2/2)

Urban Transport Problems			Jakarta	Ha Noi
Primary Classification	Secondary Classification	Tertiary Classification		
(E) Social Injustice	1) Presence of the transportation-poor	Presence of areas not serviced by public transit	A	C
		Presence of disaster-prone areas	A	C
		Low mobility of pedestrians and NMT users	A	C
		Shortage of barrier-free facilities	A	C
		Gender-related disparity in mobility	B	C
	2) Adverse impact on local communities by the construction of transport facilities	Inadequate relocation compensation for local inhabitants	C	C
	3) Deficient compensation system for victims of traffic accidents	Absence of insurance policies	C	C
	4) Negligent policing on violations of traffic rules	Police corruption	B	C
	5) Disadvantage of fare scales	Biased subsidization	A	A
		Inappropriate fare scales for the poor	A	B

Source: Compiled by the study team from the JICA master plan study reports.

Rating results are summarized in Tables 4.4 and 4.5 and presented in the radar chart format in Figures 4.3 and 4.4. As seen in Figure 4.4, Jakarta with its urban scale far exceeding that of Ha Noi shows distinctly higher levels of seriousness in most of the five primary categories of urban transport problems. Inconvenience in transportation is rated as high as traffic congestions, and the degree of social injustice is rated serious. Regarding Ha Noi, the higher ratio of seriousness is found only in two categories of traffic congestions and traffic safety. In the rating scale 2, however, these problems show much higher ratios in urgency, especially pronounced in the capacity shortage of infrastructure. High scores on the rating scale 1 indicate urgent needs to take actions, while those on the rating scale 2 point to medium- to long-term needs to prepare and implement necessary measures and development projects.

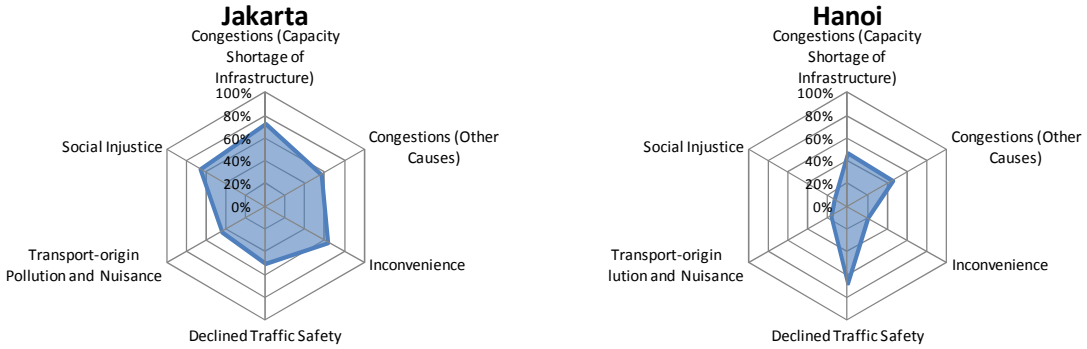
Diagnoses of urban transport problems in cities worldwide are enclosed in the Appendix of the Report. To come up with these figures, trainees from various countries evaluated their own cities by using the Checklist for Urban Transportation Diagnosis in the Comprehensive Urban Transportation Planning and Project by JICA in October 2011.

Table 4.4 Diagnoses of Urban Transport Problems in Jakarta and Ha Noi (Rating Scale 1)

Transport Problems	No. of Tertiary Items	Maximum Points	Jakarta		Ha Noi	
			Points	Ratio to Maximum	Points	Ratio to Maximum
Congestions (Capacity Shortage of Infrastructure)	5	15	11	73 %	7	47 %
Congestions (Other Causes)	17	51	29	57 %	23	45 %
Inconvenience	10	30	19	63 %	6	20 %
Declined Traffic Safety	8	24	12	50 %	16	67 %
Transport-origin Pollution and Nuisance	6	18	8	44 %	3	17 %
Social Injustice	10	30	20	67 %	4	13 %
Total	56	168	99	59 %	59	35 %

Source: Compiled by the study team.

Figure 4.3 Diagnoses of Urban Transport Problems in Jakarta and Ha Noi (Rating Scale 1)



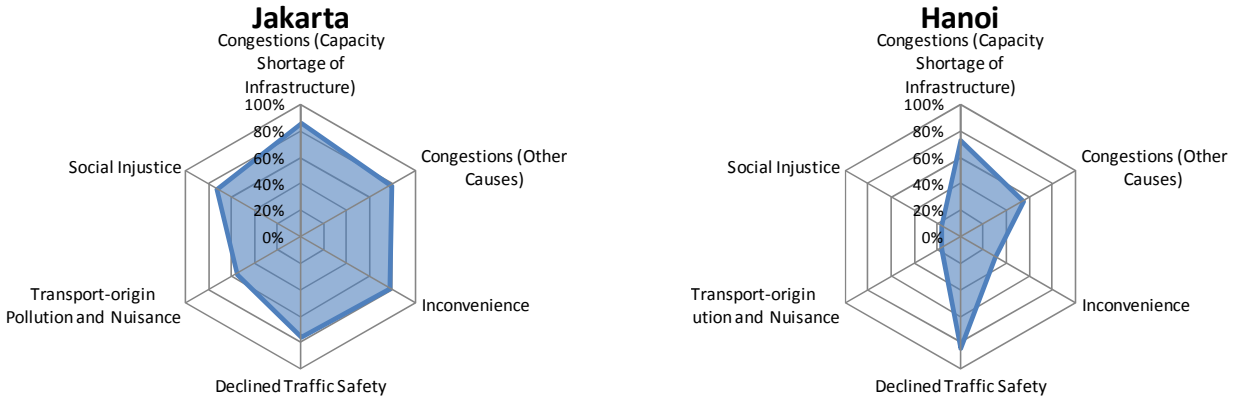
Source: Compiled by the study team.

Table 4.5 Diagnoses of Urban Transport Problems in Jakarta and Ha Noi (Rating Scale 2)

Transport Problems	No. of Tertiary Items	Maximum Points	Jakarta		Ha Noi	
			Points	Ratio to Maximum	Points	Ratio to Maximum
Congestions (Capacity Shortage of Infrastructure)	5	15	13	87 %	11	73 %
Congestions (Other Causes)	17	51	40	78 %	28	55 %
Inconvenience	10	30	23	77 %	9	30 %
Declined Traffic Safety	8	24	18	75 %	20	83 %
Transport-origin Pollution and Nuisance	6	18	10	56 %	3	17 %
Social Injustice	10	30	22	73 %	5	17 %
Total	56	168	126	75 %	76	45 %

Source: Compiled by the study team.

Figure 4.4 Diagnoses of Urban Transport Problems in Jakarta and Ha Noi (Rating Scale 2)



Source: Compiled by the study team.

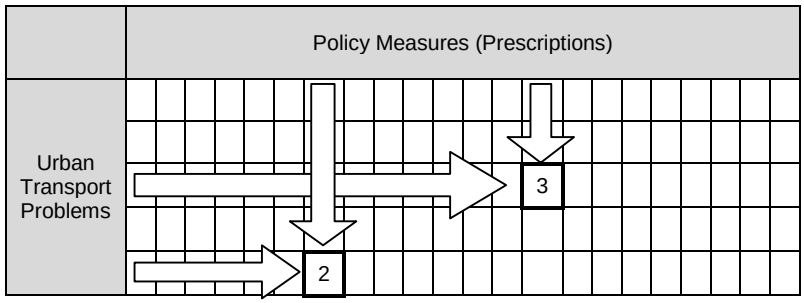
4.3 Prescriptions for Urban Transport Problems

Necessary prescriptions (countermeasures and development projects) are listed up in the matrix format vis-a-vis the diagnostic ratings of urban transport problems. The prepared matrix format can be used to identify how to deal with problems and issues of urban transportation in individual cities.

1) Matrix Preparation for Diagnoses and Prescriptions

The vertical axis shows rows of itemized urban transport problems and the horizontal axis lists columns of prescribed measures to solve the problems. Each cell where a row and a column cross is marked by a circle with some rated evaluation on the effectiveness of the prescription (column) in relation to the designated problem (row). This format is named Diagnosis and Prescription Matrix (Figure 4.5). There are a number of points to be carefully considered in proposing prescriptions, as explained below.

Figure 4.5 Diagnosis and Prescription Matrix



Source: Study Team

2) Typological Classification of Prescriptions

As discussed in Section 3.2 of Chapter 3, measures to deal with urban transport problems consist of (i) construction and improvement of transport infrastructure such as roads and intersections, (ii) improvement of various traffic controls to utilize the available infrastructure more efficiently, (iii) traffic demand management (TDM) for inducing or transforming the demand itself to lessen its burden on the available infrastructure, (iv) improvement of traffic safety facilities and public education, (v) improvement of transport-originating air pollution and nuisance and (vi) construction and improvement of facilities for pedestrians and cyclists. Furthermore, it is also necessary to improve the transport-related administrative capability and the financing of transport development. Large cities in the developed countries invariably experienced the futility of keep supplying additional transport infrastructure to meet the rapid pace of motorization during the latter half of 20th century. Since the turn of the present century, the growing trend in these cities has been to counter the ever-increasing demand by upgrading public transits and enforcing various TDM measures.

a) Prescriptions are categorized into primary, secondary and tertiary levels of classification along the line adopted for transport problems (Table 4.6).

b) Prescriptions are compiled basically from the projects proposed in the JICA master plan studies, with additional measures of traffic control from the viewpoint of traffic engineering and advanced TDM measures.

c) TDM measures are listed up from the on-going practices in the world and various published sources.

Table 4.6 Typology of Prescribed Measures for Transport Problems

Development Strategy (Prescribed Measures for Transport Problems)		
Primary Classification	Secondary Classification	Tertiary Classification
Land Use / Urban Structure		・ Compact multi-core urban structure
Infrastructure	Road Infrastructure	・ Construction of urban highways and arterial roads
		・ Construction of missing links in the network
		・ Establishment of grade-separated network
		・ Development of feeder roads and local roads
		・ Strengthening of road maintenance system (improvement of pavement)
		・ Grade separation at major intersections
		・ Improved designs for intersections at grade with traffic
		・ Removal of roundabouts
		・ Construction and widening of bridges
	Transit Infrastructure	・ Construction and improvement of urban railways
		・ Restructuring of bus network
		・ Construction and improvement of bus stops
		・ Construction and improvement of bus terminals
		・ Diversification and replacement of vehicles
		・ Modernization of bus services
		・ Integrated separation of bus, minibus and para-transit services
Traffic Management	Road Traffic Management	・ Installation of traffic signals
		・ Improvement of signal control (green phases for left- and right-turn traffic)
		・ Introduction of zone traffic control
		・ Efficiency improvement of traffic control
		・ Development of roadside and off-road parking space
		・ Strict policing on illegal parking
	Traffic Demand Management	・ Suppression on ownership and use of private automobiles
		・ Facilitation of modal shift
		・ Transit-oriented development policy
		・ Demand dispersing measures
	Traffic Safety	・ Public education on traffic safety
		・ Construction and improvement of traffic safety facilities
		・ Strengthening of policing on traffic rule violations
Organization / Institution	Transport Planning and Administration	・ Clear definitions of administrative jurisdiction between related agencies or departments
		・ Establishment of an administrative coordinating body for urban transport development and management
		・ Capacity development of personnel
	Management and Operation of Transit Systems	・ Efficiency improvement of management systems (licensing and permits, enforcement of regulations, etc.)
		・ Establishment of fiscal independence and abolition of subsidies
		・ Modernization of operating systems
	Institutions for Project and Program Implementation	・ Improvement of the procedure for land acquisition or appropriation
		・ Development of PPP schemes
		・ Capacity development of personnel
	Shortage of Finance	・ Increase of revenue sources
		・ Creation of transport-specific revenue sources

Source: Compiled by the study team.

3) Rating of Matrix Prescriptions

On each matrix component (=cell), the members of the study team judge whether or not the measure indicated in the column is effective to solve the problem in the row and thereby eliminate the irrelevant components from the matrix. The remaining components are then rated by assigning 1 to 3 points to three levels of their effectiveness as shown below.

- 3 points: The measure contributes decisively to the solution of the problem and its effect lasts a long time.
- 2 points: The measure either contributes decisively to the solution of the problem or its effect lasts a long time.
- 1 point: The measure to some degree contributes to the solution of the problem, but its effect is not necessarily long-lasting.

The rating of the matrix components is far from having some theoretical backup. It is performed with practical but informed judgment on the scale and the durability of the expected impact. There is no more sensible way to rate on the same plane the hugely expensive construction of urban highways or railways and the improvement of driving manners or the introduction of one-way traffic control. The matrix method no doubt lacks the strict procedure used in economic analysis of a project, but it is suggested as a simple pragmatic tool for judging the effectiveness of a given measure and the relative scale of the effect from the measure prescribed for a given transport problem. Time will show whether or not the matrix method is practicable enough. Table 4.7 shows an example of applying the matrix method.

Table 4.7 Matrix Preparation for Diagnoses and Prescriptions

Urban Transport Problems		Prescribed Measures for Transport	Land Use / Urban St	Infrastructure																Traffic Management													Organization / Institution										
				Road Infrastructure									Transit Infrastructure							Road Traffic Management						Traffic Demand Management				Traffic Safety			Transport Planning and Administration			Management and Operation of Transit Systems			Institutions for Project and Program Implementation			Shortage of Finance	
Primary Classification	Secondary Classification	Tertiary Classification	・Compact multi-core urban structure	・Construction of urban highways and arterial roads	・Construction of missing links in the network	・Establishment of grade-separated network	・Development of feeder roads and local roads	・Strengthening of road maintenance system (improvement of pavement)	・Grade separation at major intersections	・Improved designs for intersections at grade with traffic	・Removal of roundabouts	・Construction and widening of bridges	・Construction and improvement of urban railways	・Restructuring of bus network	・Construction and improvement of bus stops	・Construction and improvement of bus terminals	・Diversification and replacement of vehicles	・Modernization of bus services	・Integrated separation of bus, minibus and para-transit services	・Installation of traffic signals	・Improvement of signal control (green phases for left- and right-turn	・Introduction of zone traffic control	・Efficiency improvement of traffic control	・Development of roadside and off-road parking space	・Strict policing on illegal parking	・Suppression on ownership and use of private automobiles	・Facilitation of modal shift	・Transit-oriented development policy	・Demand dispersing measures	・Public education on traffic safety	・Construction and improvement of traffic safety facilities	・Strengthening of policing on traffic rule violations	・Clear definitions of administrative jurisdiction between related	・Establishment of an administrative coordinating body for urban	・Capacity development of personnel	・Efficiency improvement of management systems (licensing and	・Establishment of fiscal independence and abolition of subsidies	・Modernization of operating systems	・Improvement of the procedure for land acquisition or appropriation	・Development of PPP schemes	・Capacity development of personnel	・Increase of revenue sources	・Creation of transport-specific revenue sources
(A) Traffic Congestions	1) Congestions on urban highways	Shortage of road capacity*	2	3	2	1	2	1	1			2														2	2	1	1				1		1					2	1	1	2
	2) Congestions on single-lane sections of arterial motorways	Shortage of road capacity*	3	3	3	2	2	1	2	1	1	2	1	1						1	1	1	1	1	1	2	2	1	1	1		1	1	1	1						1	2	2
		Mingling of intra-city and inter-city traffic	1	1	1	2	1	1	1											1	1	1																					
		Poor road surface pavement*					1	3	1	1		1																					1		1							1	1
		Abandoned cars after accidents and															1	1					1																				
		Ill-mannered driving																					1								1												
		Inadequate public education on traffic																													1		1										
		Roadside parking and vending stalls																														1	1										
	3) Congestions on roads in the CBD	Excessive traffic demand	2	1																						2	1	1	1														
		Increase of private traffic volume																								2	2	1															
		Roadside parking*																						3	2	1	1	1				1											
		Negligent policing over illegal parking																							3	1																	
		Mingling of automobiles, two-wheelers																					1							1													
		Shortage of public transit services											3	2	1	1	1	1	1									1							1	1							
		Inefficient bus network												3	1	1	1	1	1									1							1	1							
		Ill-mannered driving																												1		2			1								
	4) Congestions at intersections	Shortage of capacity*							2	1	1																																
		Inefficient traffic control at intersections																		2	1	1	1																				
		Ill-mannered driving																												1		2			1								
	5) Congestions of bus traffic and at bus stops	Excessive bus services																1	1																						1		
		Obstruction of through traffic by parked													2																	1											
		Ill-mannered driving																												1		2			1								
(B) Inconvenience in Transportation	1) Low passenger convenience of public transit	Absence of affordable public transit												1					1																								
		Poor access to public transit services												1					1																								
		Unpredictability of travel time												1		1		1																									
	2) Low passenger comfort and safety	High occupancy ratio on public transit																1																									
		Inefficient bus network												1				1																									
	3) Inconvenience to transfer passengers	Inconvenience of transfer at transport													1	1																											
		Too frequent transfers												1																													
	4) Low user convenience of taxi services	Dishonest taxi drivers wilfully refusing																	1													1											
		Poor transparency of taxi fare																	1																			1					
	5) Low user convenience of para-	Lowered service level due to															1	1																	1	1		1					
(C) Declined Traffic Safety	1) Lowered pedestrian safety (crosswalks)	Ill-mannered driving																												1		2			1								
		Shortage of pedestrian facilities																																									
	2) Lowered pedestrian safety	Capacity shortage of sidewalks					1																		1																		
	3) Traffic accidents on motorways	Mixed traffic of automobiles and NMT																					1																				
		Poor road surface pavement					1																																			1	
		Traffic signal violations and ill-																												1		1											
		Presence of locations prone to cause																												1	1												
	4) Declined law and order on	High occupancy ratio of public transit															1	1																									
(D) Transport-originating Air Pollution and Nuisance	1) Atmospheric pollution by exhaust gases	Entry of trucks to the CBD																					1									1											
		Increase of private automobiles											1					1								1	1																
	2) Noises and vibrations caused by motorized traffic	Increase of night traffic																					1									1											
		Increase of ill-maintained vehicles																					1																				
		Poor road surface pavement						1																																		1	
	3) Landscape and sunlight	Damages by the construction of																																							1		
(E) Social Injustice	1) Presence of the transportation-poor	Presence of areas not serviced by												1					1																								
		Presence of disaster-prone areas																					1								1												
		Low mobility of pedestrians and NMT															1		1																								
		Shortage of barrier-free facilities																													1											1	
		Gender-related disparity in mobility																	1									1															
	2) Adverse impact on local	Inadequate relocation compensation																																					1			1	
	3) Deficient compensation system	Absence of insurance policies																												1								1					
	4) Negligent policing on violations	Police corruption																					1																		1		
	5) Disadvantage of fare scales	Biased subsidization																																				1			1	1	
		Inappropriate fare scales for the poor																																		1		1			1		

4) Prescribed Measures for Transport Problems: Importance of Individual Measures

The more effective a given prescription is to a given problem, and the more serious the problem is, all the more important the prescription would be, it is reasonable to argue. This relationship is expressed as [importance of a prescribed measure]=[scale of the effect from the measure]×[seriousness of the problem]. The importance $\boldsymbol{Z}_i$ of the prescribed measure i is expressed in the following relationship,

$$\{\boldsymbol{Z}_i\} = \{\boldsymbol{Y}_k\}^t \times \{\boldsymbol{X}_{ki}\}$$

Where $\boldsymbol{Y}_k$ stands for the seriousness of the problem k, $\boldsymbol{X}_{ki}$ for the scale of the effect from the prescribed measure i on the problem k and t for the transposition of the column vector $\{\boldsymbol{Y}_k\}$.

(1) Prescribed Measures for Transport Problems: Relative Importance of Subsectors

The importance of a prescribed measure is defined above as the product of the seriousness of the problem and the degree of contribution by the prescribed measure to the solution of a problem. The implication from this is that the importance of a given measure varies among cities that are vexed by different degrees of seriousness of the problem. As shown in Tables 4.7 and 4.8, the points assigned to transport problems on the level of tertiary classification are added up respectively to the secondary and the primary classification levels. The ratio of the rated points on the primary classification level, or on the sub-sectoral level, to the maximum points of the subsector (i.e. when all transport problems of tertiary classification are rated A in seriousness) can be compared with the same ratios of other subsectors. The results should be able to indicate the relative importance of measures prescribed for each subsector.

(2) Examples of Application

On the basis of the diagnoses shown in Table 4.2, prescribed measures are rated for Jakarta and Ha Noi where, as mentioned earlier, the respective JICA master plan study has been underway including traffic surveys.

Prescribed measures are rated per category of transport problems and the assigned points are added up to see the relative importance of subsectors (Tables 4.8 and 4.9). The results are shown in radar charts (Figures 4.6 and 4.7). The rated scores on the tertiary categories are already shown in Table 4.3. As seen in the said table, restructuring of bus service networks and suppression on automobile ownerships and use are high in the list of priorities for Jakarta, whereas strengthening of policing on violations of traffic rules and public education on traffic safety are of higher priority in Ha Noi.

After the matrix preparation is ready for rating, the scores on the tertiary level are aggregated per secondary and then primary classification category. The ratio of the assigned points to the maximum score (when all categories are rated very serious and assigned 3 points) is then calculated per secondary and primary category aggregation. Tables 4.8 and 4.9 show the results of calculation. In the rating scale 1 (seriousness score), development and improvement of infrastructure is more important than traffic management in Jakarta. Road and railway infrastructure show comparable importance in the infrastructure subsector. In contrast, traffic management is more important than infrastructure development in Ha Noi. In the infrastructure subsector, road development is more important than railway and bus transit development. In the traffic management subsector in Ha Noi, road traffic management and improvement of traffic safety are of higher priority. This seems to reflect the overwhelming predominance of private two-wheelers (motorbikes) in the intra-city traffic. The scores by the rating scale 1 highlight the urgent needs to adopt relevant prescriptions, but tend to underestimate the needs for medium- to

long-term measures. The rating of transit infrastructure development is not high in Ha Noi, but this is partly due to the informed judgment of the participants in the rating sessions.

Regarding Ha Noi, moreover, tertiary categories related to the shortage of public transit services are mostly rated C (not serious). This is primarily because motorbikes are affordable private means of travel in the city in the judgment of experts. If transit development should be judged seriously needed to service the current motorbike passengers and thus rated A, the ratio of seriousness would more or less double from 15% to 35% in the rating scale 1 and from 29% to 48% in the rating scale 2. It will be necessary therefore to carefully ascertain those sensitive tertiary categories that are liable to influence the aggregated outcome of rating and to improve the procedure and the interpretation of the matrix of diagnoses and prescriptions.

Prescriptions for urban transportation problems in cities worldwide are enclosed in the Appendix of the Report. To come up with these figures, trainees from various countries evaluated their own cities by using the Checklist for Urban Transportation Diagnosis in the Comprehensive Urban Transportation Planning and Project by JICA in October 2011.

Table 4.8 Relative Importance of Prescribed Measures (Rating Scale 1): Jakarta and Ha Noi

Development Strategy (Prescribed Measures for Transport Problems)		Jakarta		Ha Noi		Jakarta		Ha Noi	
Primary Classification	Secondary Classification	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
Land Use / Urban Structure		22	22	7	7	92 %	92 %	29 %	29 %
Infrastructure	Road Infrastructure	225	119	86	62	73 %	78 %	28 %	41 %
	Public Transport Infrastructure		106		24		68 %		15 %
Traffic Management	Road Traffic Management	178	51	134	44	62 %	53 %	47 %	46 %
	Traffic Demand Management		81		35		87 %		38 %
	Traffic Safety		46		55		48 %		57 %
Organization / Institution	Transport Planning and Administration	96	27	60	24	65 %	56 %	41 %	50 %
	Transit Management and Operation		16		6		59 %		22 %
	Institutions for project and program Implementation		22		8		73 %		27 %
	Finance		31		22		74 %		52 %
Total		521	521	287	287	68 %	68 %	38 %	38 %

Source: Compiled by the study team.

Table 4.9 Relative Importance of Prescribed Measures (Rating Scale 2): Jakarta and Ha Noi

Development Strategy (Prescribed Measures for Transport Problems)		Jakarta		Ha Noi		Jakarta		Ha Noi	
Primary Classification	Secondary Classification	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
Land Use / Urban Structure		23	23	14	14	96 %	96 %	58 %	58 %
Infrastructure	Road Infrastructure	264	136	142	97	85 %	89 %	46 %	63 %
	Public Transport Infrastructure		128		45		82 %		29 %
Traffic Management	Road Traffic Management	227	72	178	58	80 %	75 %	62 %	60 %
	Traffic Demand Management		87		58		94 %		62 %
	Traffic Safety		68		62		71 %		65 %
Organization / Institution	Transport Planning and Administration	111	36	81	30	76 %	75 %	55 %	63 %
	Transit Management and Operation		17		9		63 %		33 %
	Institutions for project and program Implementation		23		13		77 %		43 %
	Finance		35		29		83 %		69 %
合計		625	521	415	287	82 %	68 %	54 %	38 %

Source: Compiled by the study team.

Figure 4.6 Relative Importance of Prescribed Measure for Transport Problems (Rating Scale 1)

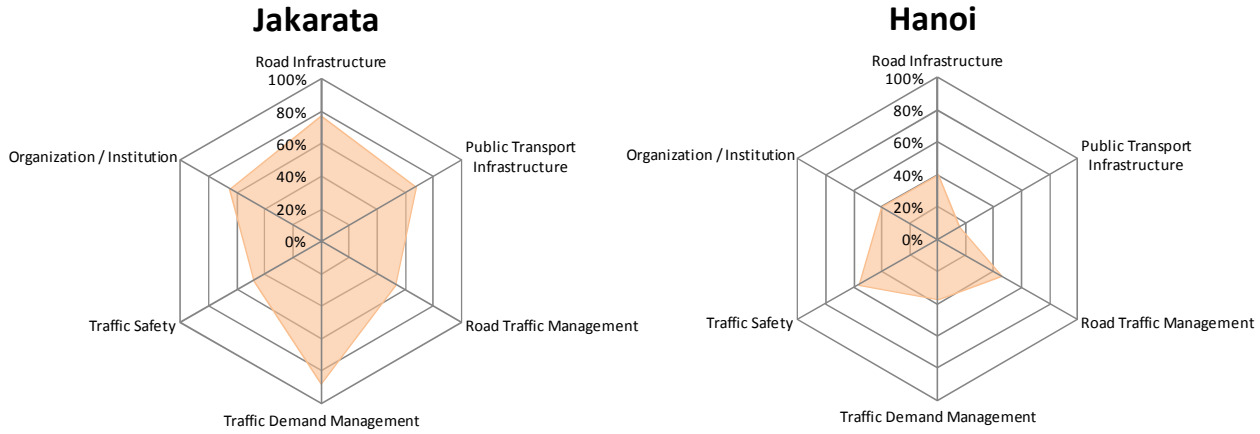


Figure 4.7 Relative Importance of Prescribed Measure for Transport Problems (Rating Scale 2)

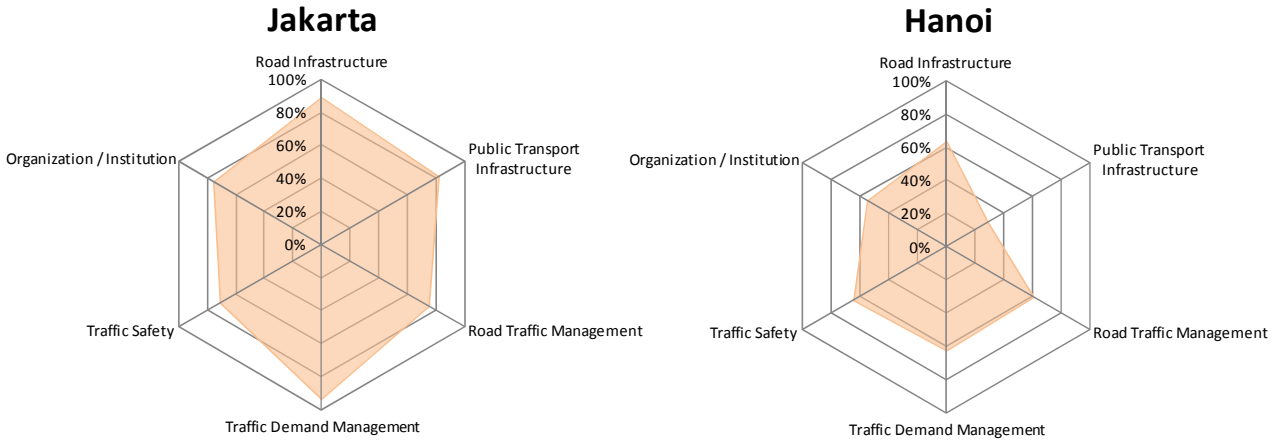


Table 4.10 Relative Importance of Prescribed Measures (Rating Scale 1): Jakarta and Ha Noi

Development Strategy (Prescribed Measures for Transport Problems)			Jakarta			Ha Noi		
Classification			(3)	(2)	(1)	(3)	(2)	(1)
Primary (1)	Secondary (2)	Tertiary (3)						
Land Use / Urban Structure		・ Compact multi core urban structure	**22**	22	22	7	7	7
Infrastructure	Road Infrastructure	・ Construction of urban highways and arterial roads	**22**	119	225	7	62	86
		・ Construction of missing links in the network	16			5		
		・ Establishment of grade-separated network	11			3		
		・ Development of feeder roads and local roads	16			11		
		・ Strengthening of road maintenance system (improvement of pavement)	11			14		
		・ Grade separation at major intersections	17			8		
		・ Improved designs for intersections at grade with traffic	7			5		
		・ Removal of roundabouts	6			2		
		・ Construction and widening of bridges	13			7		
	Public Transport Infrastructure	・ Construction and improvement of urban railways	9	106		1	24	
		・ Restructuring of bus network	**28**			7		
		・ Construction and improvement of bus stops	9			1		
		・ Construction and improvement of bus terminals	8			2		
		・ Diversification and replacement of vehicles	11			3		
		・ Modernization of bus services	19			8		
		・ Integrated separation of bus, minibus and para-transit services	**22**			2		
Traffic Management	Road Traffic Management	・ Installation of traffic signals	6	51	178	3	44	134
		・ Improvement of signal control (green for left- and right-turn traffic)	5			2		
		・ Introduction of zone traffic control	5			2		
		・ Efficiency improvement of traffic control	**20**			10		
		・ Development of roadside and off-road parking space	6			10		
		・ Strict policing of illegal parking	9			**17**		
	Traffic Demand Management	・ Suppression on ownership and use of private automobiles	**29**	81		14	35	
		・ Facilitation of modal shift	**25**			10		
		・ Transit-oriented development policy	18			8		
		・ Demand dispersing measures	9			3		
	Traffic Safety	・ Public education on traffic safety	15	46		19	55	
		・ Construction and improvement of traffic safety facilities	12			5		
		・ Strengthening policing on traffic rule violations	19			**31**		
Organization / Institution	Transport Planning and Administration	・ Clear definitions of administrative jurisdiction between related agencies and departments	9	27	96	5	24	60
		・ Establishment of an administrative coordinating body for urban transport development and management	3			1		
		・ Capacity development of personnel	15			18		
	Management and Operation of Transit Systems	・ Efficiency improvement of management systems (licenses and permits, enforcement of regulations, etc.)	7	16		2	6	
		・ Establishment of fiscal independence and abolition of subsidies	0			0		
		・ Modernization of operating systems	9			4		
	Institutions for Project and Program Implementation	・ Improvement of the procedure for land acquisition or appropriation	0	22		0	8	
		・ Development of PPP schemes	6			2		
		・ Capacity development of personnel	16			6		
	Shortage of Finance	・ Increase of revenue sources	18	31		15	22	
		・ Creation of transport-specific revenue sources	13			7		
Total			521			287		

Note: 20 or more points are shown by bold letters. Source: Compiled by the study team.

Table 4.11 Relative Importance of Prescribed Measures (Rating Scale 2): Jakarta and Ha Noi

Development Strategy (Prescribed Measures for Transport Problems)			Jakarta			Ha Noi		
Classification			(3)	(2)	(1)	(3)	(2)	(1)
Primary (1)	Secondary (2)	Tertiary (3)						
Land Use / Urban Structure		・ Compact multi0core urban structure	**23**	23	23	14	14	14
Infrastructure	Road Infrastructure	・ Construction of urban highways and arterial roads	**23**	136	264	14	97	142
		・ Construction of missing links in the network	17			10		
		・ Establishment of grade-separated network	13			6		
		・ Development of feeder roads and local roads	**20**			16		
		・ Strengthening of road maintenance system (improvement of pavement)	16			16		
		・ Grade separation at major intersections	19			13		
		・ Improved designs for intersections at grade with traffic	8			7		
		・ Removal of roundabouts	6			4		
		・ Construction and widening of bridges	14			11		
	Public Transport Infrastructure	・ Construction and improvement of urban railways	12	128		2	45	
		・ Restructuring of bus network	**32**			14		
		・ Construction and improvement of bus stops	12			2		
		・ Construction and improvement of bus terminals	10			4		
		・ Diversification and replacement of vehicles	13			6		
		・ Modernization of bus services	**23**			13		
		・ Integrated separation of bus, minibus and para-transit services	**26**			4		
Traffic Management	Road Traffic Management	・ Installation of traffic signals	9	72	227	6	58	178
		・ Improvement of signal control (green phases for left- and right-turn traffic)	7			4		
		・ Introduction of zone traffic control	7			4		
		・ Efficiency improvement of traffic control	**25**			14		
		・ Development of roadside and off-road parking space	9			11		
		・ Strict policing of illegal parking	15			19		
	Traffic Demand Management	・ Suppression on ownership and use of private automobiles	**31**	87		**22**	58	
		・ Facilitation of modal shift	**26**			17		
		・ Transit-oriented development policy	**21**			13		
		・ Demand dispersing measures	9			6		
	Traffic Safety	・ Public education on traffic safety	**21**	68		**23**	62	
		・ Construction and improvement of traffic safety facilities	15			7		
		・ Strengthening policing on traffic rule violations	**32**			**32**		
Organization / Institution	Transport Planning and Administration	・ Clear definitions of administrative jurisdiction between related agencies and departments	12	36	111	7	30	81
		・ Establishment of an administrative coordinating body for urban transport development and management	3			2		
		・ Capacity development of personnel	**21**			**21**		
	Management and Operation of Transit Systems	・ Efficiency improvement of management systems (licenses and permits, enforcement of regulations, etc.)	8	17		4	9	
		・ Establishment of fiscal independence and abolition of subsidies	0			0		
		・ Modernization of operating systems	9			5		
	Institutions for Project and Program Implementation	・ Improvement of the procedure for land acquisition or appropriation	0	23		0	13	
		・ Development of PPP schemes	6			4		
		・ Capacity development of personnel	17			9		
	Shortage of Finance	・ Increase of revenue sources	**21**	35		18	29	
		・ Creation of transport-specific revenue sources	14			11		
Total			625			415		

Note: 20 or more points are shown in bold letters. Source: Compiled by the study team.

4.4 Choices on Basic Components of Urban Transport Strategy

Large cities in the development countries selected for the present study are mostly in the early phase of motorization. This implies that automobile ownerships and use will increase at accelerating speed from now on and accordingly that the problem of traffic congestions will quickly go from bad to worse or even from worse to the worst ever. It is expected that the road network will extend its reach to catch up with ever-expanding urban sprawl spurred by the new town development in the suburbs and the construction of outer ring roads, among others.

It is now generally acknowledged regarding mega cities in the world that it would be no longer possible to continue catching up with the pace of motorization by constructing more and more roads to maintain a favorable service standard for motorized traffic. It is no exaggeration to say that the most fundamental issue shared by global urban policymakers is how to facilitate a shift in traffic demand from the private use of passenger cars to some public transit systems. However, in many large cities of the developing world, such modal shift is a vain issue because transit systems are either not available, or not up to the standard to take on the shift of passengers from private automobiles.

It is, therefore, urgently necessary for the respective cities in the developing world to construct and operate a transit system. Basic questions that must be addressed to in formulating an urban transport strategy for a given city is to decide on the type of public transits suited to the city. Concurrently, it is necessary to select and put into effect a set of traffic management measures which will help achieve efficient and effective utilization of the proposed transit system. The study team prepared a number of flow charts to show the procedures for selecting a transit alternative and applicable TDM measures. This section explains how to use the flow charts in application.

1) Alternatives for Urban Transport Strategy

(1) Approach

As mentioned earlier in Section 4.1, the issue of universal importance in urban transportation of modern societies is in how to facilitate the modal shift of traffic demand by suppressing individual means of travel and encouraging the use of some transit system. The shift presupposes the presence of a transit system well-equipped in both quantitative and qualitative aspects of its operation. In many large cities of the developing countries, railway transits are not fully developed, if not entirely absent, and public transportation is provided by a fleet of buses, minibuses and vans or other types of para-transit vehicles. In these cities, a passenger car bestows a social prestige to its owner. Therefore, owners of private automobiles tend to disfavor demeaning rides on public transits.

The development of a railway transit requires a huge outlay of capital and takes a long time to complete. If a railway system should be introduced when the bulk of citizens cannot afford to pay the fare and thus the fare revenue cannot support its operation, it would have to be subsidized heavily to the extent of threatening the public sector coffers. Under such circumstances, it would be too much to expect any favorable turns from the private sector participation.

The focus of the present study is to seek possibilities of devising a method or methods to identify a suitable transit system which could play a central role in urban transportation for a given city, and to judge whether or not the city is ready for introducing railways or urban highways. For a big undertaking such as these, a feasibility study can of course give some definitive answer, but considerable time and money will have to be spent to get the answer this way. Accordingly, the present study asks what kinds of information are necessary in the procedures designed to reach a number of strategic judgments, in a manner as quick and simple as possible, about whether or

not a transit system or any other crucial undertaking for urban transport is worth consideration at all. The required types of data are indicated in the order of importance at each step of the procedures, which are presented in the flow chart format.

The following five procedures for strategic judgments are prepared and shown separately in five flow charts.

- Procedure to judge the selection of a basic public transport mode
- Procedure to judge the introduction of a railway transit system
- Procedure to judge the introduction of a BRT system
- Procedure to judge a selective set of TDM measures
- Procedure to judge the introduction of urban highways

To see how the procedures are practicable for formulating an urban transport strategy, the present study selected two cities each from India, Vietnam and Indonesia and collected various data on transport conditions, policies and programs in these cities. The obtained data are fed as inputs to the respective flow charts to make strategic judgments. These judgments are then checked vis-a-vis the actual strategies in 6 cities. In other words, the practical usefulness of the procedures is tested by the case study on six cities.

At the end, what is learned from the case study and methodological inadequacies which become apparent during the process are reviewed to see a possible course of improvement ahead. The findings of the case study are summarized in the following paragraphs. More details are available in Appendix D.

(2) Public Transport Modes and Their Characteristics

Before trying out the procedures for making strategic judgments concerning the selection of a suitable public transport mode, salient characteristics of several public transport modes are briefly summarized in Table 4.12.

Table 4.12 General Specifications of Public Transport Modes (1/2)

	Metro (MRT)	LRT	Existing Railways	Monorail and AGT	BRT	Conventional Bus
Exclusiveness	- Operated on exclusive rails - Grade separation from other transport	- Operated mainly on exclusive rails - Sometimes mixed with other traffic	- Commuter trains mixed with Inter-city long distance trains	- Operated on exclusive rails or guideways - Grade separation from other transport	- Use exclusive lanes - Occasionally share certain sections of roads with other vehicles	- Mixed with other motorized traffic
Interval between stations / bus stops km	1.5	0.8-1.5	3-15	0.8-1.5	0.4-1.0	0.2-0.4
Vehicles	Electric trains	- Electric motor cars - Articulated cars - Low-floor cars	Electric trains Rolling stock	- Electric motorcars	Conventional bus, articulated bus, low-floor bus, high-floor bus (to fit the high platform), diesel bus and hybrid bus	Conventional bus, articulated bus, low-floor bus, diesel bus and hybrid bus
Number of seating	50-80 per car	65-85 per car	60-90 per car	30-75 per car	- 40 per standard bus - 65-85 per articulated bus	- 40 per standard bus - 65 per articulated bus

Table4.12 General Specifications of Public Transport Modes (2/2)

Average Speed (km/hr)	25-55	20-30	40-60	25-40	15-35	15-35
Transport Capacity (PPHPD)	～60,000	～30,000	～30,000	～15,000	～8,000	～6,000
Minimum Radius Maximum Gradient	50m 8% (Linear Metro) 160m 3%	20m 8%	300m 3%	100m 6%		
Investment (US$ million /km)	60-100 (under ground) 30-50 (viaduct)	30-50	10-20	30-50	6-13	-

2) Procedures for Formulating Basic Urban Transport Strategy

The following five sets of flow chart and table are prepared to show the procedures designed respectively to make strategic decisions regarding public transport development in a given city.

Figure 4.8: Flow chart for judging the selection of a basic public transport mode

Table 4.13: Steps to Judge a Suitable Public Transport System

The procedure is designed to identify a suitable public transport mode for a given city. The steps in the procedure require such data as the scale of urban economy, traffic volume on the transport corridors1 and the affordable fare scale for citizens, among others. At the end of making decisions at every step, it is possible to select a suitable mode out of the available alternatives of metro transit, medium-capacity transit, BRT and line bus. Subsequent to the selection, it is necessary to formulate an entire public transport system that would integrate other modes of lower capacity with the selected transit system. If a BRT system is selected, for example, it is necessary to organize its operation in orderly integration with conventional line bus services.

Figure 4.9: Flow chart for judging the validity of introducing a railway transit system

Table 4.14: Steps to Judge the Justification for a Railway Transit System

The procedure is designed to judge the justification for railway transit operation in a given city. The steps in the procedure require such data as existing urban railways, population size and scale of urban economy, traffic demand on the transport corridors, and development programs underway or in the pipeline.

Figure 4.10: Flow chart for judging the validity of introducing a BRT system

Table 4.15: Steps to Judge the Justification for a BRT System

The procedure is designed to judge the justification for BRT operation in a given city. The steps in the procedure require such data as existing urban railways, population size and scale of urban economy, traffic demand on the transport corridors, development programs underway or in the pipeline, and availability of road space for BRT services.

Figure 4.11: Flow chart for judging the validity of introducing traffic demand management

Table 4.16: Steps to Judge the Justification for TDM Measures

[1] To estimate a possible size of traffic demand to be shifted to a railway transit, BRT, or urban highways, it is not enough to get the traffic data only on one arterial thoroughfare. In addition to the thoroughfare (road or railway) of largest traffic volume and hence the largest possible source of traffic shift, a few roads running parallel to it must be added to estimate the possible shift of traffic demand. In this study, a bundle of such thoroughfares are called “transport corridor.”

The procedure is designed to judge the needs and feasibility of traffic demand management in a given city. The steps in the procedure require such data as the intensity and extent of traffic congestions in the city, on-going or proposed programs and projects for road network improvement, balance between traffic demand and available capacity of transport infrastructure, and the degree of effectiveness of the on-going TDM measures if already in force. If deemed necessary, suitable types of TDM measures are identified for the city.

Figure 4.12: Flow chart for judging the validity of introducing urban highways

Table 4.17: Steps to Judge the Justification for Urban Highways

The procedure is designed to judge the justification for urban highways in a given city. The steps in the procedure require such data as existing urban highways, the scale of urban economy, automobile ownerships, traffic volume on the transport corridors, availability of space for new urban highways, on-going and proposed programs and projects, and environmental consideration.

Figure 4.8 Flow Chart for Selecting a Basic Public Transport Mode

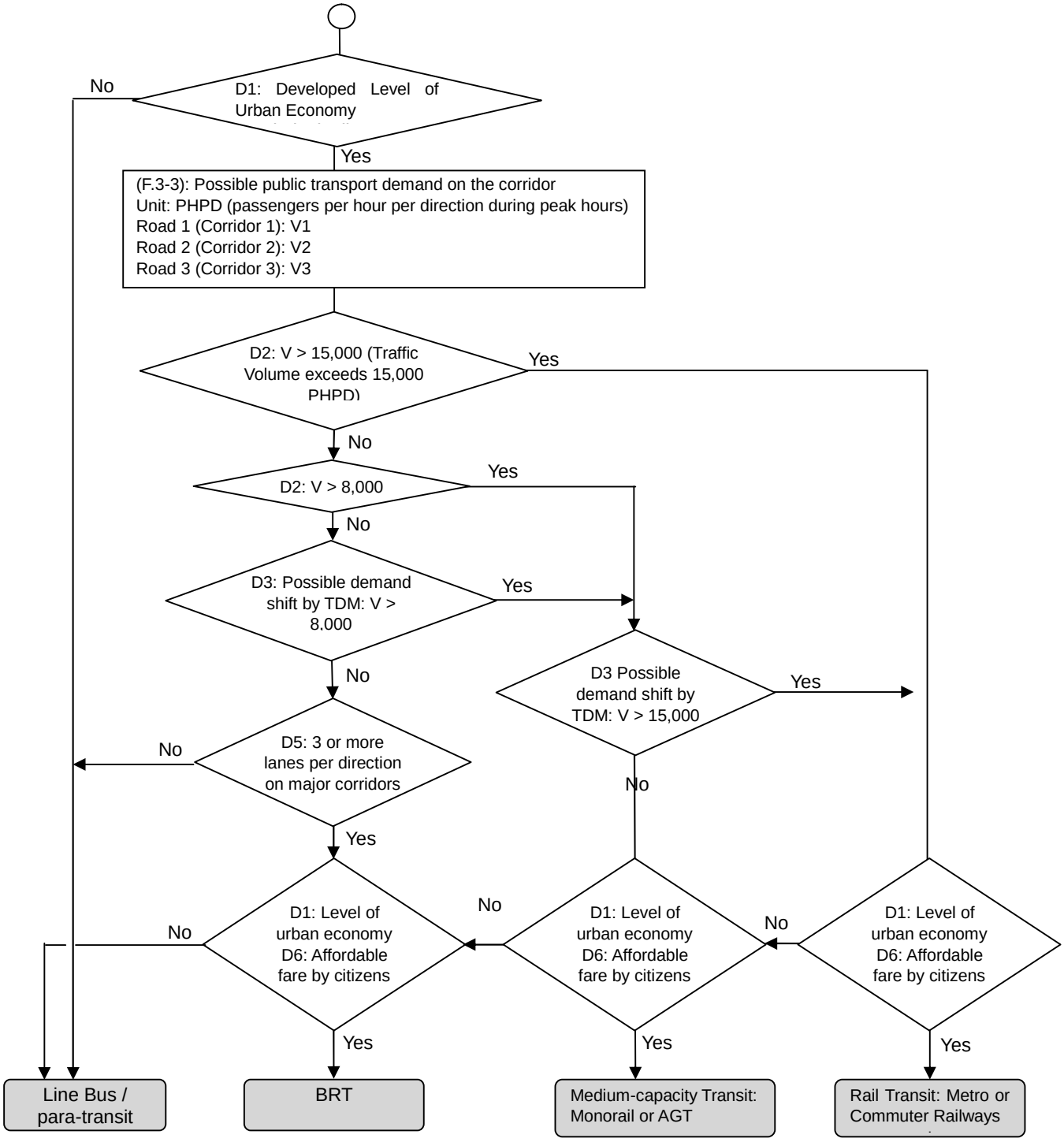


Table 4.13 Steps to Judge a Suitable Public Transport System

Item No. For Judgment	Strategic Question	Information Necessary for Judgment	Yes No
D1	Do the current social and economic conditions of the city exceed the justifiable level of development to sustain the operation of a BRT or metro system?	(F.2-1) Judge affirmative, when per capita GDP exceeds US$700, or GRDP of the city (= the city's population multiplied by per capita GDP) reaches US$3.0 million.[1)]	Y/N
D2	Is the current passenger traffic on major corridors sufficiently large?	(F.3-3) Judge affirmative, when passenger traffic during peak hours on one of three major corridors exceeds 8,000PPHPD (for a BRT system), or 15,000PPHPD (for a metro system).	Y/N
D3	Are some TDM measures now in force to promote the modal shift to public transportation? Or, Is it feasible to expect the suppression of demand by TDM measures?	(I.3-3) What Is the current level of public awareness about the need of modal shift? (I.3-4) If 10% of the passengers on private automobiles should shift to public transport, can the existing system absorb the shift? (I.3-5) What are the measures necessary to back up the absorptive capacity of public transport? (I.3-6) Is there any measure in force to suppress the private use of passenger cars? (I.3-7)On-going measures to promote the use of public transport (I.3-8) What types of TDM measures are feasible to restrict the private ownership and use of automobiles in the city?	Y/N
D5	Is there enough road space for BRT operation?	(F.3-3) Judge affirmative, when arterial roads have 3 or more lanes in one direction (two lanes in some parts of the way are acceptable) (I.2-16) Availability of land for BRT facilities	Y/N
D6	Estimation of fare scales and user affordable fare	(F.4-7, 4-11, 4-13) Judgment is made on the basis of current bus fares and the average user affordable fare (US dollars per trip) calculated from the following formula User affordable fare $=G*(-31.28*\ln(3G)+353)*10^{-6}$ Where, G stands for per capita GRDP of the city (in US dollars) Per capita GRDP is estimated as worth 300% of per capita GDP.[2)]	Y/N

Notes: 1) In Chapter 3, it is suggested that the operation of a metro system would be possible when GRDP (calculated by multiplying the city population by per capita GDP) exceeds US$3.0 billion and that the operation of a BRT system would become sustainable when per capita GDP reaches the range of US$700 – 3,000.
2) See descriptions in Chapter 1.

Figure 4.9 Flow Chart for Judging the Justification for a Railway Transit System

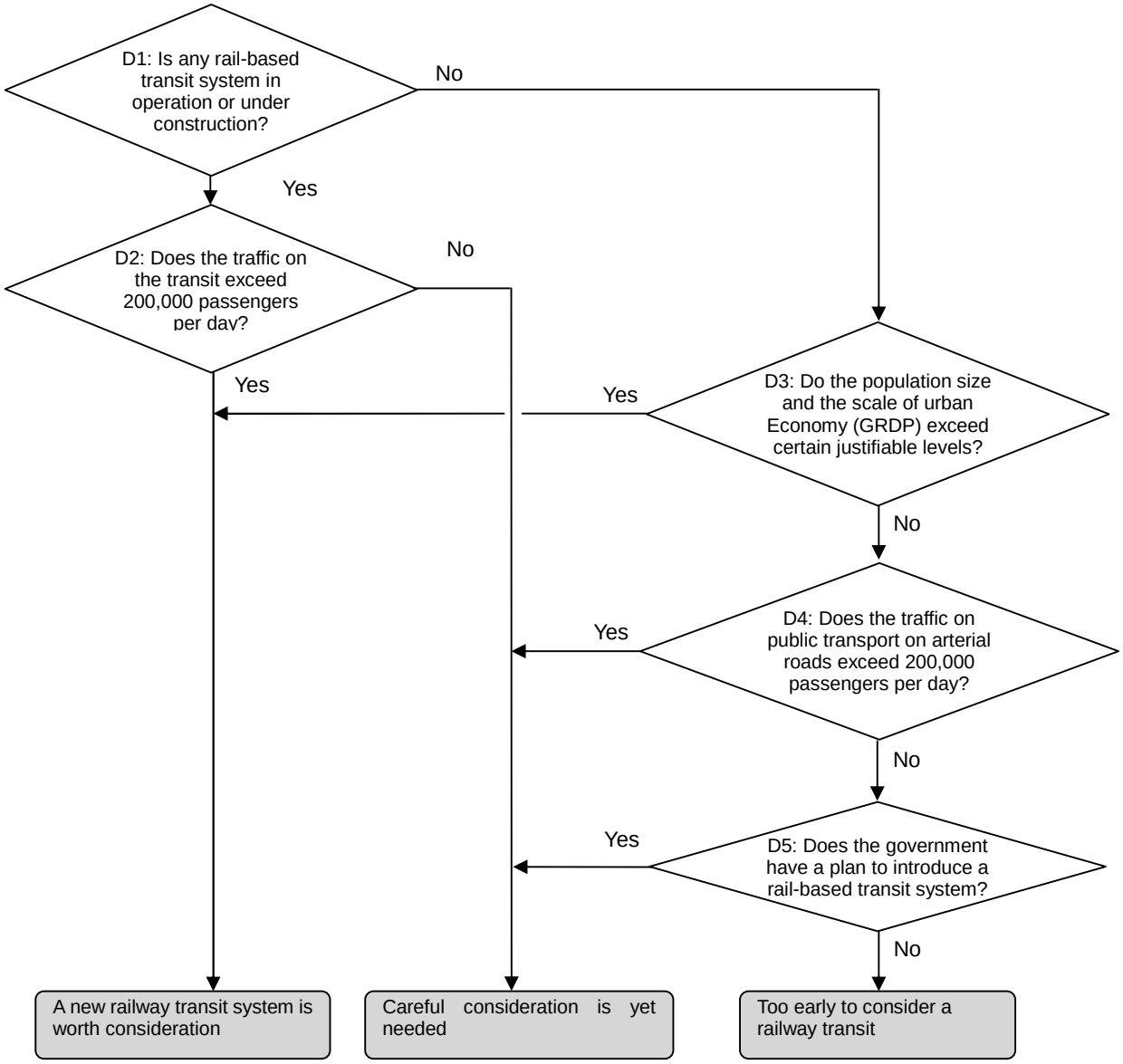


Table 4.14 Steps to Judge the Justification for a Railway Transit System

Item No. For Judgment	Strategic Question	Information Necessary for Judgment	Yes No
D1	Is any rail-based transit system already in operation?	（F.4-2）	Y/N
D2	Does the traffic on the transit exceed 200,000 passengers per day?	（F.4-10）	Y/N
D3	Do the population size and the scale of urban Economy (GRDP) exceed the justifiable levels discussed in Chapter 3?	(F.2-1) See the description for D1 in Figure 4.8 and Table 4.13.	Y/N
D4	Does the traffic on public transport on arterial roads exceed 200,000 passengers per day?	(F.3-3) See the description forD2 in Figure 4.8 and Table 4.13.	Y/N
D5	Does the government have a plan to introduce a rail-based transit system?	(F.3-3, I.3-2)	Y/N

Figure 4.10 Flow Chart for Judging the Justification for a BRT System

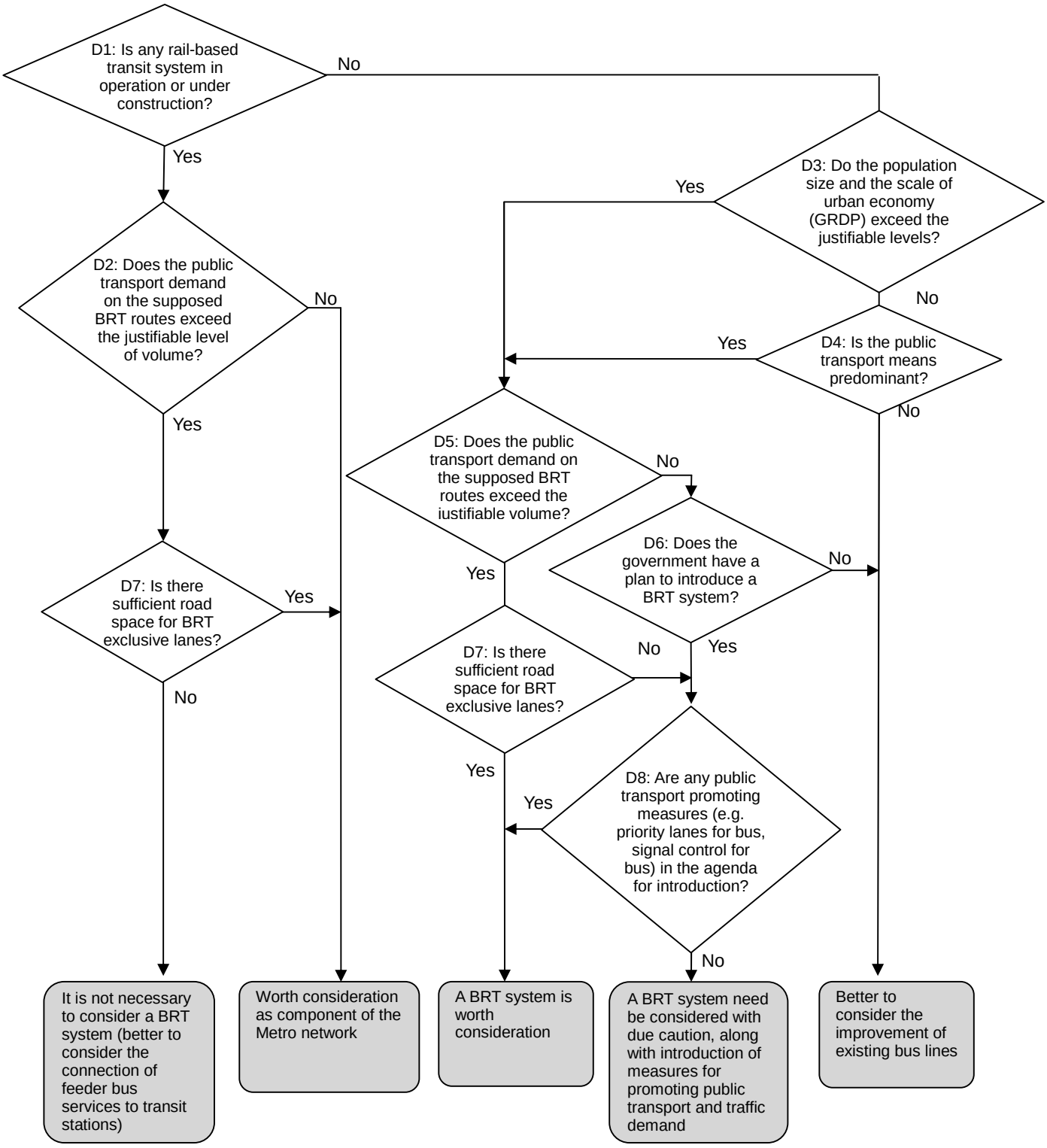


Table 4.15 Steps to Judge the Justification for a BRT System

Item No. For Judgment	Strategic Question	Information Necessary for Judgment	Yes No
D1	Is any rail-based transit system already in operation or under construction?	（F.4-2, F.4-10）	Y/N
D2	Does the public transport demand on the supposed BRT routes exceed the justifiable level of volume?	(F.4-10)	Y/N
D3	Do the population size and the scale of urban Economy (GRDP) exceed the justifiable levels as discussed in Chapter 3?	(F2-1) See the description for D1 in Figure 4.8 and Table 4.13.	Y/N
D4	Is the public transport means predominant?	(F.3-1)	Y/N
D5	Does the public transport demand on the supposed BRT routes exceed the justifiable volume?	(F.3-3) Appropriate traffic levels for respective public transport modes are defined as follows. BRT < 8,000 < Monorail & AGT < 15,000 < LRT < 30,000 < Metro (unit: PPHPD)	Y/N
D6	Does the government have a plan to introduce a BRT system?	(F4-10)	Y/N
D7	Is there sufficient road space for BRT exclusive lanes?	(F.3-3, I.2-15) 3 or more lanes in one direction (2 lanes in some part of the roads are acceptable)	Y/N
D8	Are measures promoting public transport (e.g. priority lanes for bus, signal control for bus) in the agenda for introduction?	(F.5-1, I,3-7)	Y/N

Figure 4.11 Flow Chart for Judging the Justification for TDM Measures

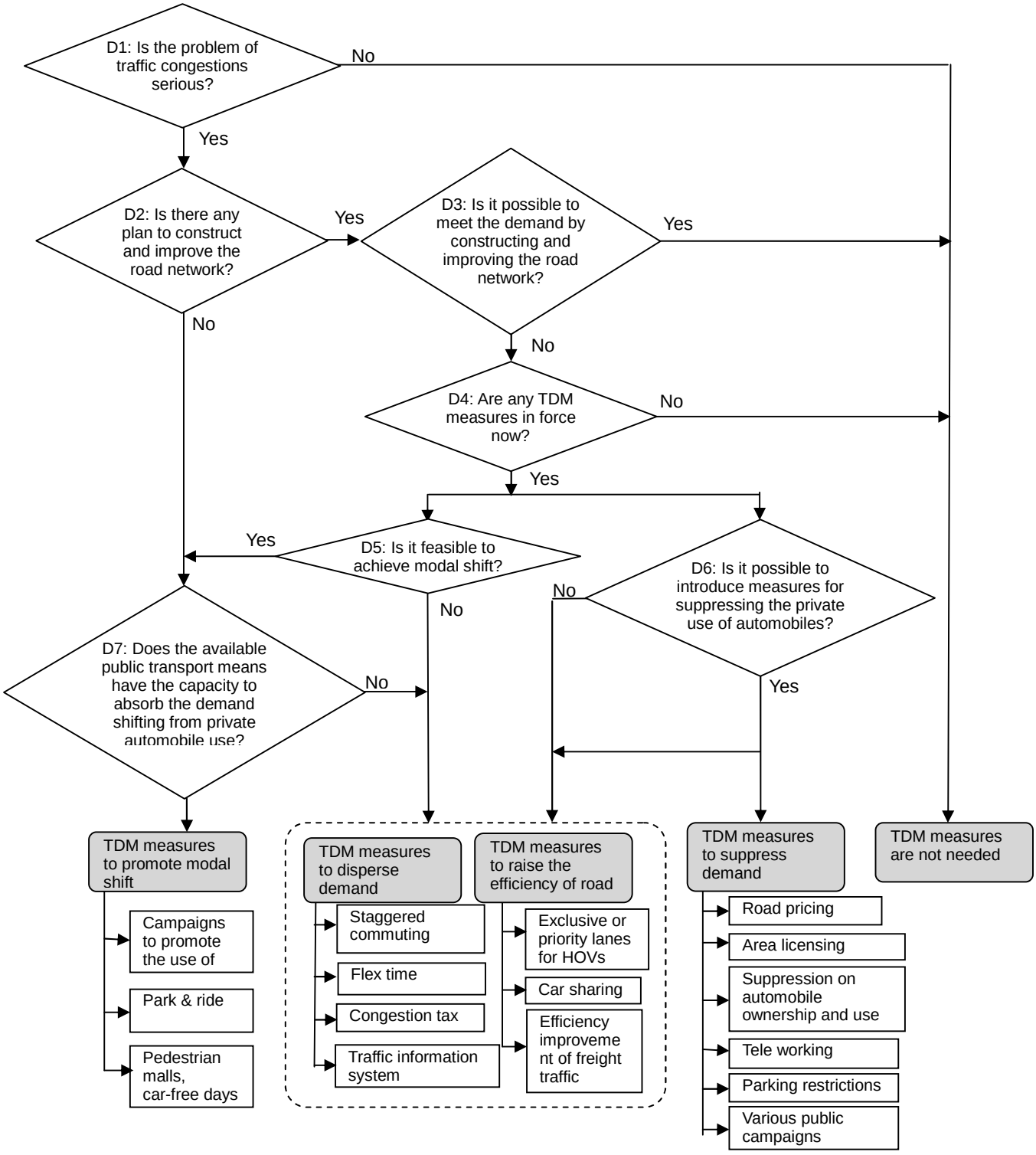


Table 4.16 Steps to Judge the Justification for TDM Measures

Item No. For Judgment	Strategic Question	Information Necessary for Judgment	Yes No
D1	Is the problem of traffic congestions serious?	(I.1-1)	Y/N
D2	Is there any plan to construct and improve the road network?	(F.3-3)	Y/N
D3	Is it possible to meet the demand by the construction and improvement of the road network?	(I.2-2)	Y/N
D4	Are any TDM measures in force now? Or, is there any possibility of introducing TDM in the policy agenda?	(I.3-6, I.3-7, I.3-8)	Y/N
D5	Is the need of modal shift well-understood by the public?	(I.3-3, I.3-4, I.3-5)	Y/N
D6	Is it possible to introduce measures for suppressing the private use of automobiles?	(I.3-6, I.3-8)	Y/N
D7	Does the available public transport means have the capacity to absorb the demand that would shift from private automobile use?	(I.3-4)	Y/N

Figure 4.12 Flow Chart for Judging the Justification for Urban Highways

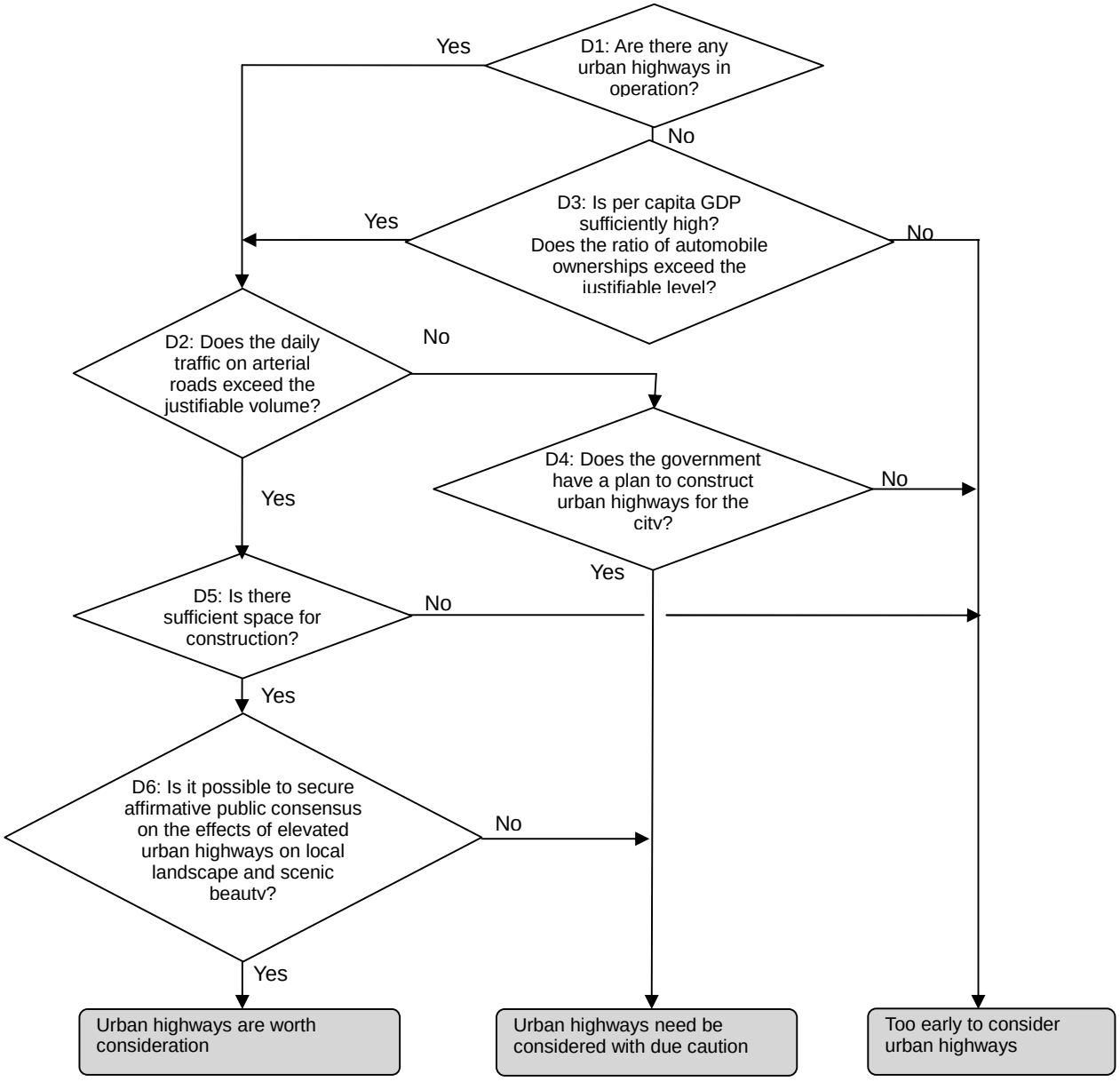


Table 4.17 Steps to Judge the Justification for Urban Highways

Item No. For Judgment	Strategic Question	Information Necessary for Judgment	Yes No
D1	Are there any urban highways in operation?	(F.3-4)	Y/N
D2	Does the daily traffic on arterial roads exceed the justifiable volume?	(F.3-3)	Y/N
D3	Is per capita GDP sufficiently high? Or, does the ratio of automobile ownerships exceed the justifiable level?	(F2-1, F.3-2)	Y/N
D4	Does the government have a plan to construct urban highways for the city?	(I.2-4, I.3-2)	Y/N
D5	Is there sufficient space for construction?	(F.3-3, I.2-15) Enough space for 3 to 2 lanes in one direction	Y/N
D6	Is it possible to secure affirmative public consensus on the effects of elevated urban highways on local landscape and scenic beauty?	(I.2-3)	Y/N

3) Verification of Guidelines for Formulating Urban Transport Strategy

The procedures discussed in the foregoing section are collectively called guidelines from here on. As mentioned earlier, the present study selected six cities or two cities each from India, Vietnam and Indonesia and collected information on current transport conditions, policies and programs. Table 4.18 summarizes general profiles of six cities. The collected data includes the types of data needed for the suggested procedures to make strategic judgments about urban transport development. The present study made a case study of six cities by using the collected data as inputs to the flow charts. The results of the case study are compared to the actual master plan strategies of six cities to verify the practical validity of the suggested guidelines.

Table 4.19 compares the strategic judgments according to the guidelines and the proposals in the respective transport master plans in six cities. Regarding the procedures (I), (II), (III) and (V), the results of the case study agree with the proposals of the master plans in most of six cities. The suggested procedures are judged wholly practicable to identify feasible prospects of urban transport development.

Regarding the procedure (IV), however, the agreement is rather weak. Part of the reason is that the feasibility of introducing a certain selection of TDM measures is liable to be affected by complex combinations in a given city of such factors as the degree of public awareness, income levels of city dwellers and the capacity of available alternative modes of travel.

The suggested guidelines do not claim to suggest specific locations for the strategic decisions they help to make. Judgments are based on the aggregate transport conditions taken as a whole concerning a given city. Take, for example, the traffic volume data collected on three transport corridors regarding six cities. It is possible to go on to the examination of investment prospects along these corridors, but one has to keep in mind that these corridors do not necessarily represent the true development axes in these cities.

Table 4.18 Six Cities Selected for Case Study

Country / City		Vietnam		India		Indonesia	
		Ha Noi	Ho Chi Minh	Hyderabad	Pune	Jakarta	Surabaya
Population (in 1000)	Administrative City	2,740(2009)	6,184(2010)	4,300(2010)	3,300(2010)	9,223(2009)	2,938(2009)
	Urban Agglomeration	6,472(2009)	7,439(2010)	5,300(2010)	6,100(2010)	18,445 (2010)	5,696(2007)
Growth Rate of Population	Administrative City	2.3% (‘05-‘09)	3.1% (’09-‘10)	2% (’09-‘10)	3% (’09-‘10)	1.6% (‘05-‘10)	1.44%
	Urban Agglomeration	4.5% (‘05-‘09)	3.0% (’05-‘10)	5% (’09-‘10)	5% (’09-‘10)	4.6% (‘05-‘10)	-
Area	Administrative	3,345 km^2	2,095 km^2	175 km^2	343 km^2	662 km^2	326 km^2
	Agglomeration	-	494 km^2	-	1,340 km^2	5,925 km^2	2,152 km^2
Urban Functions		National Capital		State Capital		National Capital	Provincial Capital
GDRP (Administrative City)		205,890 VND million (2009)	414,068 VND million (2010)	10.13 US$ billion (‘07-‘08)	2.86 US$ billion (’02-‘03)	757,023,453 Rupiah (2009)	149,792,615 Rupiah (2008)
GDRP Per capita (Administrative City)		31.8 VND mil (2009)	3,100 (2010)	1,178 USD (‘07-‘08)	1,052 USD (‘03-‘04)	82,079,958 Rupiah (2009)	51,608,010 Rupiah (2008)
Available Public Transport Modes		Bus Motorized two-wheelers	Bus Minibus BRT Shared taxi LRT/MRT Subways	Bus Minibus Shared taxi Intra-city railways Inter-city railways	Bus BRT Shared taxi	Bus Minibus BRT Shared taxi Intra-city railways Inter-city railways Motorized two wheelers Bicycles Taxi Bajai (3-wheeler) Bemo (bus)	Bus Minibus Intra-city railways Inter-city railways Motored two wheelers Taxi Angguna (taxi truck)

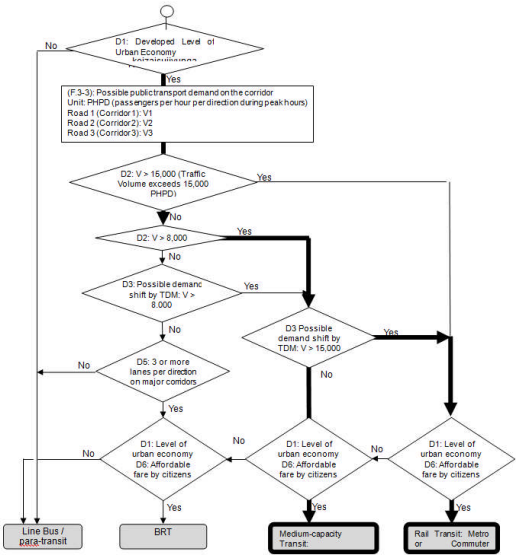
Table 4.19 Comparison of Flow Chart Judgments and Master Plan Proposals

	Country / City	Vietnam		India		Indonesia	
		Ha Noi	Ho Chi Minh	Hyderabad	Pune	Jakarta	Surabaya
(I) Judgment on a basic public transport mode	Agreement*	□ transport corridor is different	□	□	□	□	□
	Study Team Proposal	Medium capacity transit: Monorail or AGT Or, Metro or commuter railways	Metro or commuter railways	Metro or commuter railways	Metro or commuter railways	Metro and BRT	Medium capacity transit: Monorail or AGT
	Master Plan Proposal	Metro and BRT	Metro and BRT	Metro and existing commuter railways	Short to Medium Term: BRT and monorail Long Term: Metro and monorail	Upgrading of existing intra-city railways	Commuter trains by modernizing existing railways
(II) Judgment on a railway transit	Agreement*	□	□	□	□	□	□
	Study Team Proposal	Consideration with due caution	Worth consideration	Worth consideration	Worth consideration	Worth consideration	Consideration with due caution
	Master Plan Proposal	Introduction proposed	Introduction proposed	Expected to be proposed in the master plan now under preparation	Monorail and Metro proposed for the medium to long term	Through trains proposed to connect two existing railway lines	Commuter trains by modernizing existing railways
(III) Judgment on a BRT system	Agreement*	□	□	△	□	×	□
	Study Team Proposal	Worth consideration as component of Metro network	Worth consideration	Worth consideration as component of Metro network	Worth consideration	Worth consideration as component of Metro network	Worth consideration
	Master Plan Proposal	Introduction proposed	Introduction proposed	No sign of preparation	BRT NW proposed as short-term project	Extension proposed	Two BRT routes proposed
(IV) Judgment on feasible TDM measures	Agreement*	△	△	―	△	△	―
	Study Team Proposal	Demand dispersal and efficiency improvement of road space use are worth consideration	Demand dispersal and demand suppression are worth consideration	Demand dispersal is worth consideration	Demand dispersal is worth consideration	Demand dispersal and efficiency improvement of road space use are worth consideration	Too early to introduce TDM
	Master Plan Proposals	Some measures proposed on automobile ownerships	Traffic management system and concomitant institutional development	No mention of TDM	Development of parking space and charging of roadside parking	Road pricing proposed	No specific proposal
(V) Judgment on urban highways	Agreement*	×	□	―	―	□	×
	Study Team Proposal	Too early to consider	Worth consideration	Worth consideration	Too early to consider	Worth consideration	Too early to consider
	Master Plan Proposal	No proposal	Radial urban highways proposed	Outer ring road under construction, no mention of its extension plan	Not included in the plan	2nd outer ring road proposed	3 toll roads proposed
(xxiv) onsulted Master Plans	Title	Comprehensive Urban Development Plan Study in Ha Noi (HAIDEP)	Urban Transport Planning Study in Ho Chi Minh (HOUTRANS)		Comprehensive Mobility Plan for Pune City	Comprehensive Transport Planning Study in Metropolitan Jakarta (SITRAMP2)	Regional Development Planning Study in Metropolitan Surabaya
	Year of Study	2009	2004		2008	2004	2011
	Organizer	JICA	JICA		Pune Municipal Corporation	JICA	JICA

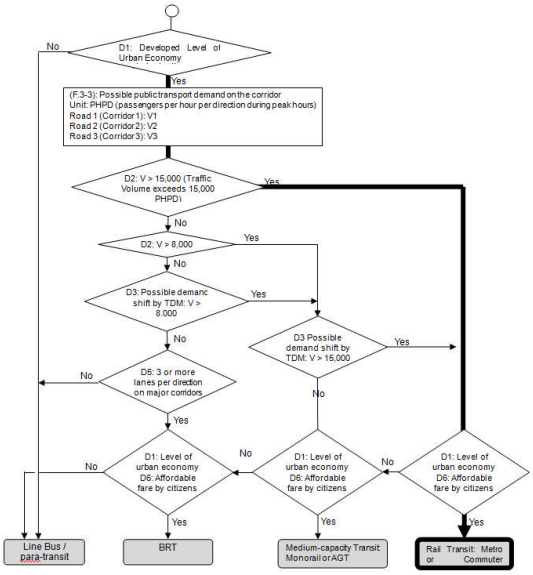
Note: □ not much different from the master plan proposal; △ different in some part; × no congruity with MP;
― not possible to judge

(1) Six Cities: Judgments about Suitable Public Transport Mode

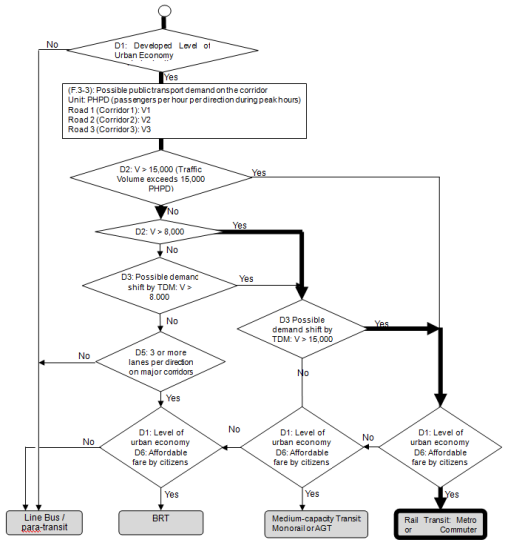
Hanoi



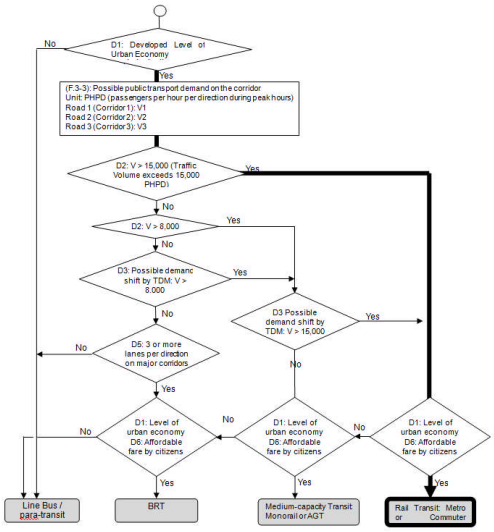
HCMC



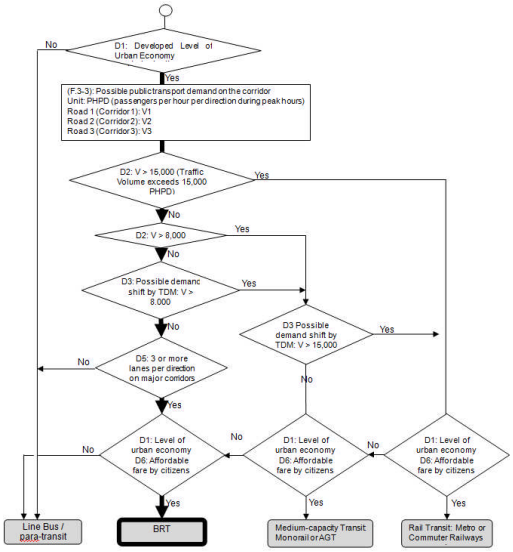
Hyderabad



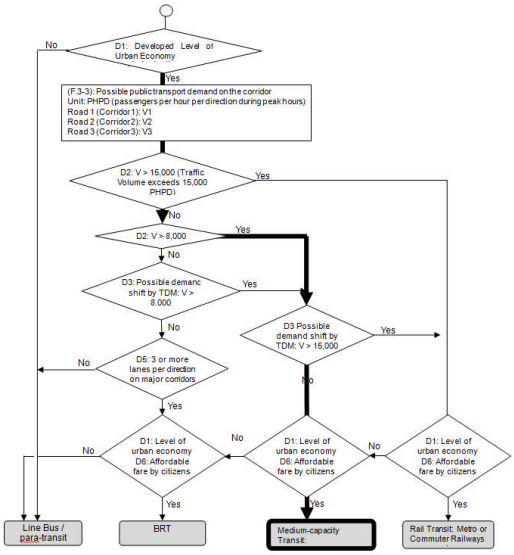
Pune



Jakarta

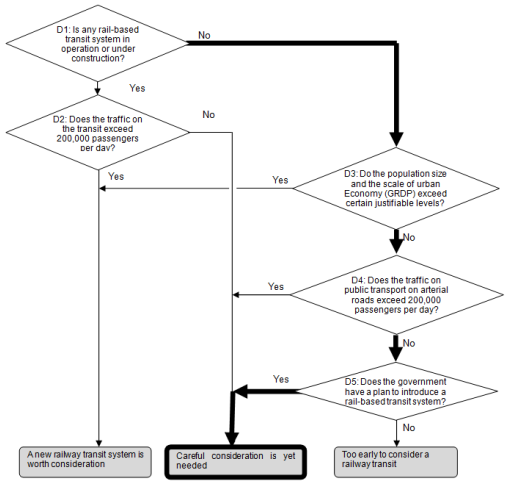


Surabaya

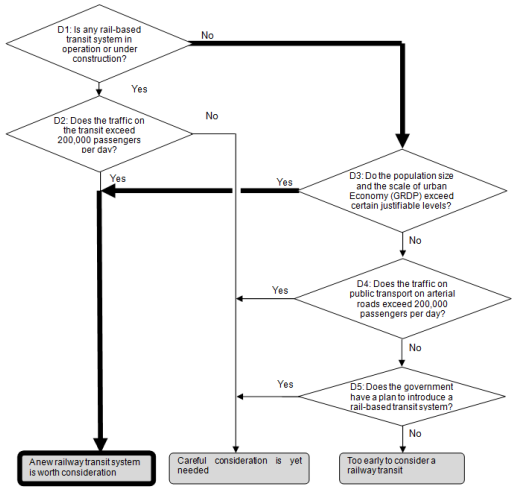


(2) Six Cities: Judgments about Railway Transit

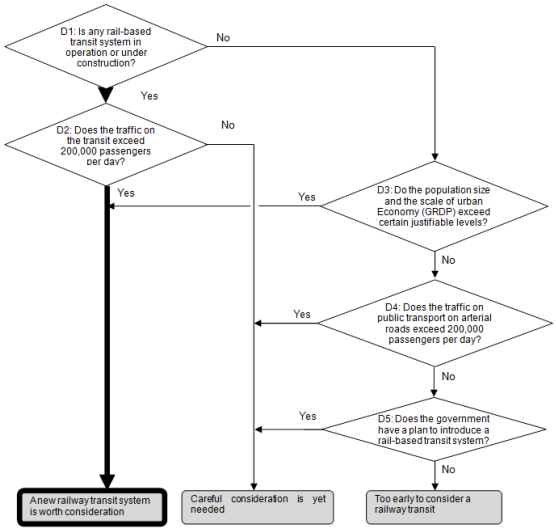
Hanoi



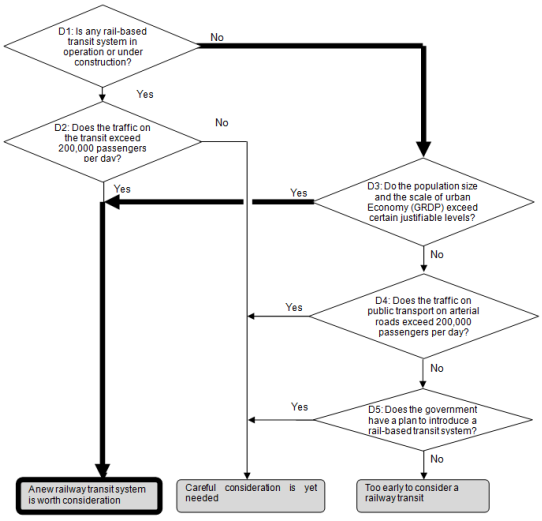
HCMC



Hyderabad



Pune



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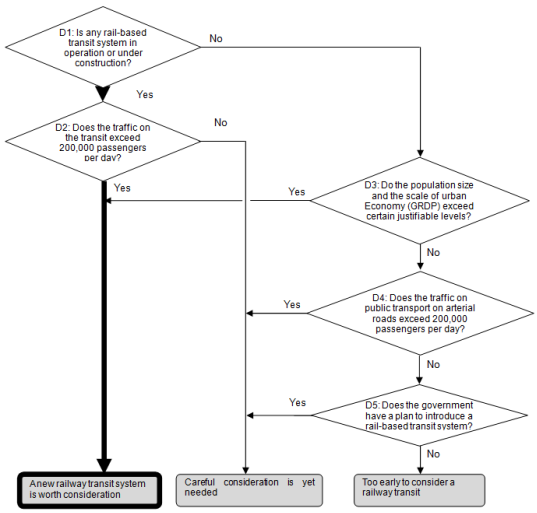
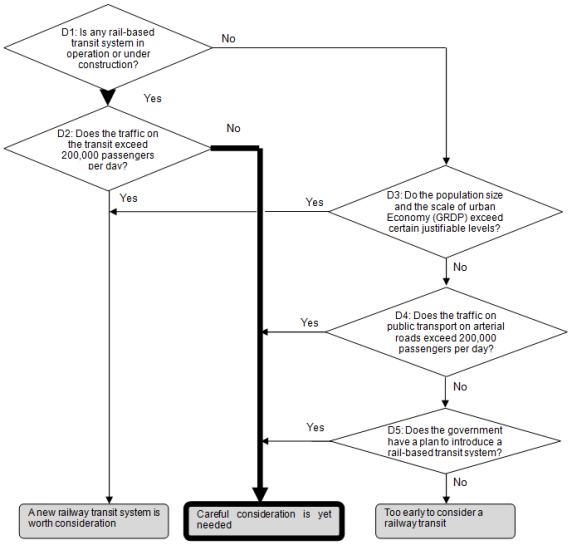
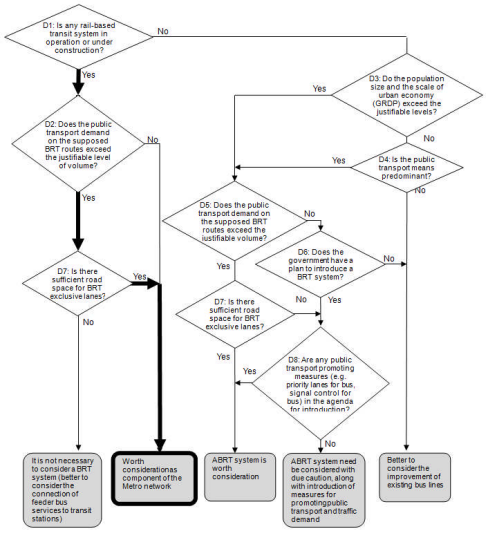


Surabaya



(3) Six Cities: Judgments about BRT System

Hanoi



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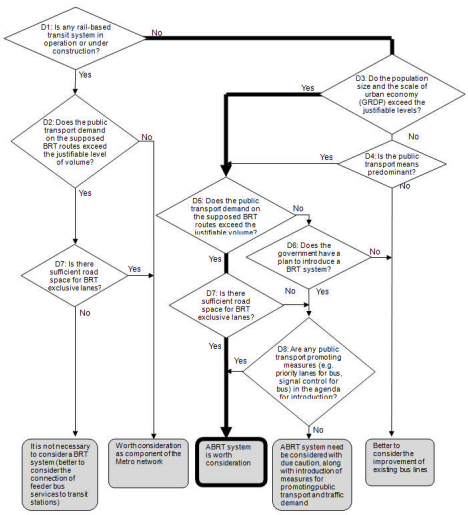
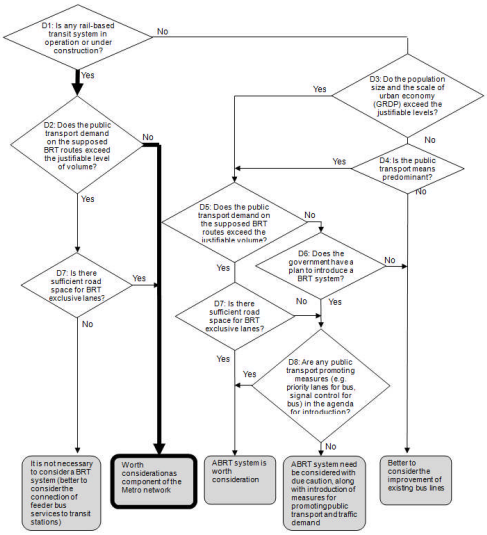
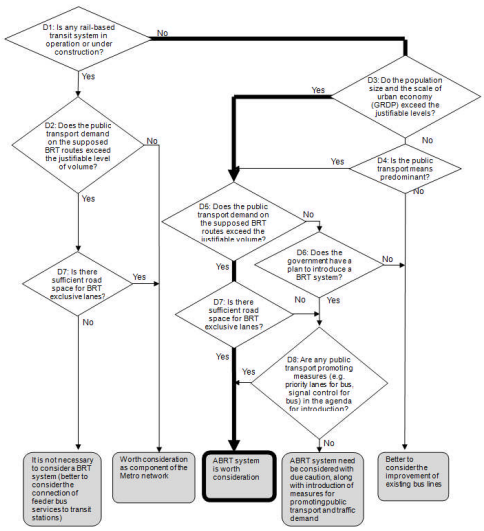


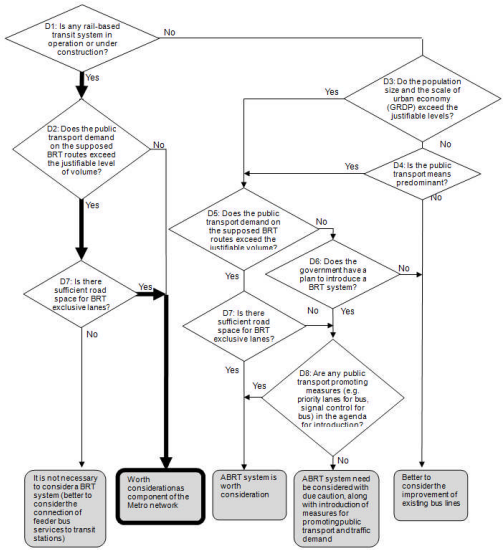
Hyderabad



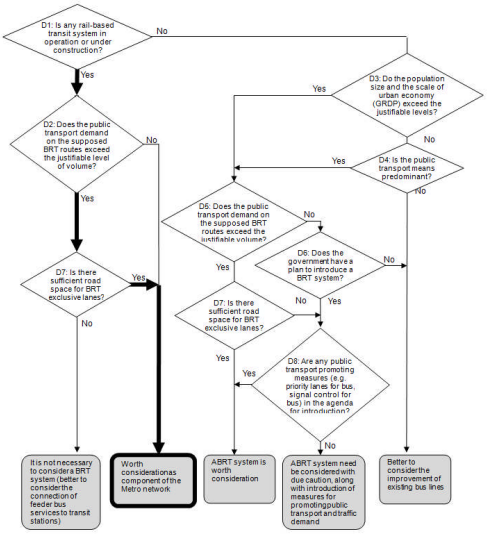
Pune



Jakarta

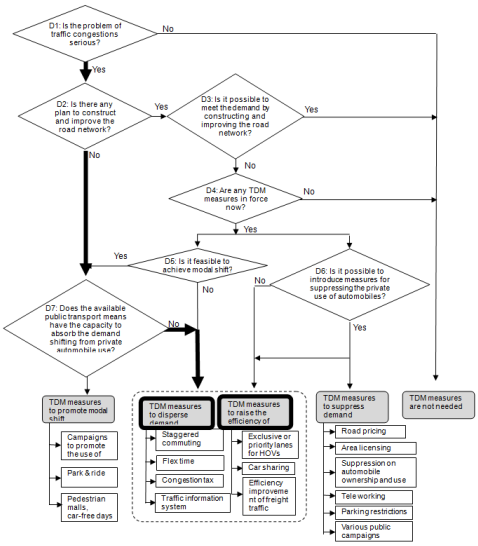


Surabaya



(4) Six Cities: Judgments about TDM Measures

Hanoi



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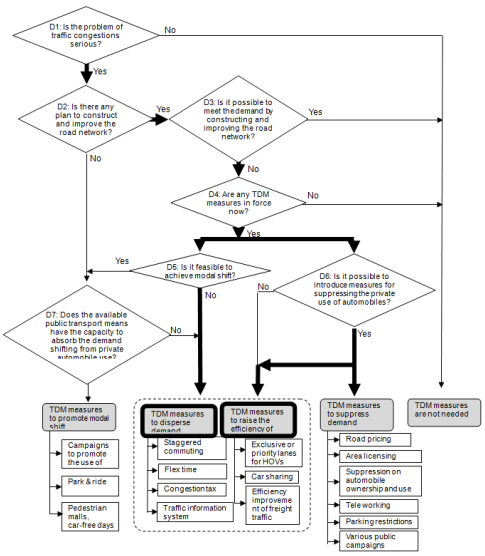
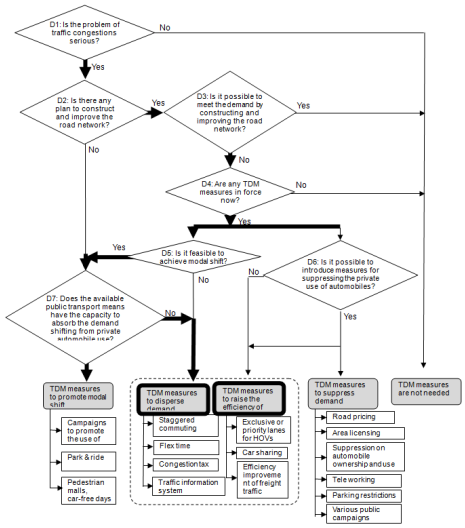


Hyderabad



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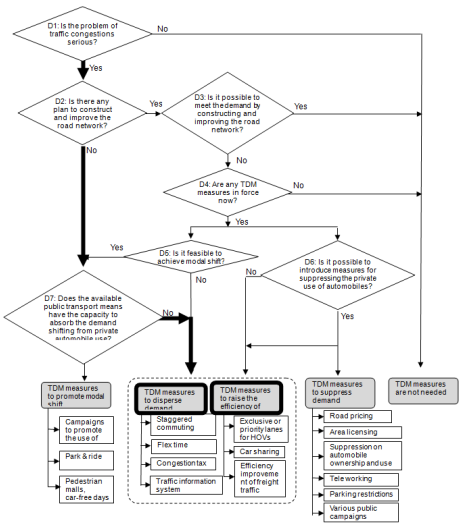

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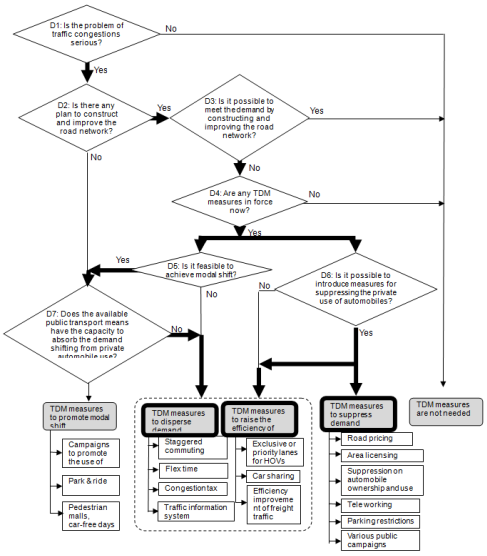

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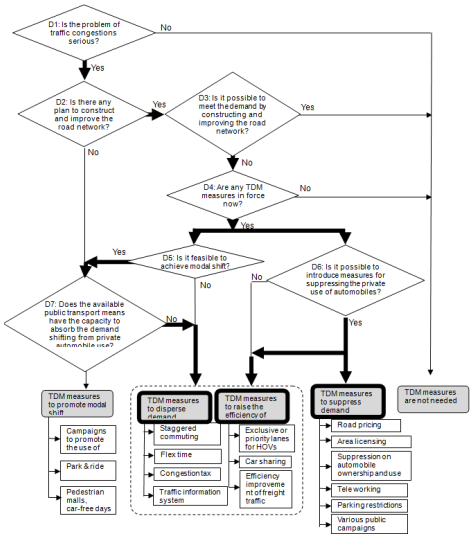
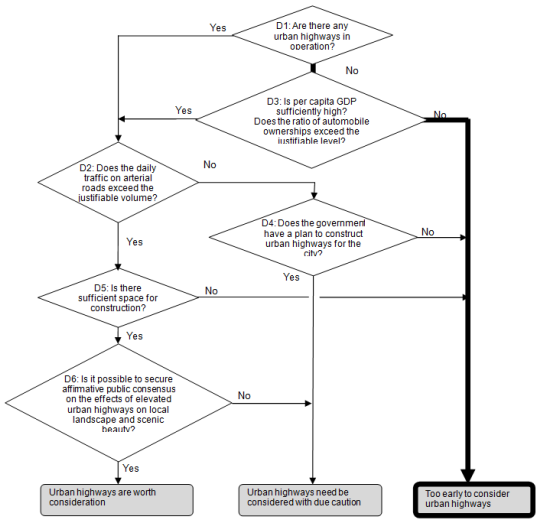


(5) Six Cities: Judgments about Urban Highways

Hanoi



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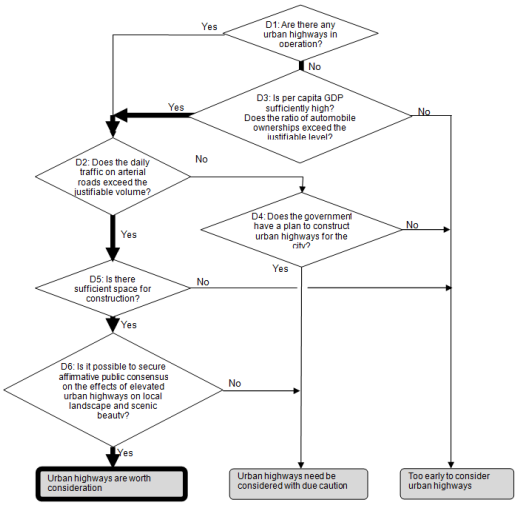
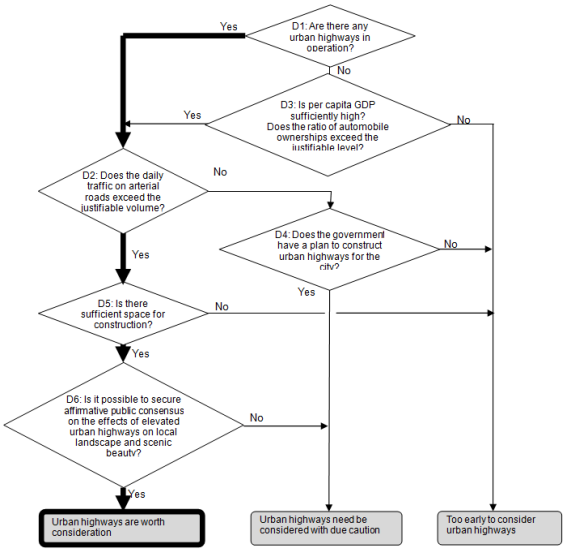
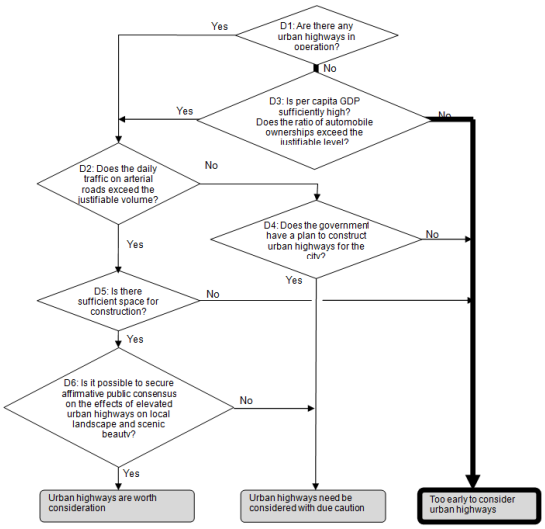


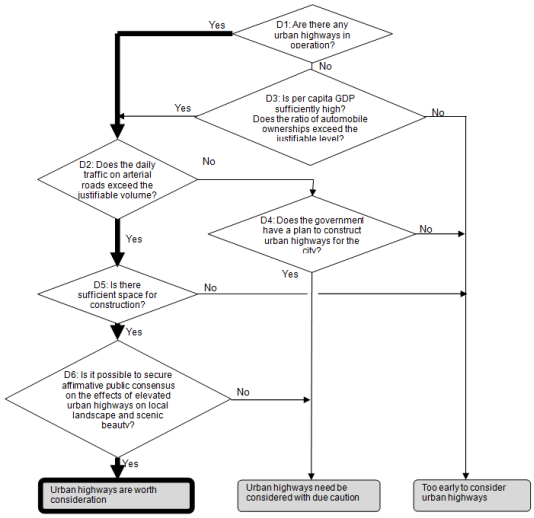
Hyderabad



Pune



Jakarta



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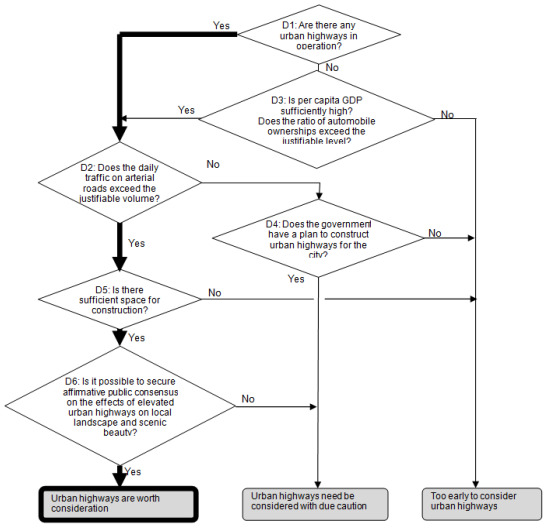


4.5 How to Utilize the Proposed Guidelines

1) Application to JICA Technical Cooperation Program

Once the matrix methodology of diagnosis and prescription on urban transport problems and the procedures for making medium- to long-term strategic decisions are devised and verified reasonably practicable, the next step would be to ask how the devised guidelines could be put to best possible use, or what could be achieved now by the application of the guidelines. This section argues from the viewpoint of donors a logical extension that the guidelines could point to the possible courses for technical cooperation.

The results from matrix diagnoses and prescriptions and the strategic selections along the flow charts can be usefully combined to differentiate the types of technical cooperation.

To paraphrase, the relative importance of urban transport problems is defined, as discussed earlier in Section 4.2, as the product of the seriousness of an individual problem and the effectiveness of contribution a prescribed measure makes towards the solution of the problem. Therefore, the effectiveness of the same prescribed measure varies from one city to another where the seriousness of the problem is different. As shown in Tables 4.8 and 4.9, the relative importance of each prescribed measure is aggregated to see the relative importance of each subsector (The method for rating points and calculating the ratios of the rated points to the maximum points is already explained in Subsection 4) of Section 4.2). By comparing the ratios of the rated points about the respective subsectors between the cities, it is possible to distinguish different patterns of subsectoral priorities among them. Table 4.20 distinguishes four different types of cities by the relative importance of subsectoral priorities in urban transport development. Typological differences are visually clear in the radar charts of Figure 4.13. The all-round type has high ratios of relative importance in all six subsectors, whereas the road-oriented type shows high priorities in three subsectors of road infrastructure, road traffic management and traffic safety. The other two types also show high ratios in the relevant subsectors. (Ratios in the table are somewhat exaggerated to emphasize the differences among the types.)

For a city of all-round type, it would be most suitable to conduct a master plan study that covers the entire subsectors. If such a master plan study has been undertaken for the said city in the recent past, it would be necessary to follow up the progress of the program proposed by the study. And if some delays should be found, it would be necessary to take some actions, e.g. updating the program components and scheduling, to expedite the progress of implementation. In such a case, it would be necessary as well to add alternative financing sources in the updated program, by proposing organizational and institutional development such as some scheme for private sector participation or application of some user-pay principle.

Cities of the other types would need subsector-specific studies for plan formulation. A city of road-oriented type, for example, would require a plan that covers not only physical road infrastructure but proposes appropriate projects and measures for road traffic management and safety along with the construction and improvement of roads.

If the application of the guidelines to a city of transit-oriented type indicates some justifiable degree of feasibility on a metro or BRT system, it might be better to conduct a full-scale feasibility study without going through subsector-wide plan formulation. In a similar vein, if the introduction of urban highways is justifiably indicated for a city of road-oriented type, it would be reasonable to conduct a feasibility study with due consideration of a PPP scheme for private sector participation.

There are few successful cases of full-scale traffic management in the cities of developing countries. Partly because of this, practically no subsector study of TDM orientation has been undertaken so far. However, it would be reasonably justified to formulate a TDM plan which would propose a selection of measures for inducing traffic demand towards the anticipated operation of a BRT or metro system.

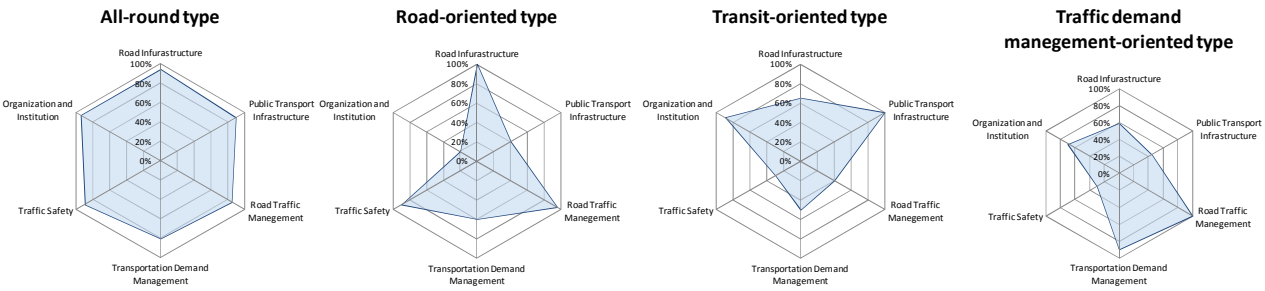
Although the case study in this section could make use of more detailed data than the typological analysis of cities in Chapter 2, it is undeniable that the availability of necessary information is still too limited to apply the guidelines properly. It must be admitted that the present study managed to present the foregoing fruits of endeavor by overdoing somewhat arbitrary simplification of data handling and analytical interpretation. It must be reiterated however that the primary purpose of the guidelines is to devise a compact and simple format to judge whether or not to accept the transport-related requests for technical cooperation from developing countries. In addition, the guidelines could be readily put to use when a project preparation study is conducted prior to the requested full-scale study project. The validity of transport projects and measures that are affirmatively judged by the application of the guidelines must be examined and reexamined closely during the subsequent process of study undertaking. Proposals on financing arrangement and concomitant institutional development also need be elaborated to suit the conditions of the city where the study is to be undertaken.

Table 4.20 Four Types of Subsectoral Importance in Transport Development

(unit: %)

	All -round Type	Road-oriented Type	Transit-oriented Type	TDM-orientated Type
Road Infrastructure	95	100	65	60
Public Transport Infrastructure	90	40	100	45
Road Traffic Management	85	95	40	100
Traffic Demand Management	80	60	50	90
Traffic Safety	90	90	30	30
Organization / Institution	95	20	90	70

Figure 4.13 Radar Patterns of Relative Subsectoral Importance of Transport Development



2) Useful Application in Other Types of JICA Projects

(1) Urgent Issues and Long-term Strategy

To recapitulate, the matrix format of diagnosis and prescription is explained and applied in Section 4.3 and the flow chart procedures for strategic judgments are described and applied in Section 4.4. The matrix and the flow chart methods are both developed out of the analyses in Chapters 2 and 3 and two of the important outputs of the present study. The matrix method is applied to manifested urban problems in a given city and helps ascertain the relative importance of the respectively prescribed measures.

The flow chart method is applied to identify a basic public transport mode for a given city. In other words, it deals with key issues in any long-term strategy for urban transport development: viz. how to select a most suitable alternative from the costly large-scale projects like a railway transit, a BRT system and/or urban highways and how to decide on a selection of TDM measures best suited or most acceptable to the conditions in a given city. The combined application of two methods will help identify urgent issues and see through the future course of medium- to long-term strategic issues.

(2) Quick Processing of Transport-related Requests from Developing Countries

With the aid of the guidelines, it is possible to judge quickly whether or not to accept the official requests for a study project on urban transport development.

(3) Checklist for Preliminary Studies

Preliminary studies not only on urban transportation but also on any other sectors and subsectors must collect many relevant data and information within a short time limit. The urban data sheet and the interview sheet prepared by the present study could be used as a manual for collecting data and interviewing experts. Moreover, the matrix method is useable as a checklist for collecting data on urban transport conditions.

(4) Application of the Guidelines in Master Plan Studies

The analytical findings and the devised methods of the present study could be usefully consulted during the early stage of a JICA master plan study on urban transport. The review of sixty some JICA master plan studies conducted in the past would give insightful hints to a team about to embark on a similar study on urban transportation.

(5) Guidelines as Materials for Training

JICA has a sizable training program for capacity development in diverse fields. The matrix method and the flow chart method could be used as exercise materials for group seminars on urban transportation issues or for the counterpart training during the implementation of a JICA urban transport study project. When the two methods are applied in exercise to the actual city the trainees live or know at first hand, the outcome of training would be substantial in impact.

3) Next Steps

The present study has developed three tools to deal with urban transport development: namely, the tool to diagnose problems and subsectoral priorities, the tool to prescribe appropriate measures to solve or alleviate the problems, and lastly the tool to select a most strategically suitable alternative for transport development. The tools are simple and compact in design to provide quickly whatever answers they are meant to provide, but there is no denying that the logic employed in the process of devising these tools is sometimes too crude to stand up to well-intentioned scrutiny. It will be necessary to improve their designs and raise their practicability. The following efforts will be needed for future improvements.

(1) Diagnosis

Individual urban transport problems are rated to three ranks of “very serious”, “serious” and “not serious.” However, the present study failed to provide a clear definition of what constitutes the seriousness or the lack thereof. The individual transport problems themselves are heavily dependent on the subjective judgment on what is “problematic.” To introduce the element of objectivity into such judgments, there are possibly two courses to take as shown below.

- It is possible to define three ranks in quantitative terms for certain types of transport problems.
- Each individual problem is broke down to 5 to 10 descriptions of its concrete manifestations, and the rating into one of three ranks is done by counting the number of descriptions judged serious.

(2) Prescription

The elements (= cells in the matrix) of prescriptions as per problems are rated for their respective effectiveness by taking into consideration the possible size of investment requirements and the possible size of passengers who are either affected by or benefit from a given prescription, but it must be admitted that the large part of the rating is philosophical. It might be necessary to accumulate case studies to improve the rating towards a more tangible approach.

It would be useful to determine the average unit cost for each prescribed project or measure. Then, the total cost of a project or measure prescribed for a given city can be obtained by an input of the required scale of investment.

(3) Strategic Judgment

The flow charts for making strategic judgments are extremely simplified. Inadequacies will become immediately apparent when they are applied to a real city. Paths for judgment will have to be increased in the flow charts to ensure more general applicability.

The tools devised by the present study, however simple and compact both in design and original intention, must be continuously modified by feeding back the inadequacies found during the repeated application trials, just like all-purpose computer programs or any types of manuals.

Figure 4.14 Diagnosis of Urban Transportation Problems in Cities Worldwide (1/2)

Note: To come up with these figures, trainees from various countries evaluated their own cities by using the Checklist for Urban Transportation Diagnosis in the Comprehensive Urban Transportation Planning and Project by JICA in October 2011.

Figure4.14 Diagnosis of Urban Transportation Problems in Cities Worldwide (2/2)

Figure 4.15 Prescriptions of Urban Transportation Problems in Cities Worldwide (1/2)

Note: To come up with these figures, trainees from various countries evaluated their own cities by using the Checklist for Urban Transportation Diagnosis in the Comprehensive Urban Transportation Planning and Project by JICA in October 2011.

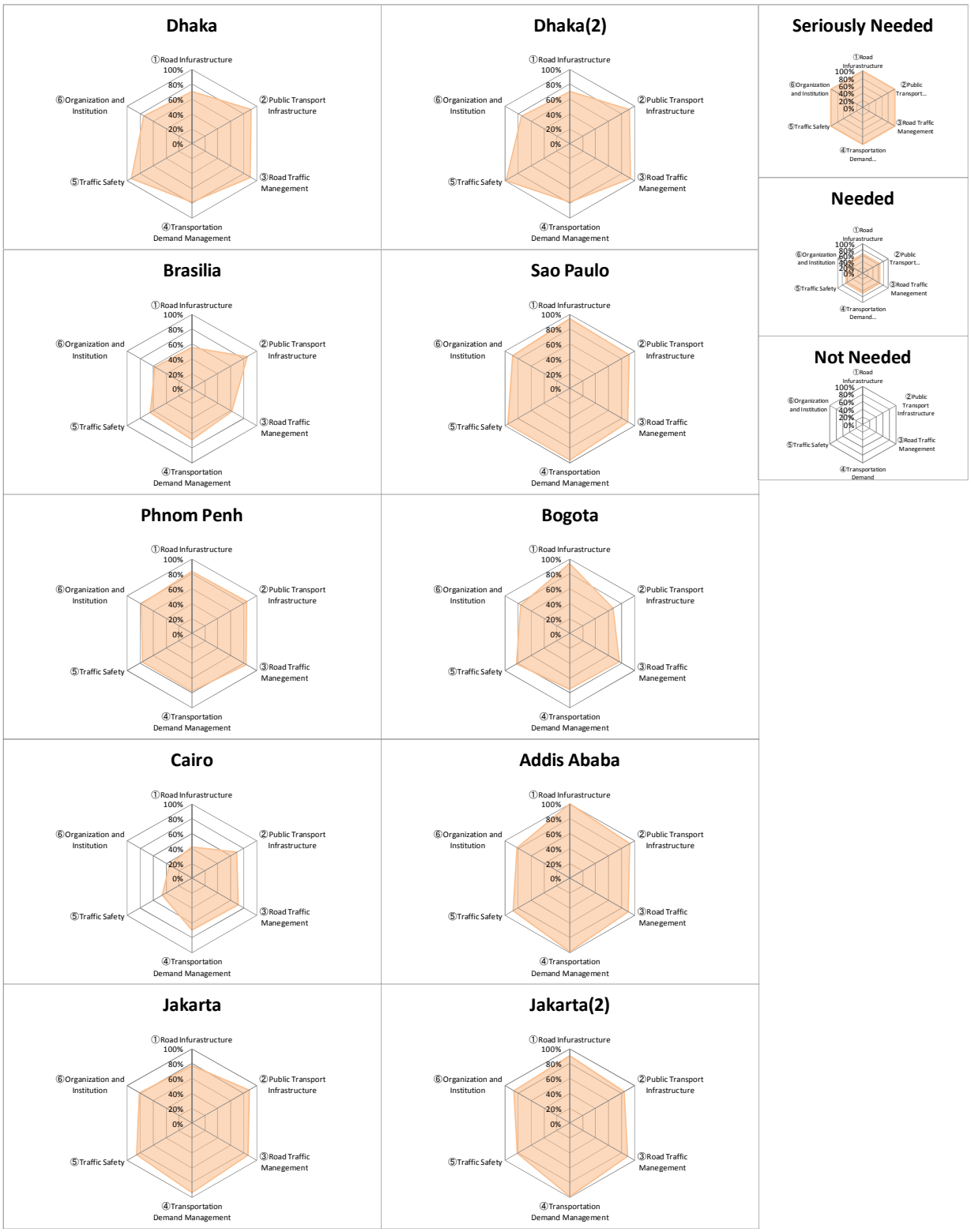


Figure4.15 Prescriptions of Urban Transportation Problems in Cities Worldwide (2/2)