The Federative Republic of Brazil

Rio de Janeiro State Secretariat of Transportation - SETRANS Rio
Rio de Janeiro Municipal Secretariat of Transportation – SMTRio
Federal District Secretariat of Transportation - SETRANS-DF
Traffic Department of Federal District - DETRAN DF

Study On
The Introduction of Intelligent Transport Systems
In The Federative Republic of Brazil

FINAL REPORT

June, 2013

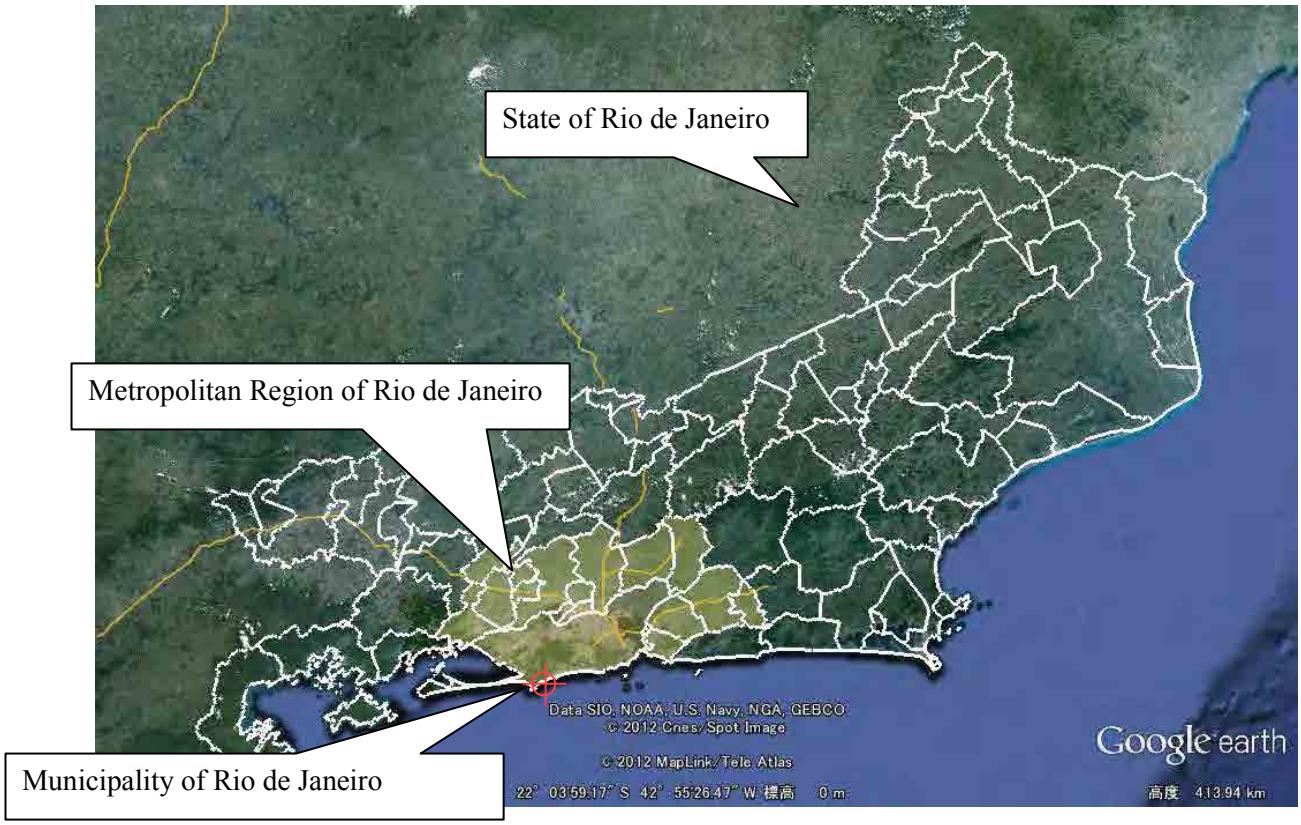
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NIPPON KOEI CO., LTD.
NIPPON KOEI LATIN AMERICA - CARIBBEAN Co., Ltd.

LOCATION MAP

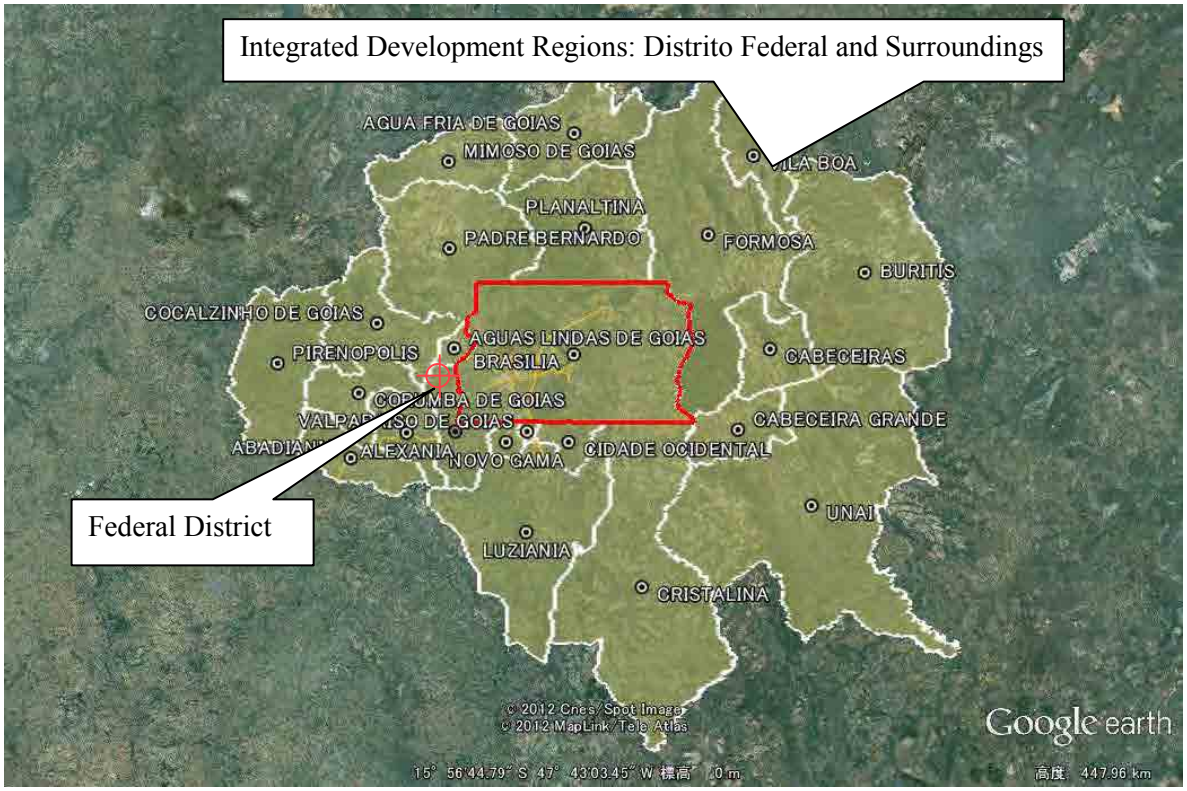
Source: Open Street Map

Location Map of the Study Area 1 - Entire Brazil



Source: JICA Study Team

Location Map of the Study Area 2 - Rio de Janeiro



Source: JICA Study Team

Location Map of the Study Area 3 - Federal District

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ABBREVIATIONS

Abbreviations	Long Title
ABC	Agência Brasileira de Cooperação
BRT	Bus Rapid Transit
CCTV	Closed Circuit Television
CET-Rio	Companhia de Engenharia de Tráfego
CO2	Carbon Dioxide
DENATRAN	Departamento Nacional de Trânsito
DER DF	Departamento de Estrada de Rodagem do Distrito Federal
DETRAN	Departamento Estadual de Trânsito
DFTRANS	Transporte Urbano do Distrito Federal
DF	Distrito Federal
DF/R	Draft Final Report
DSRC	Dedicated Short Range Communication
ETC	Electronic Toll Collection
F/R	Final Report
FETRANPOR	Federation of the Companies of Transports of Passengers of the State of Rio de Janeiro
FIFA	Federation Internationale de Football Association
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile communications
IBGE	Instituto Brasileiro de Geografia e Estatstica
IC/R	Inception Report
ISO	International Organization for Standardization
IT/R	Interim Report
ITACA	Intelligent Traffic Adaptive Control Area
ITS	Intelligent Transportation Systems
JCC	Joint Coordination Committee
JICA	Japan International Cooperation Agency
METRO DF	Companhia do Metropolitano do Distrito Federal
O&M	Operation and Maintenance
OCR	Optical Character Reader
PAC	Programa de Aceleração do Crescimento
PC	Personal Computer

PCU	Passenger Car Unit
PDTU	Plano Diretor de Transporte Urbano e Mobilidade do Distrito Federal e Entorno.
RFID	Radio Frequency Identification
RJ	Rio De Janeiro
RMRJ	Região Metropolitana do Rio de Janeiro
SETRANS	Rio de Janeiro Seretaria de Estado de Transportes
SIMRAV	Sitema Integrado de Monitoramento e Registo Automatico de Vehiculos
SINIAV	Sistema Nacional de Identificacao Automatica de Vehiculos
SMTR	Secretaria Municipal de Transportes
TOR	Terms of Reference
VMS	Variable Message Sign

CHAPTER 1 INTRODUCTION

1.1 STUDY BACK GROUND

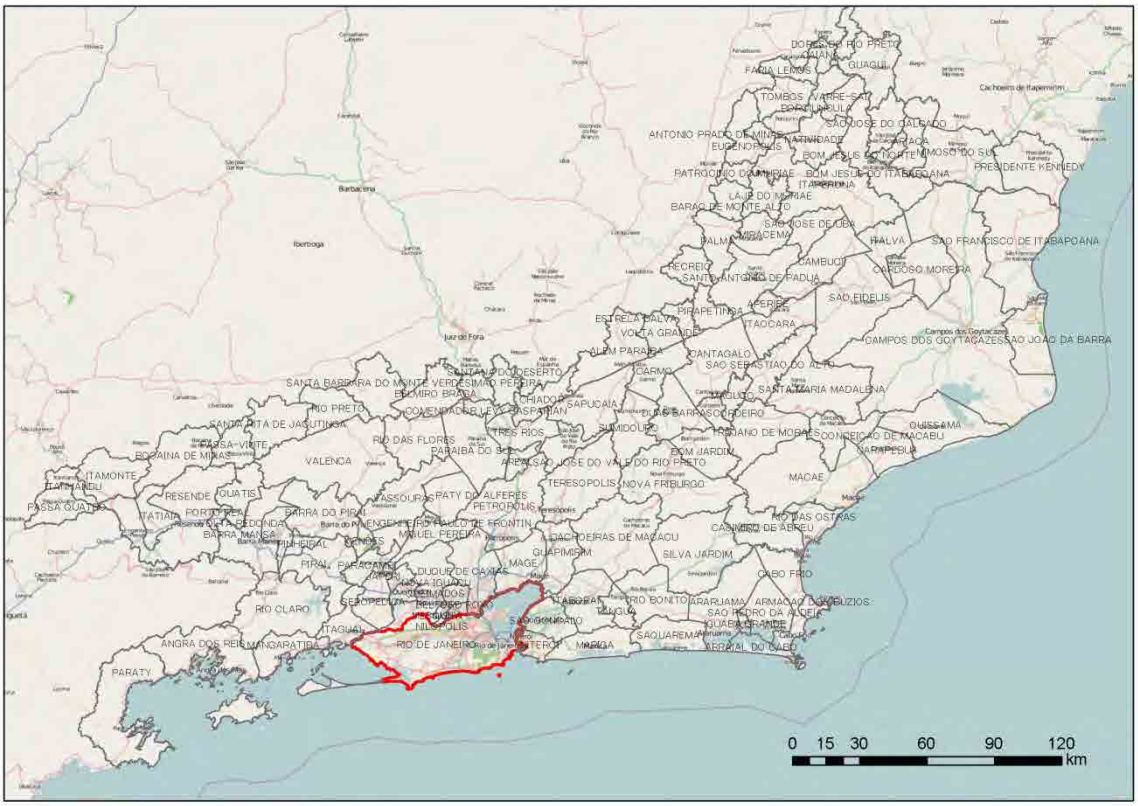
Brazil, as its stable and healthy economic development, shows GDP growth rate at 7.5% in 2010. After Lehman's fall, Brazilian economy quickly recovered by their strong economic potentials such as high domestic consumption, various types of export industries, vast agricultural land and abundant natural resources. Brazil is not only agricultural country but also industrial country as typified by small jet industry which is the highest ranked in the world and has full-set industrial base.

Gracing at transportation figures, the domestic sales of new cars in 2011 is over 3.4 million, and it's ranked at No. 4 in the world, next to Japan. The rapid growth of number of vehicles is one of the major causes of the serious congestion in the major cities in Brazil.

Brazilian government is urgently developing city and transportation infrastructure for upcoming well-known international events such as FIFA World Cup at 12 Brazilian cities in 2014 and Olympic Games in 2016 at Rio de Janeiro. Rio de Janeiro, the second largest city in Brazil, has 11 million population in the metropolitan area and 6 million in the city. They are now preparing for these two big events. The mass-transit network such as subway and bus are already well developed .However the traffic congestion becomes quite serious during the rush hour in the morning and evening, which is known as social problem. Thus, it's not enough to accommodate all traffic/transport demand. In addition, frequent flood occurs in recent years due to the weakness of infrastructure. Hence, proper information management and provision to the users is urgently needed to achieve risk and crisis management, together with overcoming the weakness of existing infrastructure.

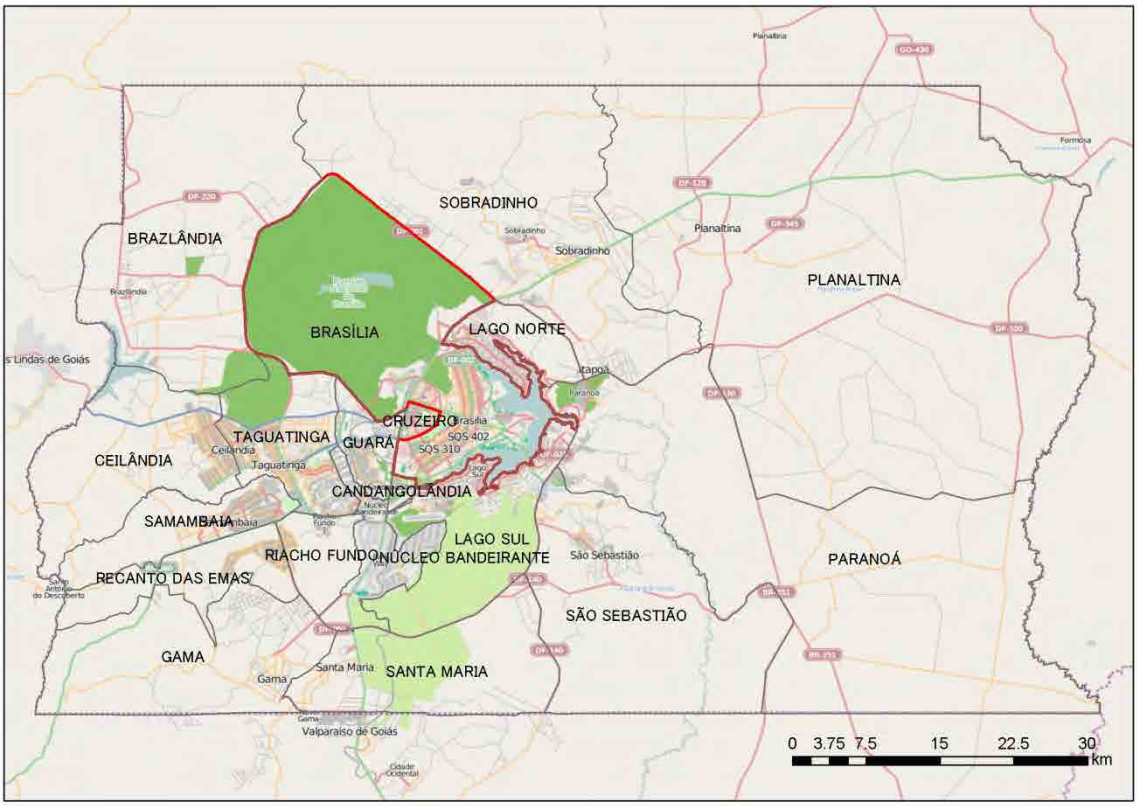
1.2 OBJECT AND STUDY AREA

The objective of the study is to assist the Rio De Janeiro Metropolitan Area and Federal District to improve and modernize the traffic and transportation system in each city by applying ITS, through formulating a Master Plan for ITS development and prioritizing ITS projects in Rio De Janeiro Metropolitan Area that could be implemented in a phased manner and assist for preliminary design for the Short Term Plan. The study area is shown in Figure 1-1 and Figure 1-2.



Source: JICA Study Team

Figure 1-1 Location Map of the Study Area (Rio de Janeiro)



Source: JICA Study Team

Figure 1-2 Location Map of the Study Area (Federal District)

1.3 SCOPE OF WORKS

The five technical approaches are set out in order to fulfill the objectives of the study.

Approach1: ***Preparation of ITS Master Plan Based on ITS Architecture***
Approach2: ***ITS Study Based on Brazilian- Japanese Technology Exchange***
Approach3: ***Study for Disaster-Related ITS***
Approach4: ***Study on Short Term ITS Menus***
Approach5: ***Area-Wise Traffic/Transportation Analysis and Evaluation of ITS Menus***

[Approach1]: Preparation of ITS Master Plan Based on ITS Architecture

The scope of the Study, according to the TOR, is i) Formulation of ITS Master Plan in the Rio De Janeiro Metropolitan Area, ii) Preliminary Design for Short Term Plan iii) Formulation of Preliminary ITS Master Plan in Federal District. However the ITS Master Plan covers the area ITS which are consisted of the different systems operated by a number of different agencies, and some ITS facilities are already installed or under planning. Therefore it is important to organize a basic framework to assure a consistency of the entire system and efficiency for future expansion. In order to secure this, the ITS architecture for the Rio De Janeiro metropolitan area will be prepared for the basic framework for the Master Plan.

[Approach 2]: ITS Study Based on Brazilian- Japanese Technology Exchange

Brazil has introduced Japanese system as their terrestrial digital broadcasting. Comparing with the analog broadcasting, the terrestrial digital broadcasting can deal with not only high quality video and sounds but also data broadcasting. It is also compatible for information provision to moving object. Therefore, if the devices compatible with the terrestrial digital broadcasting grow popular, more value added information can be provided.

Regarding this, the study team will investigate the possibility to utilize the technological feature of the terrestrial digital broadcasting between both countries.

[Approach 3]: Study for Disaster-Related ITS

The study team will carry out study for disaster-related ITS, particularly in regard of the background of the establishment of the information integration center. The interview survey will also be conducted to find out the current operation procedures to propose and formulate the disaster-related ITS menus. The figure below shows that question items of interview.

[Approach 4]: Study on Short Term ITS Menus

It is necessary to promptly study on ITS menus for upcoming large scale event. The study team will commence study on ITS menus as Short Term Plan in early terms. The cutting edge technology shall be utilized for the Short Term Plan to reduce traffic congestion and provide the essential information. ITS menus as Short Term Plan and these menus also could be converted the upcoming large scale events which are based on three perspectives;

1. Real-Time Congestion Monitoring,
2. Enhancement of Effectiveness of Mass-Transit and
3. Direct and Dynamic Information Provision to Large Scale Event Participant.

[Approach 5]: Examination of Hourly Traffic Condition in Whole Metropolitan Area and Evaluation on the Effect of ITS Menus

(1) Traffic survey for the evaluation on the effect of ITS menus

It is necessary to understand hourly traffic condition in the whole metropolitan area and traffic problems in order to formulate ITS master plan. In this study, the traffic survey will be conducted for the evaluation on the effect of ITS menus.

The study result on present and future traffic conditions conducted by the past studies will be referred. In Addition, it is considered to use the data provided by CCTV which is developed in the metropolitan region and provided by the transportation operators.

(2) Traffic study for the evaluation on the effect of ITS master plan

The aim of ITS menus is to alleviate the traffic congestion in urban areas. For example, “Electric Tall Collection” on expressways, “Traffic Information” and “Intelligent Traffic Signal Control”, “Increasing the Convenience of Public Transport such as Bus Location System” and “Congestion Charge” on ordinary roads are possible. These menus are effect for hourly traffic, not daily traffic.

It is necessary to estimate hourly traffic flow in order to evaluate the effect of ITS menus implemented. Therefore, estimating traffic volume, examining traffic problems and evaluating the effect of ITS menus will be conducted at “Macro Level”, ”Micro Level” and ”Meso Level,” which is the intermediate scale level between “Macro” and ”Meso.”

(3) Traffic study for the evaluation on the effect of ITS menus in large-scale event

The target year of traffic demand forecast and the point of view of traffic study is determined, considering the large-scale events in the future in Rio de Janeiro.

<Large-scale events in Rio de Janeiro>

⇩

2012 - United Nations Conference on Sustainable Development
2014 - FIFA World Cup
2016 - Olympic Games

1.4 SCHEDULE OF THE STUDY AND PROGRESS

The entire work period of this Study is approximately 12 months beginning with the preparatory work at the beginning of July 2012, and completing with the submission of the final report in the middle of May 2013, as shown below.

The Study is divided into two stages with the following objectives:

Phase-1: Formulation of ITS Master Plan for Rio de Janeiro

Phase-2: Preparation of Preliminary Design for Short Term Plan for Rio de Janeiro and Preliminary ITS Master Plan for Federal District

The workshop will be held at the following period:

1st Seminar: At the end of Formulation of Draft ITS Master Plan for Rio de Janeiro

2nd Seminar: At the end of Preparation of Preliminary Design for Short Term Plan for Rio de Janeiro and Preliminary ITS Master Plan for Federal District

Table 1-1 Phase of the Study

Items	2012							2013					
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Study Phase													
1.ITS Master Plan Formulation for RJ													
2.Preliminary ITS Master Plan for DF													
3.Preliminary Design for Short Term Plan													
Report Submission		▽ IC/R					▽ IT/R			DF/R	▽	▽	F/R
Training							▲						
Seminar						▼1st					▼ 2nd		

Source: JICA Study Team

Counterparts of this project are below;

-SETRANS Rio (Coordinator: Mr. Henrique Futuro)

-SMTR (Coordinator: Mr. Alberto Nygaard)

-SETRANS DF (Coordinator: Mr. Umberto Menezes)

-DETRAN DF (Coordinator: Ms. Yara Geraldini)

CHAPTER 2 CLARIFICATION OF CURRENT INTELLIGENT TRANSPORT SYSTEMS CONDITION IN RIO DE JANEIRO

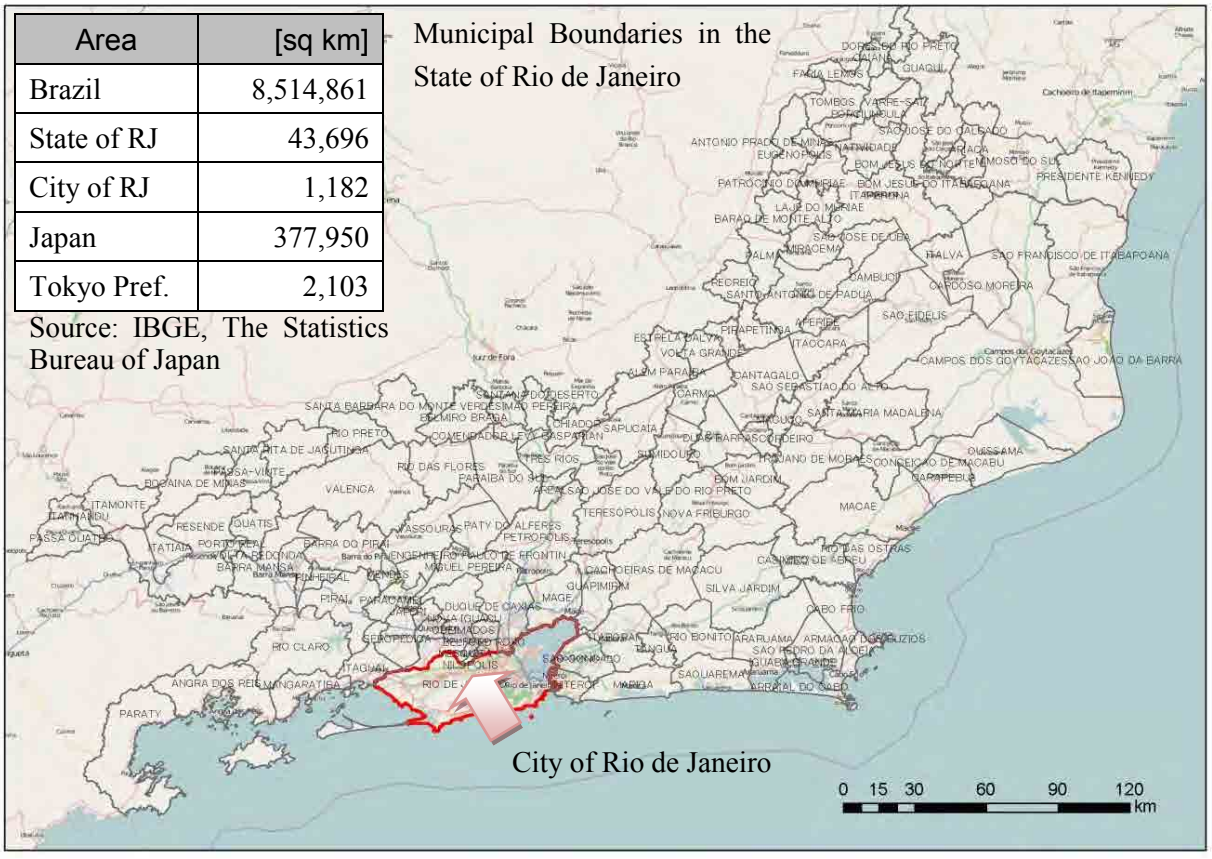
2.1 REGIONAL CHARACTERISTICS OF RIO DE JANEIRO

2.1.1 Administration

The state of Rio de Janeiro is located in the southeast of Brazil. The map is shown in Figure 2-1.

Area	[sq km]
Brazil	8,514,861
State of RJ	43,696
City of RJ	1,182
Japan	377,950
Tokyo Pref.	2,103

Source: IBGE, The Statistics Bureau of Japan



Source: Google Earth, OpenStreetMap

Figure 2-1 Location of Rio de Janeiro

Brazil is divided into administrative divisions, which consists of 26 states and one federal district. The state of Rio de Janeiro consists of 92 municipalities. The Metropolitan Region of Rio de Janeiro is shown in Figure 2-2. In Brazil, there are 32 metropolitan regions (*Regiões Metropolitanas*: RM), three integrated development regions (RIDE), and four urban agglomerations, as shown in Table 2-1.

Metropolitan Region Rio de Janeiro
Belford Roxo
Duque de Caxias
Guapimirim
Itaboraí
Itaguaí
Japeri
Magé
Marica
Mesquita
Nilópolis
Niterói
Nova Iguaçu
Paracambi
Queimados
Rio de Janeiro
São Gonçalo
São João de Meriti
Seropédica
Tanguá

Source: JICA Study Team

Figure 2-2 Administrative Boundaries of Rio de Janeiro

Table 2-1 Administrative Division in Brazil

States (26+1)			Metropolitan Regions (RM) and Integrated Development Regions (RIDE) (39)			
1	Acre		1	Aglomeração Urbana do Litoral Norte Rio Grande do Sul	28	RM Natal
2	Alagoas		2	Aglomeração Urbana do Nordeste Rio Grande do Sul	29	RM Norte/Nordeste Catarinense
3	Amapá		3	Aglomeração Urbana do Sul Rio Grande do Sul	30	RM Porto Alegre
4	Amazonas		4	'Aglomerado Urbano Cuiabá-Várzea Grande	31	RM Recife
5	Bahia		5	RIDE Distrito Federal e Entorno	32	RM Rio de Janeiro
6	Ceará		6	RIDE Pólo Petrolina/PE e Juazeiro/BA	33	RM Salvador
7	Distrito Federal		7	RIDE Grande Teresina	34	RM São Paulo
8	Espírito Santo		8	RM Aracaju	35	RM Sudoeste Maranhense
9	Goiás		9	RM Baixada Santista	36	RM Tubarão
10	Maranhão		10	RM Belém	37	RM Vale do Aço
11	Mato Grosso		11	RM Belo Horizonte	38	RM Vale do Itajaí
12	Mato Grosso do Sul		12	RM Campinas	39	RM Vale do Rio Cuiabá
13	Minas Gerais		13	RM Carbonífera		
14	Pará		14	RM Cariri		
15	Paraíba		15	RM Curitiba		
16	Paraná		16	RM Florianópolis		
17	Pernambuco		17	RM Fortaleza		
18	Piauí		18	RM Foz do Rio Itajaí		
19	Rio de Janeiro		19	RM Goiânia		
20	Rio Grande do Norte		20	RM Grande São Luís		
21	Rio Grande do Sul		21	RM Grande Vitória		
22	Rondônia		22	RM João Pessoa		
23	Roraima		23	RM Londrina		
24	Santa Catarina		24	RM Macapá		
25	São Paulo		25	RM Maceió		
26	Sergipe		26	RM Manaus		
27	Tocantins		27	RM Maringá		

Source: JICA Study Team

2.1.2 Economy

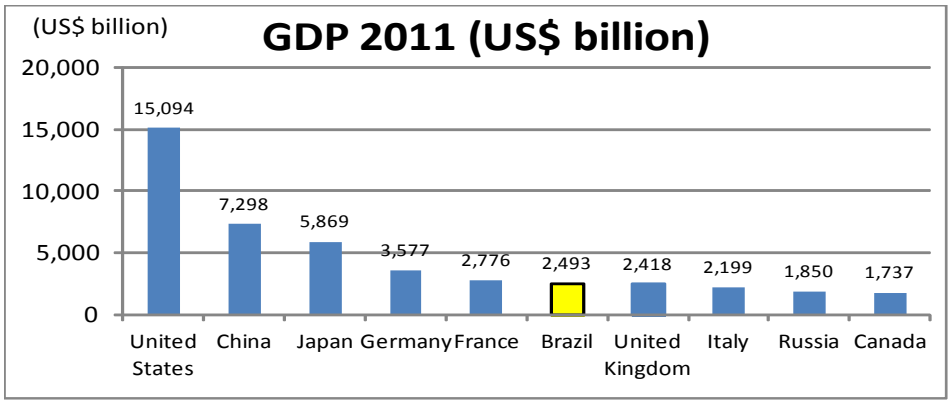
(1) Gross Domestic Product

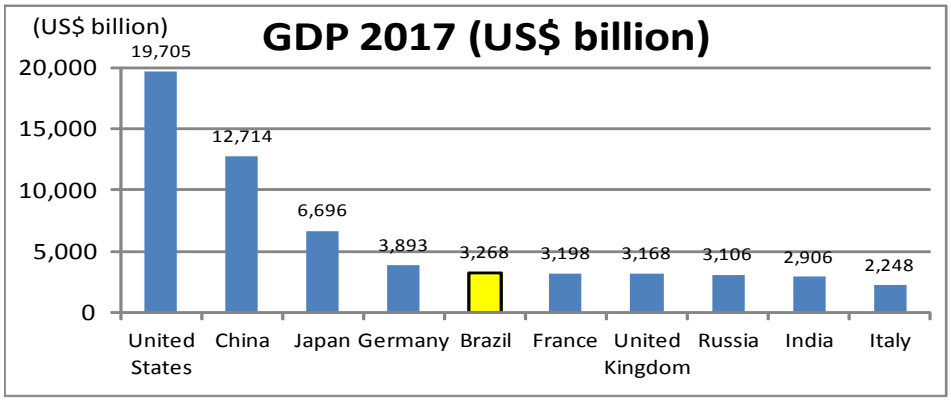
1) Position in World Economy

Brazil is the sixth largest world economy in terms of gross domestic product (GDP). By 2017, Brazil will become the world's fifth largest economy based on estimated data.

Table 2-2 GDP (Current Prices) in 2011 and 2017 (Estimated)

Rank	2011			2017	
	Country	GDP (US$ in billions)		Country	GDP (US$ in billions)
1	United States	15,094	→	United States	19,705
2	China	7,298	→	China	12,714
3	Japan	5,869	→	Japan	6,696
4	Germany	3,577	→	Germany	3,893
5	France	2,776	↗↘	**Brazil**	**3,268**
6	**Brazil**	**2,493**	↘↗	France	3,198
7	United Kingdom	2,418	→	United Kingdom	3,168
8	Italy	2,199	↗↘	Russia	3,106
9	Russia	1,850	↘↗	India	2,906
10	Canada	1,737	↘↗	Italy	2,248



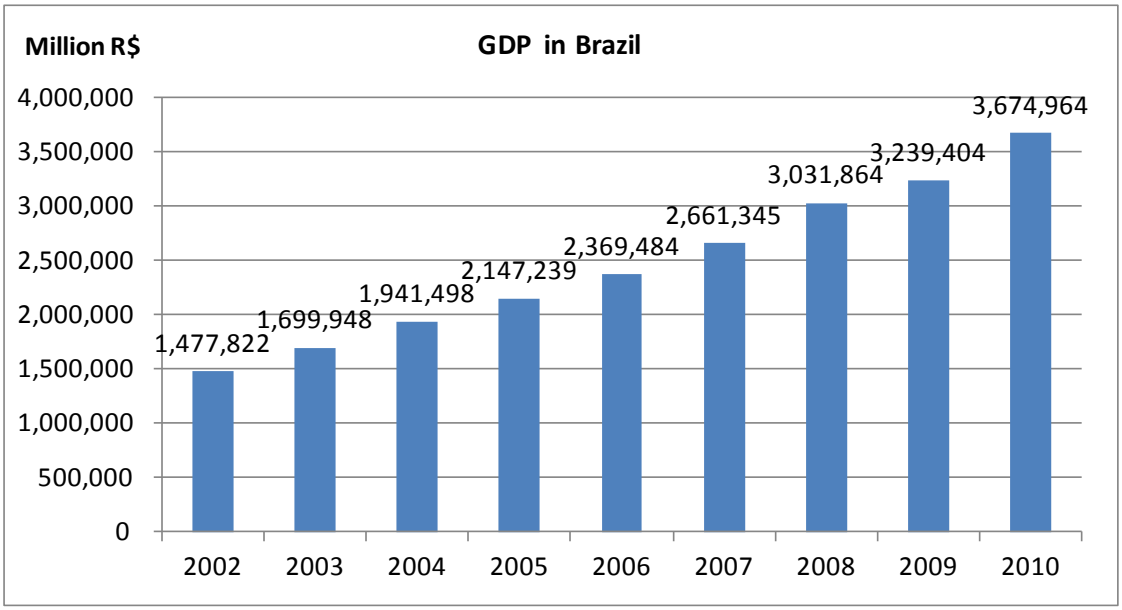


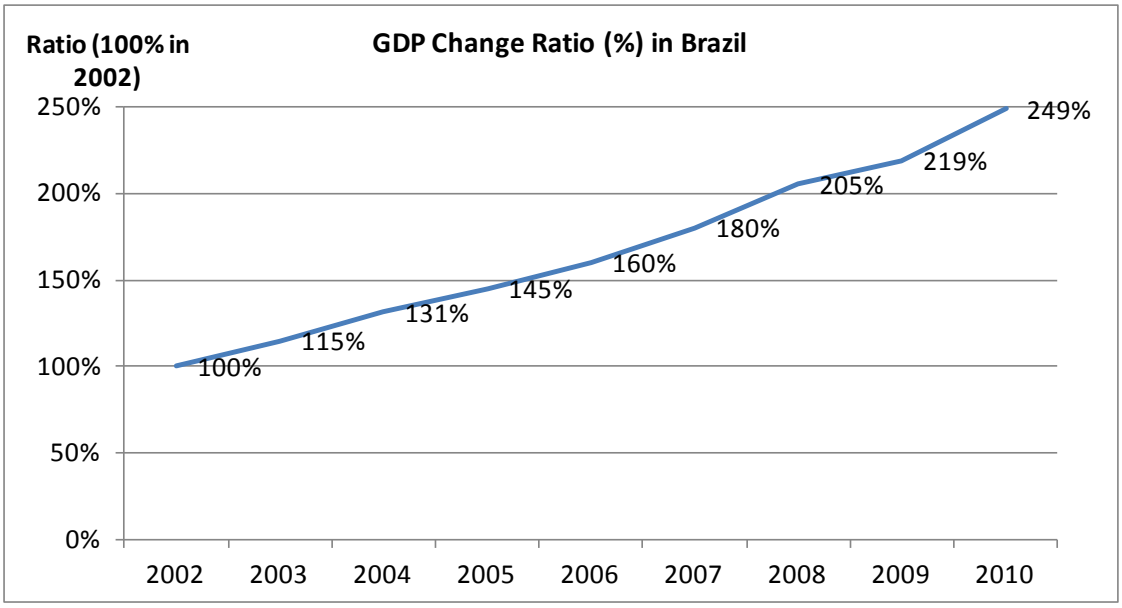
Source: Economic Outlook Database April 2011 (IMF)

Figure 2-3 GDP (Current Prices) in 2011 and 2017 (Estimated)

2) Trend in Brazil

The GDP (current prices) in Brazil has been increasing in the last nine years. GDP in 2010 was about 2.5 times higher than in 2002.





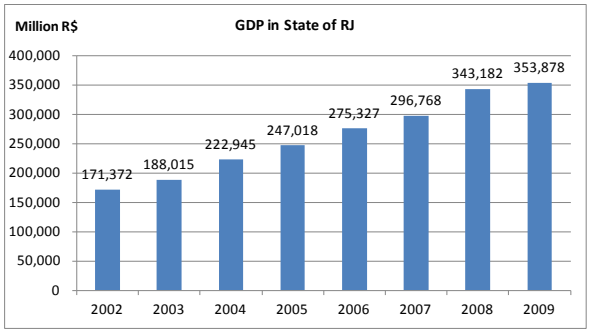
Source: IBGE

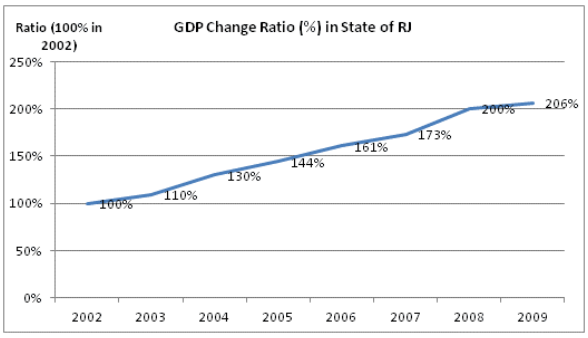
Figure 2-4 GDP (Current Prices) Trend in Brazil

3) Trend in Rio de Janeiro

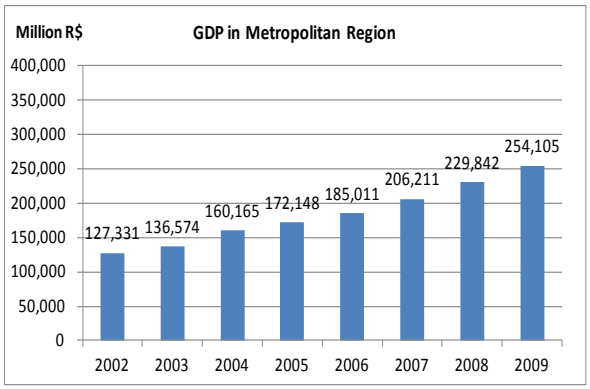
The GDP (current prices) in Rio de Janeiro has also been increasing in the last eight years. GDP in 2009 was almost twice the GDP in 2002.

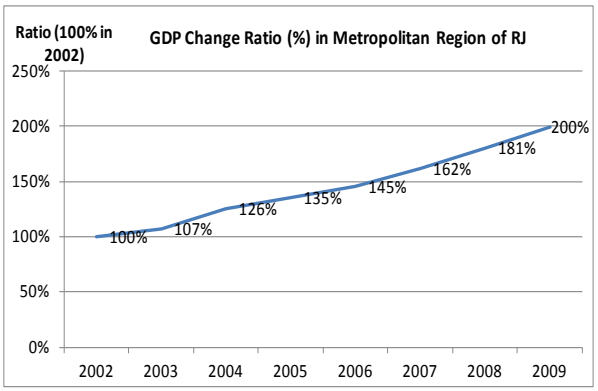
[State]



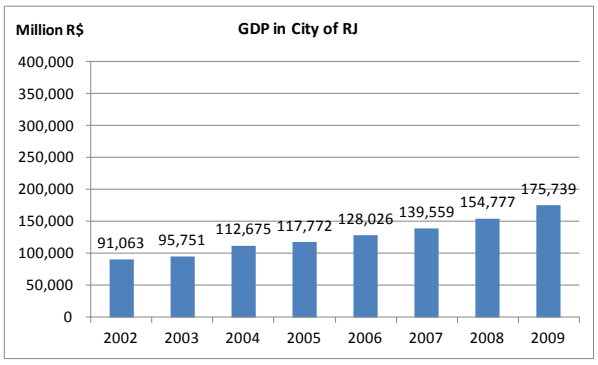


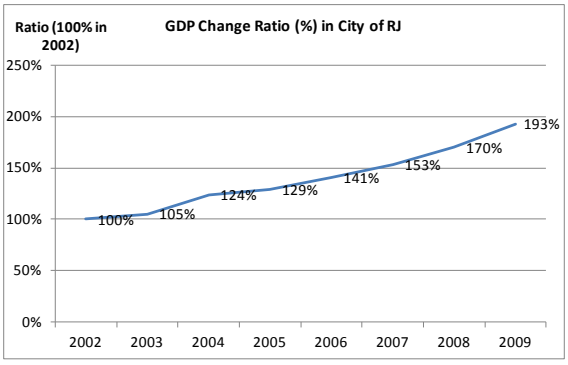
[Metropolitan Region]





[City]





Source: IBGE

Figure 2-5 GDP (Current Prices) Trend in Rio de Janeiro

(2) GDP per Capita

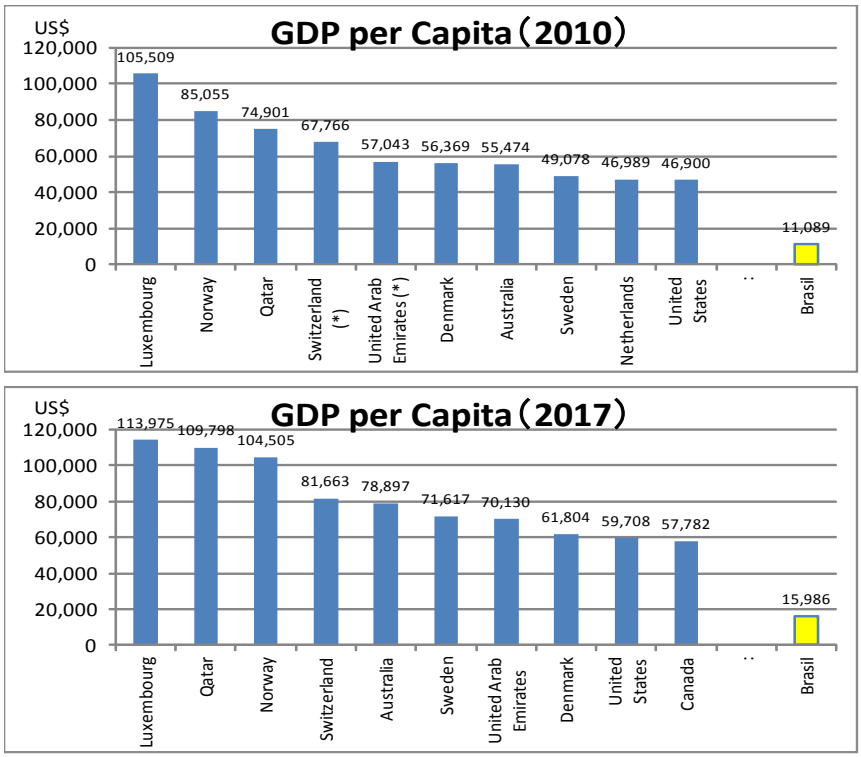
1) Position in World Economy

In terms of GDP (current prices) per capita, Brazil is the 54th largest economy. By 2017, Brazil will become the world's 55th largest economy based on GDP estimated data.

Table 2-3 GDP (Current Prices) per Capita in 2010 and 2017 (Estimated)

Rank	2010			2017	
	Country	GDP per capita (US$)		Country	GDP per capita (US$)
1	Luxembourg	105,509	→	Luxembourg	113,975
2	Norway	85,055	↘	Qatar	109,798
3	Qatar	74,901	↗	Norway	104,505
4	Switzerland (*)	67,766	→	Switzerland	81,663
5	United Arab Emirates (*)	57,043	↗	Australia	78,897
6	Denmark	56,369	↘	Sweden	71,617
7	Australia	55,474	↗	United Arab Emirates	70,130
8	Sweden	49,078	↘	Denmark	61,804
9	Netherlands	46,989	↗	United States	59,708
10	United States	46,900	↘	Canada	57,782
54	Brazil	11,089	55	Brazil	15,986

*: Estimated value based on 2009 data

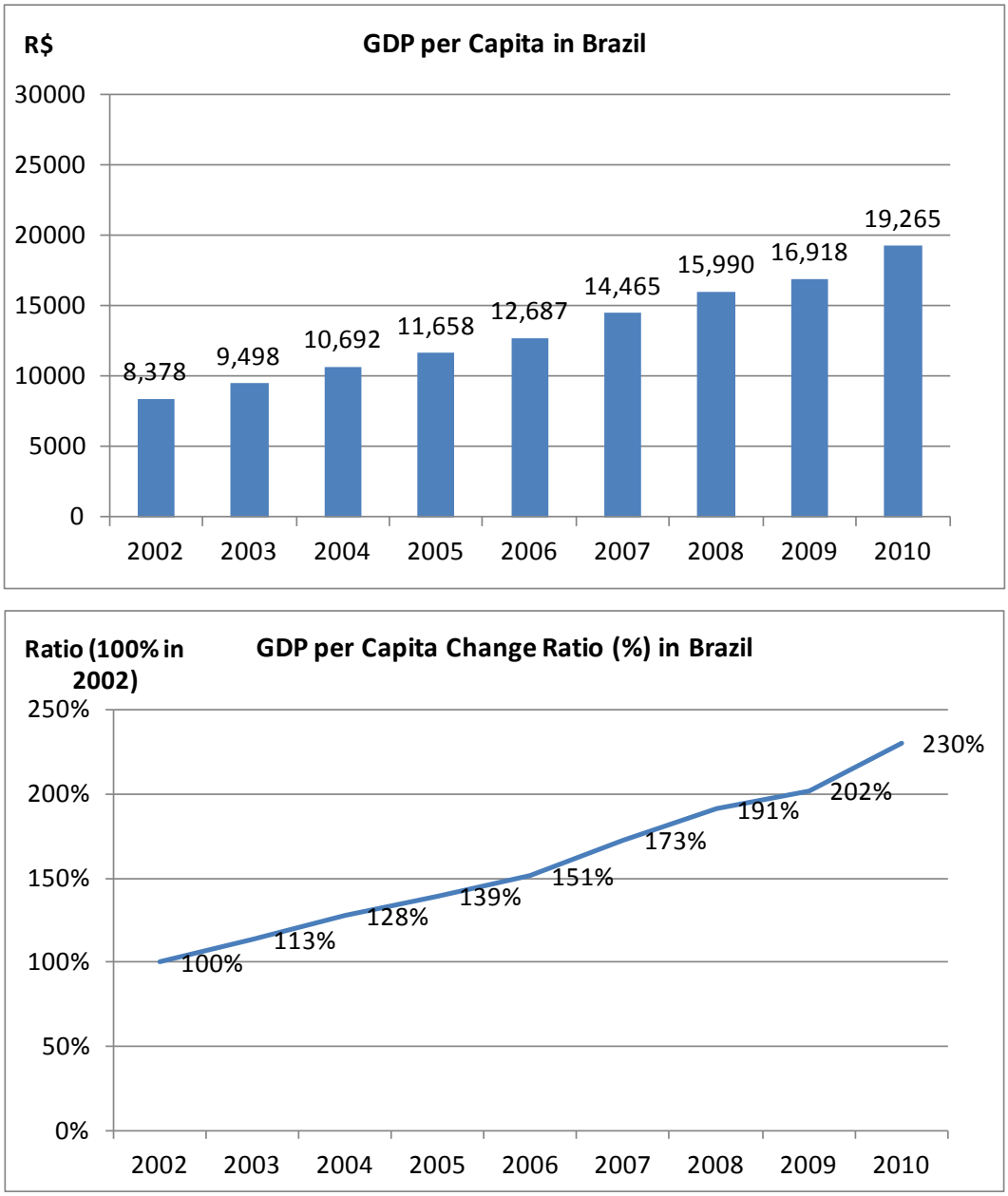


Source: Economic Outlook Database April 2011 (IMF)

Figure 2-6 GDP (Current Prices) per Capita in 2010

2) Trend in Brazil

The GDP per capita in Brazil has also been increasing in the last nine years. GDP per capita in 2010 was about 2.3 times higher than in 2002.



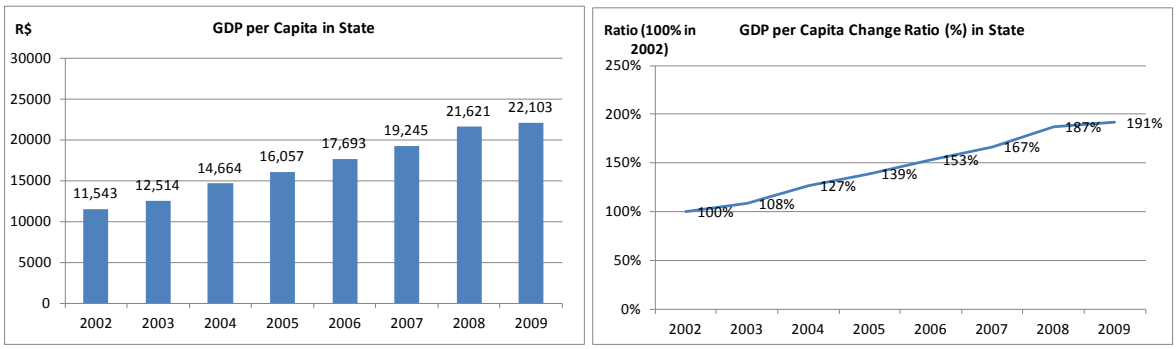
Source: IBGE

Figure 2-7 Trend of GDP (Current Prices) per Capita in Brazil

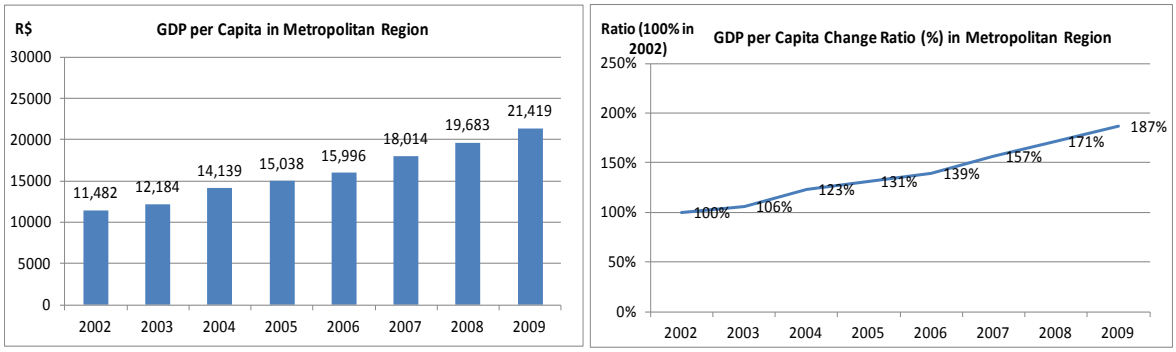
3) Trend in Rio de Janeiro

The GDP (current prices) per capita in Rio de Janeiro has also been increasing in the last eight years. GDP in 2009 was almost twice the GDP in 2002.

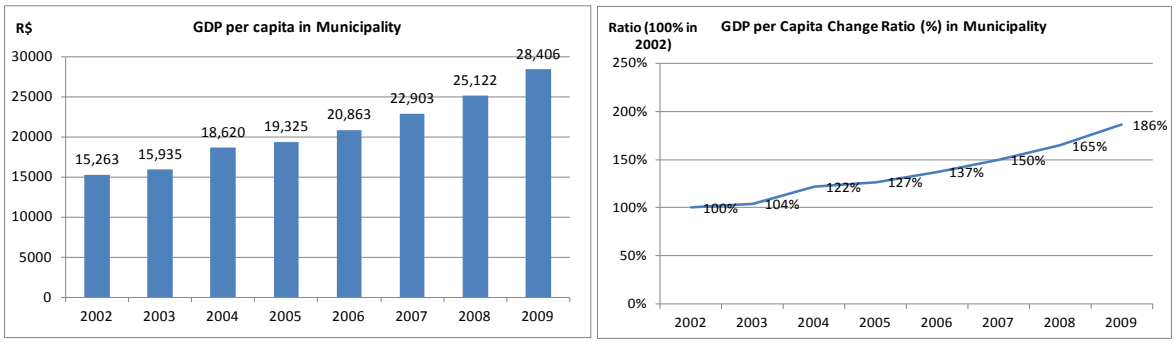
[State]



[Metropolitan Region]



[Municipality]

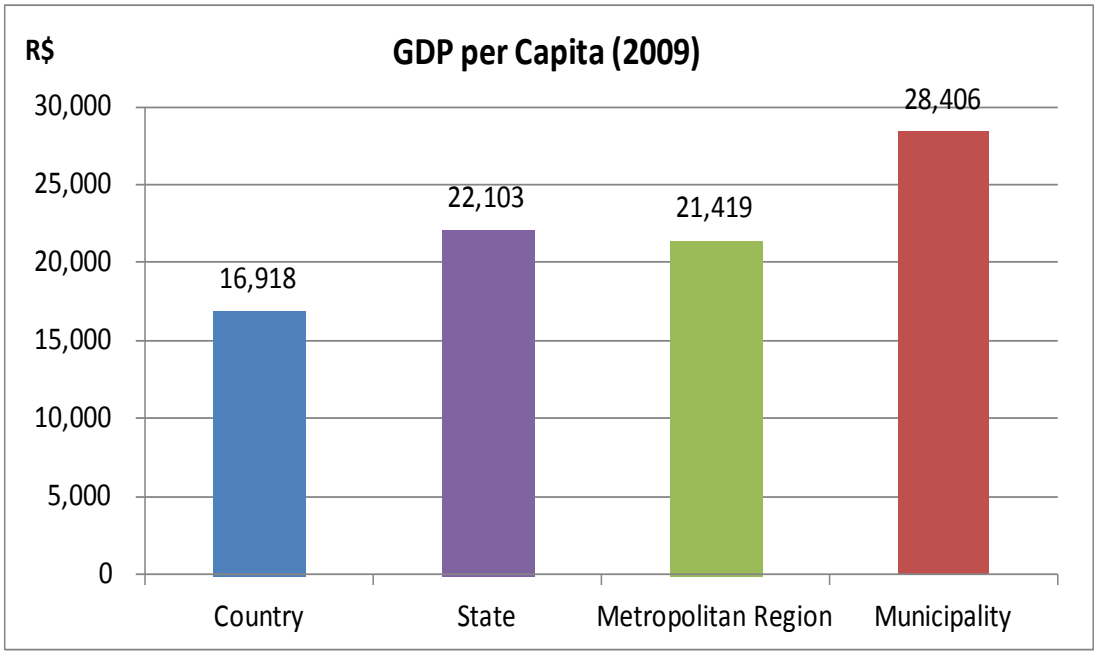


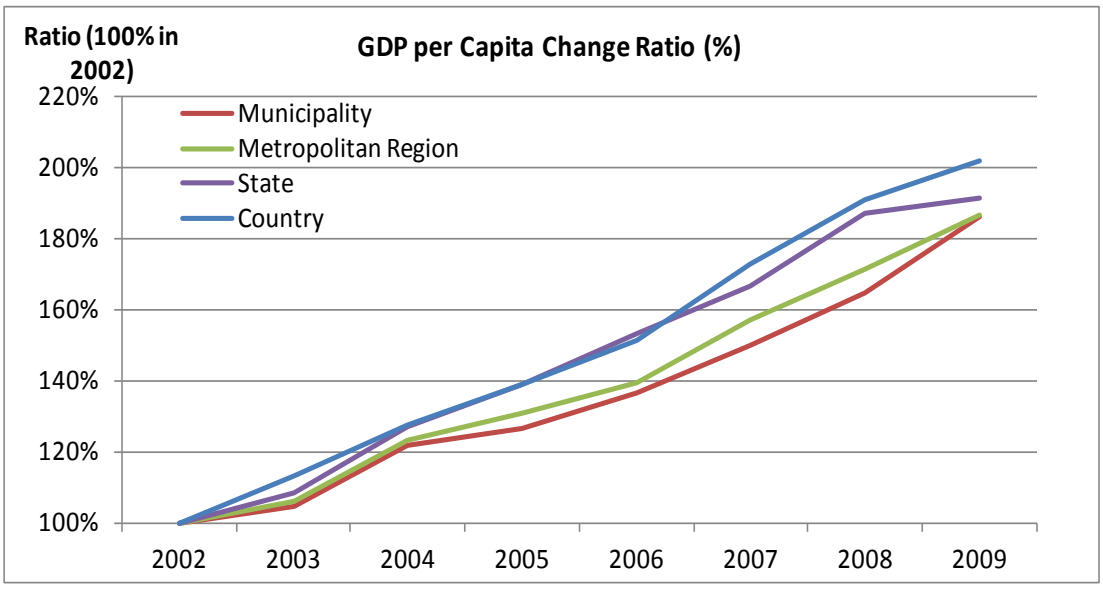
Source: IBGE

Figure 2-8 Trend of GDP (current prices) per Capita in Rio de Janeiro

4) Comparison of GDP Data in Brazil

Comparing the GDP (current prices) per capita among country, state, metropolitan region, and municipality of Rio de Janeiro, the municipality earned the biggest growth. However, the state and metropolitan region have grown faster than the municipality. According to this data, Rio de Janeiro, as a whole, has great potential and economy is expanding very fast.





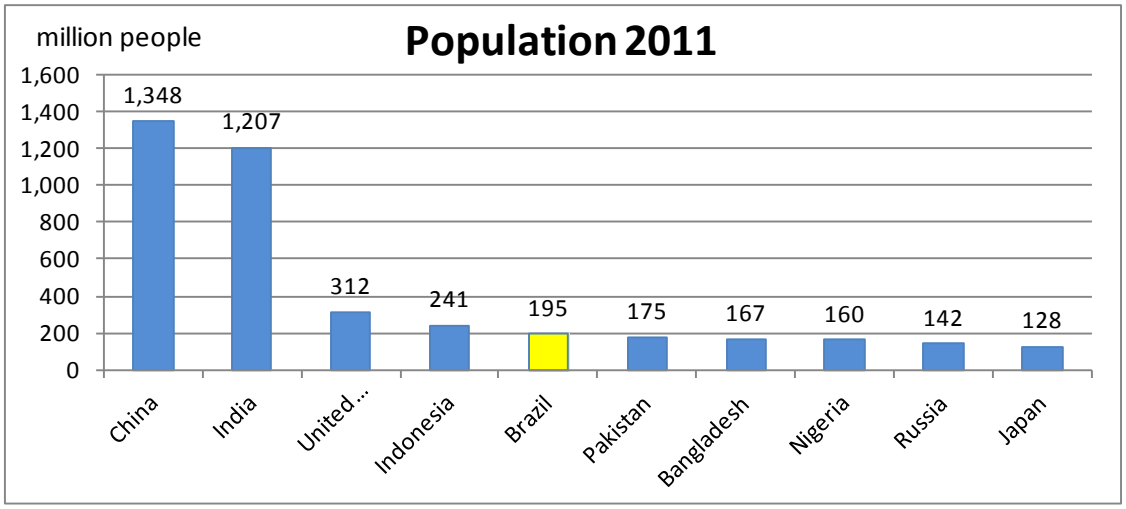
Source: IBGE

Figure 2-9 Trend of GDP (Current Prices) per Capita in Rio de Janeiro

(3) Population

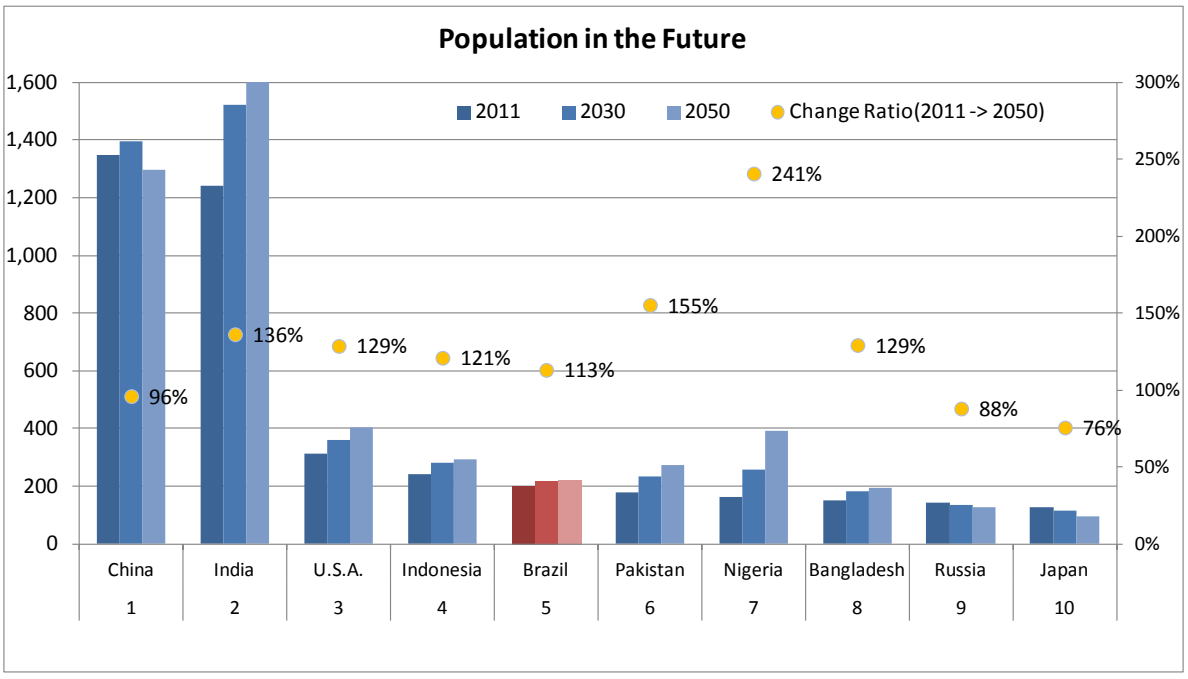
1) Population in the World

Brazil is the fifth largest country in terms of population based on 2011 data as shown in Figure 2-10, whereas, Japan is the tenth largest in population. The forecast shows that Brazil´s population will increase by 13% in the next 20-40 years.



Source: Economic Outlook Database, April 2011 (IMF)

Figure 2-10 Population in the World



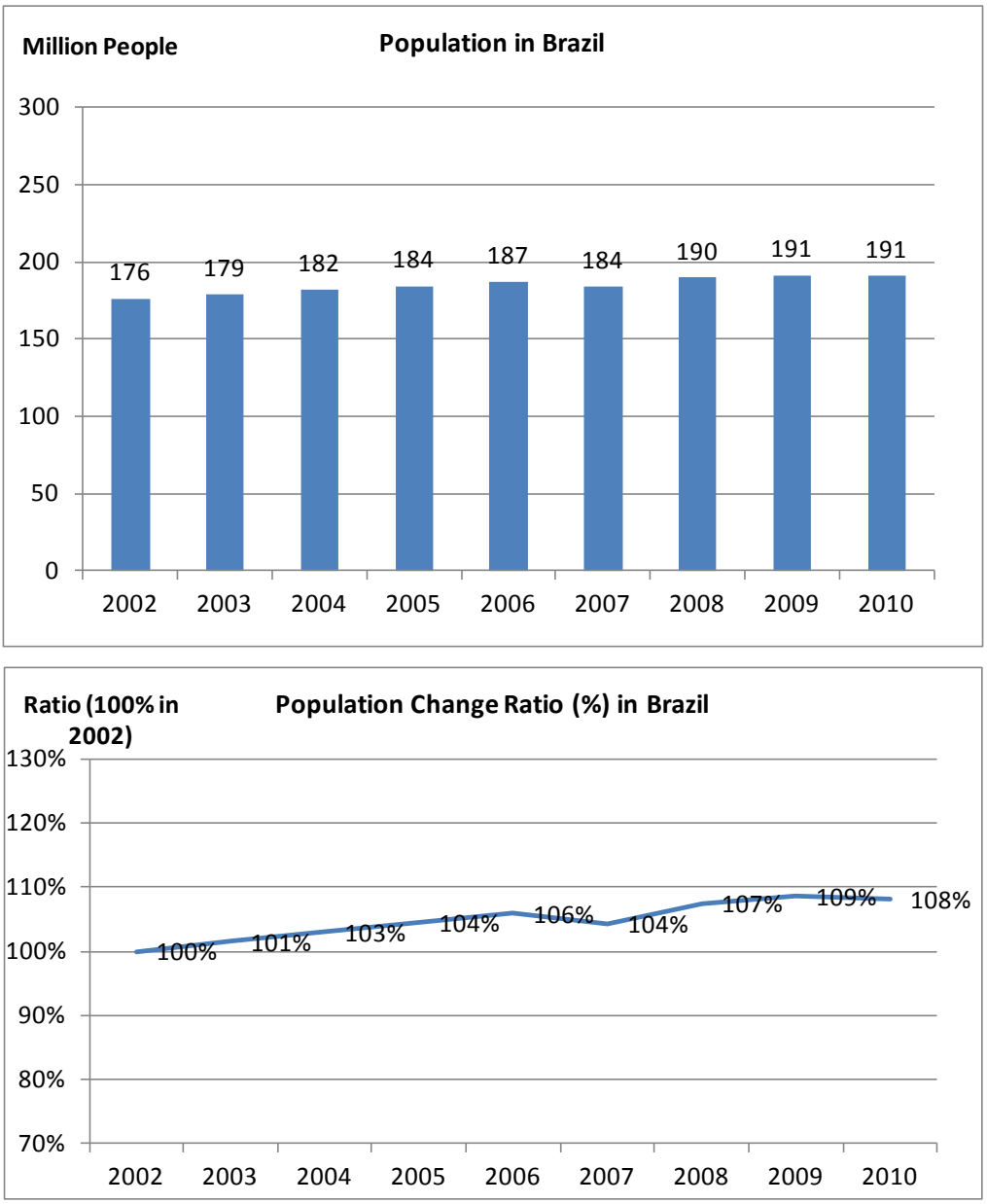
Source: Statistics Bureau of Japan

Figure 2-11 Future Population in the World

2) Population of Brazil

i) Trend

According to the Brazilian Institute of Geography and Statistics (IBGE: *Instituto Brasileiro de Geografia e Estatística*), population in Brazil has been increasing in recent years. In the comparison between 2002 and 2010 population, there was a growth of 8%, reaching around 191 million people. The population transition is shown in Figure 2-12.

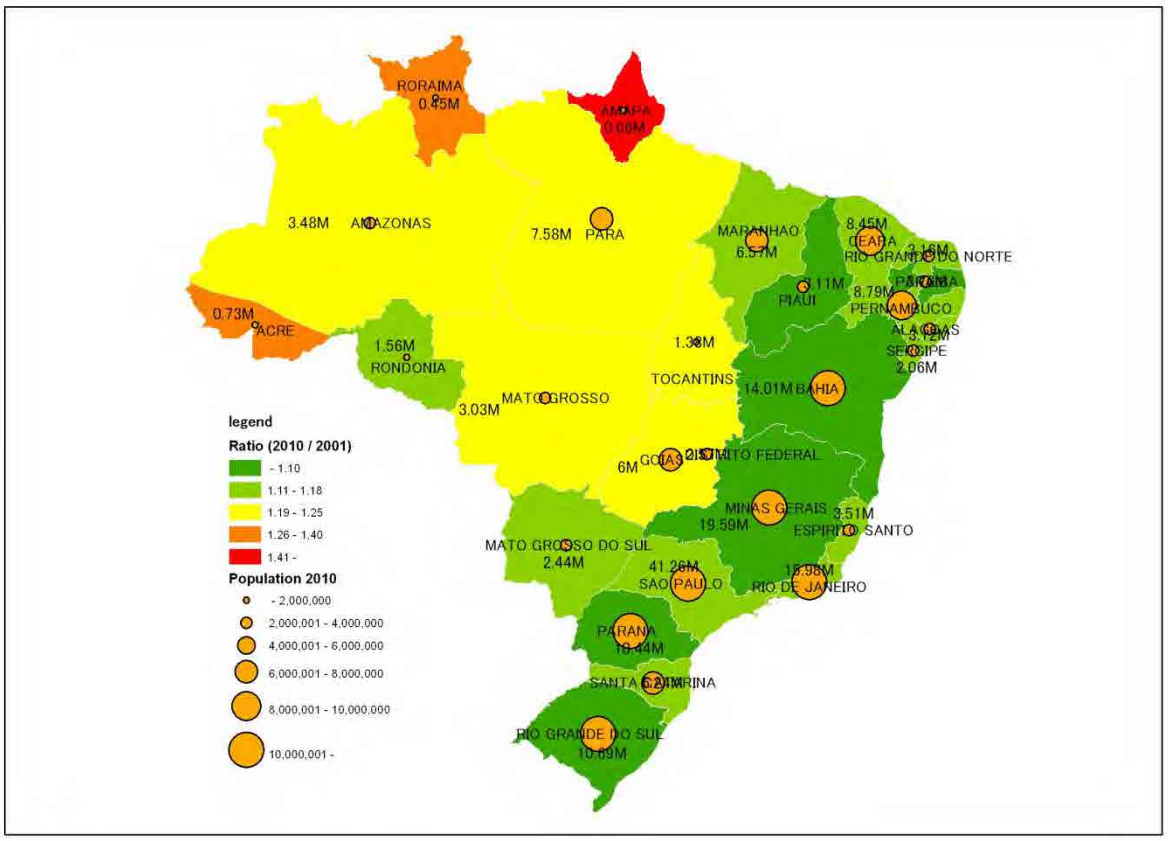


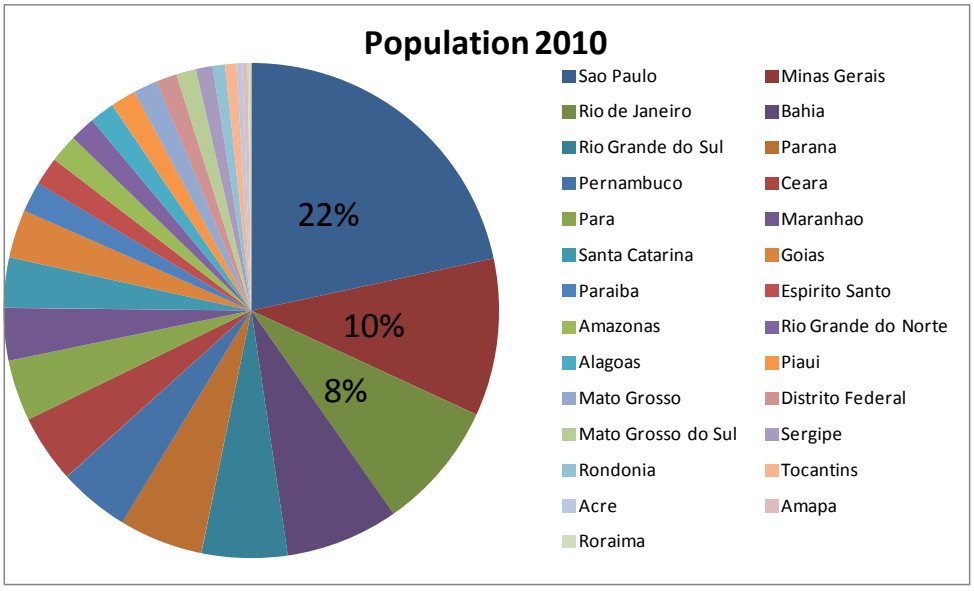
Source: IBGE

Figure 2-12 Population Trend in Brazil

ii) Distribution

In terms of population, the state of Rio de Janeiro has the third largest in Brazil. The population growth ratio in the state of Rio de Janeiro between 2001 and 2011 is relatively low, reaching the range from 1.11 to 1.18.





Source: IBGE, Figure is made by the JICA Study Team

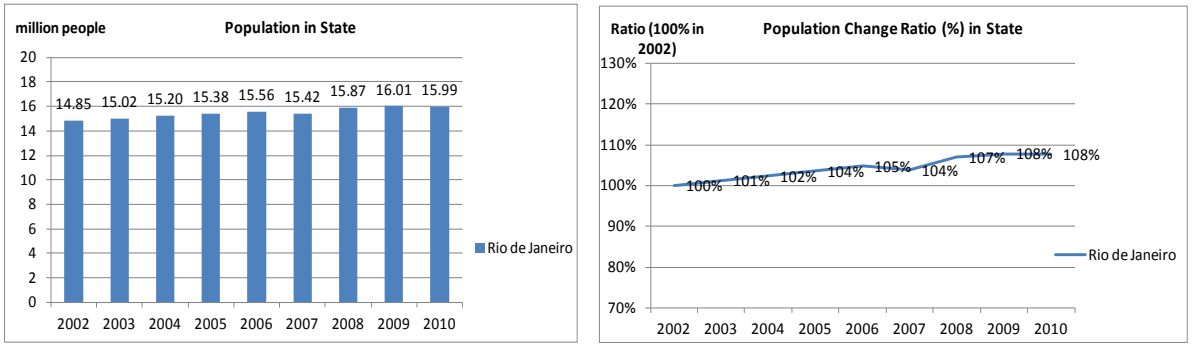
Figure 2-13 Population Distribution of States in Brazil

3) Trend in Rio de Janeiro

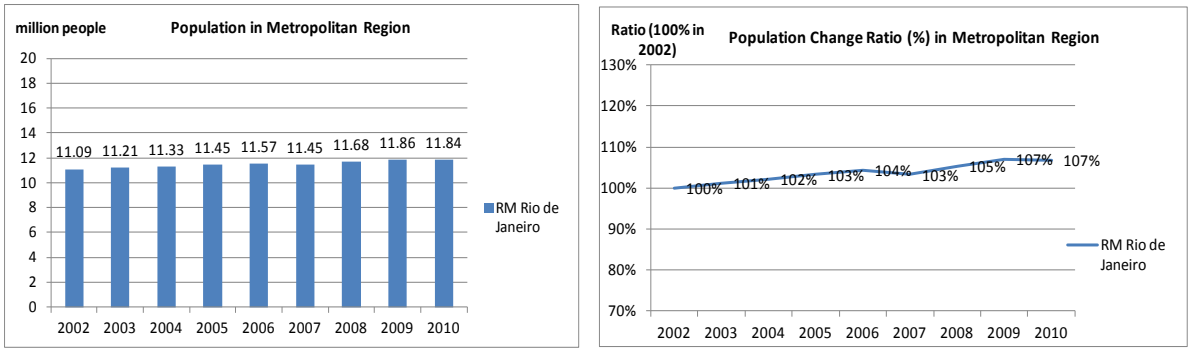
i) Trend

The population increase ratio in Rio de Janeiro is equal to the level of Brazil. Based on the data, the population outside the municipality of Rio has increased significantly compared to the population living within the municipality.

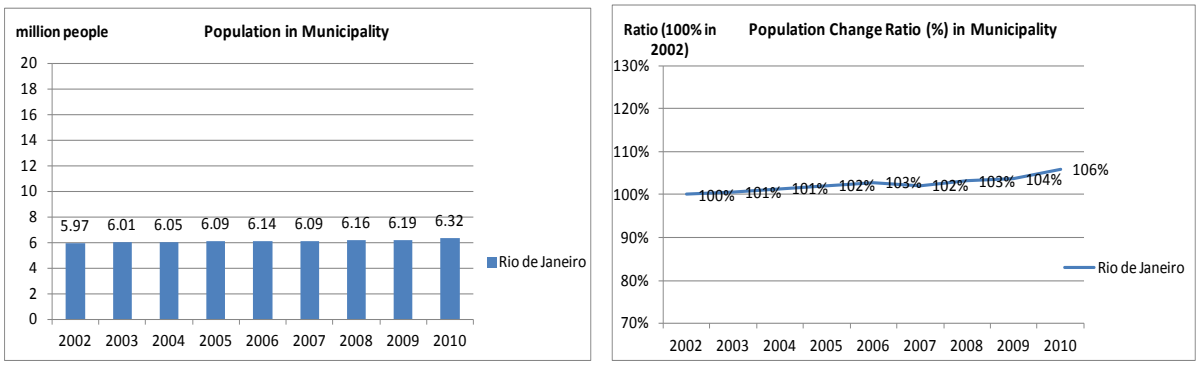
[State]



[Metropolitan Region]



[Municipality]

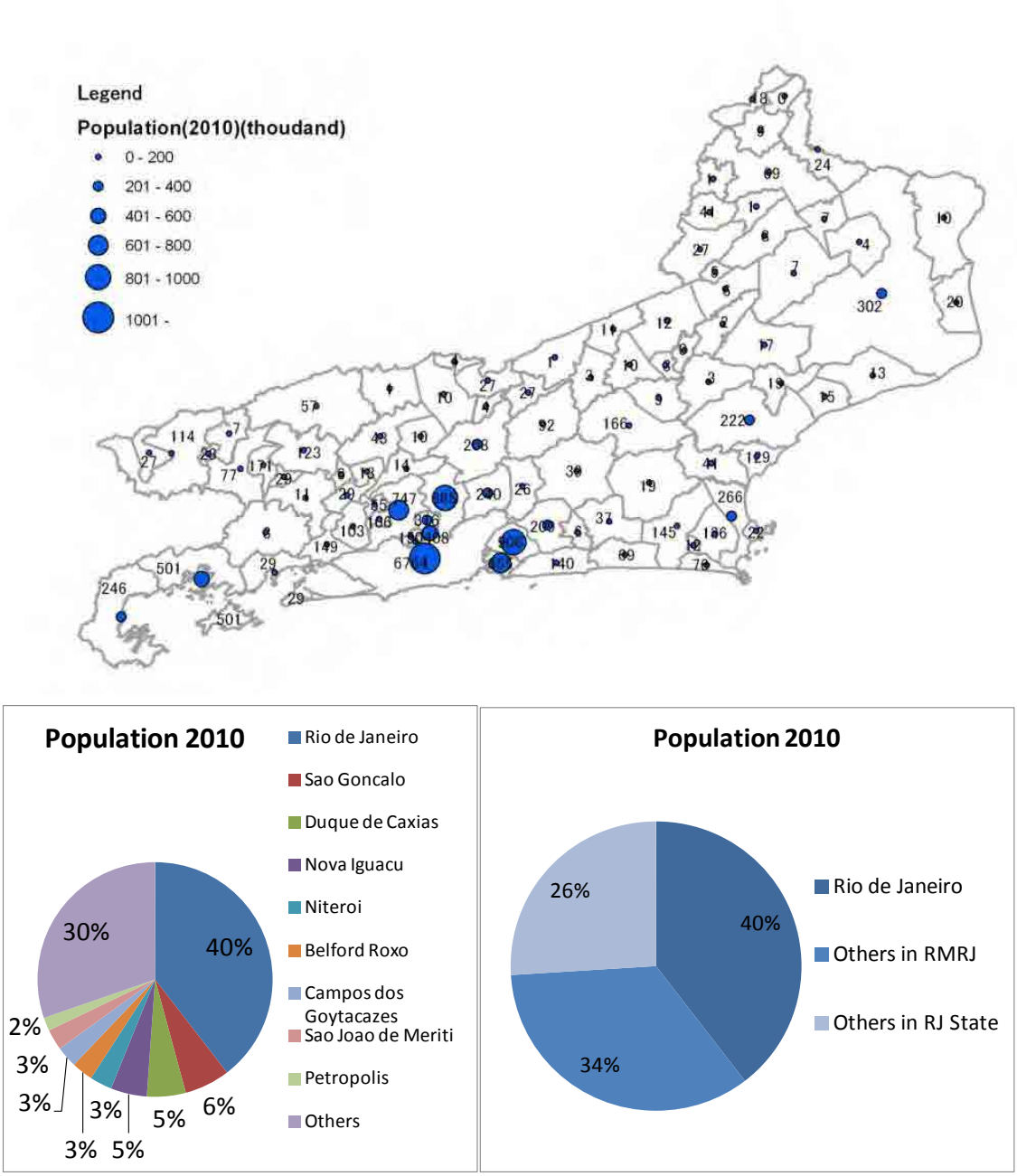


Source: IBGE

Figure 2-14 Population Trend in Rio de Janeiro

ii) Distribution

The population of the state of Rio de Janeiro is concentrated in the Metropolitan Region. In the state of Rio de Janeiro, the population share of the municipality of Rio de Janeiro is about 40%, while the Metropolitan Region contributes about 74% of the whole state population.

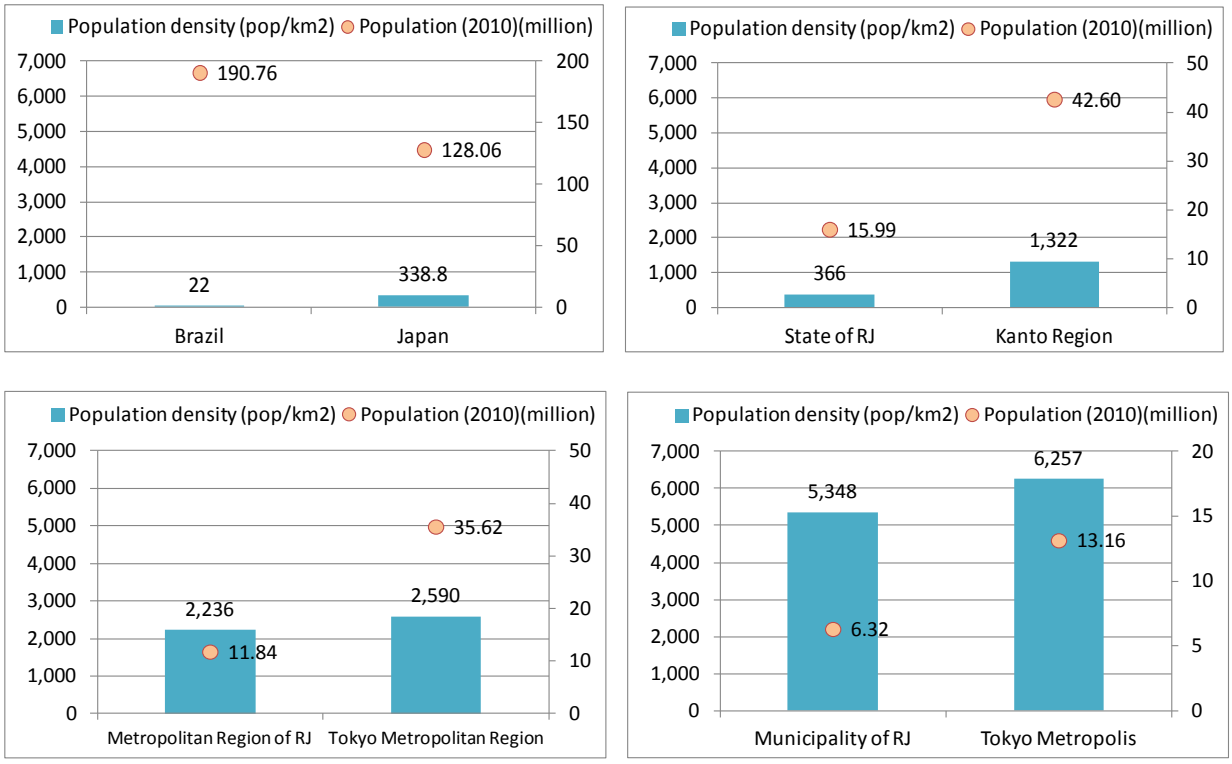


Source: IBGE, Figure is made by the JICA Study Team

Figure 2-15 Population Distribution of Cities in Rio de Janeiro

(4) Population Density

The population density was compared between Brazil and Japan and between Rio de Janeiro and Kanto/Tokyo. For the country scale, state scale, and metropolitan region scale, the population density of Japan is higher than Brazil. However, population densities of Rio de Janeiro and Tokyo are almost at the same level. The rise in population of the city of Rio de Janeiro is quite remarkable in recent years.



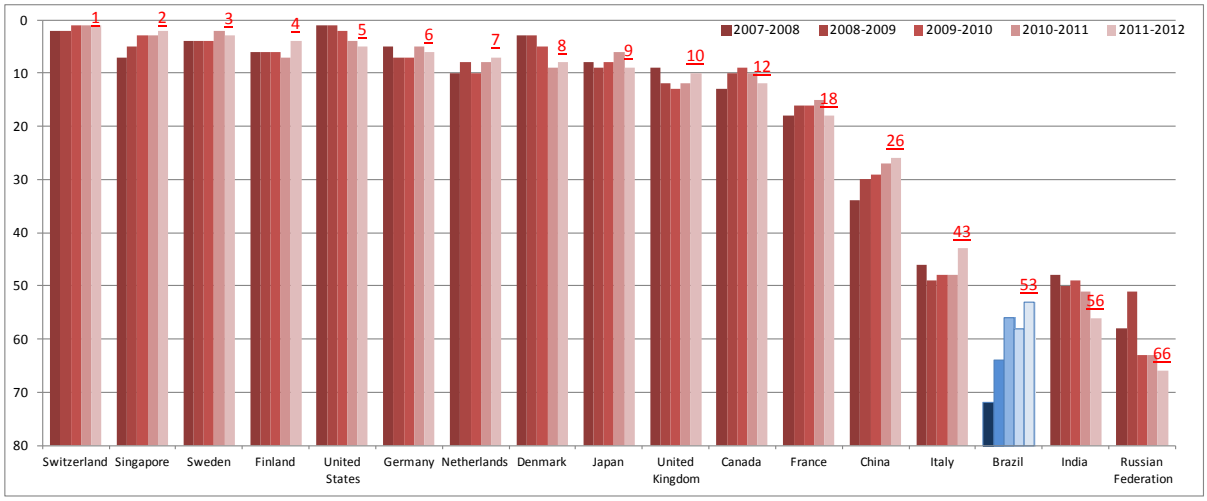
Source: IBGE, Statistics Bureau of Japan

Figure 2-16 Population Density of Brazil and Japan

2.1.3 Global Competitiveness

(1) Global Competitiveness Ranking

Based on the global competitiveness ranking assessed by the World Economic Forum, Brazil ranked 53rd in the world. However, in the last five years, Brazil has grown rapidly compared with other countries which take part in the Group of Eight (G8) and in the association of emerging national economies: Brazil, Russia, India, China, and South Africa (BRICs).

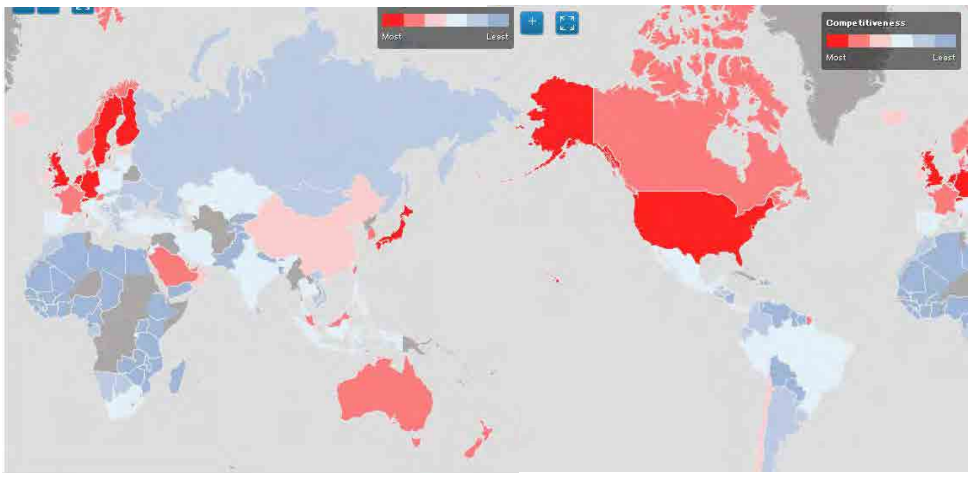


Source: The Global Competitiveness Report (World Economic Forum)

Figure 2-17 Competitiveness Ranking (High-ranked Countries, G8 Countries, and BRICs)

[The Global Competitiveness Report - World Economic Forum]

- The World Economic Forum
  An independent international organization committed in improving the state of the world by engaging business, political, academic, and other leaders of society to shape global, regional, and industry agendas.
- The Global Competitiveness Report
  Since 2005, the World Economic Forum has based its competitiveness analysis on the Global Competitiveness Index (GCI), a comprehensive tool that measures the microeconomic and macroeconomic foundations of national competitiveness. Competitiveness has been defined as the set of institutions, policies, and factors that determine the level of productivity of a country.

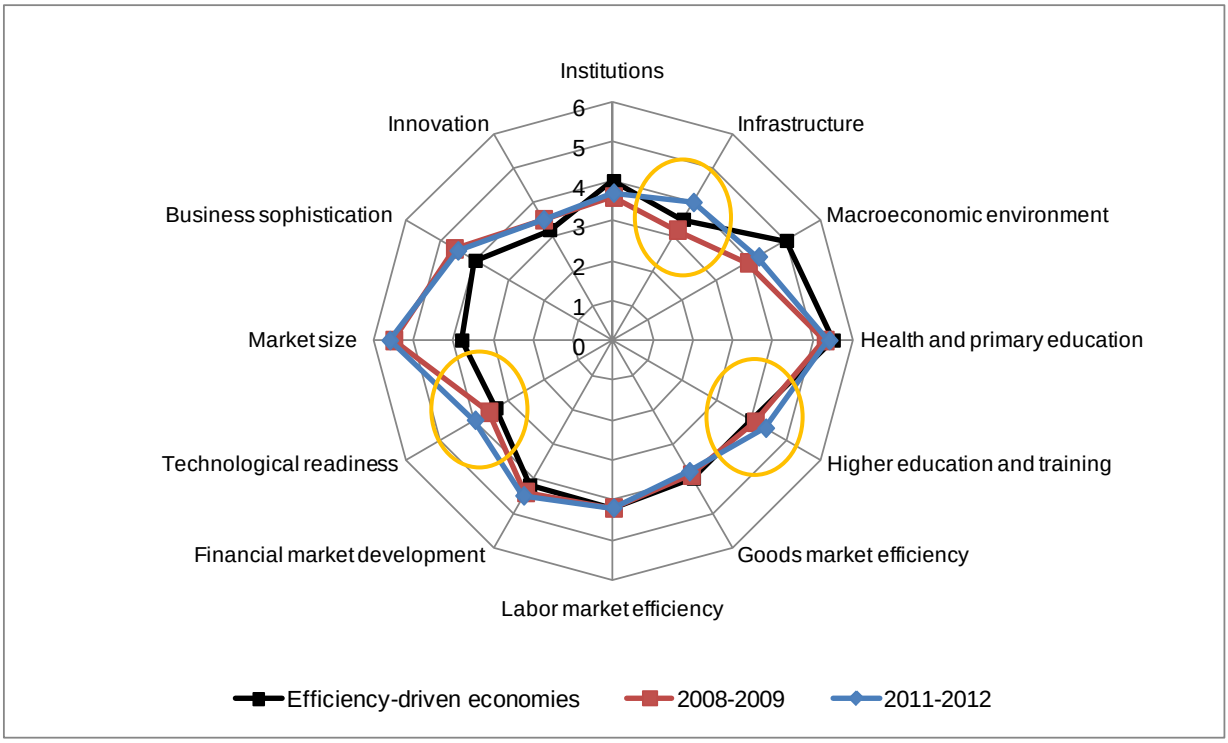


http://www.weforum.org/issues/global-competitiveness

(2) Competiveness Index of Brazil

The index shows the advantages and growing domains of Brazil. The advantages of Brazil seem to be "health and primary education", "financial market development", "market size", and "business sophistication". The growing domains are "infrastructure", "higher education and training", and "technological readiness".

[Comparison between 2008 and 2011]



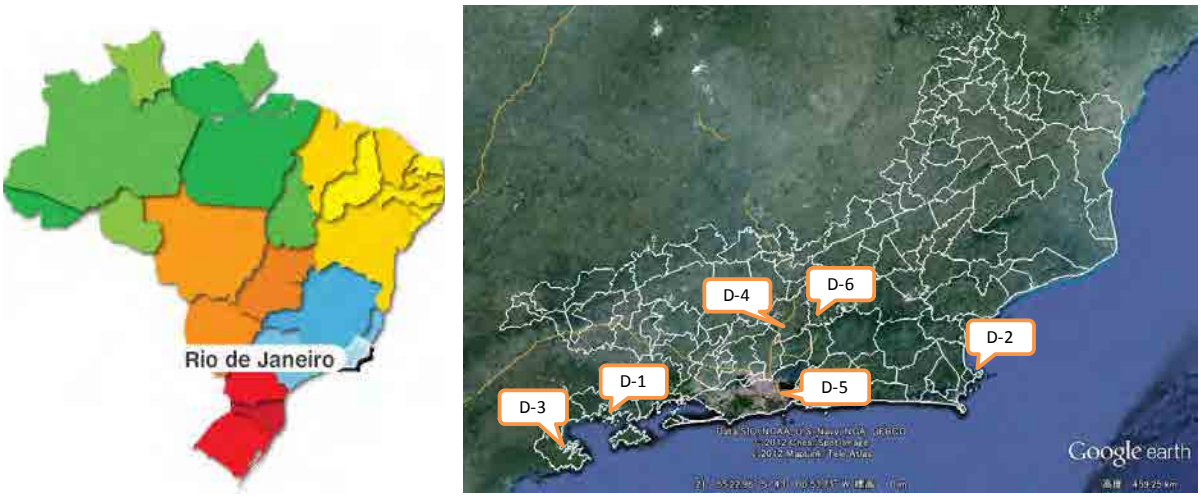
Source: The Global Competitiveness Report (World Economic Forum)

Figure 2-18 Competitiveness Index of Brazil

2.1.4 Sightseeing Resources and Statistics

(1) Sightseeing Resources Location

On the website of the Ministério do Turismo, it is possible to search main tourist destinations. The sightseeing resources locations in the state of Rio de Janeiro shown on the website are as follows:



No	Theme	Destination	Photo
D-1	Sun and Beach, Social	Angra dos Reis	
D-2	Sun and Beach, Culture, Nature	Armacao de Buzios	
D-3	Sun and Beach, Culture, Eco Tourism, Social, Natural	Paraty	
D-4	Culture, Eco Tourism	Petropolis	
D-5	Sun and Beach, Culture, Nature, Business, Events	Rio de Janeiro	
D-6	–	Parque Nacional Serra dos Orgaos	

Source: Ministério do Turismo

Figure 2-19 Main Sightseeing Locations in the State of Rio de Janeiro

In addition, sightseeing resources locations in the city of Rio de Janeiro shown on the website are as follows:

No	Type	Destination	Photo
1	Hill	Pao de Acucar	
2	Hill	Morro do Corcovado	
3	Hill	Morro da Urca	
4	Park	Jardim Botanico (Botanical Garden)	
5	Lake	Lagoa Rodrigo de Freitas	
6	Sea	Boardwalk on Copacabana Beach	
7	Sea	View of the beach in the city of Rio	
8	Sea	Guanabara Bay	
9	Architecture	Lapa	
10	Sport	Estadio do Maracana (Maracana Stadium)	
11	Event	New Year's Eve on Copacabana beach Fireworks at Copacabana	
12	Event	Carnival in Rio	

Source: Ministério do Turismo

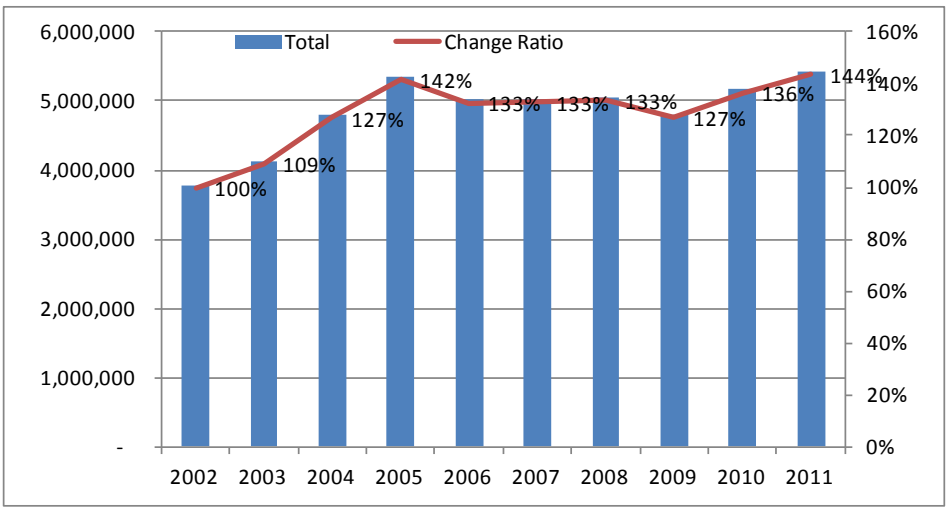
Figure 2-20 Main Sightseeing Locations in the City of Rio de Janeiro

(2) Number of Tourists

1) Inbound tourists to Brazil

i) Trend

The number of inbound tourists to Brazil is more than 5 million and has been increasing since 2002.

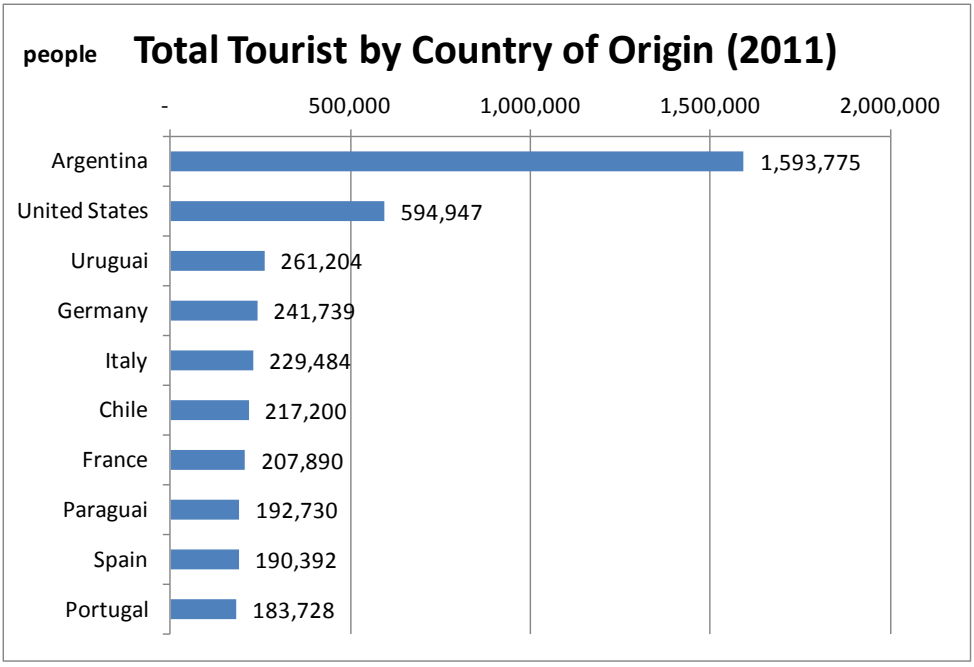


Source: Ministério do Turismo

Figure 2-21 Trend of Inbound Tourists to Brazil

ii) Origin Countries of Tourists

Majority of international inbound tourists to Brazil are from Argentina and the United States.

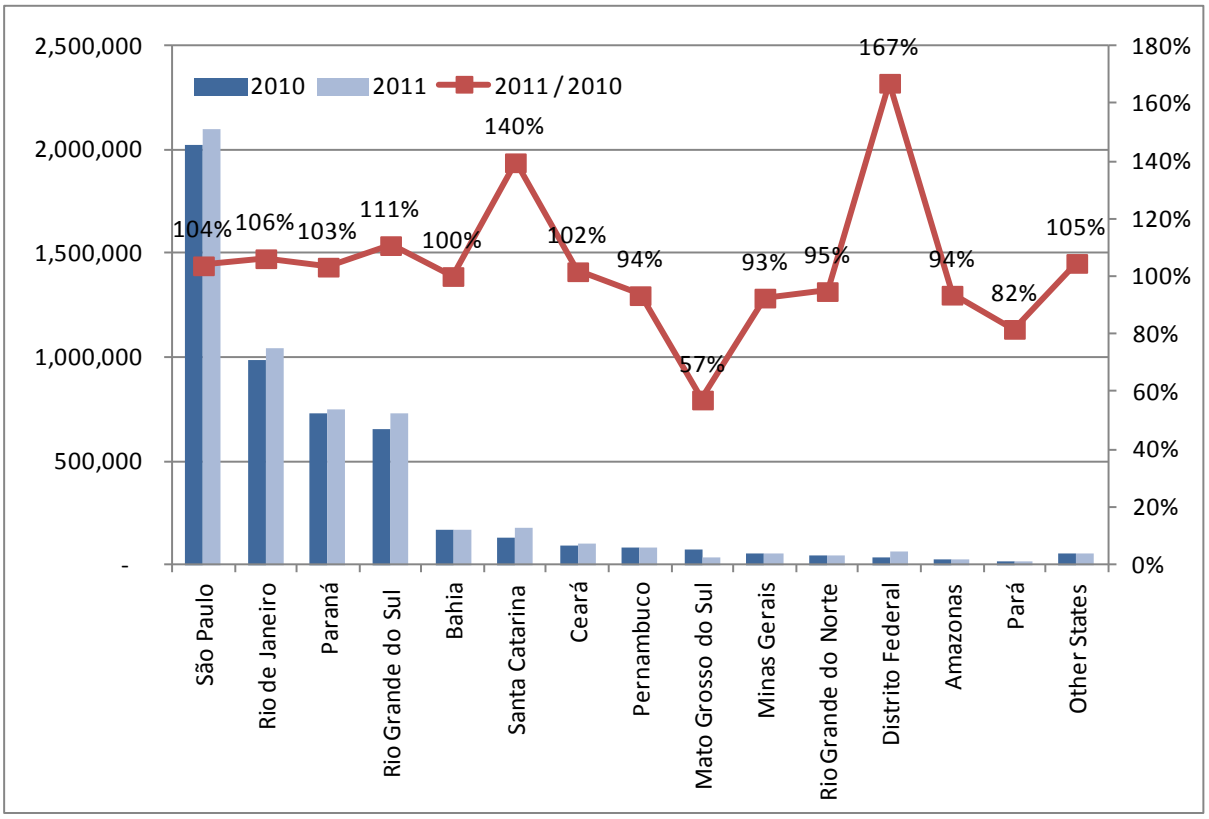


Source: Ministério do Turismo

Figure 2-22 Number of Inbound Tourists to Brazil by Country of Origin

iii) Tourists to Each State

Inbound tourists to Brazil mainly go to the states of Sao Paulo, Rio de Janeiro, Parana, and Rio Grande do Sul. The state of Rio de Janeiro is the second major destination for international inbound tourists to Brazil.



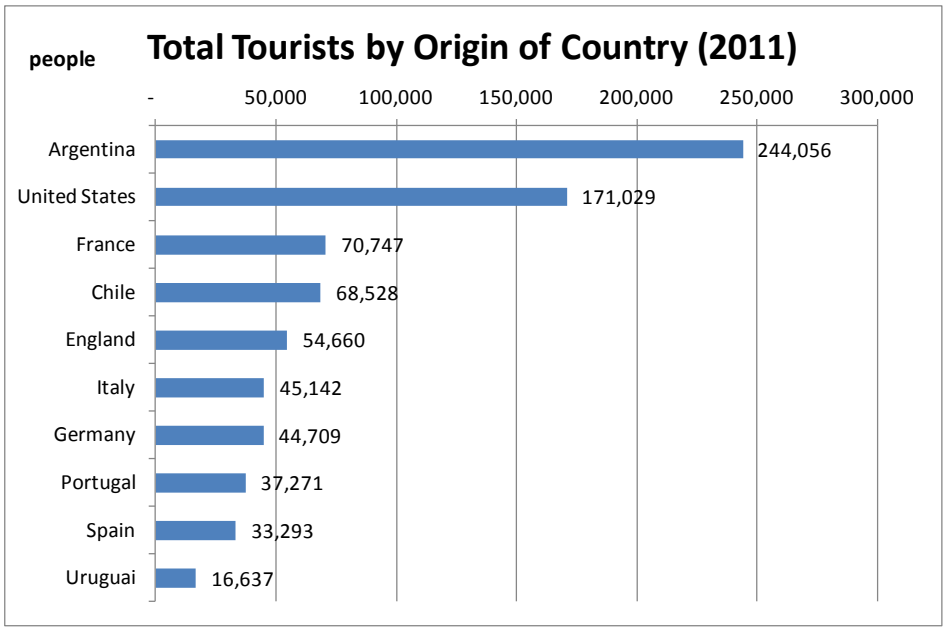
Source: Ministério do Turismo

Figure 2-23 Inbound Tourists by Destination State in Brazil

2) Inbound tourist to the State of Rio de Janeiro

i) Origin Countries of Tourists

The majority of international inbound tourists to the state of Rio de Janeiro are from Argentina and the United States. In addition, it is necessary to note that France is the third biggest tourist origin to Rio de Janeiro.

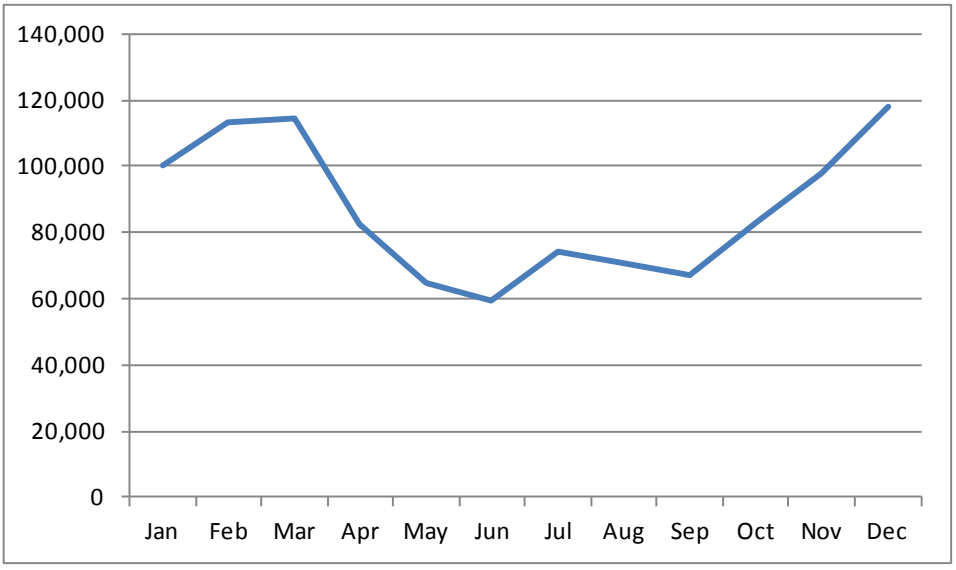


Source: Ministério do Turismo

Figure 2-24 Inbound Tourists to the State of Rio de Janeiro by Country of Origin

ii) Monthly Tourist Arrivals

The state of Rio de Janeiro has two monthly peaks of inbound tourists in December and February because of annual events like New Year's Eve and Carnival.

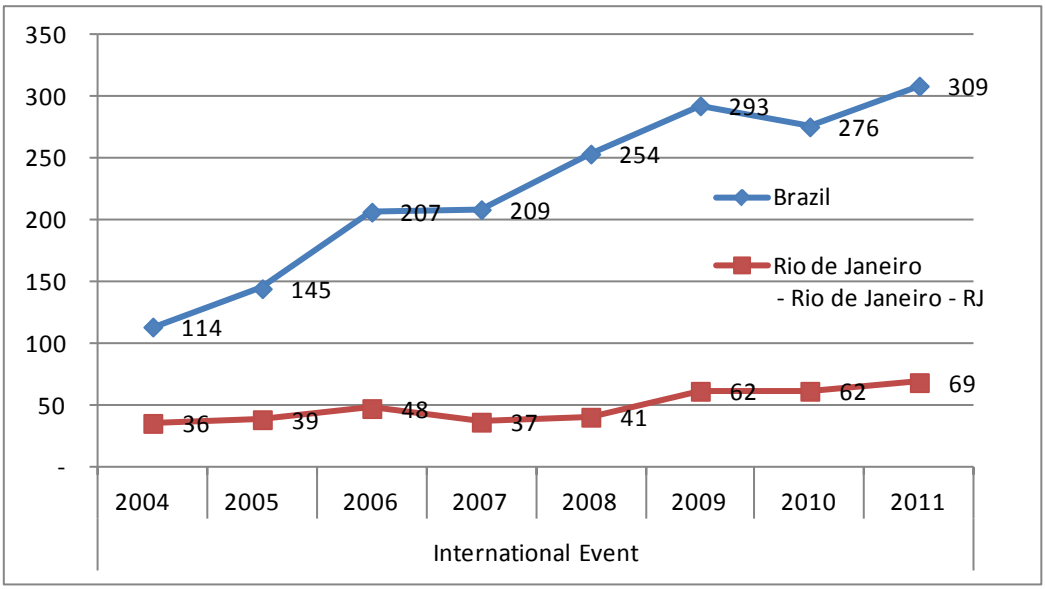


Source: Ministério do Turismo

Figure 2-25 Monthly Tourist Arrivals to the State of Rio de Janeiro

(3) International Events (Congress and Conference)

The city of Rio de Janeiro is one of the busiest cities for international events in Brazil.



Source: Ministério do Turismo

Figure 2-26 Characteristics of International Events in the City of Rio de Janeiro

(4) Annual Big Events and Upcoming Important Big Events

1) Annual Big Events

There are two big events held annually in the city of Rio de Janeiro, as shown in Table 2-4.

Table 2-4 Annual Big Events in the City of Rio de Janeiro

No.	Event	Location	Date	No. of Visitors
1	Carnival	Centro-RJ	8-12 Feb. 2013 28 Feb. 2014 12 Feb. 2015	60,000
2	New Year's Eve (Revéillon de Copacabana)	Copacabana	31-Dec.–1 Jan.	About 2 million

Source: JICA Study Team

i) Carnival (http://www.rio-carnival.net/)

Rio Carnival has become world famous through its Samba Parade, which includes a show, display, and competition among Rio samba schools.

ii) Copacabana Reveillon (http://www.rio.rj.gov.br/web/riotur)

This is the party to celebrate the arrival of New Year on the beach of Copacabana held every New Year's Eve. On Copacabana Beach, screens and stages are built for famous artists and bands. Fireworks display usually last about 20 minutes to celebrate New Year.

2) Upcoming Large Scale Events

Four large-scale events are scheduled in the city of Rio de Janeiro in the next five years, as shown in Table 2-5.

Table 2-5 Upcoming Large-scale Events in the City of Rio de Janeiro

No.	Event	Location	Date	No. of Visitors
1	World Youth Day	Rio de Janeiro	23-28 July 2013	Not estimated yet
2	FIFA Confederations Cup	Belo Horizonte, Brasília, Fortaleza, Recife, Rio de Janeiro, Salvador	15-30 June 2013	On average, more than 60,000 fans will watch each of the 16 matches
3	FIFA World Cup	Belo Horizonte, Brasília, Cuiabá, Curitiba, Fortaleza, Manaus, Natal, Porto Alegre, Recife, Rio de Janeiro, Salvador, São Paulo	12 June-13 July 2014	About 3.7 million tourists
4	Olympic Games	Rio de Janeiro	5-21 Aug 2016	More than 10,500 athletes 6.1 million spectators during the games with maximum 470,000 visitors per day

Source: JICA Study Team

i) World Youth Day (http://www.rio2013.com/en)

The World Youth Day, held annually in the dioceses of the world, provides an international meeting of young people with the Pope every two or three years, which lasts about a week.

ii) FIFA(Fédération Internationale de Football Association**) Confederations Cup** (http://www.fifa.com/confederationscup/index.html)

This competition is held every four years. In recent times, it has been seen as a warm-up event of the host country of the next FIFA World Cup. Matches will be held in six cities including Rio de Janeiro.

iii) FIFA World Cup (http://www.copa2014.gov.br/en)

The FIFA World Cup is one of the biggest sporting events held every four years. Matches will be held in 13 cities including Rio de Janeiro.

iv) Olympic Games (http://www.rio2016.org.br/)

The Olympic Games is held every four years. In 2016, the host city will be Rio de Janeiro. It is anticipated that funding will grow from US$80 million to at least US$200 million by 2016 to support a variety of sports infrastructures and program developments.

3) Transportation Plan for the Annual Events

The experiences in traffic and transportation operations during Rio's annual large events, as shown in Table 2-6, should be helpful in making strategies for the upcoming large-scale events. Based on these experiences, public transport and traffic operators should work together in large-scale events.

Table 2-6 Experiences in Rio's Annual Large-Scale Events

Event	Location	Spectators	Public Transport System Serving the Event	Departing Passengers per Hour	Traffic and Transport Supporting Staff	Special Measures
New Year's Eve	Copacabana Beach	2,000,000	Metro 36 bus services	90,000	800 municipal traffic staff 60 traffic engineers of CET	120 road closures 152 intersections managed
	Ipanema Beach	500,000	28 bus services	50,000	200 municipal traffic staff	55 road closures 90 intersections managed
	Barra Beach	150,000	15 bus services	25,000	50 municipal traffic staff 10 traffic engineers of CET	8km of road closures
Carnaval	Sambodrómo	60,000	Metro 63 bus services Suburban railway	60,000	60 municipal traffic staff 30 traffic engineers of CET 60 military policemen	94 road closures
Maracana Games	Maracanã	80,000	Metro 47 bus services Suburban railway	60,000	50 municipal traffic staff 30 traffic engineers of CET	6 road closures
Rio Marathon	Barra - South zone - Rio center	-	-	-	30 municipal traffic staff 10 traffic engineers of CET	7 road closures

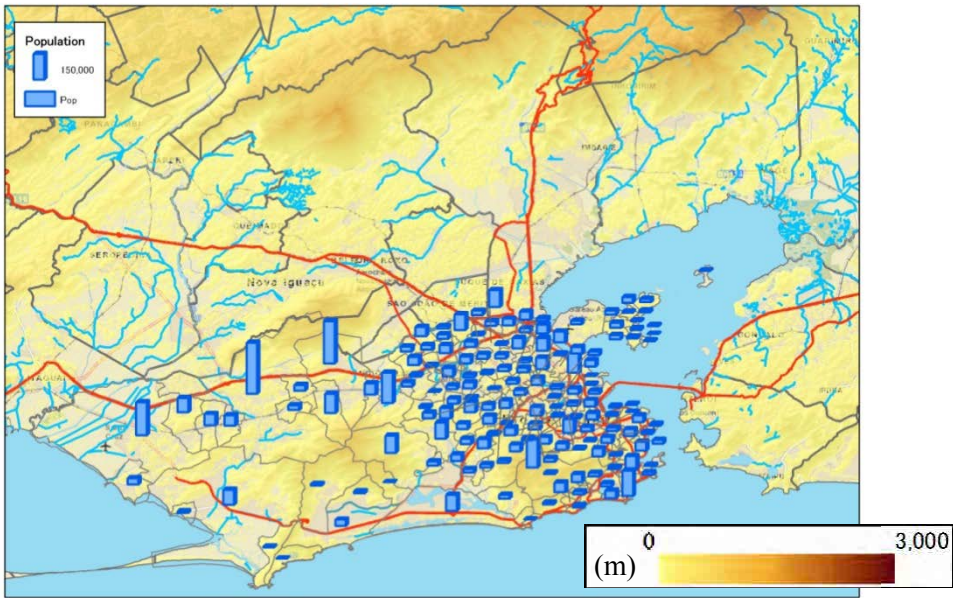
Source: Transport Strategic Plan for the Rio 2016 Olympic and Paralympic Games

(5) Geographic Conditions

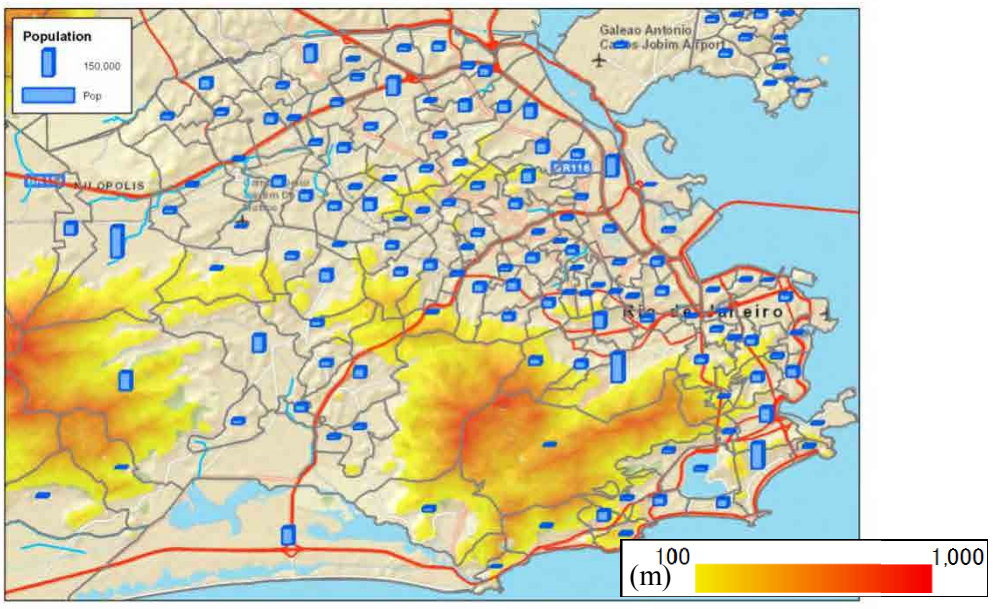
1) Hills and Rivers

Using the meshed altitude data derived from the Space Shuttle Radar contour figures are developed as shown in Figure 2-27. The hills and water areas like rivers and lakes are mixed together as well as those close to populated areas in the city of Rio de Janeiro.

[Metropolitan Region]



[Rio City]



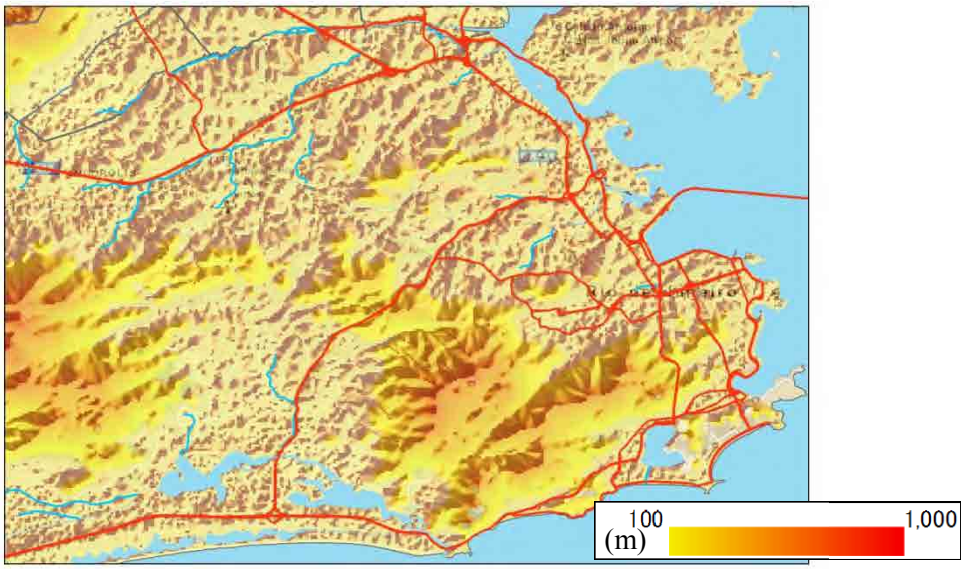
Source: Shuttle Radar Topography Mission (SRTM) (http://www2.jpl.nasa.gov/srtm/)
Population data were prepared based on the data provided by SMTR

Figure 2-27 Contours in Rio de Janeiro

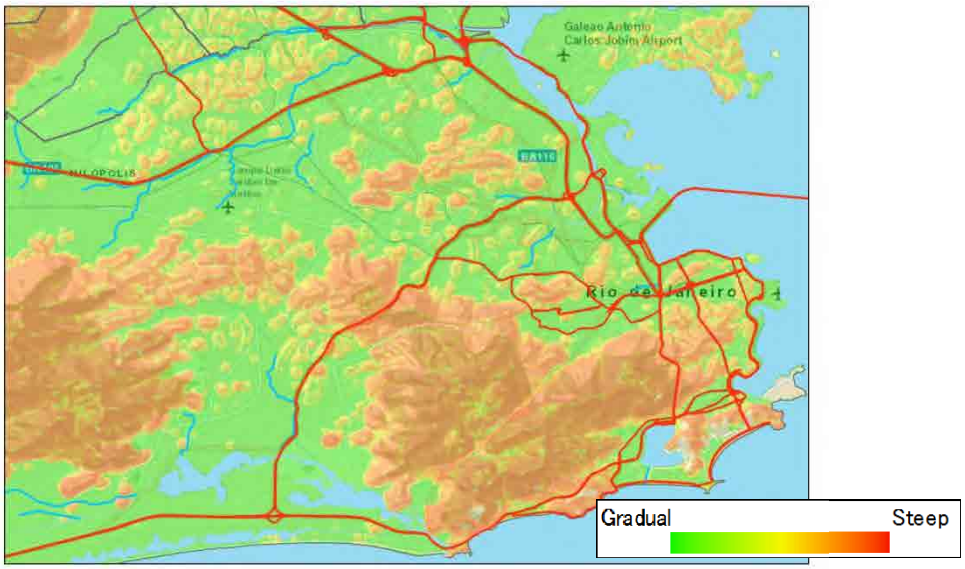
2) Topological Features in Central Rio

Through spatial analysis, topological features like hill shade and slope angle are calculated. The ring connecting Centro, Copacabana, Barra da Tijuca, and Meler surrounds the hills area. The area along the border between the hills and urban areas needs to be considered as a high-risk area for natural disasters.

[Hills and Contour]



[Slope]



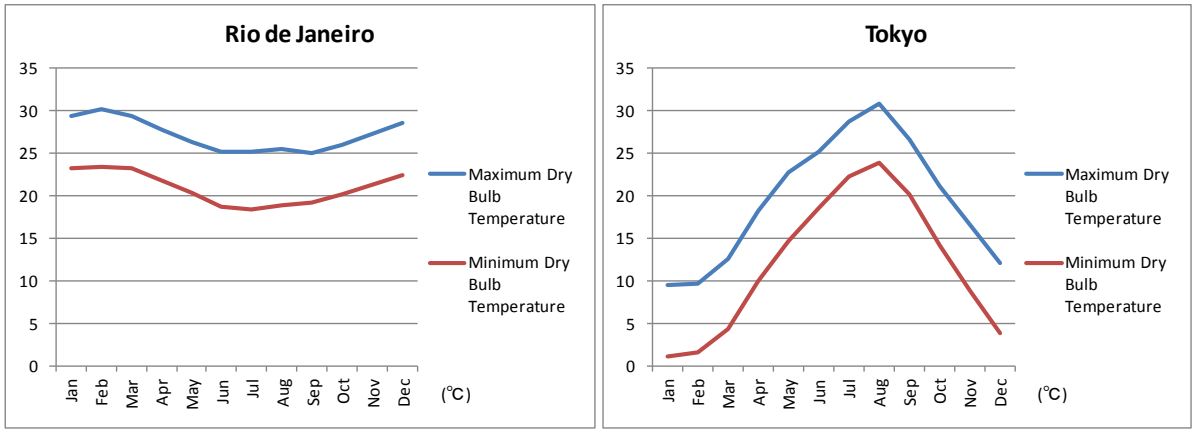
Source: Shuttle Radar Topography Mission (SRTM) (http://www2.jpl.nasa.gov/srtm/)

Figure 2-28 Topographic Characteristics in Rio de Janeiro

(6) Weather Conditions

Aside from the characteristics of topology, there is a feature in the weather conditions of Rio de Janeiro. Rio de Janeiro has two seasons. These are hot season where it is accompanied by rainy season and cool season accompanied by dry season. The hot and rainy season in Rio de Janeiro is from November to April.

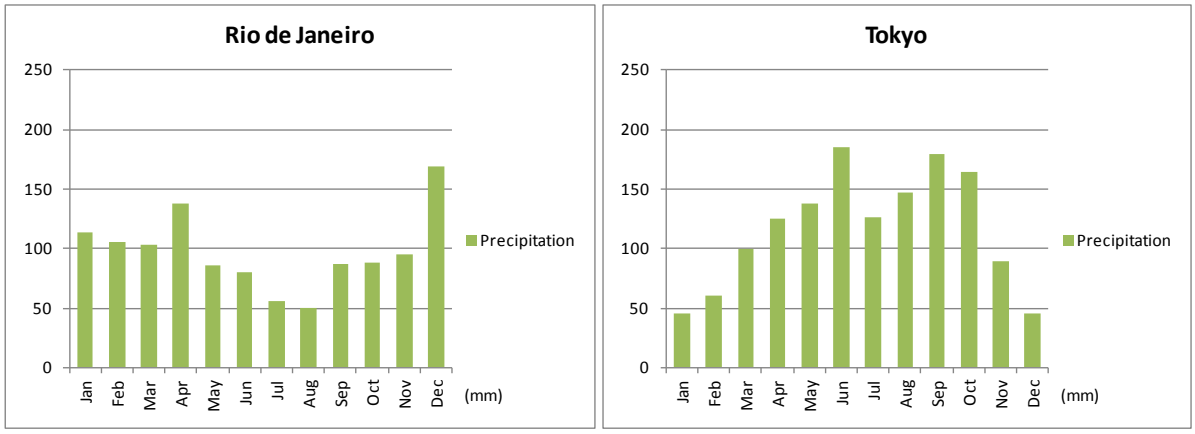
[Temperature]



Source: UNdata (United Nations Statistics Division)

Figure 2-29 Temperatures in Rio de Janeiro and Tokyo

[Precipitation]



Source: UNdata (United Nations Statistics Division)

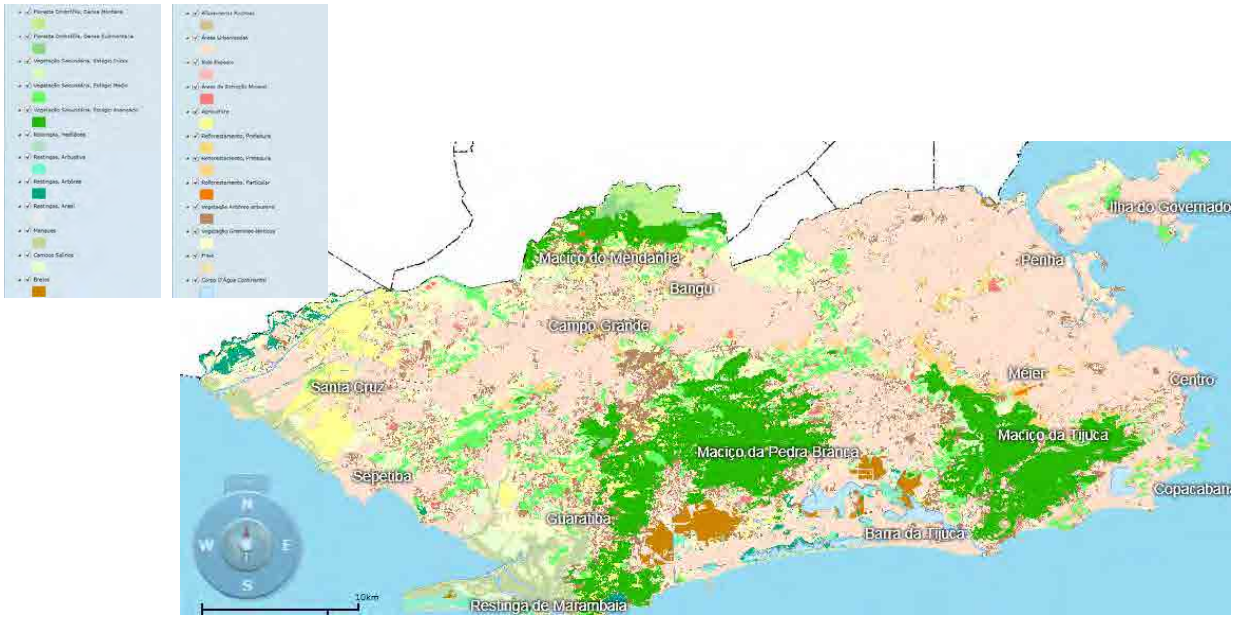
Figure 2-30 Precipitation Comparison in Rio de Janeiro and Tokyo

(7) Natural Environment

Rio de Janeiro has rich natural resources. Vegetation covers about 30% while the urbanized area covers about 44% of the total land area. In Figure 2-31, land cover is quite complicated especially in the southern area.

Table 2-7 Area by Land Cover in the City of Rio de Janeiro

Land Cover		Area	Share
Areas of vegetation Atlantic	Rain Forest Montana	882 ha	0.7%
	Rain Forest Submontane	347 ha	0.3%
	Secondary vegetation - Early stage	3,096 ha	2.5%
	Secondary vegetation - Middle stage	6,117 ha	5.0%
	Secondary vegetation - Advanced stage	16,500 ha	13.5%
	Restinga	1,959 ha	1.6%
	Mangrove	3,399 ha	2.8%
	Apicum	1,323 ha	1.1%
	Marsh	1,666 ha	1.4%
	Subtotal	**35,290 ha**	**28.9%**
Urban and anthropic	Urban area	53,117 ha	43.5%
	Agriculture	5,249 ha	4.3%
	Arboreal vegetation and shrubs	8,662 ha	7.1%
	Grassy-woody vegetation	13,593 ha	11.1%
	Mineral extraction areas	347 ha	0.3%
	Bare soil	68 ha	0.1%
	Subtotal	**81,037 ha**	**66.4%**
Other classes	Rocky outcrop	759 ha	0.6%
	Waterbody continental	2,131 ha	1.7%
	Beach	653 ha	0.5%
	Reforestation	2,158 ha	1.9%
	Subtotal	**5,805 ha**	**4.7%**
Total Land Area		**122,131 ha**	**100%**



Source: Secretaria Municipal de Meio Ambiente (http://www.rio.rj.gov.br/web/smac/)

Figure 2-31 Land Cover in Rio de Janeiro

(8) Natural Disaster

1) Record of Great Disaster

Due to weather conditions, namely heavy rainfall in a specific period, and due to the mixed land cover between urban areas and hills, a lot of natural disasters have occurred in Rio de Janeiro. In the last two years, three serious natural disasters were recorded, where floods and mudslides took place.

i) January 2010 floods and mudslides

Duration: 30 December 2009–6 January 2010

Fatalities: At least 85 people died

Areas affected: Angra dos Reis and Ilha Grande (State of Rio de Janeiro)

Source: http://www.abc.net.au/news/2010-01-03

ii) April 2010 floods and mudslides

Duration: 5 April 2010–mid-April 2010

Fatalities: About 250 people died

Areas affected: Rio de Janeiro, Niterói, Sao Gonçalo, Paracambi, Engenheiro Paulo de Frontin, Magé, Nilópolis, Petrópolis, Maricá and Araruama (state of Rio de Janeiro)

Source: http://news.bbc.co.uk/2/hi/americas/8619624.stm

iii) January 2011 floods and mudslides

Duration: 11 January 2011

Fatalities: About 900 people died

Areas affected: Teresópolis, Nova Friburgo, Petrópolis, Sumidouro, and São José do Vale do Rio Preto (state of Rio de Janeiro)

Source: http://oglobo.globo.com/rio/

Source: Subsecretaria de Defesa Civil do Rio de Janeiro (http://www0.rio.rj.gov.br/defesacivil/)

Figure 2-32 Photos of the Disaster in Rio de Janeiro

2) AlertaRio

i) Alert System of Landslides

The AlertaRio is a system set up to inform relevant authorities of the probability of landslide occurrences when the rain gauges detect rain values that exceed the preset limits of the Institute of Geotechnical (*Fundação Instituto de Geotécnica*: Geo-Rio). Geo-Rio which operates within the Municipal Works (*Secretaria Municipal de Obras*: SMO) is responsible for public safety in terms of geological issues, such as landslides and mudslides. The Department for Civil Defense of the city of Rio de Janeiro utilizes this alert system for disaster management and advises on evacuation.

The probability of landslides is defined in AlertaRio, as follows:

1) Low Probability

Possibility of circumstantial occurrences of landslides (depends on conditions related to natural or anthropogenic effects, such as breakage of pipes, thermal expansion, and vibrations).

2) Average Probability

Possibility of occasional occurrences of landslides (triggered by rains predominantly on artificial slopes (cut or fill)).

3) High Probability

Occurrence of landslides in sparse areas (triggered by heavy rains in natural and artificial slopes).

4) Very High Probability

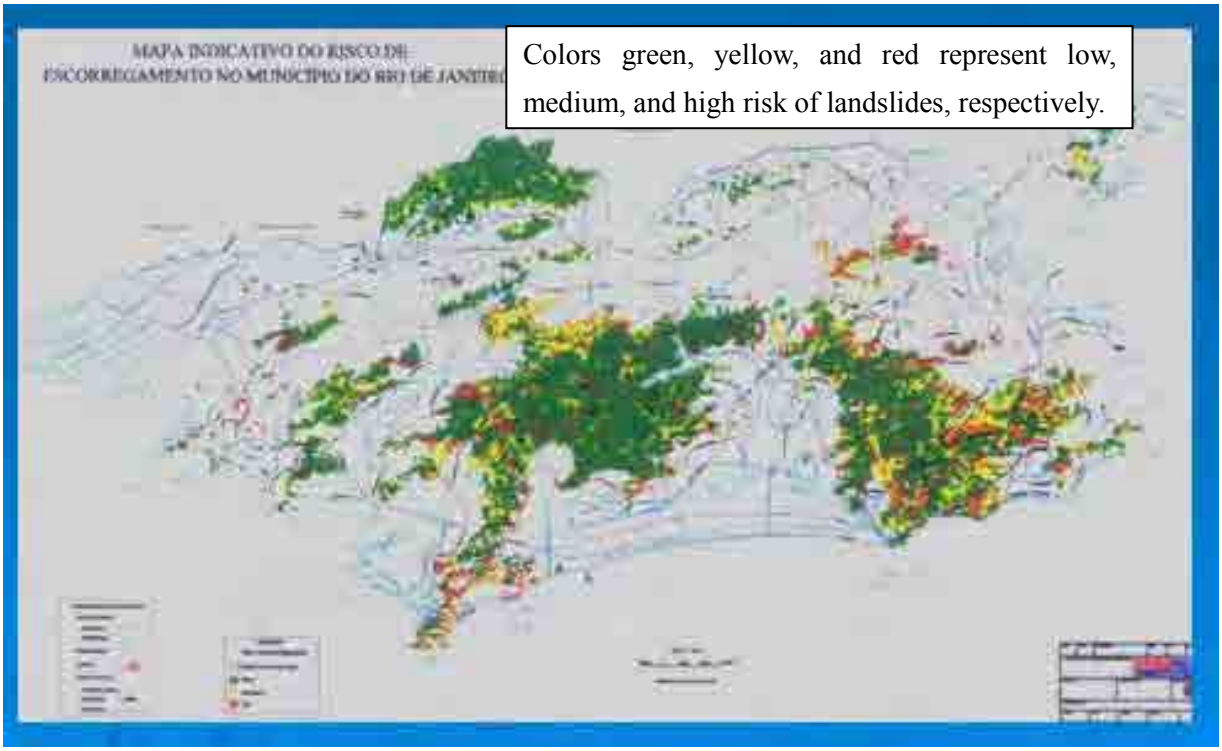
Occurrence of widespread landslides (triggered by heavy rains on natural and artificial embankments, especially routes that cut upland).

ii) Probability of Landslides in Rio de Janeiro

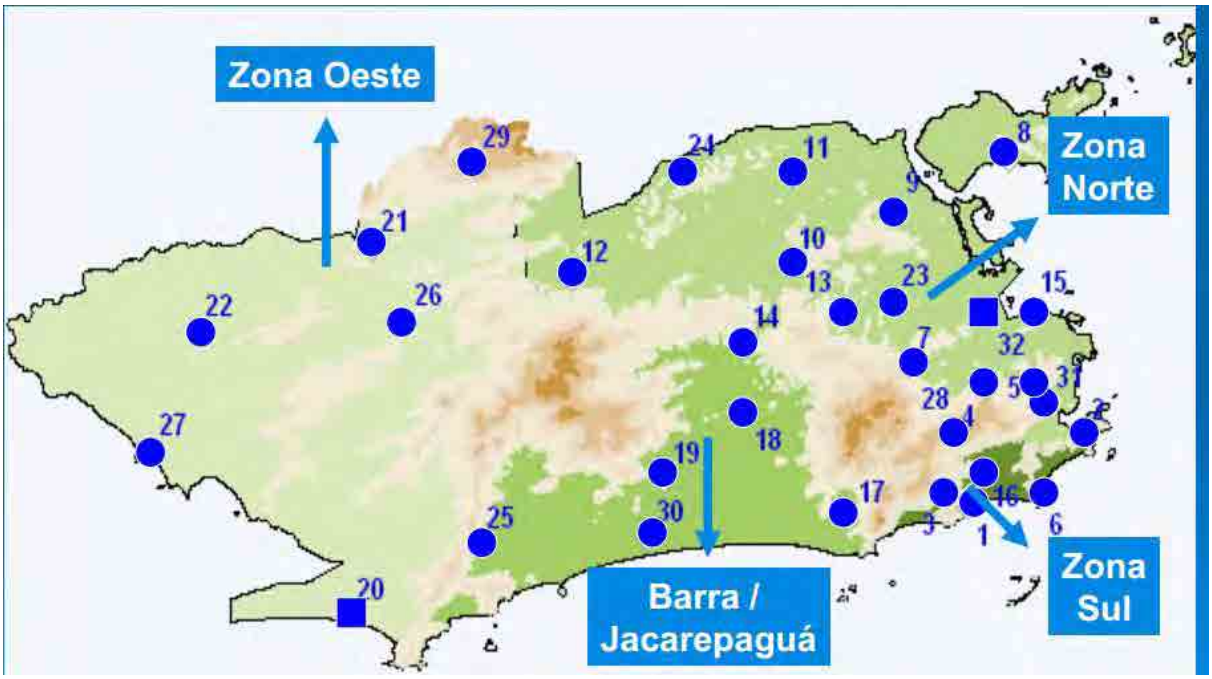
The probability of landslide estimated by Geo-Rio is based on the relationship between the rain fall and the risk of landslide.

The maps of landslide risk and locations of rain gauge used by AlertaRio are shown in Figure 2-33.

[Risk of landslide]



[Rain gauge stations]



Source: AlertaRio Home Page (http://www0.rio.rj.gov.br/alertario/)

Figure 2-33 Map of the Landslide Risk and Rain Gauge Stations

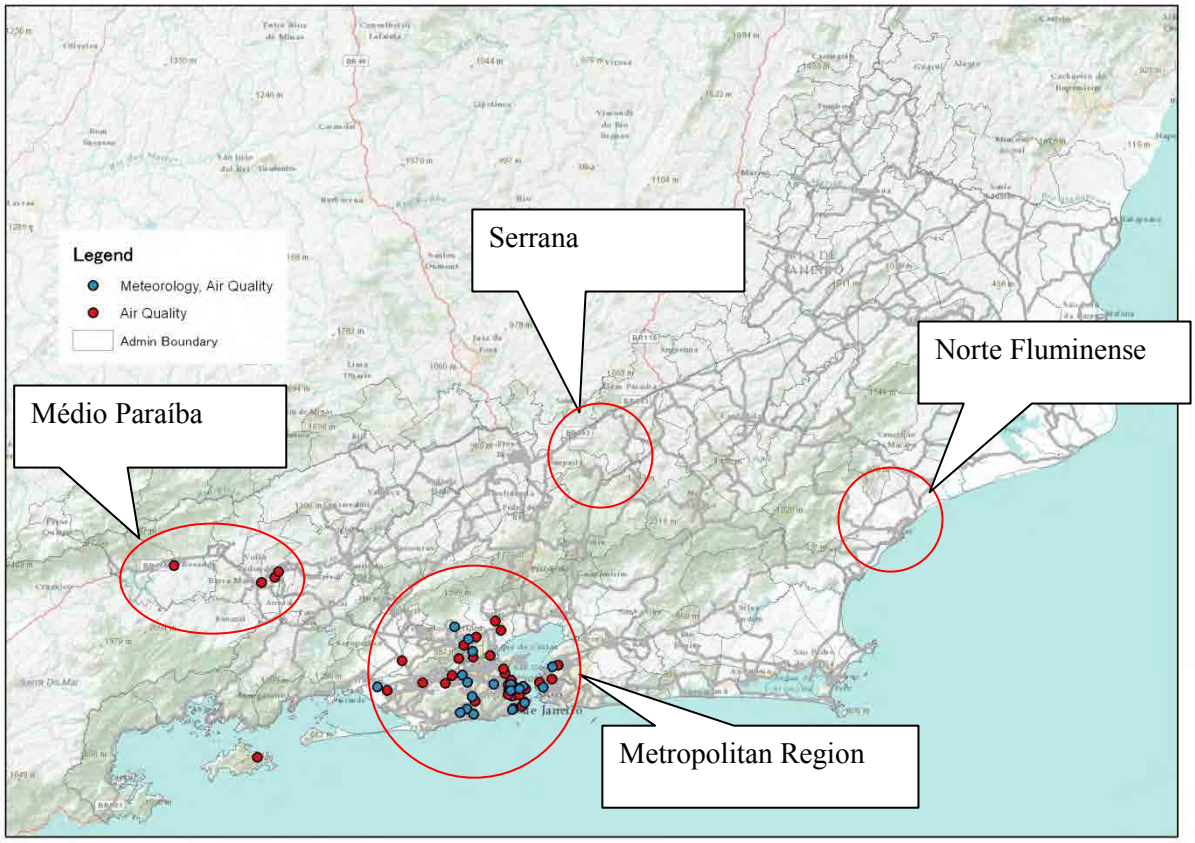
(9) Air Quality

Air quality is monitored by the state and city related bodies.

1) Quality of Air (INEA)

The State Environmental Institute (*El Instituto Nacional De los Espacios Acuaticos*: INEA) is linked with the Secretary of State for Environment. This organization was created by Law No. 5101 on 04 October 2007. Its objective is to protect, conserve, and restore the environment to promote sustainable development. The INEA publishes the results of air quality monitoring, as well as the water levels of rivers monitored.

The stations for monitoring air quality are shown in Figure 2-34. Some examples of monitoring results are shown below, which are downloaded from the website of INEA. Based on Table 2-8, the air quality is good at this time.



Source: Station points are provided by INEA

Figure 2-34 Monitoring Stations for Air Quality by INEA

Table 2-8 Monitoring Results by INEA on 3 October 2012 (Example)

Automatic network		
Station	**Pollutant**	**Classification**
Médio Paraíba – 03/10/2012		
Barra Mansa – Boa Sorte	PM10	Bom
Barra Mansa – Bocaininha	PTS	Regular
Barra Mansa – Roberto Silveira	PTS	Regular
Barra Mansa – Vista Alegre	PM10	Regular
Quatis	NO2	Bom
Resende – Casa Lua	PTS	Regular
Resende – Cidade Alegre	PTS	Regular
Volta Redonda – Belmonte	PTS	Regular
Volta Redonda – Retiro	O3	Regular
Volta Redonda – Santa Cecilia	O3	Regular
Metropolitan Region – 03/10/2012		
Duque de Caxias – Sao Bento	PM10	Bom
Itaguai – Monte Serrat	O3	Bom
Jacarepagua	PM10	Bom
Japeri	O3	Regular
Niteroi – Icarai	SO2	Bom
Nova Iguacu	O3	Bom
Recreio dos Bandeirantes	O3	Bom
Santa Cruz	O3	Regular
Norte Fluminense – 03/10/2012		
Macae – Fazenda Airis	O3	Regular
SERRANA – 03/10/2012		
Cantagalo – Euclidelandia	PM10	Bom
Note: Bulletin updated daily from 15 h.		

IQA - Air Quality Index							
Classification	**PTS**	**PM10**	**SO2**	**NO2**	**O3**	**CO**	**Effects**
	média (24h)	média (24h)	média (24h)	média (1h)	média (1h)	média (8h)	
	ug/m3	ug/m3	ug/m3	ug/m3	ug/m3	ug/m3	
Bom (0-50)	0-80	0-50	0-80	0-100	0-80	0-5000	**Health insurance**
Regular (51-100)	81-240	51-150	81-365	101-320	81-160	5001-10000	**Tolerable**
Inadequada (101-199)	241-375	151-250	366-800	321-1130	161-200	10001-17000	**Inappropriate welfare**
Má (200-299)	376-625	251-420	801-1600	1131-2260	201-800	17001-34000	**Offensive Health**
Péssima (300-399)	626-875	421-500	1601-2100	2261-3000	801-1000	34001-46000	
Crítica (acima de 400)	876-1000	501-600	2101-2620	3001-3750	1001-1200	46001-57500	

Source: JICA Study Team

2) MonitorAr-Rio (SMAC)

In the cities, the Municipal Secretariat of the Environment (*Secretaria Municipal de Meio Ambiente*: SMAC) is in charge of monitoring air quality. This organization is the central organization of the municipal environmental management system.

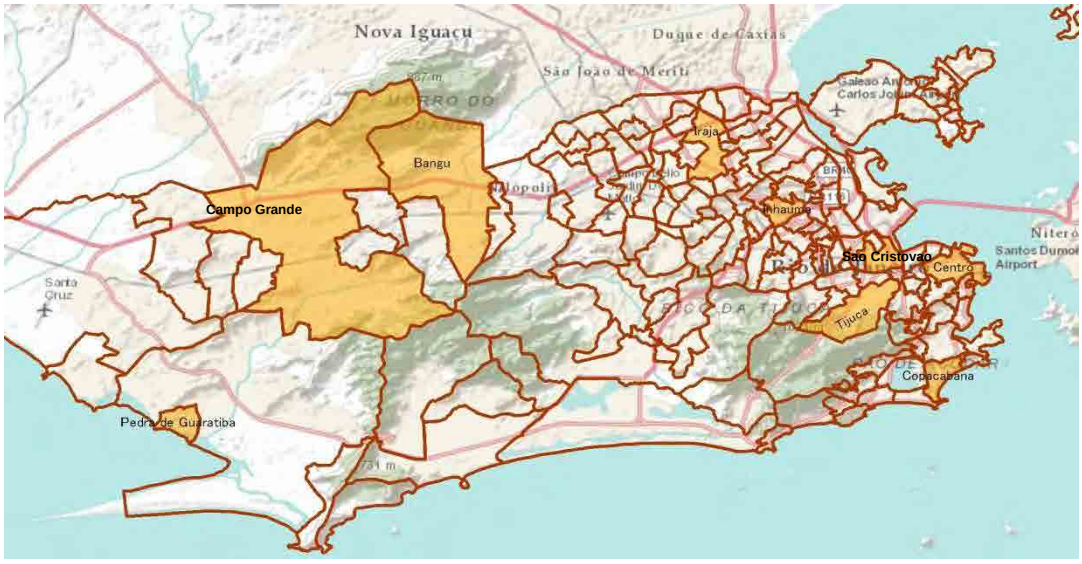
It also publishes the results of air quality monitoring. An example of monitored results is shown in Table 2-9, which was downloaded from the website of INEA. Based on the table below, air quality is almost good at this time.

Table 2-9 Monitoring Result by SMAC on 3 October 2012 (Example)

Station	Maximum Concentration Pollutants Monitored					Air Quality Index (IQA)	Classification
	SO2 [µg/m³](3)	CO (ppm) (2)	MP10 (µg/m³)(3)	O3 [µg/m³](1)	NO2 [µg/m³](1)		
Bangu	3,5	0,7	54,4	**170,8**	79,8	126	Inadequada
Copacabana	4,0	0,4	**58,3**	49,5	ND	55	Regular
São Cristóvão	9,3	0,3	**30,2**	138,0	ND	30	Boa
Unidade Móvel Inhaúma	Temporariamente desativada para reposicionamento						
Campo Grande	1,5	0,6	52,9	**142,3**	91,2	89	Regular
Centro	5,2	0,3	**39,4**	52,6	ND	39	Boa
Irajá	3,5	0,5	37,6	**112,9**	81,3	71	Regular
Pedra de Guaratiba	NM	NM	63,4	**124,6**	NM	78	Regular
Tijuca	1,7	0,7	45,2	**80,1**	ND	50	Regular
Concentration ranges of pollutants to calculate the IQA	SO2 [µg/m³](3)	CO (ppm) (2)	MP10 (µg/m³)(3)	O3 (µg/m³)	NO2 (µg/m³)(1)	Air Quality Index (IQA)	Classification
	0 - 80	0 - 4	0 - 50	0 - 80	0 - 100	0 - 50	BOA
	81 - 365	4,1 - 9	51 - 150	81 - 160	101 - 320	51 - 100	REGULAR
	366 - 800	9,1 - 15	151 - 250	161 - 200	321 - 1130	101 - 199	INADEQUADA
	801 - 1600	15,1 - 30	251 - 420	201 - 800	1131 - 2260	200 - 299	MÁ
	1601 - 2100	30,1 - 40	421 - 500	801 - 1000	2261 - 3000	> 300	PÉSSIMA

Classification	Meaning of Classification
BOA	Virtually no health risks.
REGULAR	People of sensitive groups may experience dry cough and tiredness. The population in general is not affected.
INADEQUADA	The entire population may have symptoms such as dry cough, fatigue, burning eyes, nose and throat. People of sensitive groups may experience more serious health effects.
MÁ	The entire population may have worsening symptoms such as dry cough, fatigue, burning eyes, nose and throat and still has shortness of breath and wheezing. More serious effects on the health of sensitive groups.
PÉSSIMA	The entire population can present serious risks of manifestations of respiratory and cardiovascular diseases. Increase in premature deaths in people sensitive groups

(1) Average maximum 1 h, (2) Average maximum 8 h, (3) Average 24 h, (4) IQA calculated for the last 24 h, ND - Not available, NM - Not monitored by the station



Source: JICA Study Team

Figure 2-35 Monitoring Areas for Air Quality by SMAC

2.1.5 Current Condition of Telecommunications

(1) Telecommunications in Brazil

1) General

Brazil's telecommunications and technology information has expanded rapidly and is one of the highest worldwide. This is due to the Brazilian economic growth and exploitation mainly by private companies. The main public policy for telecommunications in Brazil is in the National Broadband Program (*Programa Nacional de Banda Larga*: PNBL) established by the Decree 7.175/2010, it was intended to increase the coverage of fast internet in Brazil, reducing the cost to the end user, and increasing the speed of connection.

The PNBL also includes investments in the direct federal government on 31,000 km of Optical Fiber Backbone, which has materialize by the end of 2012 that will extend to major Brazilian cities, reaching almost half of the country's population. The telecommunication sector in Brazil was primarily responsible for the record history of foreign inflows into the country in 2011. The establishment of a National Network that makes use of optical fibers in the field of Union aims to improve the infrastructure for broadband in Brazil and disseminate the service offering. The priority of the National Network is to focus on creating a network for the federal corporate capital, which meets the needs of the government and the public, and offers capacity in locations without communication service providers or with high rates or low economic attractiveness, as well as in low-income areas in the metropolitan regions.

Source: http://www4.planalto.gov.br/brasilconectado/pnbl/implantacao-e-desenvolvimento

Figure 2-36 Development Plan of Optical Fiber National Network

The federal government is conducting these actions for these sectors in order to achieve the following goals by 2015:

- The number of households with access to the internet will be more than double, from 17.4 million to 40 million;
- Growth will be similar with TV subscriptions: it will be 32% of households against the current 18%;
- 70% of the population will use the internet, against 41.7% stated in the survey of 2009;
- Each monthly service of 190 minutes will increase by 75% of the current average;
- All public schools in Brazil will have broadband internet. Today, it is only available in urban schools; and
- The share of domestic production in the national market for equipment and telecommunication apparatus will rise to 70% between 2017 and 2022.

Another key objective of the PNBL is to take up the countryside compliance with voice and data. To achieve this goal, the government will bid to track a frequency of 450 MHz (Sub-ranges of 451 MHz to 458 MHz and from 461 MHz to 468 MHz) that will be used in reaching remote rural areas with a progressive increase in coverage and speed.

2) Fixed telephone

The number of fixed telephones in Brazil is relatively low and since 2002 this number has been more or less stagnant and even decreasing, losing customers to mobile telephones.

Brazil ended 2011 with 43 million users accessing the Fixed Switched Telephone Service (STFC), a growth of 2.1% over the previous year as detailed in the chart below. With this evolution, density service reached 22 accesses for each group of one hundred residents.

Between 2010 and 2011, the density service in Brazil and the number of hits per hundred residents had a slight increase, from 21.7 to 22.

Source: ANATEL

Figure 2-37 Access and Density of Fixed Telephone in Brazil

Among the units of the federation, Sao Paulo, with 38.6 accesses to every hundred residents, had the highest density service; Maranhão, with six hits to every hundred residents, had the lowest density. Between 2010 and 2011, the highest growth was recorded in Acre, where the density increased by 13.8%, from 9.4 to 10.7. The largest decrease of 14.3% was in Amapá, where the index fell from 9.8 to 8.4. The following chart presents the density of fixed telephones throughout the country.

Source: ANATEL

Figure 2-38 Density of Fixed Telephone in Each State

3) Mobile telephone

Brazil ended 2011 with 242.2 million accesses to the mobile service, a growth of 19.4% in the previous year, when the country had 202.9 million accesses. The following chart shows how the number of mobile accesses has evolved in recent years.

In 2011, the density of the service accesses reached 123.9 operations in every hundred people with an increase of 18.3% compared to 2010, when Brazil surpassed access to the personal mobile service per capita.

Source: ANATEL

Figure 2-39 Access and Density of Mobile Telephone in Brazil

In comparison with 2010, all units of the state had grown in density service at the end of 2011, only Maranhão had not exceeded the goal of a cellular per capita density (80.4), although it registered the highest percentage growth in the previous year.

Between 2010 and 2011, the largest variations in density of personal mobile service occurred in Maranhão (32.2%), Piauí (27.6%), and Pará (27.1%). The smallest variations were recorded in Santa Catarina (13.9%), in the Spirit Ghost (14%), and Rio Grande do Sul (14.2%). The following graph shows the development of density in all Brazilian states between 2010 and 2011.

Source: ANATEL

Figure 2-40 Access and Density of Mobile Telephone in Each State

One of the main characteristics of the mobile service is the rapid technological change associated with the provision of service. In 2010, there were more terminals exclusively for analog (Advanced Mobile Phone System (AMPS) technology) assets in the plant personal mobile service operators. In 2011, the same happened with the accesses of the Time Division Multiple Access (TDMA) digital technology or so called second generation (2G).

The development and bidding for the fourth generation mobile (4G) is one of the priority actions in Brazil since it will expand access to telecommunications mobile high speed broadband. This means that the population will have access to data services with speeds of up to ten times higher than those of today with telephony 3G.

Furthermore, this new technology will be critical to ensure that future needs are met by way of a larger broadband for major sporting events that will be hosted by Brazil like the FIFA Confederations Cup 2013, World Cup in 2014, and Olympics in 2016. The frequency range of 2.5 GHz, which will allow the operation of 4G telephony, will be auctioned this year, with great interest from the sector and a prediction of large investments.

-Smartphone-

The smartphone market in Brazil has been growing. One of the key factors contributing to this market growth is the declining price of smartphones. The smartphone market in Brazil has also been provided in a number of incentives by the local government for the production of the 4G technology of smartphones in the country.

Recently, many navigation services have been available on smartphones in advanced countries. In Brazil, the Google Map application service has also been introduced. The effectiveness and convenience of the smartphone will improve together with network speed enhancement.

Source: JICA Study Team

Figure 2-41 Google Map with Smartphone

-Mobile phone with One-Seg TV function-

Due to the implementation of digital TV in Brazil, One-Seg TV function is also available, both on existing/traditional phones and on smartphones. During the London Olympics, many mobile phones with this service were sold to enable users to watch the Olympic Games in Brazil. Since then, the mobile phone with One-Seg TV function has not been so popular. If useful and important information could be accessed by using data broadcasting, it would most certainly be more popular. Currently, there are few services that provide data broadcasting. The data broadcasting specification of One-Seg TV function is Ginga, defined by Forum SBTVD— Brazilian System for Digital Television (*Sistema Brasileiro de Televisão Digital*: SBTVD). See detail in 1.1.5 (1) 6) Digital TV. Figure 2-42 shows a picture of a smartphone with One-Seg TV function in Brazil. The One-Seg TV can be watched in Brazil. When the user activates One-Seg TV function, the data broadcasting service starts to show various information. However, in Brazil, the broadcaster is not always broadcasting it. Besides, the band of data broadcasting is not used effectively. The band can be used for various information services in the future.

Source: JICA Study Team

Figure 2-42 Smartphone with One-Seg TV

-Experiment project for data broadcasting -

From 2009 to 2010, the Japanese Ministry of Internal Affairs and Communications performed a substantial experiment on data broadcasting in Brazil. The purpose of this experiment is to emulate a real broadcasting system (broadcasting control system, receiving terminal, and interactive service) and the main features of the project are as follows:

-To contribute in publishing the Operational Guideline for the combined use of broadcasting and interactive services.

-To accelerate commercial services by showing a built on-site model system based on the above Operational Guideline for broadcast related members.

The conclusion of the project was favorable in relation to interactive services. For this reason, the Brazilian government needs to encourage private companies to import requirements from commercial services into Ginga specifications and the Operational Guideline must be improved to accelerate commercial services in the near future.

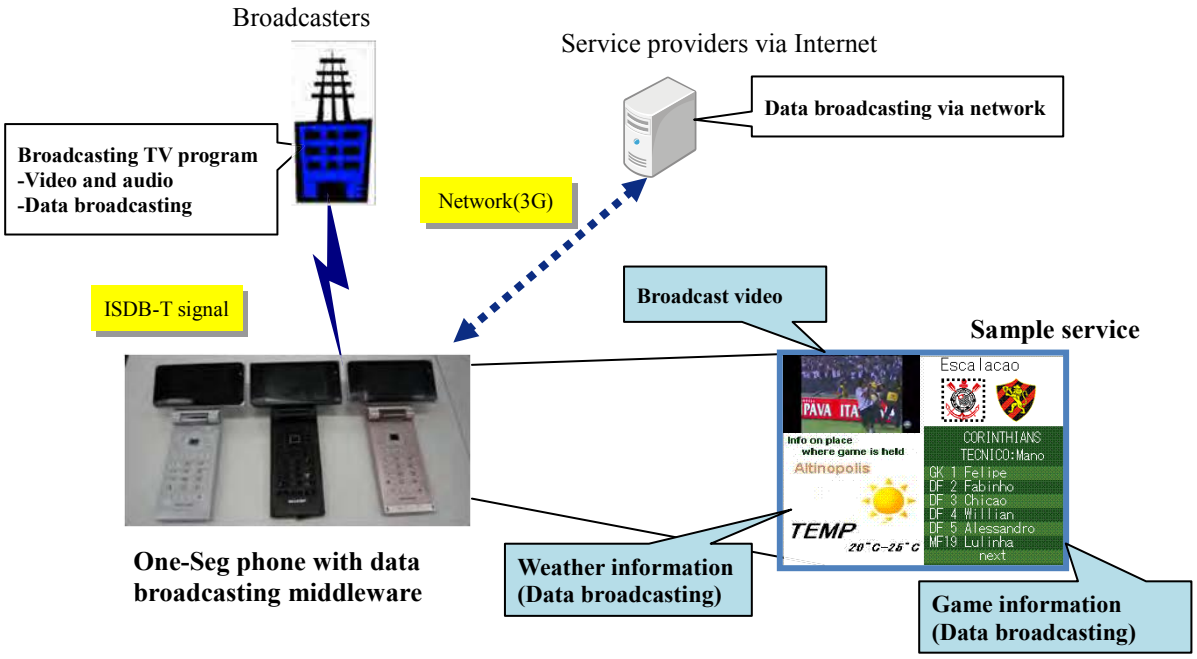


Figure 2-43 System Architecture of Experiment

4) Multimedia (Internet)

The main telecommunication service to offer fixed access to broadband Internet was the Multimedia Communication Services (*Serviços de Comunicaçao Multimídia*: SCM) in 2011, with a growth of 16.8% over the previous year. Brazil ended the year with 18.5 million accesses to the service and, as a result of this expansion of supply, there are 30.7 accesses for every hundred households.

Source: ANATEL

Figure 2-44 Access and Density of Multimedia (Internet) in Brazil

Federal District (63.7), São Paulo (53.1), Rio de Janeiro (42.2), Paraná (36.9), Santa Catarina (36.4), and Rio Grande South (31.4) were the six states of the Federation that ended the year with a greater density. The states with the lowest densities of SCM were Amapá (3.1), Maranhão (6.8), Pará (7.0), Piauí (8.8), and Alagoas (10.9). The following chart shows how density service has evolved throughout the country between 2010 and 2011.

Source: ANATEL

Figure 2-45 Access and Density of Multimedia in Each State

This growth in the number of accesses of SCM was the result of providing allied government investment projects, such as the National Broadband Plan and Broadband in Schools Project Public Urban. Besides these 18.5 million accesses of SCM at the end of the year, Brazil had 41.1 million mobile accesses to the Internet with the personal mobile service.

5) Television (TV)

With over 2.9 million additional subscribers, Brazil ended 2011 with 12.7 million subscription services to Pay TV reflecting a growth of 29.6% over the previous year. Considering the IBGE estimate of 3.3 people per home, the pay TV services are available to 42 million Brazilians.

As a result of this growth, 21.2% of households were served by the service by the end of 2011, and the chart below shows the evolution of the number of signatures in recent years.

Source: ANATEL

Figure 2-46 Access and Density of TV in Brazil

Federal District (39), Sydney (38.2), Rio de Janeiro (33.1), Amazonas (22.7), Rio Grande do Sul (22.3), and Santa Catarina (22.1) were the only units of the Federation which closed with an above average performance (21.2) of national density of TV services in 2011. Although it registered the largest percentage change in the number of households served between 2010 and 2011, the Piauí ended the year with the lowest penetration service, with 5.3 subscriptions for every 100 households. In late 2011, São Paulo had more than 5.1 million signatures for pay TV services, which accounted for 40.4% of all accesses. The graph below shows the evolution of density of TV services between 2010 and 2011.

Source: ANATEL

Figure 2-47 Access and Density of TV in Each State

In many countries, the Smart TV services by which users can receive various services on TV via Internet connection, have been introduced in recent years. Current Pay TV services in Brazil are based on cable television (CATV) or satellite broadcasting, but services based on Internet connection are likely to start soon.

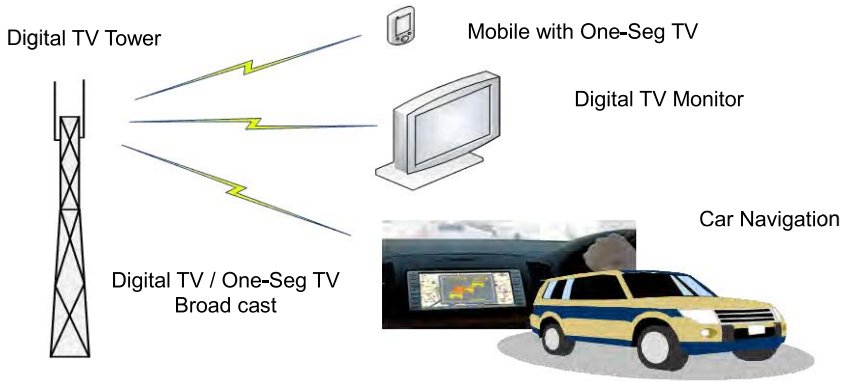
- Digital TV -

Television is the basic electronic product used in Brazil, with 96.6% presence in the lives of citizens. The Brazilian government chose the Integrated Services Digital Broadcasting - Terrestrial (ISDB-T) International as their broadcasting system. It is based on ISDB-T which is maintained by the Association of Radio Industries and Businesses (ARIB), a Japanese organization and by Forum SBTVD. The choice aimed to benefit society as well as the content production sector and industry, by promoting social inclusion in the country. It took into account the free high-definition (HD) reception and mobility. The system also allows other services to use band spectrum more efficiently. Today ISDB-T is accessible to over 550 million residents in countries with an aggregate GDP of more than US$7 trillion, ensuring a worldwide market for converters and transmitters at competitive prices. Data broadcasting, coupled with the presence of television in the country, opens up great possibilities of services for the citizens, as well as business opportunities for broadcasters and advertisers. On this line, the government has been supporting initiatives and content innovative digital applications, games or platforms to serve the citizens. In this context, Brazilian Ginga was developed by scientists, as middleware standard for interactivity in the Brazilian digital TV.

Ginga is the specification of Brazilian digital TV. It is managed by Forum SBTVD, and its specifications are released by the Brazilian Association of Technical Standards *(Associação Brasileira de Normas Técnicas*: ABNT). Ginga contains two subsystems, i.e., Ginga-NCL and Ginga-J. Ginga-NCL is a language to show video, image, and text on digital TV. It can also contain Lua (script language) to describe basic procedure and application. Ginga-J is a language to run Java application on digital TV. Broadcasters can provide interactive and rich services for users by using the above subsystems.

By 2011, digital TV had already reached about 46% of the households in Brazil, which corresponds to more than 87 million people. The switch-off of the analogue signal is expected to be in 2016. Until then, the generating stations and retransmitting of television will use the two forms of transmission.

Owing to the digital TV implementation, digital TV or One-Seg TV can be watched on the mobile, TV monitor, and car navigation as shown below:



Source: JICA Study Team

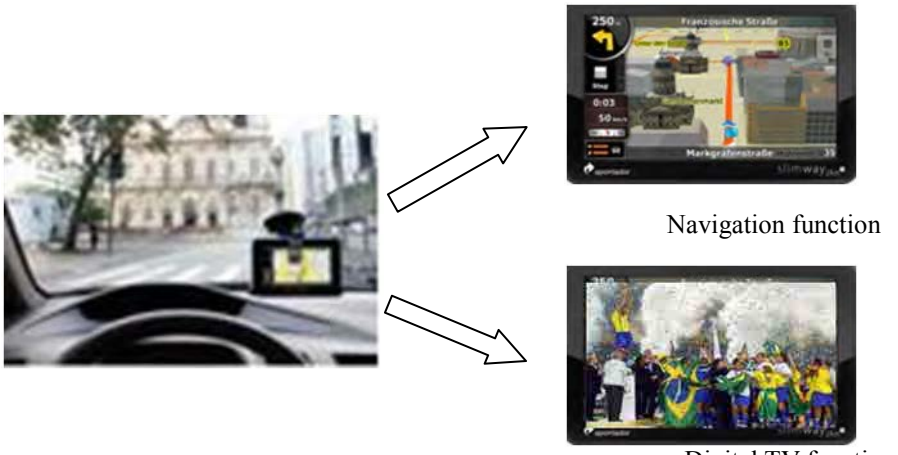
Figure 2-48 Digital TV Broadcasting Image

6) Car Navigation System in Brazil

The navigation system is becoming increasingly popular in Brazil. Most new cars coming onto the Brazilian market are not equipped with navigation system, but recently, some Japanese cars have been equipped with the Japanese navigation system upon arrival in Brazil. With the rise of car use in Brazil, navigation systems have been increasing accordingly.

The prices of the systems are from R$350 to R$450 for domestic product and R$600 to R$900 for international product. The domestic product is more popular and familiar to the Brazilians. The main function of the navigation system is to display a map of where you are and to show the route for your specified destination in 3D or other such display, based on the location data from the Global Positioning System (GPS) receiver. There is no other information on traffic such as traffic jams. Another major function, which is very popular in Brazil, is to be able to watch digital TV and to listen to FM/AM radio.

Due to the increasing popularity of smartphone and its navigation services, the popularity of the car navigation system has not increased recently. See Smartphone Section in 2.1.5(1)3) Mobile telephone as reference.



Navigation function

Digital TV function

Source: Maker Home Page

Figure 2-49 Navigation Terminal in Cars

7) Government Network

The communication network serviced by the private telecommunication company is utilized for the communication between the national agency and federal state. This physically dedicated network has never been utilized for government network, but the military is utilizing their frequencies for its dedicated communication network provided by the Brazilian Agency of Telecommunications (*Agência Nacional de Telecomunicações*: ANATEL).

The Brazilian Association of State Entities for Information Technology and Communication (*Associação Brasileira de Entidades Estaduais de Tecnologia da Informação e Comunicação*: ABEP) has a mission to promote the use of information and communication technologies in public administration. This is aimed at improving governance, service delivery, and citizenship. Under ABEP, an entity is activating in each state to promote the use of information and communication technologies in public administration. In the state, they contract a private telecommunication company to build the public administration network and use the private telecommunication company's network as Virtual Private Network (VPN).

(2) Telecommunications in Rio de Janeiro

The trend of telecommunication in Rio de Janeiro is the same as that of Brazil. Rio de Janeiro (RJ) has been leading the telecommunication growth in Brazil together with the Federation: Brasilia (DF) and San Paulo (SP).

The density and the increasing rate of fixed telephones, mobile phones, multimedia (internet), and TV between 2010 and 2011 are shown in Table 2-10 below.

Table 2-10 The density and the increasing rate by each devices

Item	Density		Increasing Rate
	2010	2011	
Fixed telephone	33.3 (access/100 population)	33.6 (access/100 population)	100.9%
Mobile telephone	114.9 (access/100 population)	135.4 (access/100 population)	118%
Multimedia	30.9 (access/100 households)	42.2(access/100 households)	137%
TV	27.8 (access/100 households)	33.1(access/100 households)	119%

Source: JICA Study Team

The density of fixed telephones in Rio de Janeiro (RJ) had a slight increase from 33.3 to 33.6, while the density of mobile phones has rapidly increased from 114.9 to 135.4.

The digital TV was already implemented and has been served for Rio de Janeiro (RJ).

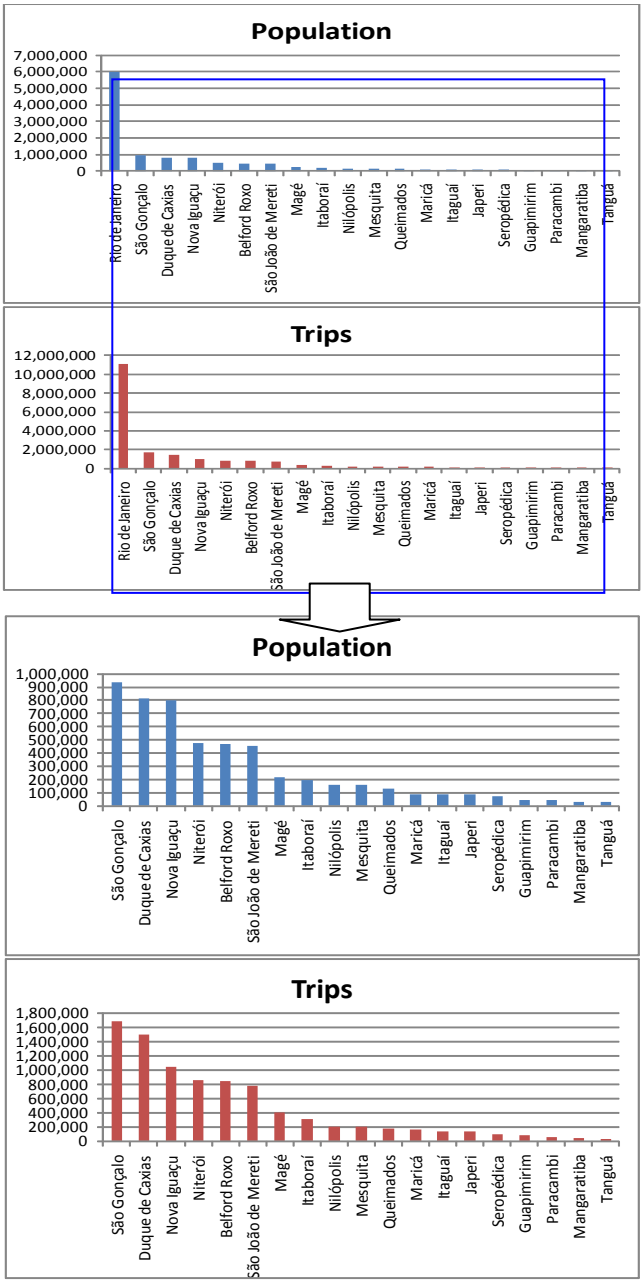
2.2 TRAFFIC/TRANSPORTATION CHARACTERISTICS IN RIO DE JANEIRO

2.2.1 Overall Condition

(1) Demand

1) Number of Trips

The majority of trips in the Metropolitan Region of Rio de Janeiro (*Região Metropolitana do Rio de Janeiro*: RMRJ) are generated by the people living in the municipality of Rio de Janeiro. The next most popular municipalities are Sao Goncalo, Duque de Caxias, Nova Iguacu, Niteroi, Belford Roxo, and São João de Mereti.



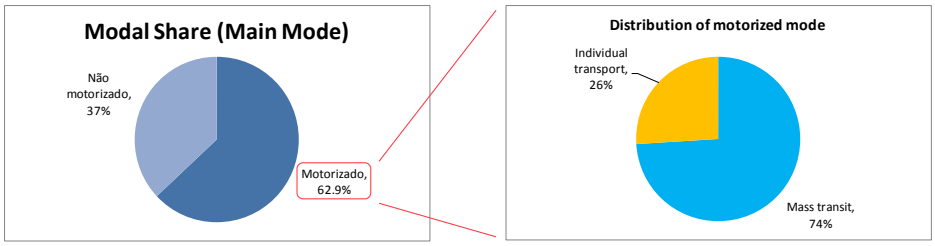
Source: PDTU/RJ 2005

Figure 2-50 Number of Trips in the Metropolitan Region of Rio de Janeiro

2) Modal Share

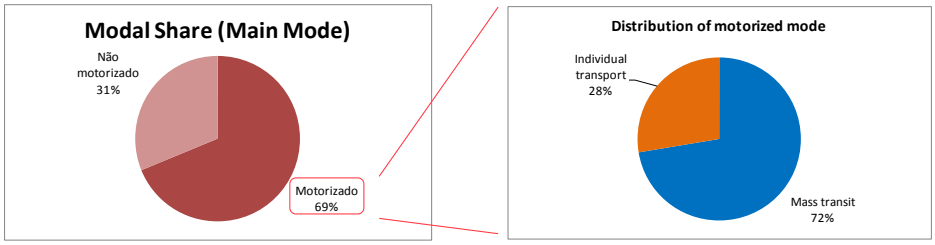
For motorized trips, 74% of trips are made by mass transit in RMRJ and 72% in the municipality of Rio de Janeiro compared with Tokyo, where 51% of motorized trips are done by mass transit.

[Metropolitan Region]



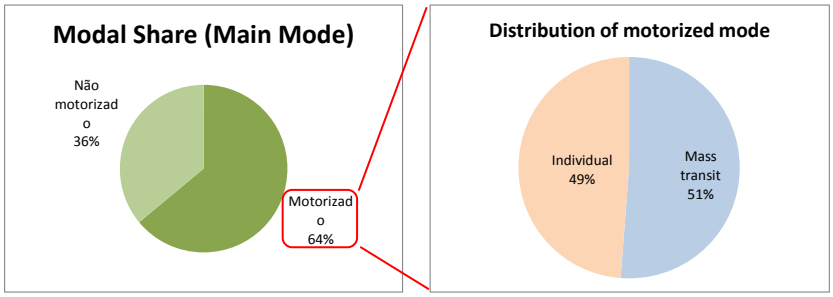
Source: PDTU/RJ 2005

[City of Rio (Origin)]



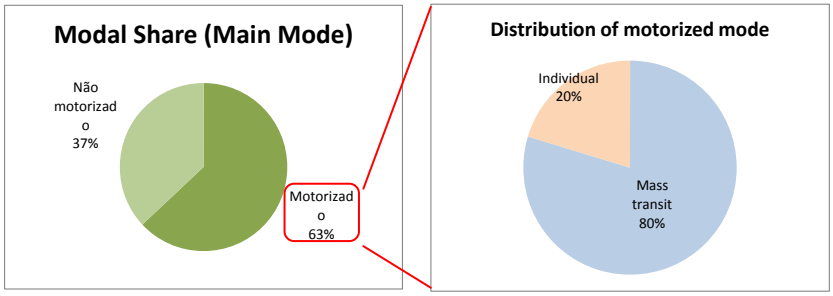
Source: PDTU/RJ 2005

[Tokyo Metropolitan Region]



Source: Tokyo Metropolitan Person Trip Survey

[Central Tokyo (23 special wards)]

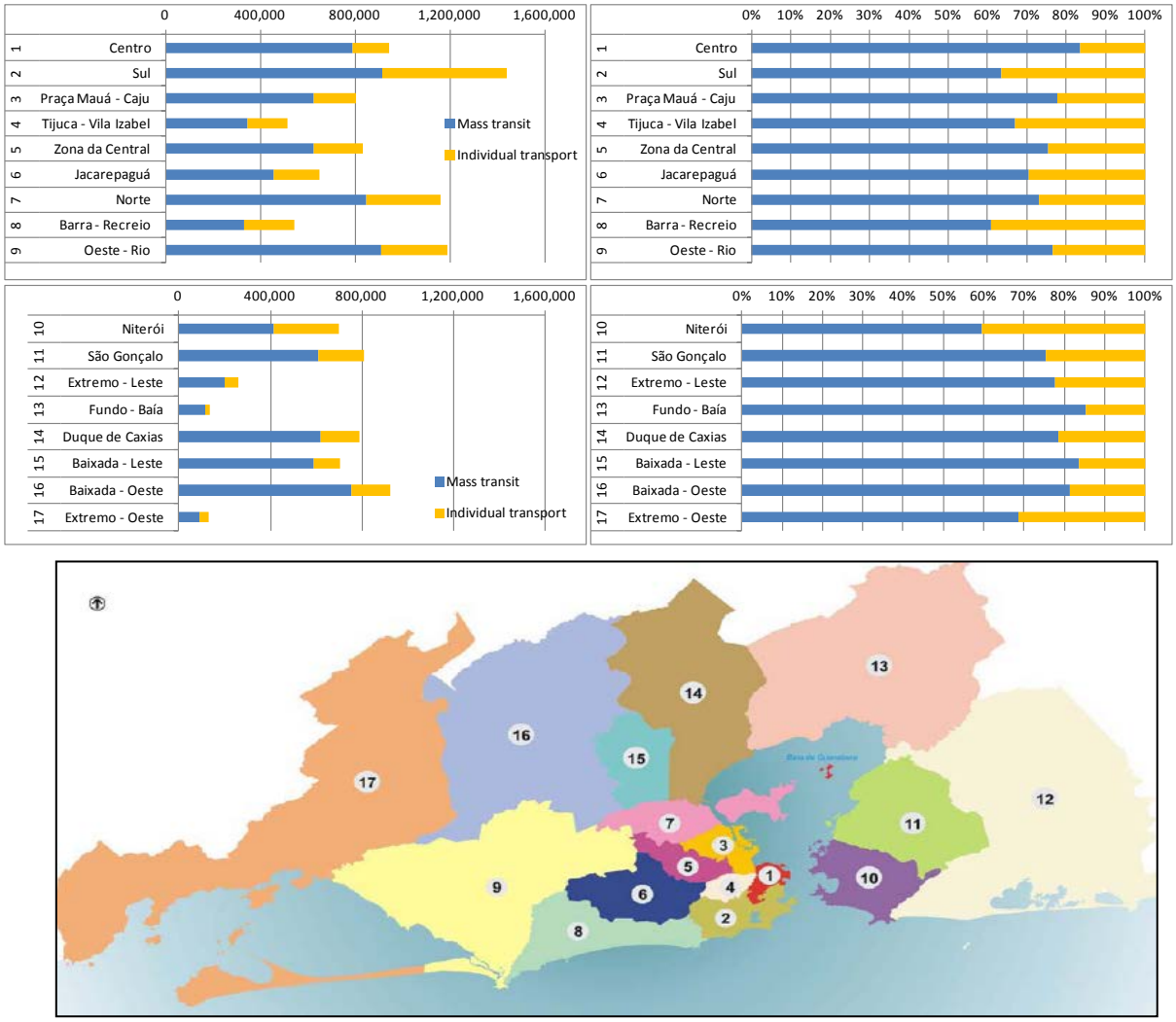


Source: Tokyo Metropolitan Person Trip Survey

Figure 2-51 Modal Shares in Rio and Tokyo

These figures show the modal share of trips originating from each zone. The share of mass transit in all motorized trips is around 70%–80 %. However, only Niteroi has a larger proportion of the individual trips.

[Distribution of motorized mode in macro zones (Origin)]



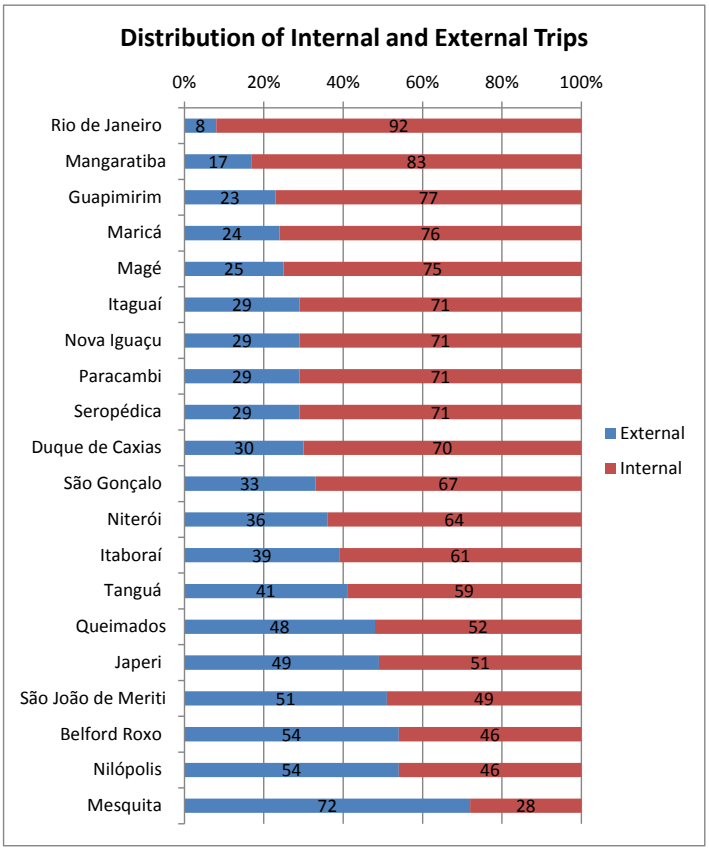
Source: PDTU/RJ 2005

Figure 2-52 Modal Share in Macro Zones

3) Attraction and Generation

In the municipality of Rio de Janeiro, internal trips amount to more than 90% of the total trips generated from the municipality of Rio de Janeiro. In other municipalities surrounding the municipality of Rio de Janeiro, such as Nova Iguacu and Niteroi, the share of external trips is about 30%, which seems that trips generated from these municipalities are coming to the municipality of Rio de Janeiro.

[Distribution of internal and external trips (Motorized)]



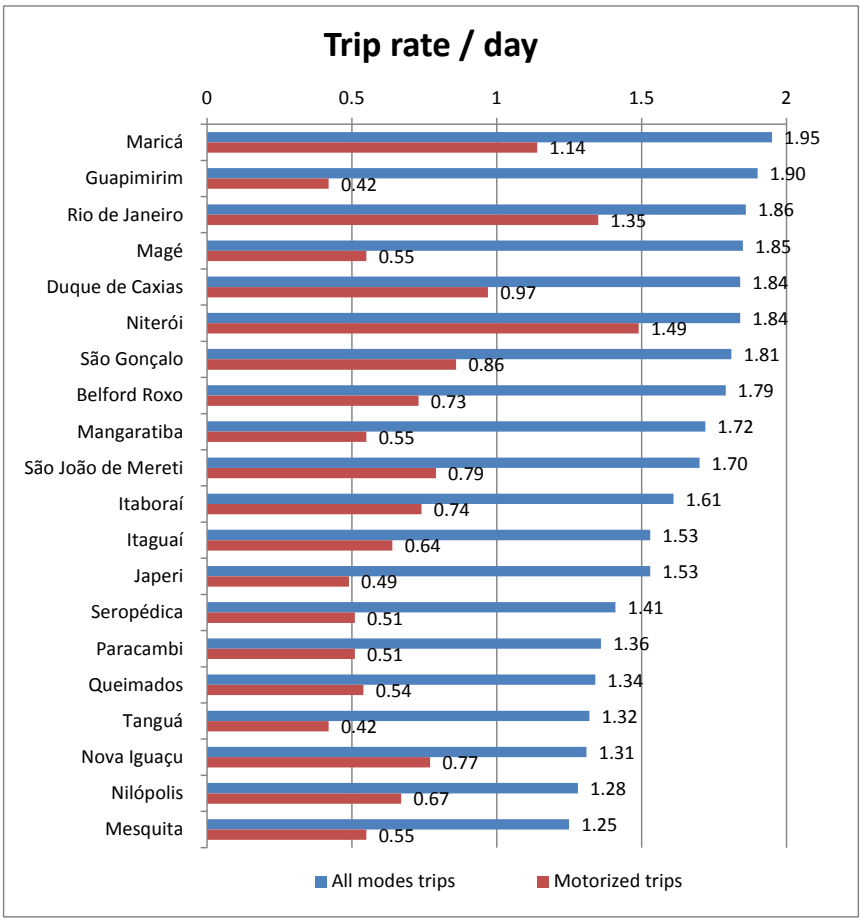
Source: PDTU/RJ 2005

Figure 2-53 Internal and External Trips in Each Municipality

4) Trip Rate

Larger cities show more trip rates. As for motorized trips, Niteroi shows the largest trip rate in RMRJ followed by Rio de Janeiro and Marica.

[Trip rate per day per person]



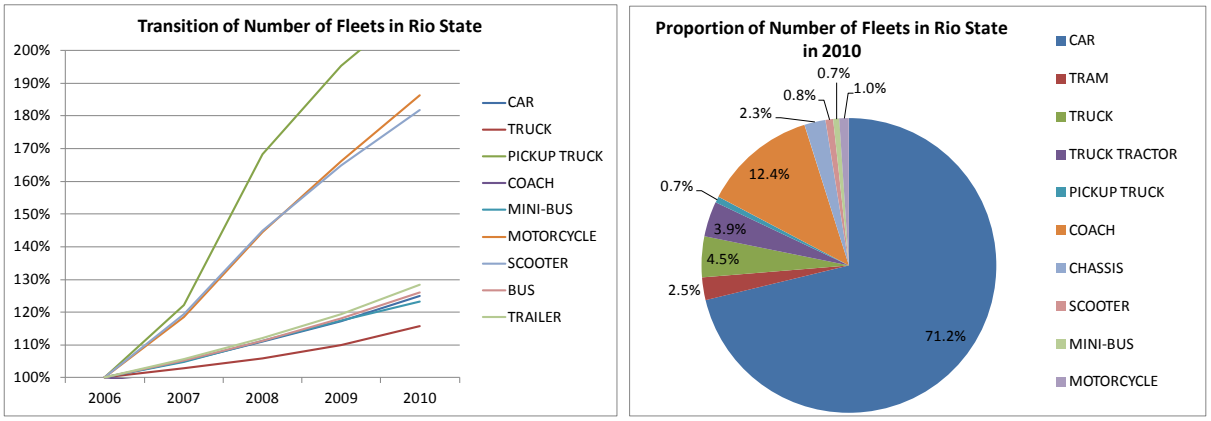
Source: PDTU/RJ 2005

Figure 2-54 Trip Rate (/day/person) in Each Municipality

(2) Number of Fleet

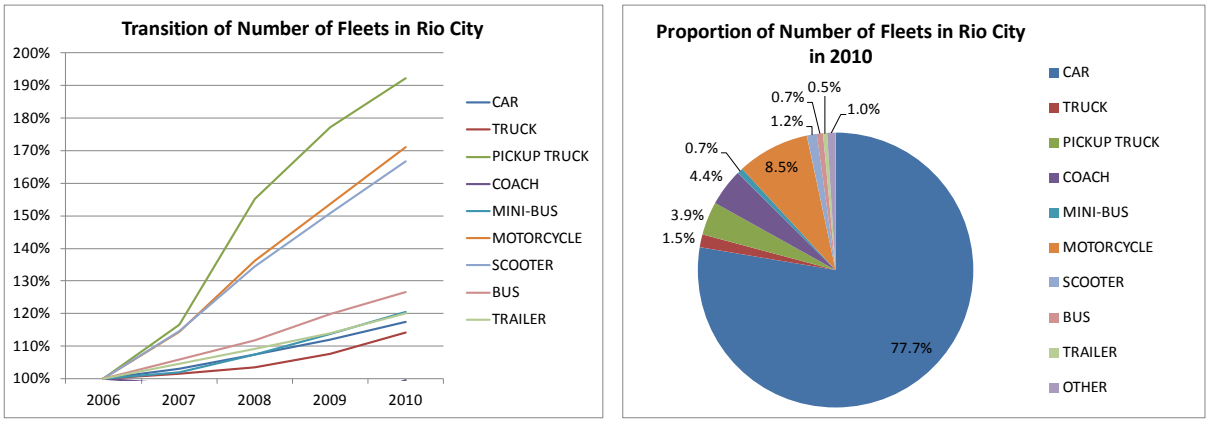
The number of fleets has increased in the last five years. The increased rates in RMRJ are higher than in RJ.

[State of Rio]



Source: DENATRAN

[City of Rio]



Source: DENATRAN

Figure 2-55 Number of Fleets in Rio

2.2.2 Traffic Conditions

(1) Road Network

1) Classification by Administrator

i) Basic Classification

In the Metropolitan Region of Rio de Janeiro, the road networks are administrated by the federal government, state government, and municipal government. In the municipality of Rio de Janeiro, the municipal government is the only road administrator.

Table 2-11 Road Administrators in the Metropolitan Region of Rio de Janeiro

Area	Road Type	No. of Lines	Example	Administrators
City of Rio de Janeiro	Federal Road	1	BR-101 (Av. Brasil)	Municipal Government of Rio
	State Road	1	Linha Vermelha	Municipal Government of Rio
	Municipal Road	Many	Linha Amarela Av. das Americas	Municipal overnment of Rio
Other Cities	Federal Road	5	BR-040, BR-101, BR-116, BR-465, BR-493	Federal Government
	State Road	21	RJ-116, RJ-124 RJ-085, RJ-127	Rio State
	Municipal Road	Many	-	Each Municipality

Source: JICA Study Team

ii) Network

Figure 2-56 shows the trunk road network in the Metropolitan Region of Rio de Janeiro.

Source: JICA Study Team

Figure 2-56 Current Road Network in RMRJ by Administrators

iii) Concession

In Brazil, the main expressways are operated by private companies. There are eight concession roads existing in the Metropolitan Region of Rio de Janeiro.

Table 2-12 Concession Road in the Metropolitan Region of Rio de Janeiro

Road Admin.	No.	Name	Total Length (km)	Length in RMRJ (km)	Concession Company
Federal Government	BR-116	NovaDutra	402	64.8	CCR NovaDutra (Grupo CCR)
	BR-101	Ponte	13.2	13.2	CCR Ponte (Grupo CCR)
	BR-040	CONCER	179.9	48.5	CONCER - Companhia de Concessão Rodoviária Juíz de Fora-Rio
	BR-116	CRT	142.5	39.3	CRT - Concessionária Rio Teresópolis S/A
	BR-101	Fluminense	320.1	135.7	Autopista Fluminense (Grupo OHL Brasil)
Rio State	RJ-116	Rota 116	140.4	11.9	Concessionária Rota 116 S/A
	RJ-124	ViaLagos	56.0	0.0	CCR ViaLagos (Grupo CCR)
Rio City	-	Linha Amarela	17.4	17.4	Linha Amarela S/A - LAMSA

Source: JICA Study Team

Figure 2-57 shows the concession roads in the Metropolitan Region of Rio de Janeiro. Radial roads from the municipality of Rio de Janeiro are operated by private companies.

Source: JICA Study Team

Figure 2-57 Concession Road Network in RMRJ

2) Length of Road Network

[By administrators]

Table 2-13 shows the length of road networks in RMRJ. In the municipality of Rio de Janeiro, the length of main road is about 300 km.

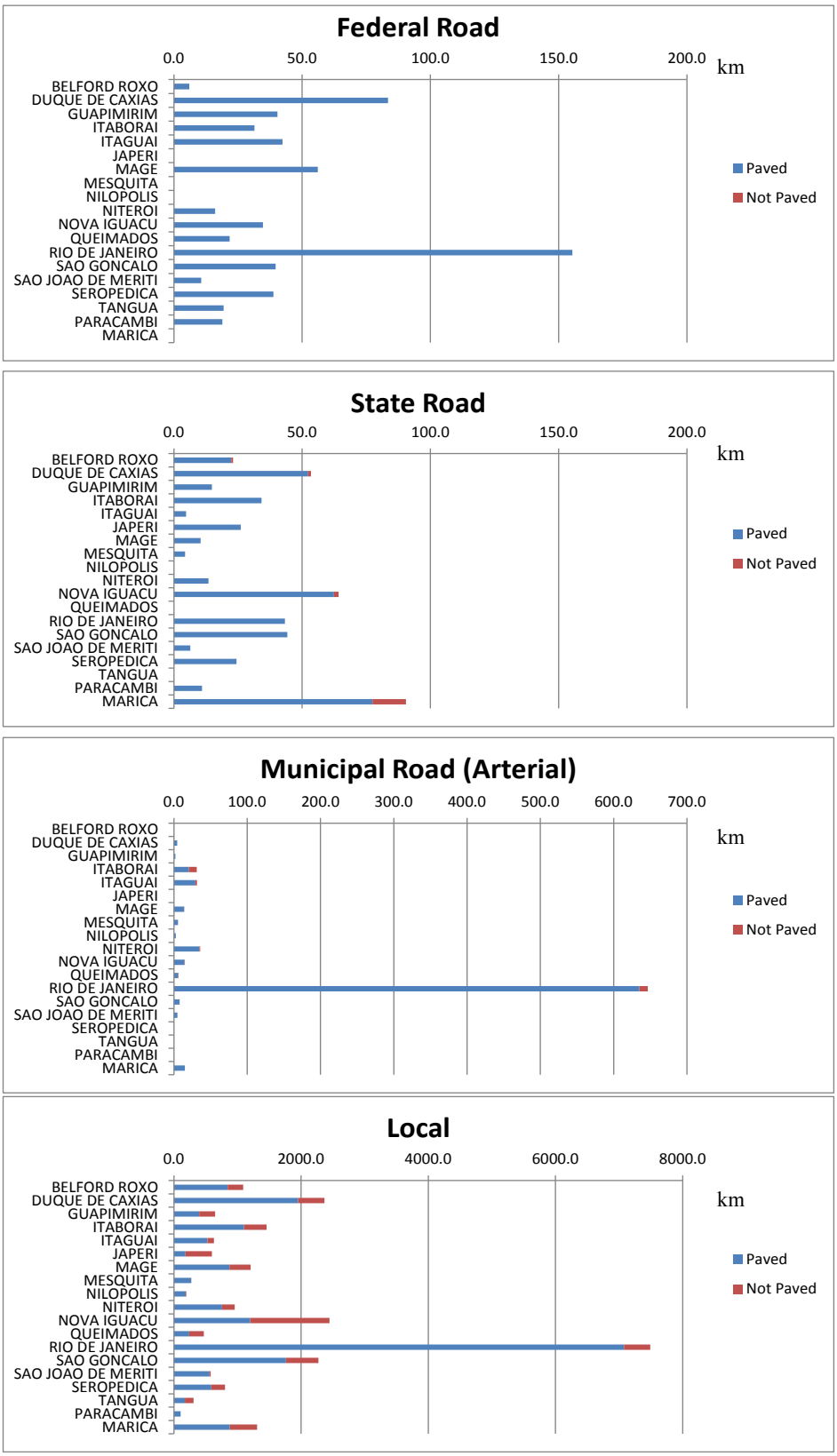
Table 2-13 Length of Roads in the Metropolitan Region of Rio de Janeiro

Administrators	Type of Management	No. of Roads	Road No.	Total Length (km)	Total Length in RMRJ (km)
Federal Government	Concession	5	040, 101, 116	1,057.7	301.5
	Federal Government (DNIT)	3	101, 465, 493	-	67.8
	City Government (CET-Rio)	1	101 (Rio City)	-	65
Rio State	Concession	2	116, 124	196.4	11.9
	State Government (DER)	19	85, 93, 99, 101, 102, 104, 105, 106, 107, 110, 111, 112, 114, 115, 118, 119, 122, 125, 127	-	390.4
	City Government (CET-Rio)	1	71 (Linha Vermelha)	-	14.1
Rio City	Concession	1	Linha Amarela	17.4	17.4
	City Government (CET-Rio)	Many	-	-	280 (Arterial Road)
Other Municipalities	Government	Many	-	-	172.8 (Arterial Road)

Source: DER - RJ Road Map

[By pavement condition]

In RMRJ, some of the local roads are still unpaved.



Source: Navteq Data

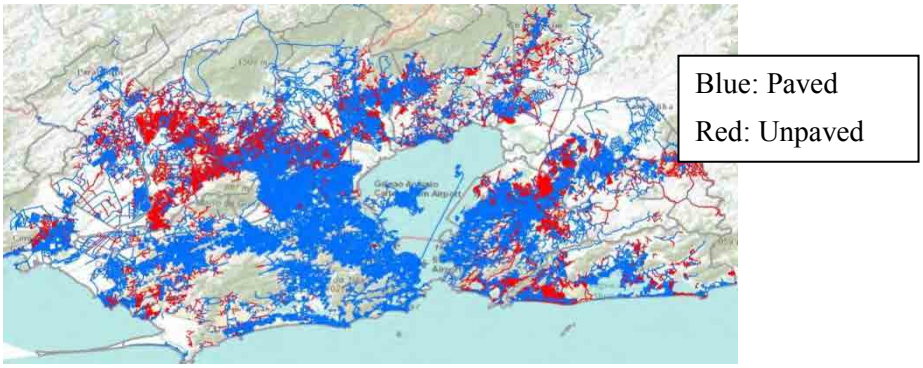
Figure 2-58 Length of Roads in the Metropolitan Region of Rio de Janeiro

[Federal road]

[State road]

[Municipality road (Arterial)]

[Local road]

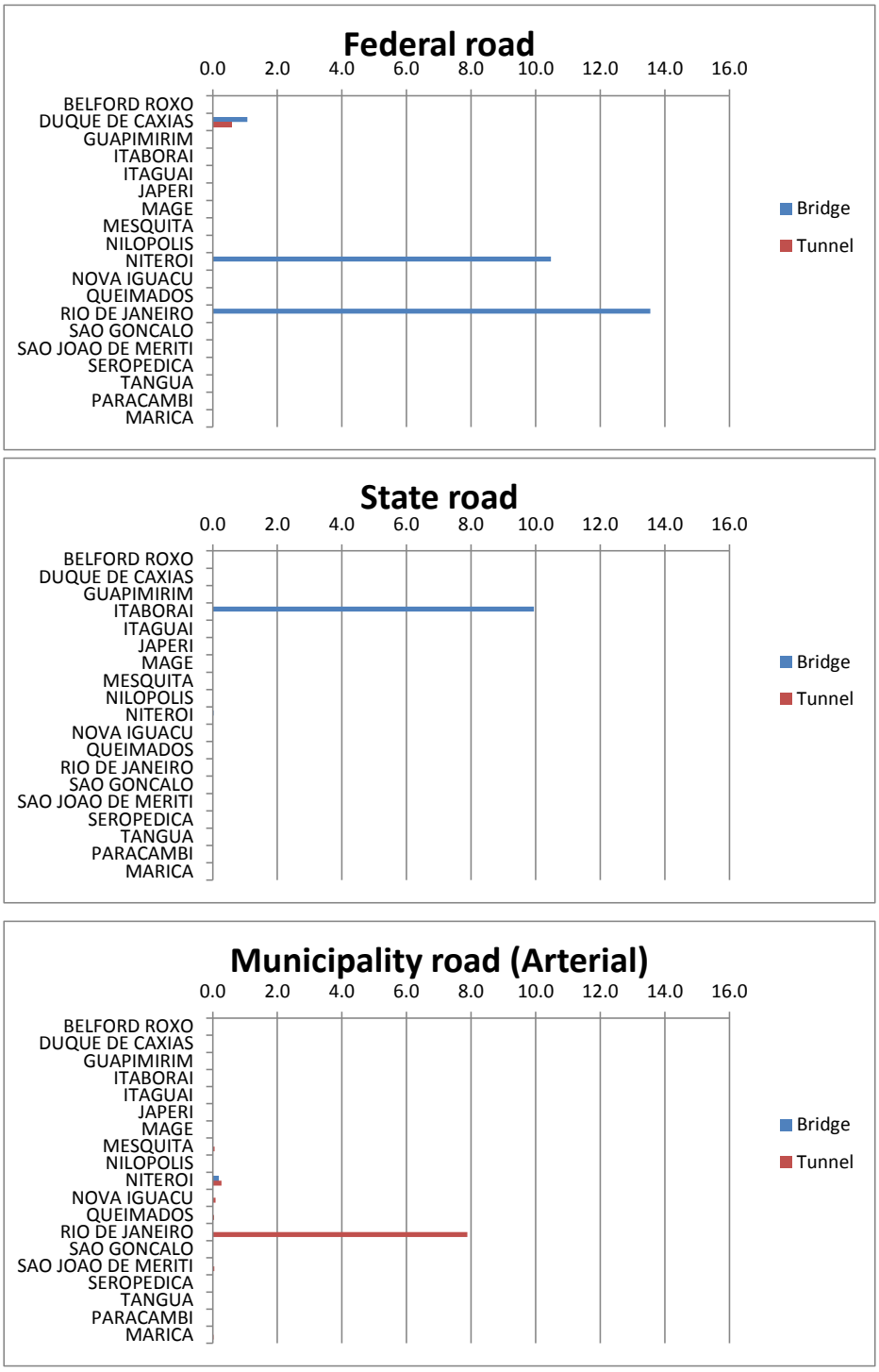


Source: Navteq Data

Figure 2-59 Pavement Condition in the Metropolitan Region of Rio de Janeiro

[Bridge and tunnel]

These figures show the length of bridges and tunnels in each municipality. The municipality of Rio de Janeiro has many bridges and tunnels. Strategic maintenance is necessary in these sections.



Source: Navteq Data

Figure 2-60 Length of Bridge and Tunnel in the Metropolitan Region of Rio de Janeiro

[Federal road, bridge, and tunnel]

[State road, bridge, and tunnel]

No tunnel exists.

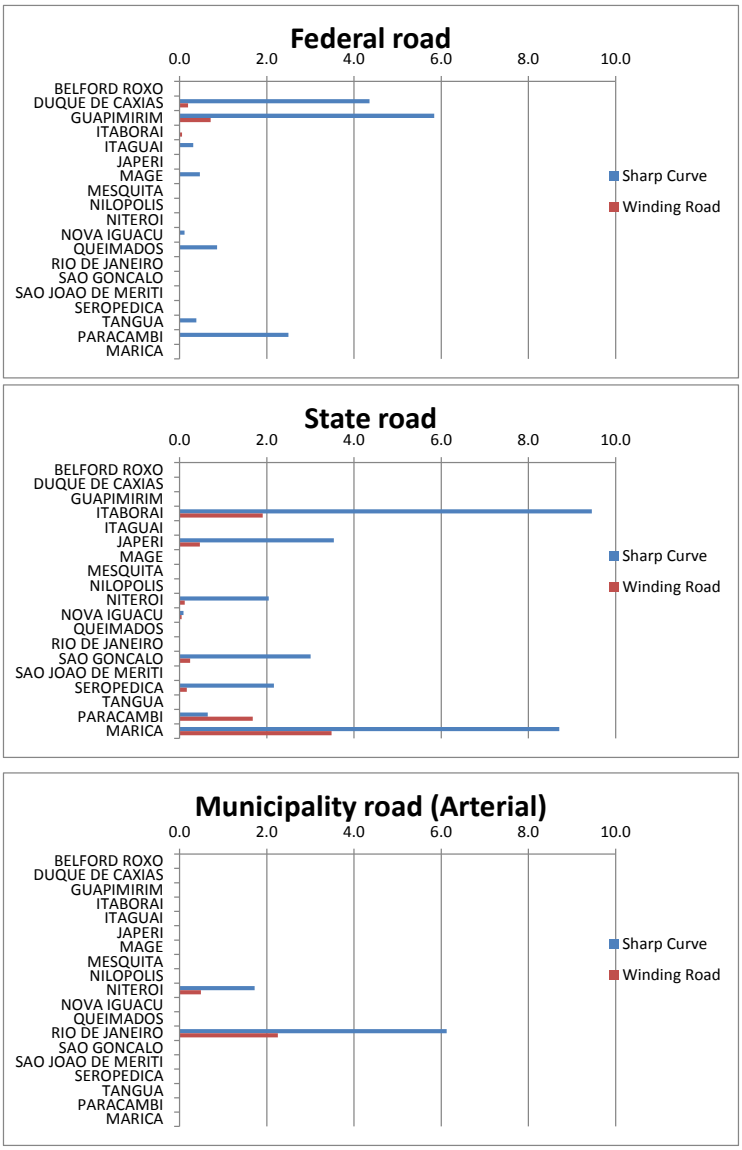
[Municipality road, bridge, and tunnel]

Source: Navteq Data

Figure 2-61 Location of Bridges and Tunnels in the Metropolitan Region of Rio de Janeiro

[Traffic sign for "sharp curve" and "winding road"]

In the road network of RMRJ many sharp curves and winding roads exist because of its geographic characteristics. In these sections ITS services for road safety are necessary.



Source: Navteq Data

Figure 2-62 Location of Traffic Sign for "Sharp Curve" and "Winding Road" in the Metropolitan Region of Rio de Janeiro

(2) Planned Network

In the RMRJ, new roads of about 200 km long are planned. However, the municipality of Rio de Janeiro does not have a specific plan for a new road network.

Table 2-14 Length of Planned Roads in the Metropolitan Region of Rio de Janeiro

Administrators	No. Of Roads	Road no.	Total Length in RMRJ (km)	
Federal Government	1	BR-493|109 (Outer Ring)	77.1	
Rio State	5	RJ-102 RJ-103 RJ-113 RJ-115 RJ-125	15.4 42.4 14.4 21.0 14.2	107.2
Rio City	-	-	-	
Other Municipalities	3	Mage, Itaborai, Niteroi	8.9	

Source: DER - RJ Road Map

Source: JICA Study Team

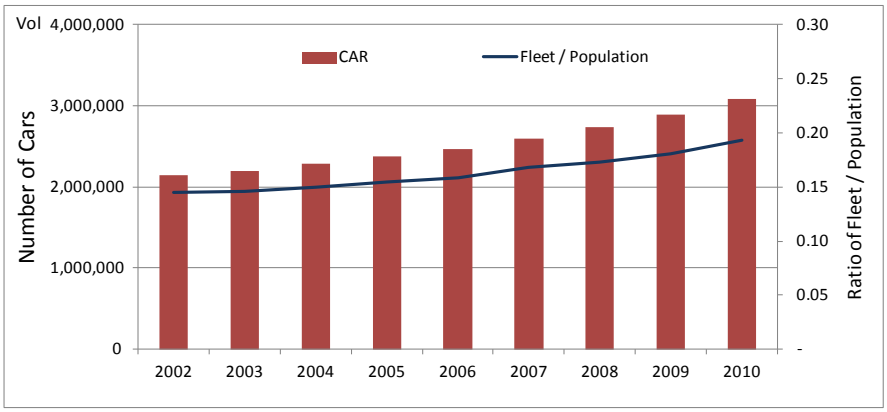
Figure 2-63 Planned Road Network in RMRJ

(3) Traffic Volume

1) Number of Cars

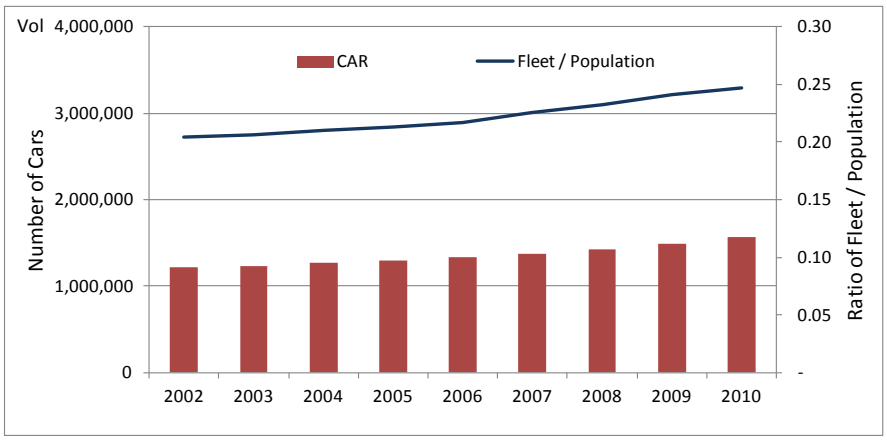
The number of cars in Rio de Janeiro has been increasing, but the number of cars per population is still low compared with industrial countries.

[Number of cars in the state of Rio de Janeiro]



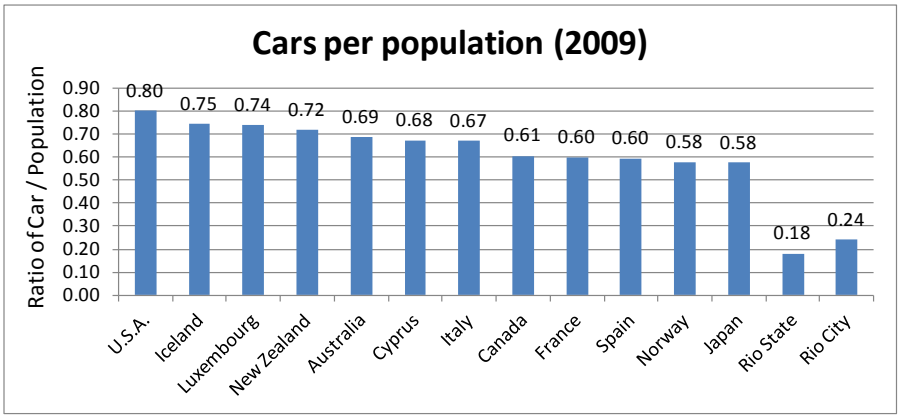
Source: DENATRAN

[Number of cars in the city of Rio de Janeiro]



Source: DENATRAN

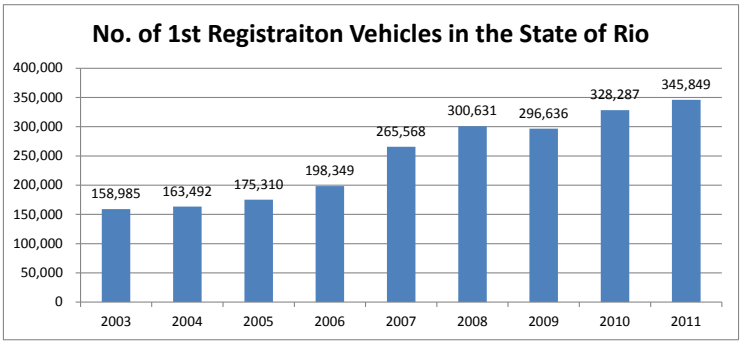
[Number of cars/population in the world]



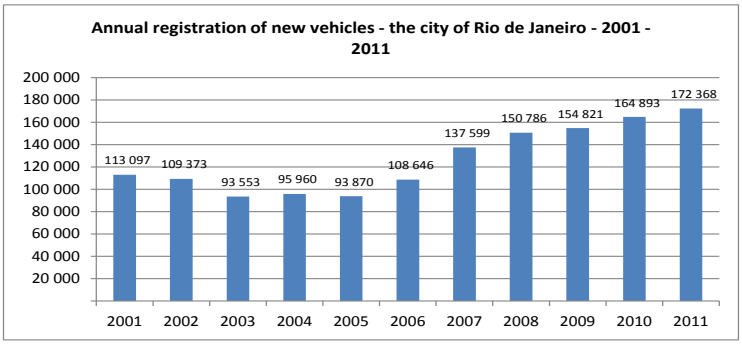
Source: Statictics Bureau of Japan

Figure 2-64 Number of Cars in Rio and the World

[New car registration in the state of Rio de Janeiro]



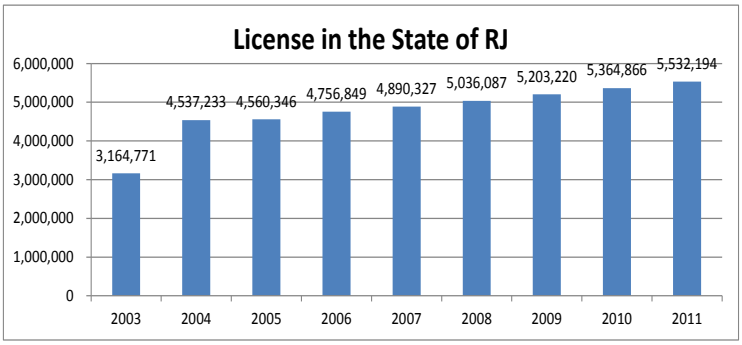
[New car registration in the city of Rio de Janeiro]



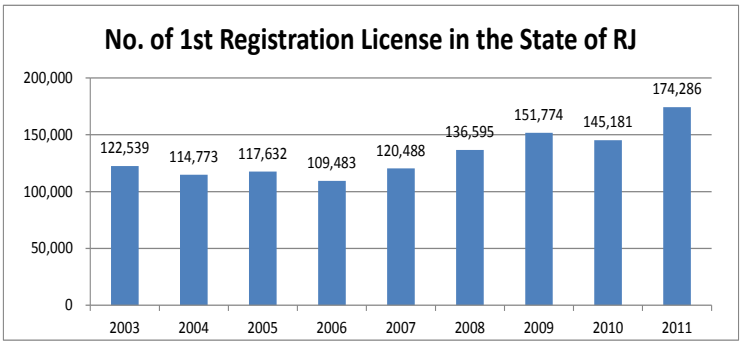
Source: DETRAN - RJ

Figure 2-65 Car Registration in Rio

[Driving license in the state of Rio de Janeiro]



[New driving license in the state of Rio de Janeiro]



Source: DETRAN - RJ

Figure 2-66 Driving License Registration in the State of Rio de Janeiro

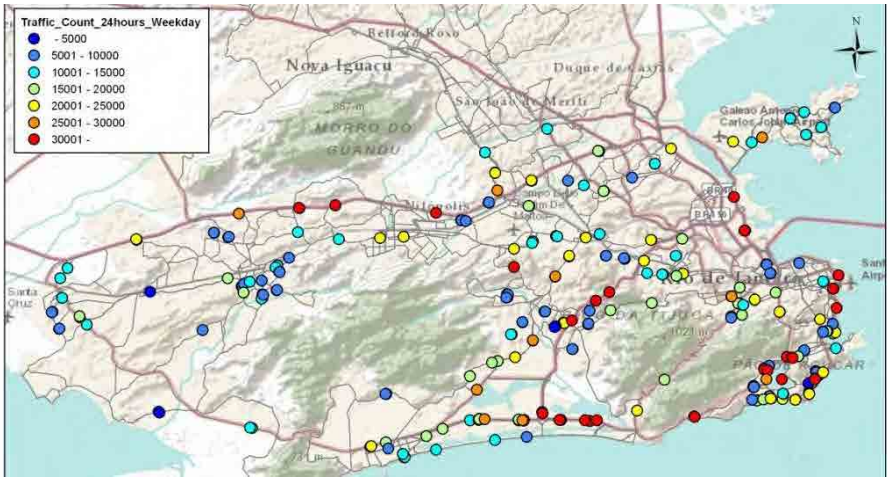
2) Traffic Count Data

Traffic count data derived from traffic monitoring equipment is provided by the Traffic Engineering Company of Rio de Janeiro (*Companhia de Engenharia de Tráfego do Rio de Janeiro*: CET-Rio) (http://www.rio.rj.gov.br/web/smtr/exibeconteudo?article-id=107097). Detailed analysis of traffic characteristics is shown in Chapter 3.

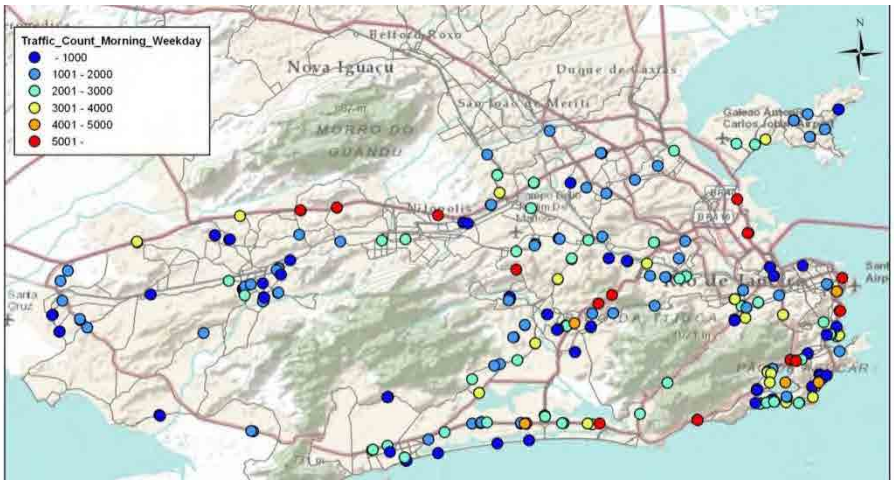
Traffic volume for 24 hours (7:00 a.m.–7:00 a.m.), morning peak (7:00 a.m.– 9:00 a.m.), and evening peak (5:00 p.m.– 7:00 p.m.) from the average weekday traffic volume data in May 2012 is shown in Figure 2-67.

Trunk roads like Av. Brasil, Av. das Americas, and Linha Amarela have high traffic volume. Also, the Centro and South Zone of the city of Rio de Janeiro show high traffic volume.

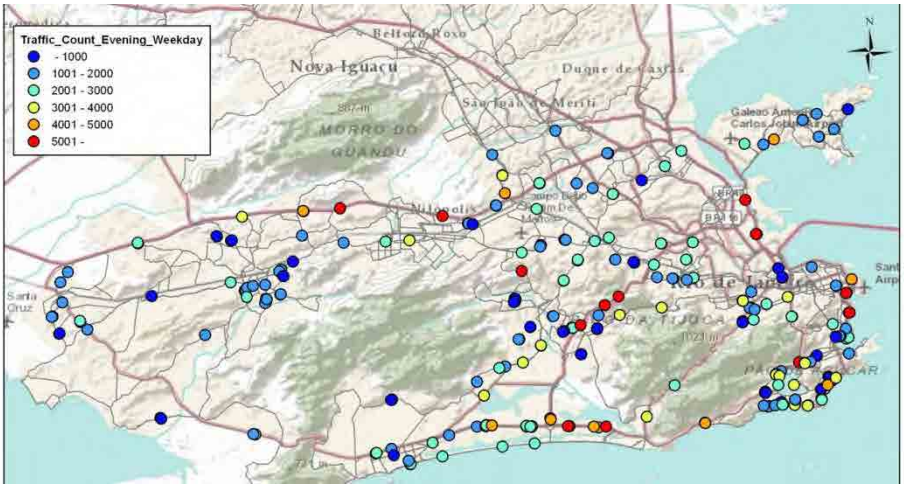
[Weekday 24 hours]



[Weekday morning peak]



[Weekday evening peak]



Source: JICA Study Team

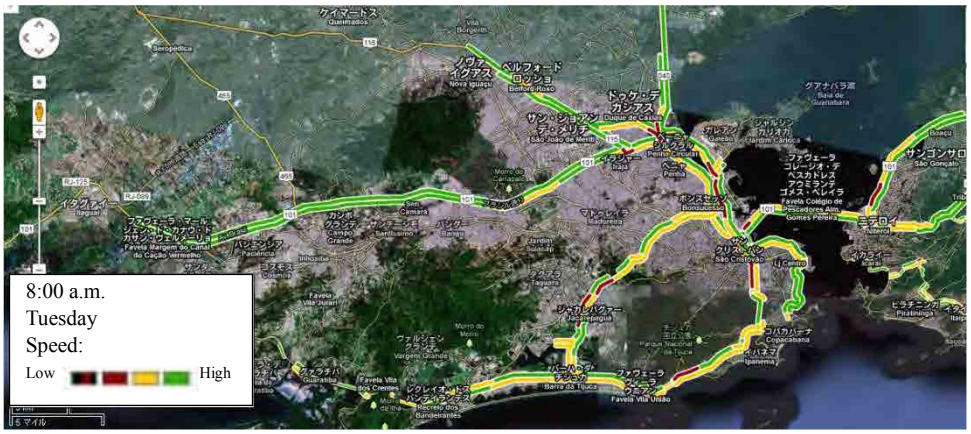
Figure 2-67 Traffic Volume

(4) Travel Speed

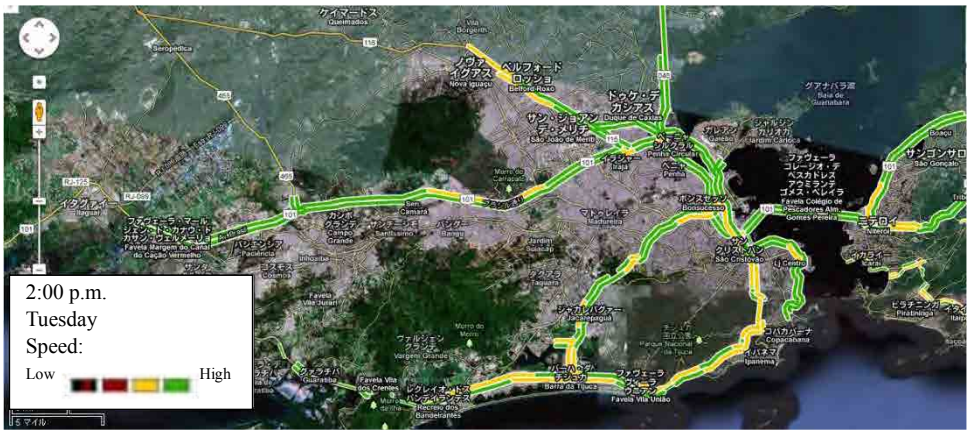
These figures show that traffic jams usually occur along arterial roads in the city of Rio de Janeiro and tend to occur in the evening.

[Reference: Traffic condition in the city of Rio de Janeiro (Google)]

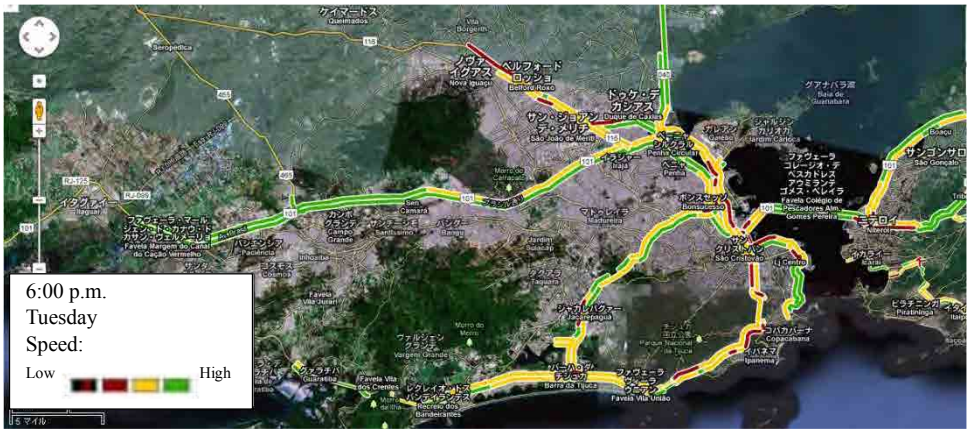
Tuesday 8:00 a.m.



Tuesday 2:00 p.m.



Tuesday 6:00 p.m.



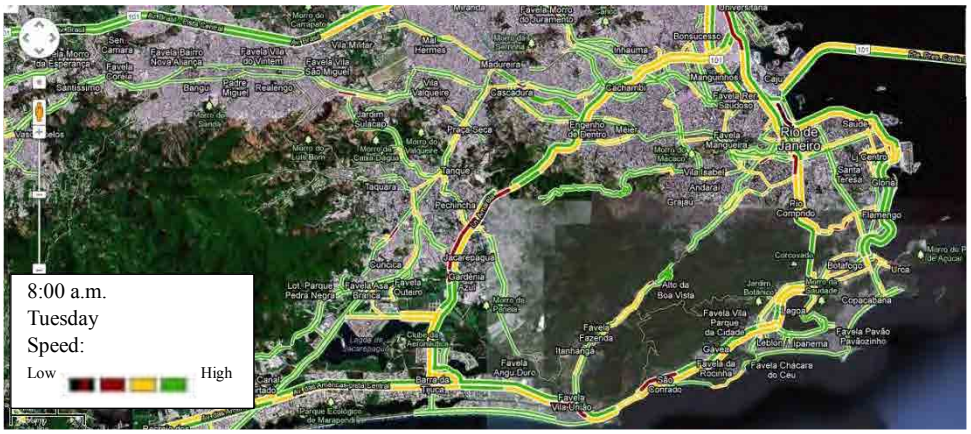
Source: Google map

Figure 2-68 Traffic Condition in the City of Rio de Janeiro

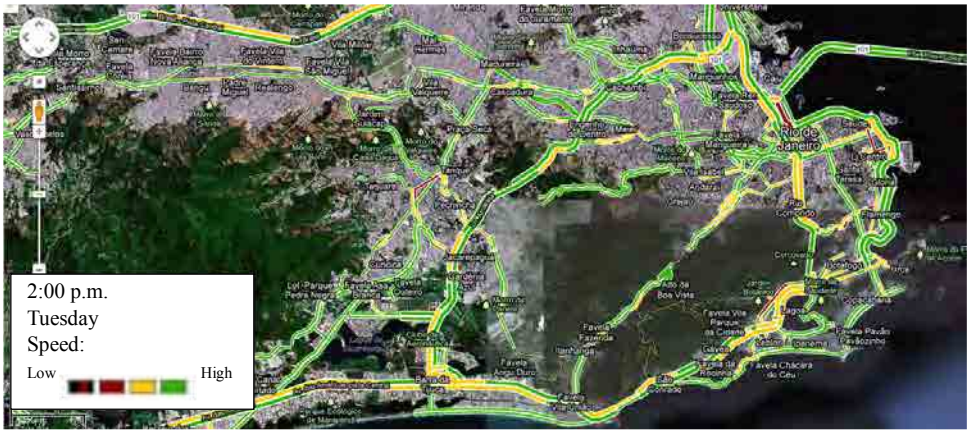
In particular, traffic jam tends to occur along the road between Barra da Tijuca, Copacabana, and Centro.

[Ref: Traffic condition in the central Rio (Google)]

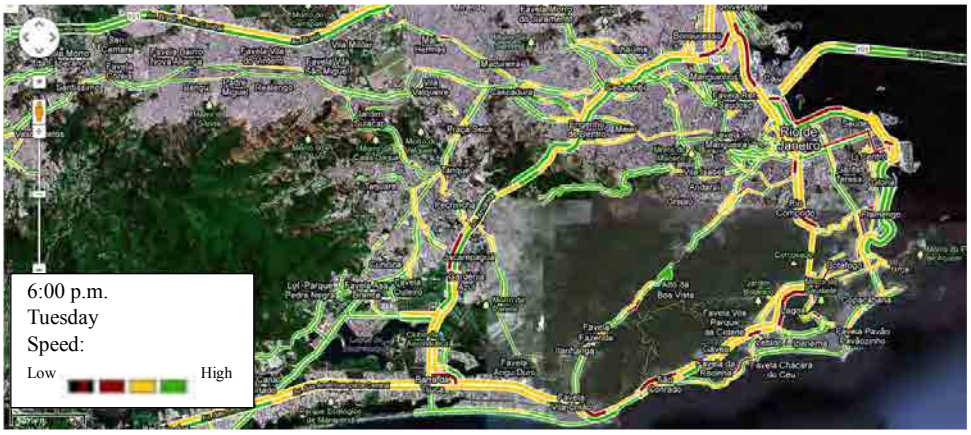
Tuesday 8:00 a.m.



Tuesday 2:00 p.m.



Tuesday 6:00 p.m.



Source: Google map

Figure 2-69 Traffic Condition in Central Rio

(5) Traffic Monitoring

The Rio Operations Center (*Centro de Operações da Prefeitura do Rio*: COR) was opened in December 2010. The traffic operation center of CET-Rio is located here as well as other organizations, such as the civil defense department and security department.

Bulletins are published every day from COR, and normally there are three bulletins published on its website (http://www.rio.rj.gov.br/web/corio). In these bulletins, traffic conditions are evaluated and relayed to the public.

Source: JICA Study Team

Figure 2-70 Photo of COR


RIO PREFEITURA

Prefeitura do Rio informa

Boletim de Notícias do Centro de Operações Rio

CENTRO DE OPERAÇÕES RIO

CLARO A PARCIALMENTE NUBLADO | Quarta-feira 17/10/12 | 35° / 17°

Trânsito

Informações sobre o trânsito em tempo real no Twitter: www.twitter.com/operacoesrio

Vias Expressas

Intenso

Avenida Brasil, sentido Centro, de Bangu a Deodoro, Vila Militar, Coelho Neto, Cordovil, Penha, Bonsucesso e Benfica.
Linha Vermelha, sentido Centro, altura da Washington Luiz.

Bom

Aterro do Flamengo, Autoestrada Lagoa-Barra e Estrada Grajaú-Jacarepaguá. Elevados do Joá, da Perimetral e Paulo de Frontin. Túneis do Joá, de São Conrado, Zuzu Angel, Acústico, Rebouças e Santa Bárbara.

LINHA AMARELA

Segundo a Lamsa, o trânsito no sentido Barra segue lento da Linha Vermelha a Bonsucesso. No sentido Centro, trânsito bom.

Interdições na Linha Amarela

A Lamsa, concessionária que administra a Linha Amarela, fará as seguintes interdições nesta semana:
- Na Linha Amarela, altura do bairro Abolição, até sexta-feira (19/10/12) e no domingo (21/10/12), entre 22h30 e 5h.
- No Túnel da Covanca, até sexta-feira (19/10/12) e no domingo (21/10/12), entre 22h30 e 5h.

Nos dois trechos, o trânsito funcionará através de faixas reversíveis. Em caso de imprevistos, a interdição poderá ser cancelada e remarcada para outra data. Nos dias em que houver eventos no Estádio João Havelange (Engenhão), a interdição deverá começar duas horas depois do término do evento.

Source: JICA Study Team

Figure 2-71 Daily Bulletin from COR

An example of a bulletin for traffic conditions is shown below.

[17 October 2012, 6:00 a.m.]

Expressways

Good

Aterro do Flamengo, Autoestrada Lagoa-Barra e Estrada Grajaú-Jacarepaguá. Elevados do Joá, da Perimetral e Paulo de Frontin. Túneis do Joá, de São Conrado, Zuzu Angel, Acústico, Rebouças e Santa Bárbara.

Congested

Avenida Brasil, sentido Centro, de Bangu a Deodoro, Vila Militar, Coelho Neto, Cordovil, Penha, Bonsucesso e Benfica.

Linha Vermelha, sentido Centro, altura da Washington Luiz.

Linha Amarela (Based on concession company information)

Traffic to Barra is slow. Traffic to Centro is good.

Rio-Niteroi Bridge (Based on concession company information)

Traffic is normal in both directions.

Centro

Good

Avenida Presidente Vargas, Avenida Rio Branco e Avenida Passos. Trevo das Forças Armadas. Rua de Santana e Praça da República. Elevado 31 de Março. Avenidas Rodrigues Alves, sentido Centro; General Justo, sentido Centro; e Av. Marechal Câmara.

Zona Oeste

Good

Avenidas Lúcio Costa, Salvador Allende e Ministro Ivan Lins. Largo da Taquara. Avenidas Cesário de Melo e Rua da Feira. Estradas dos Bandeirantes e dos Três Rios. Avenidas Santa Cruz, das Américas, Embaixador Abelardo Bueno, Geremário Dantas e Ayrton Senna.

Zona Sul

Good

Avenidas Epitácio Pessoa, Borges de Medeiros, Delfim Moreira, Vieira Souto, Atlântica. Ruas Jardim Botânico, Barata Ribeiro, Prefeito Mendes de Morais, Lauro Sodré, Venceslau Brás, São Clemente, Humaitá, Voluntários da Pátria, Pinheiro Machado, das Laranjeiras e Corte do Cantagalo

Zona Norte

Good

Avenidas Dom Helder Câmara, Marechal Rondon, Pastor Martin Luther King Jr. e Amaro Cavalcanti. Ruas Uruguai, Hermengarda, Maxwell, Dias da Cruz, Conde de Bonfim, Teodoro da Silva, e Viaduto de Todos os Santos. Praça da Bandeira, Avenida Maracanã e Radial Oeste.

[17 October 2012, 11:00 a.m.]

Expressways

Good

Aterro do Flamengo, Estrada Grajaú-Jacarepaguá. Elevado do Joá. Túneis do Joá, de São Conrado, Acústico.

Congested

Túnel Rebouças. Elevado Paulo de Frontin. Linha Vermelha, sentido Centro, altura da Washington Luiz.

Slow

Túnel Santa Bárbara, sentido Laranjeiras. Autoestrada Lagoa-Barra, sentido Lagoa. Túnel Zuzu Angel, sentido Gávea. Elevado da Perimetral, sentido Aterro. Viaduto do Gasômetro.

Avenida Brasil, sentido Centro, em Brás de Pina, e, na pista lateral, da Penha até Bonsucesso.

Linha Amarela (Based on concession company information)

Traffic is normal.

Rio-Niteroi Bridge (Based on concession company information)

Traffic to Niterói is normal.

Traffic to Rio has slow access to the Perimeter and Novo Rio Bus Terminal

Centro

Good

Avenida Rio Branco e Avenida Passos. Trevo das Forças Armadas. Rua de Santana e Praça da República. Avenidas General Justo, sentido Centro; e Av. Marechal Câmara.

Congested

Avenida Presidente Vargas, sentido Candelária. Avenidas Francisco Bicalho e Rodrigues Alves.

Slow

Avenida 31 de Março, sentido Túnel Santa Bárbara.

Zona Oeste

Good

Avenidas Lúcio Costa, Salvador Allende e Ministro Ivan Lins. Largo da Taquara. Avenidas Cesário de Melo e Rua da Feira. Avenidas Santa Cruz, das Américas e Ayrton Senna.

Congested

Rua André Rocha. Estradas dos Bandeirantes, do Mendanha e dos Três Rios. Avenida Embaixador Abelardo Bueno.

Slow

Avenidas Geremário Dantas e Nelson Cardoso.

Zona Sul

Good

Avenidas Epitácio Pessoa, Delfim Moreira, Vieira Souto, Atlântica. Ruas Jardim Botânico, Barata Ribeiro, Prefeito Mendes de Morais, Lauro Sodré, Venceslau Brás, São Clemente, Voluntários da Pátria, das Laranjeiras.

Congested

Avenida Borges de Medeiros. Ruas Pinheiro Machado, Humaitá e das Laranjeiras.

Slow

Corte do Cantagalo, sentido Copacabana.

Zona Norte

Good

Avenida Marechal Rondon. Ruas Uruguai, Hermengarda, Maxwell, Dias da Cruz, Conde de Bonfim e Viaduto de Todos os Santos. Praça da Bandeira, Avenida Maracanã e Radial Oeste.

Congested

Avenidas Pastor Martin Luther King Jr. e Amaro Cavalcanti. Ruas Teodoro da Silva e São Francisco Xavier.

[17 October 2012, 6:00 p.m.]

Expressways

Good

Aterro do Flamengo.

Congested

Túnel Rebouças. Elevado Paulo de Frontin. Estrada Grajaú-Jacarepaguá. Elevado do Joá. Túneis do Joá, de São Conrado, Acústico.

Slow

Linha Vermelha, sentido Baixada, do Caju à Infraero e, sentido Centro, da Infraero ao acesso à Linha Amarela.

Avenida Brasil, sentido Zona Oeste, altura do Caju, Bonsucesso e Parada de Lucas.

Autoestrada Lagoa-Barra, sentido Barra.

Perimetral, sentido Avenida Brasil.

Linha Amarela (Based on concession company information)

Traffic is slow in both directions.

Rio-Niteroi Bridge (Based on concession company information)

Traffic to Rio is slow until the access to Av. Brasil,

Traffic to Niterói is slow until reaching the toll plaza

Centro

Congested

Avenida Rio Branco e Avenida Passos. Rua de Santana e Praça da República. Avenidas General Justo, sentido Centro; e Av. Marechal Câmara.

Slow

Avenida 31 de Março, sentido Catumbi. Avenida Presidente Vargas, sentido Candelária. Avenidas Francisco Bicalho e Rodrigues Alves, sentido Avenida Brasil. Trevo das Forças Armadas

Zona Oeste

Congested

Rua André Rocha. Estradas dos Bandeirantes, do Mendanha e dos Três Rios. Avenida Embaixador Abelardo Bueno. Avenidas Lúcio Costa, Salvador Allende e Ministro Ivan Lins. Largo da Taquara. Avenidas Cesário de Melo e Rua da Feira. Avenidas Santa Cruz. Avenidas Geremário Dantas e Nelson Cardoso.

Slow

Avenidas das Américas, sentido Recreio, e Ayrton Senna, sentido Linha Amarela. Avenida Lúcio Costa, sentido Recreio, altura da Praça do Ó.

Zona Sul

Congested

Rua Humaitá e das Laranjeiras. Vieira Souto, Atlântica. Barata Ribeiro, Prefeito Mendes de Morais, Lauro Sodré, Venceslau Brás, São Clemente, Voluntários da Pátria, das Laranjeiras.

Slow

Corte do Cantagalo, sentido Copacabana. Avenida Borges de Medeiros, sentido Túnel Rebouças. Ruas Pinheiro Machado, sentido Túnel Santa Bárbara. Avenidas Epitácio Pessoa, sentido Túnel Rebouças e Delfim Moreira, sentido São Conrado. Rua Jardim Botânico, sentido Gávea.

Zona Norte

Congested

Ruas Teodoro da Silva e São Francisco Xavier. Avenida Marechal Rondon. Ruas Uruguai, Hermengarda, Maxwell, Dias da Cruz, Conde de Bonfim.

Slow

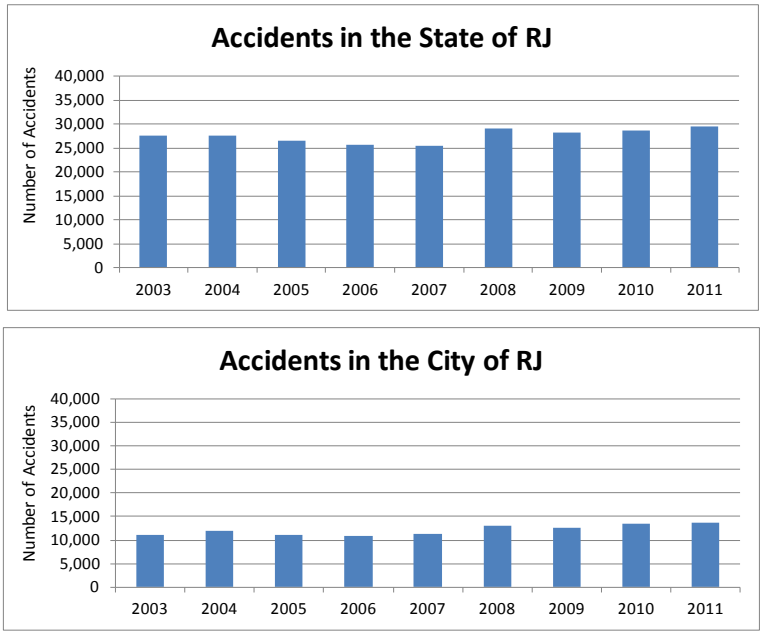
Avenidas Pastor Martin Luther King Jr. e Amaro Cavalcanti. Viaduto de Todos os Santos. Praça da Bandeira, sentido Méier, Avenida Maracanã, sentido Usina e Radial Oeste, sentido Méier. 24 de Maio, Arquias Cordeiro, altura do Engenhão. Dom Hélder Câmara, sentido Engenho de Dentro.

(6) Traffic Accidents

1) Number of Traffic Accidents

The number of traffic accidents has been constant through the years and it is necessary to reduce this figure.

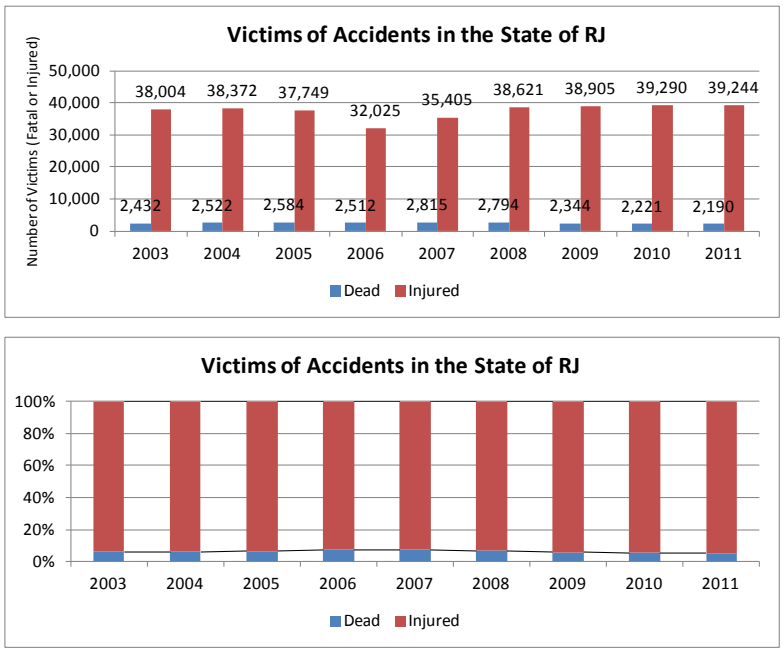
[Traffic accidents]



Source: DETRAN – RJ provided

Figure 2-72 Number of Traffic Accidents in Rio de Janeiro

[Fatal and injured accidents in the state of Rio de Janeiro]



Source: DETRAN – RJ provided

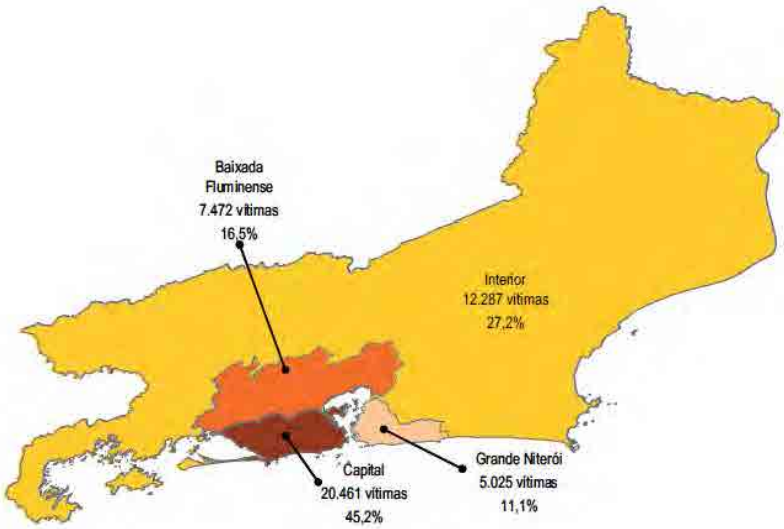
Figure 2-73 Number of Victims of Accident in Rio de Janeiro

2) Location of traffic accidents

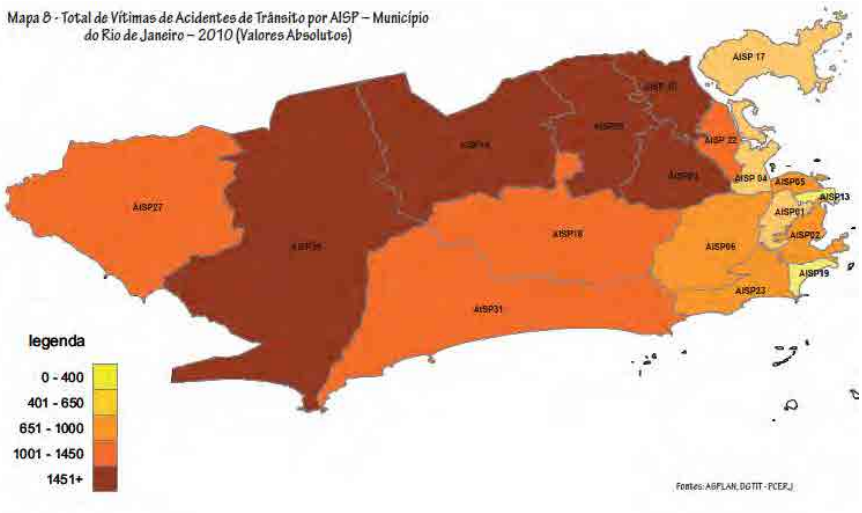
Figure 2-74 shows that traffic accidents happened more in the city of Rio de Janeiro and along Av. Brasil.

[Distribution of traffic accidents in 2010]

State-wise



City-wise



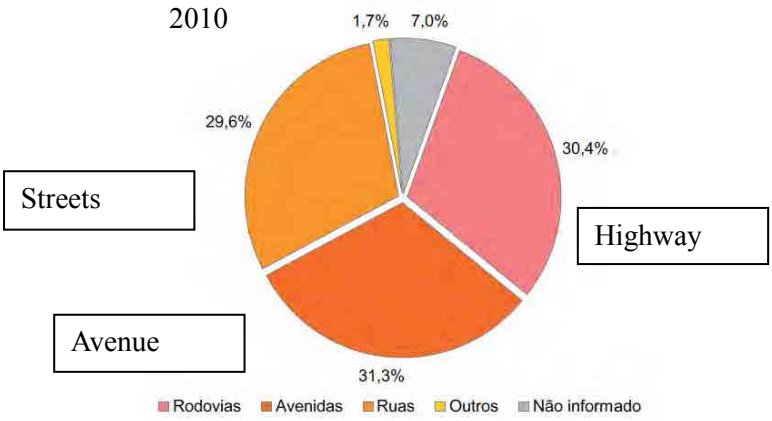
Source: Instituto de Segurança Pública

Figure 2-74 Distribution of Traffic Accidents in Rio de Janeiro

3) Traffic accidents by road type

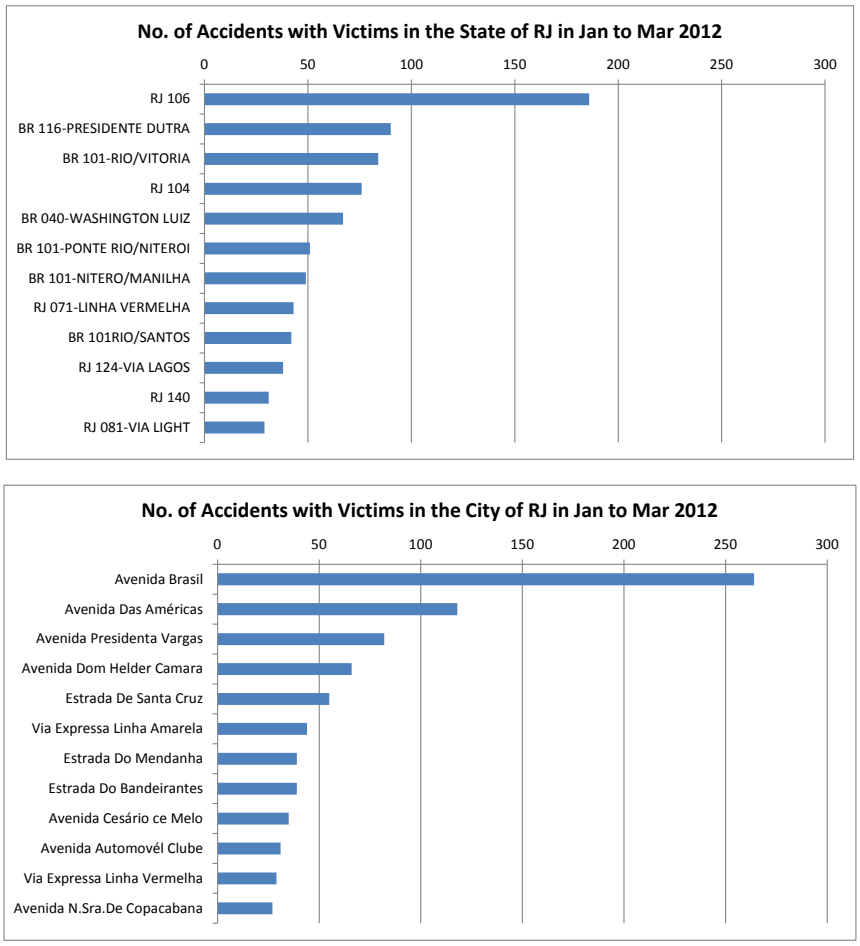
In the state of Rio de Janeiro, traffic accidents happened evenly on highways, avenues and streets. The roads, RJ 106, and Av. Brasil have the largest records of traffic accidents.

[Traffic accidents in the state of Rio de Janeiro by road types in 2010]



Source: Instituto de Segurança Pública

[Traffic accidents in the state of Rio de Janeiro by roads in 2012]



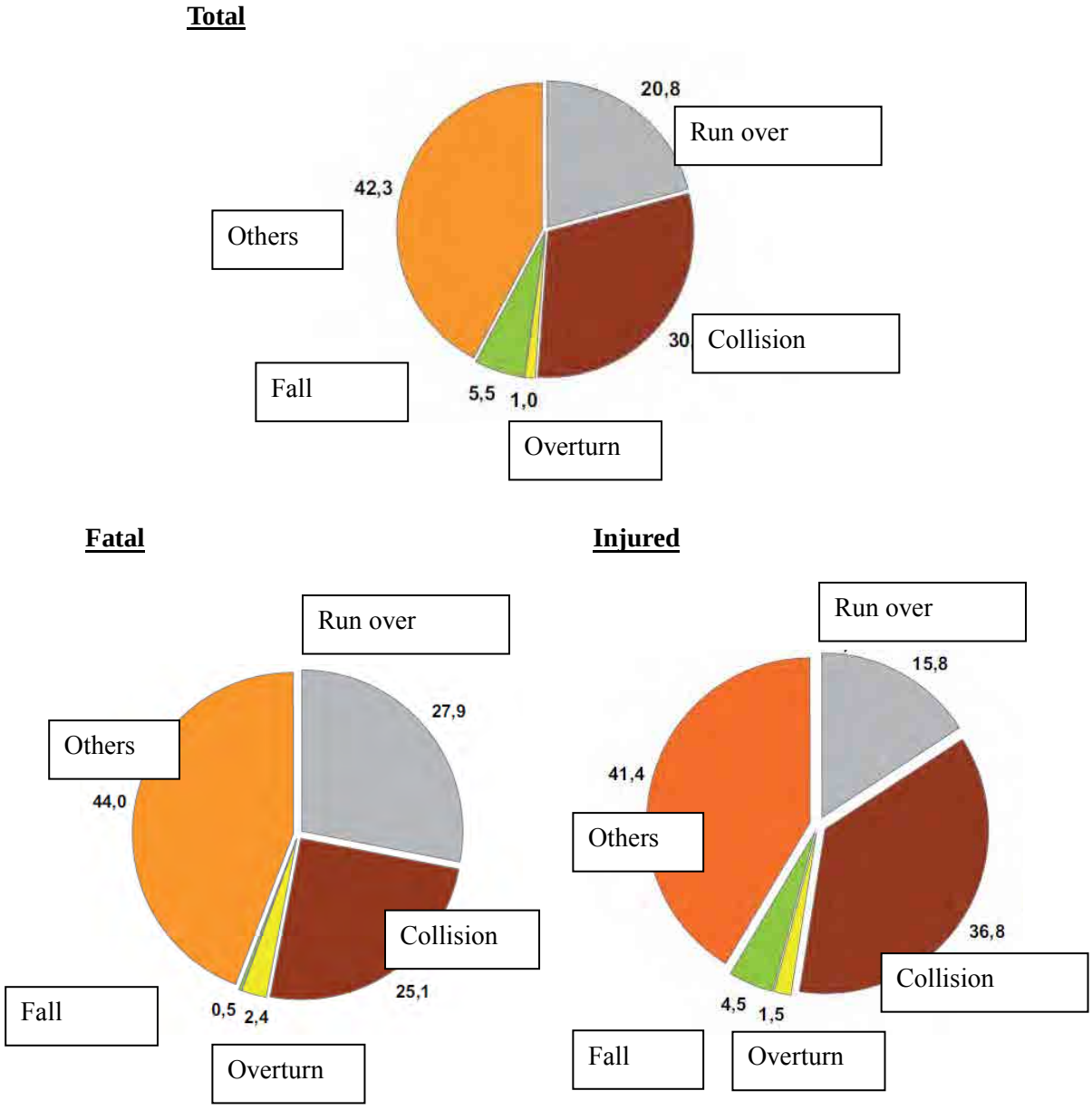
Source: DETRAN – RJ provided

Figure 2-75 Traffic Accidents by Roads and Road Types in Rio de Janeiro

4) Type of traffic accidents

Types of traffic accidents are mainly “collision” and “run over”. ITS could assist drivers to reduce these kinds of traffic accidents.

[Traffic accidents in the state of Rio de Janeiro by type in 2010]



Source: Instituto de Segurança Pública

Figure 2-76 Traffic Accidents by Types in Rio de Janeiro

(7) Traffic Control in Rio

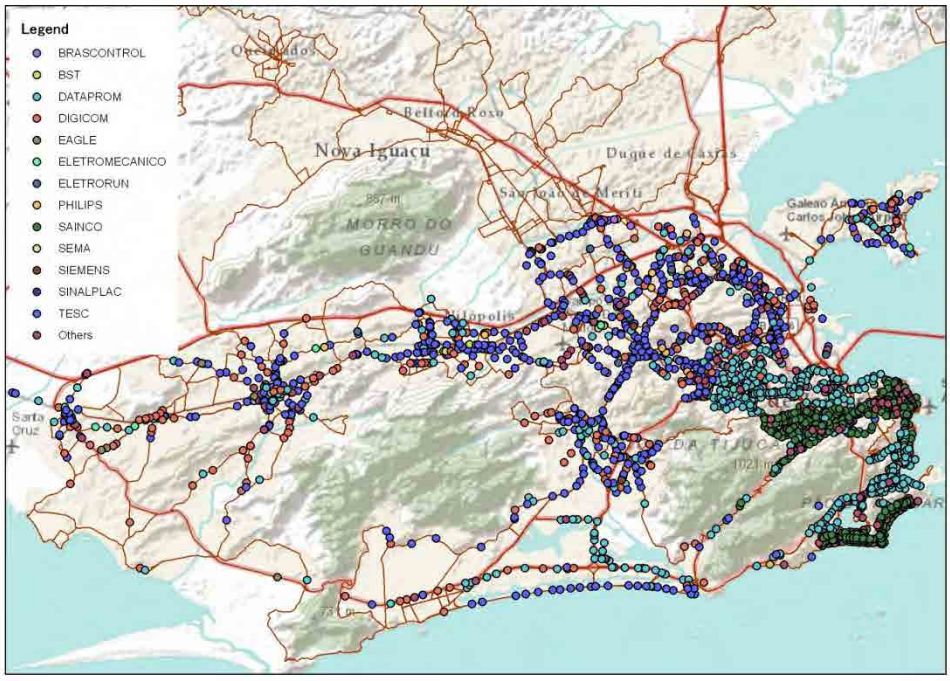
1) Operation in the City of Rio de Janeiro

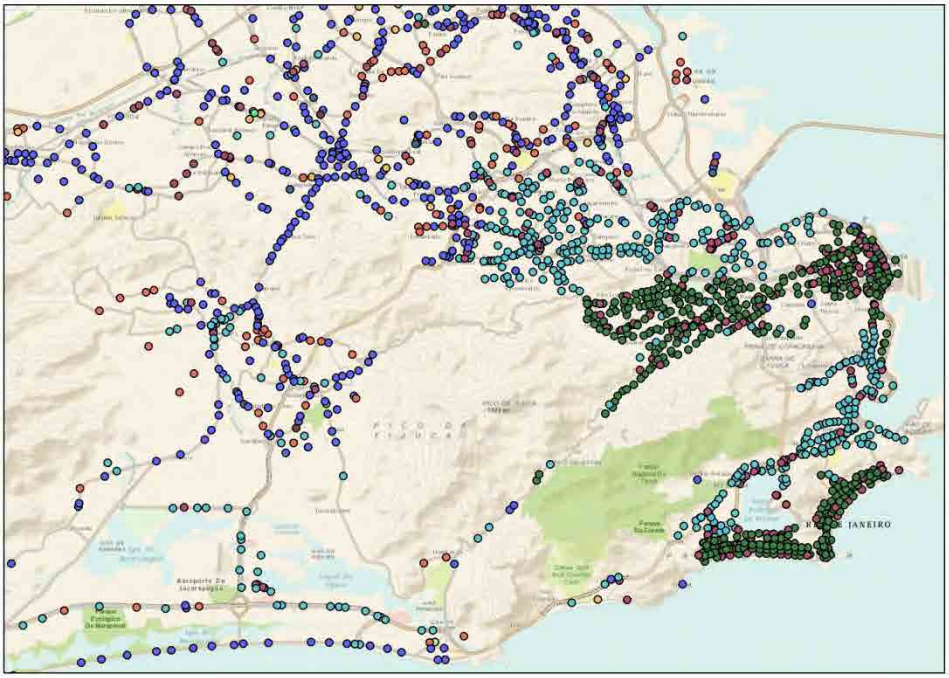
In the city of Rio de Janeiro the municipality operates road traffic. The government company, called CET-Rio, is in charge of the traffic control, such as traffic signals, variable message sign (VMS), and speed monitoring. The location of equipment for traffic operations and conditions of traffic control are described below.

i) Signal

Traffic signals are located all over the city, especially in Centro and South zones.

[Traffic signals in the city of Rio de Janeiro]





Source: CET-Rio provided

Figure 2-77 Traffic Signals in the City of Rio de Janeiro

Table 2-15 List of Traffic Signals by Type in the City of Rio de Janeiro

Type	No. of Signals	Company
BRASCONTROL BTC - 2001	2	BRASCONTROL
BST / RT 87 P	3	BST
DATAPROM / Dataprim	33	DATAPROM
DATAPROM / DP-40	551	DATAPROM
DATAPROM / DP-40 - R2	1	DATAPROM
DIGICOM / CD-100	1	DIGICOM
DIGICOM / CD-200	17	DIGICOM
DIGICOM / CD-200 Plug In	193	DIGICOM
DIGICOM / FCA	5	DIGICOM
EAGLE	6	EAGLE
ELETROMECANICO	5	ELETROMECANICO
ELETRORUN	11	ELETRORUN
PHILIPS / AD-180	26	PHILIPS
SAINCO / RMX-Y	483	SAINCO
SEMA	1	SEMA
SIEMENS	2	SIEMENS
SINALPLAC	1	SINALPLAC
TESC / Flexcon II	6	TESC
TESC / Flexcon III	108	TESC
TESC / Flexcon III 4F	52	TESC
TESC / Flexcon III Baby	7	TESC
TESC / Flexcon IIIa	8	TESC
TESC / Flexcon IIIs	318	TESC
TESC / Flexcon IV	5	TESC
TESC / Meng - M2DA	145	TESC
TESC / Meng - M3	3	TESC
(Connected Directly into Light)	1	
(Sub Controller)	254	
(Off)	1	
(No there / Manual Drive)	13	
(No there / Drive by Battalion of PM)	1	
(No there / Drive by Firefighters)	1	
(No there / Signal in Flashing)	1	
Total	2,265	

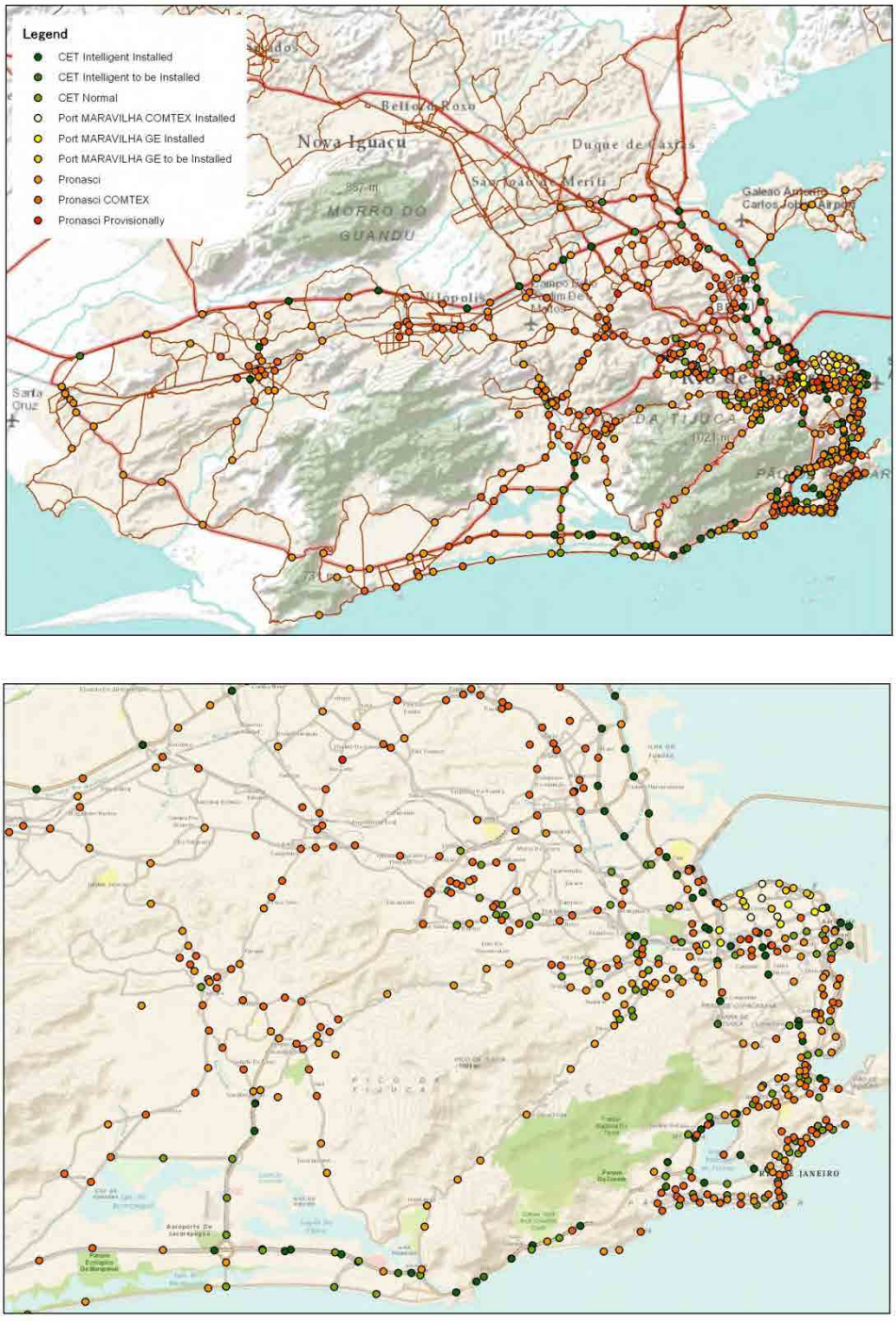
Company	No. of Signals
BRASCONTROL	2
BST	3
DATAPROM	585
DIGICOM	216
EAGLE	6
ELETROMECANICO	5
ELETRORUN	11
PHILIPS	26
SAINCO	483
SEMA	1
SIEMENS	2
SINALPLAC	1
TESC	652
Total	1,993

Source: JICA Study Team

ii) Cameras

Cameras are located all over the city, especially concentrated in Centro and South zones.

[Cameras in the city of Rio de Janeiro]



Source: CET-Rio provided

Figure 2-78 Cameras in the City of Rio de Janeiro

Table 2-16 List of Cameras by Type in the City of Rio de Janeiro

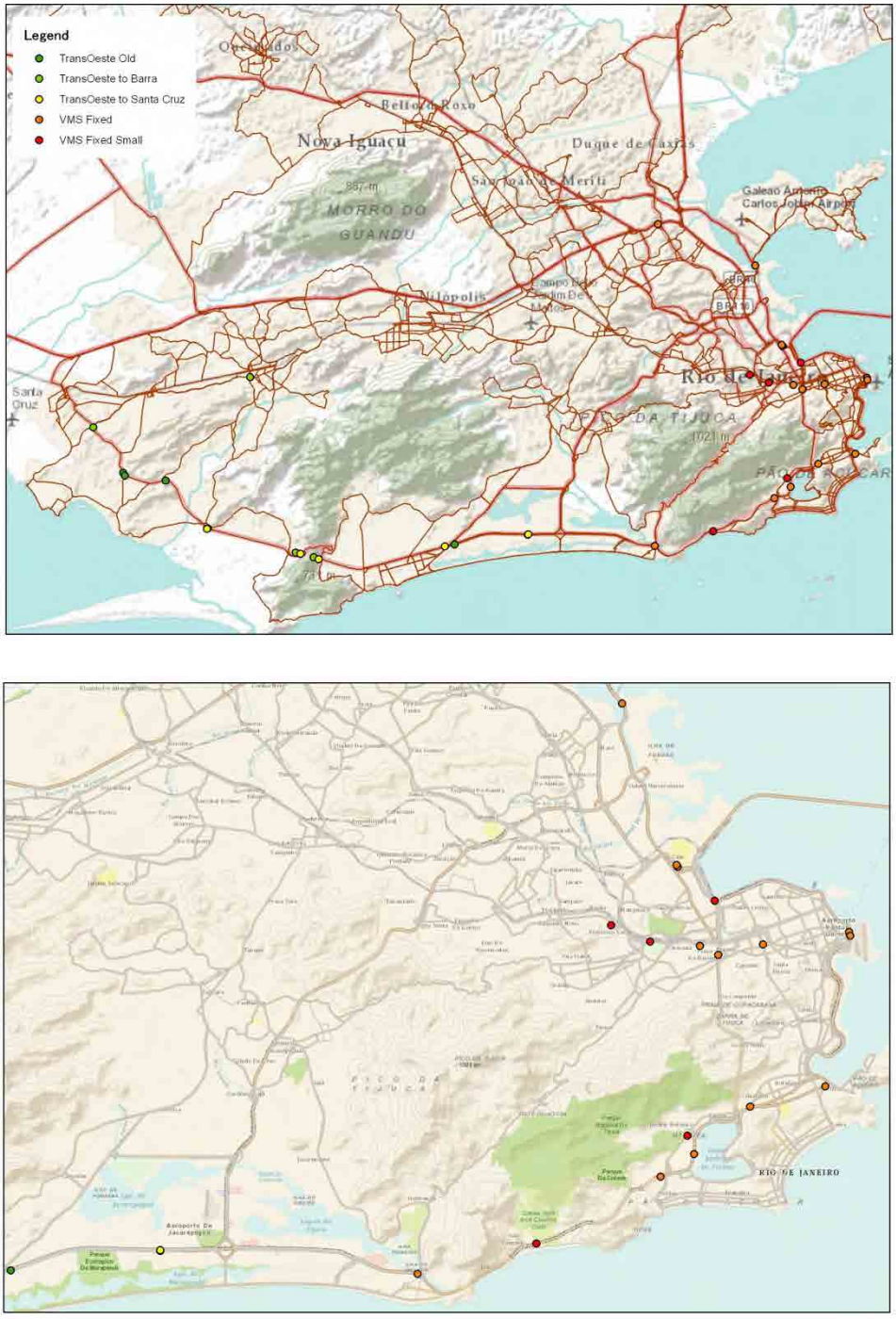
Type	No. of Cameras
CET Normal	87
CET Intelligent Installed	63
CET Intelligent to be Installed	11
Pronasci	179
Pronasci COMTEX	218
Pronasci Provisionally	3
Port MARAVILHA GE Installed	10
Port MARAVILHA COMTEX Installed	5
Port MARAVILHA GE to be Installed	6
Port MARAVILHA GE to be Installed	6
Installed Total	565
To be installed Total	23
Total	588

Source: JICA Study Team

iii) VMS

The number of VMS seems insufficient, and in particular, more VMSs need to be deployed in the central area.

[VMS in the city of Rio de Janeiro]



Source: CET-Rio provided

Figure 2-79 VMS in the City of Rio de Janeiro

Table 2-17 List of VMS by Type in the City of Rio de Janeiro

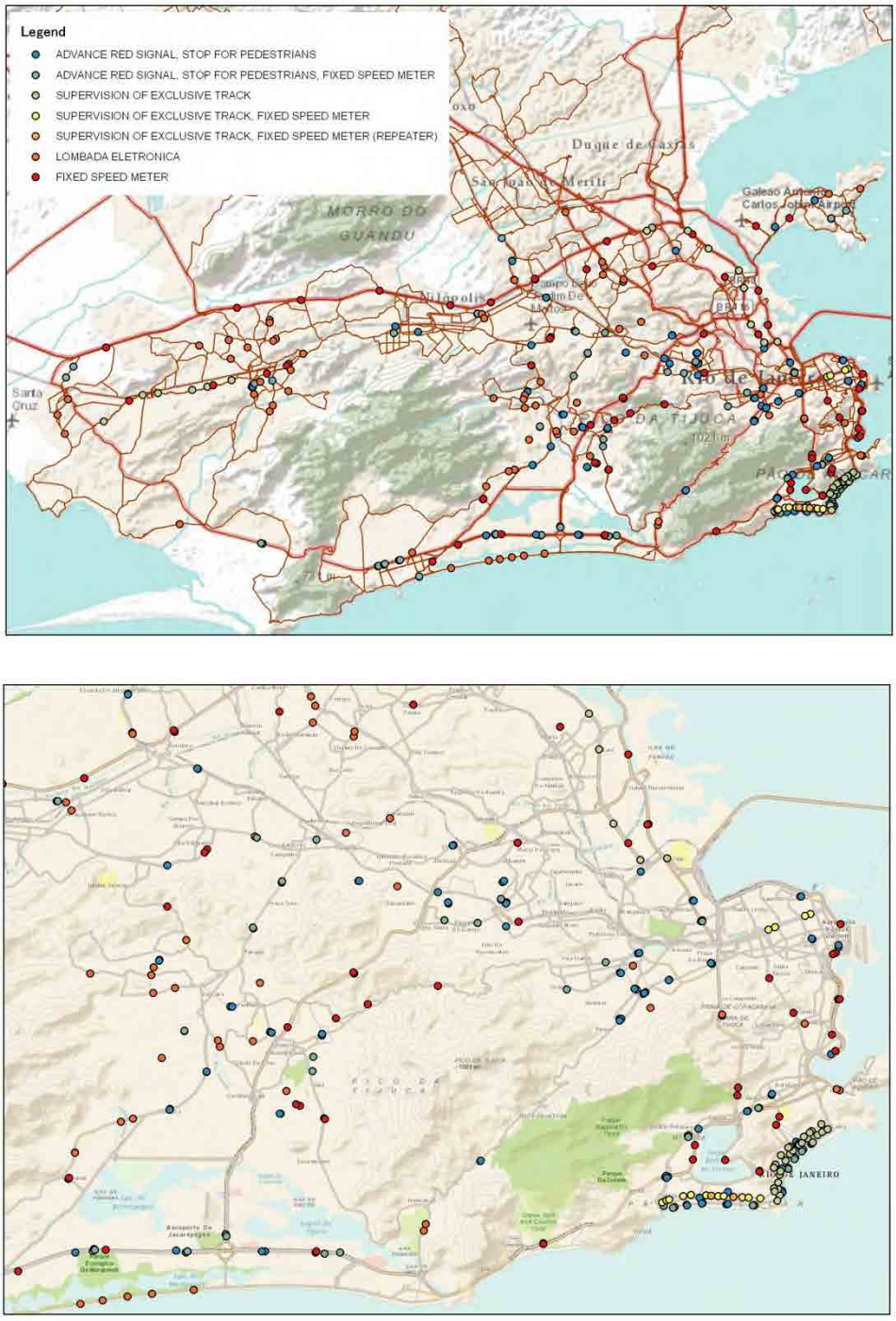
Type	No. of VMSs
VMS Fixed	15
VMS Fixed Small	5
TransOeste to Barra	5
TransOeste to Santa Cruz	5
Total	30

Source: JICA Study Team

iv) Speed Monitoring

Speed monitoring sensors are located all over the city, especially in Copacabana, Barra da Tijuca, and Campo Grande.

[Speed monitoring in the city of Rio de Janeiro]



Source: CET-Rio provided

Figure 2-80 Speed Monitoring in the City of Rio de Janeiro

Table 2-18 List of Speed Monitoring Equipment by Type in the City of Rio de Janeiro

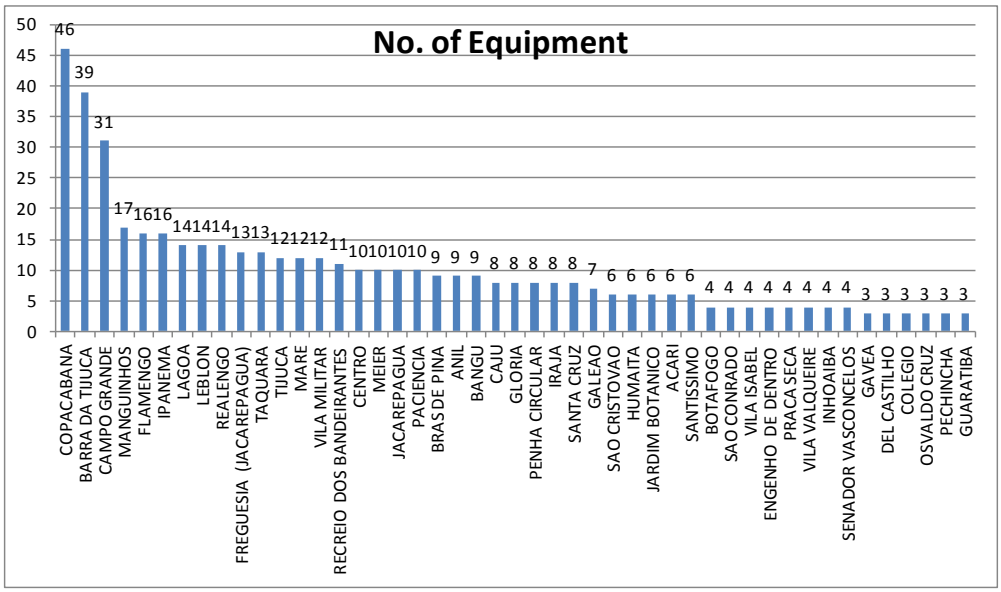
[By location]

Type	No. of Equipment
Advance Red Signal, Stop for Pedestrians	105
Advance Red Signal, Stop for Pedestrians, Fixed Speed Meter	78
Fixed Speed Meter	224
Supervision of Exclusive Track	49
Lombada Eletronica	68
Supervision of Exclusive Track, Fixed Speed Meter	15
Supervision of Exclusive Track, Fixed Speed Meter (Repeater)	2
Total	541

[By equipment]

Type	No. of Equipment
Advance Red Signal	183
Stop for Pedestrians	183
Fixed Speed Meter	319
Supervision of Exclusive Track	66
Lombada Eletronica	68
Total	819

[By area]



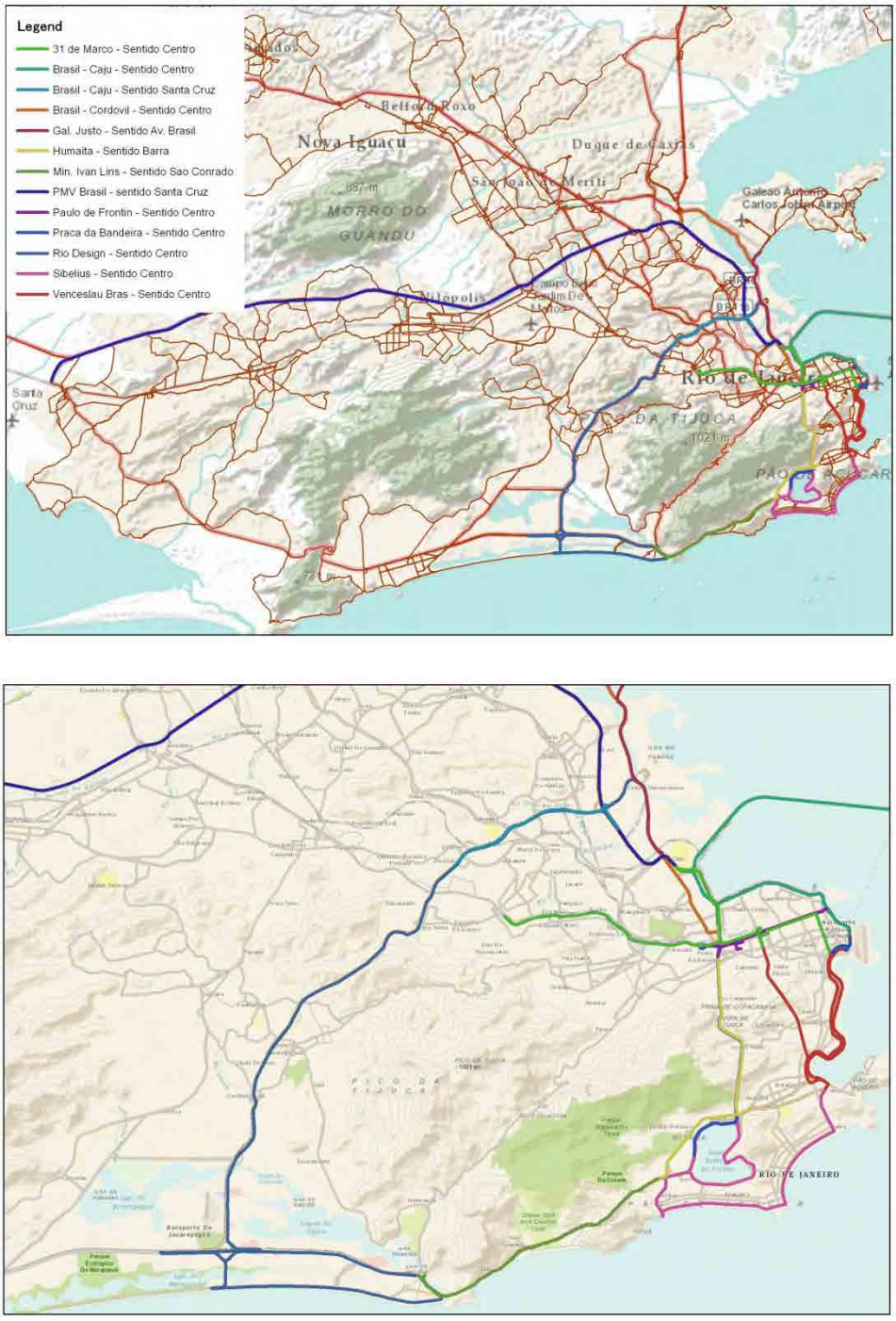
Source: JICA Study Team (Table 2-18 and Figure 2-81)

Figure 2-81 Number of Speed Monitoring Equipment by Area in the City of Rio de Janeiro

v) Special control

The CET-Rio has special traffic control routes where personnel in-charge can allocate field staff and control routes more intensively.

[Special control routes in the city of Rio de Janeiro]



Source: CET-Rio provided

Figure 2-82 Special Control Routes in the City of Rio de Janeiro

Table 2-19 List of Special Control Routes in the City of Rio de Janeiro

Route	Direction	Length (km)
Sibelius	Centro	27.3
Venceslau Bras	Centro	19.8
Praca da Bandeira	Centro	20.6
Rio Design	Centro	63.2
Min. Ivan Lins	Sao Conrado	11.6
Brasil - Cordovil	Centro	32.2
Humaita	Barra	11.7
Gal. Justo	Av. Brasil	15.8
PMV Brasil	Santa Cruz	61.1
Brasil - Caju	Santa Cruz	7.3
Brasil - Caju	Centro	22.2
Paulo de Frontin	Centro	17.2
31 de Marco	Centro	18.3
Total		328.2

Source: JICA Study Team

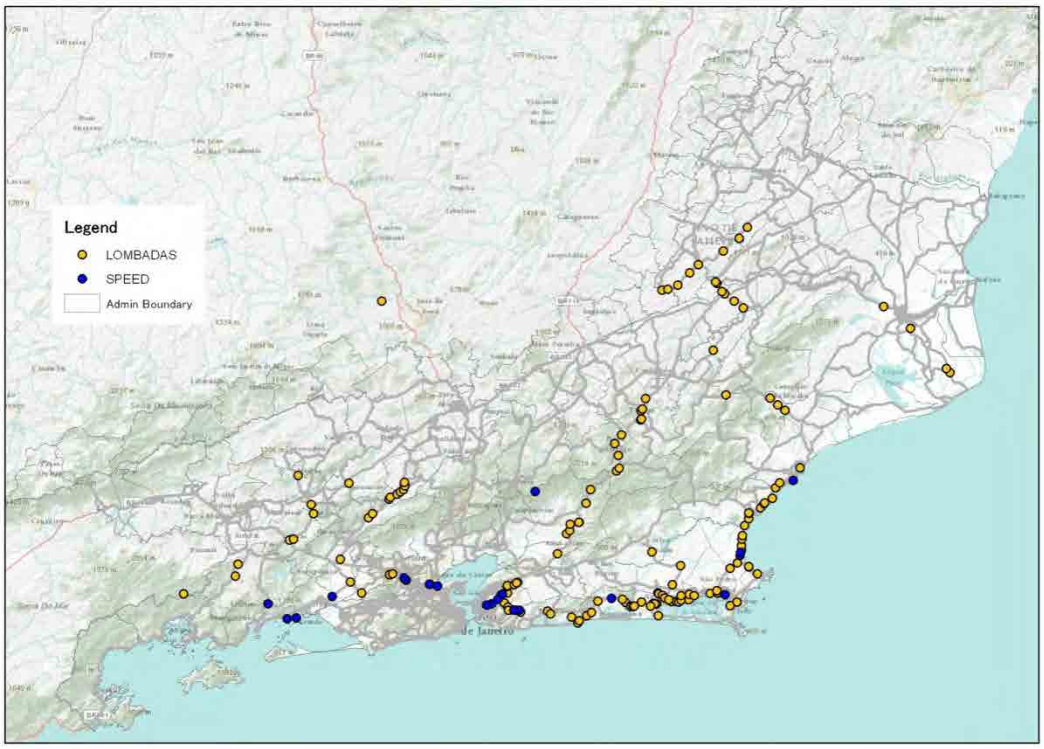
2) Operation in the State of Rio de Janeiro

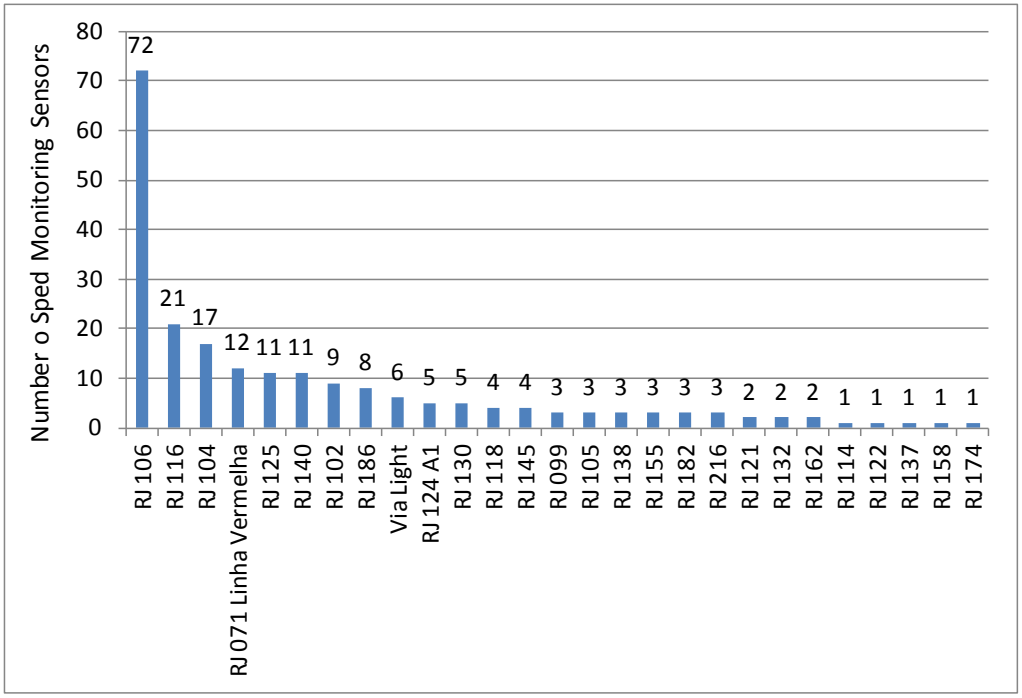
In the state of Rio de Janeiro, except for the city of Rio de Janeiro, federal, state, and municipal governments, along with concession companies, manage their road infrastructure and road traffic. Based on an interview with the Department of Roads (*Departamento de Estradas de Rodagem*: DER), DER-RJ operates road traffic using speed monitoring equipment, cameras, and VMS. As for traffic signaling, each municipal government controls their own. Here, the location of equipment for traffic operation and condition of traffic control in state roads are described.

i) Speed monitoring

There are many speed monitoring sensors deployed along RJ 106, RJ 116, and RJ 106.

[Speed monitoring in the state of Rio de Janeiro]





Source: DER - RJ provided

Figure 2-83 Speed Monitoring in the State of Rio de Janeiro

Table 2-20 List of Speed Monitoring Equipment in the City of Rio de Janeiro

[By type]

Type	No. of Equipment
LOMBADAS	155
SPEED	59
Total	214

[By road]

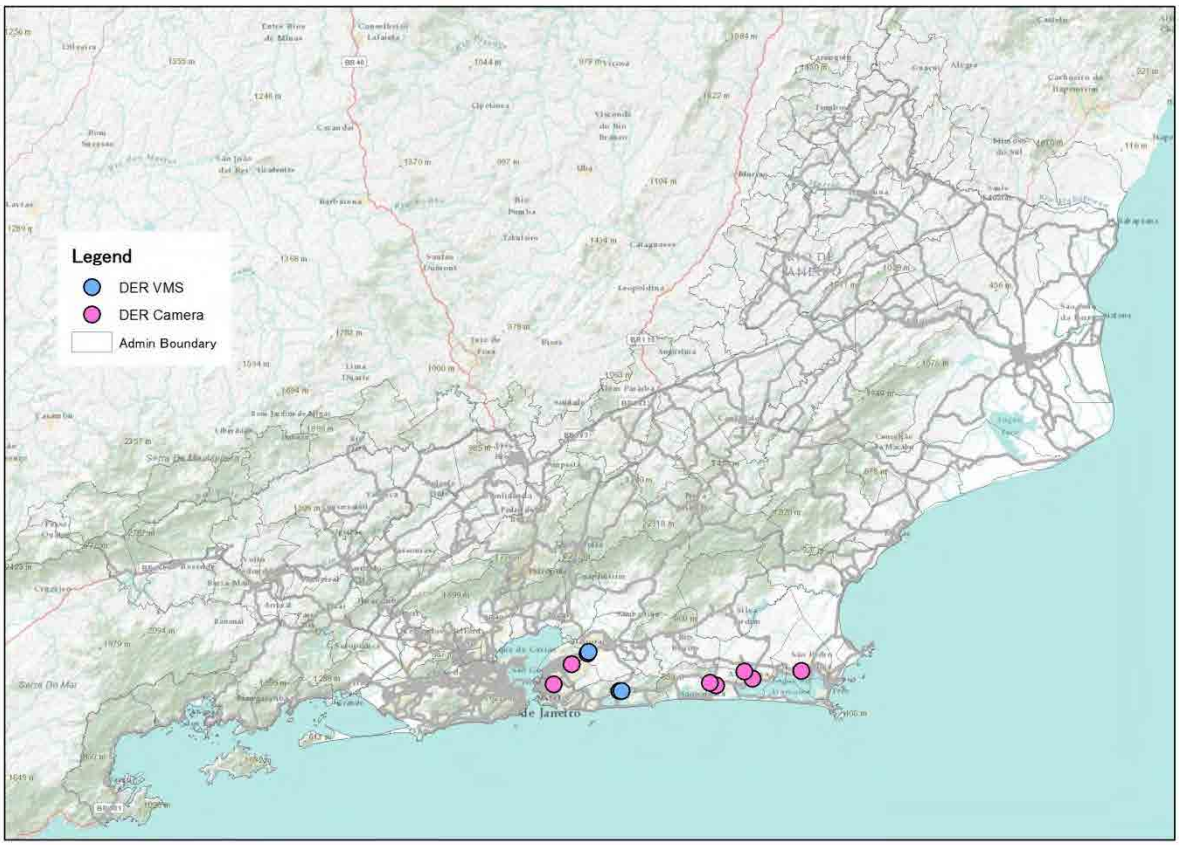
Road	LOMBADAS	SPEED	No. of Equipment
RJ 071 Linha Vermelha	0	12	12
RJ 099	1	2	3
RJ 102	9	0	9
RJ 104	6	11	17
RJ 105	3	0	3
RJ 106	48	24	72
RJ 114	1	0	1
RJ 116	21	0	21
RJ 118	4	0	4
RJ 121	2	0	2
RJ 122	1	0	1
RJ 124 A1	5	0	5
RJ 125	11	0	11
RJ 130	5	0	5
RJ 132	2	0	2
RJ 137	1	0	1
RJ 138	3	0	3
RJ 140	7	4	11
RJ 145	4	0	4
RJ 155	3	0	3
RJ 158	1	0	1
RJ 162	2	0	2
RJ 174	1	0	1
RJ 182	3	0	3
RJ 186	8	0	8
RJ 216	3	0	3
Via Light	0	6	6
Total	155	59	214

Source: JICA Study Team

ii) Cameras and VMS

Cameras and VMSs are only deployed along RJ 104 and RJ 106.

[Cameras and VMS in the state of Rio de Janeiro]



Source: DER - RJ provided

Figure 2-84 Cameras and VMS in the State of Rio de Janeiro

Table 2-21 List of Cameras and VMS Equipment in the City of Rio de Janeiro

Cameras	
Road	KP
RJ-104	1,5
RJ-104	14,0
RJ-104	21,0
RJ-106	38,0
RJ-106	70,7
RJ-106	71,4
RJ-106	86,6
RJ-106	107,3
RJ-106	110,0

VMS	
Road	KP
RJ-104	21,0
RJ-106	38,0

Source: JICA Study Team

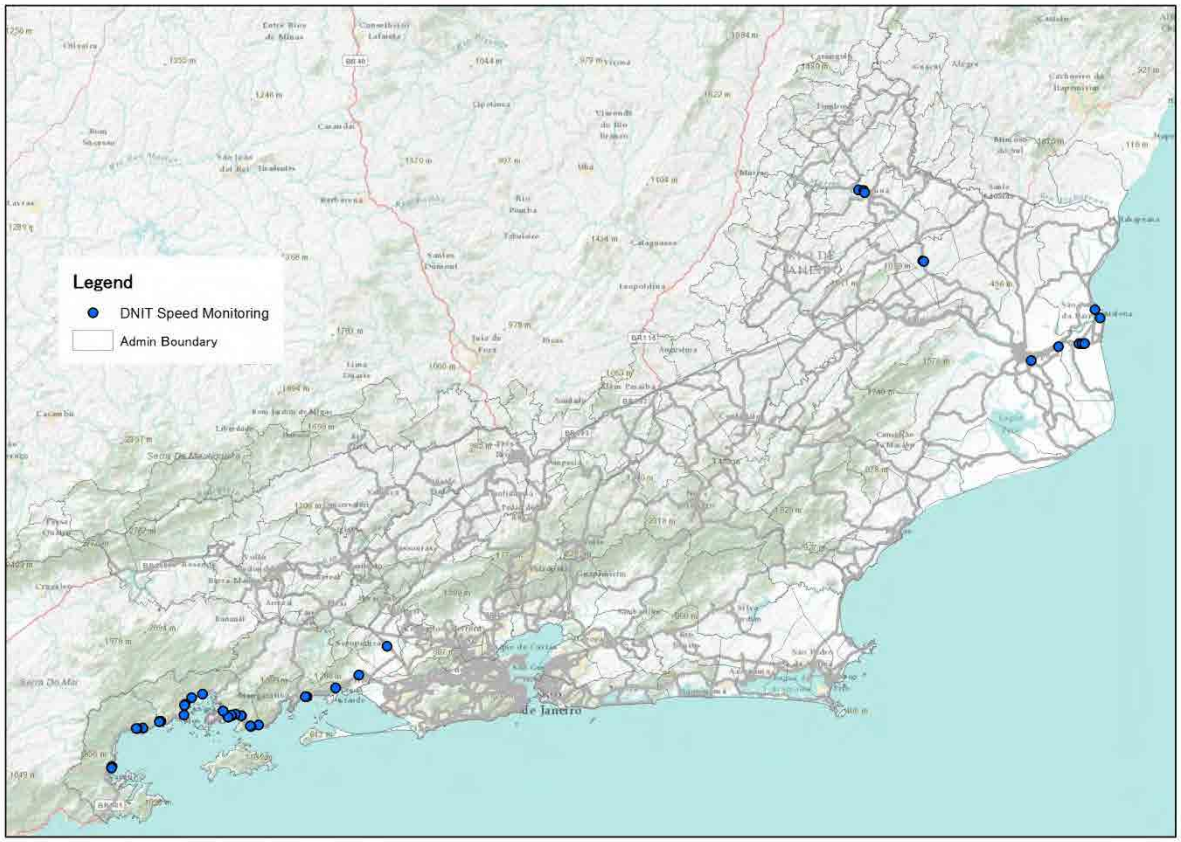
3) Operation in the Federal

In the state of Rio de Janeiro, except the city of Rio de Janeiro, federal, state, and municipal governments, along with concession companies, manage their road infrastructure and road traffic. Based on an interview with the National Department of Transport Infrastructure (*Departamento Nacional de Infraestrutura de Transportes*: DNIT), DNIT operate road traffic using speed monitoring equipment. Here, the location of equipment for traffic operation and condition of traffic control in federal roads are described.

i) Speed monitoring

In RMRJ speed monitoring sensors deployed on federal roads are only for BR 101.

[Speed monitoring on federal road in the state of Rio de Janeiro]



Source: DNIT provided

Figure 2-85 Speed Monitoring Equipment of DNIT in the State of Rio de Janeiro

Table 2-22 List of Speed Monitoring Equipment of DNIT in the State of Rio de Janeiro

Road	RMRJ	Other
BR 101	4	30
BR 356	0	12
BR 465	1	0

Source: JICA Study Team

4) Traffic Measures in Central Rio

i) Traffic signal control

[Description]

The top photo is an example of simultaneous traffic signal control along Av. Nossa Senhora de Copacabana. The bottom photo is an example of a countdown timer of green time for pedestrian.

[Photo]

Source: JICA Study Team

Figure 2-86 Simultaneous Signal Control along Av. Nossa Senhora de Copacabana

Source: JICA Study Team

Figure 2-87 Counting Green Time for Pedestrian Crossing along Av. Nossa Senhora de Copacabana

ii) Reversible Lane Control

[Description]

In Centro and South zones, reversible lane control is operated.

[Location]

Table 2-23 List of Sections for Reversible Lane in the City of Rio de Janeiro

Location	towards	extension (km)	time (h)	Total Lanes	Lanes reversed
Elevado do Joá	São Conrado	3,3	6h30m às 8h30m	2	+1
Av. Niemeyer	Leblon	3,8	6h30m às 10h30m	1	+1
Orlas de Leblon, Ipanema e Copacabana	Leme	7	7h às 10h	3	+3
Av. Princesa Isabel, Túnel Novo e Túnel Pasmado	Aterro	1,9	7h às 10h	4	+2
Rua Prof. Manoel de Abreu	Centro	1,1	6h30m às 11h	2	+2
Rua Visconde de Niterói	Centro	1,1	6h às 9h	2	+1
Rua Jardim Botânico	Gávea	1,8	17h às 21h	2	+1
Rua Humaitá	Jardim Botânico	0,6	17h às 20h	3	+1
Av. Rodrigues Alves	Av. Brasil	0,7	16h às 20h	3	+1
Rua Teixeira Soares - Radial Oeste	Méier	0,6	16h30m às 20h30m	4	+1

Source: JICA Study Team

[Photo]

Source: JICA Study Team

Figure 2-88 Example of Reversible Lane in Copacabana Area

iii) Road Closure on Sundays

[Description]

On Sundays, some roads are closed to traffic and open for recreational use.

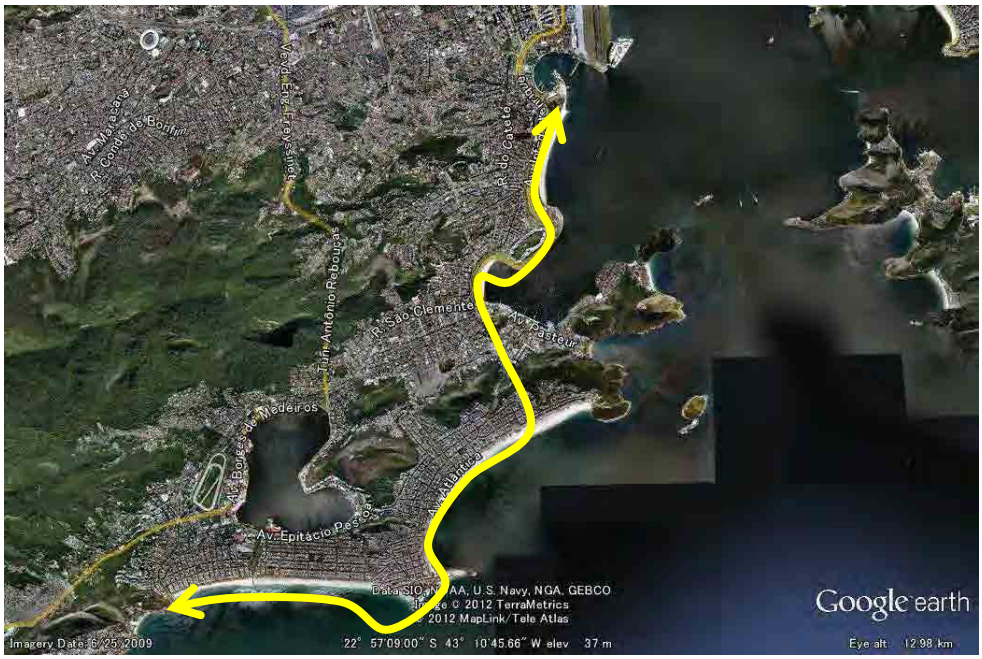
[Location]

Table 2-24 List of Sections for Road Closure in the City of Rio de Janeiro

no	Road	Lane	Day	Time
1	Avenida Infante Dom Henrique	All	Sunday	7h - 19h
2	Avenida Atlantica	Lane along the coast	Sunday	7h - 19h
3	Avenida Delfim Moreira	Lane along the coast	Sunday	7h - 19h
4	Avenida Vieira Souto	Lane along the coast	Sunday	7h - 19h

Source: JICA Study Team

[Map]



Source: JICA Study Team

Figure 2-89 Location of Sections for Road Closure in the City of Rio de Janeiro

iv) Bus Priority Operation - Bus Rapid System (BRS)

[Description]

Bus priority operation is conducted along main bus roads between Centro and South zones.

[Location]

Copacabana

Leblon / Ipanema

Pres. Antônio Carlos / 1° de Março

Rio Branco

President Vargas

[Map]

As shown on the next pages

[Photo]

Source: JICA Study Team

Figure 2-90 Photos of BRS

Copacabana

Leblon/Ipanema

Pres. Antônio Carlos/1° de Março, Rio Branco

President Vargas

> Central

> Marginal

Source: Fetranspor (http://www.fetranspor.com.br/brs/copacabana.php)

Figure 2-91 Maps of BRS

v) Bus Priority Operation - Bus Rapid Transit (BRT)

[Description]

BRT lanes have been built in recent years. In the case of Rio, because a new lane has been built for BRT, there is no impact on the existing road capacity. However, traffic signaling is shared with BRT so traffic signal control should be adapted.

[Map]

Source: JICA Study Team

Figure 2-92 Map of BRT

[Photo]

Source: JICA Study Team

Figure 2-93 Photo of BRS

(8) Other Problems Observed during the Site Visit

i) Flooding on the Road

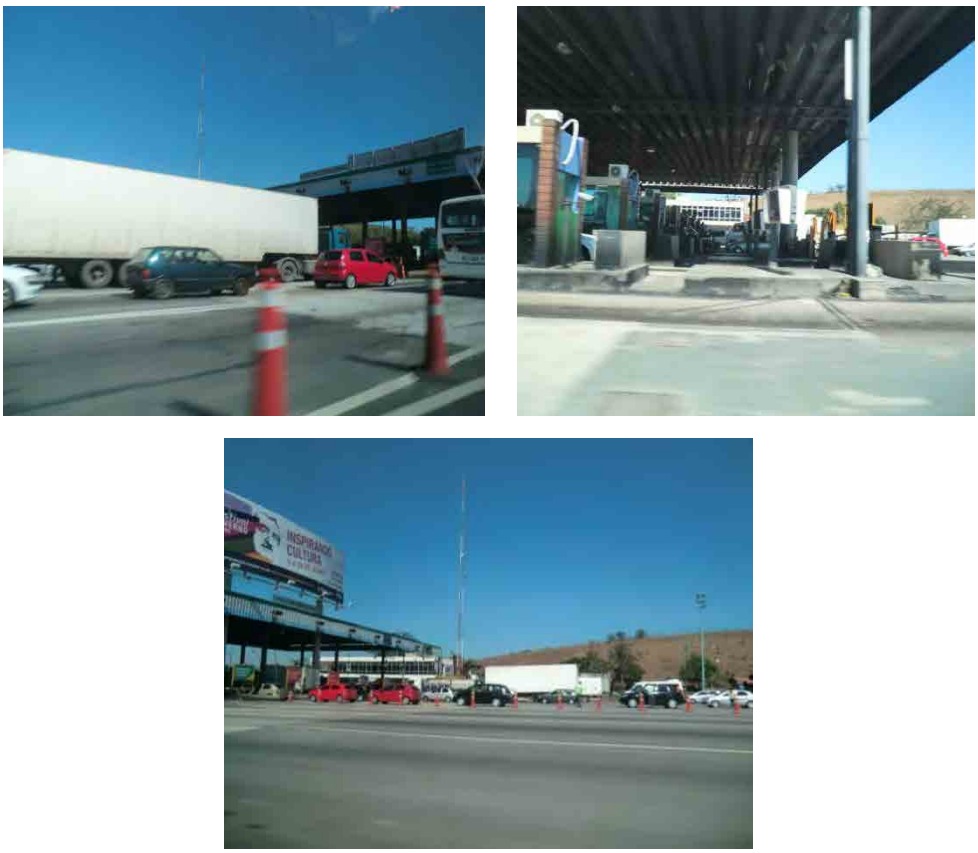
When it rains heavily, some urban roads are flooded.

Source: JICA Study Team

Figure 2-94 Photos of Road Flooding

ii) Congestion at the Toll Gate

The number of electronic toll gates as well as the utilization rate of on-board units for electronic toll collection is quite low. This is the reason why traffic jams occur at the toll gates.



Source: JICA Study Team

Figure 2-95 Photos at the Toll Gates

iii) Blockages by Bus and Vans

Bus approaching information is not provided for users in Rio de Janeiro. Sometimes groups of people leave the sidewalk and bus stop boarding area and stand in the bus lane to look for the oncoming buses. These causes buses and vans to move into the second lane of the road to pass by or pick up passengers that causes traffic jams during normal traffic.

Source: JICA Study Team

Figure 2-96 Photos at the Bus Stop

iv) Steps on the Road and Bus

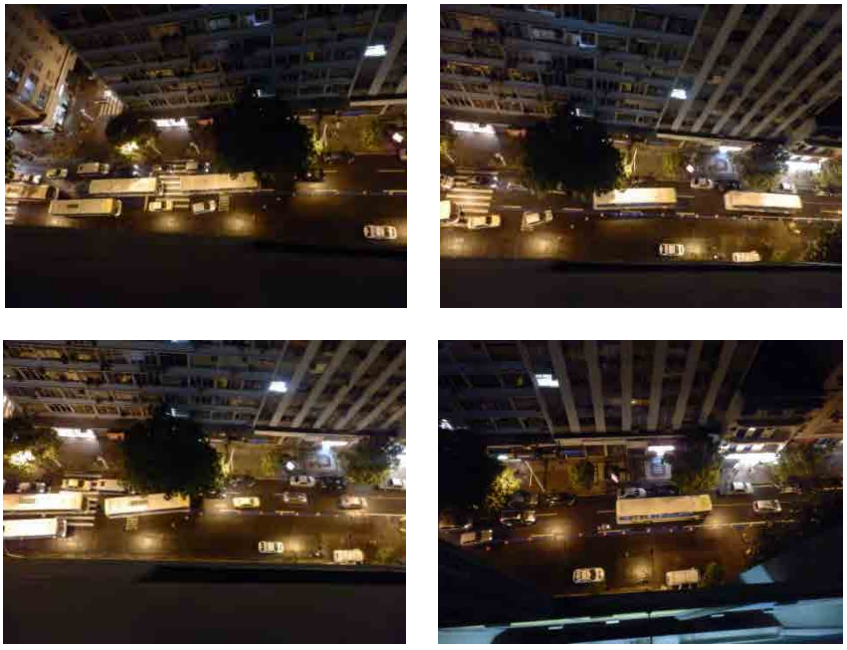
Road infrastructure needs to be improved with universal design by removing steps at the crossing and bus stops.

Source: JICA Study Team

Figure 2-97 Photos at the Pedestrian Lane

v) Traffic Jam Caused by Road Construction

Below is an example of a traffic jam caused by a road construction on Av. Nossa Senhora de Copacabana. It is important to provide an advance or real time information on road construction in order to allow time for drivers to choose an alternative route.



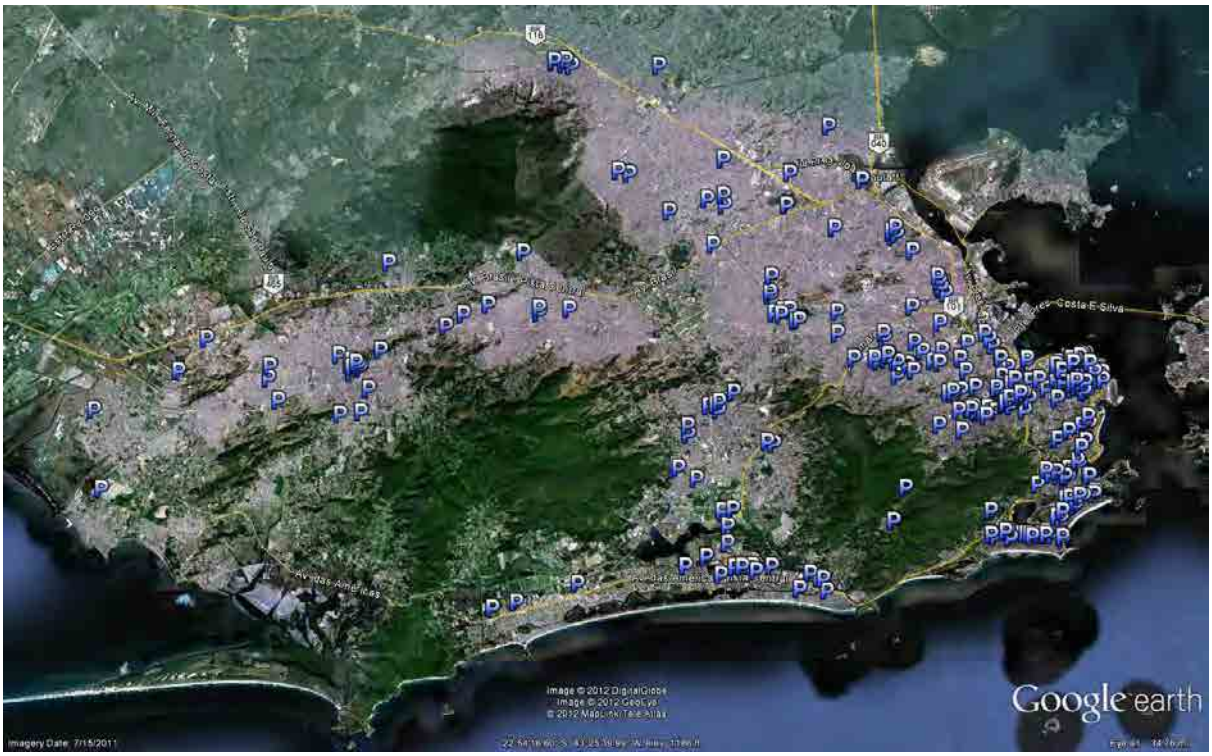
Source: JICA Study Team

Figure 2-98 Photos of Road Construction

(9) Parking

i) Location of Main Parking in the City of Rio de Janeiro

Car parking is plotted using a website provided by a private company. Most parking areas are located in Centro and South zones.



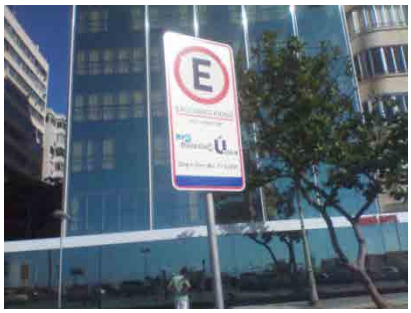
Source: http://www.maplink.com.br/

Figure 2-99 Location of Parking Areas

ii) Parking Type

Three types of car parking are provided for car users in Rio. Parking on the road is operated by CET-Rio and the others are operated by public sectors or private companies contracted by the local government.

[On the road]



[Buildings]

Source: JICA Study Team

Figure 2-100 Types of Parking

(10) Bicycles

The municipality and state of Rio de Janeiro promote the use of bicycles in order to improve the constant traffic jams and poor air condition. In the municipality, the Municipal Secretariat of the Environment (*Secretaria Municipal de Meio Ambiente*: SMAC) is in charge of a policy to encourage bicycle use and has published a map of the cycle road network.

The information shown in the website of SMAC is as follows:

"Today, the healthy and sustainable use of bicycle as a means of transportation receives great attention from the Municipal Environment.

The city currently has 290 km of bike paths with the goal of reaching 450 km by 2016."

http://www.rio.rj.gov.br/web/smac

Source: http://www.rio.rj.gov.br/web/smac

Figure 2-101 Cycle Road Network Map in the City of Rio de Janeiro

(11) Safety Issues

1) Infrastructure and Operation - BRT

It was observed that some accidents occurred due to invasion of private cars on BRT lanes.

Source: Rio Onibus

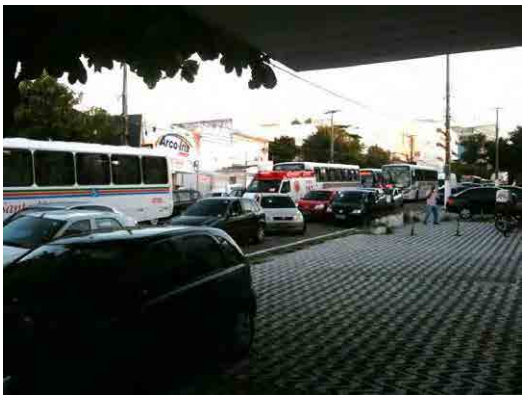
Figure 2-102 BRT Lane

2) Ambulances are stuck in traffic jams

The photo below is an example in which an ambulance car is stuck in traffic jams.

[Example]

31 Aug 2012 on Av. Rio Branco



Source: Via Certa Natal Trânsito (www.viacertanatal.com)

Figure 2-103 Example of Obstacle Location for Emergency Vehicles

13 September 2012 (Reporter of *Rádio Uirapuru*)

Comment from Chief Operating Officer, Lieutenant Paulo Roberto de Souza

"Congestion on Avenida Brazil remains the largest obstacle for fire bombeiros (services)"

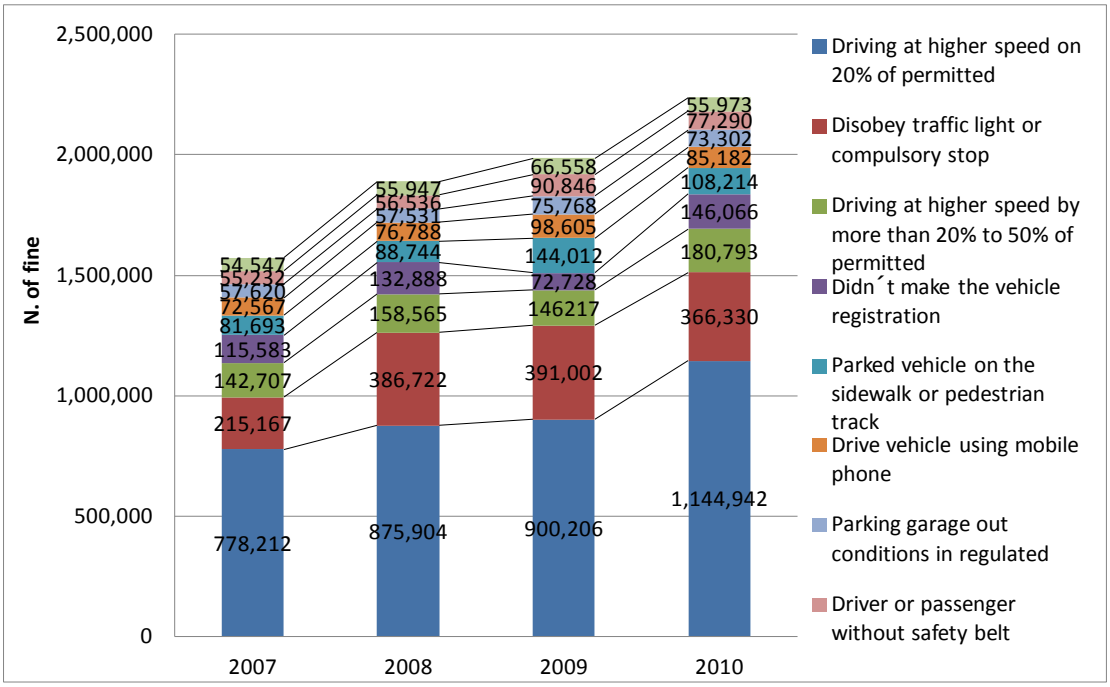
"The biggest problem faced by emergency services remains in Brazil Avenue because of traffic jams"

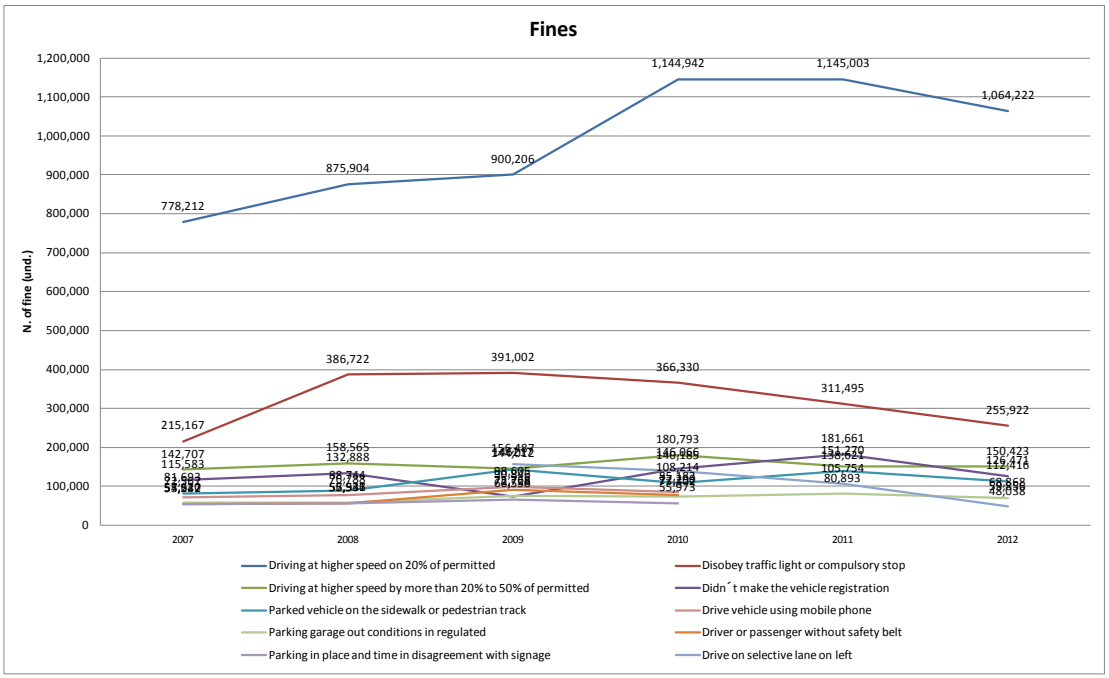
"When the fire fighting vehicle arrives at the traffic lights, few drivers give way."

Source: Rádio Uirapuru (http://www.rduirapuru.com.br/)

(12) Law Enforcement

DER–RJ *(Departamento de Estradas de Rodagens*: Department of Roads), DETRAN (*Departamento de Trânsito*: State Traffic Department), and SMTR-RJ (*Secretaria Municipal de Transportes- Rio Janeiro***:** Municipal Secretariat of Transportation) are responsible for the different types of fines in force. Speeding is the well known type of traffic violation fines in Rio, and the amount of fines is increasing.





Source: DETRAN RJ HP(http://www.detran.rj.gov.br/_estatisticas.veiculos/09.asp)

Figure 2-104 Number of Fines in the State of Rio de Janeiro