

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

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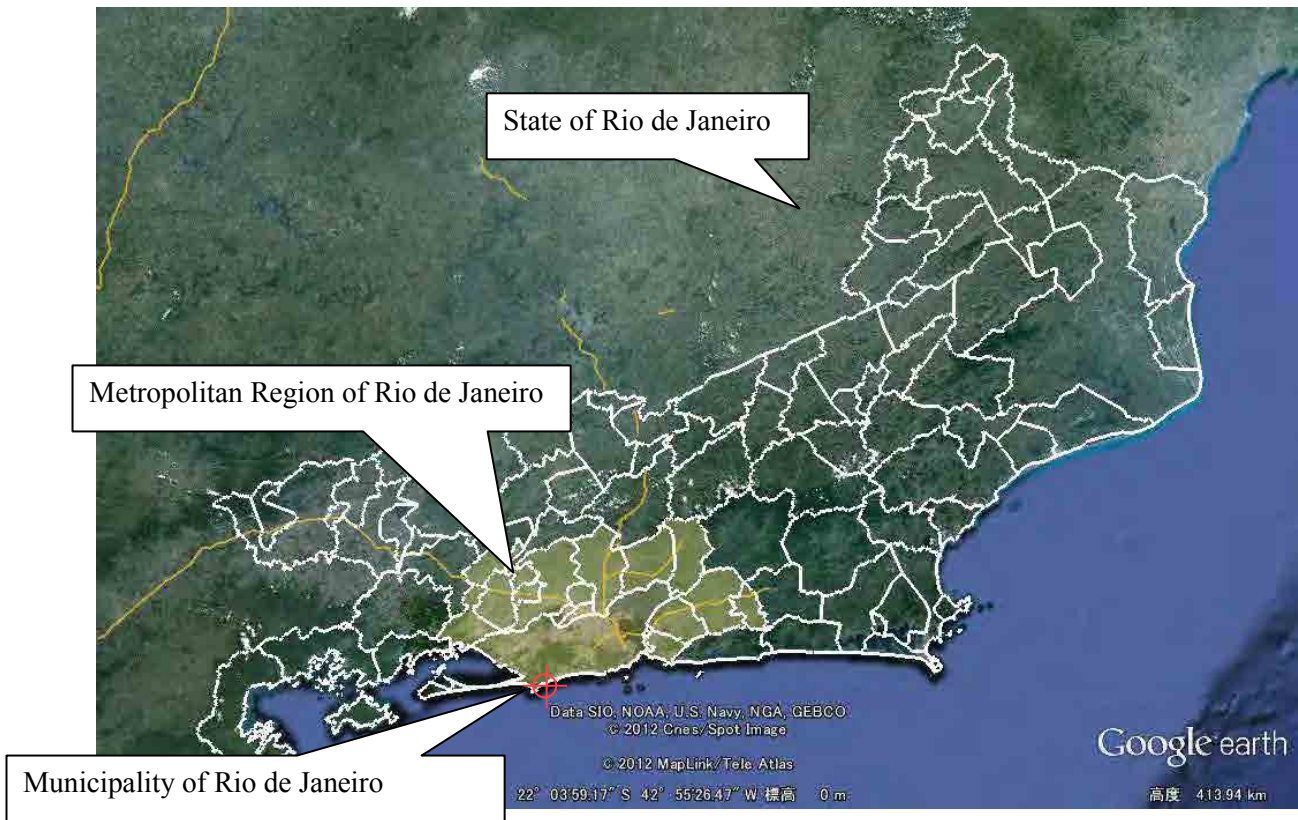
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LOCATION MAP



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

TABLE OF CONTENTS

Figure and Table List

Abbreviations

| | | |
|-----------|--|-------|
| CHAPTER 1 | INTRODUCTION | 1-1 |
| 1.1 | STUDY BACK GROUND | 1-1 |
| 1.2 | OBJECT AND STUDY AREA..... | 1-1 |
| 1.3 | SCOPE OF WORKS | 1-3 |
| 1.4 | SCHEDULE OF THE STUDY AND PROGRESS | 1-5 |
| CHAPTER 2 | CLARIFICATION OF CURRENT INTELLIGENT TRANSPORT SYSTEMS CONDITION IN RIO DE JANEIRO..... | 2-1 |
| 2.1 | REGIONAL CHARACTERISTICS OF RIO DE JANEIRO..... | 2-1 |
| 2.1.1 | Administration | 2-1 |
| 2.1.2 | Economy | 2-3 |
| 2.1.3 | Global Competitiveness | 2-16 |
| 2.1.4 | Sightseeing Resources and Statistics | 2-18 |
| 2.1.5 | Current Condition of Telecommunications | 2-37 |
| 2.2 | TRAFFIC/TRANSPORTATION CHARACTERISTICS IN RIO DE JANEIRO..... | 2-49 |
| 2.2.1 | Overall Condition..... | 2-49 |
| 2.2.2 | Traffic Conditions | 2-55 |
| 2.2.3 | Transport Condition | 2-112 |
| 2.3 | CURRENT CONDITION OF ITS IN RIO DE JANEIRO..... | 2-141 |
| 2.3.1 | ITS-Related Agencies of Rio De Janeiro Metropolitan Area..... | 2-141 |
| 2.3.2 | Current Condition of ITS Facilities..... | 2-147 |
| 2.4 | PLANS IN RIO DE JANEIRO METROPOLITAN AREA | 2-176 |
| 2.4.1 | Traffic/Transportation Related Plan..... | 2-176 |
| 2.4.2 | Urban Development Plan..... | 2-183 |
| 2.4.3 | ITS-Related Plan..... | 2-194 |
| CHAPTER 3 | SUPPLEMENTARY TRAFFIC SURVEY..... | 3-1 |
| 3.1 | REVIEW OF EXISTING TRANSPORT MASTER PLANS..... | 3-1 |
| 3.1.1 | PDTU/RMRJ 2005..... | 3-1 |
| 3.1.2 | PDTU/RMRJ 2011..... | 3-3 |
| 3.1.3 | Rio 2016 Transport Strategy | 3-6 |
| 3.1.4 | Update of the Strategic Transport Plan for the Olympic and Paralympic Games 2016 | 3-10 |
| 3.2 | SUPPLEMENTARY TRAFFIC SURVEY | 3-11 |
| 3.2.1 | Objectives and Survey Methodology | 3-11 |
| 3.2.2 | Survey Result | 3-36 |

| | | |
|-----------|---|-------|
| 3.3 | TRAFFIC DEMAND FORECAST | 3-63 |
| 3.3.1 | Context of Traffic Demand Forecast..... | 3-63 |
| 3.3.2 | Review of Existing Transport Master Plans | 3-64 |
| 3.3.3 | Methodology | 3-66 |
| 3.3.4 | Validation of Current Traffic Condition and Analysis of Future Data | 3-75 |
| 3.3.5 | Analysis of Future Traffic Condition | 3-83 |
| 3.3.6 | Evaluation of ITS Installation | 3-90 |
| 3.4 | Olympic GAMES Transport Study..... | 3-102 |
| 3.4.1 | Background Demand Characteristics in 2016..... | 3-102 |
| 3.4.2 | Olympic Games Transport Characteristics..... | 3-105 |
| 3.4.3 | Transport for Olympic Games Family Demand..... | 3-108 |
| 3.4.4 | Transport for Spectators Demand | 3-110 |
| 3.4.5 | ITS Services for Olympic Games Transport | 3-126 |
| 3.4.6 | Venue Plan..... | 3-126 |
| 3.5 | ACCESSIBILITY SURVEY | 3-145 |
| 3.5.1 | Overview | 3-145 |
| 3.5.2 | SURVEY RESULTS | 3-146 |
| 3.5.3 | COMPARISON SUMMARY | 3-152 |
| 3.5.4 | CONCLUSIONS..... | 3-153 |
| CHAPTER 4 | COMPARATIVE ANALYSIS AMONG MEGACITIES, OLYMPIC HOST CITIES, AND RIO DE JANEIRO | 4-1 |
| 4.1 | MEGACITIES COMPARATIVE ANALYSIS | 4-1 |
| 4.1.1 | Megacities Selection Process | 4-1 |
| 4.1.2 | Aerial Photo Comparison..... | 4-2 |
| 4.1.3 | Basic Public Transport Characteristics..... | 4-4 |
| 4.1.4 | Modal Split Characteristics | 4-15 |
| 4.1.5 | Summary of Basic Socioeconomic and Public Transportation Characteristics..... | 4-16 |
| 4.1.6 | Main ITS Features..... | 4-17 |
| 4.1.7 | Megacities ITS Trends and Projections..... | 4-20 |
| 4.1.8 | Comparative Summary of Rio De Janeiro | 4-22 |
| 4.2 | Comparative analysis of Olympic Cities | 4-23 |
| 4.2.1 | Selection of Target Cities | 4-23 |
| 4.2.2 | Basic Information on the Sydney 2000 Olympic Games | 4-24 |
| 4.2.3 | Basic Information on the Athens 2004 Olympic Games | 4-26 |
| 4.2.4 | Basic Information on the Beijing 2008 Olympic Games | 4-27 |
| 4.2.5 | Basic Information on the London 2012 Olympic Games | 4-29 |
| 4.2.6 | Basic Information on the Rio 2016 Olympic Games | 4-31 |
| 4.2.7 | The Key to Olympic Success | 4-32 |
| CHAPTER 5 | CLARIFICATION OF INTELLIGENT TRANSPORT SYSTEM NEEDS..... | 5-1 |

| | | |
|-----------|---|------|
| 5.1 | SURVEY ON ITS NEEDS OF USERS..... | 5-1 |
| 5.1.1 | Objective and Survey Methodology..... | 5-1 |
| 5.1.2 | Survey Results..... | 5-19 |
| 5.1.3 | Summary | 5-74 |
| 5.2 | INTERVIEWS ON ITS NEEDS OF TRANSPORTATION AGENCIES | 5-75 |
| 5.2.1 | Objective and Survey Methodology..... | 5-75 |
| 5.2.2 | Survey Results..... | 5-79 |
| 5.2.3 | Summary | 5-81 |
| CHAPTER 6 | FRAMEWORK SETTING FOR THE INTELLIGENT TRANSPORT SYSTEMS MASTER PLAN OF RIO DE JANEIRO METROPOLITAN AREA..... | 6-1 |
| 6.1 | REVIEW AND ANALYSIS OF ITS ARCHITECTURES IN MAJOR COUNTRIES | 6-2 |
| 6.1.1 | Review and Analysis of ITS Architectures in Major Countries | 6-2 |
| 6.1.2 | Analysis of the Structure of ITS Architecture | 6-3 |
| 6.2 | FRAMEWORK SETTING FOR THE ITS MASTER PLAN OF RIO DE JANEIRO METROPOLITAN AREA..... | 6-14 |
| 6.2.1 | Analysis of Current Conditions..... | 6-14 |
| 6.2.2 | Framework Setting for the Development of the ITS Master Plan of Rio de Janeiro Metropolitan Area..... | 6-15 |
| CHAPTER 7 | FORMULATION OF THE INTELLIGENT TRANSPORT SYSTEM MASTER PLAN OF RIO DE JANEIRO | 7-1 |
| 7.1 | DEFINITION OF THE ITS MASTER PLAN DEVELOPMENT POLICY..... | 7-1 |
| 7.1.1 | Strategic Plan 2012-2031 | 7-1 |
| 7.1.2 | Transport Strategic Plan for Rio 2016 Olympic and Paralympic Games..... | 7-2 |
| 7.1.3 | Policy Setting for the ITS Master Plan of Rio de Janeiro Metropolitan Area..... | 7-3 |
| 7.2 | FORMULATION OF THE ITS MASTER PLAN OF RIO DE JANEIRO | 7-4 |
| 7.2.1 | Clarification of Functional Requirement..... | 7-5 |
| 7.2.2 | Matching with User Services | 7-7 |
| 7.2.3 | Clarification of Relationship between User Service Bundles and Service Packages.. | 7-10 |
| 7.2.4 | Conceptual Design for ITS Projects..... | 7-20 |
| 7.2.5 | Deployment Plan for ITS Projects Equipment..... | 7-35 |
| 7.2.6 | Rough Cost Estimates | 7-77 |
| 7.2.7 | Economic Analysis..... | 7-87 |
| 7.2.8 | Implementation Schedule..... | 7-97 |
| CHAPTER 8 | SELECTION OF SHORT-TERM INTELLIGENT TRANSPORT SYSTEM MENUS..... | 8-1 |
| 8.1 | SELECTION POLICY FOR SHORT-TERM ITS PROJECTS..... | 8-1 |
| 8.2 | SHORT-TERM ITS PROJECTS | 8-1 |
| CHAPTER 9 | PRELIMINARY DESIGN FOR SHORT-TERM PROJECT | 9-1 |
| 9.1 | OUTLINE OF THE PRELIMINARY design..... | 9-1 |

| | | |
|------------|---|-------|
| 9.2 | project cost..... | 9-3 |
| 9.3 | ImplEmEntation plan | 9-4 |
| 9.4 | PROJECT PACKAGE 1 | 9-5 |
| 9.4.1 | Grand Design | 9-6 |
| 9.4.2 | Basic Design | 9-23 |
| 9.5 | PROJECT PACKAGE 2 | 9-45 |
| 9.5.1 | Grand Design | 9-45 |
| 9.5.2 | Basic Design | 9-47 |
| 9.6 | PROJECT PACKAGE 3 | 9-56 |
| 9.6.1 | Grand Design | 9-56 |
| 9.6.2 | Basic Design | 9-59 |
| CHAPTER 10 | CLARIFICATION OF CURRENT ITS CONDITION IN THE FEDERAL DISTRICT..... | 10-1 |
| 10.1 | REGIONAL CHARACTERISTICS OF THE FEDERAL DISTRICT | 10-1 |
| 10.1.1 | Administration | 10-1 |
| 10.1.2 | Economy of DF | 10-4 |
| 10.1.3 | Population in DF | 10-8 |
| 10.1.4 | Sightseeing Resources and Statistics | 10-13 |
| 10.1.5 | Geography and Natural Environment | 10-17 |
| 10.2 | TRAFFIC/TRANSPORT CHARACTERISTICS IN THE DF..... | 10-22 |
| 10.2.1 | Overall Condition..... | 10-22 |
| 10.2.2 | Traffic Condition..... | 10-27 |
| 10.2.3 | Public Transport Conditions..... | 10-44 |
| 10.2.4 | Accessibility Survey in the DF | 10-59 |
| 10.3 | CURRENT CONDITION OF ITS IN THE DF..... | 10-65 |
| 10.3.1 | ITS-Related Agencies of the DF | 10-65 |
| 10.3.2 | Current Condition of ITS Facilities..... | 10-68 |
| 10.4 | PLANS IN THE DF..... | 10-79 |
| 10.4.1 | Traffic/Transport-Related Plan..... | 10-79 |
| 10.4.2 | Urban Development Plan | 10-81 |
| 10.4.3 | ITS-Related Plan | 10-86 |
| CHAPTER 11 | PRELIMINARY INTELLIGENT TRANSPORT SYSTEM MASTER PLAN FOR THE FEDERAL DISTRICT | 11-1 |
| 11.1 | DEFINITION OF THE PRELIMINARY ITS MASTER PLAN DEVELOPMENT POLICY | 11-1 |
| 11.2 | CLARIFICATION OF FUNCTIONAL REQUIREMENT | 11-3 |
| 11.2.1 | Study Flow of Functional Requirements..... | 11-3 |
| 11.2.2 | Functional Requirements Diagram | 11-5 |
| 11.3 | CONCEPTUAL DESIGN FOR ITS PROJECTS..... | 11-6 |

| | | |
|------------|--|-------|
| 11.3.1 | Study on Essential ITS Projects for DF | 11-6 |
| 11.3.2 | Conceptual Design for ITS Projects..... | 11-7 |
| 11.3.3 | Rough Cost Estimates for Short-term Projects | 11-19 |
| 11.4 | PROPOSAL FOR DEVELOPMENT SCHEDULE..... | 11-23 |
| CHAPTER 12 | CONCLUSIONS AND RECOMMENDATIONS..... | 12-1 |
| 12.1 | CONCLUSIONS | 12-1 |
| 12.1.1 | Formulation of the ITS Master Plan for Rio de Janeiro..... | 12-1 |
| 12.1.2 | Preliminary design for short term project | 12-3 |
| 12.1.3 | Prelimiary ITS Master Plan for Federal District | 12-5 |
| 12.2 | RECOMMENDATIONS | 12-6 |
| 12.2.1 | Consideration of Major Aspects for ITS Project Implementation..... | 12-6 |
| 12.2.2 | Smooth Implementation of Project Packages and Effective Usage of ITS on Rio de Janeiro ITS Short Term Project..... | 12-6 |
| 12.2.3 | Next Step for the DF ITS Preliminary Master Plan | 12-7 |

APPENDIX

FIGURE AND TABLE LIST

[Figure List]

| | |
|--|------|
| Figure 1-1 Location Map of the Study Area (Rio de Janeiro)..... | 1-2 |
| Figure 1-2 Location Map of the Study Area (Federal District)..... | 1-2 |
| Figure 2-1 Location of Rio de Janeiro | 2-1 |
| Figure 2-2 Administrative Boundaries of Rio de Janeiro..... | 2-2 |
| Figure 2-3 GDP (Current Prices) in 2011 and 2017 (Estimated) | 2-3 |
| Figure 2-4 GDP (Current Prices) Trend in Brazil | 2-4 |
| Figure 2-5 GDP (Current Prices) Trend in Rio de Janeiro..... | 2-5 |
| Figure 2-6 GDP (Current Prices) per Capita in 2010..... | 2-6 |
| Figure 2-7 Trend of GDP (Current Prices) per Capita in Brazil | 2-7 |
| Figure 2-8 Trend of GDP (current prices) per Capita in Rio de Janeiro | 2-8 |
| Figure 2-9 Trend of GDP (Current Prices) per Capita in Rio de Janeiro | 2-9 |
| Figure 2-10 Population in the World..... | 2-10 |
| Figure 2-11 Future Population in the World | 2-10 |
| Figure 2-12 Population Trend in Brazil | 2-11 |
| Figure 2-13 Population Distribution of States in Brazil..... | 2-12 |
| Figure 2-14 Population Trend in Rio de Janeiro | 2-13 |
| Figure 2-15 Population Distribution of Cities in Rio de Janeiro | 2-14 |
| Figure 2-16 Population Density of Brazil and Japan | 2-15 |
| Figure 2-17 Competitiveness Ranking (High-ranked Countries, G8 Countries, and BRICs) ... | 2-16 |
| Figure 2-18 Competitiveness Index of Brazil | 2-17 |
| Figure 2-19 Main Sightseeing Locations in the State of Rio de Janeiro..... | 2-18 |
| Figure 2-20 Main Sightseeing Locations in the City of Rio de Janeiro..... | 2-19 |
| Figure 2-21 Trend of Inbound Tourists to Brazil | 2-20 |
| Figure 2-22 Number of Inbound Tourists to Brazil by Country of Origin..... | 2-20 |
| Figure 2-23 Inbound Tourists by Destination State in Brazil..... | 2-21 |
| Figure 2-24 Inbound Tourists to the State of Rio de Janeiro by Country of Origin..... | 2-22 |
| Figure 2-25 Monthly Tourist Arrivals to the State of Rio de Janeiro..... | 2-22 |
| Figure 2-26 Characteristics of International Events in the City of Rio de Janeiro | 2-23 |
| Figure 2-27 Contours in Rio de Janeiro | 2-27 |
| Figure 2-28 Topographic Characteristics in Rio de Janeiro | 2-28 |
| Figure 2-29 Temperatures in Rio de Janeiro and Tokyo | 2-29 |
| Figure 2-30 Precipitation Comparison in Rio de Janeiro and Tokyo | 2-29 |
| Figure 2-31 Land Cover in Rio de Janeiro..... | 2-30 |
| Figure 2-32 Photos of the Disaster in Rio de Janeiro..... | 2-31 |
| Figure 2-33 Map of the Landslide Risk and Rain Gauge Stations..... | 2-33 |

| | |
|--|------|
| Figure 2-34 Monitoring Stations for Air Quality by INEA..... | 2-34 |
| Figure 2-35 Monitoring Areas for Air Quality by SMAC..... | 2-36 |
| Figure 2-36 Development Plan of Optical Fiber National Network | 2-37 |
| Figure 2-37 Access and Density of Fixed Telephone in Brazil..... | 2-38 |
| Figure 2-38 Density of Fixed Telephone in Each State | 2-39 |
| Figure 2-39 Access and Density of Mobile Telephone in Brazil | 2-39 |
| Figure 2-40 Access and Density of Mobile Telephone in Each State | 2-40 |
| Figure 2-41 Google Map with Smartphone | 2-41 |
| Figure 2-42 Smartphone with One-Seg TV | 2-42 |
| Figure 2-43 System Architecture of Experiment | 2-43 |
| Figure 2-44 Access and Density of Multimedia (Internet) in Brazil..... | 2-44 |
| Figure 2-45 Access and Density of Multimedia in Each State..... | 2-44 |
| Figure 2-46 Access and Density of TV in Brazil | 2-45 |
| Figure 2-47 Access and Density of TV in Each State | 2-45 |
| Figure 2-48 Digital TV Broadcasting Image..... | 2-46 |
| Figure 2-49 Navigation Terminal in Cars | 2-47 |
| Figure 2-50 Number of Trips in the Metropolitan Region of Rio de Janeiro..... | 2-49 |
| Figure 2-51 Modal Shares in Rio and Tokyo | 2-50 |
| Figure 2-52 Modal Share in Macro Zones | 2-51 |
| Figure 2-53 Internal and External Trips in Each Municipality | 2-52 |
| Figure 2-54 Trip Rate (/day/person) in Each Municipality | 2-53 |
| Figure 2-55 Number of Fleets in Rio..... | 2-54 |
| Figure 2-56 Current Road Network in RMRJ by Administrators | 2-56 |
| Figure 2-57 Concession Road Network in RMRJ..... | 2-58 |
| Figure 2-58 Length of Roads in the Metropolitan Region of Rio de Janeiro..... | 2-60 |
| Figure 2-59 Pavement Condition in the Metropolitan Region of Rio de Janeiro | 2-61 |
| Figure 2-60 Length of Bridge and Tunnel in the Metropolitan Region of Rio de Janeiro..... | 2-62 |
| Figure 2-61 Location of Bridges and Tunnels in the Metropolitan Region of Rio de Janeiro... | 2-63 |
| Figure 2-62 Location of Traffic Sign for “Sharp Curve” and “Winding Road” in the Metropolitan Region of Rio de Janeiro..... | 2-64 |
| Figure 2-63 Planned Road Network in RMRJ | 2-65 |
| Figure 2-64 Number of Cars in Rio and the World..... | 2-66 |
| Figure 2-65 Car Registration in Rio..... | 2-67 |
| Figure 2-66 Driving License Registration in the State of Rio de Janeiro | 2-67 |
| Figure 2-67 Traffic Volume..... | 2-69 |
| Figure 2-68 Traffic Condition in the City of Rio de Janeiro..... | 2-70 |
| Figure 2-69 Traffic Condition in Central Rio | 2-71 |
| Figure 2-70 Photo of COR..... | 2-72 |
| Figure 2-71 Daily Bulletin from COR | 2-72 |

| | |
|---|-------|
| Figure 2-72 Number of Traffic Accidents in Rio de Janeiro..... | 2-78 |
| Figure 2-73 Number of Victims of Accident in Rio de Janeiro | 2-78 |
| Figure 2-74 Distribution of Traffic Accidents in Rio de Janeiro..... | 2-79 |
| Figure 2-75 Traffic Accidents by Roads and Road Types in Rio de Janeiro..... | 2-80 |
| Figure 2-76 Traffic Accidents by Types in Rio de Janeiro..... | 2-81 |
| Figure 2-77 Traffic Signals in the City of Rio de Janeiro | 2-83 |
| Figure 2-78 Cameras in the City of Rio de Janeiro..... | 2-85 |
| Figure 2-79 VMS in the City of Rio de Janeiro | 2-87 |
| Figure 2-80 Speed Monitoring in the City of Rio de Janeiro..... | 2-89 |
| Figure 2-81 Number of Speed Monitoring Equipment by Area in the City of Rio de Janeiro .. | 2-90 |
| Figure 2-82 Special Control Routes in the City of Rio de Janeiro..... | 2-91 |
| Figure 2-83 Speed Monitoring in the State of Rio de Janeiro..... | 2-94 |
| Figure 2-84 Cameras and VMS in the State of Rio de Janeiro | 2-96 |
| Figure 2-85 Speed Monitoring Equipment of DNIT in the State of Rio de Janeiro | 2-97 |
| Figure 2-86 Simultaneous Signal Control along Av. Nossa Senhora de Copacabana..... | 2-98 |
| Figure 2-87 Counting Green Time for Pedestrian Crossing along Av. Nossa Senhora de Copacabana..... | 2-98 |
| Figure 2-88 Example of Reversible Lane in Copacabana Area | 2-99 |
| Figure 2-89 Location of Sections for Road Closure in the City of Rio de Janeiro | 2-100 |
| Figure 2-90 Photos of BRS | 2-101 |
| Figure 2-91 Maps of BRS | 2-102 |
| Figure 2-92 Map of BRT..... | 2-103 |
| Figure 2-93 Photo of BRS..... | 2-103 |
| Figure 2-94 Photos of Road Flooding..... | 2-104 |
| Figure 2-95 Photos at the Toll Gates..... | 2-104 |
| Figure 2-96 Photos at the Bus Stop..... | 2-105 |
| Figure 2-97 Photos at the Pedestrian Lane..... | 2-105 |
| Figure 2-98 Photos of Road Construction..... | 2-106 |
| Figure 2-99 Location of Parking Areas..... | 2-107 |
| Figure 2-100 Types of Parking..... | 2-108 |
| Figure 2-101 Cycle Road Network Map in the City of Rio de Janeiro..... | 2-109 |
| Figure 2-102 BRT Lane | 2-110 |
| Figure 2-103 Example of Obstacle Location for Emergency Vehicles | 2-110 |
| Figure 2-104 Number of Fines in the State of Rio de Janeiro..... | 2-111 |
| Figure 2-105 Network of Public Transport in the Metropolitan Region of Rio de Janeiro | 2-113 |
| Figure 2-106 Rail Network Map..... | 2-114 |
| Figure 2-107 Average Daily Passengers of Rail..... | 2-114 |
| Figure 2-108 Railway Crossing of SuperVia | 2-115 |
| Figure 2-109 Metro Network Map..... | 2-116 |

| | |
|--|-------|
| Figure 2-110 Average Daily Passengers of Metro..... | 2-116 |
| Figure 2-111 Photo and Location of Corcovado Tram..... | 2-117 |
| Figure 2-112 Photo of Santa Teresa Tram..... | 2-117 |
| Figure 2-113 Network and Photo of the Cable Car..... | 2-118 |
| Figure 2-114 Photos of Boats..... | 2-119 |
| Figure 2-115 Average Daily Demand in Novo Rio Terminals | 2-120 |
| Figure 2-116 Location and Photo of Novo Rio Terminal..... | 2-120 |
| Figure 2-117 Average Number of Passengers of Local Buses | 2-121 |
| Figure 2-118 Local Bus Line in the City of Rio de Janeiro | 2-122 |
| Figure 2-119 Average Operation Length of Bus Services..... | 2-122 |
| Figure 2-120 Location of Bus Stops in the City of Rio de Janeiro | 2-123 |
| Figure 2-121 Maps of BRS | 2-124 |
| Figure 2-122 Daily Passengers of BRT..... | 2-126 |
| Figure 2-123 Daily Passengers of BRT by Station (Average between 1-23 September 2012)..... | 2-126 |
| Figure 2-124 Hourly Average Number of Passengers of BRT (Average between 1-23 September 2012)..... | 2-127 |
| Figure 2-125 Maps of BRT | 2-128 |
| Figure 2-126 Number of Buses Authorized by ANTT..... | 2-130 |
| Figure 2-127 Number of Passengers Transported by Interstate and International Buses | 2-130 |
| Figure 2-128 Location of Airports in the State of Rio de Janeiro..... | 2-131 |
| Figure 2-129 Yearly Aircraft, Passenger, and Cargo Movement in Galeao Airport..... | 2-131 |
| Figure 2-130 Yearly Aircraft, Passenger, and Cargo Movement in Santos Dumont Airport | 2-132 |
| Figure 2-131 Yearly Aircraft, Passenger and Cargo Movement in Roberto Marinho Airport | 2-132 |
| Figure 2-132 Yearly Aircraft, Passenger and Cargo Movement in Macae Airport | 2-132 |
| Figure 2-133 Yearly Aircraft, Passenger, and Cargo Movement in Campos Airport | 2-133 |
| Figure 2-134 Photo Images of Pier Maua | 2-134 |
| Figure 2-135 Location and Passengers of Pier Maua..... | 2-134 |
| Figure 2-136 Location of Ports for Cargoes in the State of Rio de Janeiro | 2-135 |
| Figure 2-137 Yearly Cargo Volume of Port of Rio de Janeiro | 2-135 |
| Figure 2-138 Yearly Cargo Volume of Port of Itaguaí | 2-136 |
| Figure 2-139 Yearly Cargo Volume of Port of Angra dos Reis | 2-136 |
| Figure 2-140 Yearly Cargo Volume of Port of Niterói | 2-136 |
| Figure 2-141 Location of Port for Containers in the State of Rio de Janeiro | 2-137 |
| Figure 2-142 Yearly Container Volume of Port of Rio de Janeiro | 2-137 |
| Figure 2-143 Yearly Container Volume of Port of Itaguaí | 2-137 |
| Figure 2-144 Map of Weighing Points..... | 2-138 |
| Figure 2-145 General Information of MRS Railway | 2-139 |
| Figure 2-146 MRS Rail Network in the Metropolitan Region of Rio de Janeiro | 2-139 |
| Figure 2-147 Production (tku, 10 ⁹) of MRS Railway..... | 2-140 |

| | |
|--|-------|
| Figure 2-148 Security Indicator (Train Accidents per million Train km) of MRS Railway | 2-140 |
| Figure 2-149 Hierarchy of the ITS-Related Agencies and Companies | 2-144 |
| Figure 2-150 Outline of DSRC Probe System | 2-149 |
| Figure 2-151 Overall System Diagram | 2-151 |
| Figure 2-152 Example of PDTU Report | 2-177 |
| Figure 2-153 Example of Transport Strategic Plan 1/4..... | 2-179 |
| Figure 2-154 Example of Transport Strategic Plan 2/4..... | 2-180 |
| Figure 2-155 Example of Transport Strategic Plan 3/4..... | 2-181 |
| Figure 2-156 Example of Transport Strategic Plan 4/4..... | 2-182 |
| Figure 2-157 PAC2 Projects..... | 2-184 |
| Figure 2-158 Example of Strategic Plan 2012–2031 1/2 | 2-188 |
| Figure 2-159 Example of Strategic Plan 2012–2031 2/2 | 2-189 |
| Figure 2-160 Example of Strategic Plan 2009–2012 | 2-191 |
| Figure 2-161 Plan of CICC and Image of Emergency Center | 2-197 |
| Figure 2-162 Outline of Existing INFOVIA.RJ..... | 2-199 |
| Figure 2-163 Context Diagram for SITRANS | 2-200 |
| Figure 2-164 Examples of ITS Integration Using NTCIP | 2-204 |
| Figure 2-165 Alignment of Work Groups | 2-205 |
| Figure 3-1 Structure of the Study..... | 3-2 |
| Figure 3-2 Future Network Proposal in the PDTU/RMRJ 2011..... | 3-4 |
| Figure 3-3 Planned Infrastructure for Rio 2016..... | 3-7 |
| Figure 3-4 Olympic Lane for Rio 2016 | 3-7 |
| Figure 3-5 Spectator Demand for Rio 2016..... | 3-8 |
| Figure 3-6 Comparison between Survey Locations and PDTU/Rio 2016..... | 3-12 |
| Figure 3-7 Location Map of Survey Stations..... | 3-13 |
| Figure 3-8 Counting Layout at Location 1..... | 3-14 |
| Figure 3-9 Counting Layout at Locations 2 and 3 | 3-15 |
| Figure 3-10 Counting Layout at Locations 4 and 5 | 3-16 |
| Figure 3-11 Counting Layout at Locations 6 and 7 | 3-17 |
| Figure 3-12 Counting Layout at Locations 8 and 9 | 3-18 |
| Figure 3-13 Counting Layout at Locations 10 and 11 | 3-19 |
| Figure 3-14 Counting Layout at Location 12..... | 3-20 |
| Figure 3-15 Location Comparison between Survey Routes and PDTU/Rio 2016..... | 3-21 |
| Figure 3-16 Location Map of Survey Routes..... | 3-23 |
| Figure 3-17 Instructions for Travel Time Survey..... | 3-24 |
| Figure 3-18 Data Collection Points Map Provided by CET-Rio..... | 3-31 |
| Figure 3-19 Data Collection Points Map Provided by SMTR | 3-33 |
| Figure 3-20 CCTV Data Provided by CET-Rio | 3-34 |
| Figure 3-21 Sample Image of Vitracom Siteview..... | 3-34 |

| | |
|---|------|
| Figure 3-22 CCTV Location Map for Image Processing | 3-35 |
| Figure 3-23 Total Flow per day at Each Point (Weekday) | 3-36 |
| Figure 3-24 Total Flow per Day at Each Point (Weekend) | 3-37 |
| Figure 3-25 Share of Vehicle Types per Day at Each Point (Weekday)..... | 3-38 |
| Figure 3-26 Share of Vehicle Types per Day at Each Point (Weekend)..... | 3-39 |
| Figure 3-27 Travel Speed in Each Link | 3-40 |
| Figure 3-28 Travel Speed in Each Link | 3-41 |
| Figure 3-29 Twenty Selected Lowest-speed Roads | 3-42 |
| Figure 3-30 Twenty Selected Lowest-speed Links | 3-43 |
| Figure 3-31 Twenty Selected Lowest-speed Links in the Morning and Evening | 3-44 |
| Figure 3-32 Traffic Count Points | 3-45 |
| Figure 3-33 Scatter Diagram between Traffic Volume and Speed | 3-46 |
| Figure 3-34 Traffic Volume during Weekday..... | 3-48 |
| Figure 3-35 Traffic Volume during Weekend..... | 3-49 |
| Figure 3-36 Traffic Volume at Peak Times during Weekday | 3-50 |
| Figure 3-37 Ratio of Daytime and Nighttime Volumes | 3-51 |
| Figure 3-38 Ratio of Weekday and Weekend Volumes | 3-52 |
| Figure 3-39 Average Number of Passengers | 3-54 |
| Figure 3-40 Time Proportion..... | 3-55 |
| Figure 3-41 Modal Share Derived from Cross sectional Traffic Volume | 3-55 |
| Figure 3-42 Comparison of Traffic Count Results from Image Processing and Visual Counting | 3-56 |
| Figure 3-43 Traffic Count Result by Image Processing for Point No. 291 (in vehicle/5 min) .. | 3-57 |
| Figure 3-44 Traffic Count Result by Image Processing for Point No. 351 (in vehicle/5 min) .. | 3-58 |
| Figure 3-45 Traffic Count Results by Image Processing for Point No. 378 (in vehicle/5 min) .. | 3-59 |
| Figure 3-46 Traffic Count Results by Image Processing for Point No. 401 (in vehicle/5 min) .. | 3-59 |
| Figure 3-47 Traffic Count Results by Image Processing for Point No. 498 (in vehicle/5 min) .. | 3-60 |
| Figure 3-48 Traffic Count Results by Image Processing for Point No. 540 (in vehicle/5 min) .. | 3-61 |
| Figure 3-49 Traffic Count Results by Image Processing for Point No. 546 (in vehicle/5 min) .. | 3-62 |
| Figure 3-50 Methodology for Macro-scale Analysis: Four-step Method..... | 3-63 |
| Figure 3-51 Data Used to Estimate Gross Traffic Growth from 2003 to 2011 | 3-67 |
| Figure 3-52 Existing Network for Traffic Modeling..... | 3-70 |
| Figure 3-53 Minimum Network in 2016..... | 3-71 |
| Figure 3-54 Proposed Network in 2021 | 3-71 |
| Figure 3-55 Planned Network in the DER's Map | 3-72 |
| Figure 3-56 Olympic Lanes | 3-73 |
| Figure 3-57 CET-Rio Traffic Count Points Map..... | 3-75 |
| Figure 3-58 Assignment Accuracy in "Arterial Road" Case..... | 3-76 |
| Figure 3-59 Assignment Accuracy in "Multilane Arterial Road" Case | 3-76 |

| | |
|---|-------|
| Figure 3-60 Zone Map | 3-77 |
| Figure 3-61 Total Trips..... | 3-77 |
| Figure 3-62 Distribution of OD Data..... | 3-78 |
| Figure 3-63 Spectators Demand during Critical Days | 3-80 |
| Figure 3-64 Spectators Demand + Background Demand during Critical Days..... | 3-80 |
| Figure 3-65 Distribution of Spectators Demand during Critical Days..... | 3-81 |
| Figure 3-66 Assignment Result of 2021 Day OD | 3-82 |
| Figure 3-67 Assignment Result of Day OD | 3-84 |
| Figure 3-68 Difference of Assignment Result between Existing and Future..... | 3-85 |
| Figure 3-69 Assignment Result of 8 a.m. OD..... | 3-86 |
| Figure 3-70 Assignment Result of 6 p.m. OD..... | 3-87 |
| Figure 3-71 Assignment Result of Olympic Case (Volume)..... | 3-88 |
| Figure 3-72 Assignment Result of Olympic Case (Occupancy) | 3-89 |
| Figure 3-73 Evaluation Area for Lane Management..... | 3-91 |
| Figure 3-74 Evaluation Area for ERP | 3-92 |
| Figure 3-75 Evaluation Area for Dynamic Traffic Information Provision..... | 3-93 |
| Figure 3-76 Evaluation Area for Bus Signal Optimization..... | 3-94 |
| Figure 3-77 Evaluation Area for Bus Location..... | 3-95 |
| Figure 3-78 Evaluation Area for ETC..... | 3-96 |
| Figure 3-79 Traffic Volume With and Without Reversible Lane Management..... | 3-97 |
| Figure 3-80 Occupancy With and Without Reversible Lane Management..... | 3-98 |
| Figure 3-81 Difference of Traffic Volume With and Without Reversible Lane Management ... | 3-98 |
| Figure 3-82 Occupancy With and Without ERP | 3-99 |
| Figure 3-83 Difference of Traffic Condition With and Without ERP | 3-100 |
| Figure 3-84 Demand Characteristics in the City of Rio de Janeiro in 2016 | 3-102 |
| Figure 3-85 Demand Characteristics in the Metropolitan Region of Rio de Janeiro in 2016.. | 3-103 |
| Figure 3-86 Image of Demand Characteristics in Rio | 3-104 |
| Figure 3-87 Key Issues on Background Demand in Rio..... | 3-104 |
| Figure 3-88 Olympic Areas..... | 3-105 |
| Figure 3-89 Peak Spectators Demand..... | 3-106 |
| Figure 3-90 Key Issues on Olympic Demand..... | 3-106 |
| Figure 3-91 Main Flow of Olympic Games Family Demand | 3-108 |
| Figure 3-92 Venues and Zones..... | 3-110 |
| Figure 3-93 Main Flow of Spectators in Barra Zone | 3-111 |
| Figure 3-94 Transport System of Rio Olympic Park | 3-112 |
| Figure 3-95 Transport System of RioCenter | 3-112 |
| Figure 3-96 Main Flow of Spectators in Maracana Zone | 3-113 |
| Figure 3-97 Transport System of Maracana Stadium | 3-114 |
| Figure 3-98 Transport System of Sambodromo | 3-114 |

| | |
|--|-------|
| Figure 3-99 Main Flow of Spectators in Rio Stadium | 3-115 |
| Figure 3-100 Transport System of Rio Stadium | 3-116 |
| Figure 3-101 Main Flow of Spectators in Copacabana Zone..... | 3-117 |
| Figure 3-102 Transport System of Copacabana Stadium..... | 3-118 |
| Figure 3-103 Transport System of Fort Copacabana | 3-118 |
| Figure 3-104 Transport System of Lagoa Rodrigo de Freitas..... | 3-119 |
| Figure 3-105 Transport System of Marina da Gloria..... | 3-119 |
| Figure 3-106 Transport System of Flamengo Park Cluster..... | 3-120 |
| Figure 3-107 Main Flow of Spectators in Deodoro Zone | 3-121 |
| Figure 3-108 Transport System of Deodoro Arena, Deodoro Modern Pentathlon Park, and National Shooting Center..... | 3-122 |
| Figure 3-109 Transport System of National Equestrian Center | 3-122 |
| Figure 3-110 Transport System of X Park Precinct | 3-123 |
| Figure 3-111 Main Integration Points for Spectators Demand | 3-125 |
| Figure 3-112 Requirement for ITS Services for Olympic Games Transport Management | 3-126 |
| Figure 3-113 Metro, Rail, Cable Car, Ferry, BRS and BRT Stations..... | 3-145 |
| Figure 3-114 Key Observations at Rail Stations..... | 3-146 |
| Figure 3-115 Key Observations at Metro Stations..... | 3-147 |
| Figure 3-116 Key Observations at Ferry Stations..... | 3-147 |
| Figure 3-117 Key Observations at Cable Car | 3-148 |
| Figure 3-118 Key Observations at BRS Stops | 3-148 |
| Figure 3-119 Key Observations at BRT Stops | 3-149 |
| Figure 3-120 Key Observations at Roberto Silveira Bus Terminal..... | 3-150 |
| Figure 3-121 Key Observations at Novo Rio Bus Terminal | 3-150 |
| Figure 3-122 Key Observations at Bike Rio Stations | 3-151 |
| Figure 3-123 BRT – Example of Good Accessibility and Information for Users..... | 3-152 |
| Figure 3-124 Accessibility and Information for Public Transport Users – London Example.. | 3-153 |
| Figure 5-1 Map of Survey Locations | 5-2 |
| Figure 5-2 ITS Service Domains | 5-3 |
| Figure 5-3 Samples | 5-19 |
| Figure 5-4 Gender | 5-20 |
| Figure 5-5 Age | 5-20 |
| Figure 5-6 Employment Status | 5-21 |
| Figure 5-7 Home Address | 5-21 |
| Figure 5-8 Origin of This Trip | 5-22 |
| Figure 5-9 Final Destination of This Trip | 5-22 |
| Figure 5-10 Transportation Used for This Trip..... | 5-23 |
| Figure 5-11 Purpose of This Trip | 5-23 |
| Figure 5-12 Car Use..... | 5-24 |

| | |
|---|------|
| Figure 5-13 ITS Needs of Car Users..... | 5-24 |
| Figure 5-14 Need for Travel Time Information for Road Traffic | 5-25 |
| Figure 5-15 Need for Congestion Information in the Road Network | 5-26 |
| Figure 5-16 Need for Optimized Route Navigation..... | 5-27 |
| Figure 5-17 Need for Dynamic Lane Control..... | 5-28 |
| Figure 5-18 Need for Traffic Signal Optimization..... | 5-29 |
| Figure 5-19 Need for Danger Warning of Vehicles Ahead (Accident, Obstacle, or Opposing Vehicle) | 5-30 |
| Figure 5-20 Need for Information of Parking Lot Occupation | 5-31 |
| Figure 5-21 Need for Information of Road Construction | 5-32 |
| Figure 5-22 Public Transport Use | 5-33 |
| Figure 5-23 ITS Needs of Public Transport Users | 5-33 |
| Figure 5-24 Need for Travel Time Information for Public Transport | 5-34 |
| Figure 5-25 Need for Cashless Payment..... | 5-35 |
| Figure 5-26 Need for Information of Service Condition (e.g., Delay, Suspend, Cancel, and Headway) | 5-36 |
| Figure 5-27 Need for Approaching Information (Location Information of the Next Bus/Train) | 5-37 |
| Figure 5-28 Need for Information of the Level of Occupation in Cars (Bus and Train) | 5-38 |
| Figure 5-29 Need for Priority Traffic Signal Control for the Bus..... | 5-39 |
| Figure 5-30 Event Visitors | 5-40 |
| Figure 5-31 ITS Needs for Large-Scale Events | 5-40 |
| Figure 5-32 Need for Information of the Event Provided around the Venues | 5-41 |
| Figure 5-33 Need for Information of Traffic Congestion on the Way to the Venues | 5-42 |
| Figure 5-34 Need for Information of Public Transport Timing around the Venues | 5-43 |
| Figure 5-35 ITS Needs in case of Natural Disaster..... | 5-44 |
| Figure 5-36 Need for Information of the Water Level of the River | 5-45 |
| Figure 5-37 Need for Disaster Risk Information in the Concerned Area..... | 5-45 |
| Figure 5-38 Need for Traffic/Transport Closure Information due to Disaster | 5-46 |
| Figure 5-39 Samples | 5-47 |
| Figure 5-40 Gender | 5-48 |
| Figure 5-41 Age | 5-48 |
| Figure 5-42 Employment Status | 5-49 |
| Figure 5-43 Home Address | 5-49 |
| Figure 5-44 Origin of This Trip | 5-50 |
| Figure 5-45 Final Destination of This Trip | 5-50 |
| Figure 5-46 Transportation Used for This Trip..... | 5-51 |
| Figure 5-47 Purpose of This Trip..... | 5-51 |
| Figure 5-48 Car Use..... | 5-52 |

| | |
|---|------|
| Figure 5-49 ITS Needs of Car Users..... | 5-52 |
| Figure 5-50 Need for Travel Time Information for Road Traffic | 5-53 |
| Figure 5-51 Need for Congestion Information in the Road Network | 5-54 |
| Figure 5-52 Need for Optimized Route Navigation..... | 5-55 |
| Figure 5-53 Need for Dynamic Lane Control..... | 5-56 |
| Figure 5-54 Need for Traffic Signal Optimization..... | 5-57 |
| Figure 5-55 Need for Danger Warning of Vehicles Ahead (Accident, Obstacle, or Opposing Vehicle) | 5-58 |
| Figure 5-56 Need for Information of Parking Lot Occupation | 5-59 |
| Figure 5-57 Need for Information of Road Construction | 5-60 |
| Figure 5-58 Public Transport Use | 5-61 |
| Figure 5-59 ITS Needs of Public Transport Users | 5-61 |
| Figure 5-60 Need for Travel Time Information for Public Transport | 5-62 |
| Figure 5-61 Need for Cashless Payment..... | 5-63 |
| Figure 5-62 Need for Information of Service Condition (e.g., Delay, Suspend, Cancel, and Headway) | 5-64 |
| Figure 5-63 Need for Approaching Information (Location Information of the Next Bus/Train) | 5-65 |
| Figure 5-64 Need for Information of the Level of Occupation in Cars (Bus, Train) | 5-66 |
| Figure 5-65 Need for Priority Traffic Signal Control for the Bus..... | 5-67 |
| Figure 5-66 Event Visitors | 5-68 |
| Figure 5-67 ITS Needs for Large-Scale Events | 5-68 |
| Figure 5-68 Need for Information of the Event Provided around the Venues | 5-69 |
| Figure 5-69 Need for Information of Traffic Congestion on the Way to the Venues | 5-70 |
| Figure 5-70 Need for Information of Public Transport Timing around the Venues | 5-71 |
| Figure 5-71 ITS Needs in case of Natural Disaster..... | 5-72 |
| Figure 5-72 Need for Information of the Water Level of the River | 5-73 |
| Figure 5-73 Need for Disaster Risk Information in the Concerned Area..... | 5-73 |
| Figure 5-74 Need for Traffic/Transport Closure Information Due to Disaster | 5-74 |
| Figure 5-75 ITS Service Domains | 5-77 |
| Figure 5-76 ITS Needs of Transportation Agencies..... | 5-81 |
| Figure 6-1 ITS Architecture Relationships | 6-3 |
| Figure 6-2 General Composition of ITS Architecture..... | 6-4 |
| Figure 6-3 User Service Example – ISO Reference Model | 6-4 |
| Figure 6-4 Definition of Logical Architecture (1/2) | 6-4 |
| Figure 6-5 Definition of Logical Architecture (2/2) | 6-5 |
| Figure 6-6 Highest-Level Logical Architecture | 6-6 |
| Figure 6-7 High-Level Logical Architecture..... | 6-7 |
| Figure 6-8 Definition of Physical Architecture..... | 6-8 |

| | |
|---|------|
| Figure 6-9 High-Level Physical Architecture | 6-8 |
| Figure 6-10 Layers of the U.S. National ITS Architecture | 6-10 |
| Figure 6-11 Transportation Layer | 6-10 |
| Figure 6-12 Composition of the FRAME Architecture..... | 6-12 |
| Figure 6-13 Current Condition of ITS Architecture in Brazil..... | 6-14 |
| Figure 6-14 Consistency Check between the ISO Reference Model and the National ITS Architecture of the U.S. | 6-15 |
| Figure 7-1 Ten Essential Aspects for Future Development of Rio de Janeiro State | 7-1 |
| Figure 7-2 Summary of Essential Aspects and Keywords for Setting a Policy for ITS Master Plan | 7-3 |
| Figure 7-3 ITS Master Plan Study Flow | 7-4 |
| Figure 7-4 Matching Process Source: JICA Study Team..... | 7-6 |
| Figure 7-5 Outline of the Matching Process | 7-7 |
| Figure 7-6 Results of the Matching Process Source: JICA Study Team..... | 7-8 |
| Figure 7-7 User Service Bundles and Service Packages..... | 7-11 |
| Figure 7-8 Relativity of User Service Bundles and Service Packages (1/8)..... | 7-12 |
| Figure 7-9 Relativity of User Service Bundles and Service Packages (2/8)..... | 7-13 |
| Figure 7-10 Relativity of User Service Bundles and Service Packages (3/8)..... | 7-14 |
| Figure 7-11 Relativity of User Service Bundles and Service Packages (4/8)..... | 7-15 |
| Figure 7-12 Relativity of User Service Bundles and Service Packages (5/8)..... | 7-16 |
| Figure 7-13 Relativity of User Service Bundles and Service Packages (6/8)..... | 7-17 |
| Figure 7-14 Relativity of User Service Bundles and Service Packages (7/8)..... | 7-18 |
| Figure 7-15 Relativity of User Service Bundles and Service Packages (8/8)..... | 7-19 |
| Figure 7-16 Developing Process of ITS Projects..... | 7-20 |
| Figure 7-17 ITS Physical Architecture..... | 7-35 |
| Figure 7-18 Connection of Targets and Service Types | 7-36 |
| Figure 7-19 Information Collection and User (Road Traffic)..... | 7-37 |
| Figure 7-20 Information Collection and User (Public Transport - Taxi) | 7-37 |
| Figure 7-21 Information Collection and User (Public Transport – Bus and Bus Rapid Transit (BRT))..... | 7-38 |
| Figure 7-22 Information Collection and User (Public Transport – Rail, Metro, and Cable Car) | 7-39 |
| Figure 7-23 Information Collection and User (Public Transport – Boat) | 7-39 |
| Figure 7-24 Information Collection and User (Land Freight Transport - Truck)..... | 7-40 |
| Figure 7-25 Information Collection and User (Land Freight Transport - Rail) | 7-40 |
| Figure 7-26 Information Collection and User (Safety and Security - Police)..... | 7-41 |
| Figure 7-27 Information Collection and User (Safety and Security – Civil Defense)..... | 7-41 |
| Figure 7-28 Information Collection and User (Safety and Security – Fire Brigade and Rescue) | 7-42 |

| | |
|--|------|
| Figure 7-29 Information Collection and User (Safety and Security – Ambulance)..... | 7-42 |
| Figure 7-30 Deployment Plan (Landslide Detection) | 7-49 |
| Figure 7-31 Deployment Plan (Wind Speed and Visibility Meter)..... | 7-49 |
| Figure 7-32 Deployment Plan (Weather Monitoring - RMRJ) | 7-50 |
| Figure 7-33 Deployment Plan (Weather Monitoring – Cover Area)..... | 7-50 |
| Figure 7-34 Deployment Plan (Traffic Counter - RMRJ)..... | 7-52 |
| Figure 7-35 Deployment Plan (Traffic Counter – Central Rio) | 7-52 |
| Figure 7-36 Deployment Plan (Speed Monitoring) | 7-53 |
| Figure 7-37 Deployment Plan (CCTV)..... | 7-53 |
| Figure 7-38 Deployment Plan (GPS)..... | 7-54 |
| Figure 7-39 Deployment Plan (VMS for Road Traffic - RMRJ) | 7-56 |
| Figure 7-40 Deployment Plan (VMS for Road Traffic – Central Rio) | 7-56 |
| Figure 7-41 Deployment Plan (VMS for Parking Information)..... | 7-57 |
| Figure 7-42 Deployment Plan (Traffic Signal for Adaptive Control - RJ)..... | 7-57 |
| Figure 7-43 Deployment Plan (Traffic Signal for BRT Priority) | 7-58 |
| Figure 7-44 Deployment Plan (ETC)..... | 7-58 |
| Figure 7-45 Deployment Plan (ERP) | 7-59 |
| Figure 7-46 Traveler Kilometer per Area in 2011 Day | 7-59 |
| Figure 7-47 Bus Lines and Stops | 7-66 |
| Figure 7-48 Bus Terminals and Stops | 7-68 |
| Figure 7-49 Route Map of SuperVIA | 7-70 |
| Figure 7-50 New Vehicle | 7-70 |
| Figure 7-51 Deployment Plan (Safety at the Crossing) | 7-71 |
| Figure 7-52 Route Map of Metro..... | 7-72 |
| Figure 7-53 Route Map of Cable Car..... | 7-72 |
| Figure 7-54 Location of the Port..... | 7-74 |
| Figure 7-55 Deployment Plan (Weighing Point)..... | 7-76 |
| Figure 7-56 Deployment Plan (Safety at the Crossing) | 7-76 |
| Figure 7-57 Travel Speed and Unit VOC in 2011 Prices | 7-88 |
| Figure 7-58 Simulation Area of Each Project | 7-90 |
| Figure 7-59 Result of Micro Simulation | 7-90 |
| Figure 7-60 Implementation Schedule..... | 7-97 |
| Figure 8-1 Short-Term ITS Projects and Their Implementation Schedule | 8-1 |
| Figure 9-1 Overall System Diagram | 9-2 |
| Figure 9-2 Sample Contents of Project Package 1 (1/7) | 9-16 |
| Figure 9-3 Sample Contents of Project Package 1 (2/7) | 9-17 |
| Figure 9-4 Sample Contents of Project Package 1 (3/7) | 9-18 |
| Figure 9-5 Sample Contents of Project Package 1 (4/7) | 9-19 |
| Figure 9-6 Sample Contents of Project Package 1 (5/7) | 9-20 |

| | |
|---|------|
| Figure 9-7 Sample Contents of Project Package 1 (6/7) | 9-21 |
| Figure 9-8 Sample Contents of Project Package 1 (7/7) | 9-22 |
| Figure 9-9 Conceptual Diagram of Communication Network..... | 9-24 |
| Figure 9-10 System Diagram of ITS Center and Related Systems | 9-33 |
| Figure 9-11 Flow of Data Gathering | 9-34 |
| Figure 9-12 Flow of Data Processing | 9-36 |
| Figure 9-13 Flow of Information Provision | 9-38 |
| Figure 9-14 Proposed Organization for the ITS Center | 9-43 |
| Figure 9-15 Sample Contents of Project Package 2..... | 9-46 |
| Figure 9-16 Deployment of Information Provision Panel at Bus Stop | 9-47 |
| Figure 9-17 Deployment of Information Provision Board at Bus Terminals..... | 9-49 |
| Figure 9-18 Jurisdiction Area of InterNorte and InterSul | 9-49 |
| Figure 9-19 Buses Proposed for the Introduction of Inside Bus Information Monitor | 9-50 |
| Figure 9-20 System Diagram of Bus Condition Information Provision | 9-52 |
| Figure 9-21 Data Flow of Bus Condition Information Provision | 9-53 |
| Figure 9-22 Sample Contents of Project Package 3..... | 9-58 |
| Figure 9-23 Deployment of Adaptive Signal Control..... | 9-59 |
| Figure 9-24 Deployment of VMS | 9-61 |
| Figure 9-25 System Diagram of Dynamic Signal Optimization..... | 9-64 |
| Figure 9-26 System Diagram of Variable Message Signboard System..... | 9-64 |
| Figure 9-27 Data Flow of Dynamic Signal Optimization..... | 9-65 |
| Figure 9-28 Data Flow of Variable Message Signboard System | 9-65 |
| Figure 9-29 Schematic Diagram of Preliminary Design for ITS Project (1/11) | 9-68 |
| Figure 9-30 Schematic Diagram of Preliminary Design for ITS Project (2/11) | 9-69 |
| Figure 9-31 Schematic Diagram of Preliminary Design for ITS Project (3/11) | 9-70 |
| Figure 9-32 Schematic Diagram of Preliminary Design for ITS Project (4/11) | 9-71 |
| Figure 9-33 Schematic Diagram of Preliminary Design for ITS Project (5/11) | 9-72 |
| Figure 9-34 Schematic Diagram of Preliminary Design for ITS Project (6/11) | 9-73 |
| Figure 9-35 Schematic Diagram of Preliminary Design for ITS Project (7/11) | 9-74 |
| Figure 9-36 Schematic Diagram of Preliminary Design for ITS Project (8/11) | 9-75 |
| Figure 9-37 Schematic Diagram of Preliminary Design for ITS Project (9/11) | 9-76 |
| Figure 9-38 Schematic Diagram of Preliminary Design for ITS Project (10/11) | 9-77 |
| Figure 9-39 Schematic Diagram of Preliminary Design for ITS Project (11/11) | 9-78 |
| Figure 10-1 Location of DF | 10-1 |
| Figure 10-2 Administrative Boundaries of RIDE from DF and Surrounding Areas..... | 10-3 |
| Figure 10-3 GDP (Current Prices) Trend in the DF | 10-4 |
| Figure 10-4 Trend of GDP (Current Prices) per Capita in the DF | 10-5 |
| Figure 10-5 2011 GDP per Capita in 2011 of the DF RAs | 10-6 |
| Figure 10-6 Trend of GDP (Current Prices) per Capita in the DF | 10-7 |

| | |
|--|-------|
| Figure 10-7 Population Trend in DF | 10-8 |
| Figure 10-8 Population Distribution of Cities in RIDE | 10-9 |
| Figure 10-9 Population Density of Brazil and Japan | 10-10 |
| Figure 10-10 Population and Main Shopping Centers of DF | 10-12 |
| Figure 10-11 Main Sightseeing Locations in the DF | 10-13 |
| Figure 10-12 Inbound Tourists to the DF by Country of Origin | 10-14 |
| Figure 10-13 Monthly Tourist Arrivals to the DF | 10-14 |
| Figure 10-14 Characteristics of International Events in Brazil..... | 10-15 |
| Figure 10-15 Location of Parque de Exposições Granja do Torto | 10-15 |
| Figure 10-16 Contours in RIDE and DF | 10-17 |
| Figure 10-17 Topographic Characteristics of the DF..... | 10-18 |
| Figure 10-18 Temperatures in DF and Tokyo | 10-19 |
| Figure 10-19 Precipitation Comparison in the DF and Tokyo | 10-19 |
| Figure 10-20 Air Quality Monitoring Result | 10-21 |
| Figure 10-21 Modal Split in RIDE and Tokyo..... | 10-22 |
| Figure 10-22 Transportation Demand Related to the DF..... | 10-23 |
| Figure 10-23 Number of Vehicles | 10-26 |
| Figure 10-24 Increase in the Number of Vehicles per Year | 10-26 |
| Figure 10-25 Road Network in DF | 10-28 |
| Figure 10-26 Bridges in DF | 10-29 |
| Figure 10-27 Traffic Volume Counted by Electronic Barrier..... | 10-30 |
| Figure 10-28 Traffic Volume Counted by Electronic Surveillance..... | 10-31 |
| Figure 10-29 Traffic Volume of Local Road..... | 10-32 |
| Figure 10-30 Travel Speed in DF..... | 10-33 |
| Figure 10-31 Rates of Traffic Accidents in the DF | 10-34 |
| Figure 10-32 Traffic Accidents in the DF by Accident Type and by Road Type | 10-34 |
| Figure 10-33 Traffic Accidents in the DF by Road..... | 10-35 |
| Figure 10-34 Location of Cameras in the DF | 10-36 |
| Figure 10-35 Location of Speed Monitoring Equipment in the DF..... | 10-37 |
| Figure 10-36 Traffic Light Locations in the DF..... | 10-38 |
| Figure 10-37 Red Light Running Camera Locations in the DF..... | 10-39 |
| Figure 10-38 Speed Radar Locations in the DF..... | 10-40 |
| Figure 10-39 Locations of Electronic Barriers in the DF | 10-41 |
| Figure 10-40 Photos of Cars Parked around Buildings..... | 10-42 |
| Figure 10-41 Public Transport Network in the DF | 10-45 |
| Figure 10-42 Public Transport Demand in the DF..... | 10-46 |
| Figure 10-43 Metro Passengers per Day by Station..... | 10-47 |
| Figure 10-44 Metro Passengers per Hour | 10-48 |
| Figure 10-45 Location of Bus Terminals | 10-50 |

| | |
|---|-------|
| Figure 10-46 Number of Buses Authorized by ANTT..... | 10-53 |
| Figure 10-47 Number of Passengers Transported by Interstate and International Buses | 10-53 |
| Figure 10-48 Parking Situation at the Stadium..... | 10-54 |
| Figure 10-49 Photos of the Operation Center of a Taxi Union | 10-55 |
| Figure 10-50 Demand Characteristics of Brasilia International Airport..... | 10-56 |
| Figure 10-51 Location of the Brasilia International Airport | 10-56 |
| Figure 10-52 Route Map of the Airport Bus Service | 10-57 |
| Figure 10-53 Metro System – Accessibility at the Stations | 10-59 |
| Figure 10-54 Metro System – Available User Information..... | 10-60 |
| Figure 10-55 Metro System – ITS Services..... | 10-60 |
| Figure 10-56 Metro System – Potential Safety Hazards | 10-61 |
| Figure 10-57 Bus Stop Infrastructure..... | 10-61 |
| Figure 10-58 Brasilia Municipal Terminal Infrastructure | 10-62 |
| Figure 10-59 Brasilia Interstate Terminal Infrastructure..... | 10-63 |
| Figure 10-60 Infrastructure of Other Bus Terminals..... | 10-63 |
| Figure 10-61 Bus Interior and Exterior..... | 10-64 |
| Figure 10-62 Overall System Diagram | 10-69 |
| Figure 10-63 Example of PDTU Report | 10-80 |
| Figure 10-64 PAC2 Projects..... | 10-82 |
| Figure 10-65 Example of PPA | 10-84 |
| Figure 10-66 BRT South | 10-85 |
| Figure 10-67 Network Extension of Metro-DF and LRT | 10-85 |
| Figure 10-68 ITS Brasilia Communication Equipment | 10-87 |
| Figure 11-1 Essential Aspects of DF Transportation-related Plans..... | 11-2 |
| Figure 11-2 DF Preliminary ITS Master Plan Study Flow | 11-3 |
| Figure 11-3 DF System Functional Requirement Matching Diagram | 11-5 |
| Figure 11-4 DF ITS Subsystems Organization | 11-8 |
| Figure 12-1 ITS Projects and Implementation Schedule | 12-3 |
| Figure 12-2 Design Diagram of T2MC..... | 12-5 |
| Figure 12-3 Implementation Schedule..... | 12-6 |

[Table List]

| | |
|---|-------|
| Table 1-1 Phase of the Study..... | 1-5 |
| Table 2-1 Administrative Division in Brazil | 2-2 |
| Table 2-2 GDP (Current Prices) in 2011 and 2017 (Estimated)..... | 2-3 |
| Table 2-3 GDP (Current Prices) per Capita in 2010 and 2017 (Estimated)..... | 2-6 |
| Table 2-4 Annual Big Events in the City of Rio de Janeiro | 2-24 |
| Table 2-5 Upcoming Large-scale Events in the City of Rio de Janeiro | 2-25 |
| Table 2-6 Experiences in Rio’s Annual Large-Scale Events..... | 2-26 |
| Table 2-7 Area by Land Cover in the City of Rio de Janeiro..... | 2-30 |
| Table 2-8 Monitoring Results by INEA on 3 October 2012 (Example)..... | 2-35 |
| Table 2-9 Monitoring Result by SMAC on 3 October 2012 (Example) | 2-36 |
| Table 2-10 The density and the increasing rate by each devices..... | 2-48 |
| Table 2-11 Road Administrators in the Metropolitan Region of Rio de Janeiro..... | 2-55 |
| Table 2-12 Concession Road in the Metropolitan Region of Rio de Janeiro | 2-57 |
| Table 2-13 Length of Roads in the Metropolitan Region of Rio de Janeiro | 2-59 |
| Table 2-14 Length of Planned Roads in the Metropolitan Region of Rio de Janeiro | 2-65 |
| Table 2-15 List of Traffic Signals by Type in the City of Rio de Janeiro | 2-84 |
| Table 2-16 List of Cameras by Type in the City of Rio de Janeiro | 2-86 |
| Table 2-17 List of VMS by Type in the City of Rio de Janeiro | 2-88 |
| Table 2-18 List of Speed Monitoring Equipment by Type in the City of Rio de Janeiro | 2-90 |
| Table 2-19 List of Special Control Routes in the City of Rio de Janeiro..... | 2-92 |
| Table 2-20 List of Speed Monitoring Equipment in the City of Rio de Janeiro | 2-95 |
| Table 2-21 List of Cameras and VMS Equipment in the City of Rio de Janeiro..... | 2-96 |
| Table 2-22 List of Speed Monitoring Equipment of DNIT in the State of Rio de Janeiro | 2-97 |
| Table 2-23 List of Sections for Reversible Lane in the City of Rio de Janeiro..... | 2-99 |
| Table 2-24 List of Sections for Road Closure in the City of Rio de Janeiro..... | 2-100 |
| Table 2-25 Existing Transportation Modes in the Metropolitan Region of Rio de Janeiro | 2-112 |
| Table 2-26 Existing Rail Condition | 2-114 |
| Table 2-27 Existing Condition of the Metro | 2-116 |
| Table 2-28 Existing Condition of the Tram..... | 2-117 |
| Table 2-29 Existing Condition of Cable Car..... | 2-118 |
| Table 2-30 Number of Passengers of Cable Car | 2-118 |
| Table 2-31 Existing Condition of Boat | 2-119 |
| Table 2-32 Average Number of Boat Passengers | 2-119 |
| Table 2-33 Existing Condition of Intercity Bus | 2-120 |
| Table 2-34 Existing Conditions of Local Buses..... | 2-121 |
| Table 2-35 Bus Stops in the City of Rio de Janeiro | 2-123 |
| Table 2-36 Existing BRT Condition..... | 2-125 |
| Table 2-37 Actual Passengers of BRT | 2-125 |

| | |
|---|-------|
| Table 2-38 Planned Passengers of BRT | 2-125 |
| Table 2-39 Stations and Terminals of BRT | 2-128 |
| Table 2-40 Existing Taxi Condition | 2-129 |
| Table 2-41 Number of Taxi Vehicles Permitted by the Municipality (Example)..... | 2-129 |
| Table 2-42 Existing Long Distance Bus Condition..... | 2-130 |
| Table 2-43 Existing Airport Condition..... | 2-131 |
| Table 2-44 Existing Sea Port Condition..... | 2-134 |
| Table 2-45 Existing Freight Transport Condition | 2-138 |
| Table 2-46 Number of Trucks Registered by ANTT..... | 2-138 |
| Table 2-47 Federal Government Organizations on ITS-Related Agencies | 2-141 |
| Table 2-48 State Government Organizations on ITS-Related Agencies | 2-142 |
| Table 2-49 State Government Organization on ITS-Related Agencies..... | 2-143 |
| Table 2-50 Role of ITS-Related Agencies | 2-145 |
| Table 2-51 Meteorological and Atmospheric Sensors..... | 2-149 |
| Table 2-52 Information to be Collected by Related Agencies | 2-152 |
| Table 2-53 Information to be Distributed..... | 2-153 |
| Table 2-54 Summary of PDTU/RMRJ..... | 2-176 |
| Table 2-55 Summary of Transport Strategic Plan | 2-178 |
| Table 2-56 Summary of PAC | 2-183 |
| Table 2-57 Summary of PAC2 | 2-183 |
| Table 2-58 Summary of PPA..... | 2-185 |
| Table 2-59 Summary of Strategic Plan 2012 -2031 | 2-187 |
| Table 2-60 Summary of Strategic Plan 2009-2012 | 2-190 |
| Table 2-61 Summary of Development Map in the State of Rio de Janeiro..... | 2-192 |
| Table 2-62 Example of Indicators | 2-201 |
| Table 2-63 Comparison of Standard and Application Area..... | 2-206 |
| Table 3-1 Contents of PDTU/RMRJ 2005 | 3-1 |
| Table 3-2 Contents of PDTU/RMRJ 2011 | 3-3 |
| Table 3-3 Contents of Rio 2016 Transport Strategy..... | 3-6 |
| Table 3-4 Contents of Rio 2016 Transport Strategy Update | 3-10 |
| Table 3-5 Survey Stations List | 3-12 |
| Table 3-6 Survey Routes List..... | 3-22 |
| Table 3-7 Data Collection Points List Provided by CET-Rio | 3-26 |
| Table 3-8 List of Data Collection Points Provided by SMTR..... | 3-32 |
| Table 3-9 CCTV Locations for Image Processing | 3-35 |
| Table 3-10 Data Collection Points List Provided by SMTR..... | 3-53 |
| Table 3-11 Comparison of Existing Transport Master Plans | 3-65 |
| Table 3-12 Analysis Periods for Olympic Games Scenario | 3-68 |
| Table 3-13 OD Summary Results | 3-69 |

| | |
|---|-------|
| Table 3-14 Setting of Road Capacity | 3-74 |
| Table 3-15 OD Summary Results | 3-79 |
| Table 3-16 Basic Assignment Cases | 3-83 |
| Table 3-17 List of Reversible Lane Sections in the City of Rio de Janeiro | 3-91 |
| Table 3-18 Comparison of Traffic Indicators between With and Without Cases | 3-101 |
| Table 3-19 Olympic Games Family Demand..... | 3-105 |
| Table 3-20 Main OD of Olympic Games Family Demand | 3-108 |
| Table 3-21 Venues in Barra Zone..... | 3-111 |
| Table 3-22 Venues in Maracana Zone | 3-113 |
| Table 3-23 Venues in Rio Stadium..... | 3-115 |
| Table 3-24 Venues in Copacabana Zone | 3-117 |
| Table 3-25 Venues in Deodoro Zone..... | 3-121 |
| Table 3-26 Comparison Summary between Modes | 3-152 |
| Table 5-1 Survey Locations and Number of Samples..... | 5-1 |
| Table 5-2 ITS Services Referred to in the Questionnaire..... | 5-4 |
| Table 5-3 Related Stakeholders and ITS Needs Survey Targets | 5-76 |
| Table 5-4 ITS Services Referred to in the Interview..... | 5-78 |
| Table 5-5 ITS Needs of Each Stakeholder | 5-79 |
| Table 6-1 ITS Architectures in Major Countries..... | 6-2 |
| Table 6-2 ITS Architecture Outline..... | 6-9 |
| Table 6-3 Consistency Check between the ISO Reference Model and the National ITS Architecture of the U.S. | 6-16 |
| Table 7-1 ITS Projects..... | 7-21 |
| Table 7-2 Concept of Deployment (Road Traffic) | 7-43 |
| Table 7-3 Concept of Deployment (Land Public Transport - Taxi) | 7-44 |
| Table 7-4 Concept of Deployment (Land Public Transport – Bus and BRT) | 7-44 |
| Table 7-5 Concept of Deployment (Land Public Transport – Rail, Metro, and Cable Car)..... | 7-45 |
| Table 7-6 Concept of Deployment (Land Public Transport – Boat) | 7-45 |
| Table 7-7 Concept of Deployment (Land Freight Transport – Truck) | 7-45 |
| Table 7-8 Concept of Deployment (Land Freight Transport – Rail)..... | 7-46 |
| Table 7-9 Concept of Deployment (Safety and Security – Police) | 7-46 |
| Table 7-10 Concept of Deployment (Safety and Security – Civil Defense) | 7-46 |
| Table 7-11 Concept of Deployment (Safety and Security – Fire Brigade and Rescue)..... | 7-47 |
| Table 7-12 Concept of Deployment (Safety and Security – Ambulance) | 7-47 |
| Table 7-13 Current Condition (Road Traffic) | 7-48 |
| Table 7-14 Methodology of Deployment (Road Traffic) | 7-48 |
| Table 7-15 Current Condition (Road Traffic) | 7-51 |
| Table 7-16 Methodology of Deployment (Road Traffic) | 7-51 |
| Table 7-17 Road Length..... | 7-54 |

| | |
|--|------|
| Table 7-18 Current Condition (Road Traffic) | 7-55 |
| Table 7-19 Methodology of Deployment (Road Traffic) | 7-55 |
| Table 7-20 Current Condition (Land Public Transport) | 7-60 |
| Table 7-21 Methodology of Deployment (Land Public Transport)..... | 7-60 |
| Table 7-22 Number of Taxis | 7-61 |
| Table 7-23 Related Organizations | 7-61 |
| Table 7-24 Current Condition (Land Public Transport) | 7-62 |
| Table 7-25 Methodology of Deployment (Land Public Transport)..... | 7-63 |
| Table 7-26 Number of Terminals | 7-64 |
| Table 7-27 Number of Bus Lines using the NOVO RIO Terminal..... | 7-64 |
| Table 7-28 Number of Terminals, Lines, and Buses | 7-65 |
| Table 7-29 Name of Terminals, Bus Stops, and Buses | 7-66 |
| Table 7-30 Names of Terminals | 7-67 |
| Table 7-31 Population in 2010 | 7-67 |
| Table 7-32 Current Condition (Land Public Transport) | 7-69 |
| Table 7-33 Methodology of Deployment (Land Public Transport)..... | 7-69 |
| Table 7-34 Current Condition (Land Public Transport) | 7-73 |
| Table 7-35 Methodology of Deployment (Land Public Transport)..... | 7-73 |
| Table 7-36 Current Condition (Land Freight Transport)..... | 7-75 |
| Table 7-37 Methodology of Deployment (Land Freight Transport) | 7-75 |
| Table 7-38 Rough Cost Estimates of ITS Projects..... | 7-77 |
| Table 7-39 Conditions and Assumptions for Individual ITS Projects..... | 7-78 |
| Table 7-40 ITS Related Organizations..... | 7-80 |
| Table 7-41 TTC in 2011 Prices | 7-88 |
| Table 7-42 Condition of Macro/Meso/Micro Simulation | 7-89 |
| Table 7-43 Estimated Benefits | 7-91 |
| Table 7-44 Cost-Benefit Stream (Bus Information Provision)..... | 7-93 |
| Table 7-45 Cost-Benefit Stream (ITS Center) | 7-93 |
| Table 7-46 Cost-Benefit Stream (BRT Priority System)..... | 7-94 |
| Table 7-47 Cost-Benefit Stream (ETC)..... | 7-94 |
| Table 7-48 Cost-Benefit Stream (ERP)..... | 7-95 |
| Table 7-49 Results of Sensitivity Analysis (EIRR): Bus Information Provision | 7-95 |
| Table 7-50 Results of Sensitivity Analysis (EIRR): ITS Center | 7-95 |
| Table 7-51 Results of Sensitivity Analysis (EIRR): BRT Priority System | 7-96 |
| Table 7-52 Results of Sensitivity Analysis (EIRR): ETC | 7-96 |
| Table 7-53 Results of Sensitivity Analysis (EIRR): ERP | 7-96 |
| Table 9-1 Project Package..... | 9-1 |
| Table 9-2 Project Cost..... | 9-4 |
| Table 9-3 Implementation Plan | 9-5 |

| | |
|---|-------|
| Table 9-4 Definition of Data/Information | 9-7 |
| Table 9-5 Data Gathering Process..... | 9-9 |
| Table 9-6 Categorizing the Processed Data | 9-14 |
| Table 9-7 Essential Equipment and Functional Requirement | 9-25 |
| Table 9-8 Quantity of Essential Equipment | 9-32 |
| Table 9-9 Cost of Project Package 1 | 9-39 |
| Table 9-10 Implementation Schedule for Project Package 1 | 9-41 |
| Table 9-11 Cost for Operation..... | 9-44 |
| Table 9-12 Definition of Data/Information | 9-46 |
| Table 9-13 Number of Equipment to be Deployed in the Short Term | 9-47 |
| Table 9-14 Proposed Bus Stops for Information Provision Panel..... | 9-48 |
| Table 9-15 Essential Equipment and Functional Requirement | 9-51 |
| Table 9-16 Cost of Project Package 2 | 9-53 |
| Table 9-17 Implementation Schedule of Project Package 2..... | 9-55 |
| Table 9-18 Number of Equipment to be Deployed in the Short Term | 9-59 |
| Table 9-19 Proposed Intersections for Adaptive Signal Control..... | 9-60 |
| Table 9-20 Proposed Location of VMSs | 9-61 |
| Table 9-21 Essential Equipment and Functional Requirement | 9-62 |
| Table 9-22 Essential Equipment and Functional Requirement | 9-62 |
| Table 9-23 Cost of Project Package 3 | 9-66 |
| Table 9-24 Implementation Schedule of Project Package 3..... | 9-67 |
| Table 10-1 Administrative Division in DF..... | 10-2 |
| Table 10-2 DF RAs Demographic Information | 10-11 |
| Table 10-3 Upcoming Large-scale Events in the DF | 10-16 |
| Table 10-4 Population x Job Comparison | 10-24 |
| Table 10-5 Auto and Public Transport Attraction and Production | 10-25 |
| Table 10-6 Federal Road (BR Road) in DF | 10-27 |
| Table 10-7 State Road (DF Road) in DF..... | 10-27 |
| Table 10-8 Road Density and Road Length per Capita..... | 10-28 |
| Table 10-9 Stakeholders ITS Needs..... | 10-43 |
| Table 10-10 Public Transport Services in the DF | 10-44 |
| Table 10-11 Number of Bus Lines in DF..... | 10-49 |
| Table 10-12 List of Bus Terminals in the DF..... | 10-51 |
| Table 10-13 Number of Bus Passengers | 10-52 |
| Table 10-14 Characteristics of Local Bus Services in Surrounding Municipalities in 2009.... | 10-54 |
| Table 10-15 Stakeholders ITS Needs..... | 10-58 |
| Table 10-16 Federal Government Organization on ITS-Related Agencies..... | 10-65 |
| Table 10-17 DF Organization on ITS-Related Agencies..... | 10-66 |
| Table 10-18 Role of ITS-Related Agencies | 10-67 |

| | |
|---|-------|
| Table 10-19 Information Collected by ITS-related Agencies | 10-70 |
| Table 10-20 Summary of PDTU/DF | 10-79 |
| Table 10-21 Summary of PAC | 10-81 |
| Table 10-22 Summary of PAC2 | 10-81 |
| Table 10-23 Summary of PPA..... | 10-83 |
| Table 10-24 ITS-Related Plans | 10-86 |
| Table 11-1 Summary of Current Conditions and Needs | 11-4 |
| Table 11-2 Current Stakeholder in ITS Systems | 11-6 |
| Table 11-3 Rough Cost Estimates of ITS Projects | 11-19 |
| Table 11-4 Conditions and Assumptions for Short-term ITS Projects | 11-20 |
| Table 11-5 Related Organizations for Short-term ITS System | 11-20 |
| Table 11-6 DF Implementation Plan | 11-24 |
| Table 11-7 Work Plan..... | 11-25 |
| Table 12-1 ITS Projects for Rio de Janeiro..... | 12-1 |
| Table 12-2 Result of Economic Analysis for ITS Project | 12-2 |
| Table 12-3 Project Package..... | 12-3 |
| Table 12-4 Project Cost..... | 12-4 |
| Table 12-5 Implementation Plan | 12-4 |

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 Estatística |
| 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 | Sistema Integrado de Monitoramento e Registro 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.

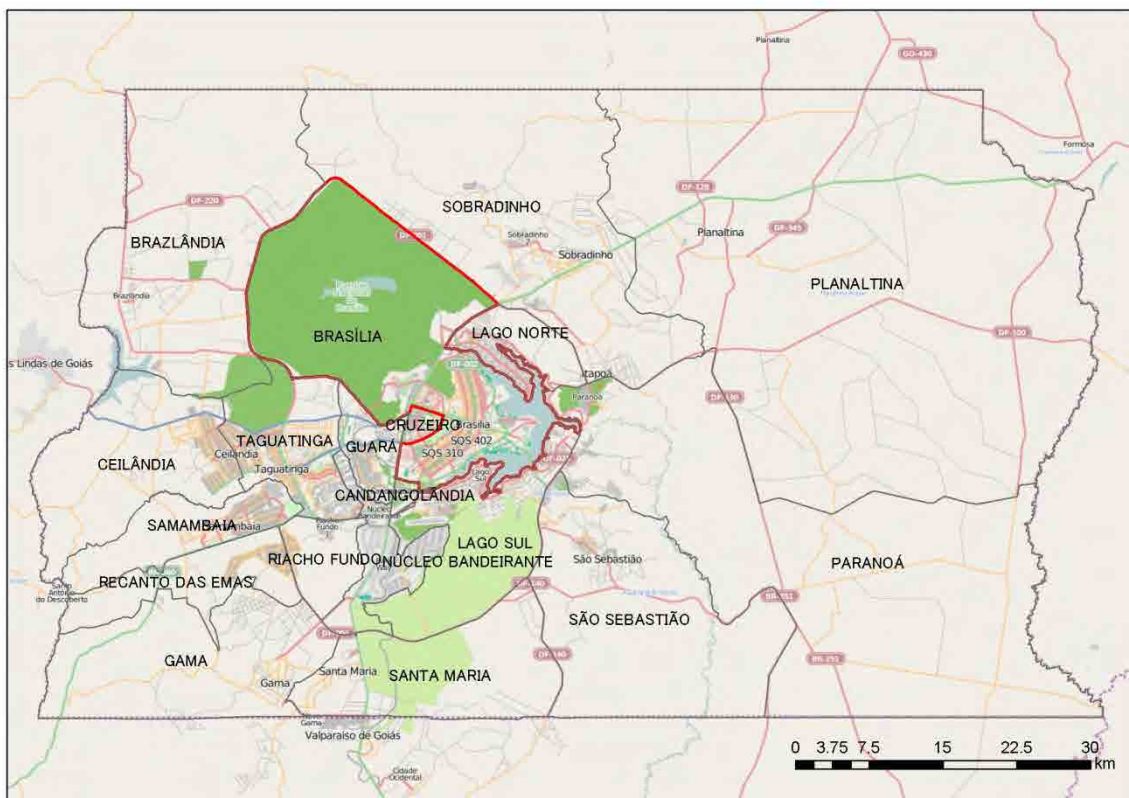
1.2 OBJECT AND STUDY AREA

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

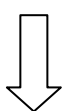
The aim of ITS menus is to alleviate the traffic congestion in urban areas. For example, “Electric Toll Collection” on expressways, “Traffic Information” and “Intelligent Traffic Signal Control”, “Increasing the Convenience of Public Transport such as Bus Location System” and “Congestion Charge” on ordinary 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;

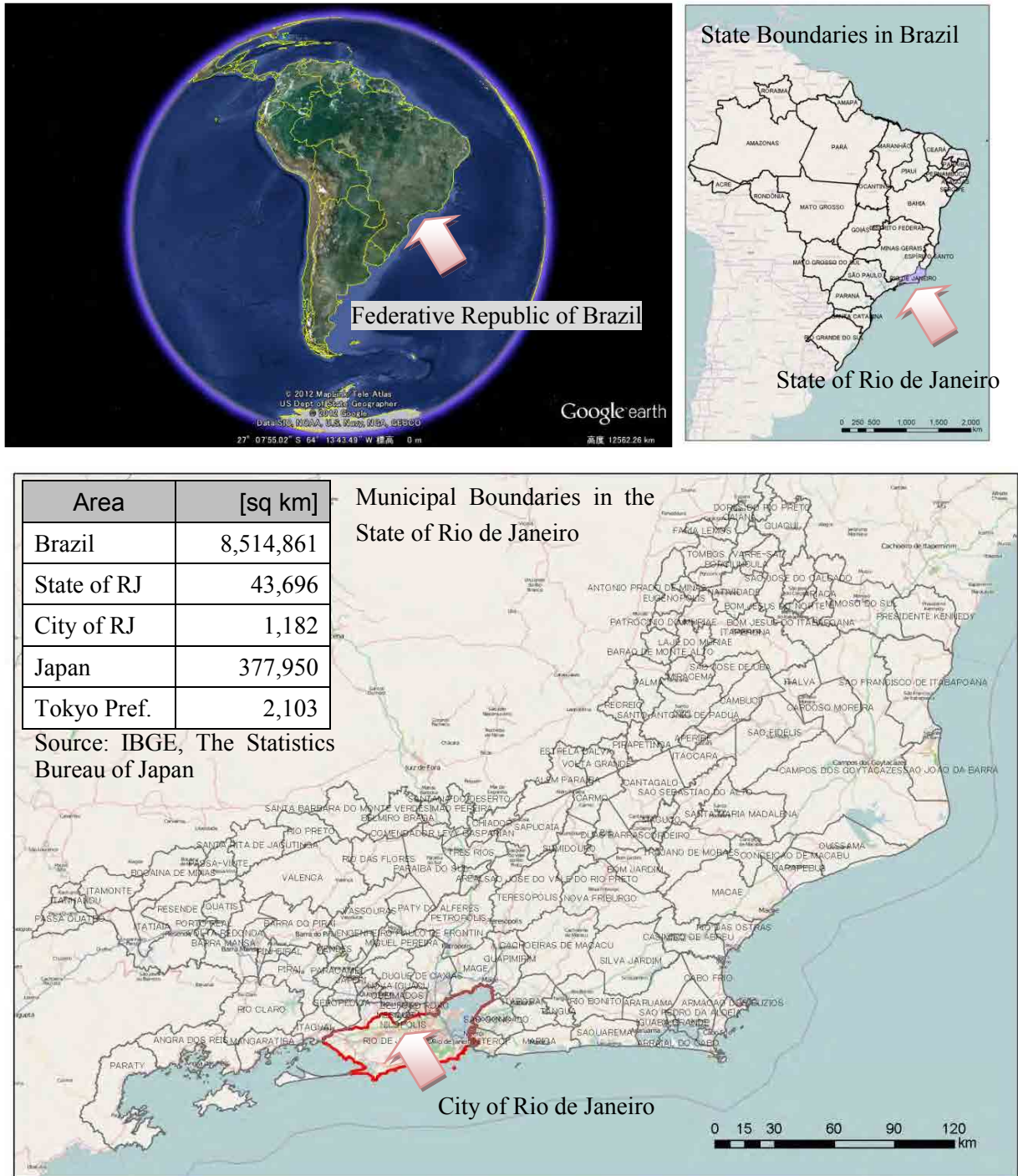
- SETRANS Rio (Coordinator: Mr. Henrique Futuro)
- SMTR (Coordinator: Mr. Alberto Nygaard)
- SETRANS DF (Coordinator: Mr. Umberto Menezes)
- DETRAN DF (Coordinator: Ms. Yara Geraldini)

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

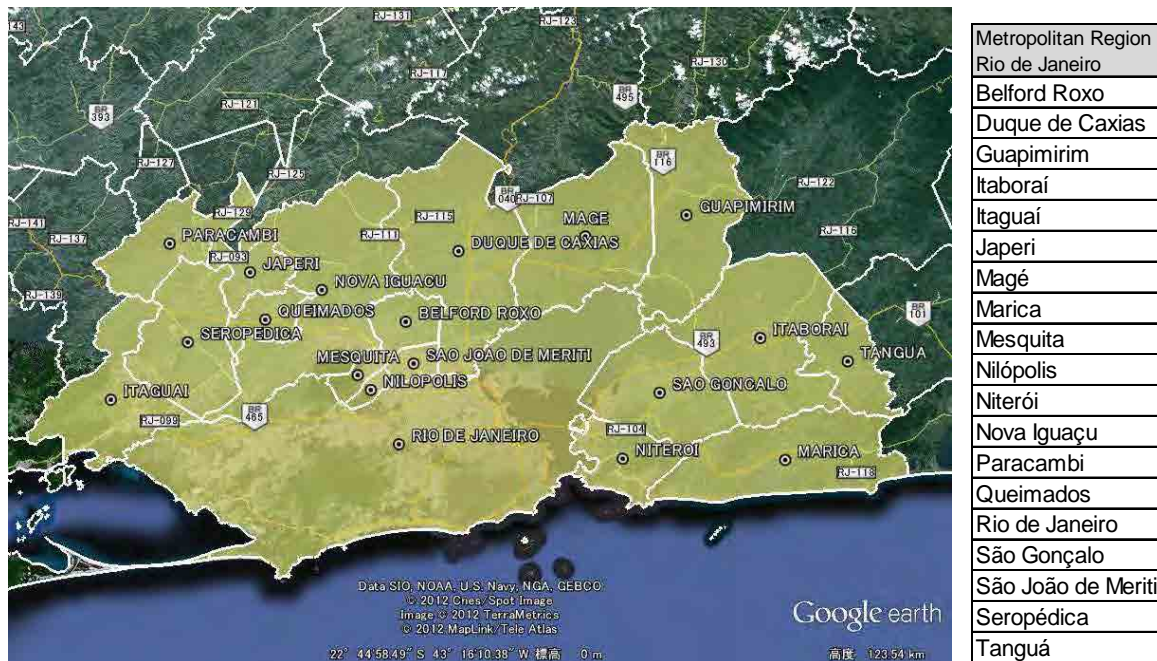
The state of Rio de Janeiro is located in the southeast of Brazil. The map is shown in Figure 2-1.



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.



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 | Aglomeración Urbana do Litoral Norte Rio Grande do Sul |
| 2 | Alagoas | 28 | RM Natal |
| 3 | Amapá | 29 | RM Norte/Nordeste Catarinense |
| 4 | Amazonas | 30 | RM Porto Alegre |
| 5 | Bahia | 31 | RM Recife |
| 6 | Ceará | 32 | RM Rio de Janeiro |
| 7 | Distrito Federal | 33 | RM Salvador |
| 8 | Espírito Santo | 34 | RM São Paulo |
| 9 | Goiás | 35 | RM Sudoeste Maranhense |
| 10 | Maranhão | 36 | RM Tubarão |
| 11 | Mato Grosso | 37 | RM Vale do Aço |
| 12 | Mato Grosso do Sul | 38 | RM Vale do Itajaí |
| 13 | Minas Gerais | 39 | RM Vale do Rio Cuiabá |
| 14 | Pará | | |
| 15 | Paraíba | | |
| 16 | Paraná | | |
| 17 | Pernambuco | | |
| 18 | Piauí | | |
| 19 | Rio de Janeiro | | |
| 20 | Rio Grande do Norte | | |
| 21 | Rio Grande do Sul | | |
| 22 | Rondônia | | |
| 23 | Roraima | | |
| 24 | Santa Catarina | | |
| 25 | São Paulo | | |
| 26 | Sergipe | | |
| 27 | Tocantins | | |

Source: JICA Study Team

2.1.2 Economy

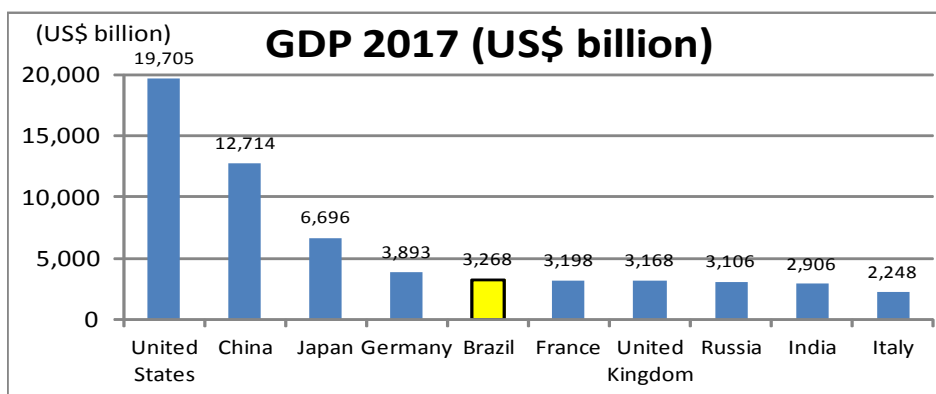
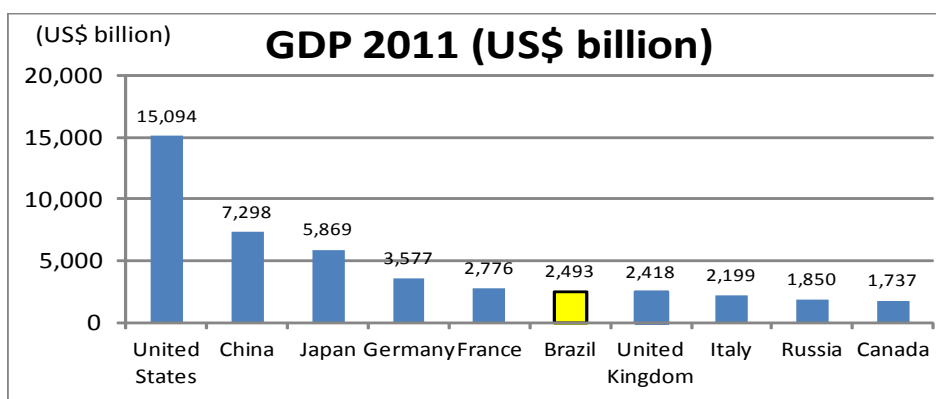
(1) Gross Domestic Product

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 |

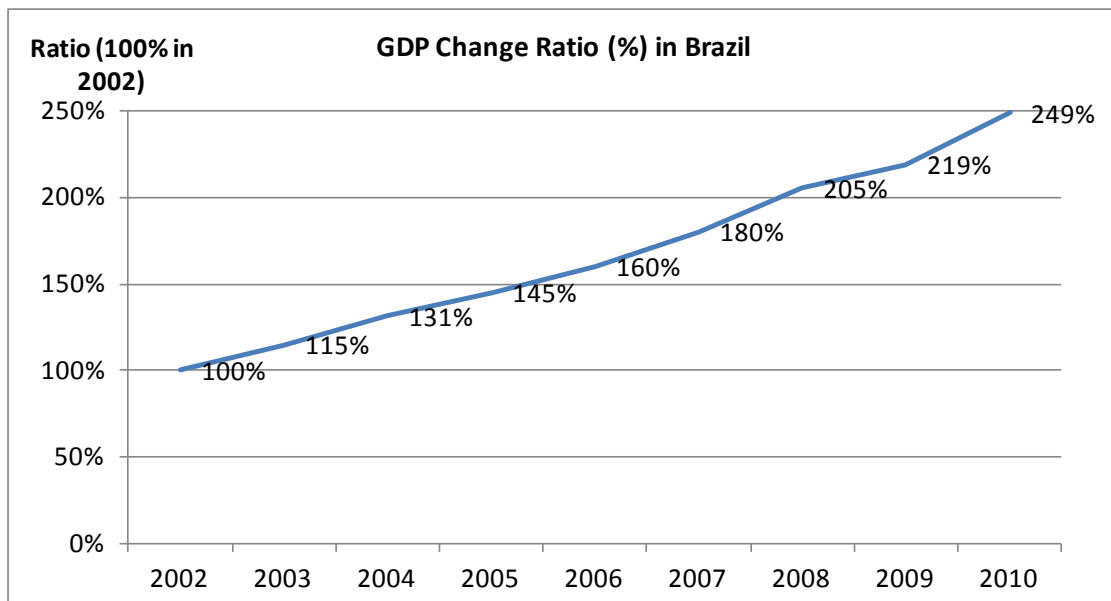
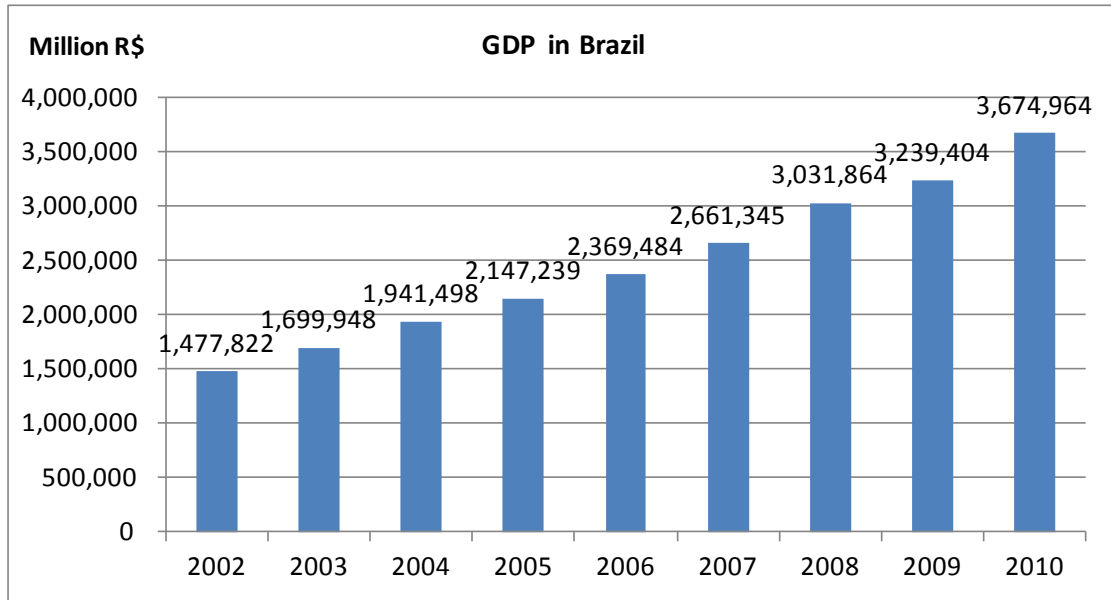


Source: Economic Outlook Database April 2011 (IMF)

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.



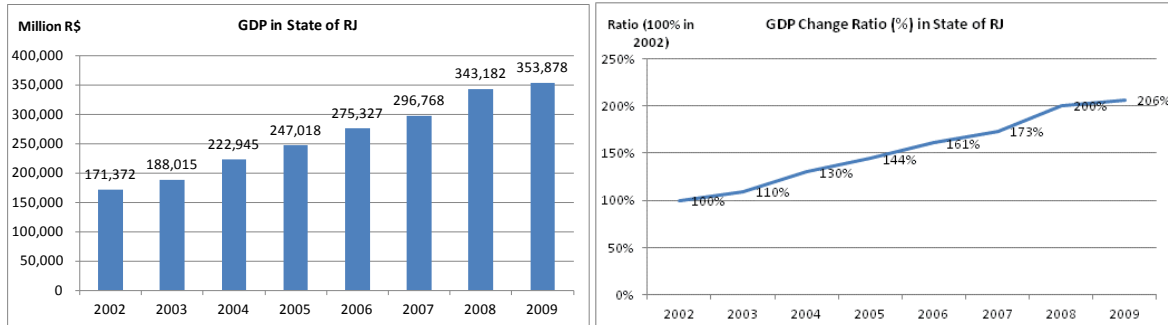
Source: IBGE

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

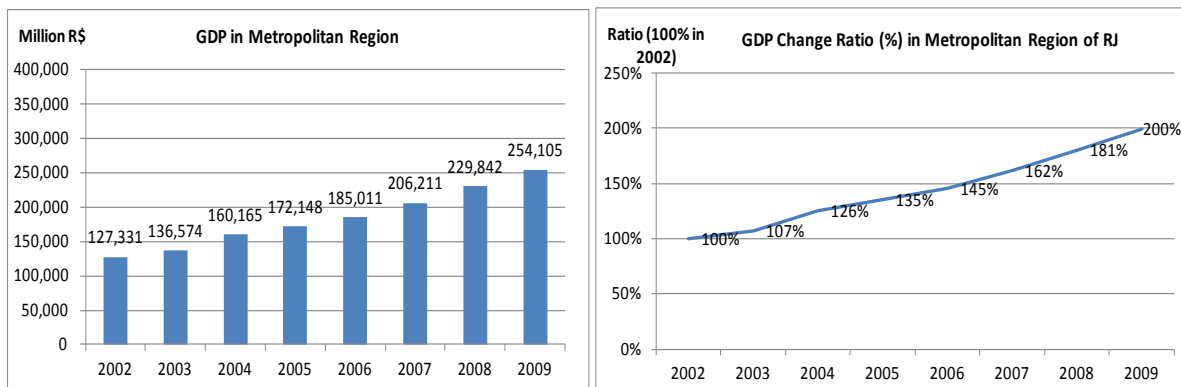
3) Trend in Rio de Janeiro

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.

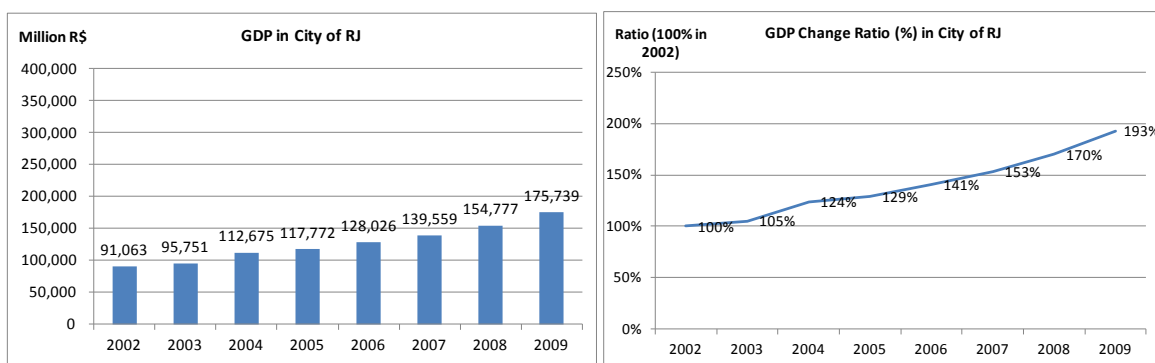
[State]



[Metropolitan Region]



[City]



Source: IBGE

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

(2) GDP per Capita

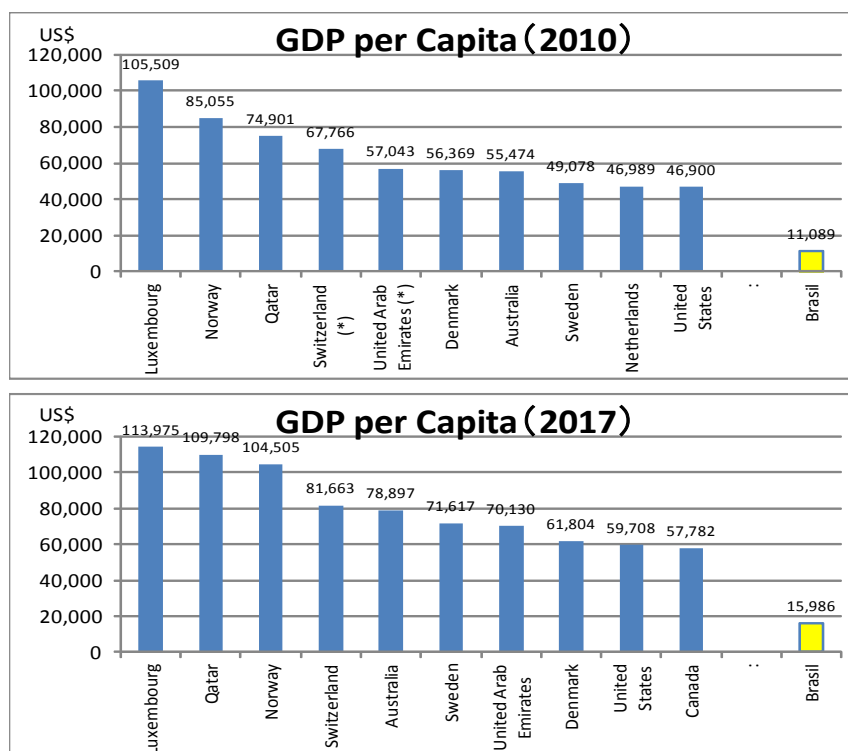
1) Position in World Economy

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

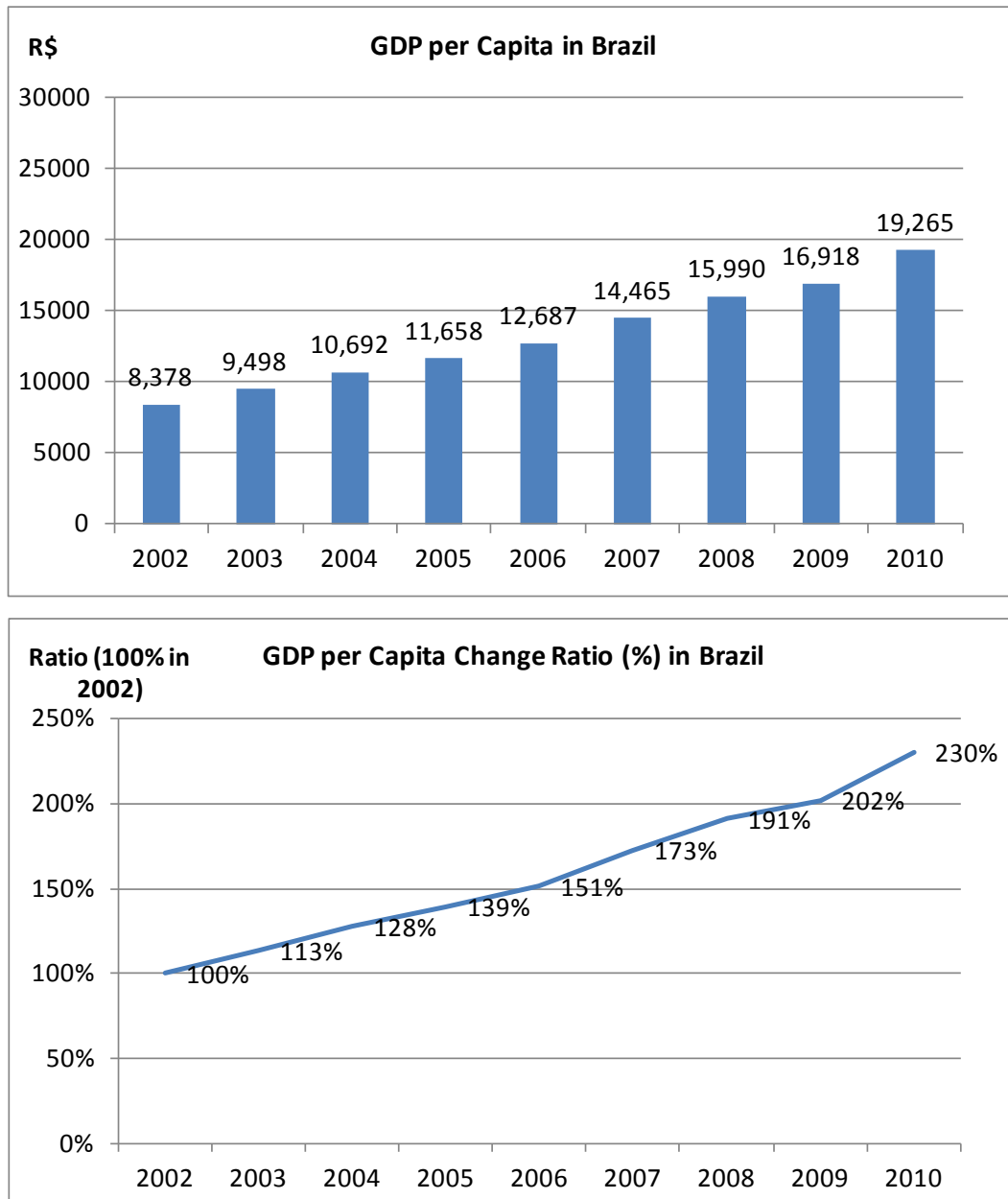


Source: Economic Outlook Database April 2011 (IMF)

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.



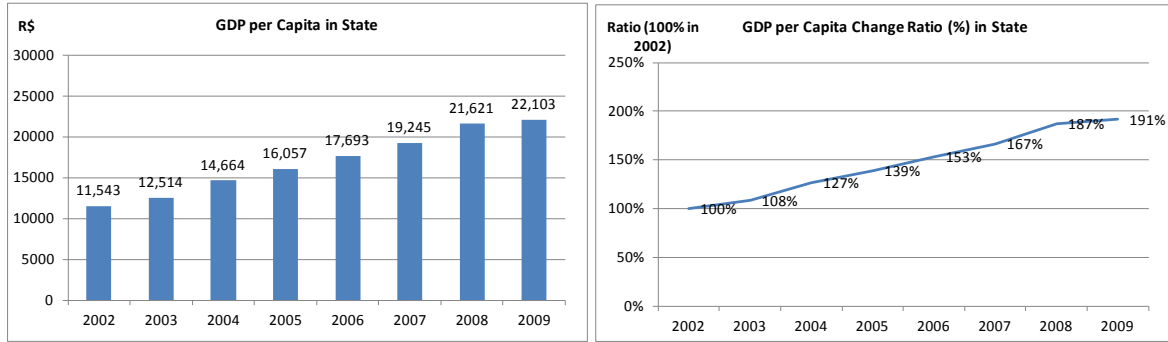
Source: IBGE

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

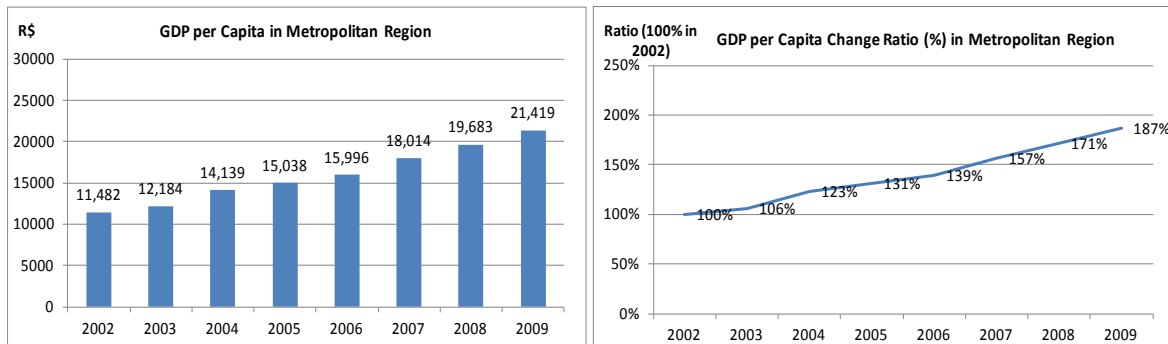
3) Trend in Rio de Janeiro

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.

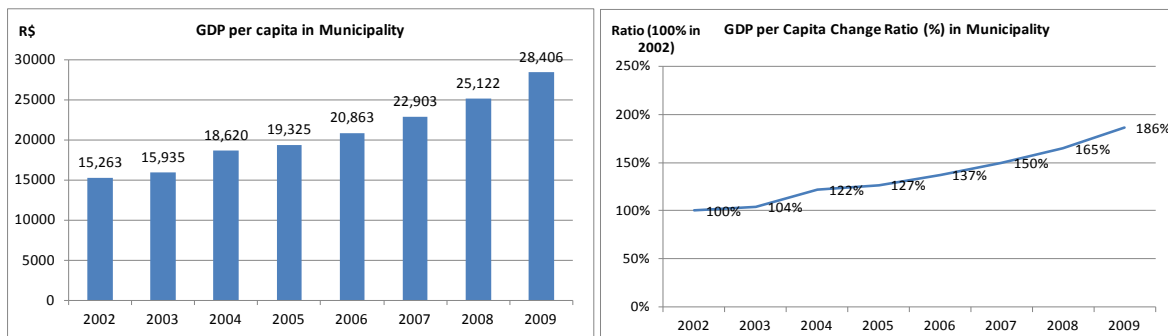
[State]



[Metropolitan Region]



[Municipality]

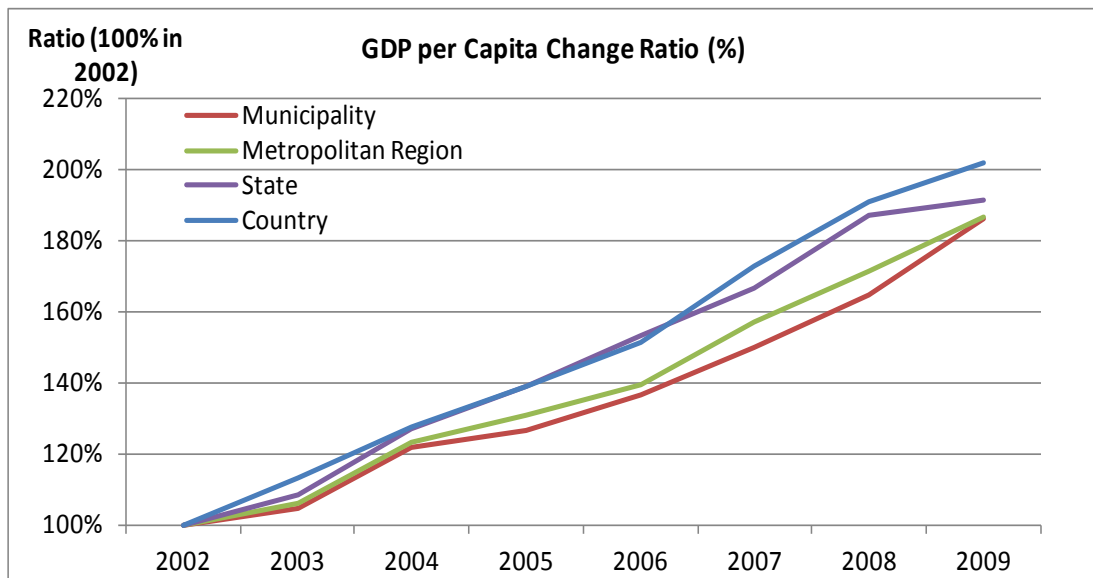
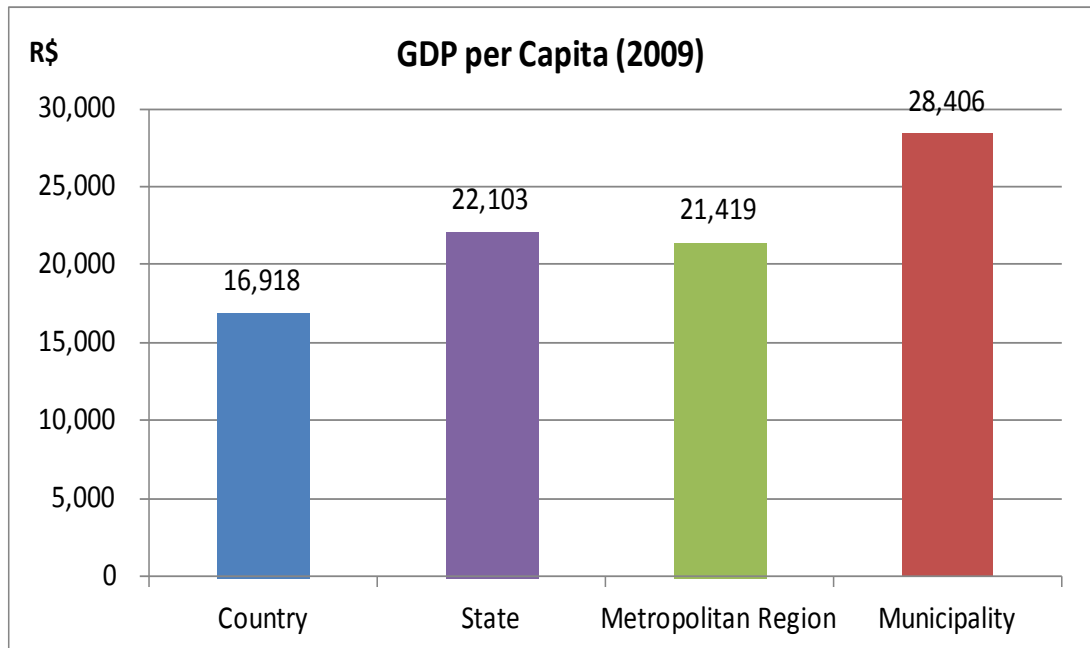


Source: IBGE

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.



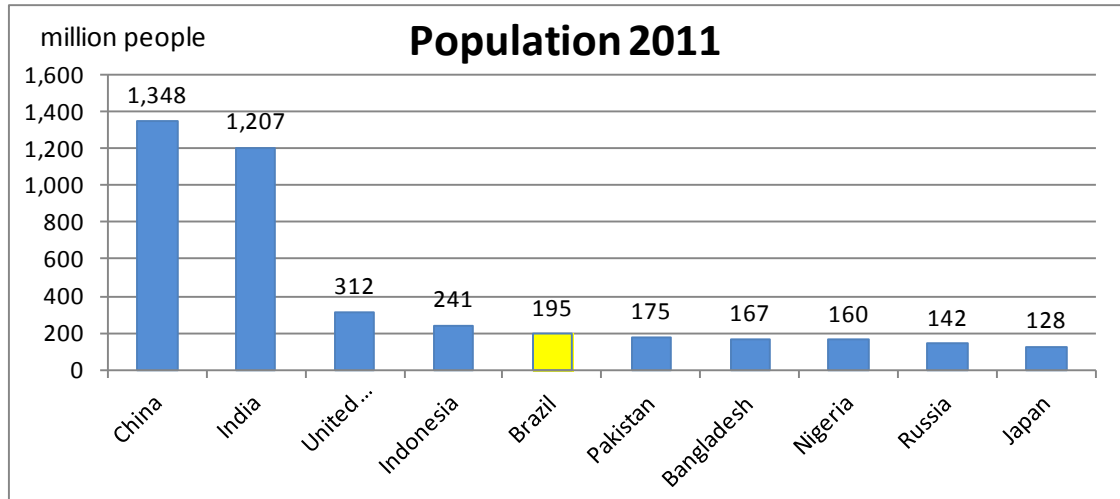
Source: IBGE

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

(3) Population

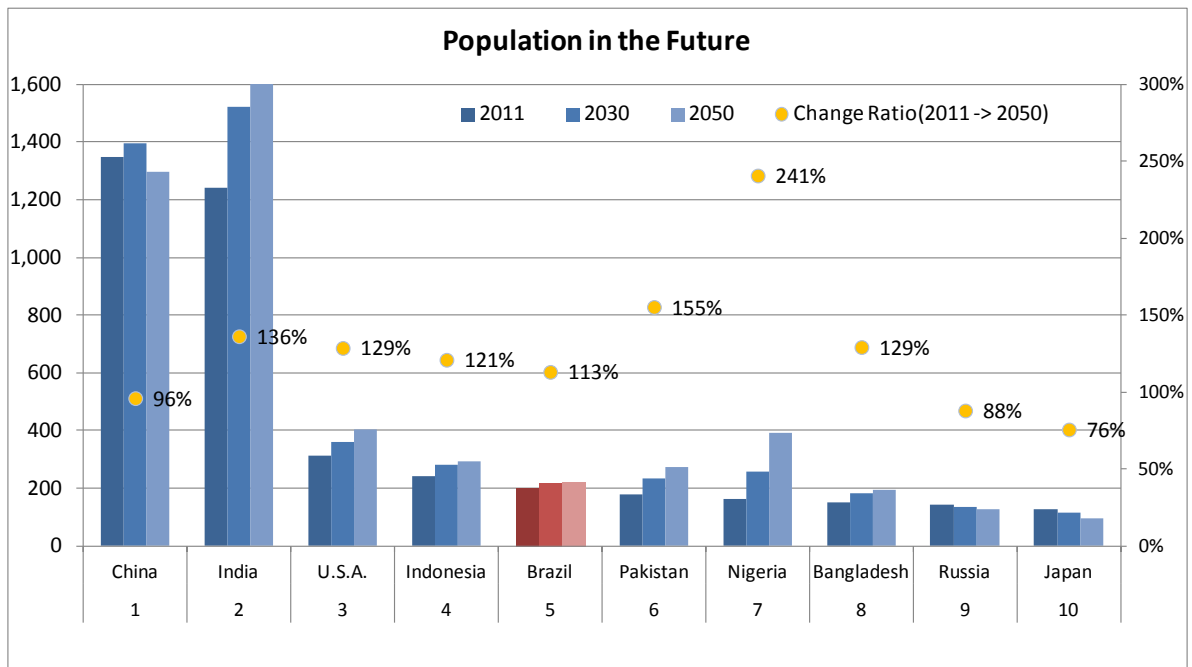
1) Population in the World

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



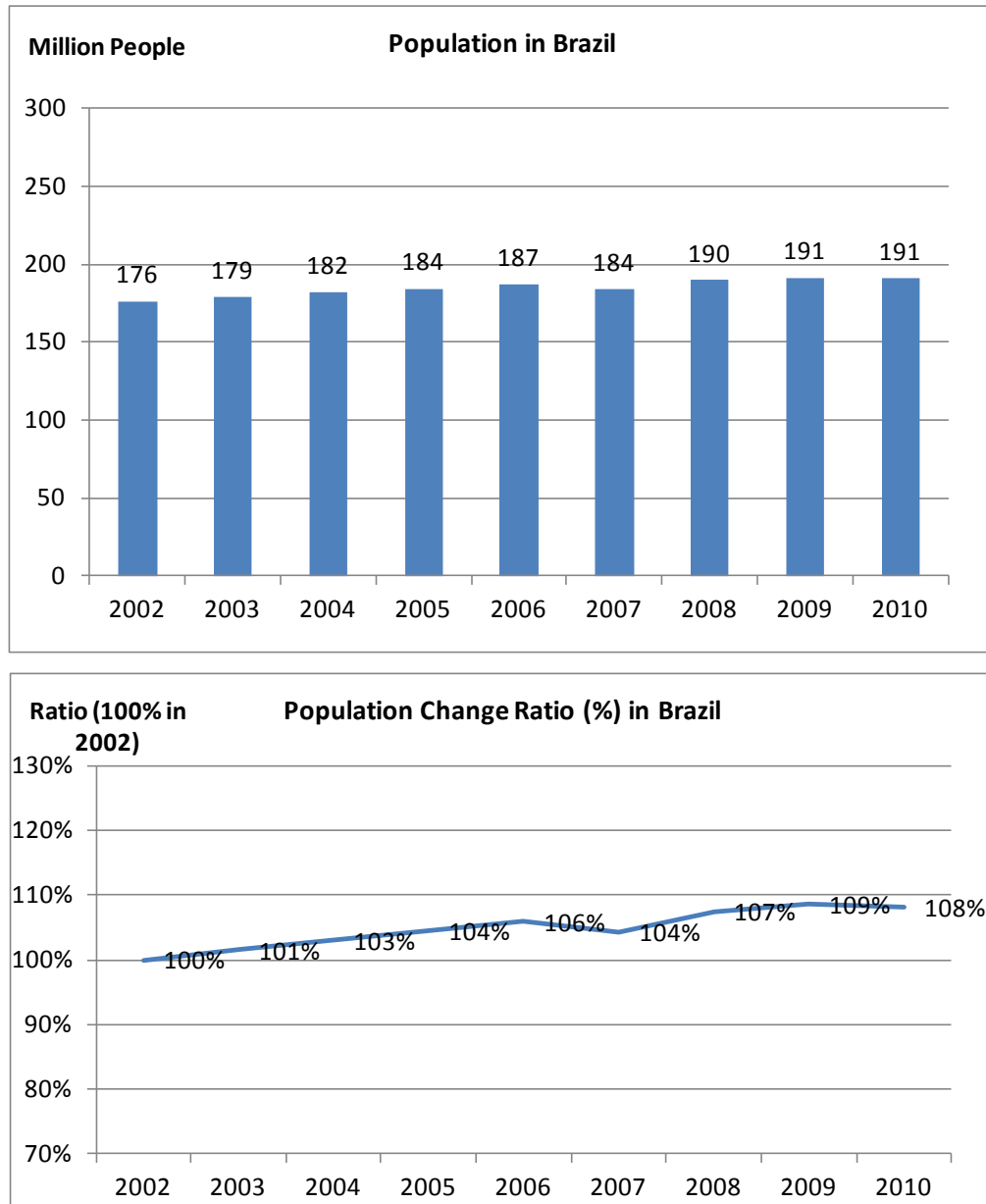
Source: Statistics Bureau of Japan

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.

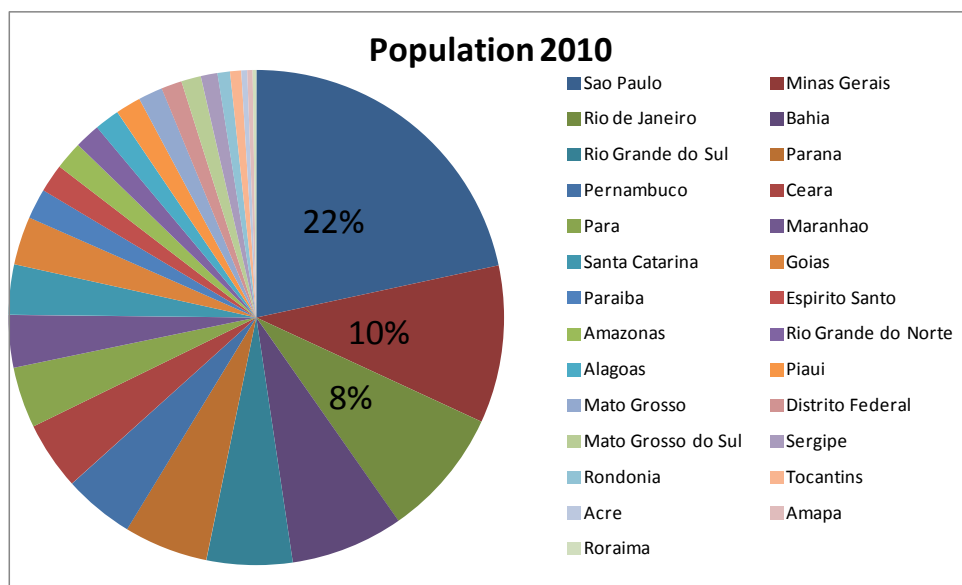
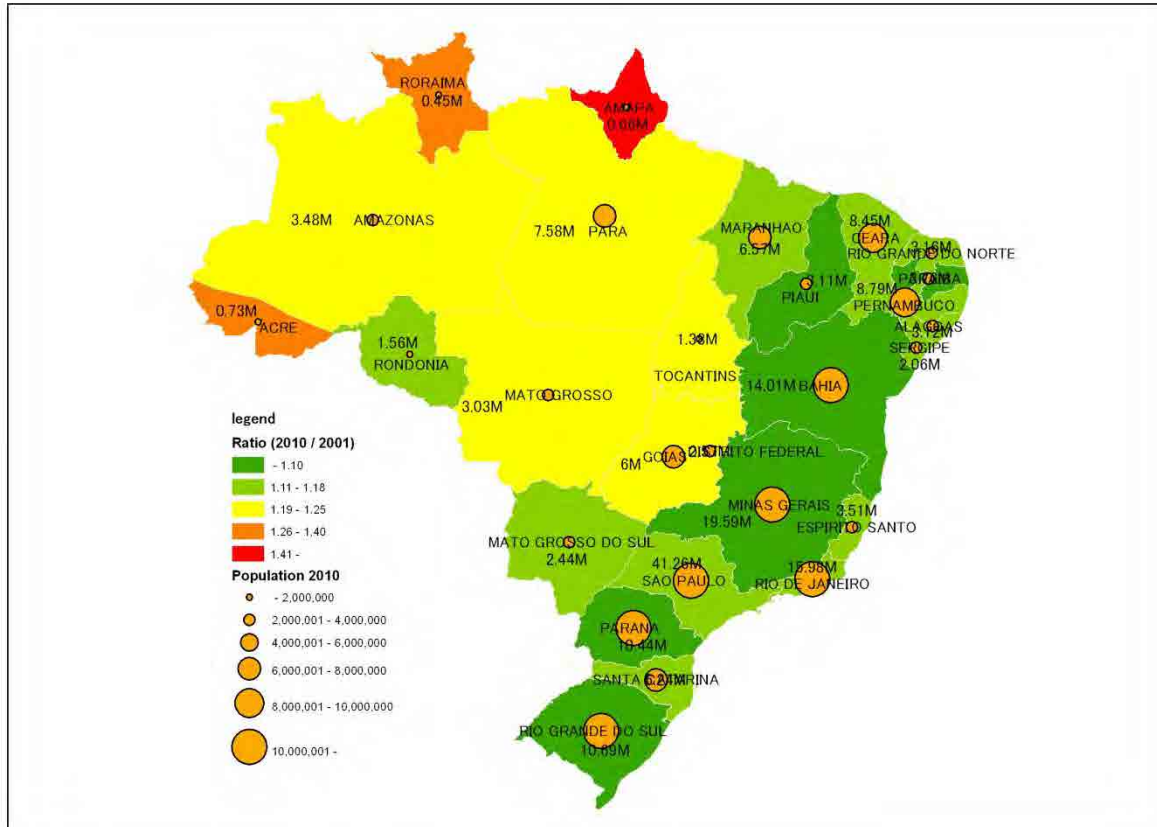


Source: IBGE

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

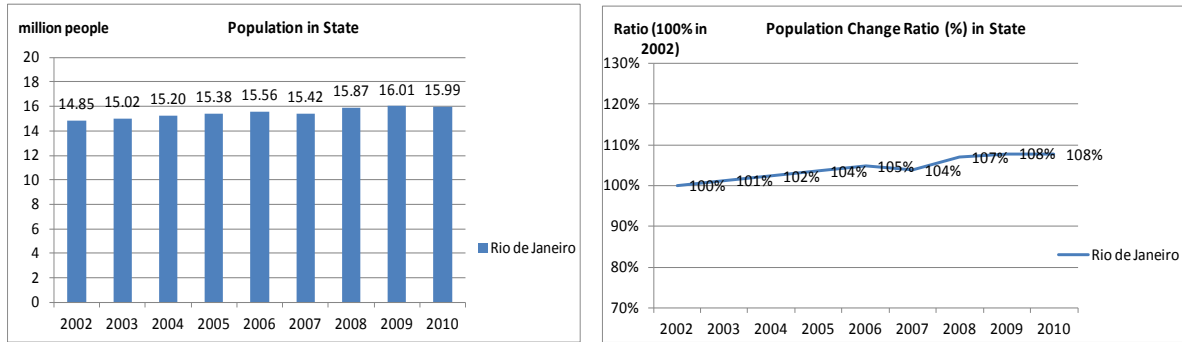
Figure 2-13 Population Distribution of States in Brazil

3) Trend in Rio de Janeiro

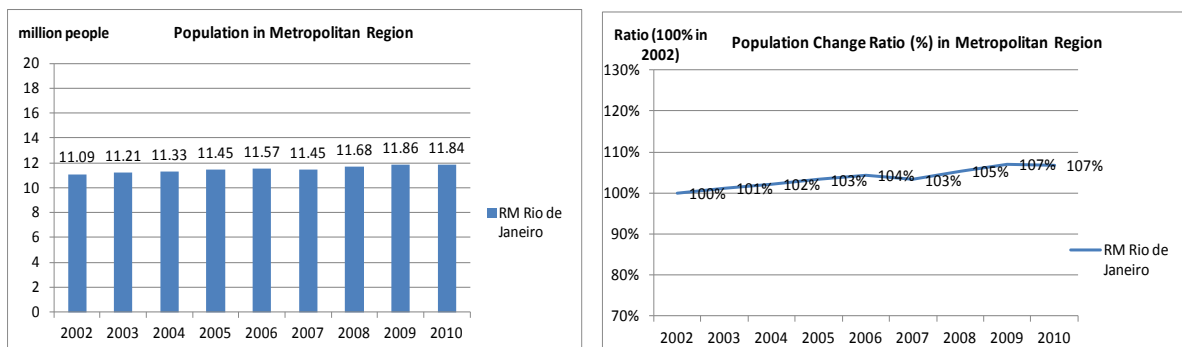
i) **Trend**

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.

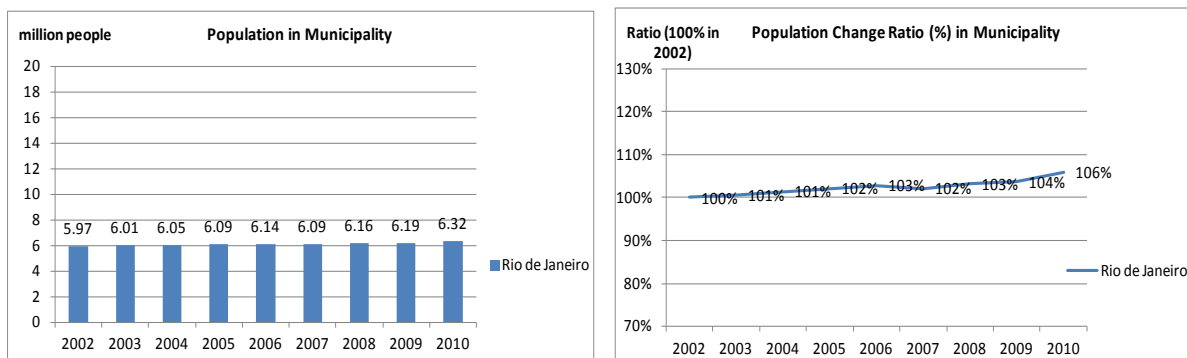
[State]



[Metropolitan Region]



[Municipality]

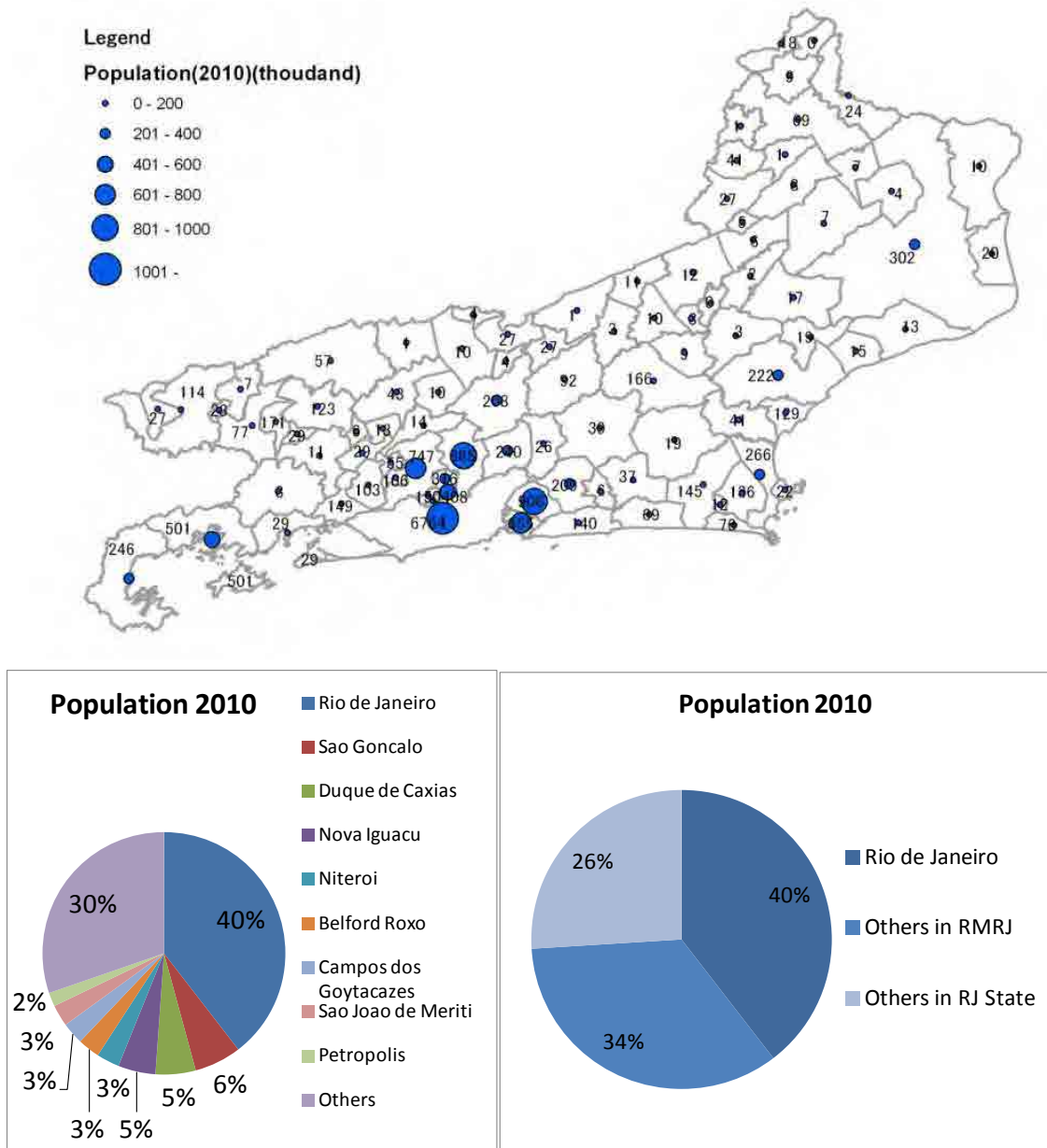


Source: IBGE

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.

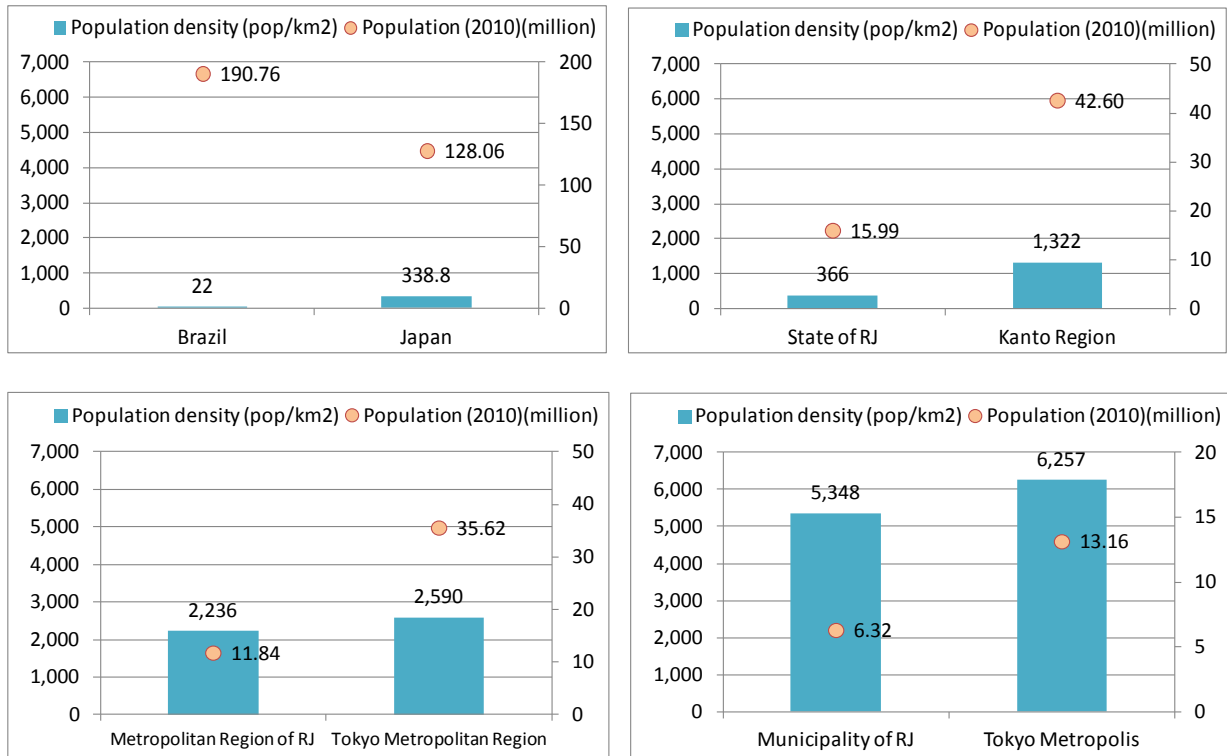


Source: IBGE, Figure is made by the JICA Study Team

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.



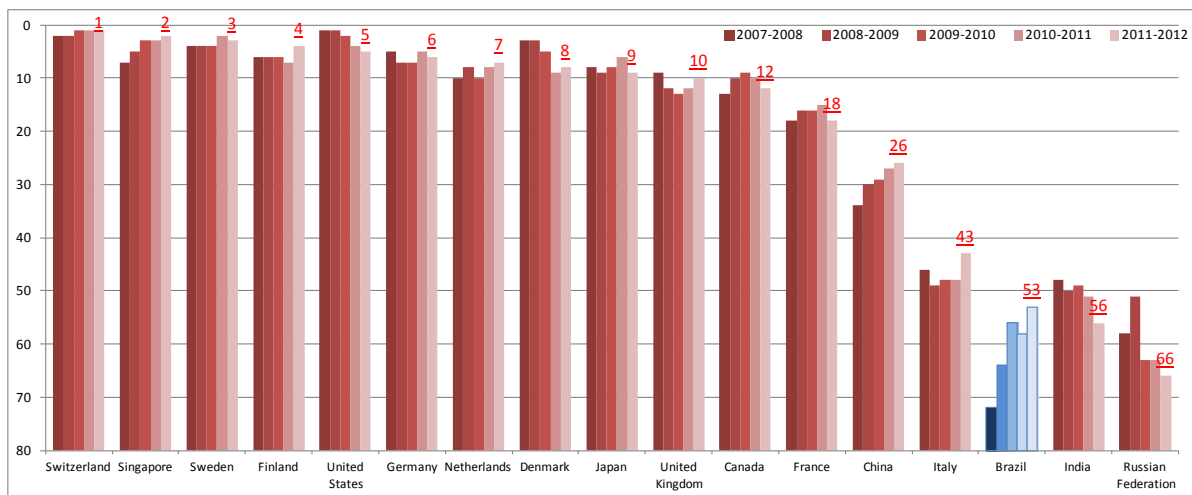
Source: IBGE, Statistics Bureau of Japan

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).

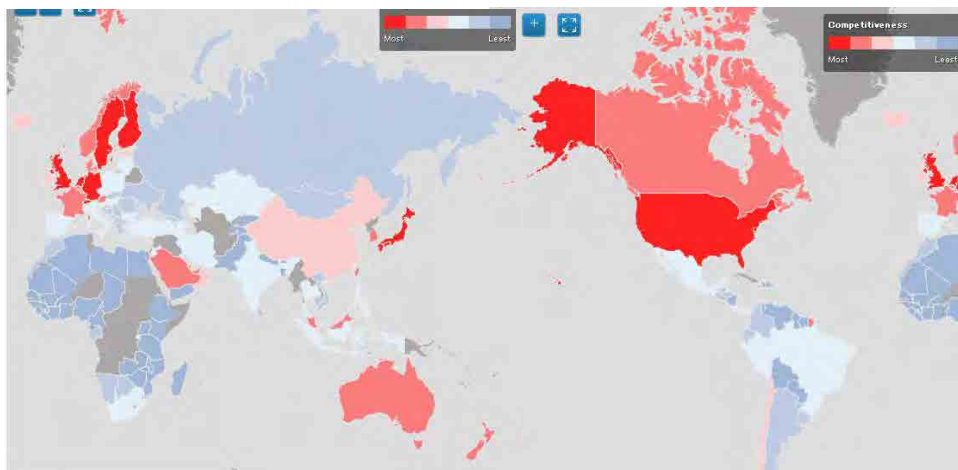


Source: The Global Competitiveness Report (World Economic Forum)

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.

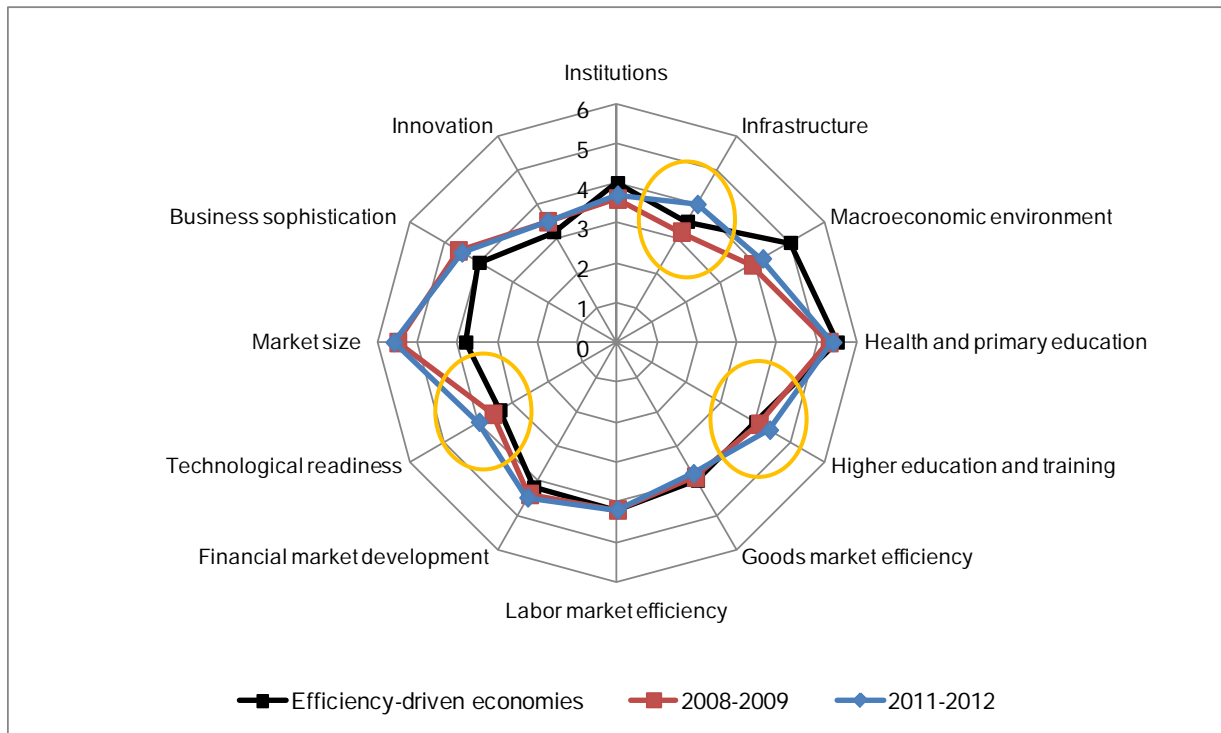


<http://www.weforum.org/issues/global-competitiveness>

(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]



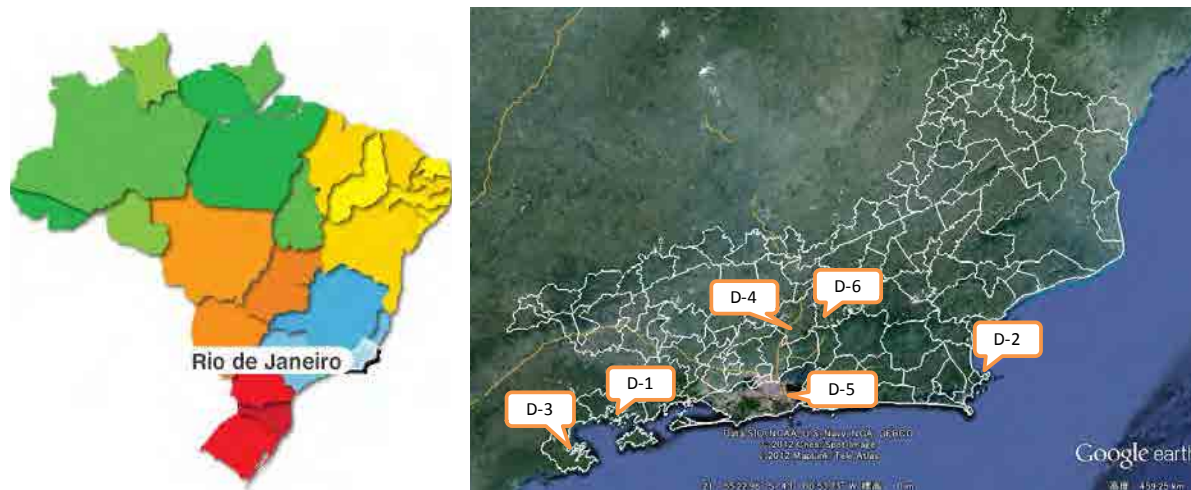
Source: The Global Competitiveness Report (World Economic Forum)

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 Botânico (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 | Estádio 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

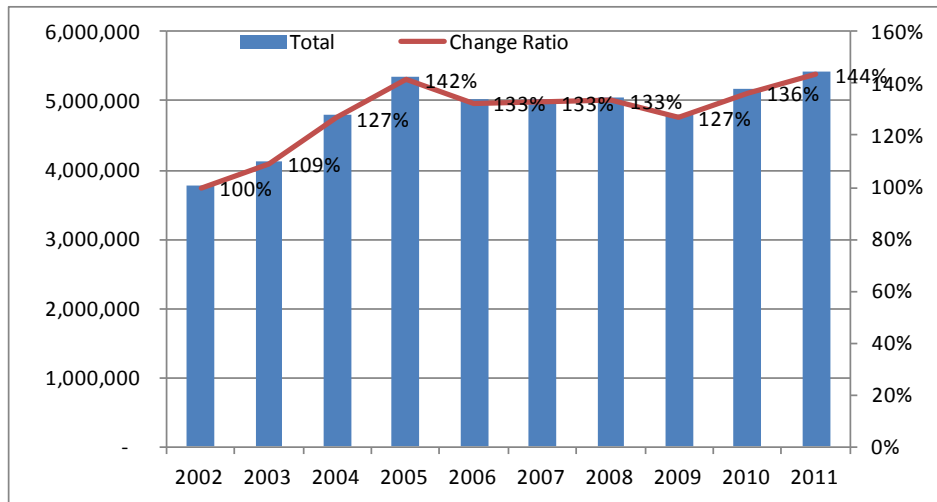
Figure 2-20 Main Sightseeing Locations in the City of Rio de Janeiro

(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.

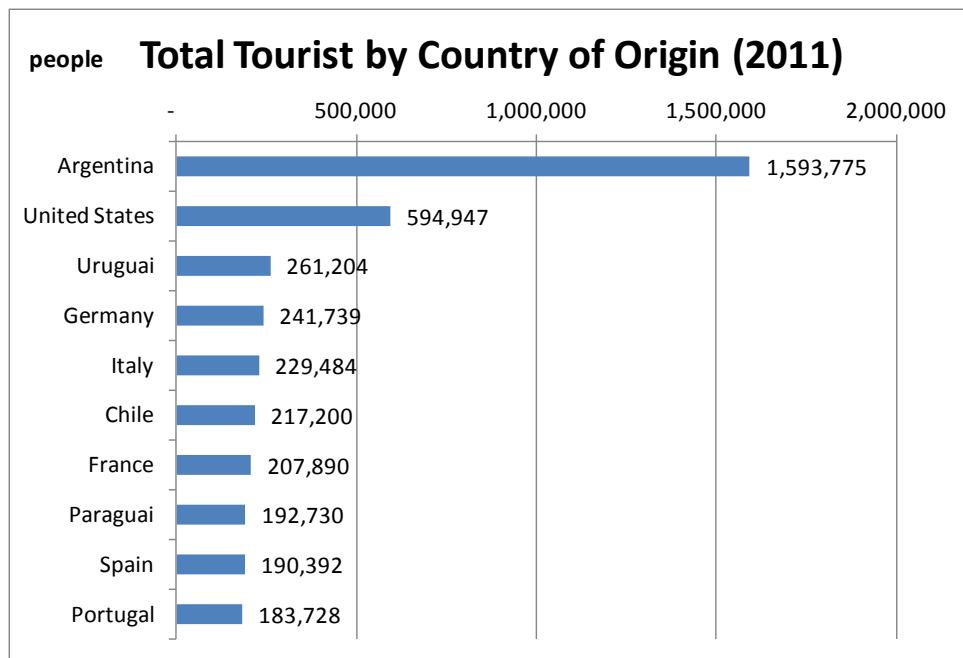


Source: Ministério do Turismo

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.

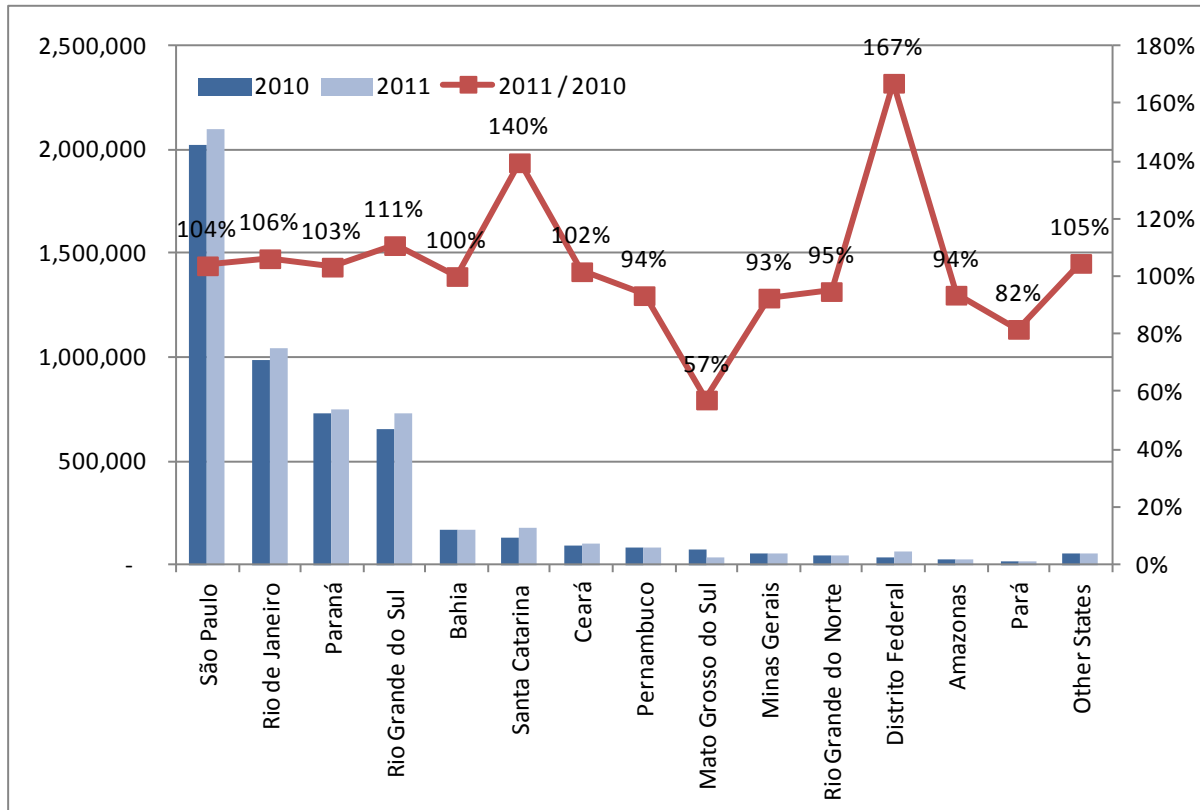


Source: Ministério do Turismo

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.



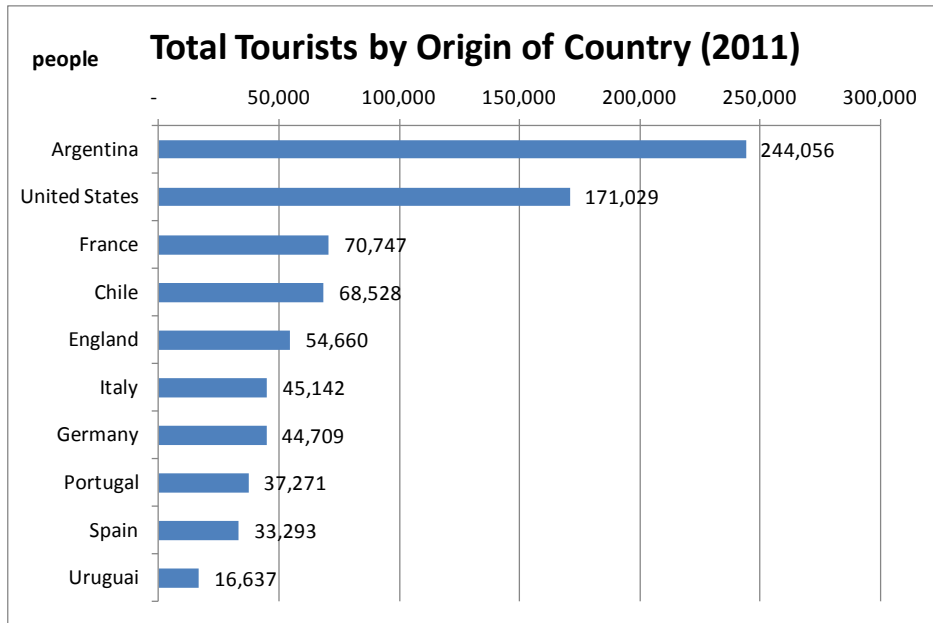
Source: Ministério do Turismo

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.

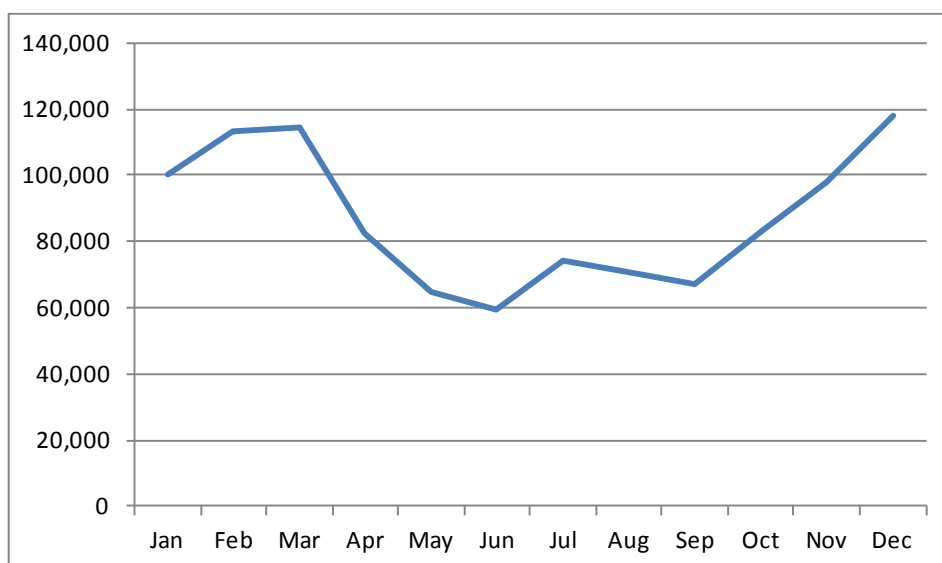


Source: Ministério do Turismo

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.

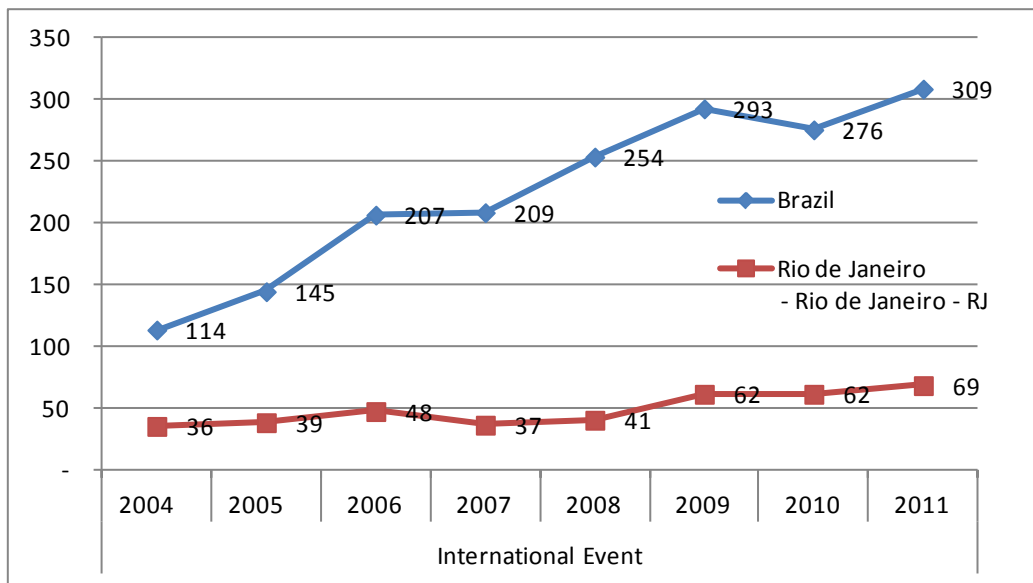


Source: Ministério do Turismo

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 (Réveillon 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 Réveillon (<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 |

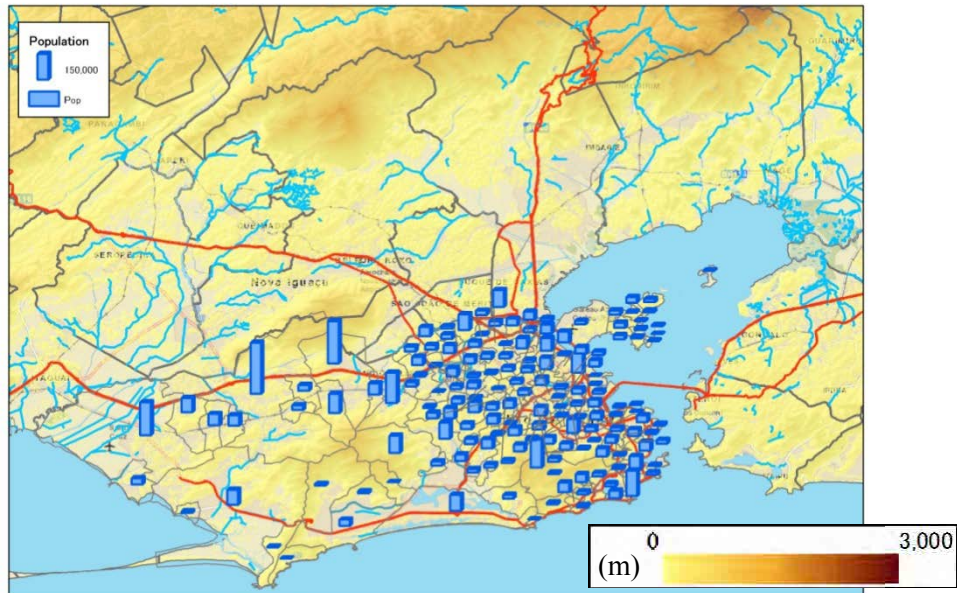
Source: Transport Strategic Plan for the Rio 2016 Olympic and Paralympic Games

(5) Geographic Conditions

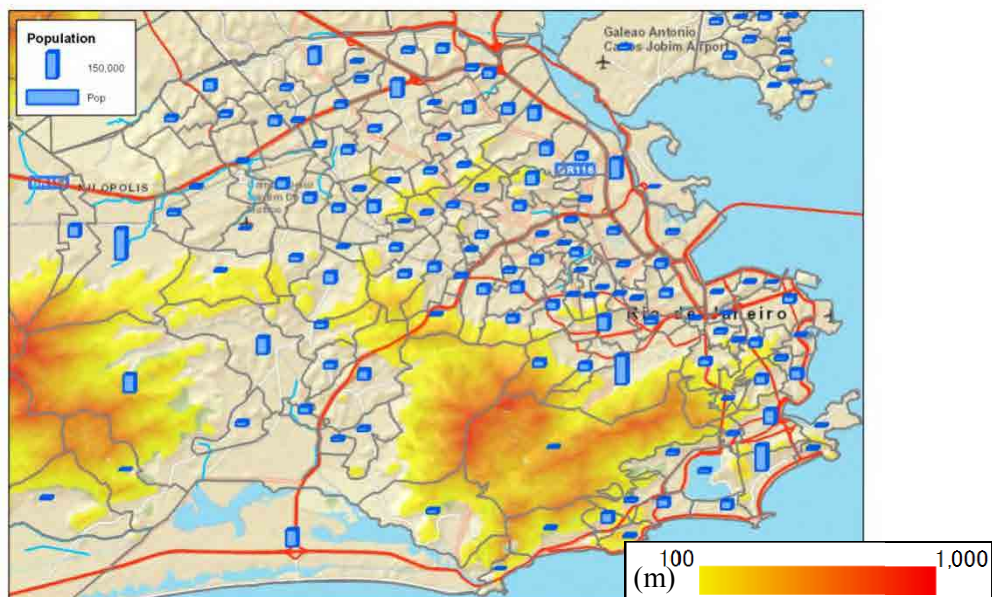
1) Hills and Rivers

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/>)

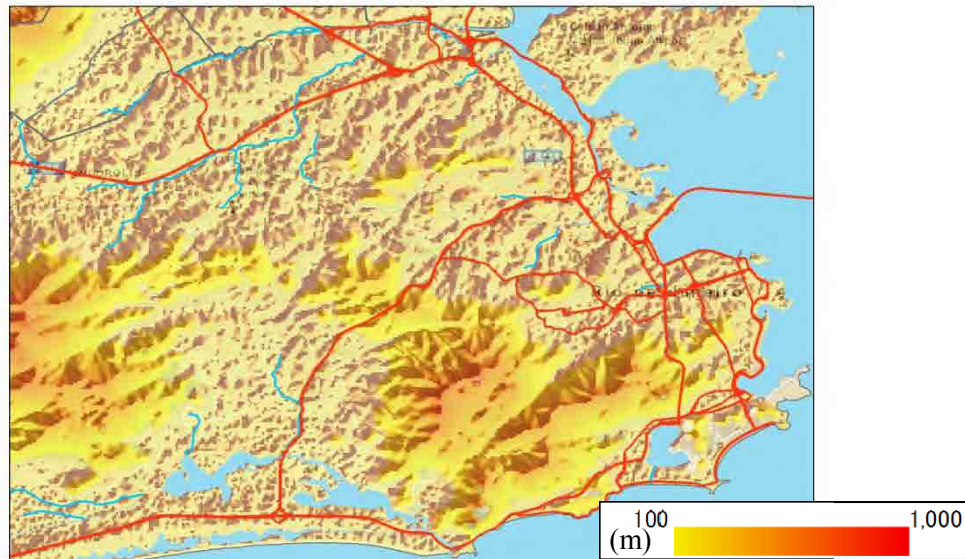
Population data were prepared based on the data provided by SMTR

Figure 2-27 Contours in Rio de Janeiro

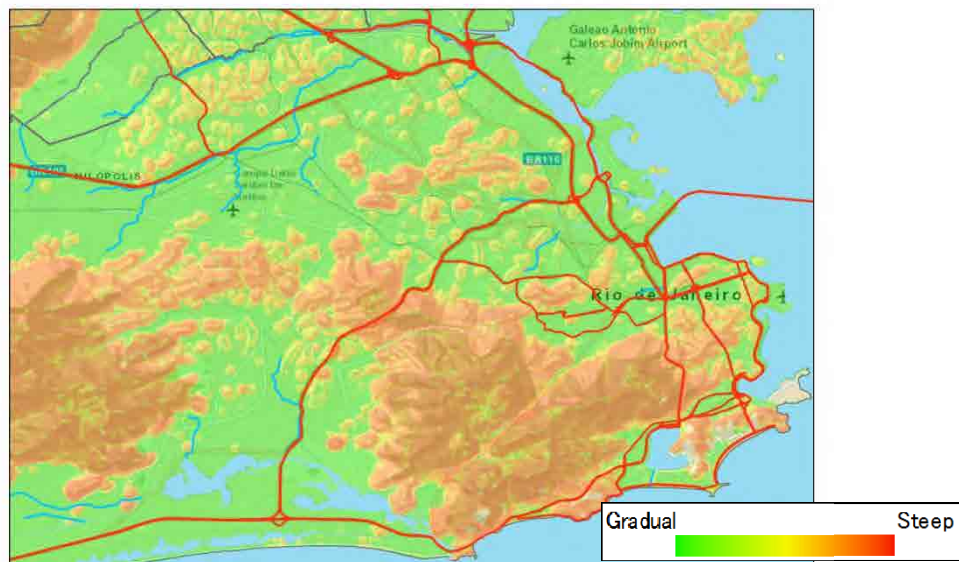
2) Topological Features in Central Rio

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]



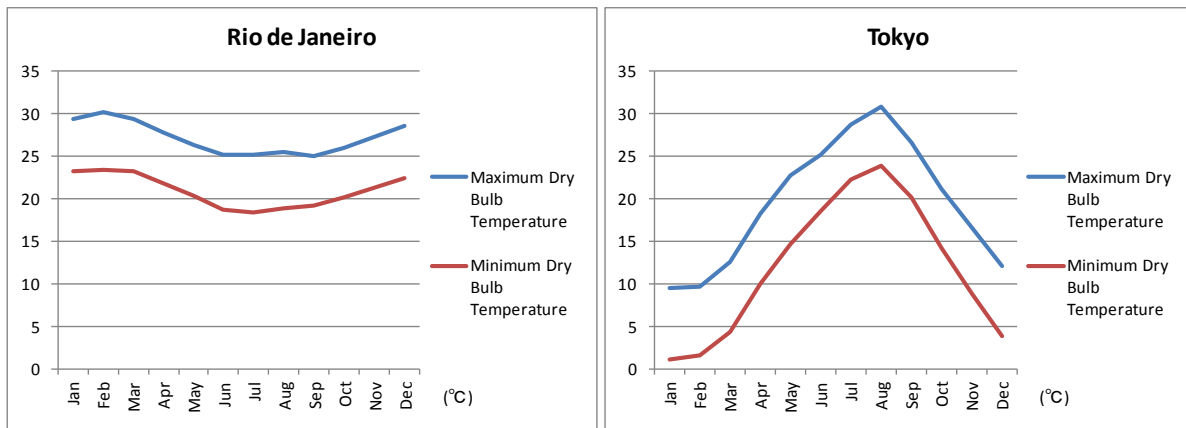
Source: Shuttle Radar Topography Mission (SRTM) (<http://www2.jpl.nasa.gov/srtm/>)

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.

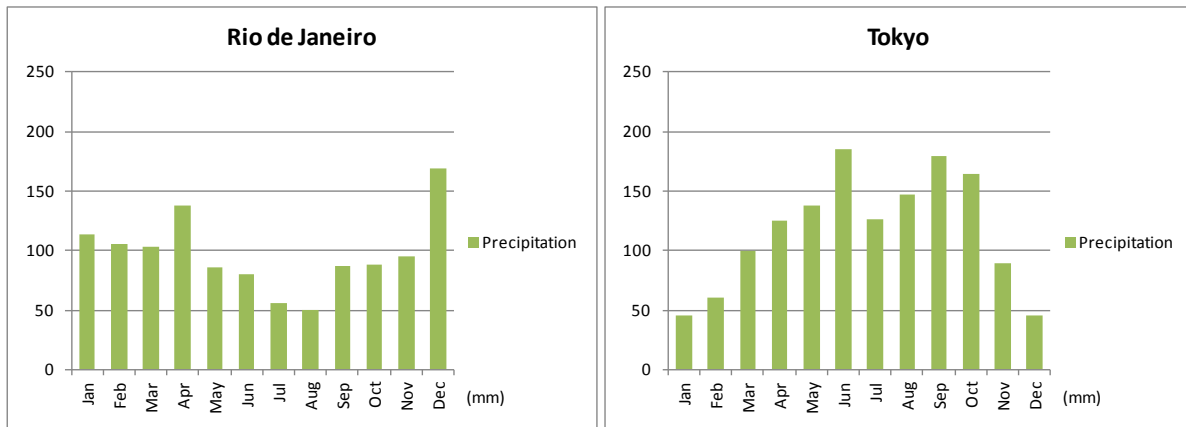
[Temperature]



Source: UNdata (United Nations Statistics Division)

Figure 2-29 Temperatures in Rio de Janeiro and Tokyo

[Precipitation]



Source: UNdata (United Nations Statistics Division)

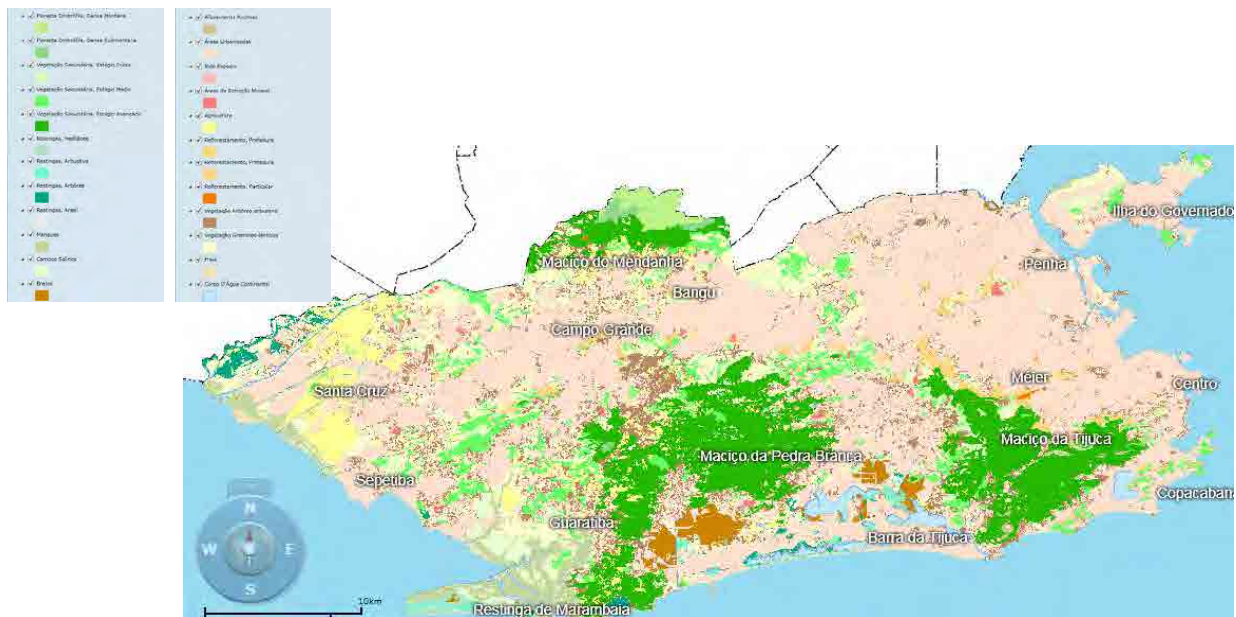
Figure 2-30 Precipitation Comparison in Rio de Janeiro and Tokyo

(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 |
| 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 |
| 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

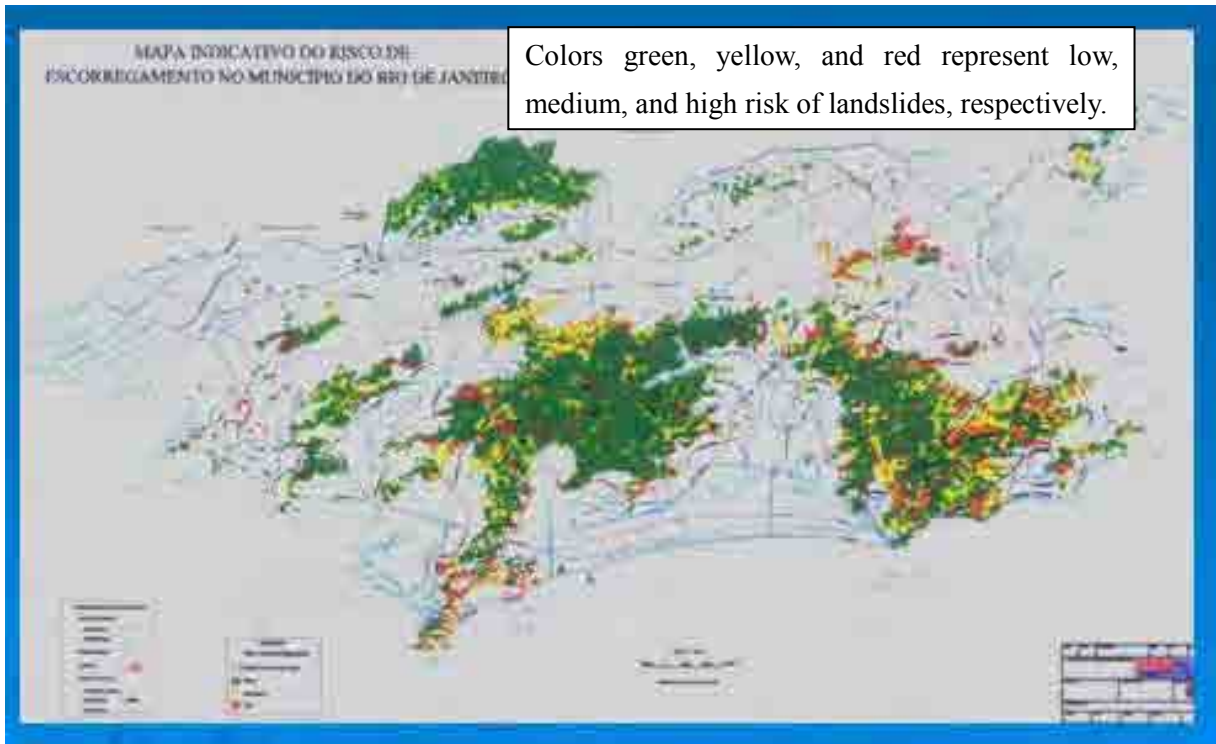
Occurrence of widespread landslides (triggered by heavy rains on natural and artificial embankments, especially routes that cut upland).

ii) **Probability of Landslides in Rio de Janeiro**

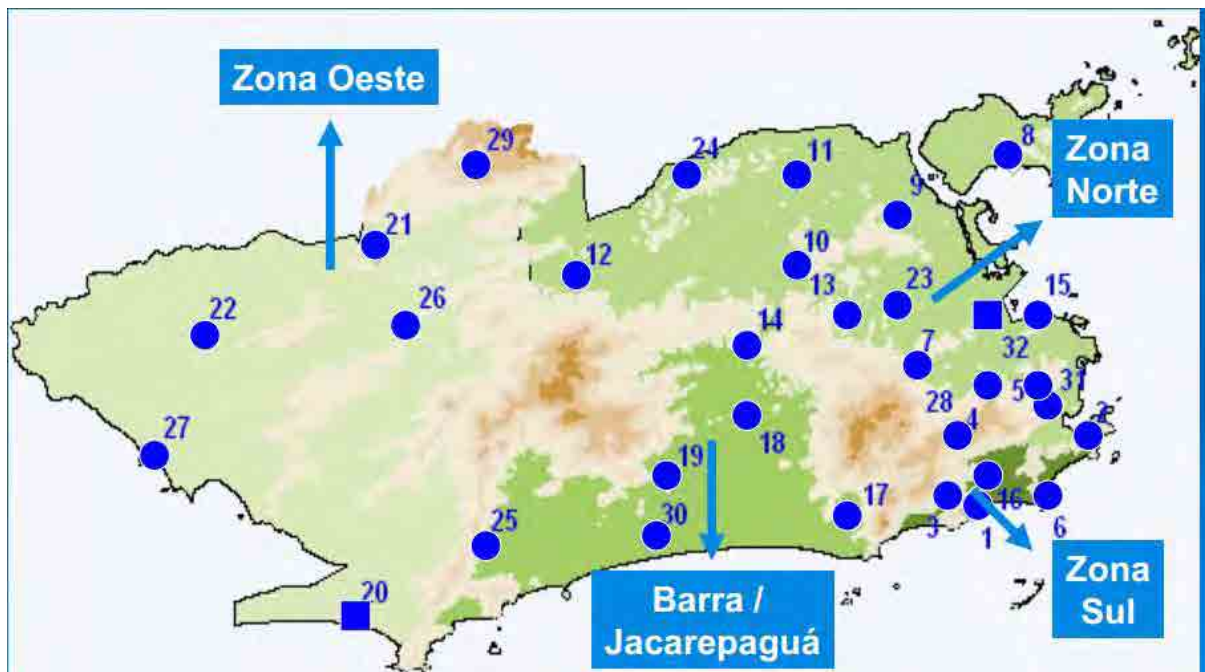
The probability of landslide estimated by Geo-Rio is based on the relationship between the rain fall and the risk of landslide.

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

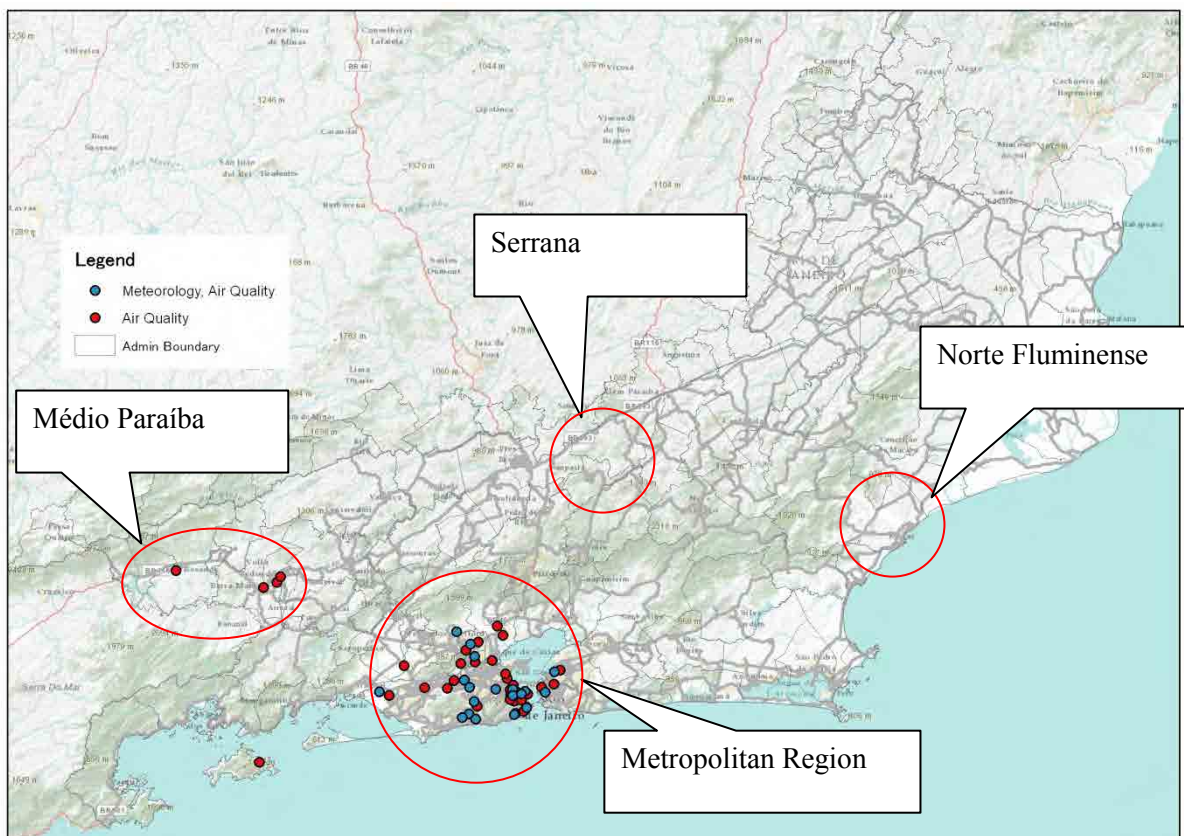
(9) Air Quality

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 Cecília | O3 | Regular |
| Metropolitan Region – 03/10/2012 | | |
| Duque de Caxias – Sao Bento | PM10 | Bom |
| Itaguaí – Monte Serrat | O3 | Bom |
| Jacarepagua | PM10 | Bom |
| Japeri | O3 | Regular |
| Niterói – Icarai | SO2 | Bom |
| Nova Iguaçu | O3 | Bom |
| Recreio dos Bandeirantes | O3 | Bom |
| Santa Cruz | O3 | Regular |
| Norte Fluminense – 03/10/2012 | | |
| Macaé – 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)

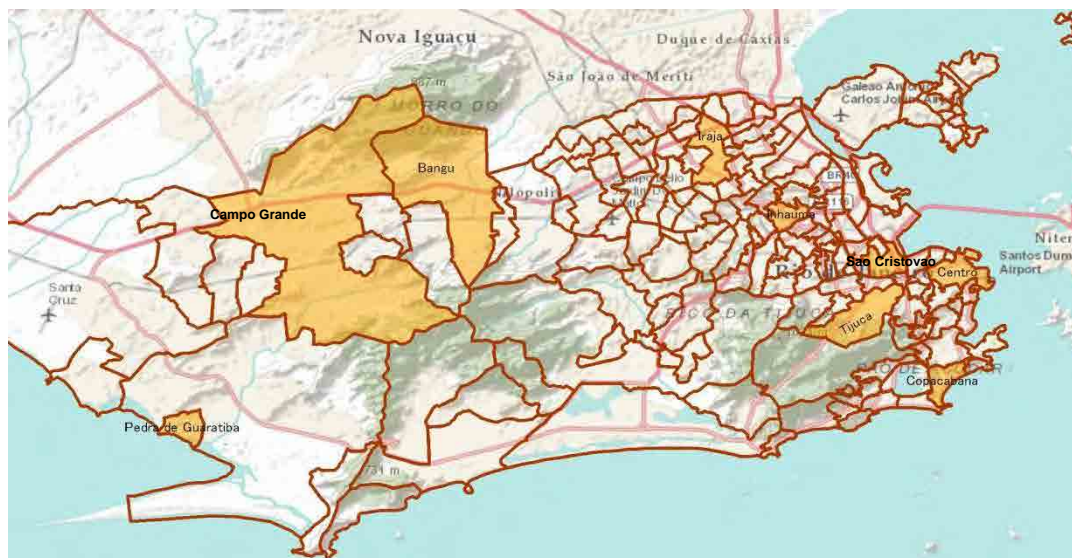
In the cities, the Municipal Secretariat of the Environment (*Secretaria Municipal de Meio Ambiente*: SMAC) is in charge of monitoring air quality. This organization is the central organization of the municipal environmental management system.

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 | MA |
| | 1601 - 2100 | 30,1 - 40 | 421 - 500 | 801 - 1000 | 2261 - 3000 | > 300 | PESSIMA |
| 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. | | | | | | |
| MA | 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. | | | | | | |
| PESSIMA | 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.

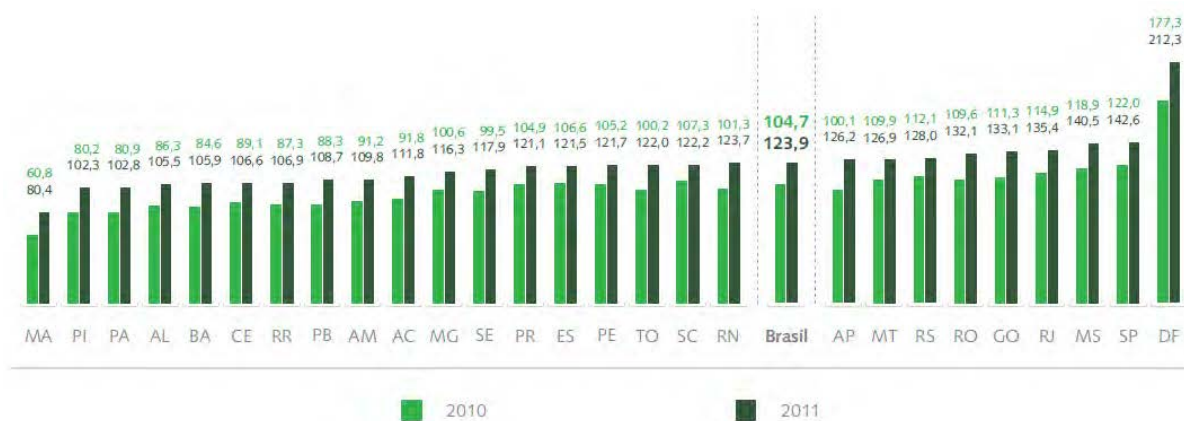


Source: ANATEL

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

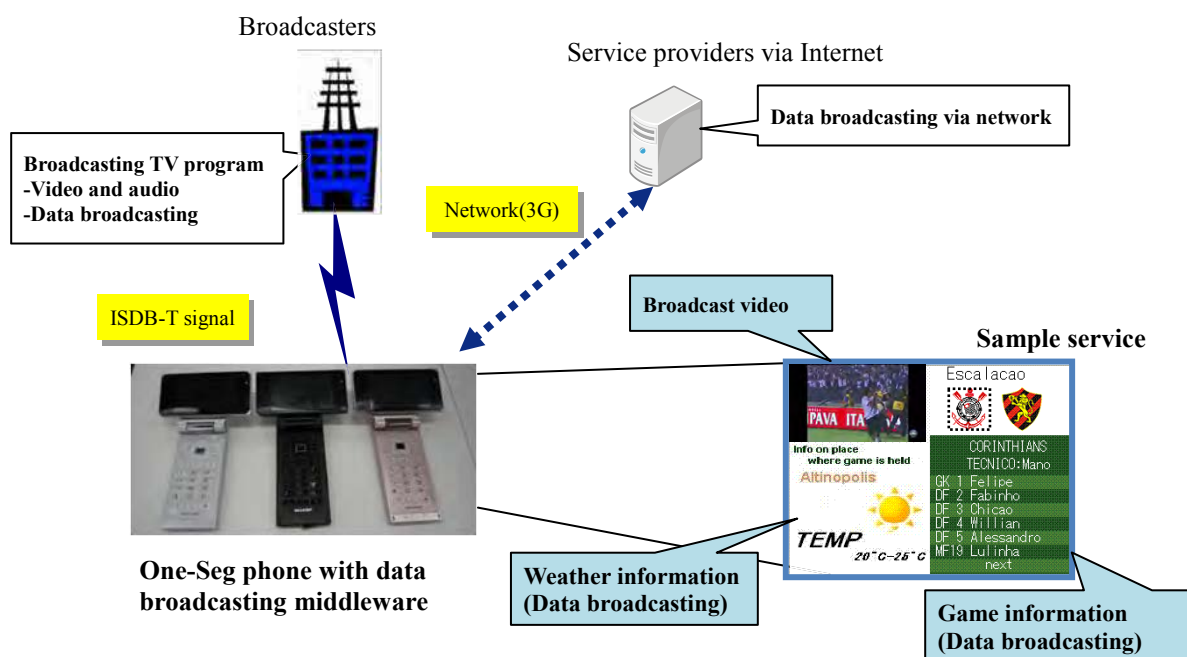
-Experiment project for data broadcasting -

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.



Video and images by ©Globo Comunicações e Participações S.A. All rights reserved.

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 Comunicação 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.

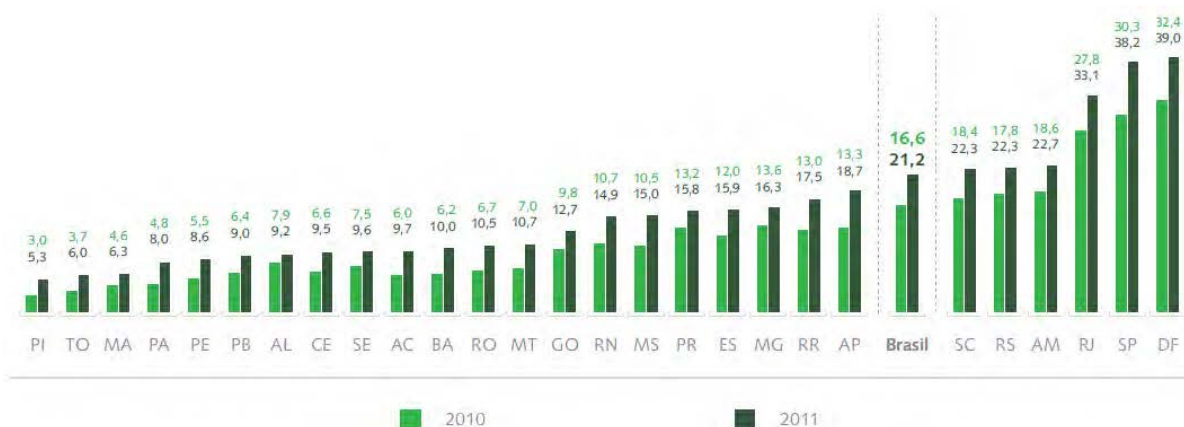
As a result of this growth, 21.2% of households were served by the service by the end of 2011, and the chart below shows the evolution of the number of signatures in recent years.



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.

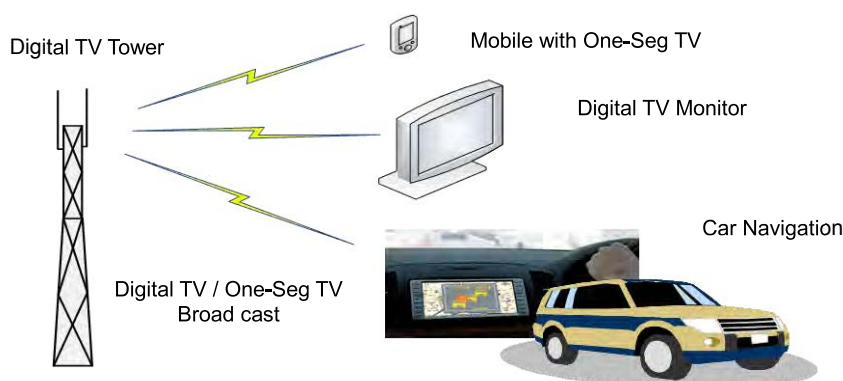
- Digital TV -

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

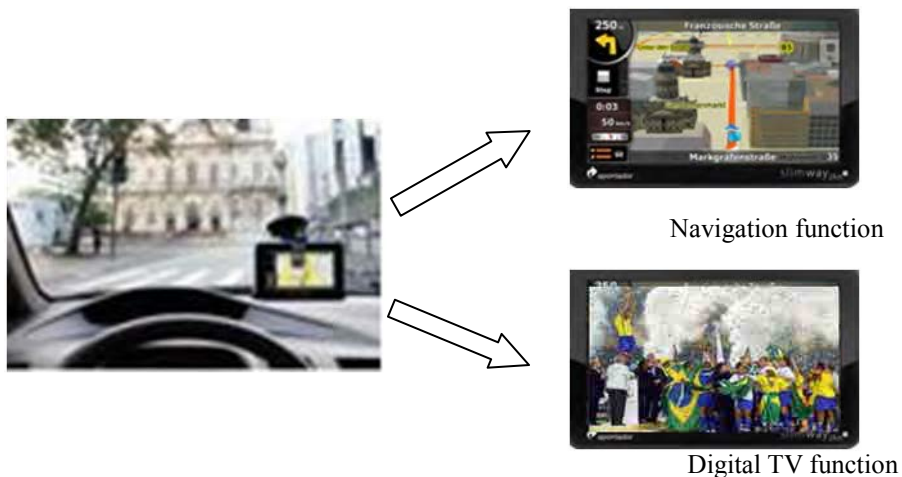
Figure 2-48 Digital TV Broadcasting Image

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.



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).

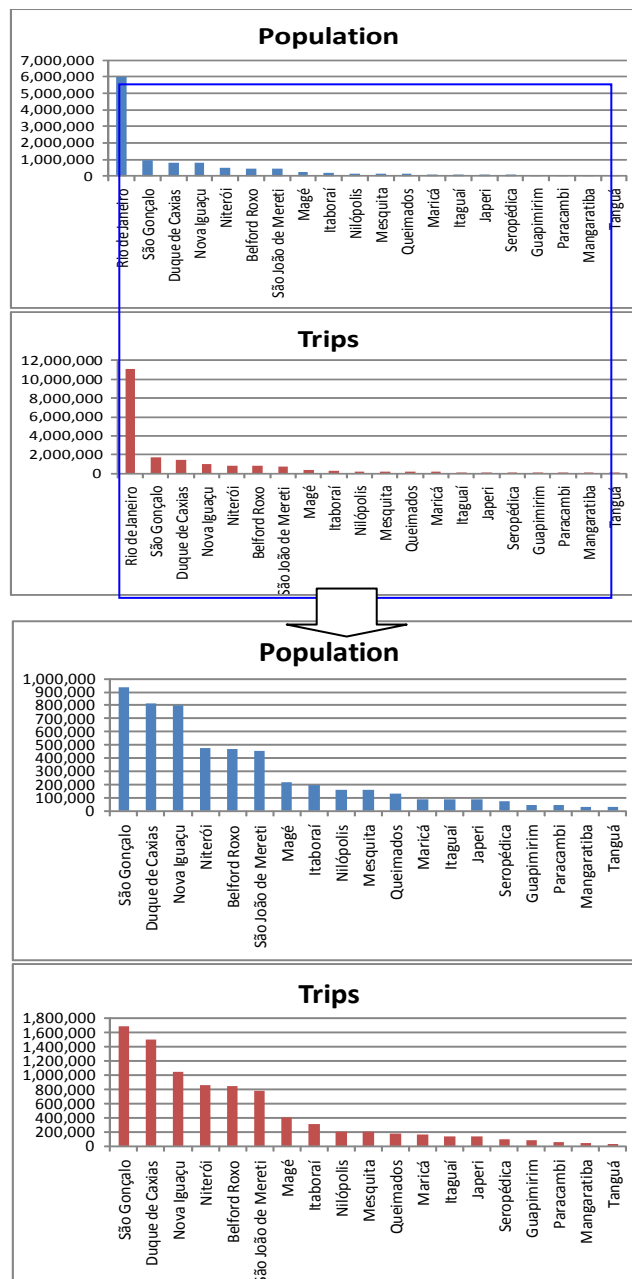
2.2 TRAFFIC/TRANSPORTATION CHARACTERISTICS IN RIO DE JANEIRO

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]



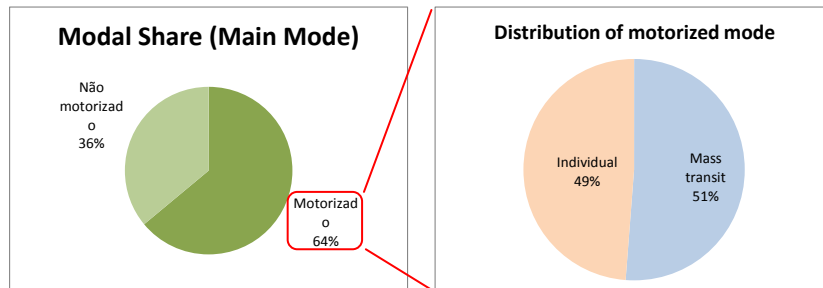
Source: PDTU/RJ 2005

[City of Rio (Origin)]



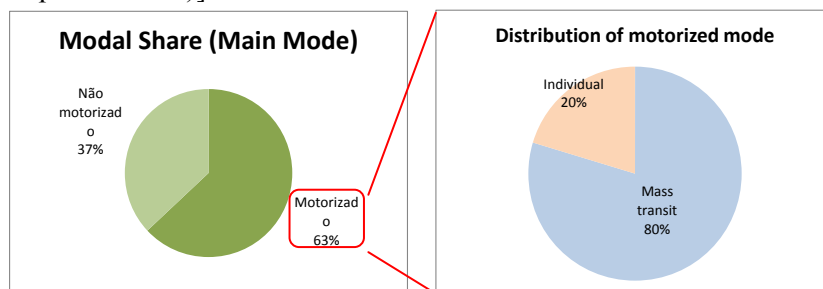
Source: PDTU/RJ 2005

[Tokyo Metropolitan Region]



Source: Tokyo Metropolitan Person Trip Survey

[Central Tokyo (23 special wards)]

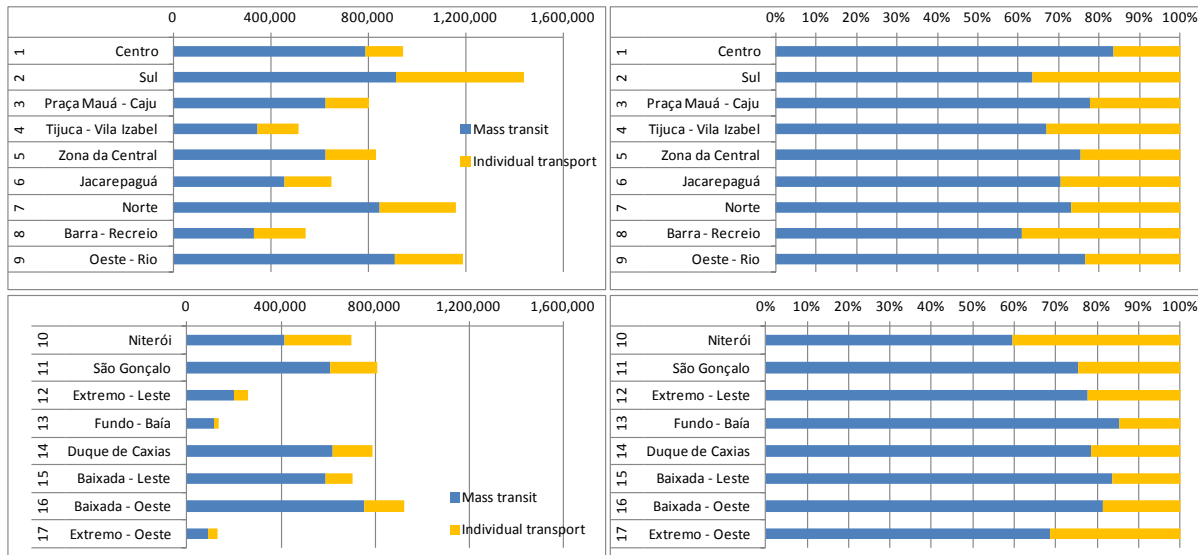


Source: Tokyo Metropolitan Person Trip Survey

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)]



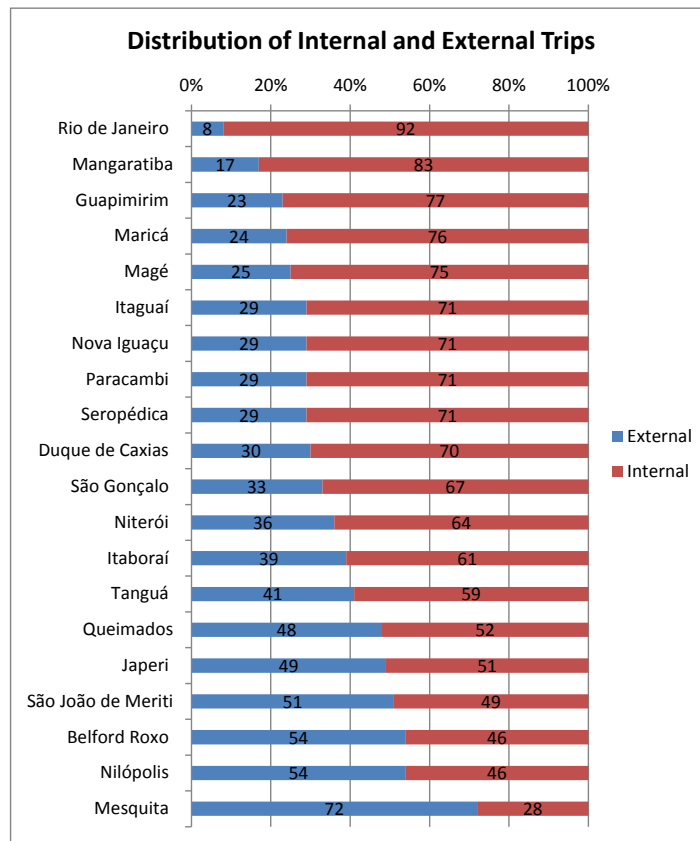
Source: PDTU/RJ 2005

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)]



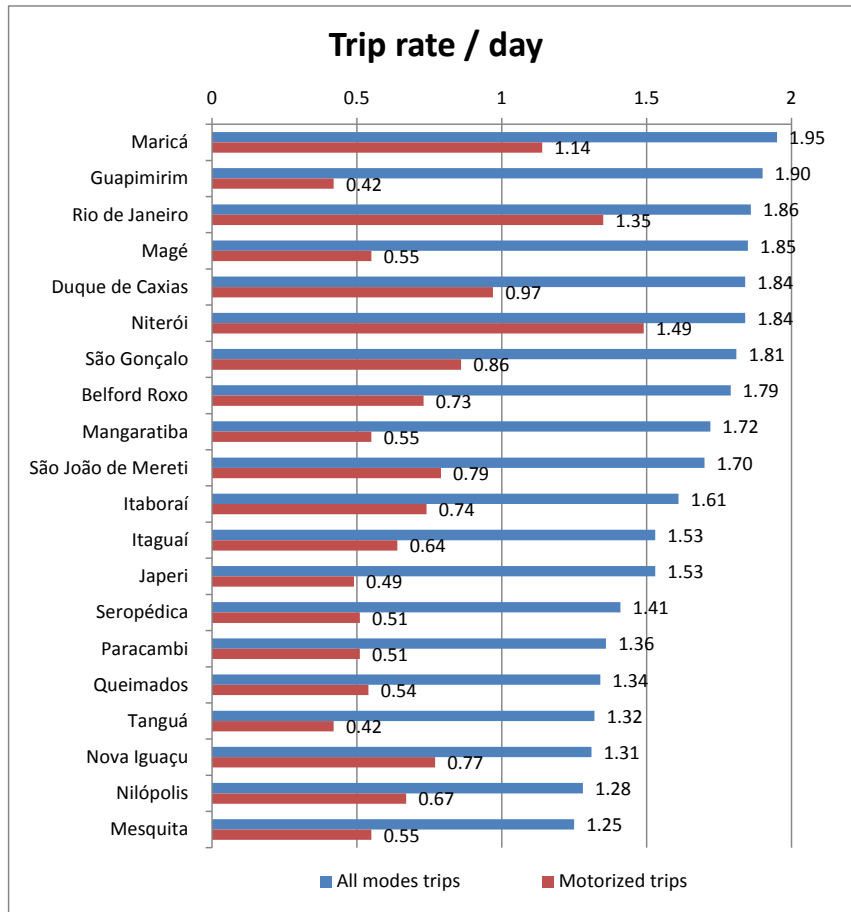
Source: PDTU/RJ 2005

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]



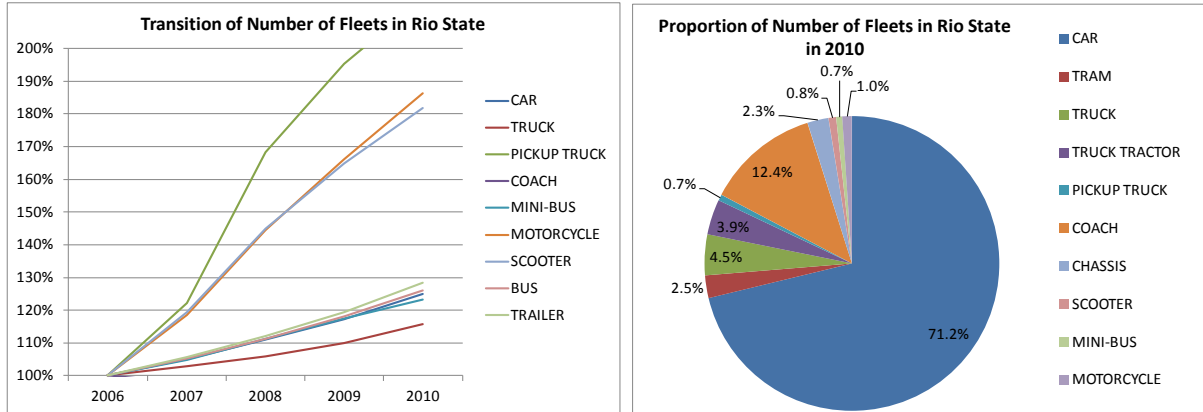
Source: PDTU/RJ 2005

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

(2) Number of Fleet

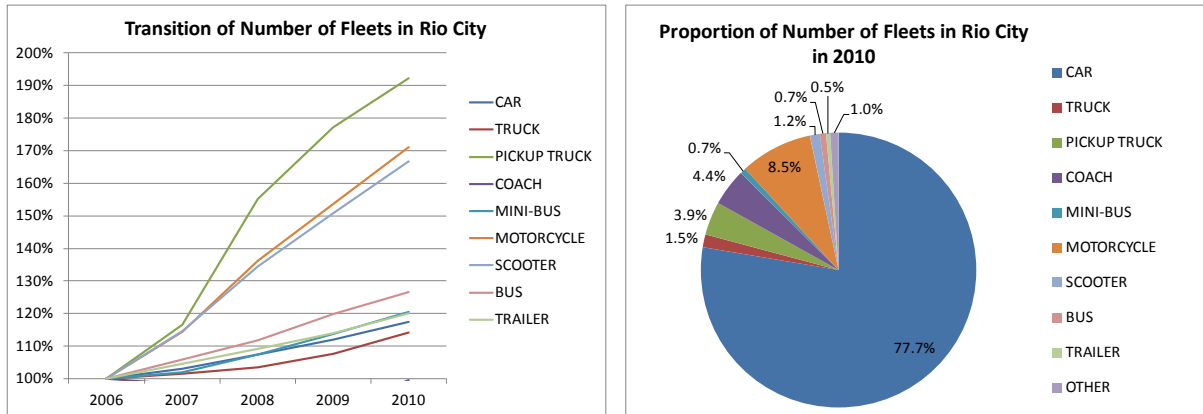
The number of fleets has increased in the last five years. The increased rates in RMRJ are higher than in RJ.

[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 Government 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.

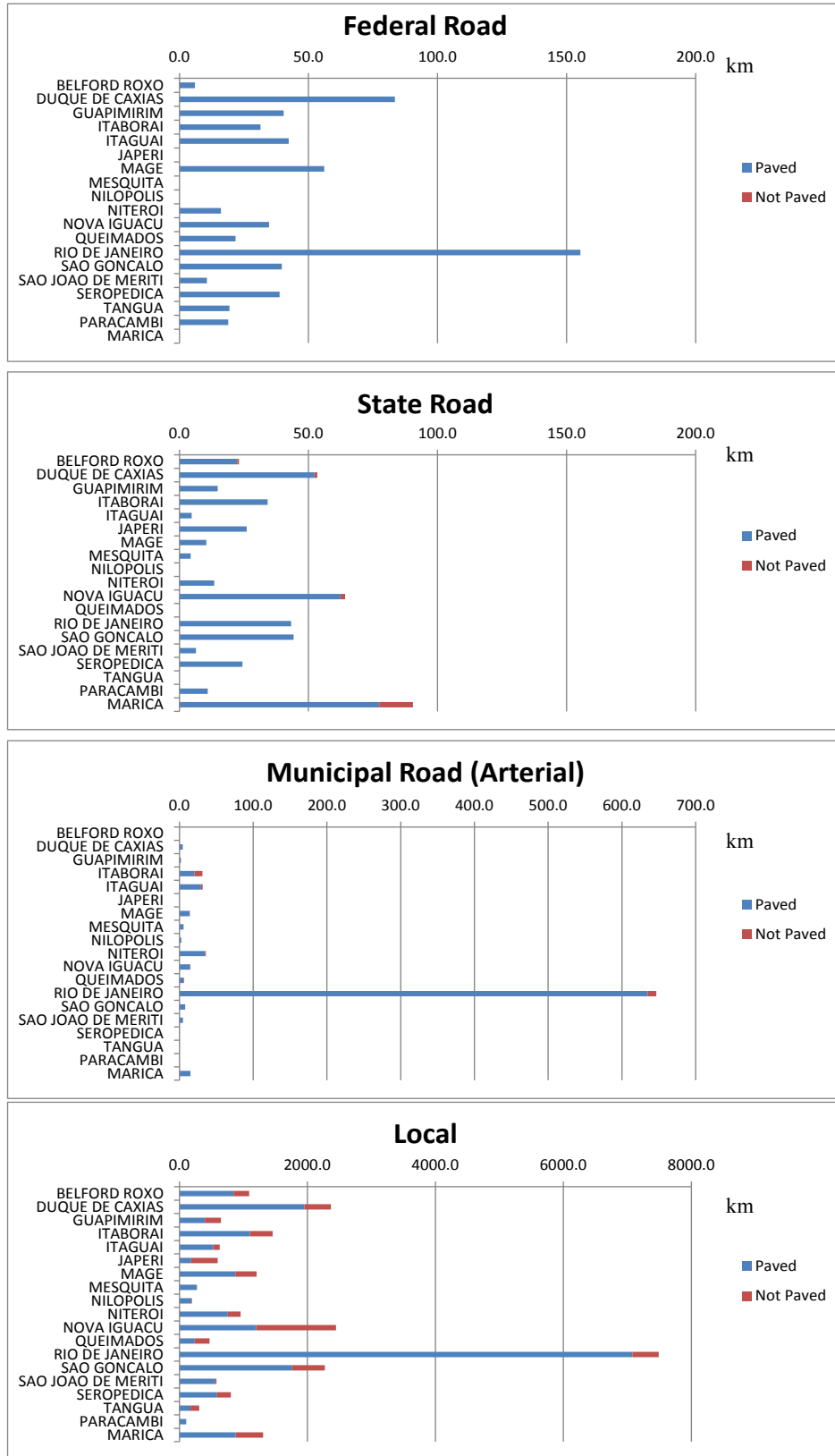
Table 2-13 Length of Roads in the Metropolitan Region of Rio de Janeiro

| 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]



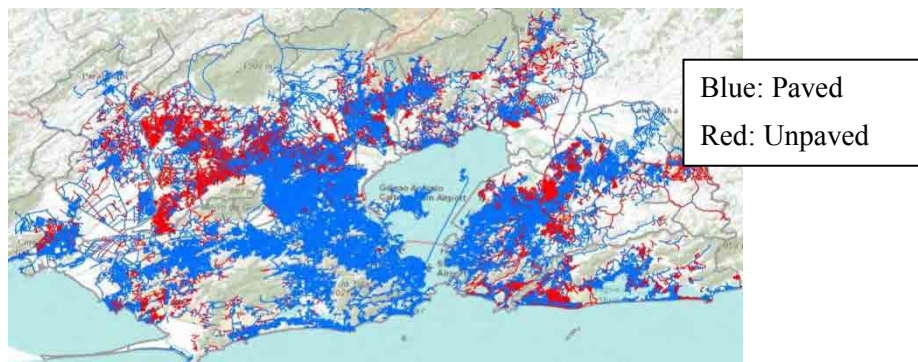
[State road]



[Municipality road (Arterial)]



[Local road]

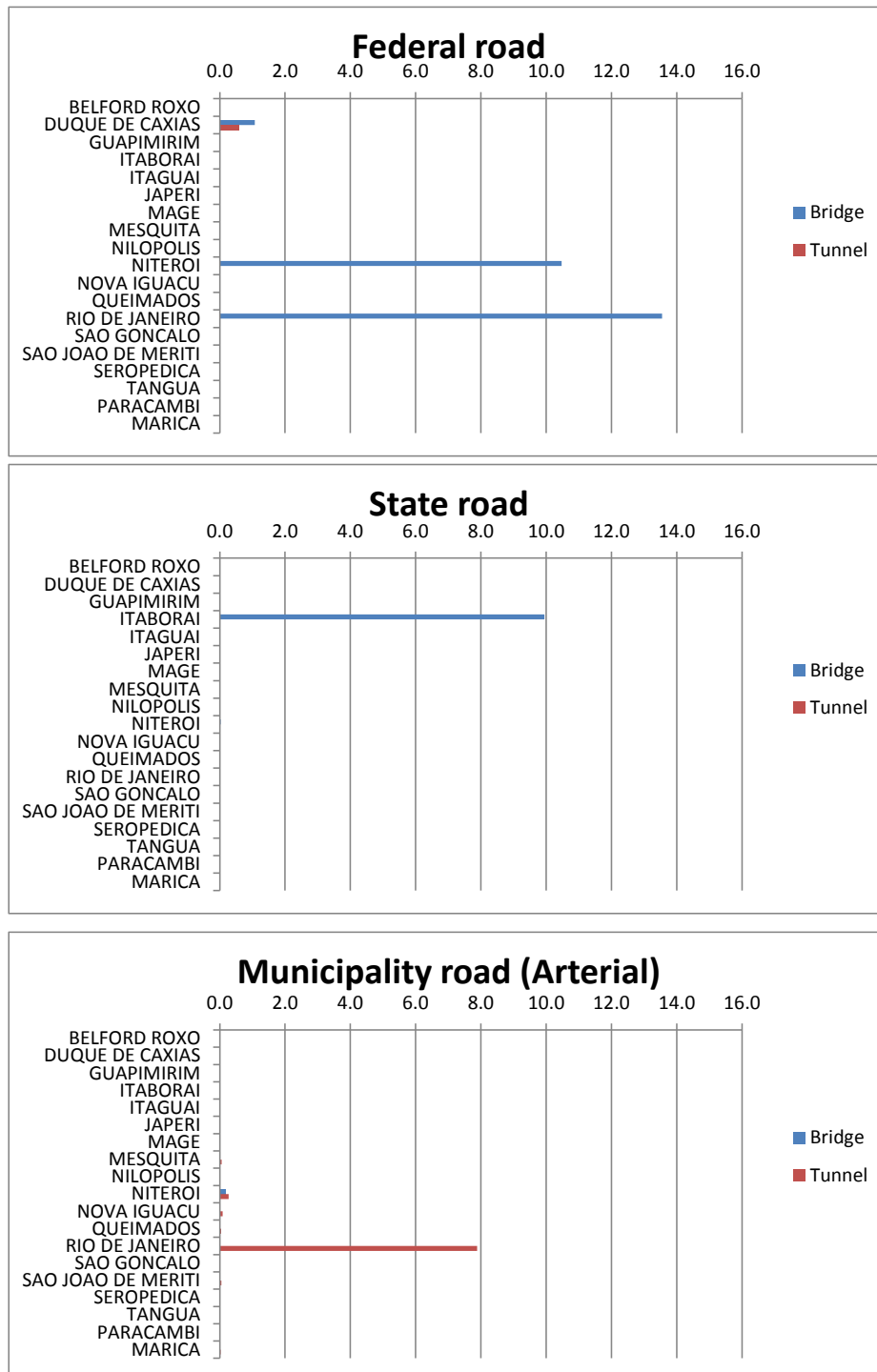


Source: Navteq Data

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.

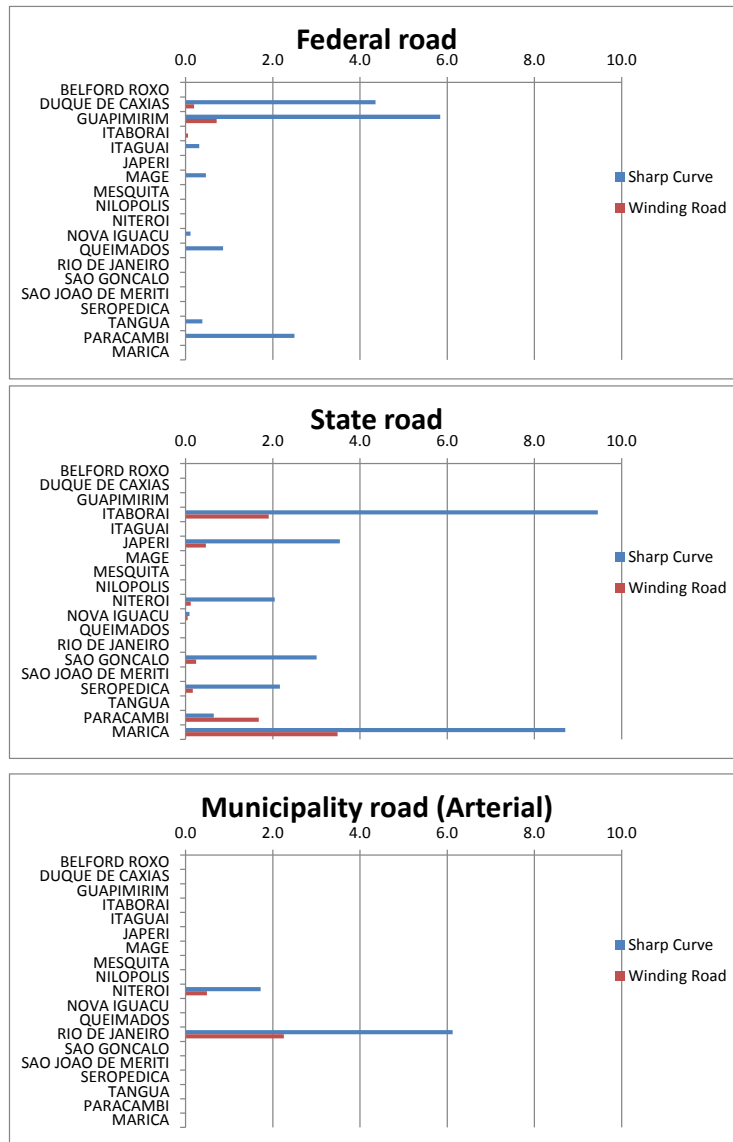


Figure 2-62 Location of Traffic Sign for “Sharp Curve” and “Winding Road” in the Metropolitan Region of Rio de Janeiro

(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 | 15.4 | 107.2 |
| | | RJ-103 | 42.4 | |
| | | RJ-113 | 14.4 | |
| | | RJ-115 | 21.0 | |
| | | RJ-125 | 14.2 | |
| Rio City | - | - | - | |
| Other Municipalities | 3 | Mage, Itaboraí, Niterói | 8.9 | |

Source: DER - RJ Road Map



Source: JICA Study Team

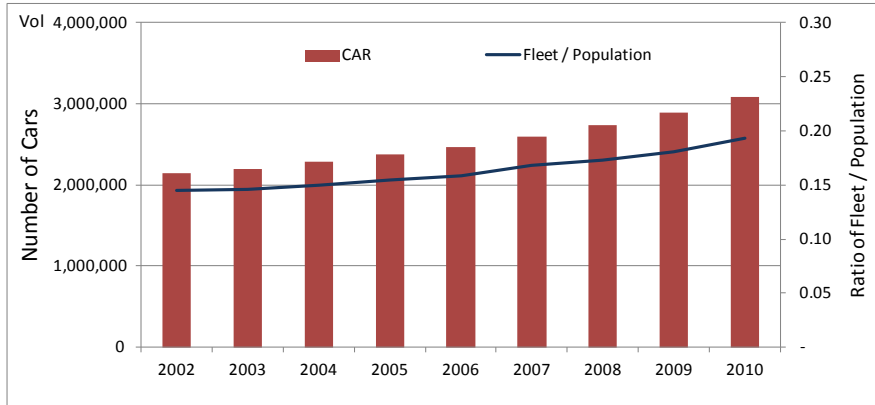
Figure 2-63 Planned Road Network in RMRJ

(3) Traffic Volume

1) Number of Cars

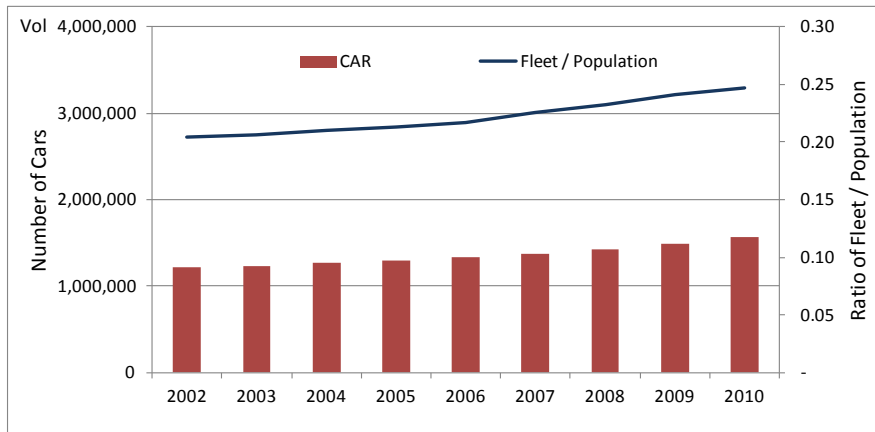
The number of cars in Rio de Janeiro has been increasing, but the number of cars per population is still low compared with industrial countries.

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



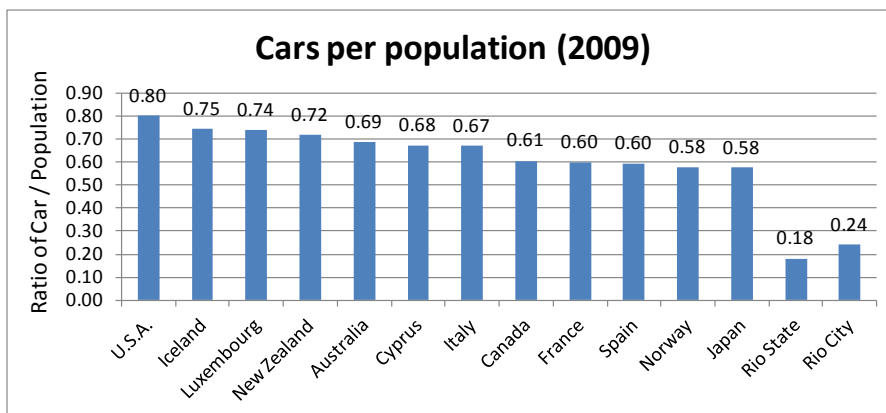
Source: DENATRAN

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



Source: DENATRAN

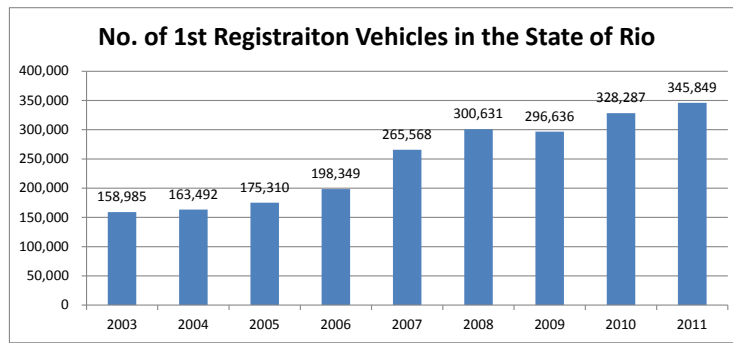
[Number of cars/population in the world]



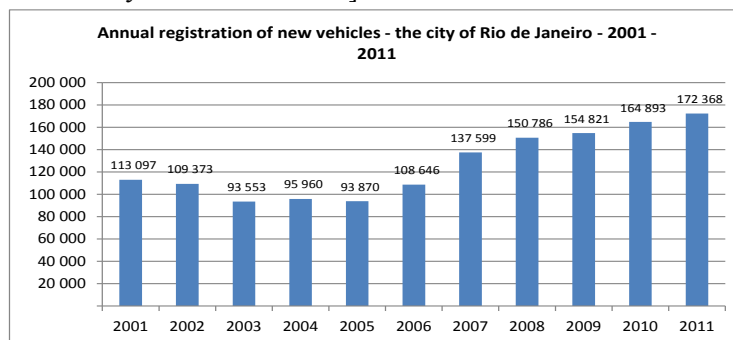
Source: Statistics Bureau of Japan

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

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



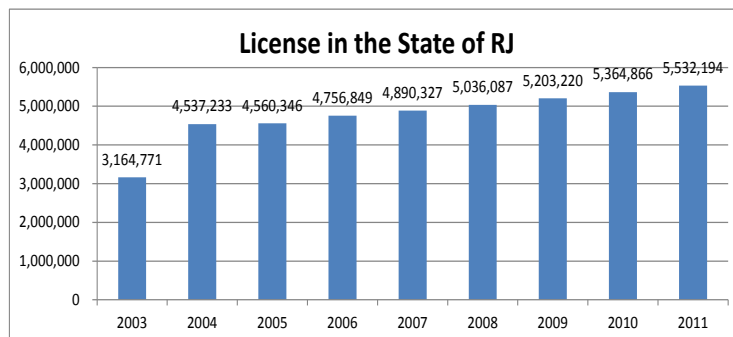
[New car registration in the city of Rio de Janeiro]



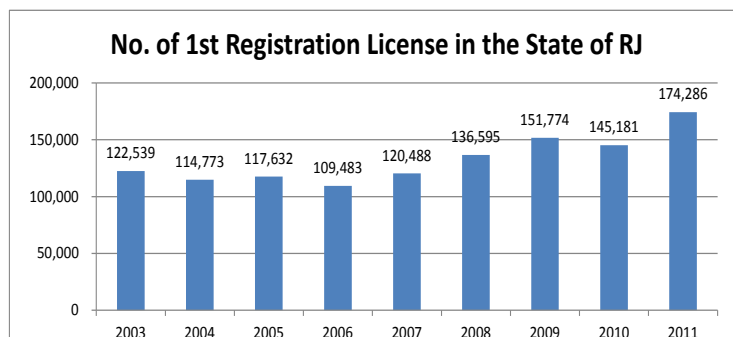
Source: DETRAN - RJ

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

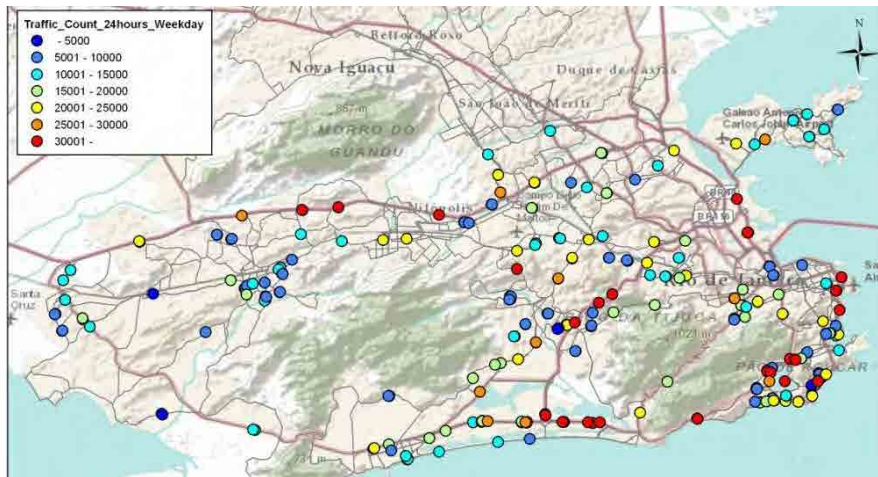
2) Traffic Count Data

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.

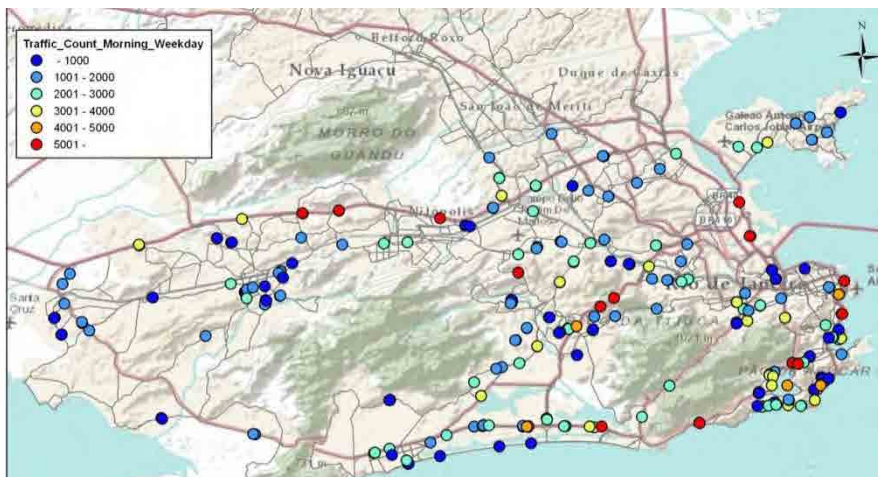
Traffic volume for 24 hours (7:00 a.m.–7:00 a.m.), morning peak (7:00 a.m.– 9:00 a.m.), and evening peak (5:00 p.m.– 7:00 p.m.) from the average weekday traffic volume data in May 2012 is shown in Figure 2-67.

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.

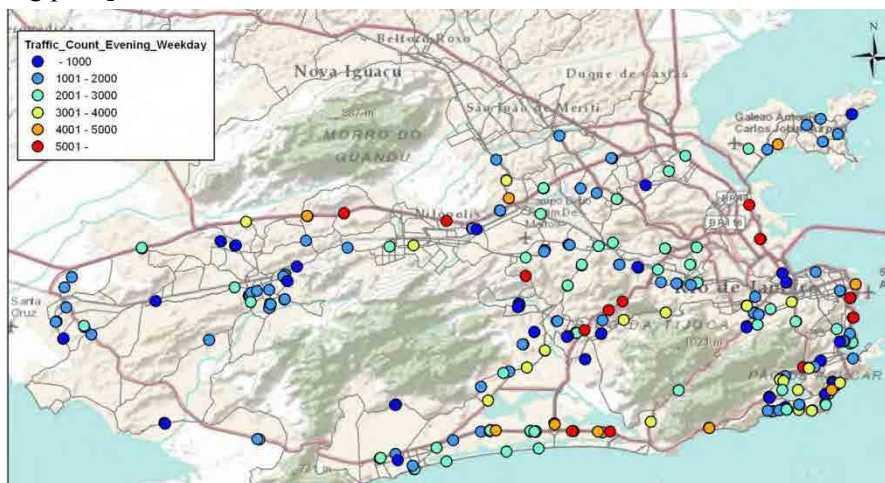
[Weekday 24 hours]



[Weekday morning peak]



[Weekday evening peak]



Source: JICA Study Team

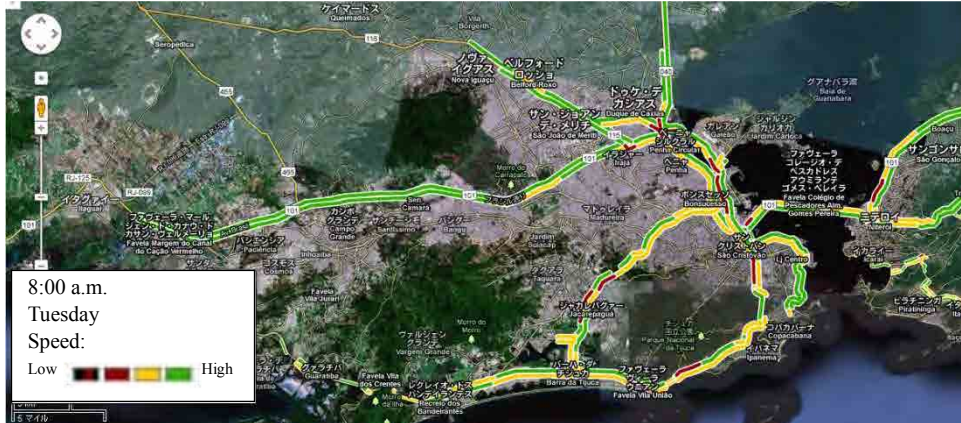
Figure 2-67 Traffic Volume

(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)]

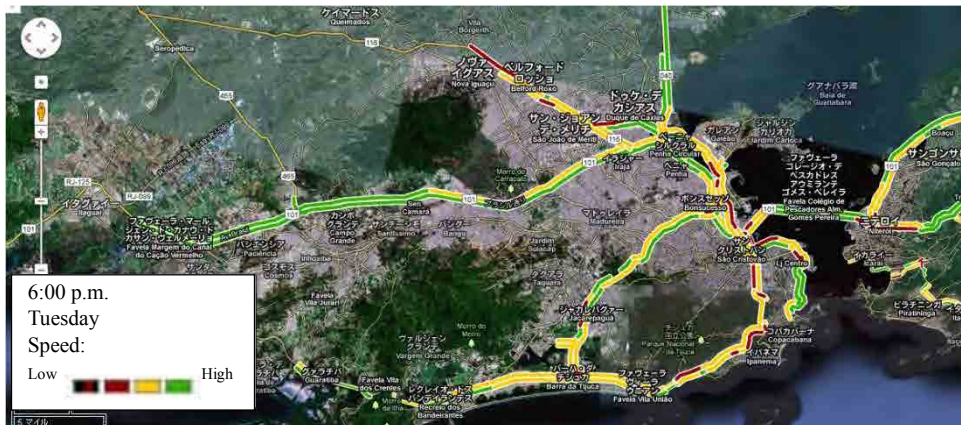
Tuesday 8:00 a.m.



Tuesday 2:00 p.m.



Tuesday 6:00 p.m.



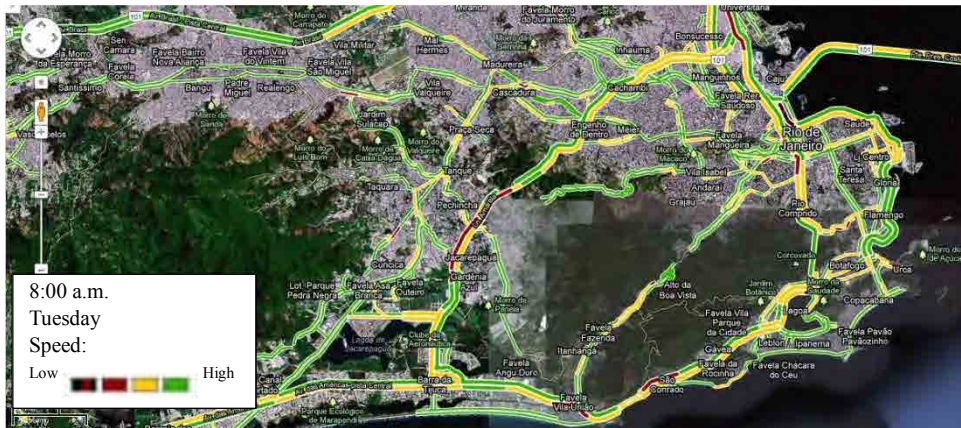
Source: Google map

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

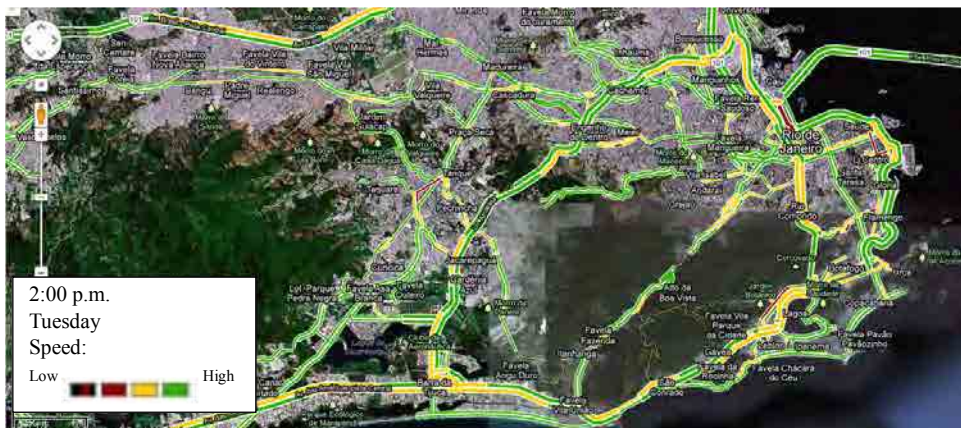
In particular, traffic jam tends to occur along the road between Barra da Tijuca, Copacabana, and Centro.

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

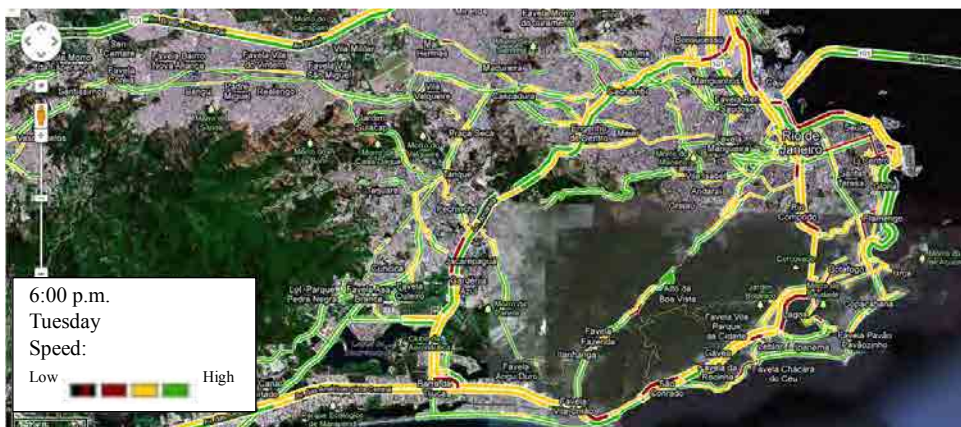
Tuesday 8:00 a.m.



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 Bangru a Deodoro, Vila Militar, Coelho Neto, Gordóvil, Periba, 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 Covaca, 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 (Engenheiro), 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 Eptácio Pessoa, Borges de Medeiros, Delfim Moreira, Vieira Souto, Atlântica. Ruas Jardim Botânico, Barata Ribeiro, Prefeito Mendes de Moraes, 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 Moraes, 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 Epiácio 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

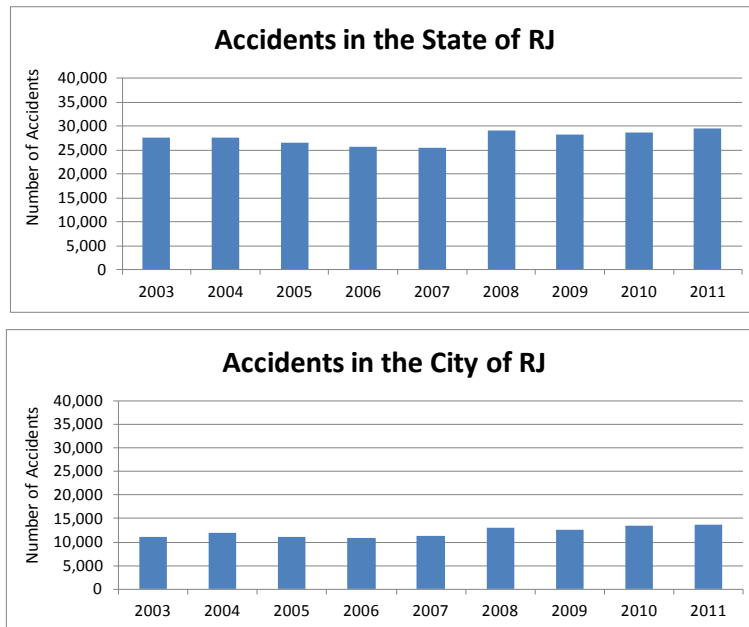
Avenidas Pastor Martin Luther King Jr. e Amaro Cavalcanti. Viaduto de Todos os Santos. Praça da Bandeira, sentido Méier, Avenida Maracanã, sentido Usina e Radial Oeste, sentido Méier. 24 de Maio, Arquias Cordeiro, altura do Engenho. Dom Hélder Câmara, sentido Engenho de Dentro.

(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.

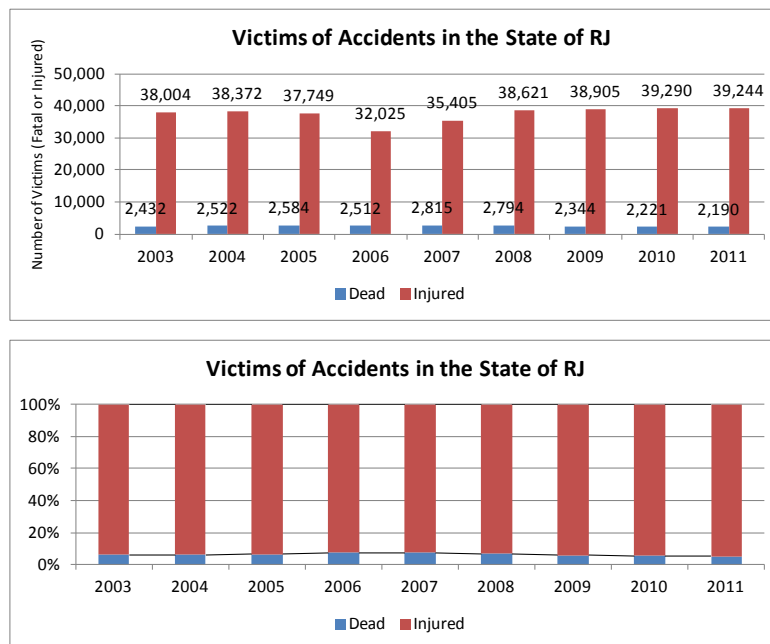
[Traffic accidents]



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

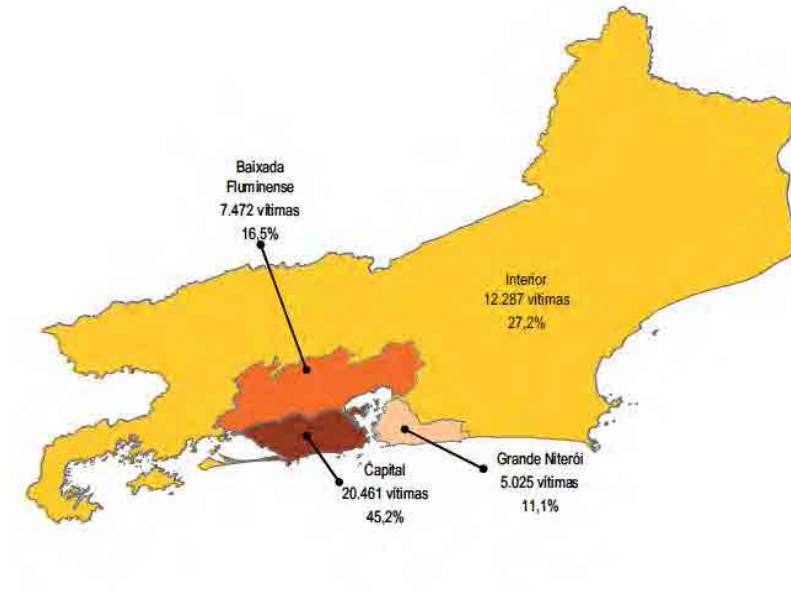
Figure 2-73 Number of Victims of Accident in Rio de Janeiro

2) Location of traffic accidents

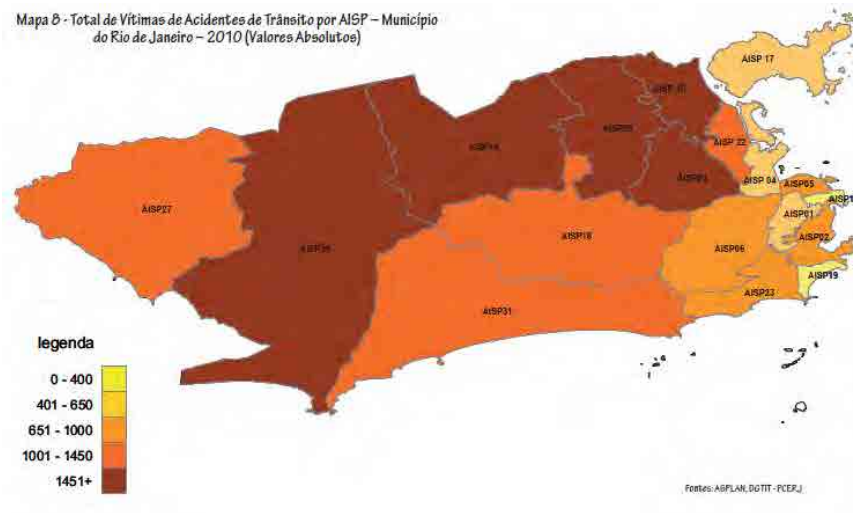
Figure 2-74 shows that traffic accidents happened more in the city of Rio de Janeiro and along Av. Brasil.

[Distribution of traffic accidents in 2010]

State-wise



City-wise



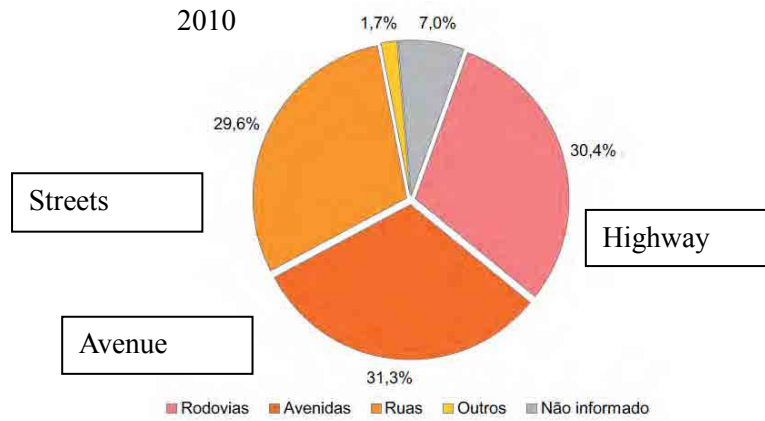
Source: Instituto de Segurança Pública

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

3) Traffic accidents by road type

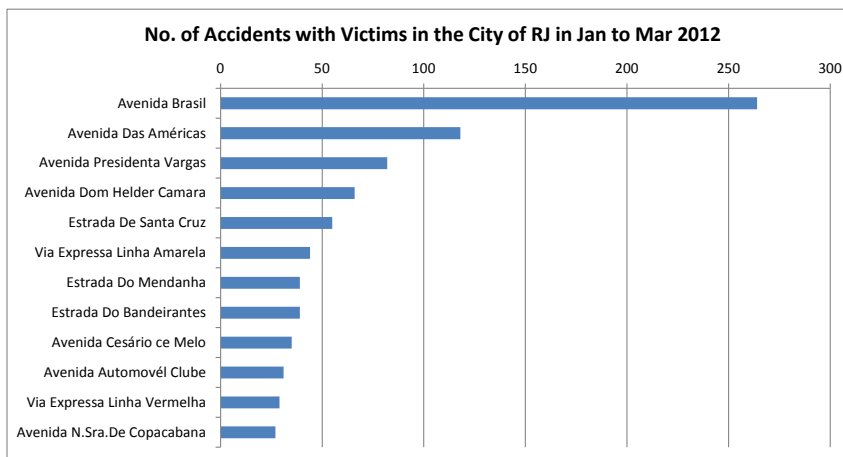
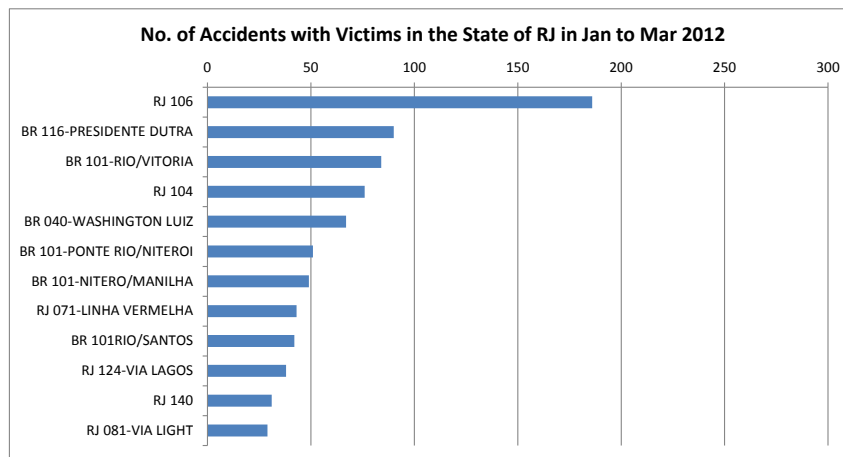
In the state of Rio de Janeiro, traffic accidents happened evenly on highways, avenues and streets. The roads, RJ 106, and Av. Brasil have the largest records of traffic accidents.

[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]



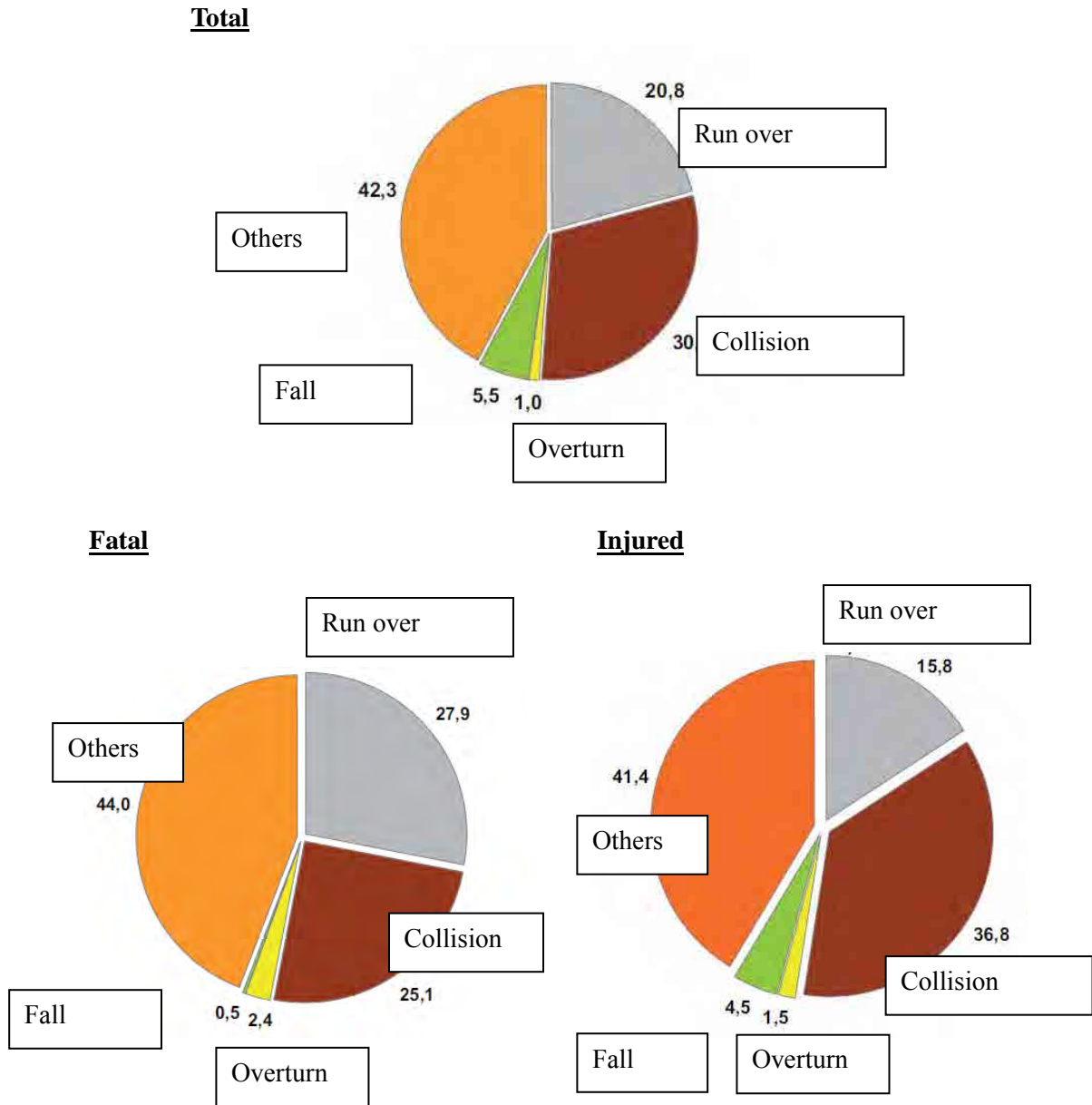
Source: DETRAN – RJ provided

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

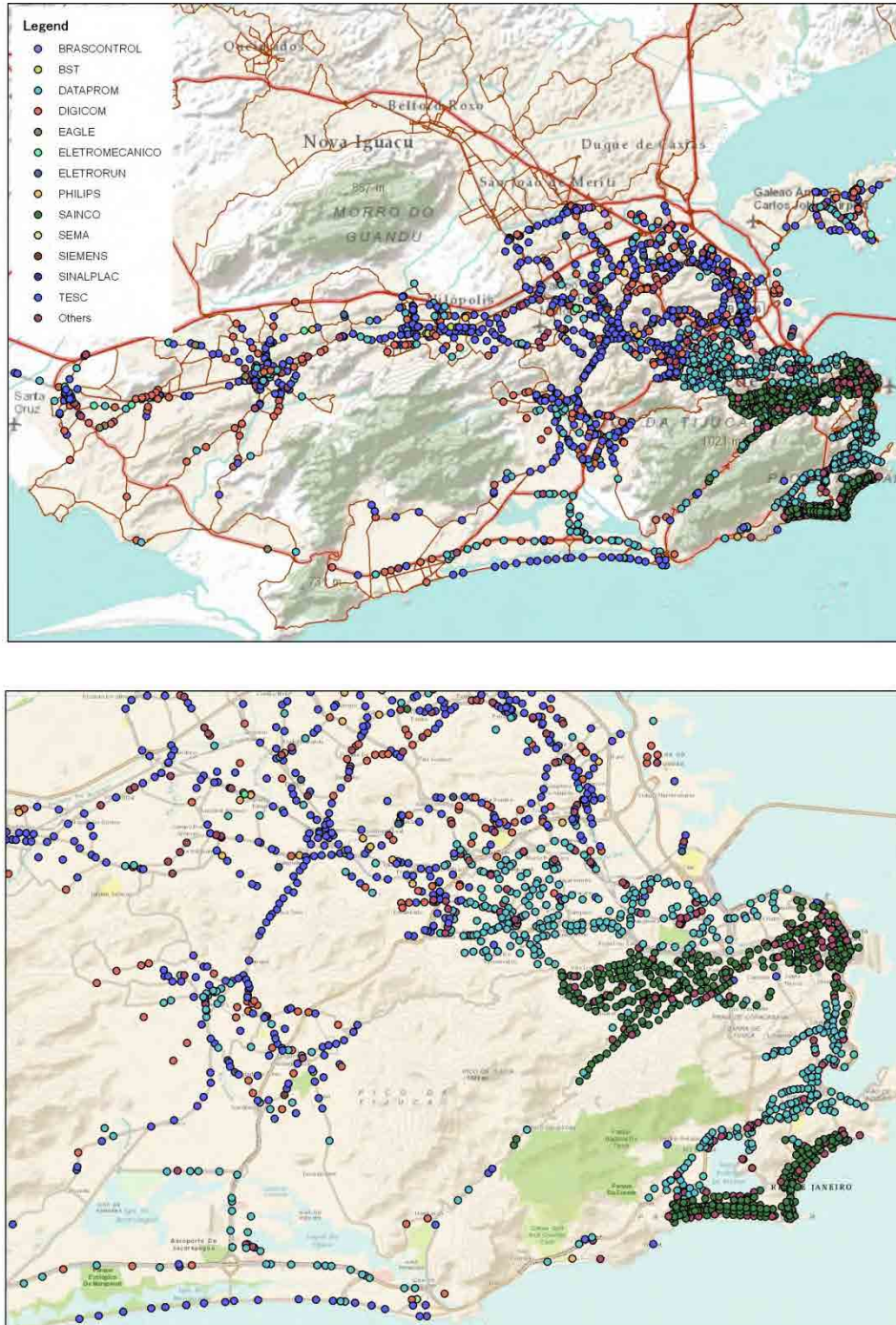
1) Operation in the City of Rio de Janeiro

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 |
| ELETROMECHANICO | 5 | ELETROMECHANICO |
| 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 | |



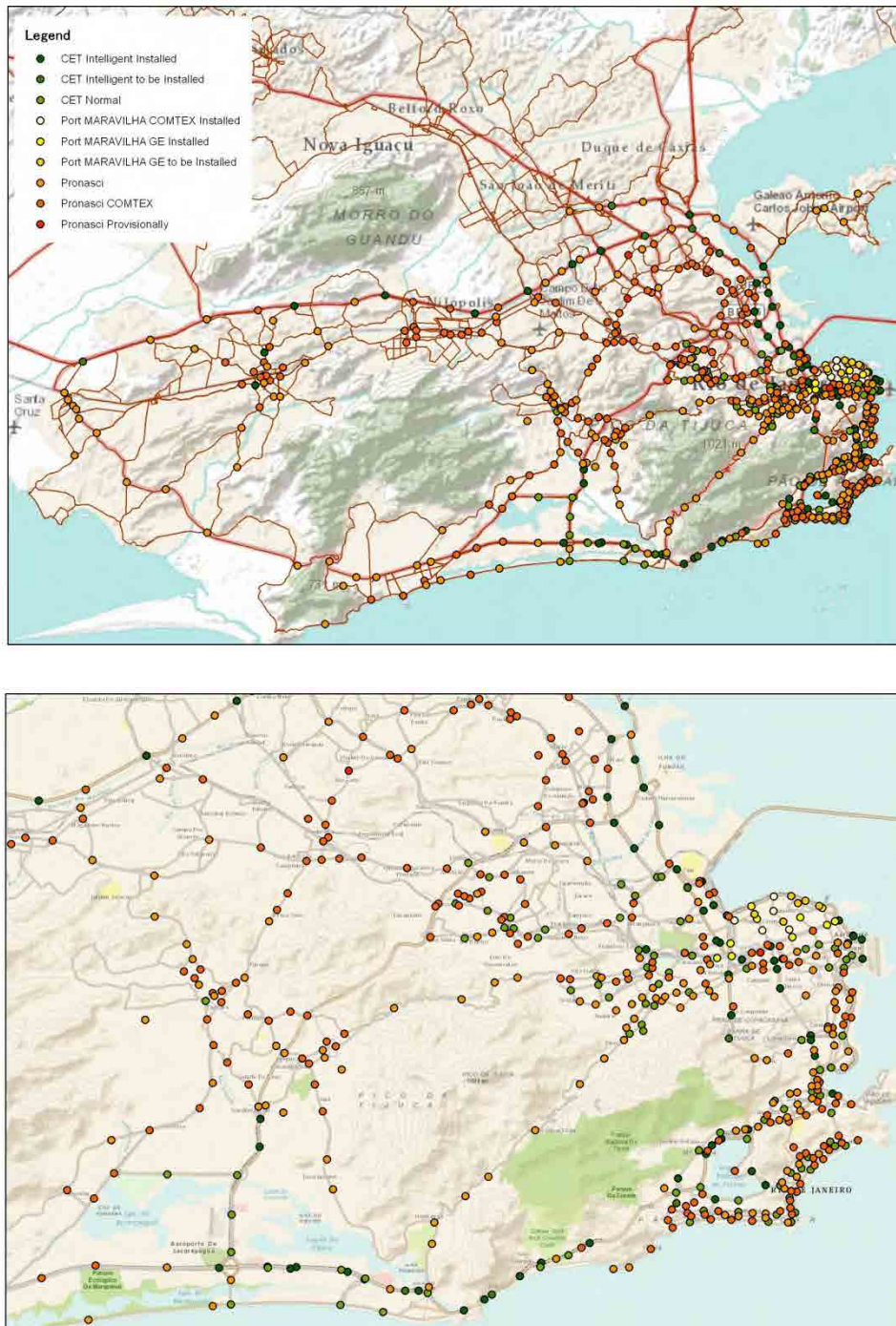
| Company | No. of Signals |
|-----------------|----------------|
| BRASCONTROL | 2 |
| BST | 3 |
| DATAPROM | 585 |
| DIGICOM | 216 |
| EAGLE | 6 |
| ELETROMECHANICO | 5 |
| ELETRORUN | 11 |
| PHILIPS | 26 |
| SAINCO | 483 |
| SEMA | 1 |
| SIEMENS | 2 |
| SINALPLAC | 1 |
| TESC | 652 |
| Total | 1,993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

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

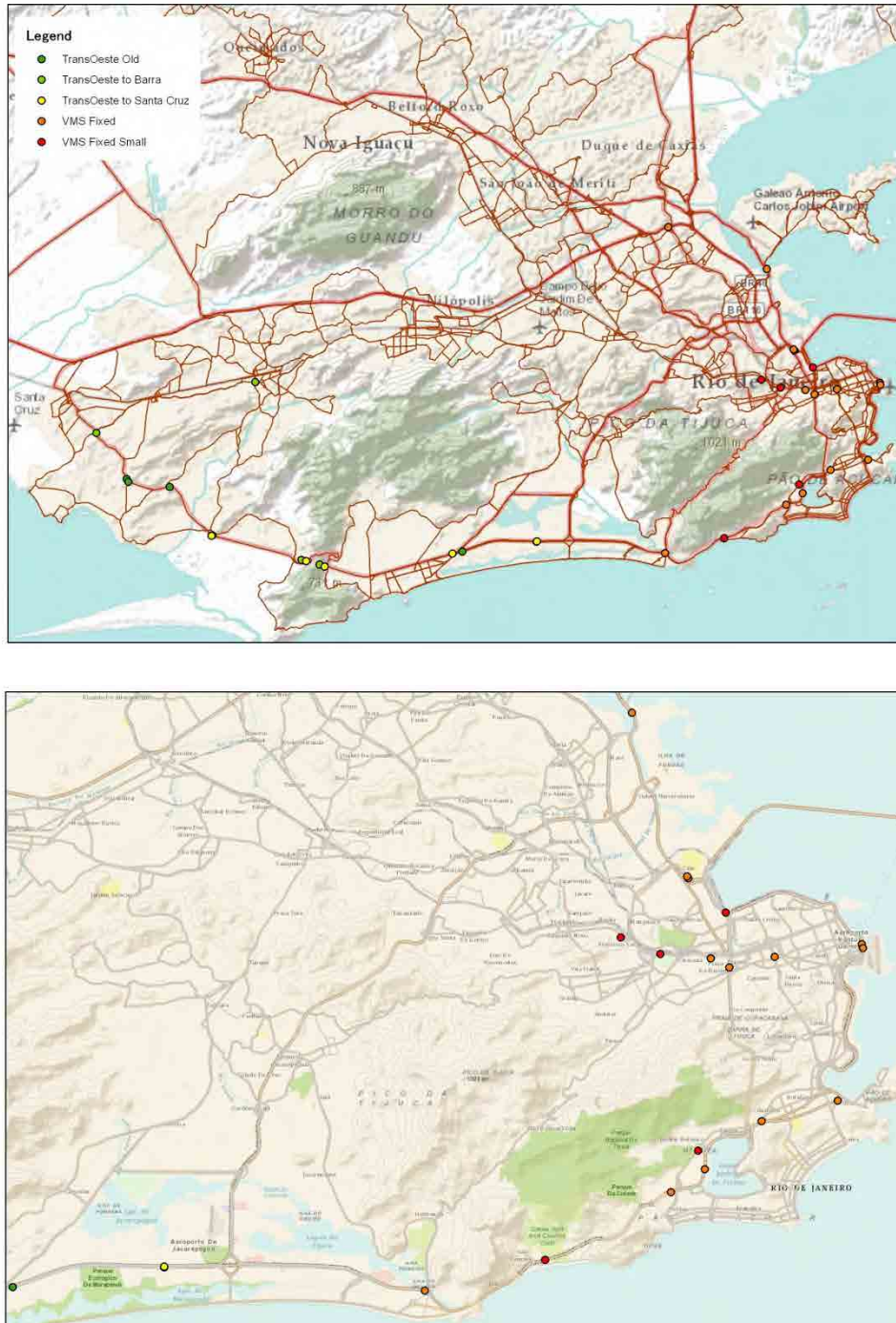
| Type | No. of Cameras |
|-----------------------------------|----------------|
| CET Normal | 87 |
| CET Intelligent Installed | 63 |
| CET Intelligent to be Installed | 11 |
| Pronasci | 179 |
| Pronasci COMTEX | 218 |
| Pronasci Provisionally | 3 |
| Port MARAVILHA GE Installed | 10 |
| Port MARAVILHA 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

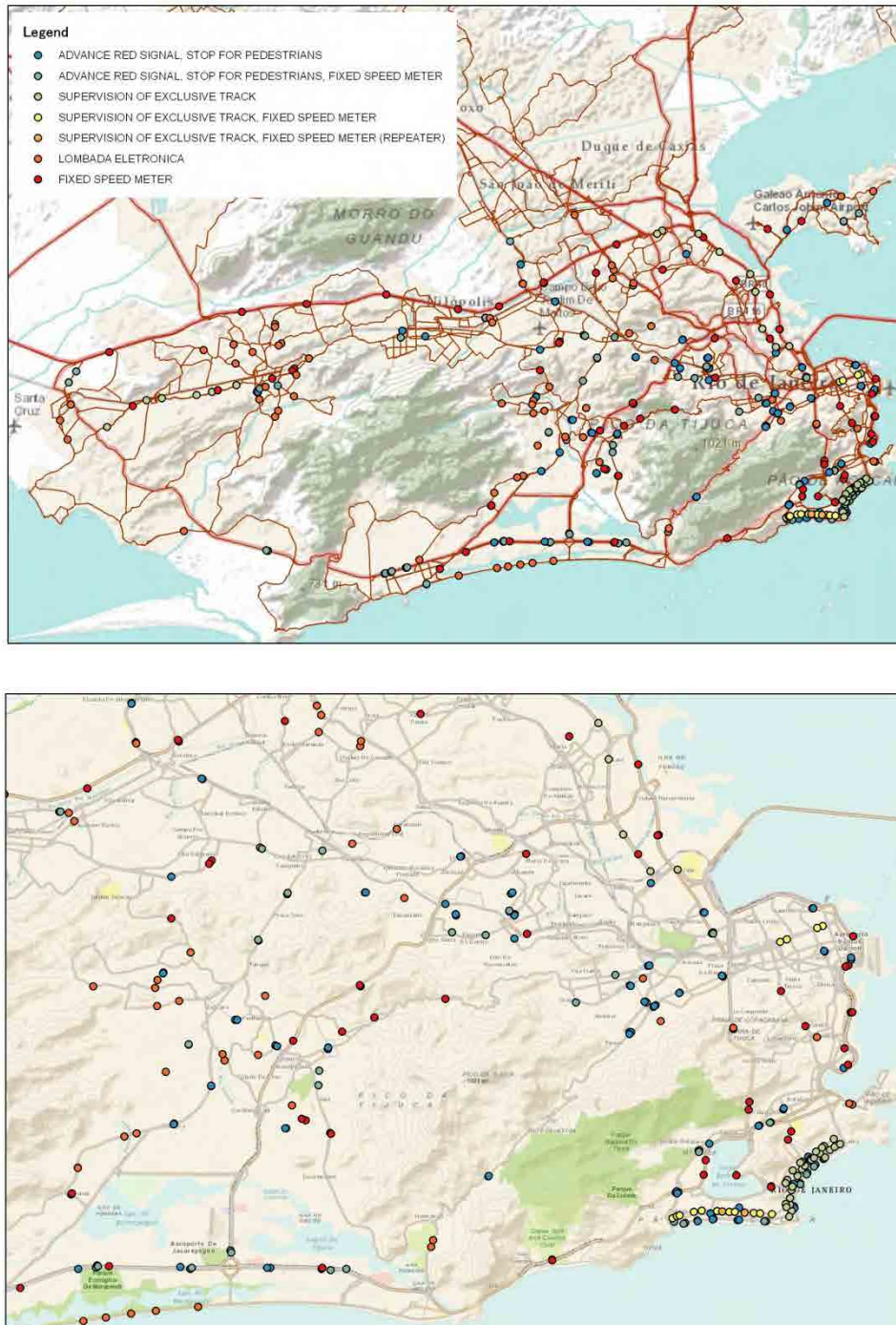
| Type | No. of VMSs |
|--------------------------|-------------|
| VMS Fixed | 15 |
| VMS Fixed Small | 5 |
| TransOeste to Barra | 5 |
| TransOeste to Santa Cruz | 5 |
| Total | 30 |

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

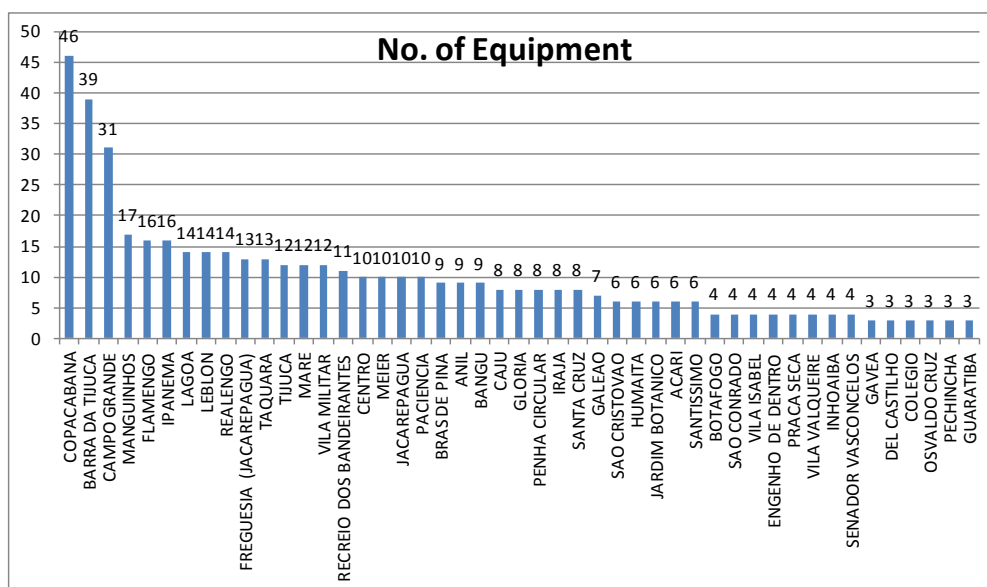
[By location]

| 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]



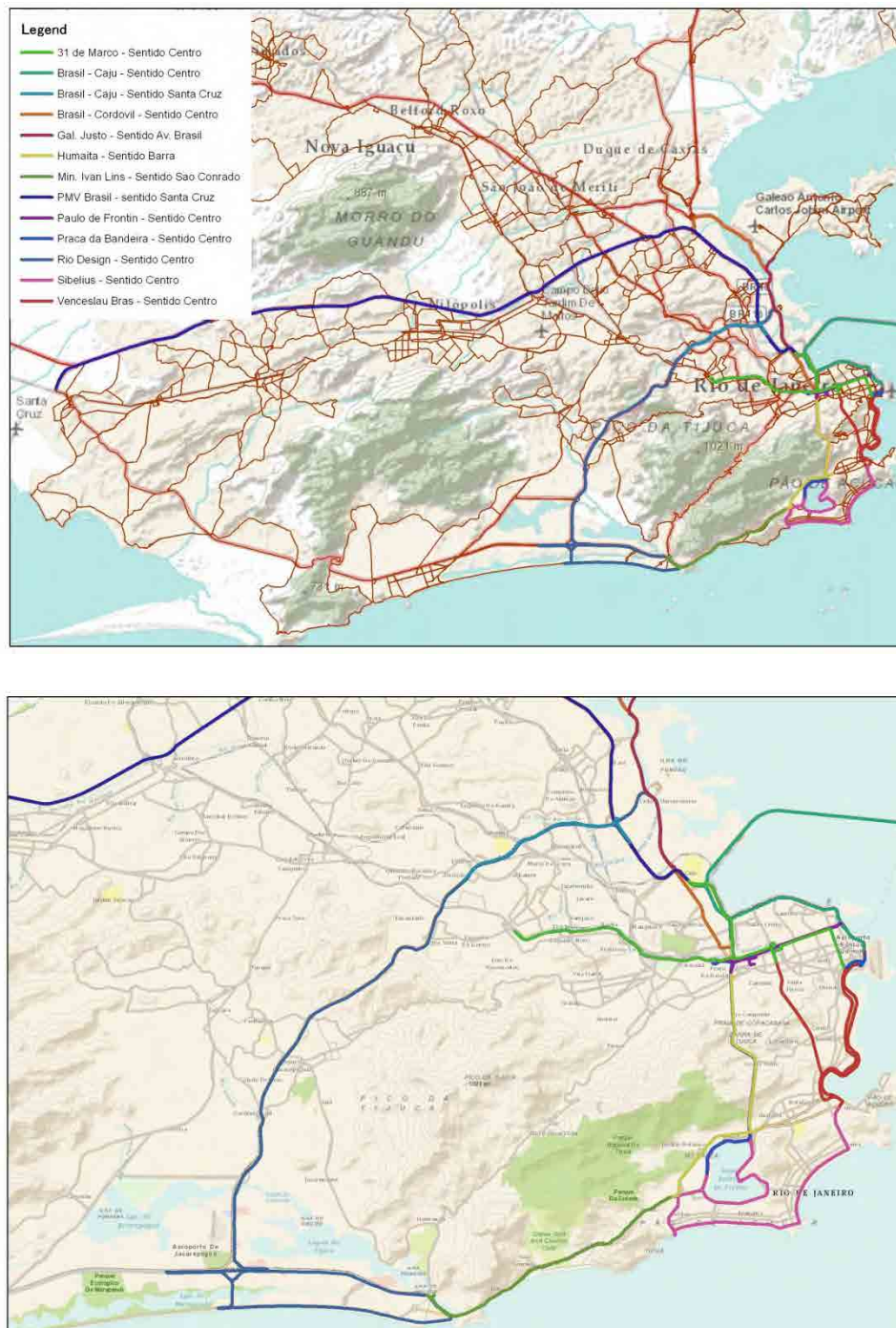
Source: JICA Study Team (Table 2-18 and Figure 2-81)

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

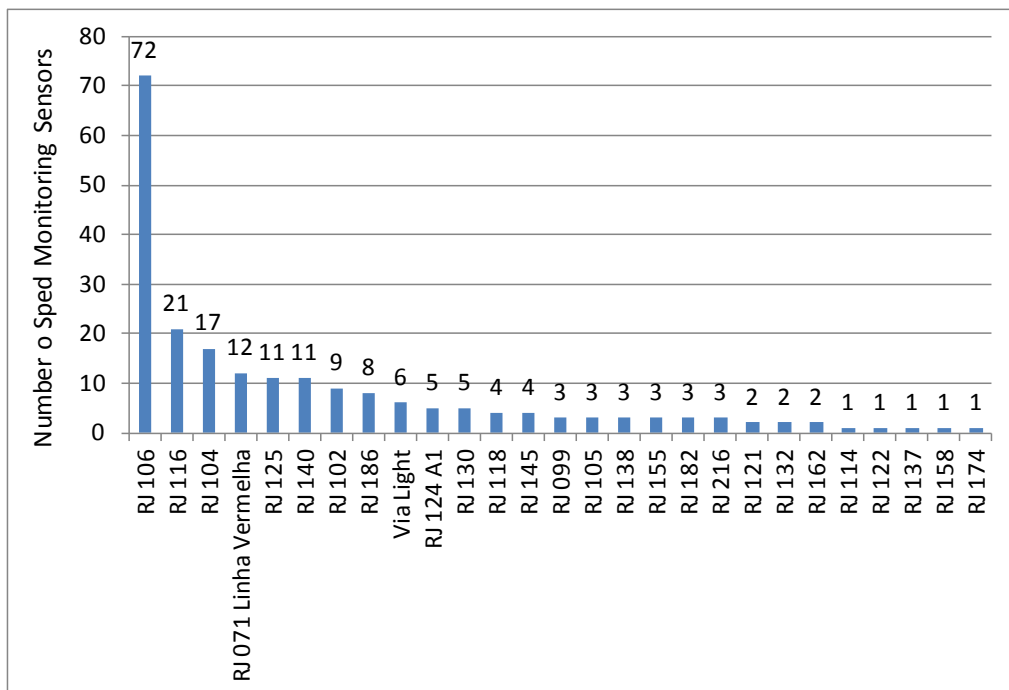
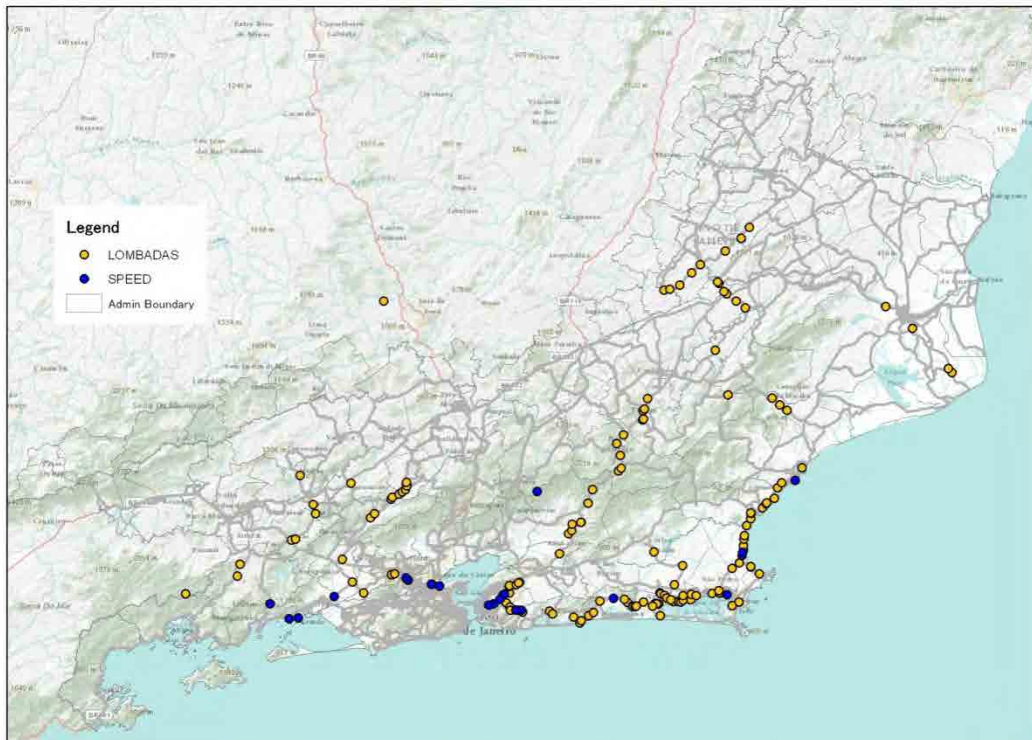
2) Operation in the State of Rio de Janeiro

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

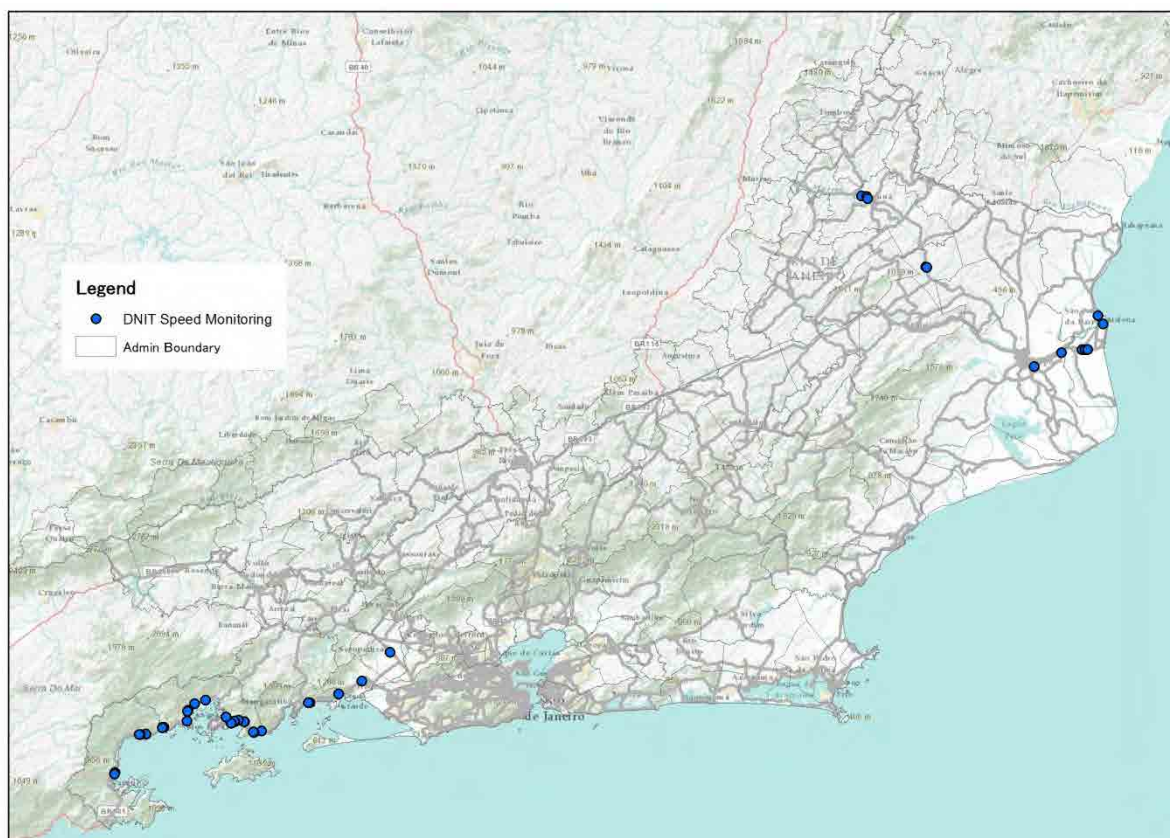
3) Operation in the Federal

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.

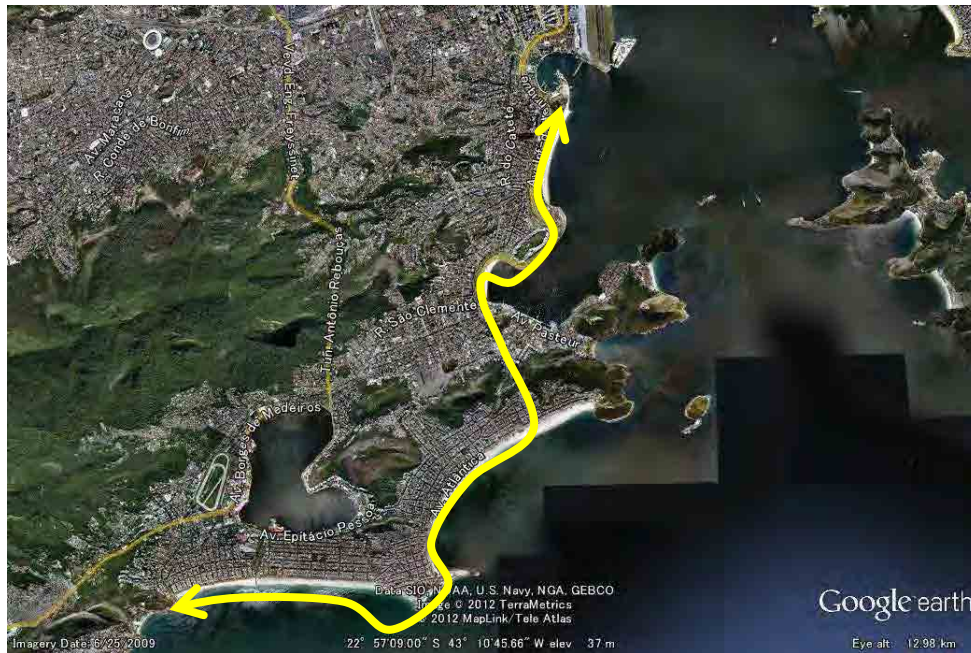
[Location]

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/1º 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.

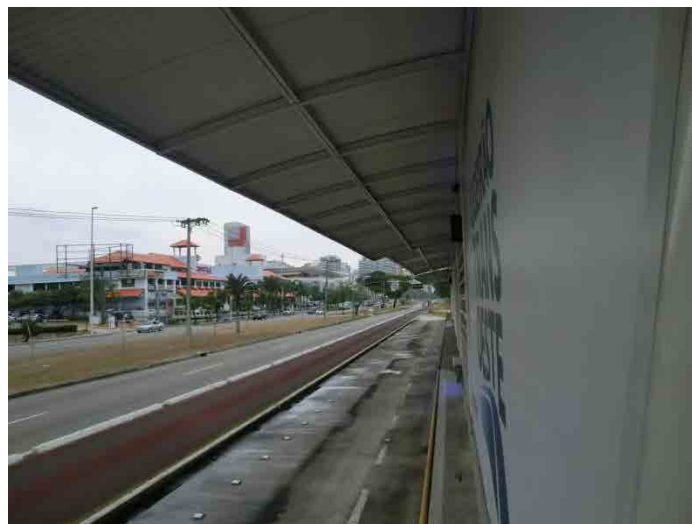
[Map]



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.

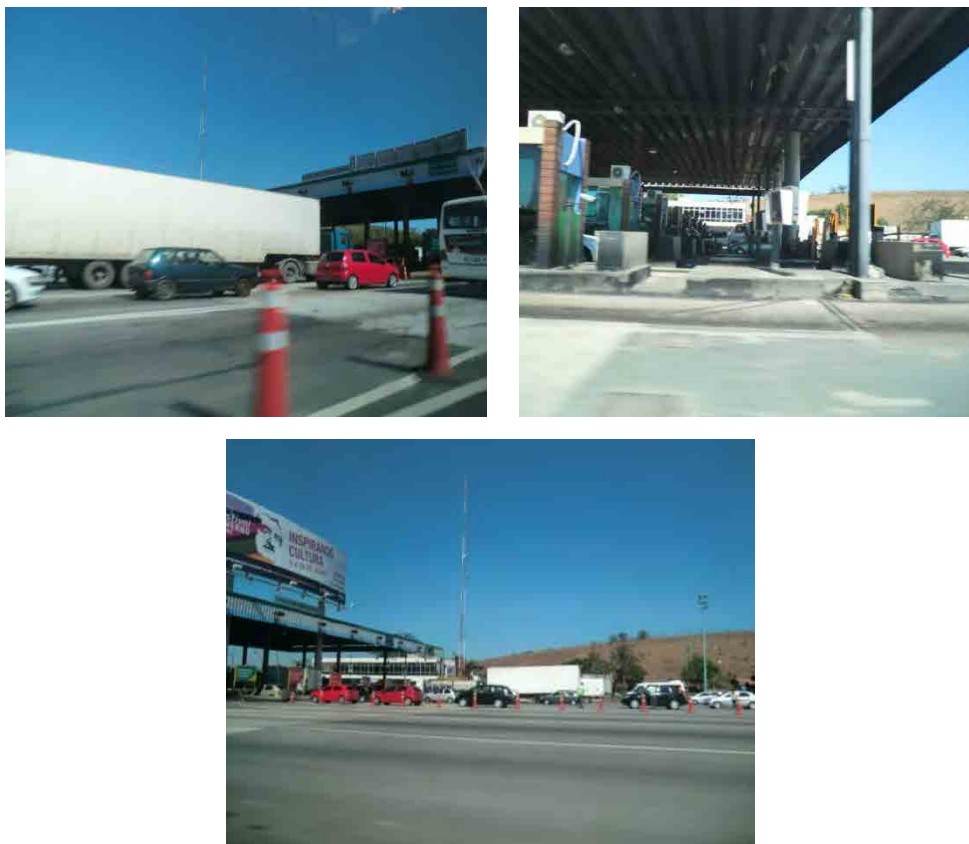


Source: JICA Study Team

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.



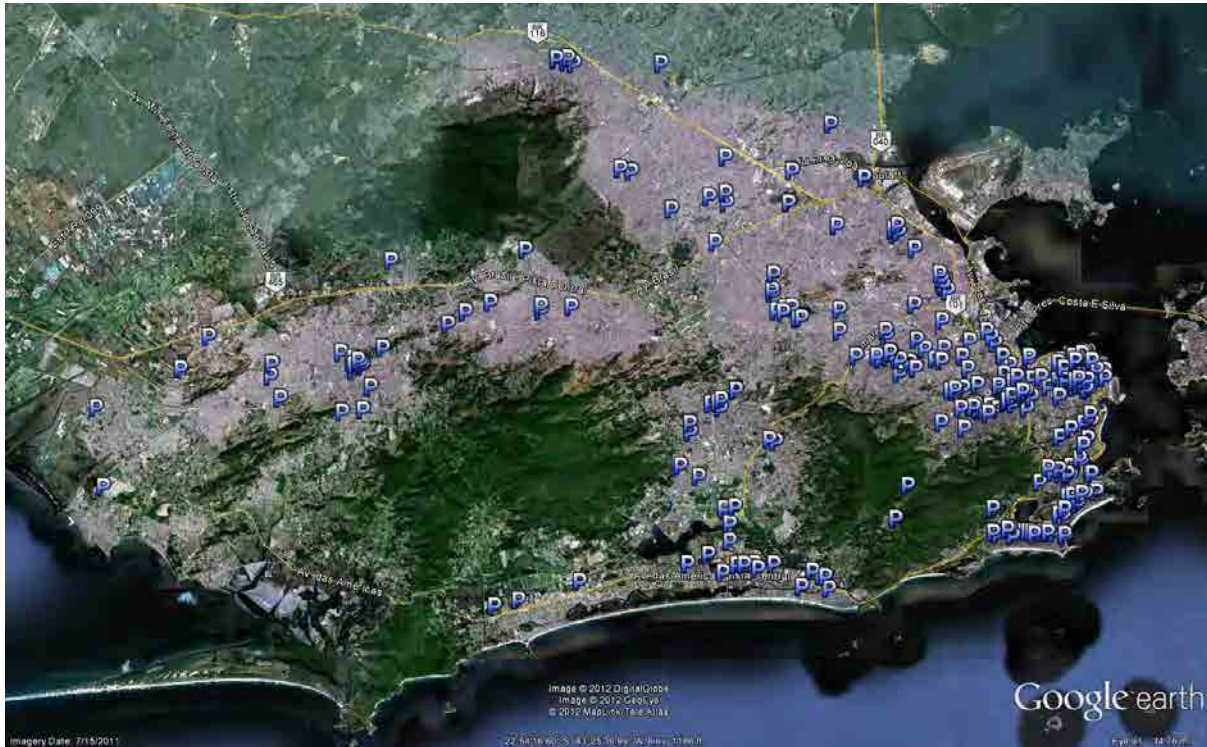
Source: JICA Study Team

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

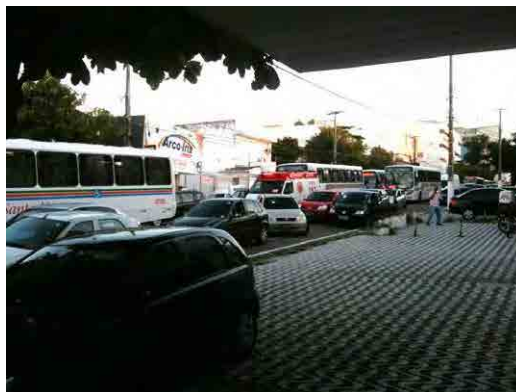
Figure 2-102 BRT Lane

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)”

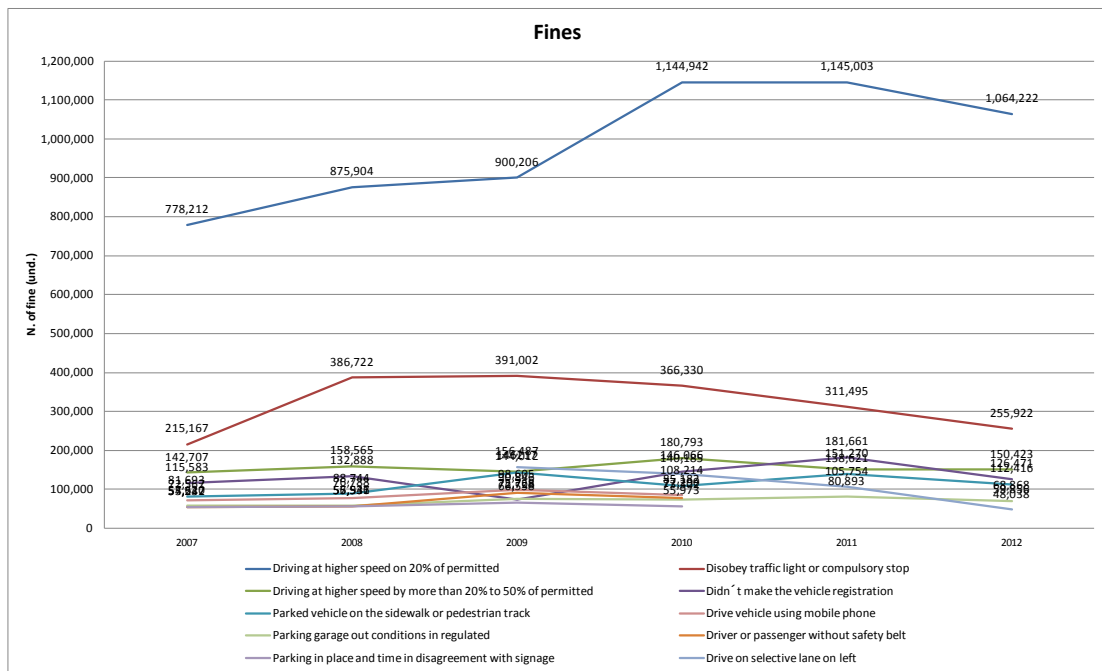
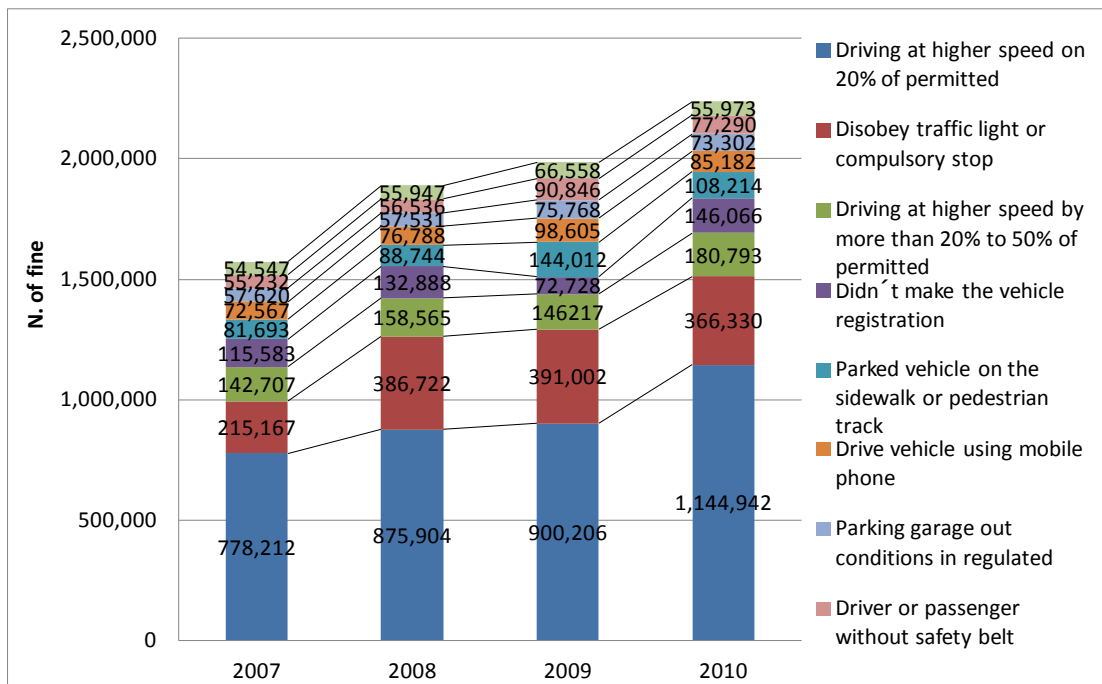
“The biggest problem faced by emergency services remains in Brazil Avenue because of traffic jams”

“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