5.1.2 Survey Results

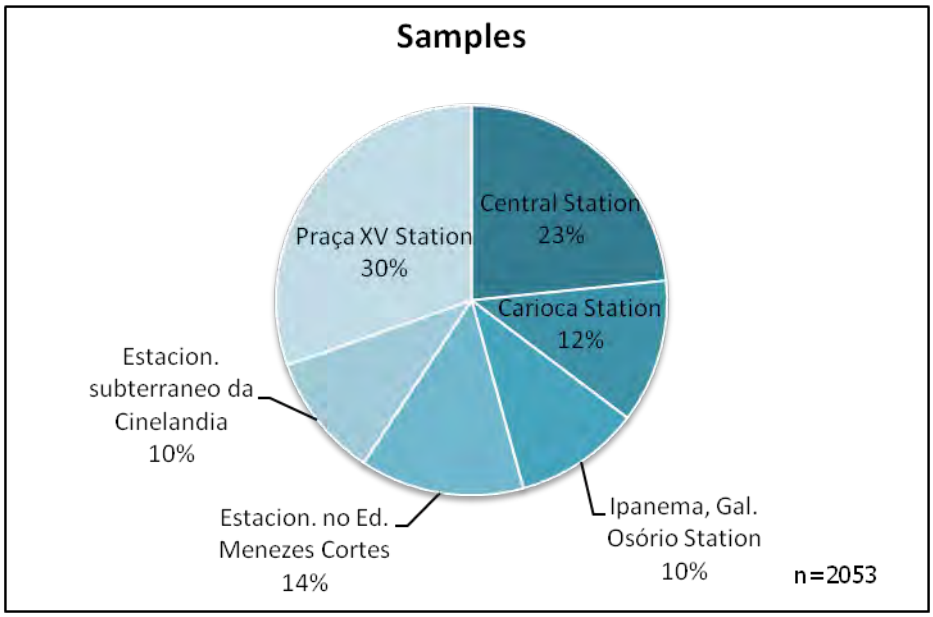
(1) August 14, 2012 (Tuesday)

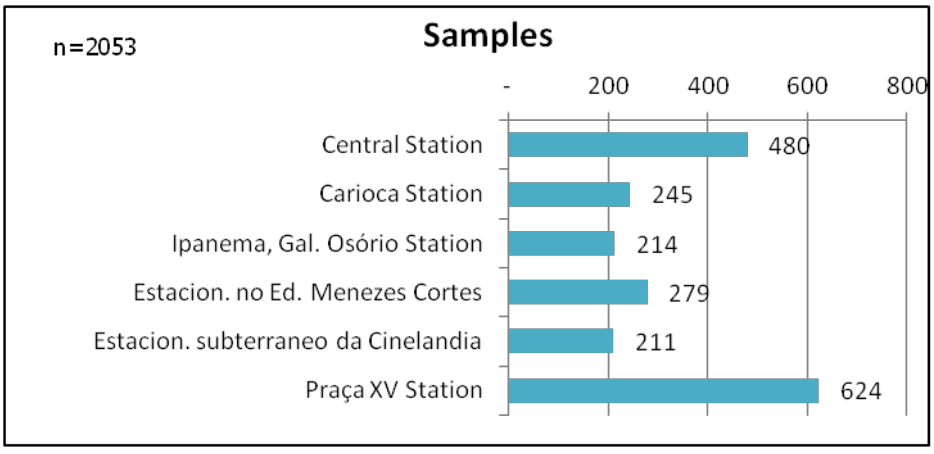
1) Basic Information of Samples

i) Samples

Total number of samples: 2053

The number of samples from each location is as shown in Figure 5-3.



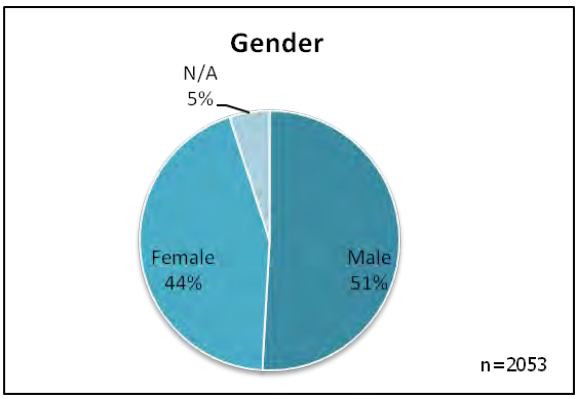


Source: JICA Study Team

Figure 5-3 Samples

ii) Gender

Males have a percentage of 51% while females have 44%.

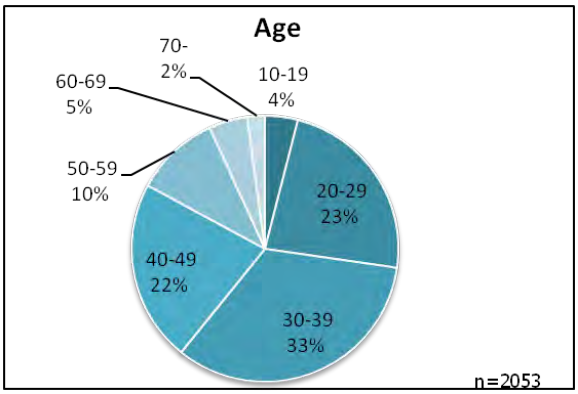


Source: JICA Study Team

Figure 5-4 Gender

iii) Age

The percentages of samples in their 20s, 30s, and 40s are large, as shown in Figure 5-5. Their combined percentage is 78% of all the samples.

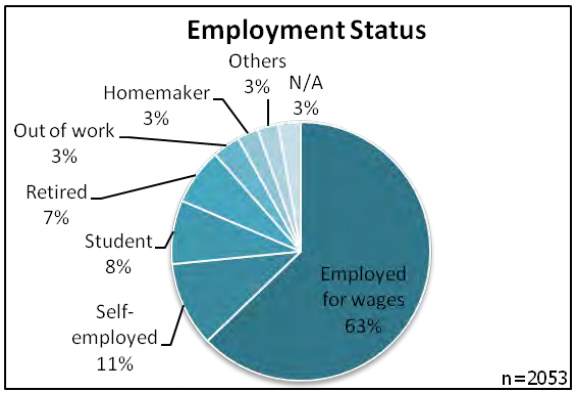


Source: JICA Study Team

Figure 5-5 Age

iv) Employment Status

The samples that are employed for wages have the top share at 63%, followed by samples that are self-employed at 11%. Of all the samples, 75% are working.



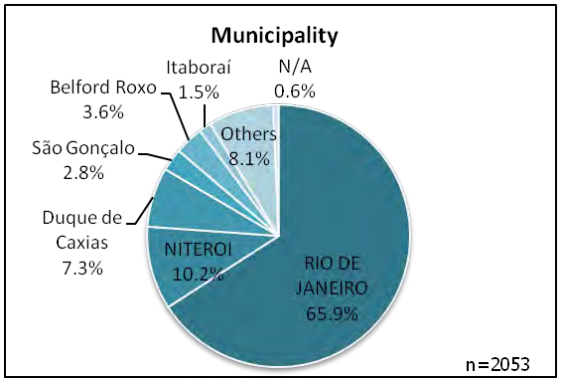
Source: JICA Study Team

Figure 5-6 Employment Status

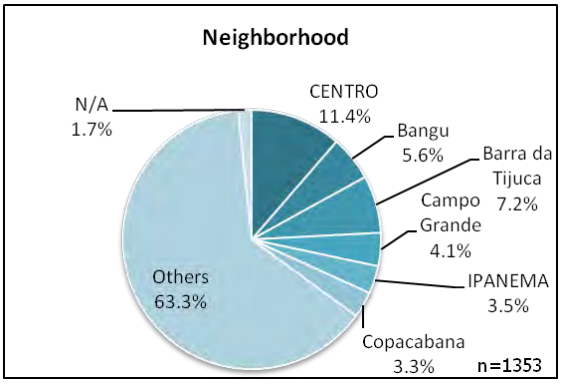
v) Home Address

Most of the samples live in Rio de Janeiro, Niteroi, or Duque de Caxias. In Rio de Janeiro, the home addresses of samples vary but the percentages of those living in Centro, Barra da Tijuca, Bangu, Campo Grande, Ipanema and Copacabana are relatively high.

[Municipality]



[Neighborhood in Rio de Janeiro City]



Source: JICA Study Team

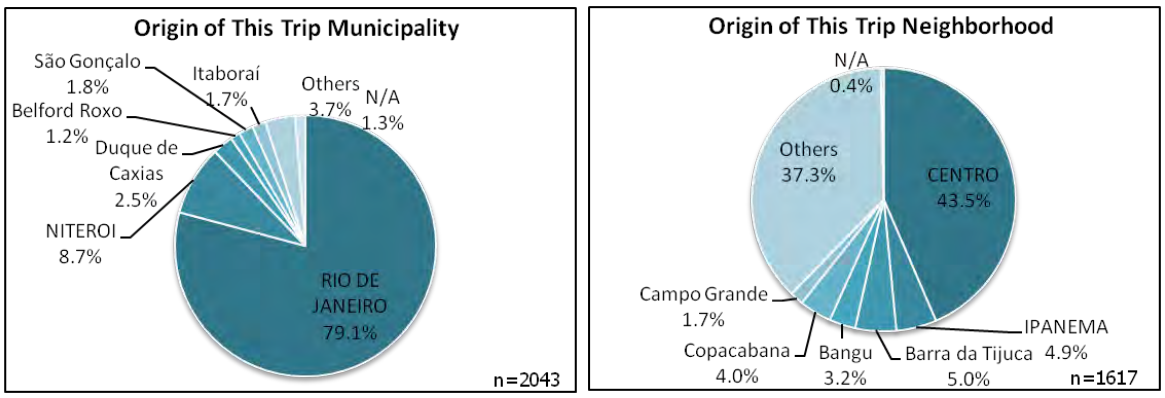
Figure 5-7 Home Address

2) Information of Trip

i) Origin of This Trip

Rio de Janeiro and Niteroi have the highest proportion of origins of trips.

[Municipality] [Neighborhood in Rio de Janeiro City]



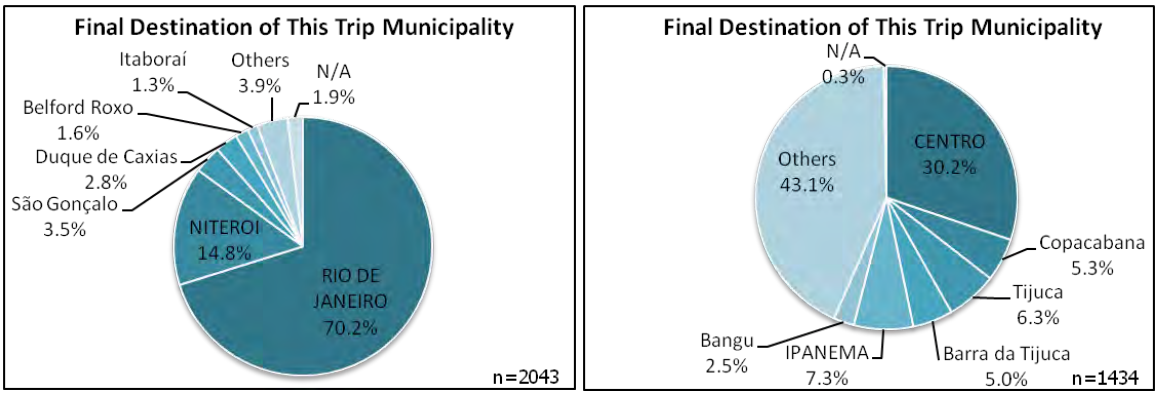
Source: JICA Study Team

Figure 5-8 Origin of This Trip

ii) Final Destination of This Trip

The destinations are more or less the same as the origins. This is because the purposes of the trips of the samples consist of “leaving home” and “going home”.

[Municipality] [Neighborhood in Rio de Janeiro City]

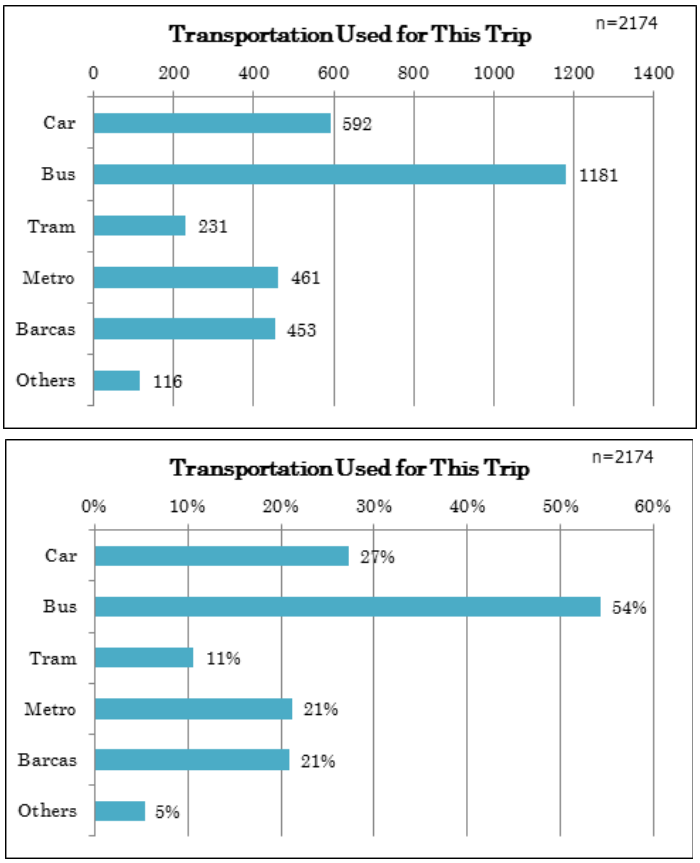


Source: JICA Study Team

Figure 5-9 Final Destination of This Trip

iii) Transportation Used for This Trip

Of all the samples, 27% use cars for their trips. More than half of the samples use buses for their trips.

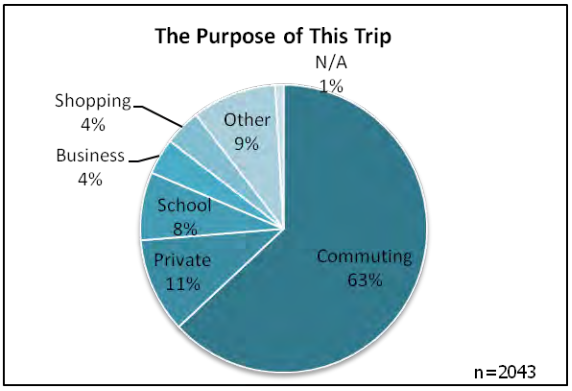


Source: JICA Study Team

Figure 5-10 Transportation Used for This Trip

iv) Purpose of This Trip

On a weekday, the main purpose of the trip was commuting, followed by private and school purposes.



Source: JICA Study Team

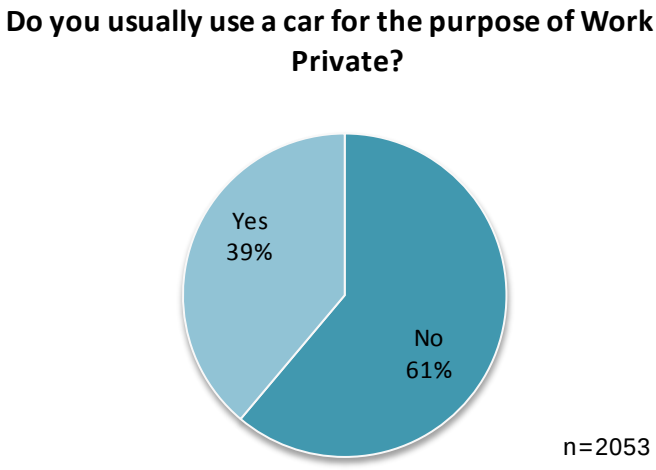
Figure 5-11 Purpose of This Trip

3) ITS Services Needs

i) For Car Users

[Do you usually use a car for work or private purpose?]

About 40% of the samples usually use a car for work or private purposes. Only car users were asked the next question.

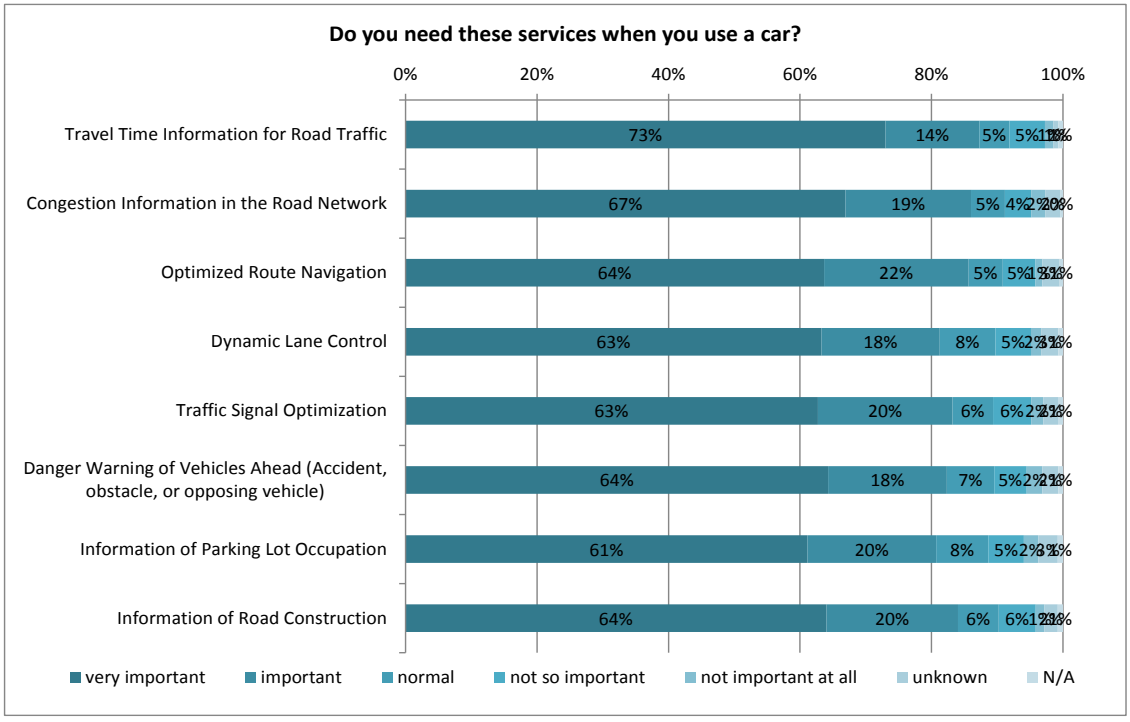


Source: JICA Study Team

Figure 5-12 Car Use

[Do you need these services when you use a car?]

More than 80% of all the samples answered that ITS services are important for their car use. "Travel time information for road traffic" seems to be especially important to them.



Source: JICA Study Team

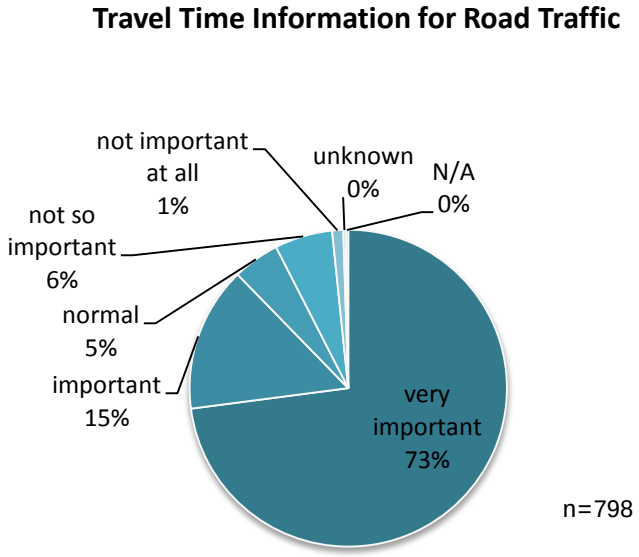
Figure 5-13 ITS Needs of Car Users

[Do you need these services when you use a car?]

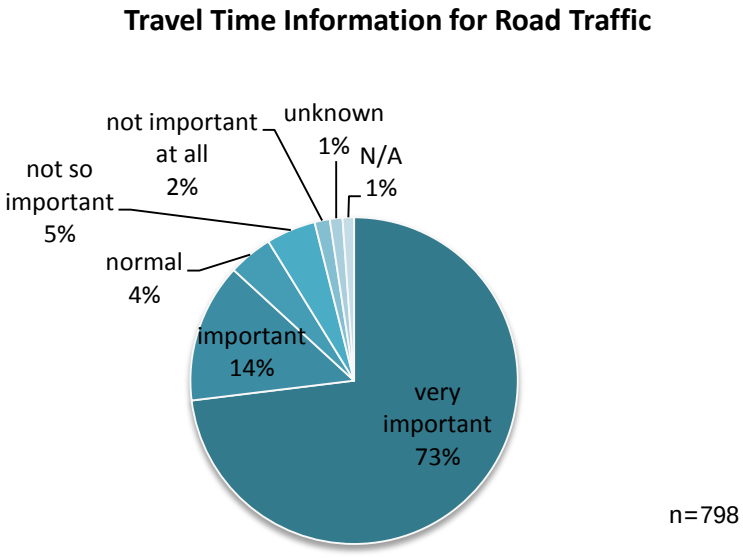
The following are the results for each service.

Service A: Travel Time Information for Road Traffic

< For Work Purpose>



<For Private Purpose>

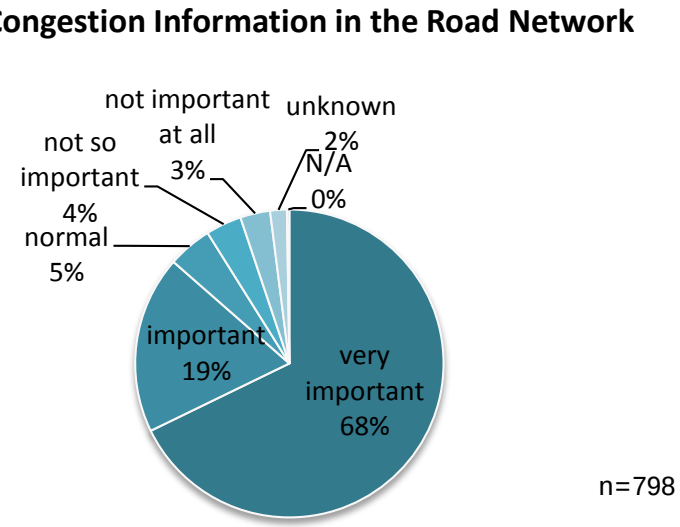


Source: JICA Study Team

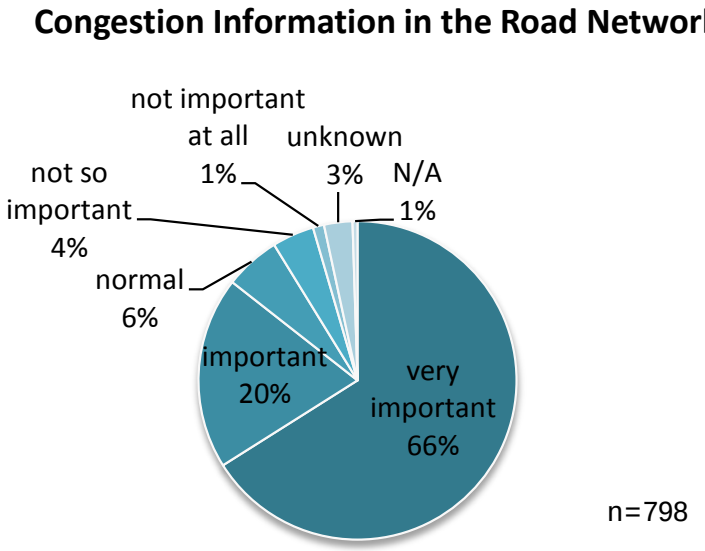
Figure 5-14 Need for Travel Time Information for Road Traffic

Service B: Congestion Information in the Road Network

< For Work Purpose>



<For Private Purpose>

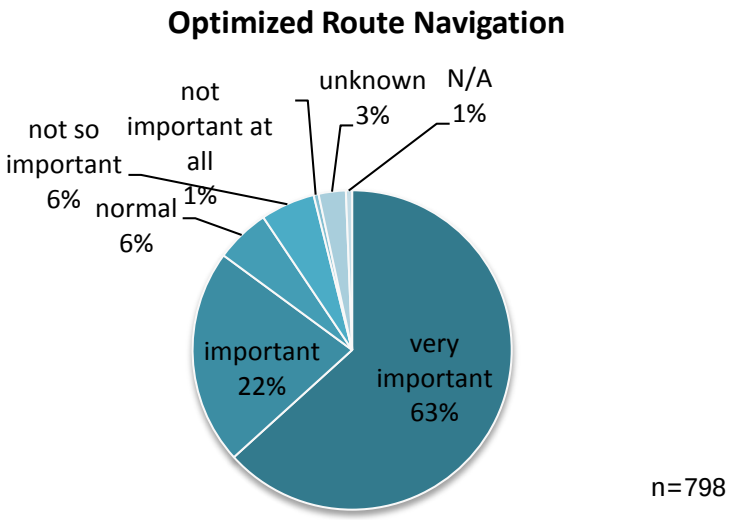


Source: JICA Study Team

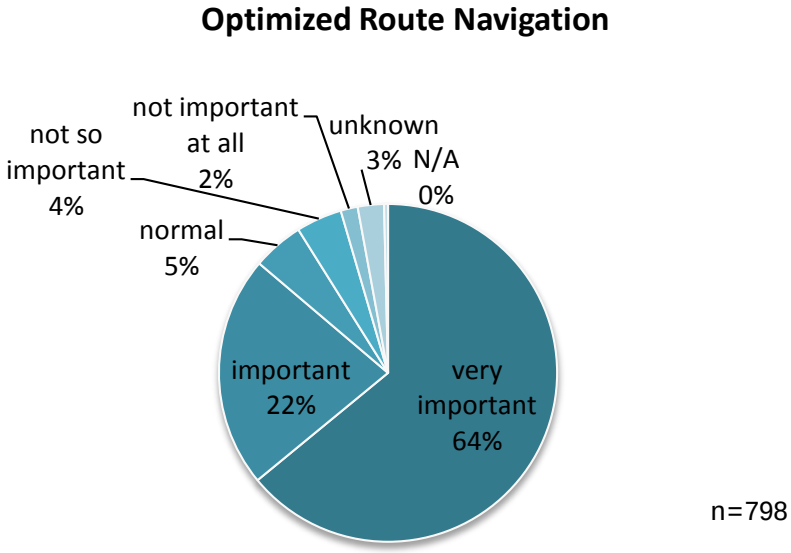
Figure 5-15 Need for Congestion Information in the Road Network

Service C: Optimized Route Navigation

< For Work Purpose>



<For Private Purpose>

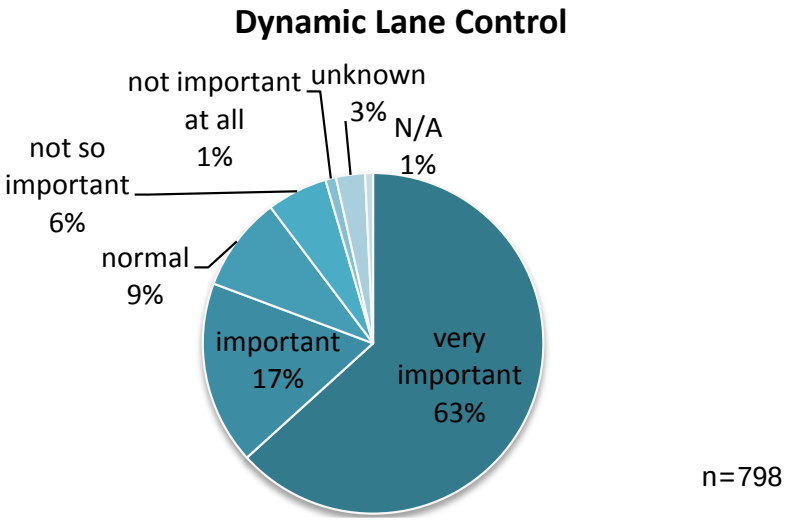


Source: JICA Study Team

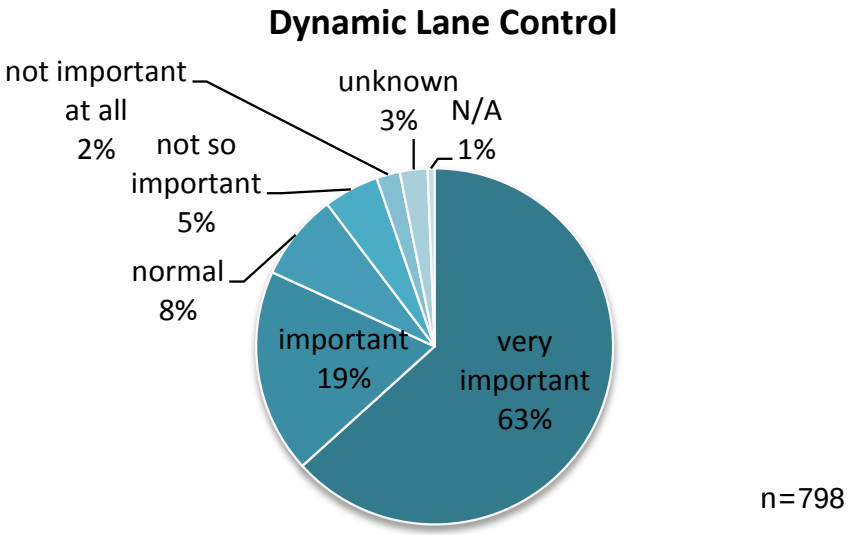
Figure 5-16 Need for Optimized Route Navigation

Service D: Dynamic Lane Control

< For Work Purpose>



<For Private Purpose>

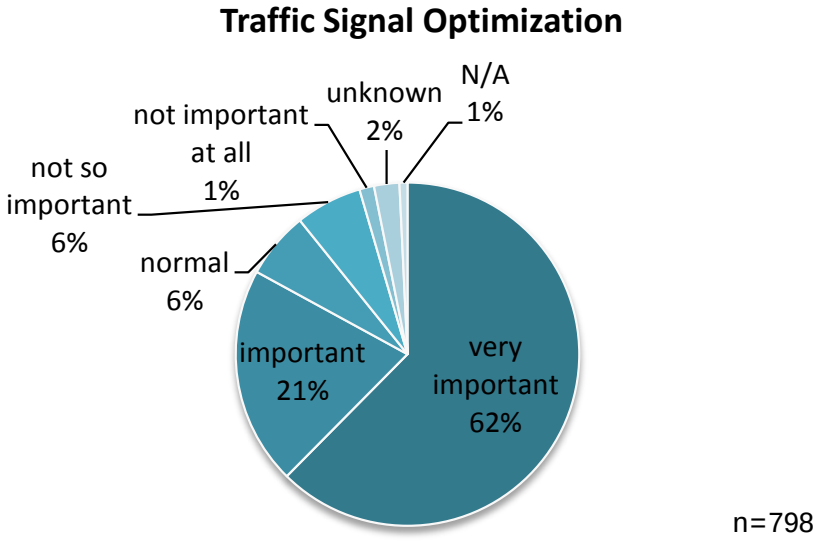


Source: JICA Study Team

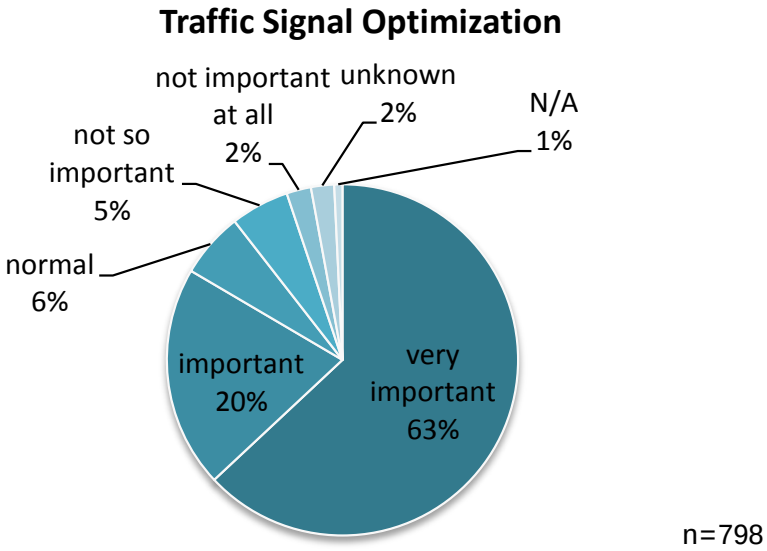
Figure 5-17 Need for Dynamic Lane Control

Service E: Traffic Signal Optimization

< For Work Purpose>



<For Private Purpose>

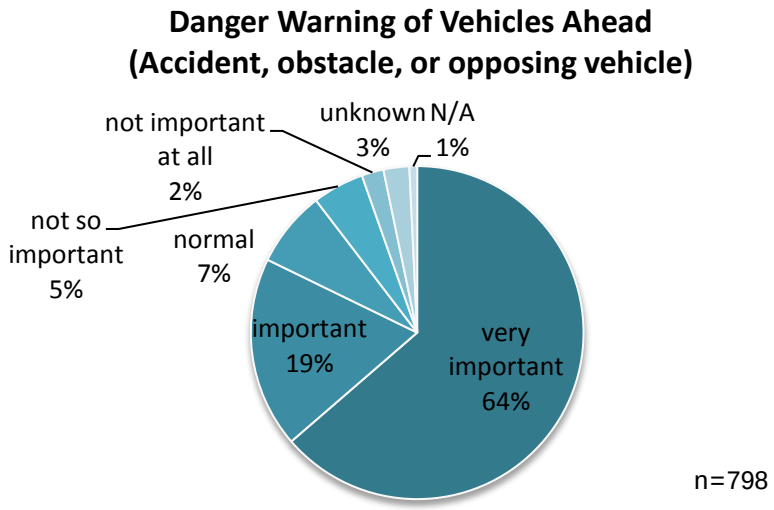


Source: JICA Study Team

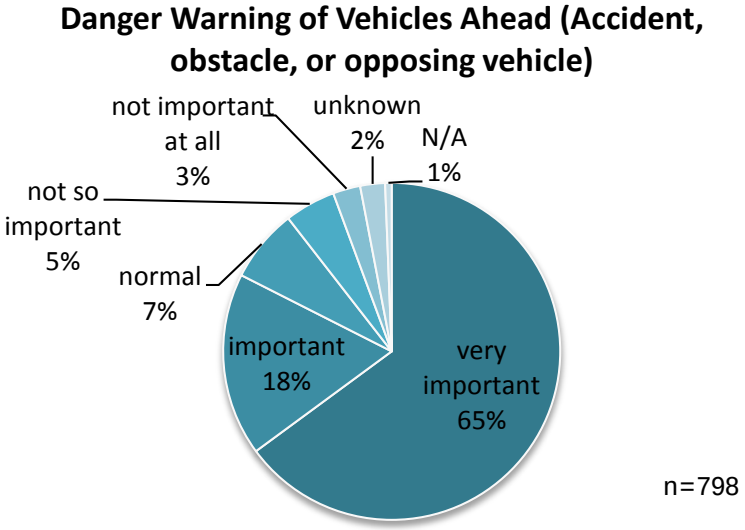
Figure 5-18 Need for Traffic Signal Optimization

Service F: Danger Warning of Vehicles Ahead (Accident, Obstacle, or Opposing Vehicle)

< For Work Purpose>



<For Private Purpose>

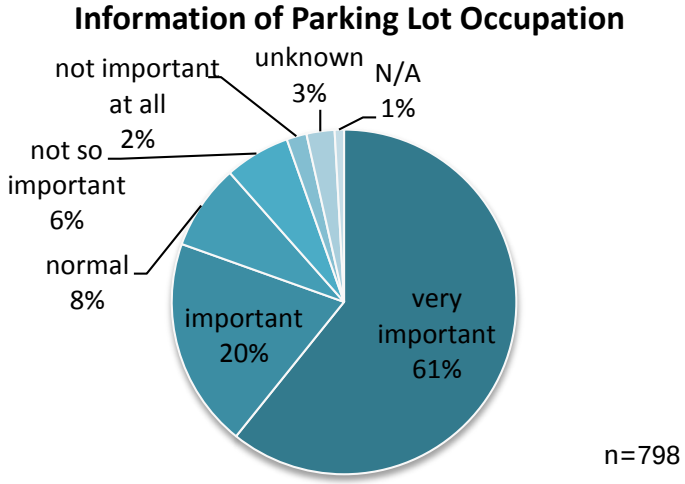


Source: JICA Study Team

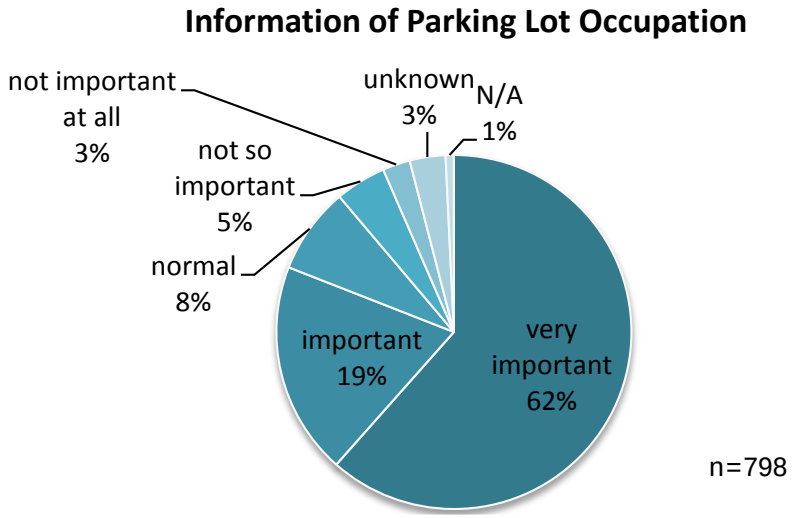
Figure 5-19 Need for Danger Warning of Vehicles Ahead (Accident, Obstacle, or Opposing Vehicle)

Service G: Information of Parking Lot Occupation

< For Work Purpose>



<For Private Purpose >

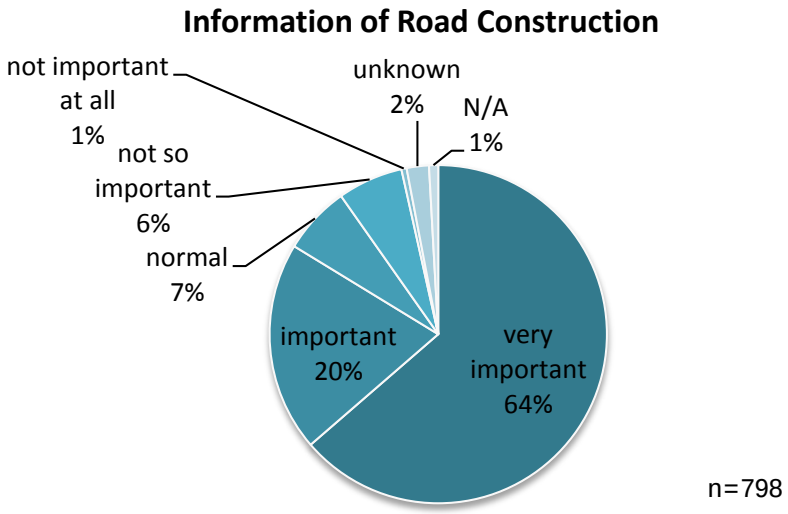


Source: JICA Study Team

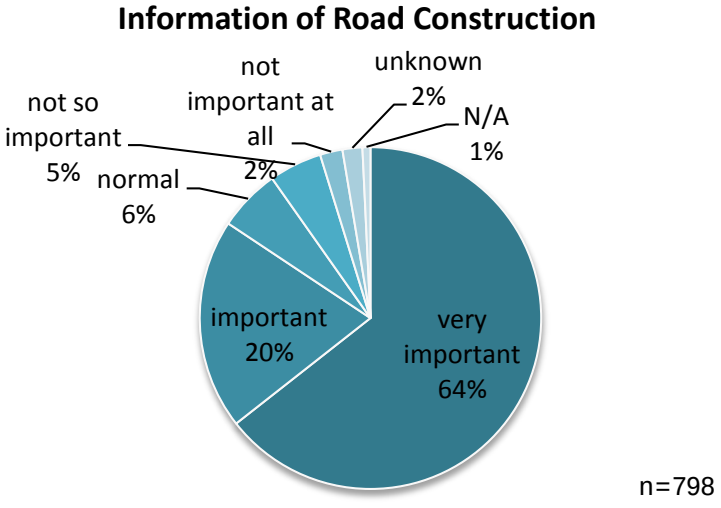
Figure 5-20 Need for Information of Parking Lot Occupation

Service H: Information of Road Construction

< For Work Purpose>



<For Private Purpose>



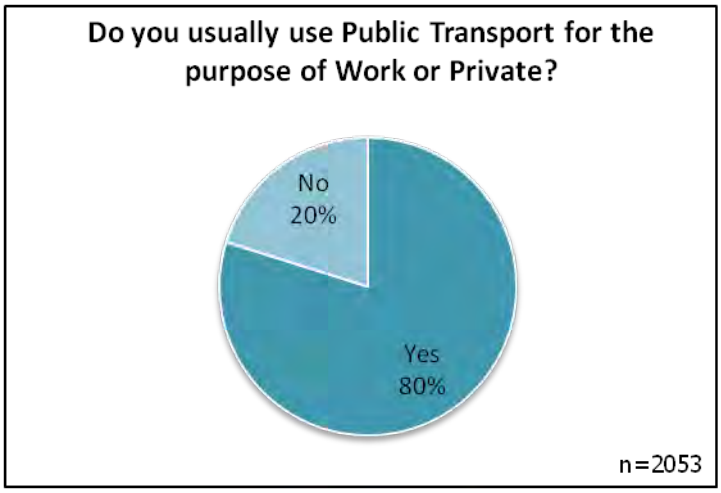
Source: JICA Study Team

Figure 5-21 Need for Information of Road Construction

ii) For Public Transport Users

[Do you usually use public transport for work or private purposes?]

About 80% of all the samples usually use public transport for work or private purposes. Only public transport users were asked the next question.

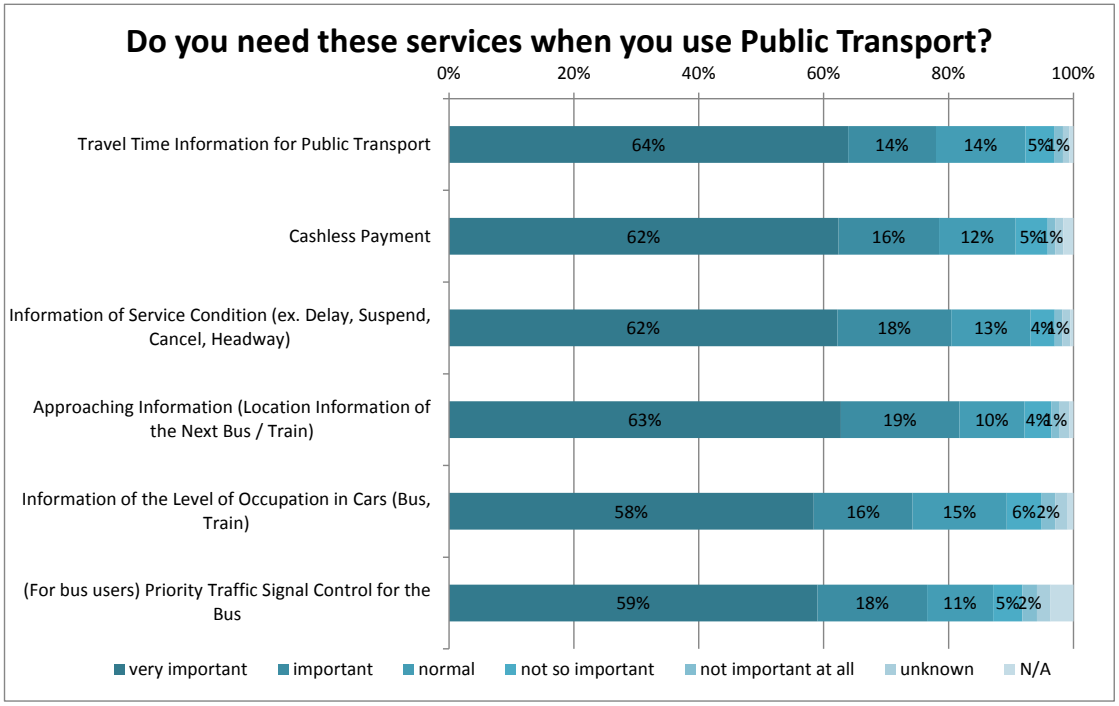


Source: JICA Study Team

Figure 5-22 Public Transport Use

[Do you need these services when you use public transport?]

About 80% of all the samples answered that ITS services are important for their public transport use. “Approaching information” and “Information of service condition” seem to be especially important to them.



Source: JICA Study Team

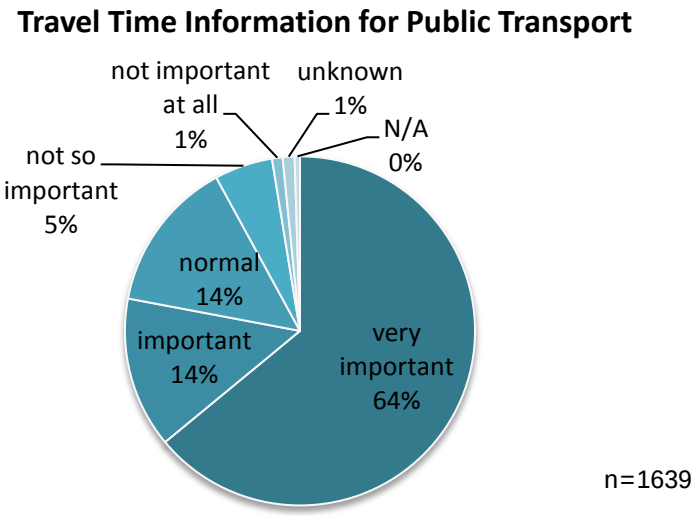
Figure 5-23 ITS Needs of Public Transport Users

[Do you need these services when you use public transport?]

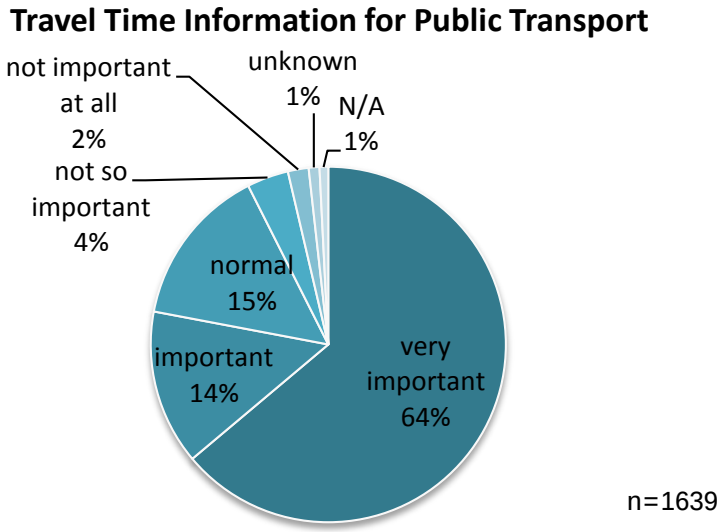
The following are the results for each service.

Service A: Travel Time Information for Public Transport

< For Work Purpose>



<For Private Purpose>

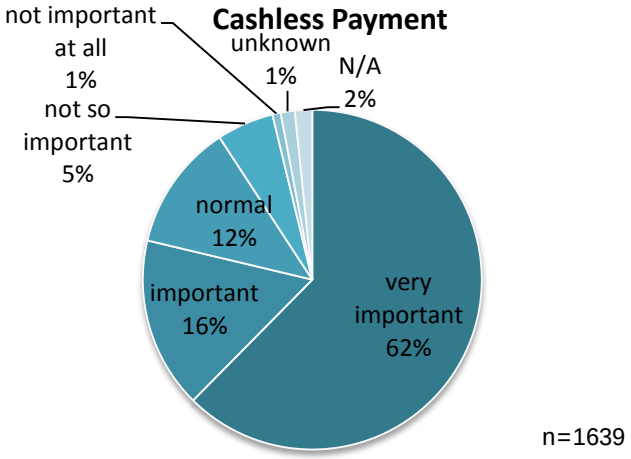


Source: JICA Study Team

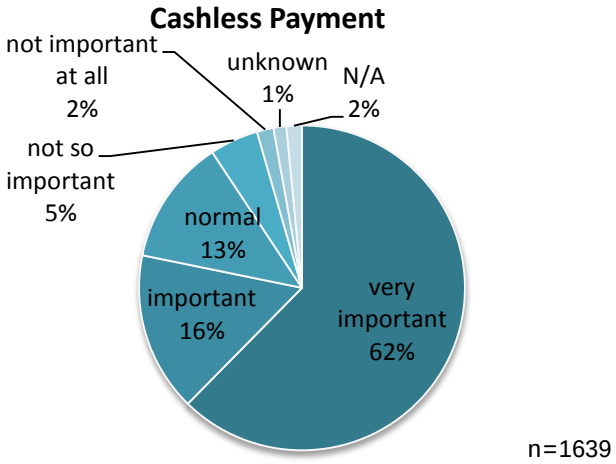
Figure 5-24 Need for Travel Time Information for Public Transport

Service B: Cashless Payment

< For Work Purpose>



<For Private Purpose>

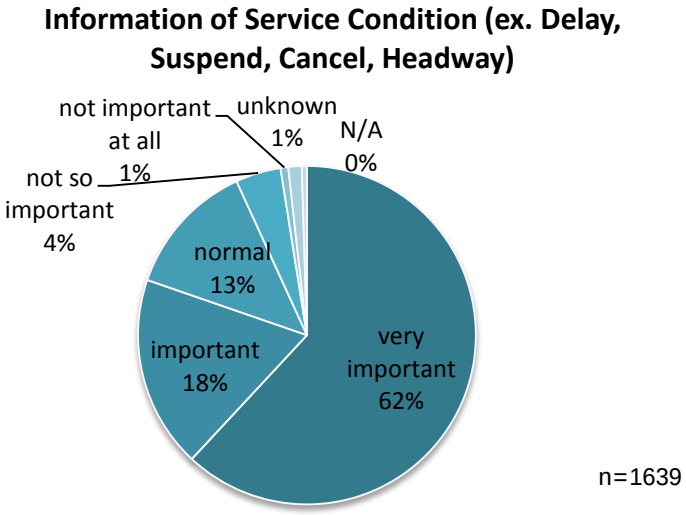


Source: JICA Study Team

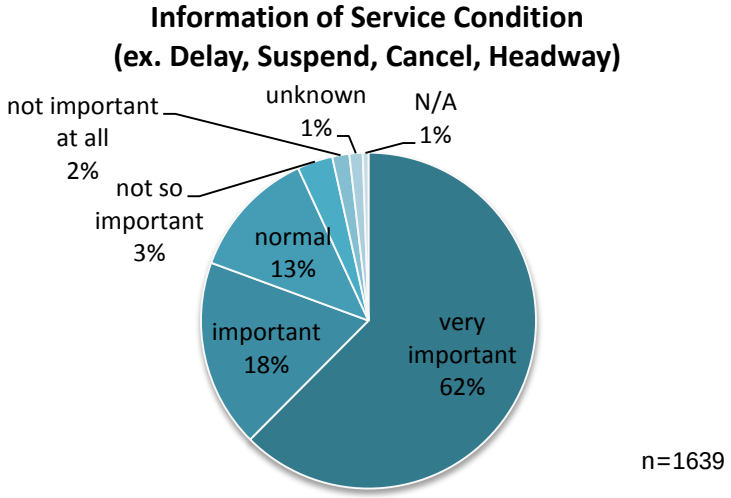
Figure 5-25 Need for Cashless Payment

Service C: Information of Service Condition (e.g., Delay, Suspend, Cancel, and Headway)

< For Work Purpose>



<For Private Purpose>

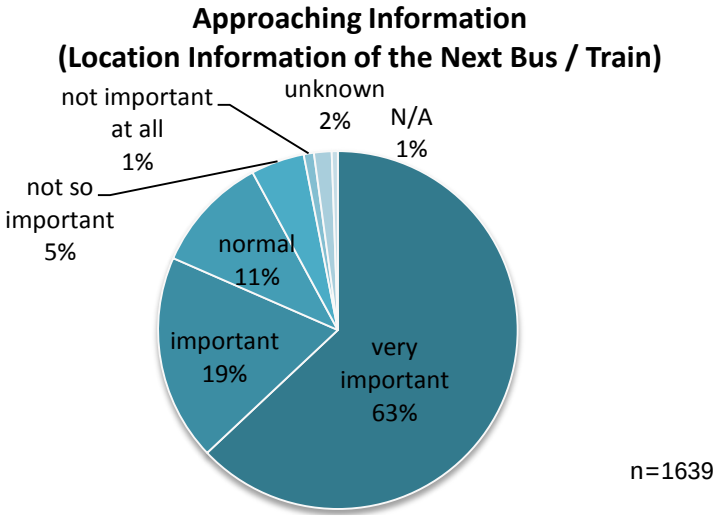


Source: JICA Study Team

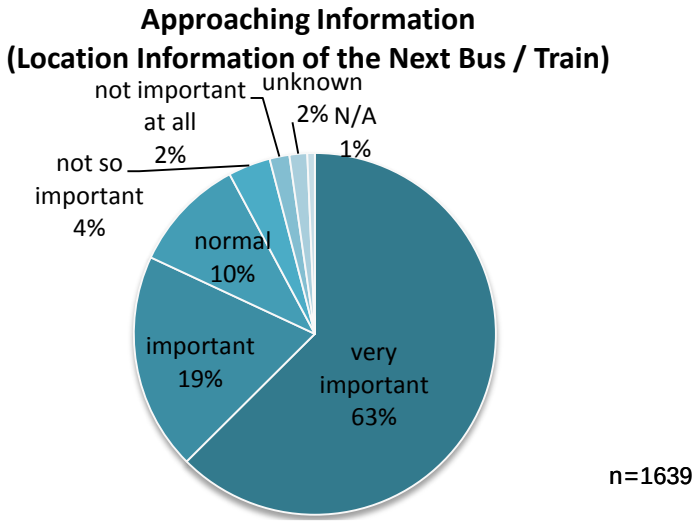
Figure 5-26 Need for Information of Service Condition (e.g., Delay, Suspend, Cancel, and Headway)

Service D: Approaching Information (Location Information of the Next Bus/Train)

< For Work Purpose>



<For Private Purpose>

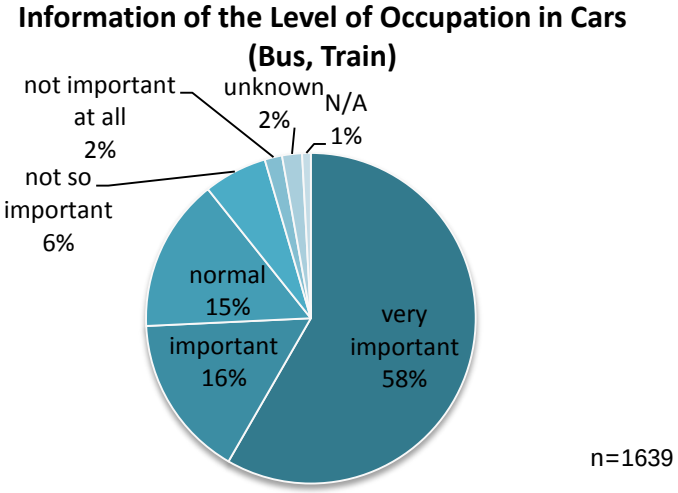


Source: JICA Study Team

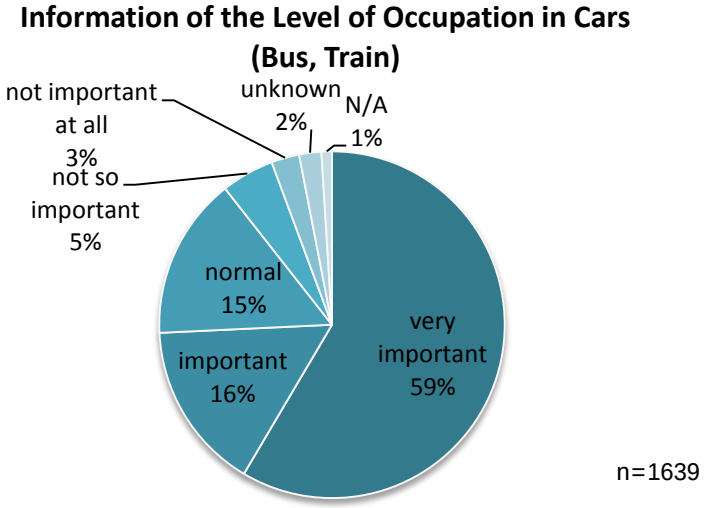
Figure 5-27 Need for Approaching Information (Location Information of the Next Bus/Train)

Service E: Information of the Level of Occupation in Cars (Bus, Train)

< For Work Purpose>



<For Private Purpose>

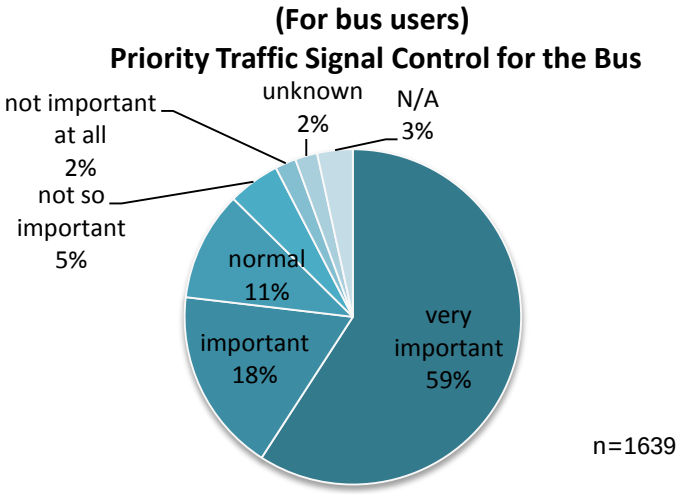


Source: JICA Study Team

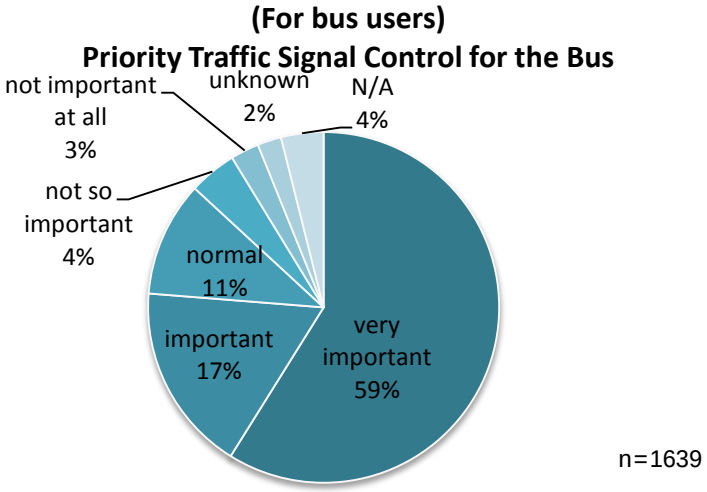
Figure 5-28 Need for Information of the Level of Occupation in Cars (Bus and Train)

Service F: (For Bus Users) Priority Traffic Signal Control for the Bus

< For Work Purpose>



<For Private Purpose>



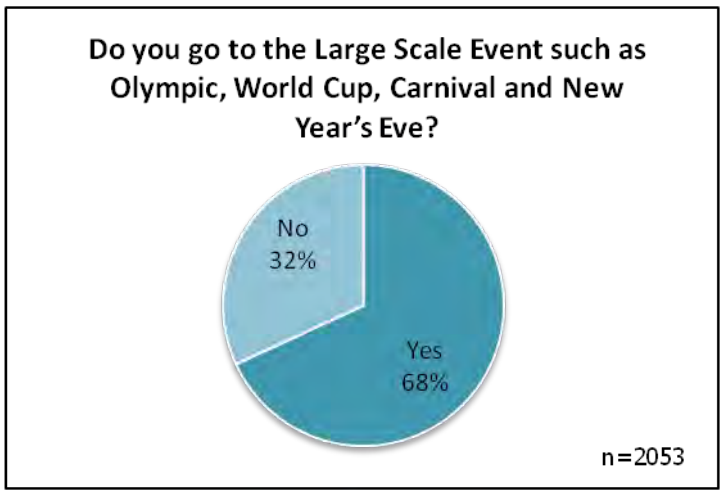
Source: JICA Study Team

Figure 5-29 Need for Priority Traffic Signal Control for the Bus

iii) Large-scale Events

[Do you go to large-scale events such as the Olympics, World Cup, Carnival, and New Year's Eve?]

About 70% of the samples go to a large-scale event such as the Olympics. Only large-scale event visitors answered the next question.

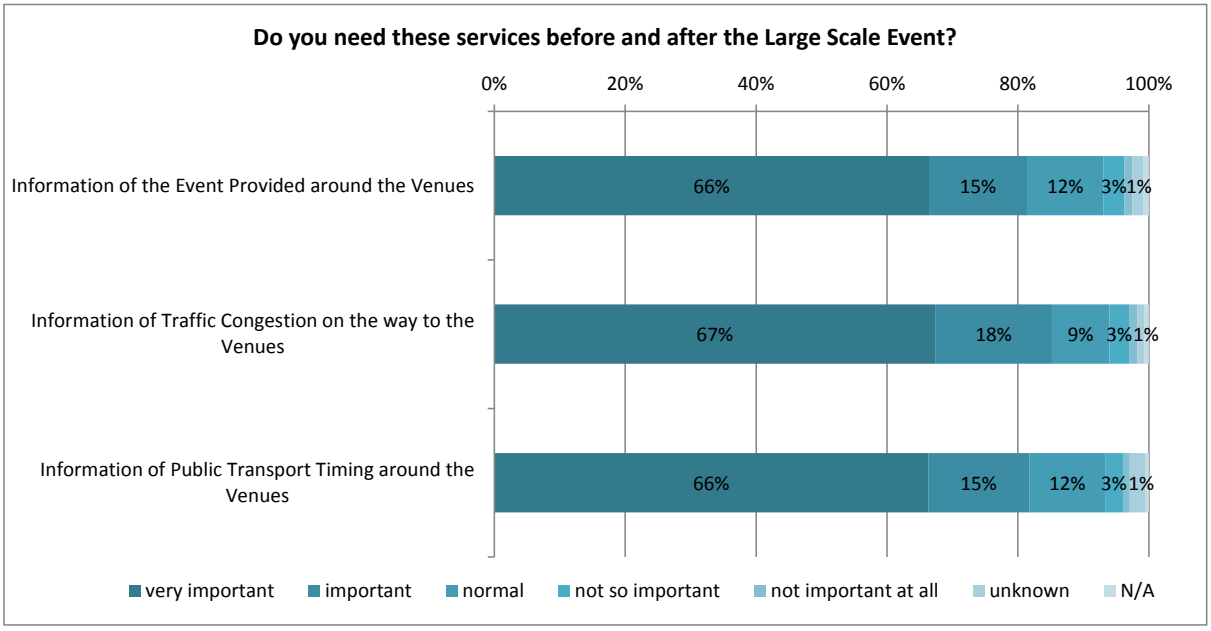


Source: JICA Study Team

Figure 5-30 Event Visitors

[Do you need these services before and after the large-scale event?]

More than 80% of the samples answered that ITS services are important in the case of large-scale events. "Information on traffic congestion on the way to the venues" seems to be especially important to them.



Source: JICA Study Team

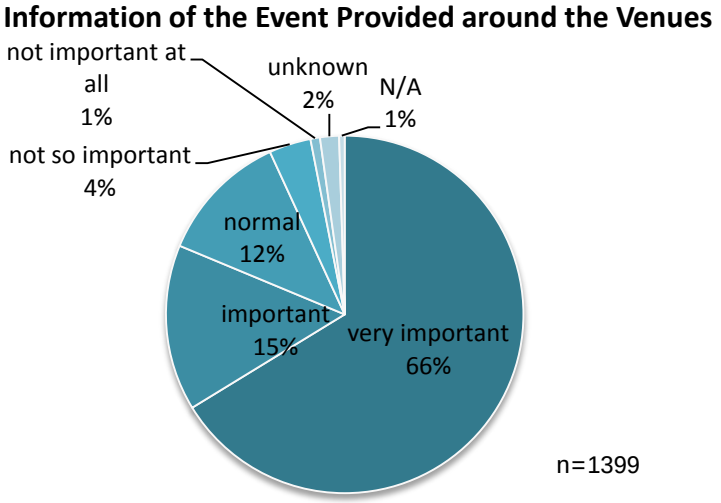
Figure 5-31 ITS Needs for Large-Scale Events

[Do you need these services before and after a large-scale event?]

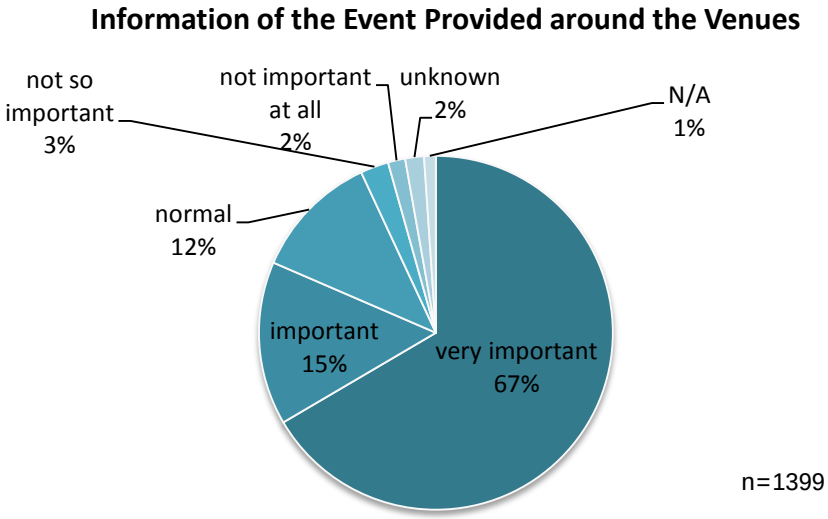
The following are the results for each service.

Service A: Information of the Event Provided around the Venues

< Before the Event>



<After the Event>

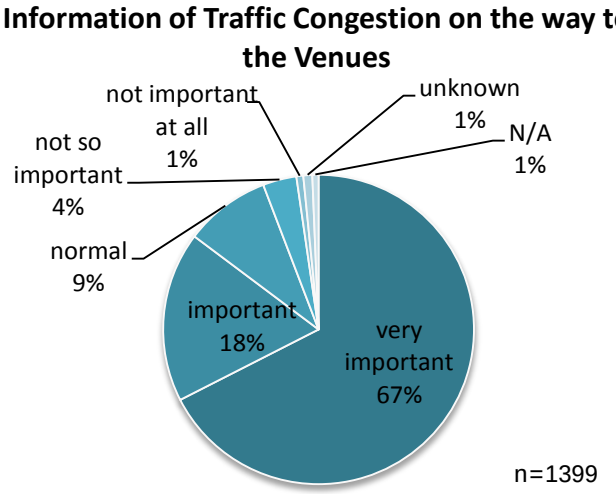


Source: JICA Study Team

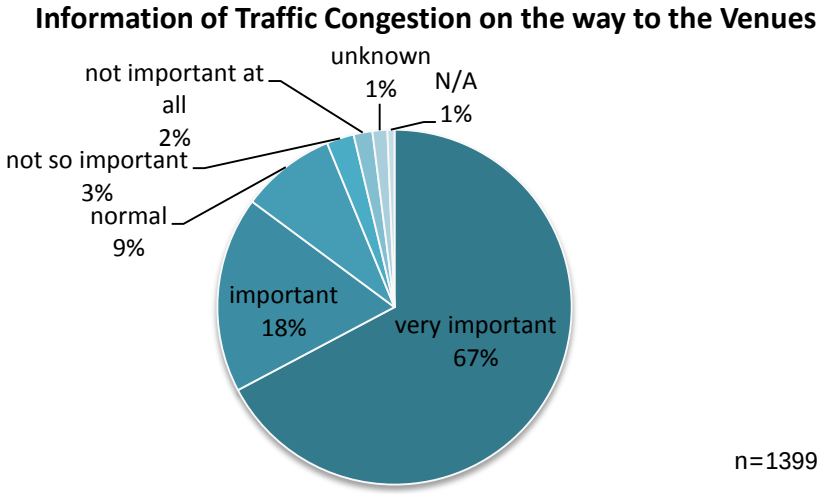
Figure 5-32 Need for Information of the Event Provided around the Venues

Service B: Information of Traffic Congestion on the way to the Venues

< Before the Event>



<After the Event>

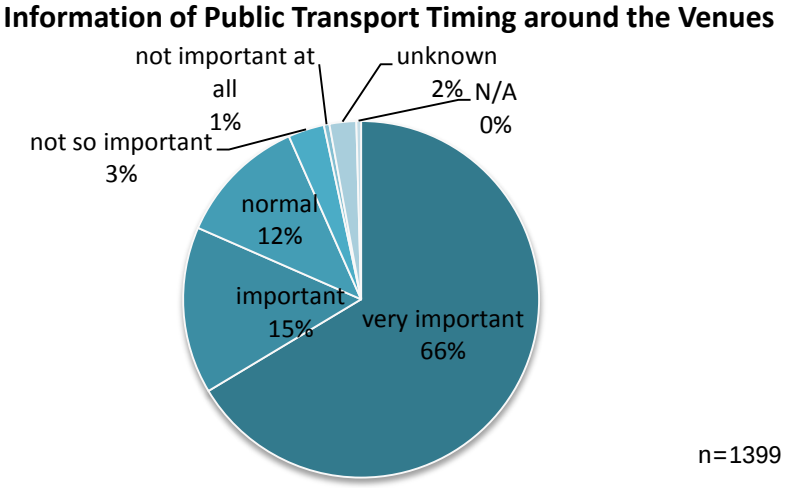


Source: JICA Study Team

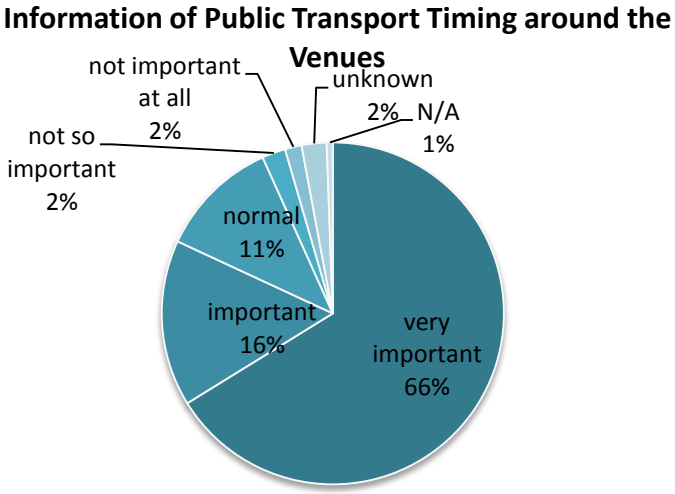
Figure 5-33 Need for Information of Traffic Congestion on the Way to the Venues

Service C: Information of Public Transport Timing around the Venues

< Before the Event>



<After the Event>



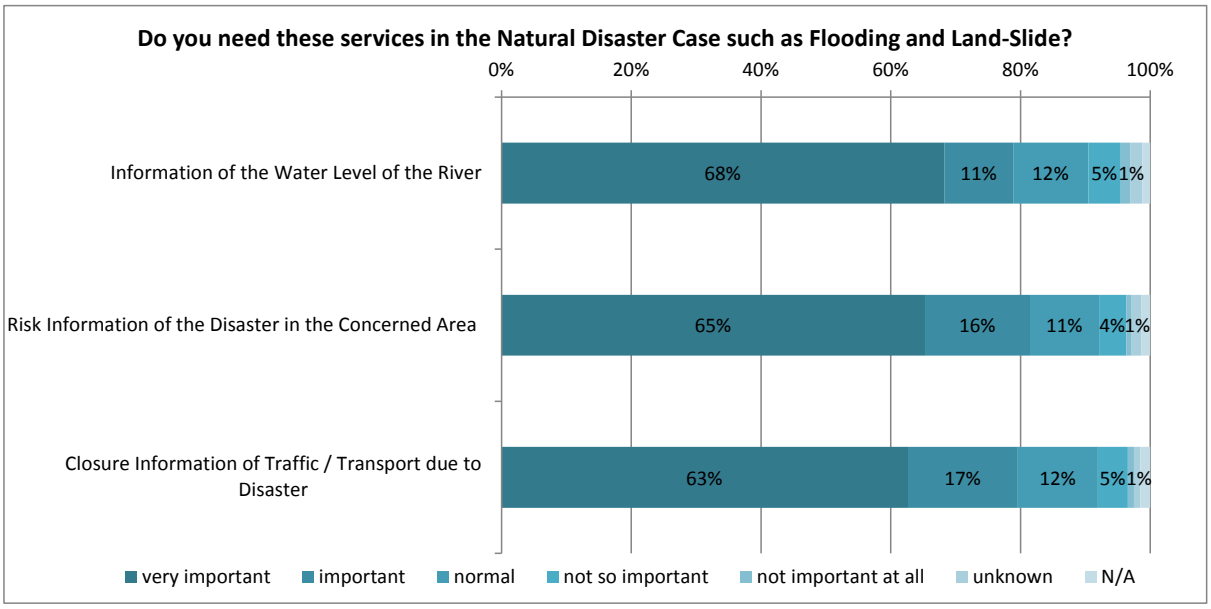
Source: JICA Study Team

Figure 5-34 Need for Information of Public Transport Timing around the Venues

iv) Natural Disaster

[Do you need these services in case of natural disaster such as flooding or landslide?]

About 80% of all the samples answered that ITS services are important in case of natural disasters. “Risk information on the disaster in the concerned area” seems to be especially important to them. This result indicates that disaster monitoring is important to reduce the risk of natural disasters.



Source: JICA Study Team

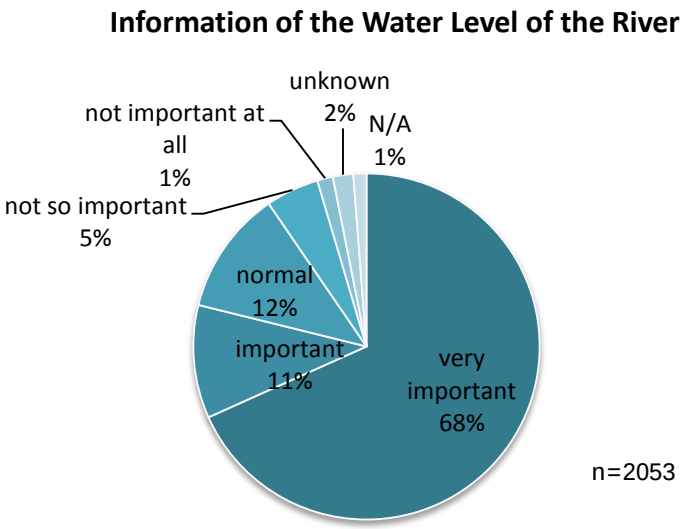
Figure 5-35 ITS Needs in case of Natural Disaster

[Do you need these services in case of natural disaster such as flooding or landslide?]

The following are the results for each service.

Service A: Information of the Water Level of the River

<In case of Natural Disaster>

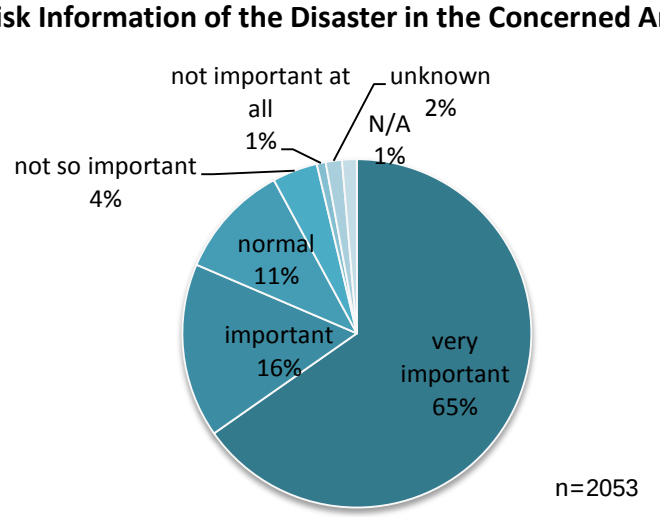


Source: JICA Study Team

Figure 5-36 Need for Information of the Water Level of the River

Service B: Risk Information of the Disaster in the Concerned Area

<In case of Natural Disaster>

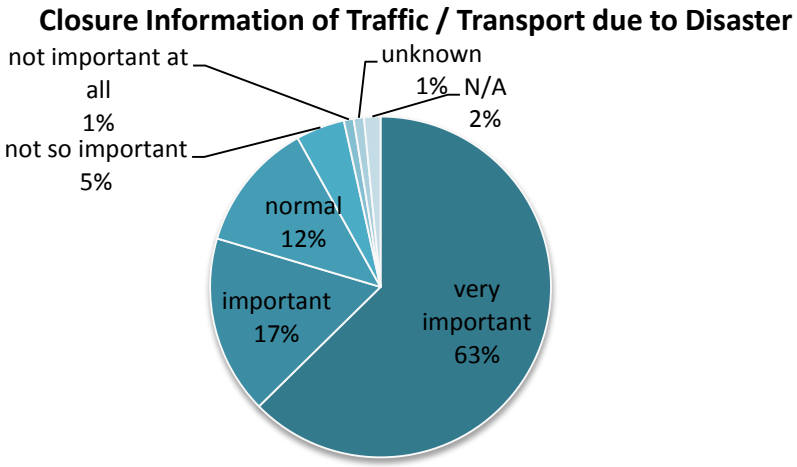


Source: JICA Study Team

Figure 5-37 Need for Disaster Risk Information in the Concerned Area

Service C: Traffic/Transport Closure Information due to Disaster

<In case of Natural Disaster>



Source: JICA Study Team

Figure 5-38 Need for Traffic/Transport Closure Information due to Disaster

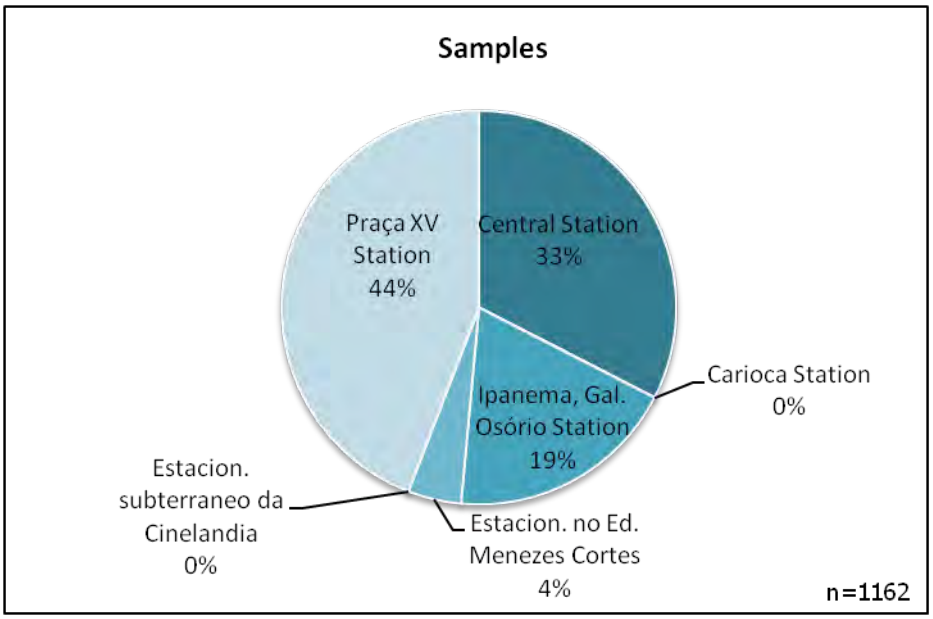
(2) August 12, 2012 (Sunday)

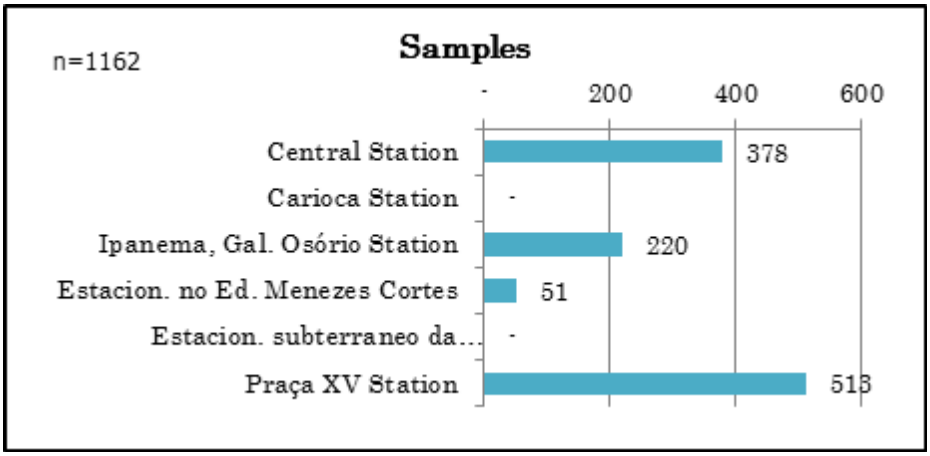
1) Basic Information of Samples

i) Samples

Total number of samples: 1162

The number of samples from each location is shown in Figure 5-39.



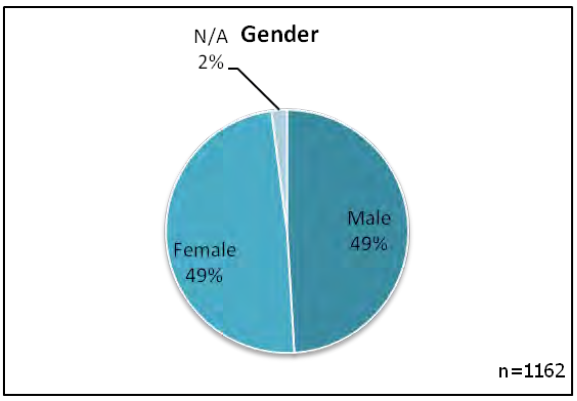


Source: JICA Study Team

Figure 5-39 Samples

ii) Gender

The percentage of male is 49%, and of female is 49%.

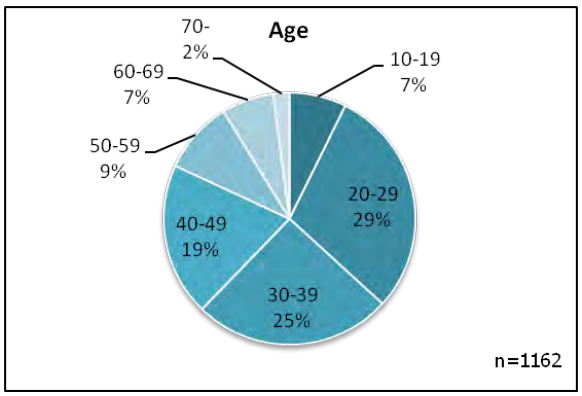


Source: JICA Study Team

Figure 5-40 Gender

iii) Age

The percentages of samples in their 20s, 30s, and 40's are large, as shown in Figure 5-41. Their combined percentage is 73% of all the samples.

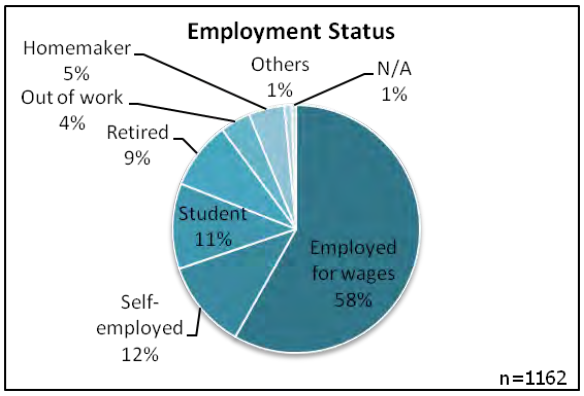


Source: JICA Study Team

Figure 5-41 Age

iv) Employment Status

The samples that are employed for wages have the top share at 58%, followed by samples that are self-employed. Of all the samples, 70% are working.



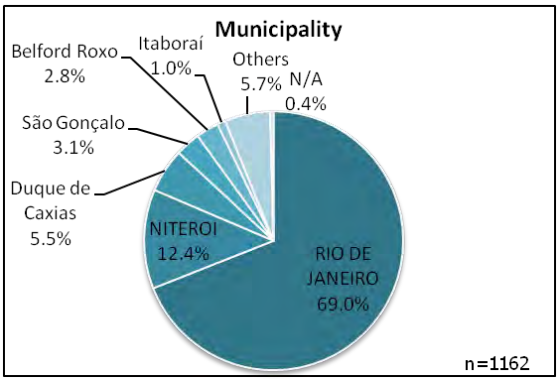
Source: JICA Study Team

Figure 5-42 Employment Status

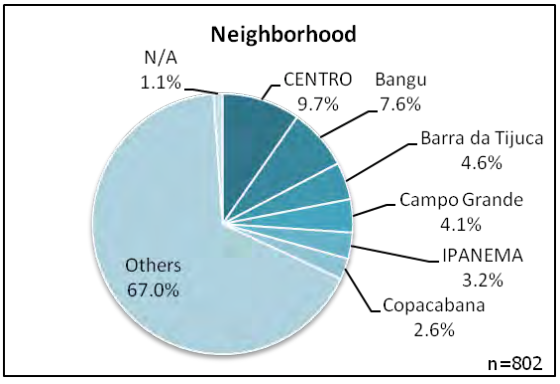
v) Home Address

Most of the samples live in Rio de Janeiro, Niteroi, or Duque de Caxias. In Rio de Janeiro, the home addresses of the samples vary but the percentages of those living in Centro, Barra da Tijuca, Bangu, Campo Grande, Ipanema and Copacabana are relatively high.

[Municipality]



[Neighborhood in Rio de Janeiro City]



Source: JICA Study Team

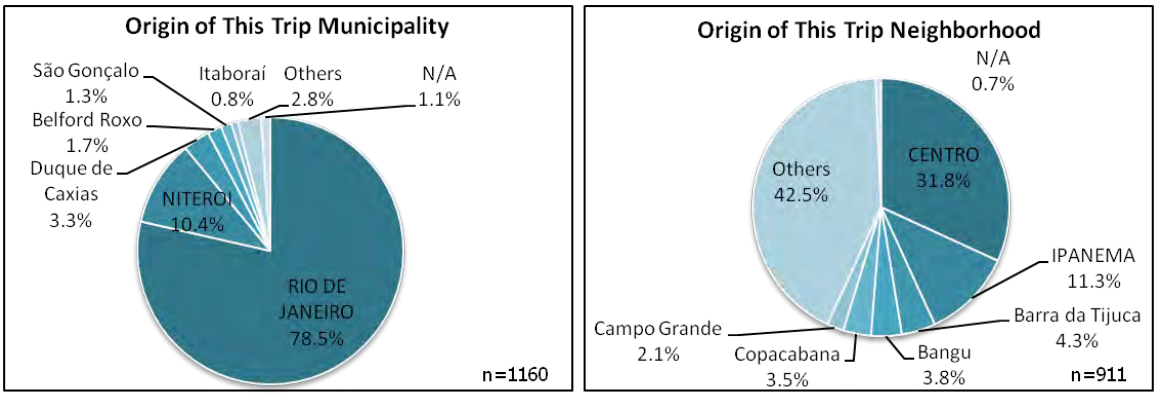
Figure 5-43 Home Address

2) Information of Trip

i) Origin of This Trip

Rio de Janeiro and Niteroi have the highest proportions of origins of the trips.

[Municipality] [Neighborhood in Rio de Janeiro City]



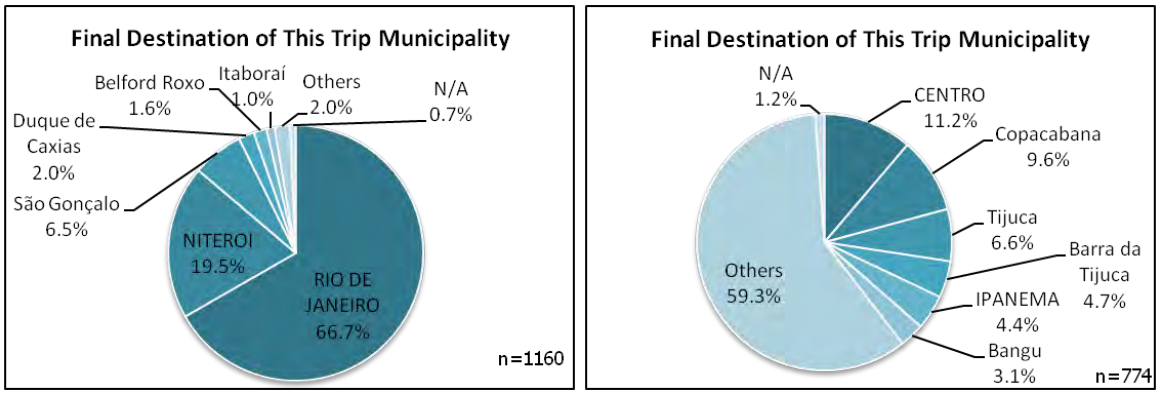
Source: JICA Study Team

Figure 5-44 Origin of This Trip

ii) Final Destination of This Trip

The characteristics of the destination are almost the same as the origin. This is because the purposes of the trips of the samples consist of “leaving home” and “going home”.

[Municipality] [Neighborhood in Rio de Janeiro City]

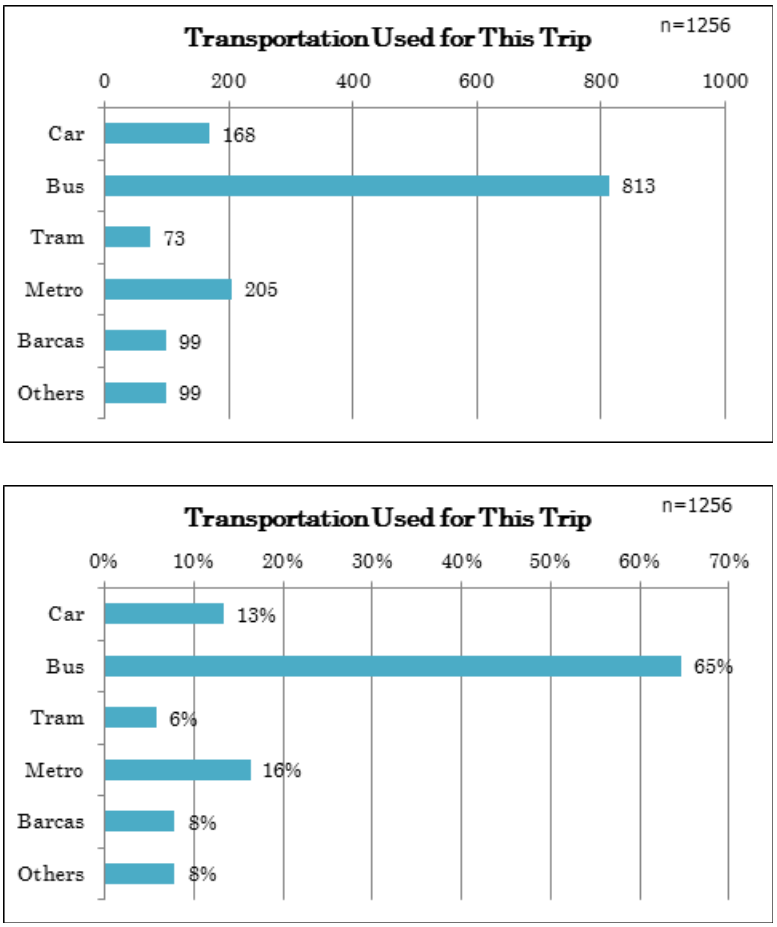


Source: JICA Study Team

Figure 5-45 Final Destination of This Trip

iii) Transportation Used for This Trip

Only 13% of all the samples use cars during the weekend, while 65% of samples use the bus for their trips.

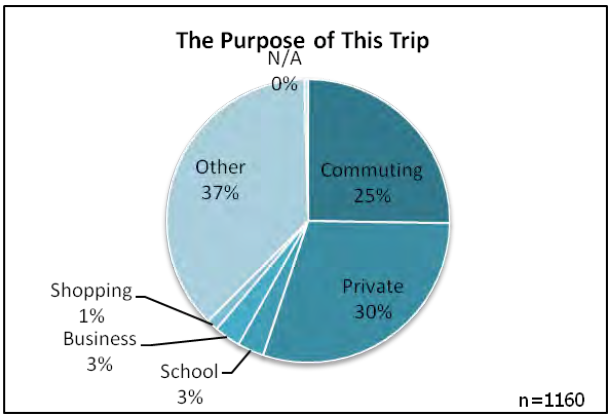


Source: JICA Study Team

Figure 5-46 Transportation Used for This Trip

iv) Purpose of This Trip

In the weekend, the main purposes of the samples were commuting and private.



Source: JICA Study Team

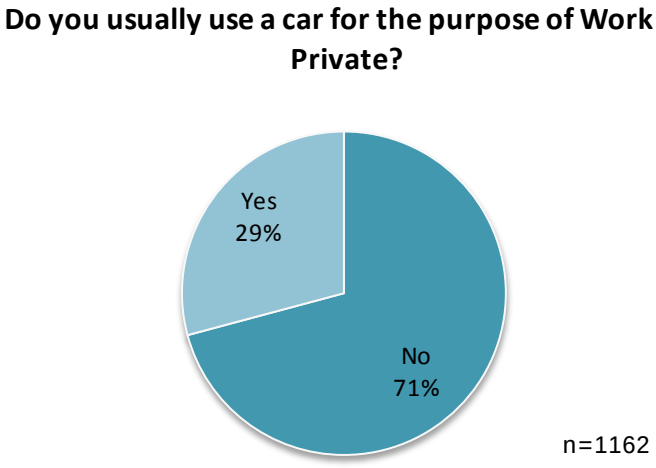
Figure 5-47 Purpose of This Trip

3) ITS Services Needs

i) For Car Users

[Do you usually use a car for work or private purposes?]

About 30% of all the samples usually use a car for work or private purposes. Only car users were asked the next question.

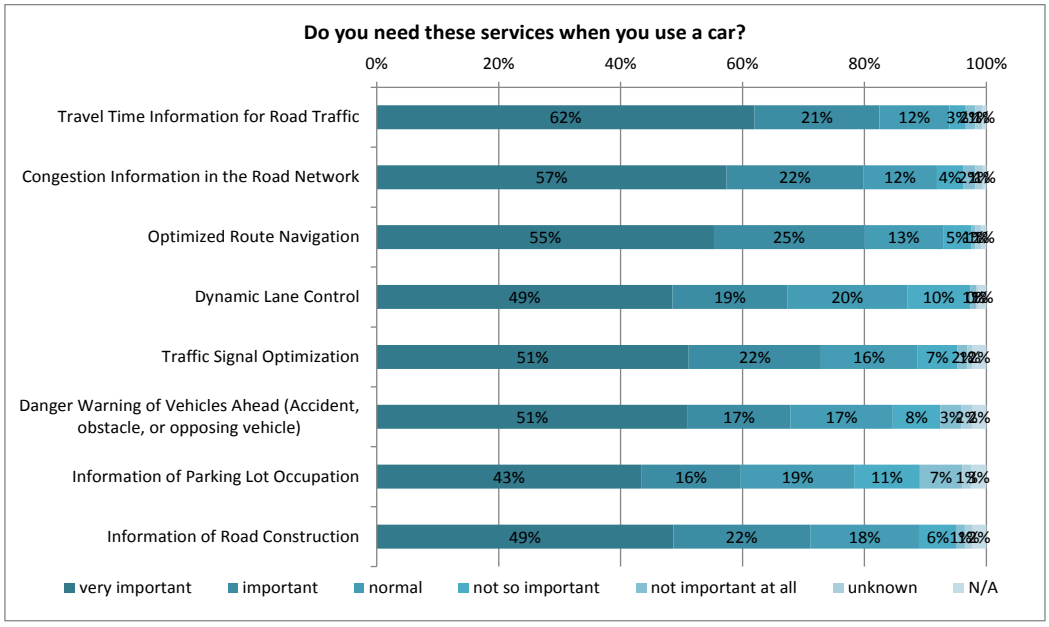


Source: JICA Study Team

Figure 5-48 Car Use

[Need for ITS service for car users]

About 80% of the samples answered that some of the ITS services are important for their car use. "Travel time information for road traffic", "Congestion information in the road network" and "Optimized route navigation" seem to be especially important to them. Other services seem to be less important during the weekend.



Source: JICA Study Team

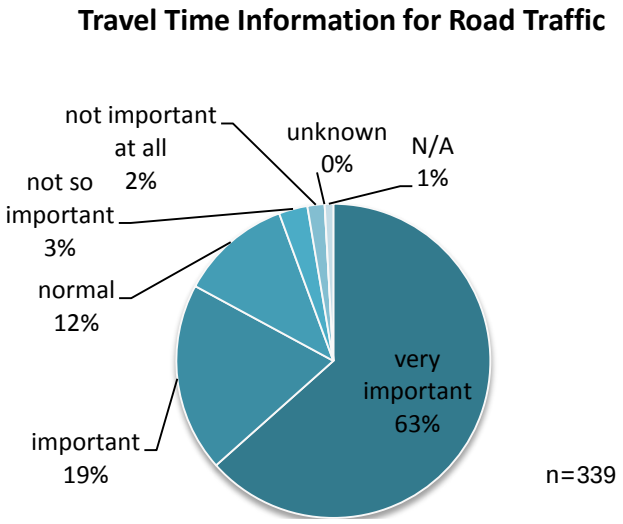
Figure 5-49 ITS Needs of Car Users

[Do you need these services when you use a car?]

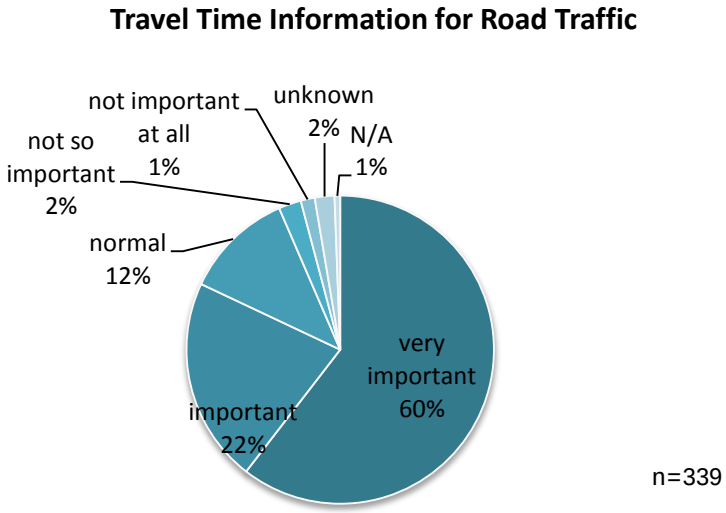
The following are the results for each service.

Service A: Travel Time Information for Road Traffic

< For Work Purpose>



<For Private Purpose>

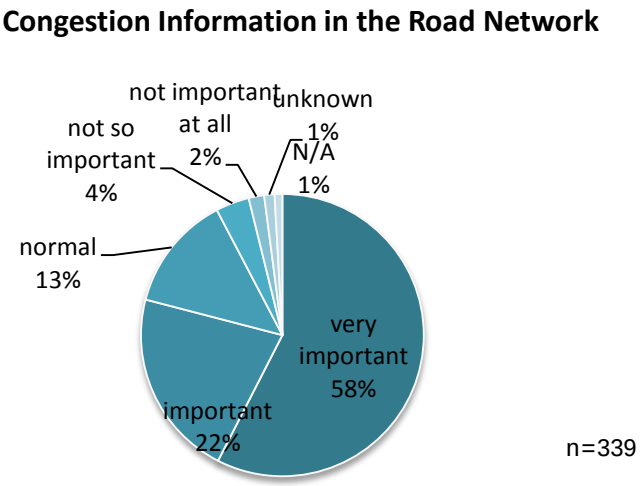


Source: JICA Study Team

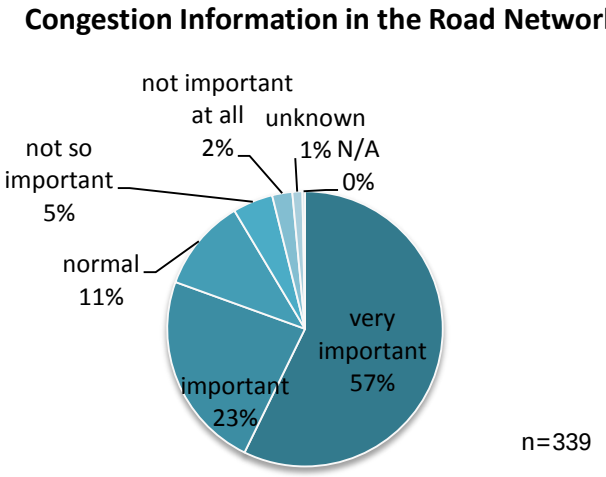
Figure 5-50 Need for Travel Time Information for Road Traffic

Service B: Congestion Information in the Road Network

< For Work Purpose>



<For Private Purpose>

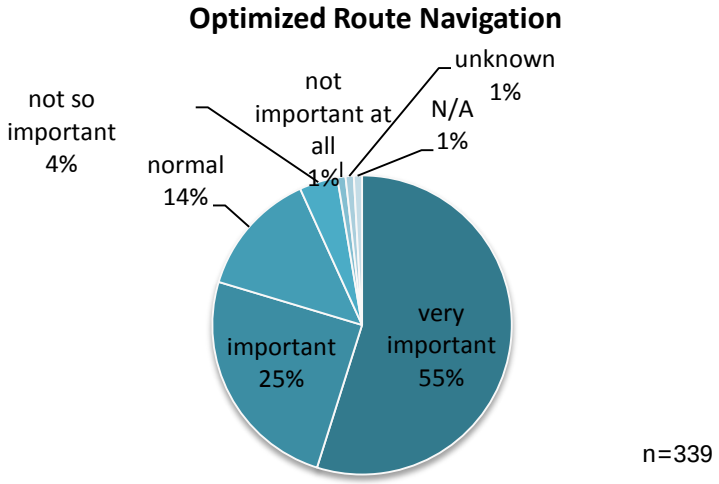


Source: JICA Study Team

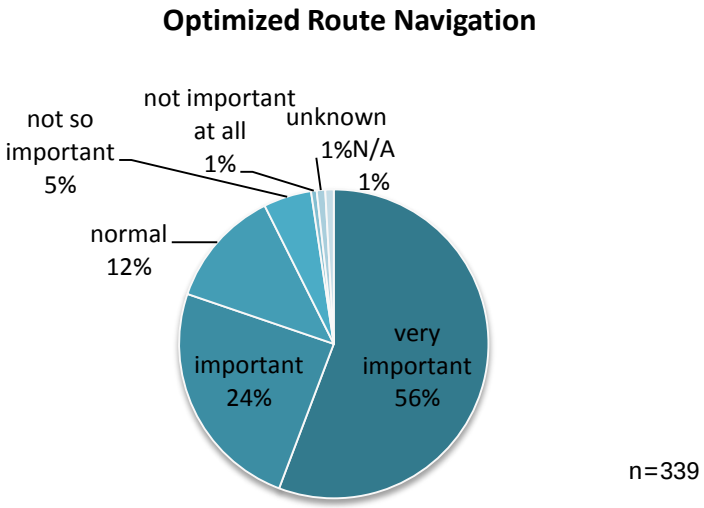
Figure 5-51 Need for Congestion Information in the Road Network

Service C: Optimized Route Navigation

< For Work Purpose>



<For Private Purpose>

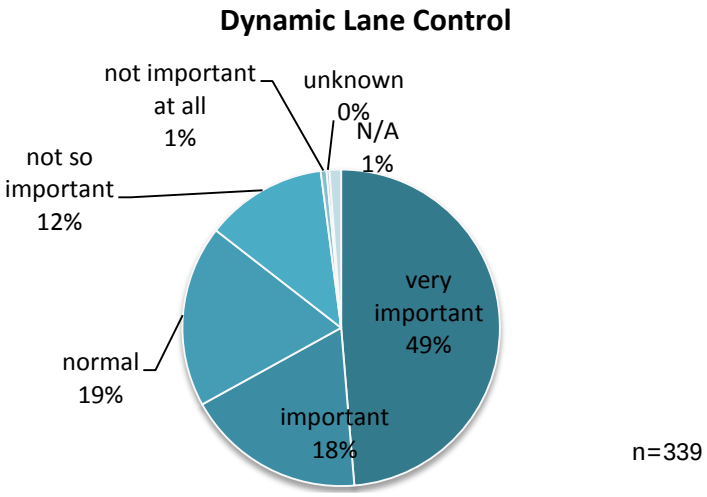


Source: JICA Study Team

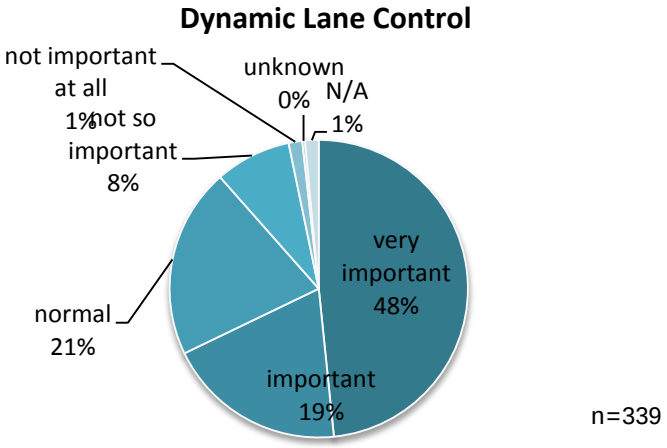
Figure 5-52 Need for Optimized Route Navigation

Service D: Dynamic Lane Control

< For Work Purpose>



<For Private Purpose>

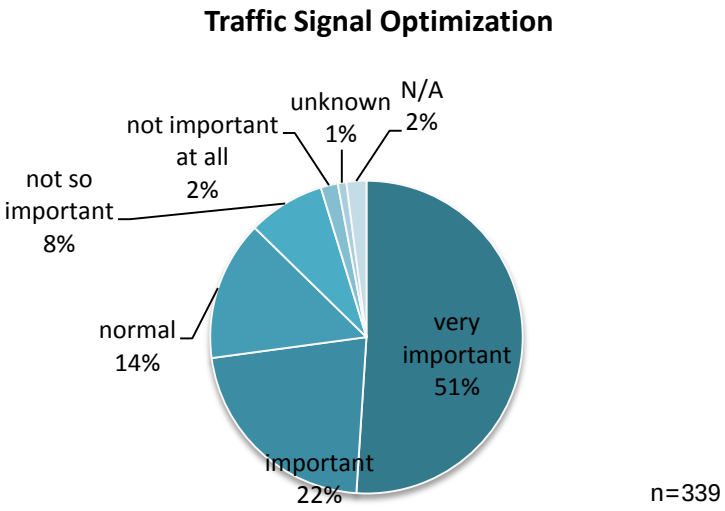


Source: JICA Study Team

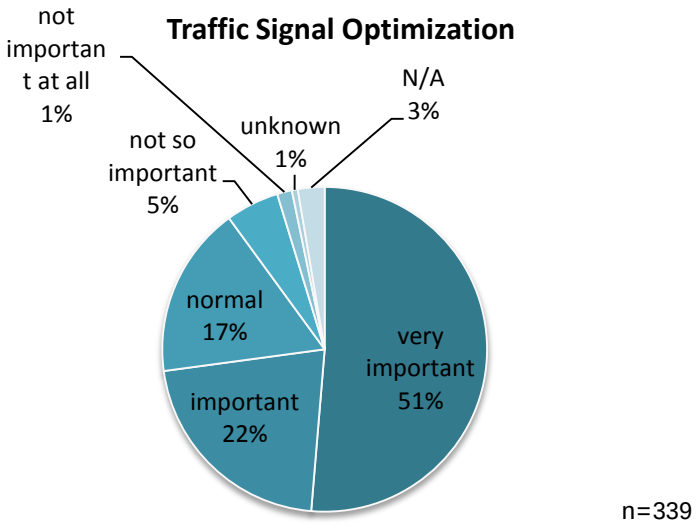
Figure 5-53 Need for Dynamic Lane Control

Service E: Traffic Signal Optimization

< For Work Purpose>



<For Private Purpose>

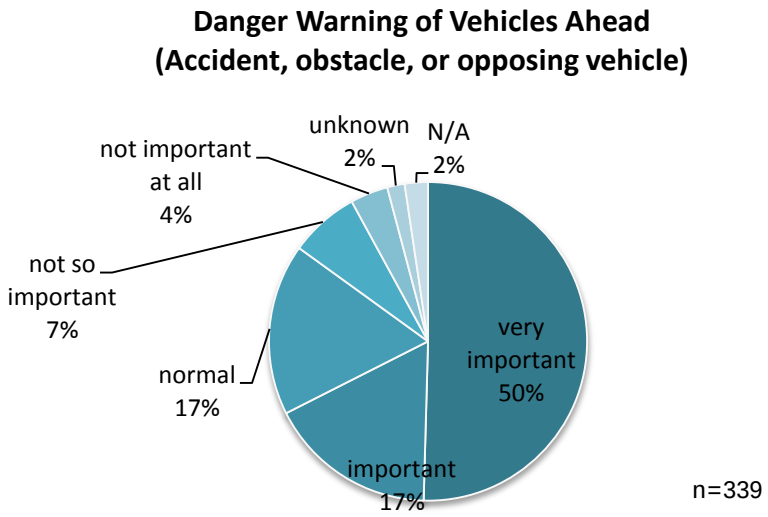


Source: JICA Study Team

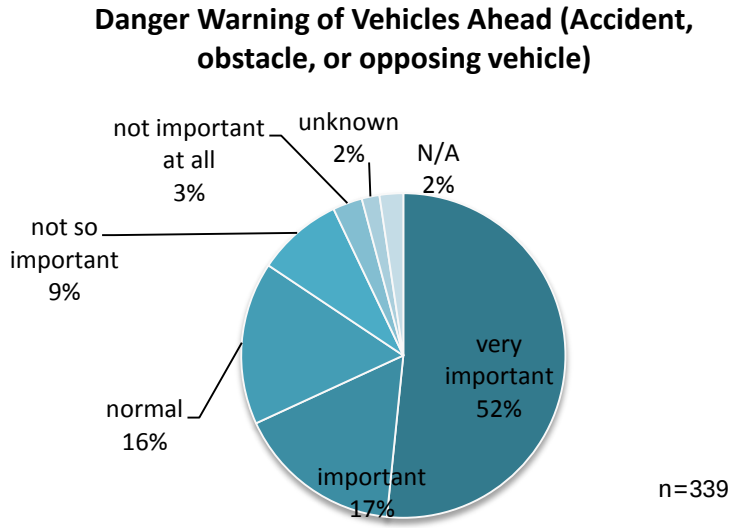
Figure 5-54 Need for Traffic Signal Optimization

Service F: Danger Warning of Vehicles Ahead (Accident, Obstacle, or Opposing Vehicle)

< For Work Purpose>



<For Private Purpose>

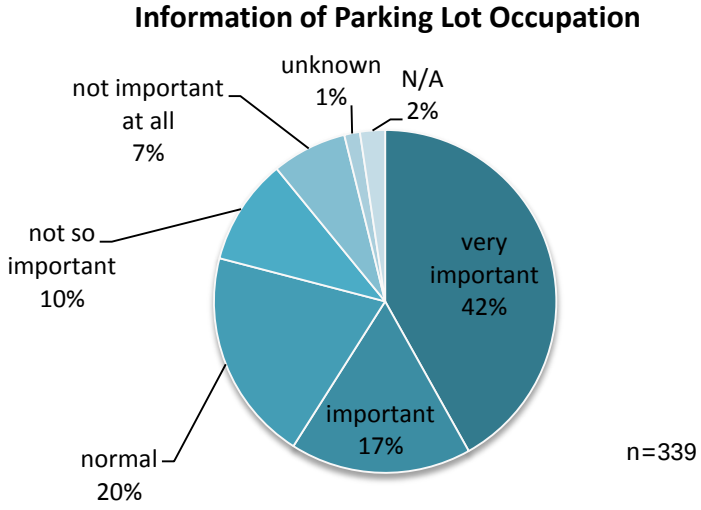


Source: JICA Study Team

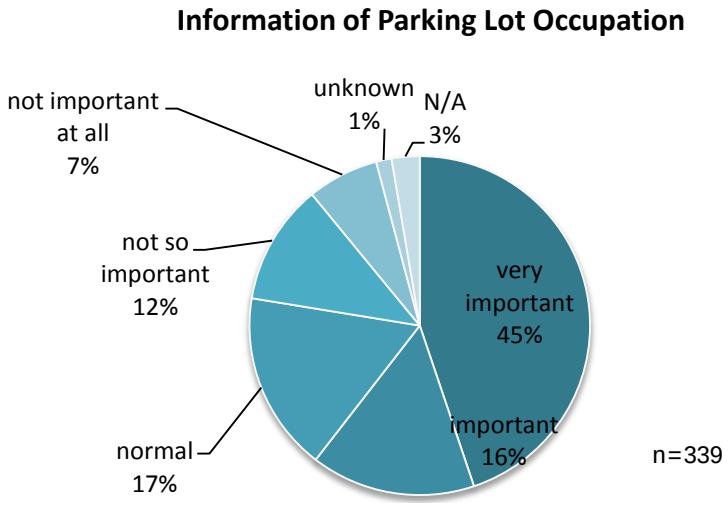
Figure 5-55 Need for Danger Warning of Vehicles Ahead (Accident, Obstacle, or Opposing Vehicle)

Service G: Information of Parking Lot Occupation

< For Work Purpose>



<For Private Purpose>

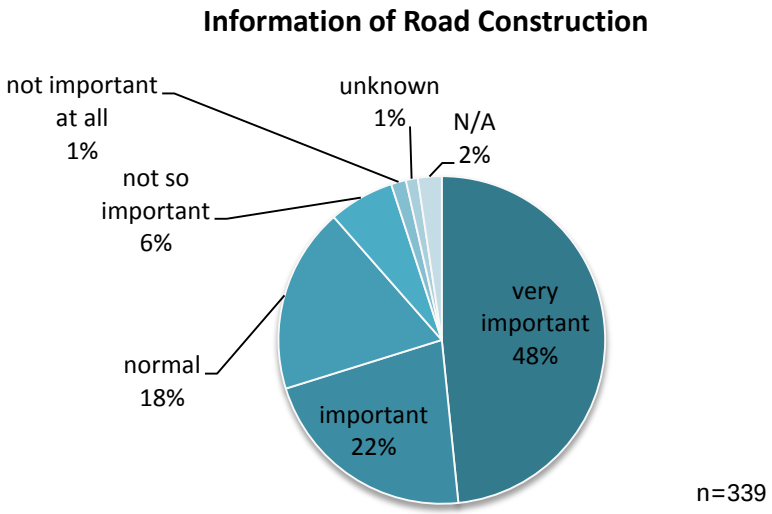


Source: JICA Study Team

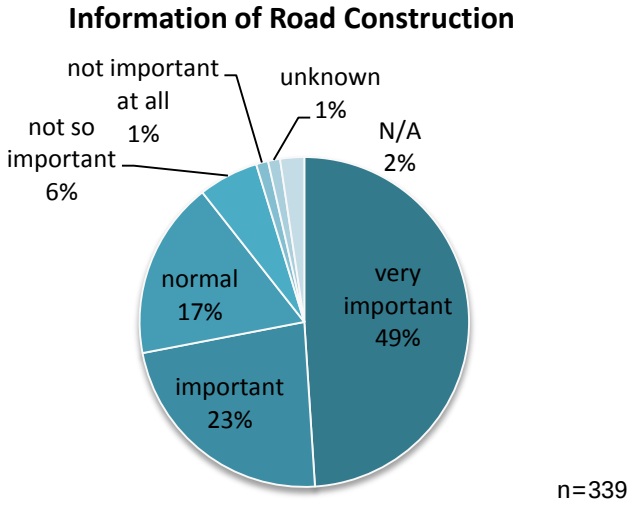
Figure 5-56 Need for Information of Parking Lot Occupation

Service H: Information of Road Construction

< For Work Purpose>



<For Private Purpose>



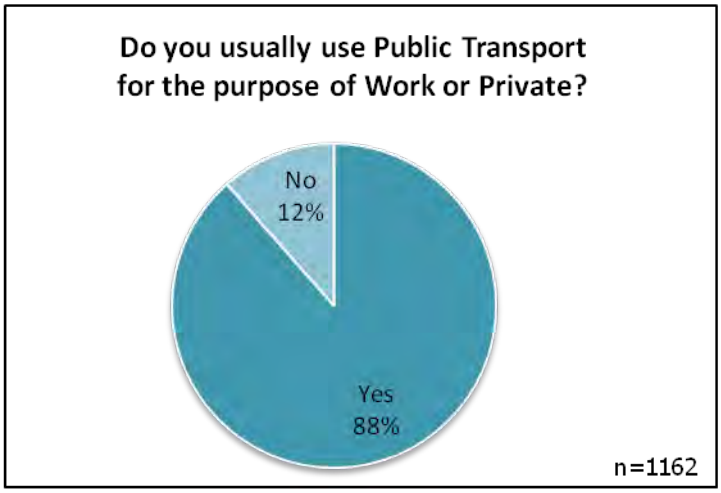
Source: JICA Study Team

Figure 5-57 Need for Information of Road Construction

ii) For Public Transport Users

[Do you usually use public transport for work or private purposes?]

About 90% of all the samples usually use public transport for work or private purposes. Only public transport users were asked the next question.

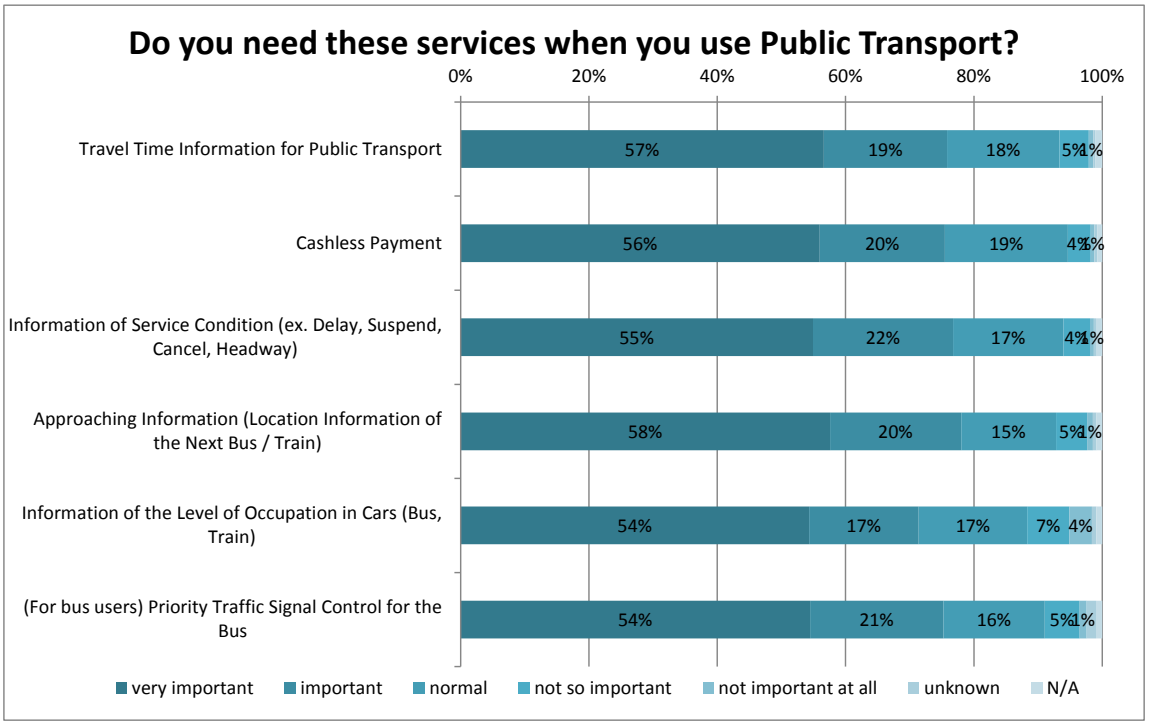


Source: JICA Study Team

Figure 5-58 Public Transport Use

[Need for ITS service for public transport users]

About 80% of all the samples answered that some of the ITS services are important for their public transport use. “Approaching information” and “Information of service condition” seem to be especially important to them. Others seem to be less important during the weekend.



Source: JICA Study Team

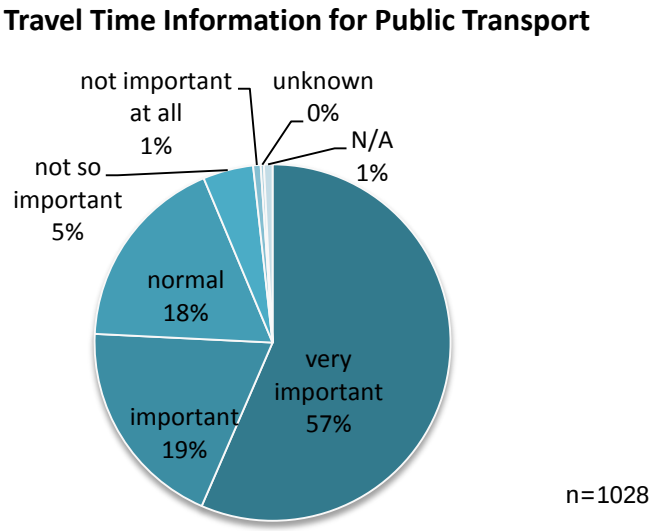
Figure 5-59 ITS Needs of Public Transport Users

[Do you need these services when you use public transport?]

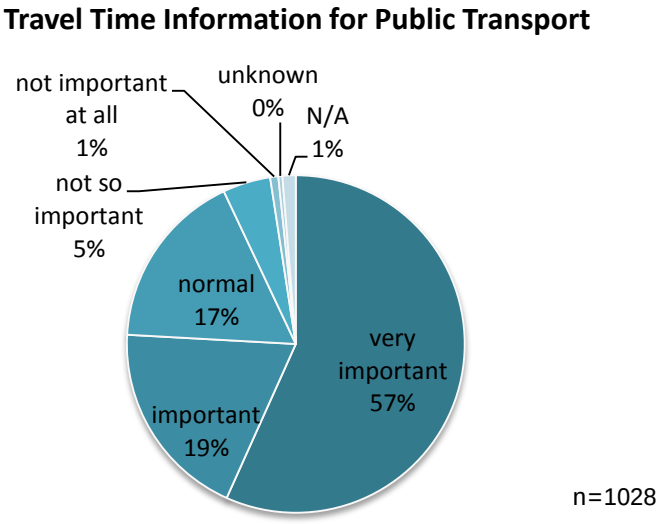
The following are the results for each service.

Service A: Travel Time Information for Public Transport

< For Work Purpose>



<For Private Purpose>

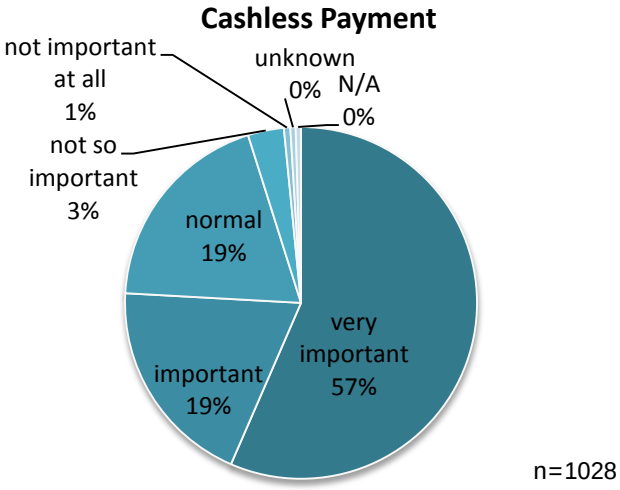


Source: JICA Study Team

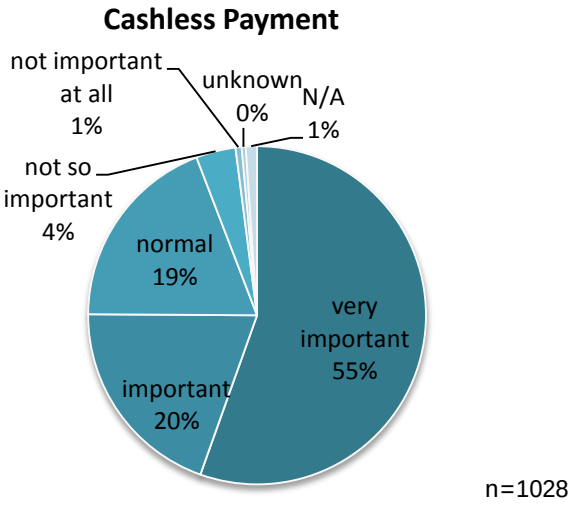
Figure 5-60 Need for Travel Time Information for Public Transport

Service B: Cashless Payment

< For Work Purpose>



<For Private Purpose>

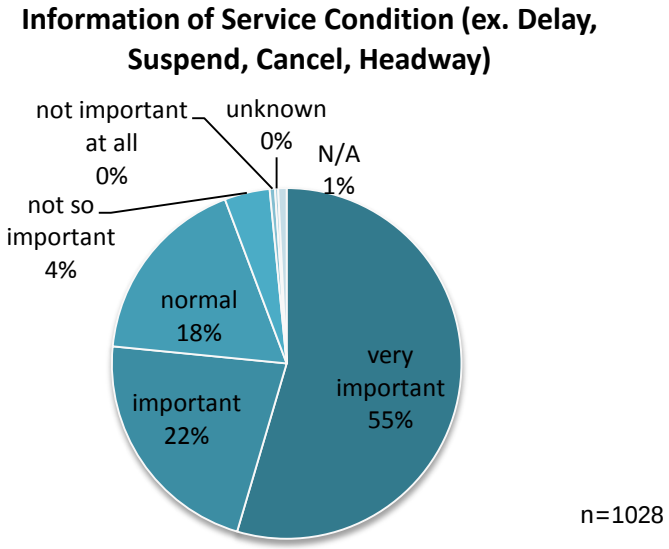


Source: JICA Study Team

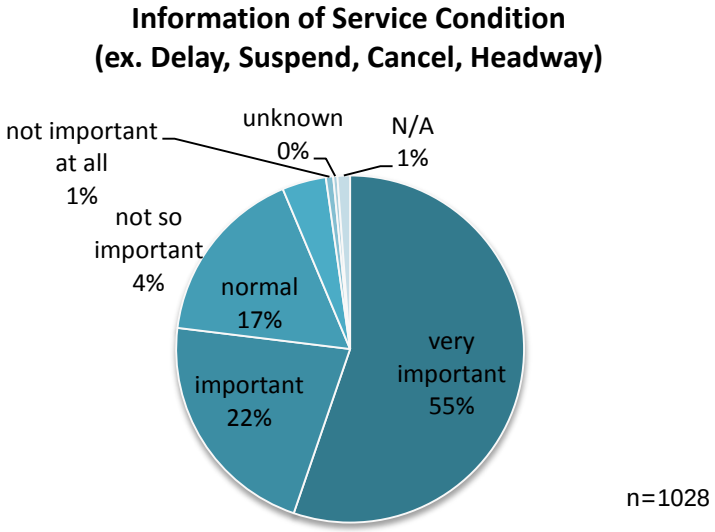
Figure 5-61 Need for Cashless Payment

Service C: Information of Service Condition (e.g., Delay, Suspend, Cancel, and Headway)

< For Work Purpose>



<For Private Purpose>

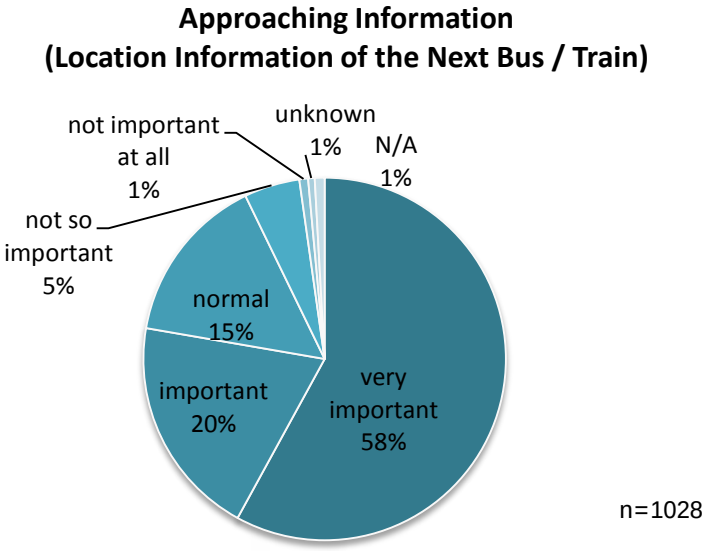


Source: JICA Study Team

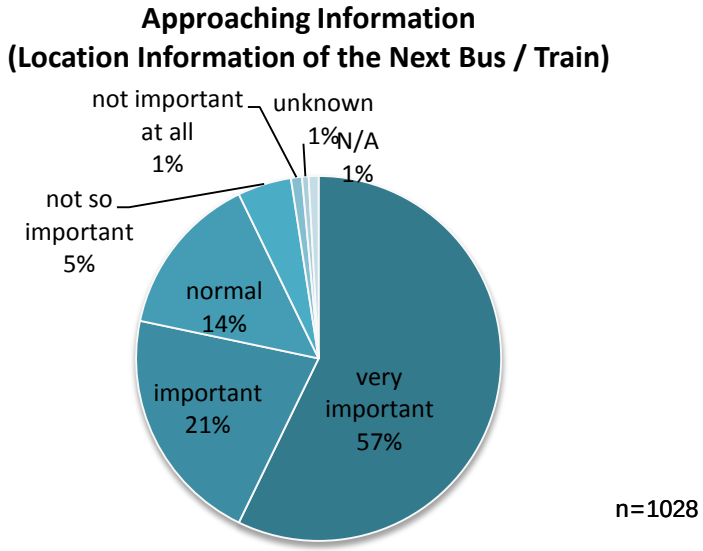
Figure 5-62 Need for Information of Service Condition (e.g., Delay, Suspend, Cancel, and Headway)

Service D: Approaching Information (Location Information of the Next Bus/Train)

< For Work Purpose>



<For Private Purpose>

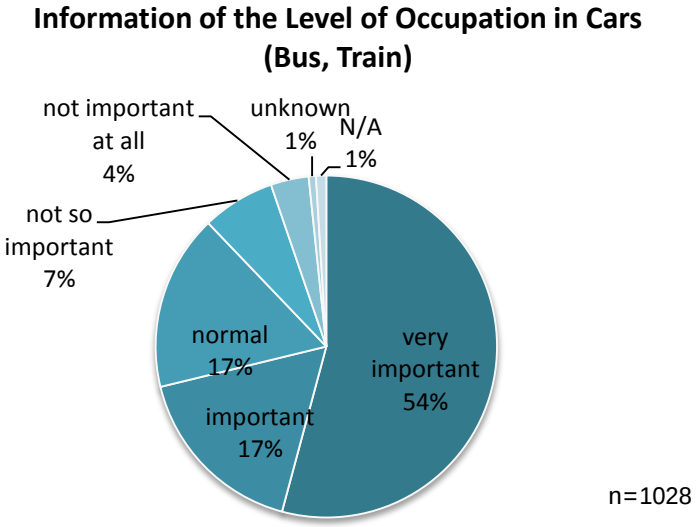


Source: JICA Study Team

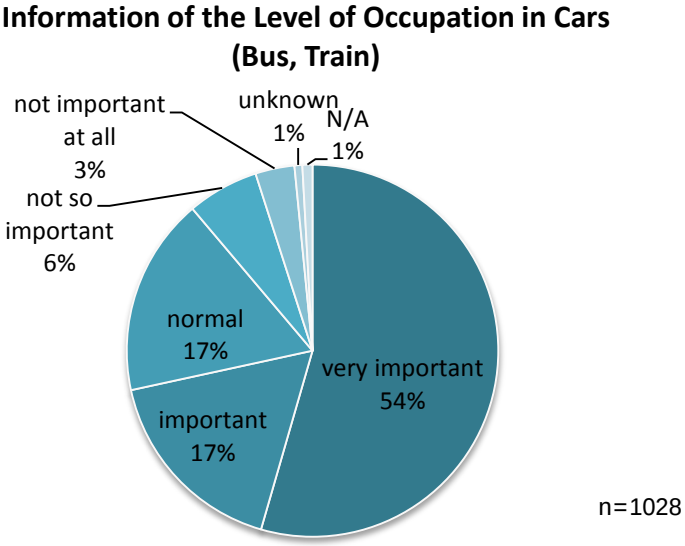
Figure 5-63 Need for Approaching Information (Location Information of the Next Bus/Train)

Service E: Information of the Level of Occupation in Cars (Bus, Train)

< For Work Purpose>



<For Private Purpose >

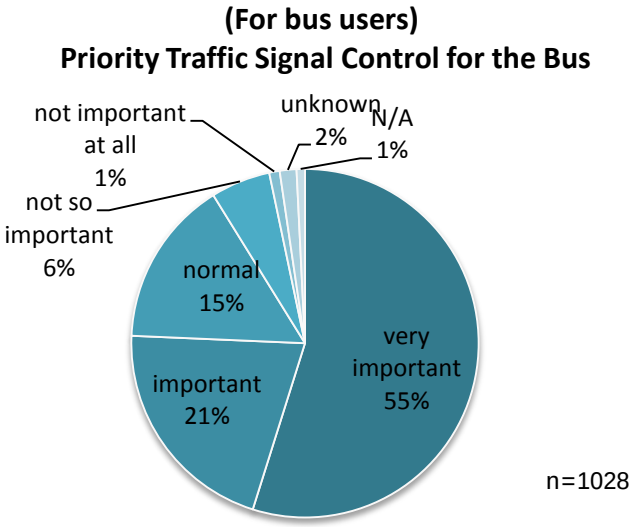


Source: JICA Study Team

Figure 5-64 Need for Information of the Level of Occupation in Cars (Bus, Train)

Service F: (For Bus Users) Priority Traffic Signal Control for the Bus

< For Work Purpose>



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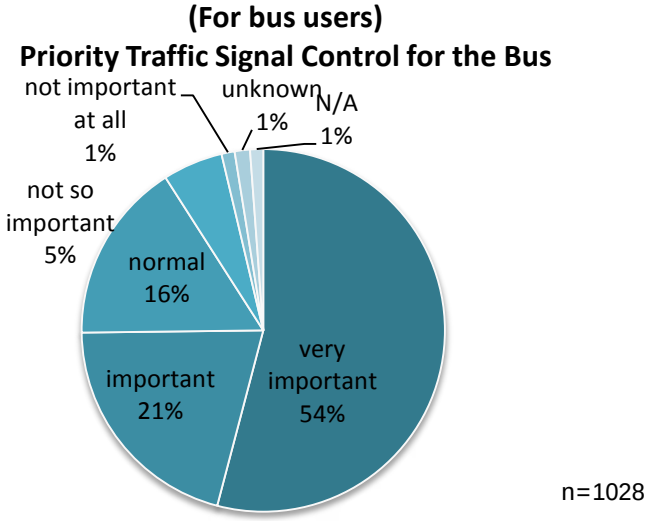


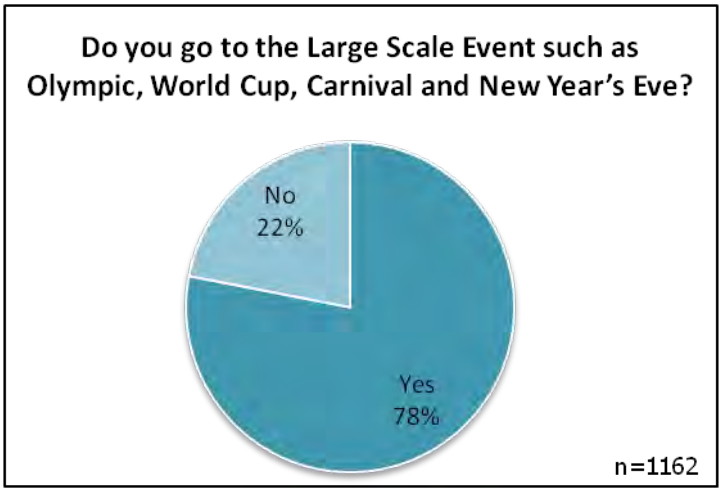
Source: JICA Study Team

Figure 5-65 Need for Priority Traffic Signal Control for the Bus

iii) Large-scale Events

[Do you go to large-sale events, such as the Olympics, World Cup, Carnival, and New Year's Eve?]

About 80% of all the samples go to a large-scale event such as the Olympics. Only large-scale event visitor answered the next question.

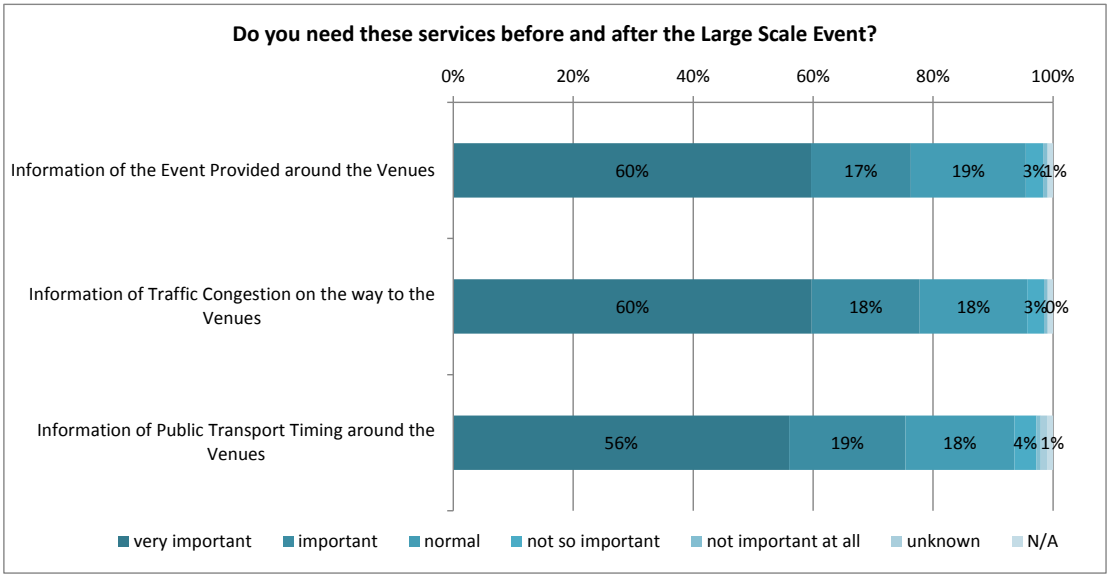


Source: JICA Study Team

Figure 5-66 Event Visitors

[Need for ITS service in a large-scale event]

More than 80% of all the samples answered that ITS services are important in the case of large-scale events. "Information of traffic congestion on the way to the venues" seems to be especially important to them.



Source: JICA Study Team

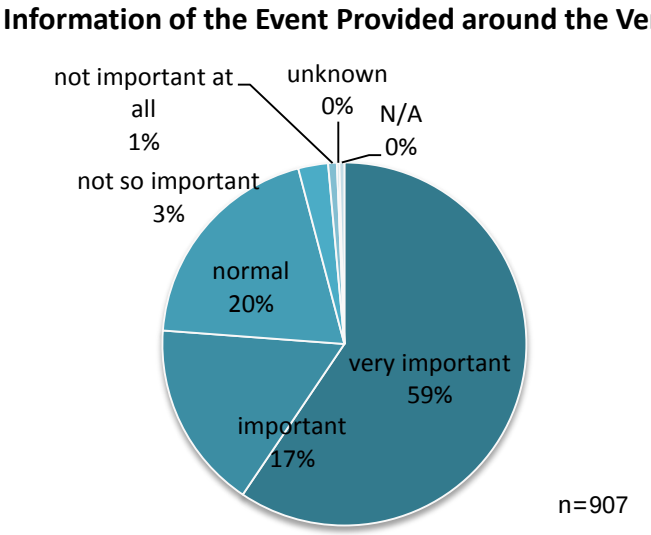
Figure 5-67 ITS Needs for Large-Scale Events

[Do you need these services before and after a large-scale event?]

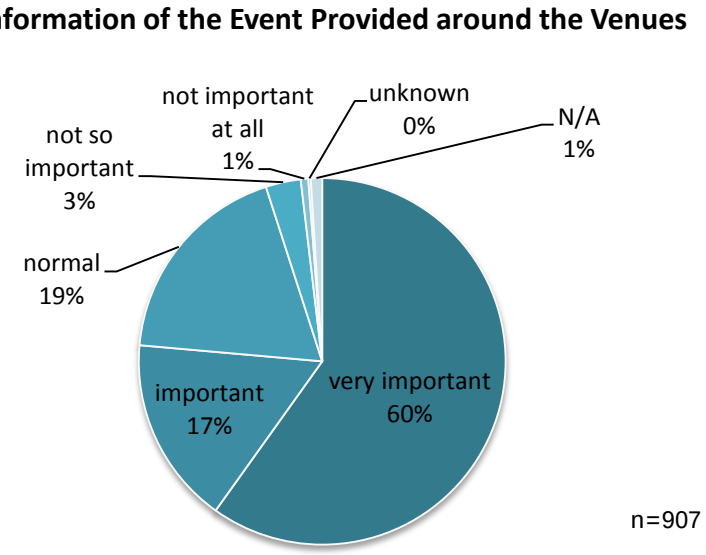
The following are the results for each service.

Service A: Information of the Event Provided around the Venues

< Before the Event>



<After the Event>

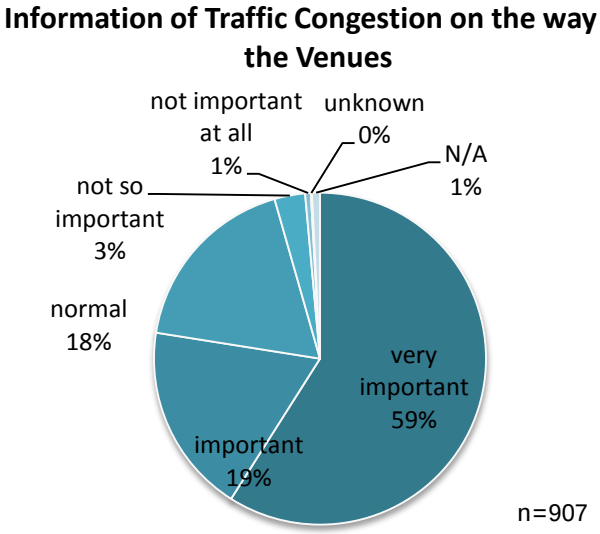


Source: JICA Study Team

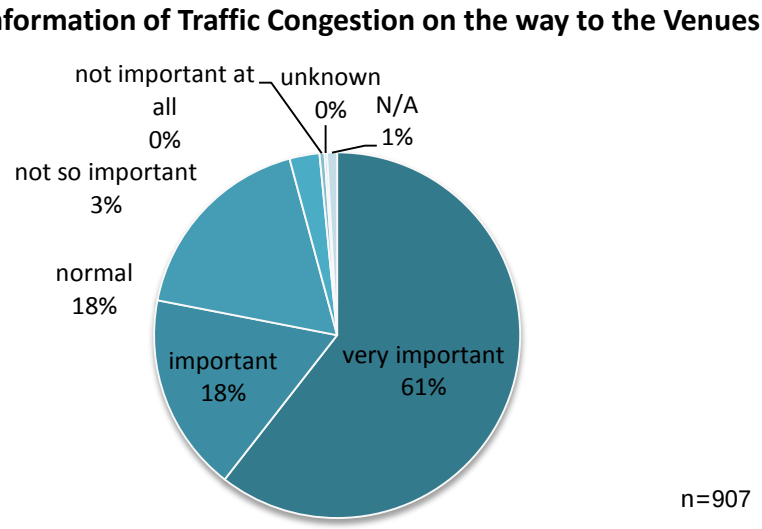
Figure 5-68 Need for Information of the Event Provided around the Venues

Service B: Information of Traffic Congestion on the Way to the Venues

< Before the Event>



<After the Event>

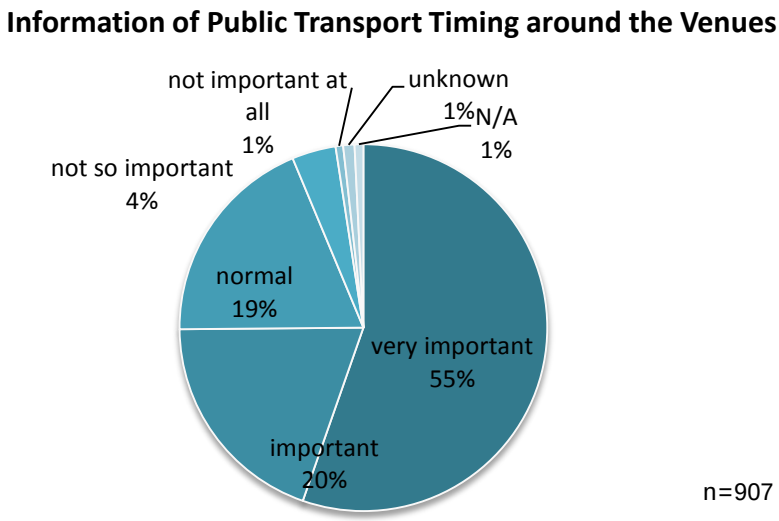


Source: JICA Study Team

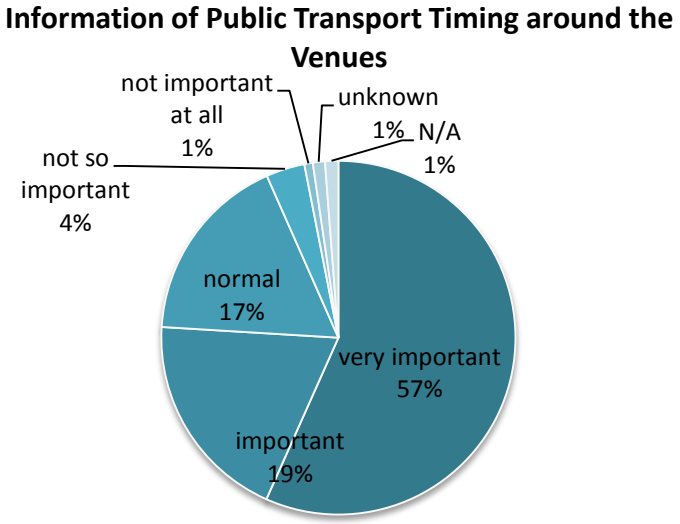
Figure 5-69 Need for Information of Traffic Congestion on the Way to the Venues

Service C: Information of Public Transport Timing around the Venues

< Before the Event>



<After the Event>



Source: JICA Study Team

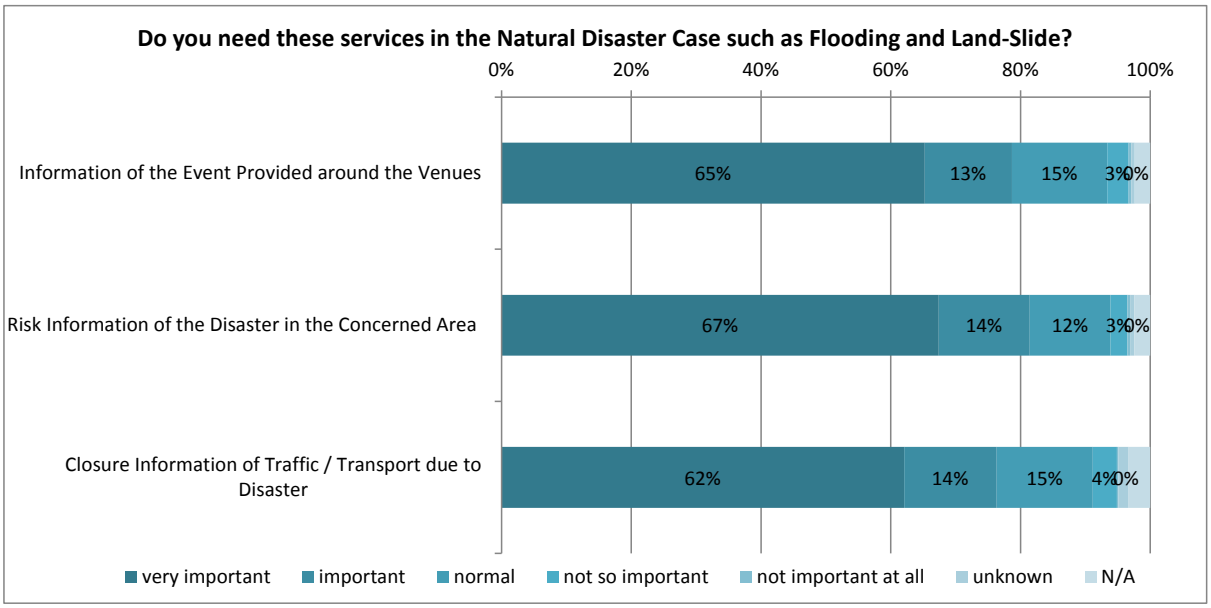
Figure 5-70 Need for Information of Public Transport Timing around the Venues

iv) Natural Disaster

[Do you need these services in case of natural disaster such as flooding or landslide?]

About 80% of all the samples answered that ITS services are important in case of natural disasters. “Risk information of the disaster in the concerned area” seems to be especially important to them. This result indicates that disaster monitoring is important to reduce the risk of natural disasters.

The results are the same during weekday and weekend. This result shows that disaster monitoring and ITS in case of natural disaster would always be important.



Source: JICA Study Team

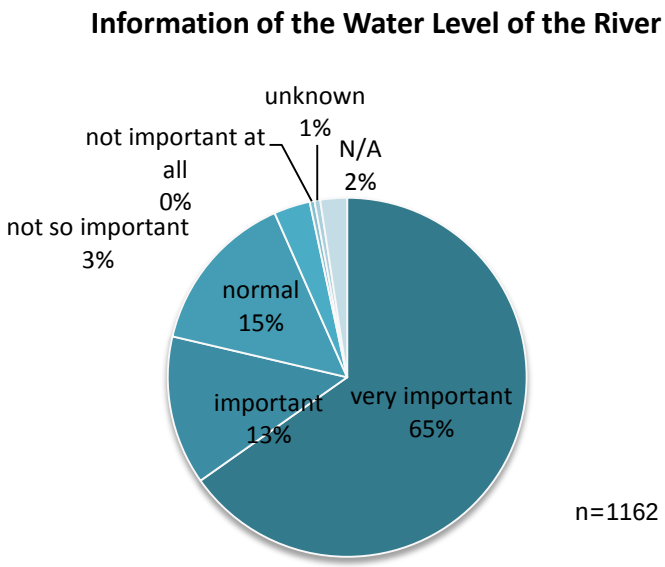
Figure 5-71 ITS Needs in case of Natural Disaster

[Do you need these services in case of natural disasters such as flooding or landslide?]

The following are the results for each service.

Service A: Information of the Water Level of the River

<In case of Natural Disaster>

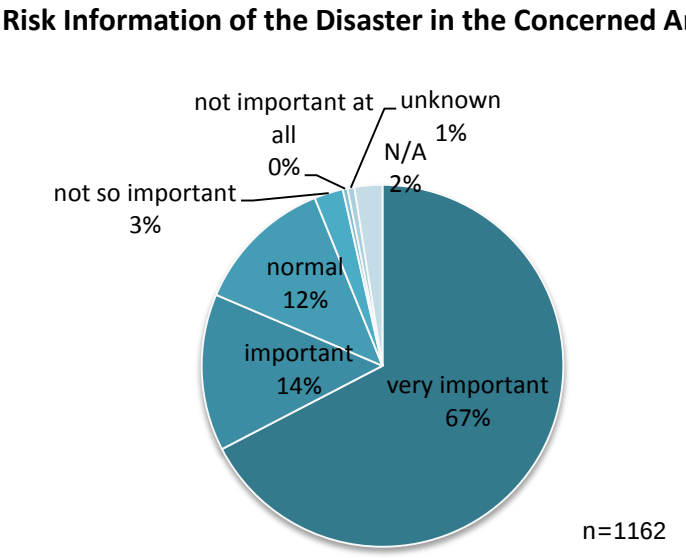


Source: JICA Study Team

Figure 5-72 Need for Information of the Water Level of the River

Service B: Risk Information of the Disaster in the Concerned Area

<In case of Natural Disaster>

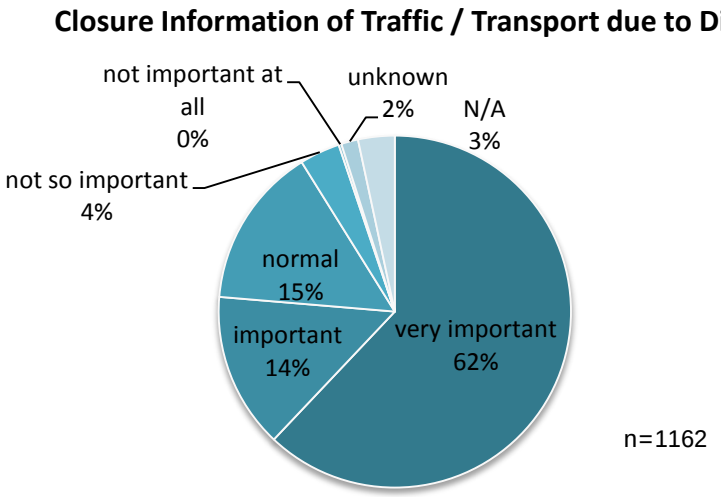


Source: JICA Study Team

Figure 5-73 Need for Disaster Risk Information in the Concerned Area

Service C: Traffic/Transport Closure Information due to Disaster

<In case of Natural Disaster>



Source: JICA Study Team

Figure 5-74 Need for Traffic/Transport Closure Information Due to Disaster

5.1.3 Summary

About 2,000 samples on August 14, 2012 (Tuesday) and about 1,000 samples on August 12, 2012 (Sunday) were collected via interviews in the field. The answers of car and public transport users to the questionnaire on ITS needs are summarized as follows:

> ITS services are very important to about 80% of the samples
> ITS services for road traffic are more important than for public transport
> More information is needed in case of disaster.

5.2 INTERVIEWS ON ITS NEEDS OF TRANSPORTATION AGENCIES

5.2.1 Objective and Survey Methodology

(1) Objective

The objective of the survey was to obtain information on the ITS needs of transportation agencies. The target of the survey was all stakeholders related to traffic and transport in Rio de Janeiro, such as public sectors for development and management, and operators.

(2) Methodology

1) Summary

The survey questions were about current problems related to stakeholders' own work, specific plans and future needs related to ITS. The survey was conducted through interview.

2) Survey Schedule

The survey was conducted from July 2012 to October 2012.

3) Survey Coverage

The survey targets, such as stakeholders, are shown in Table 5-3.

Table 5-3 Related Stakeholders and ITS Needs Survey Targets

Agencies	Name	Remarks	Survey
Traffic/Transportation Agencies			
Public/ Governmental Company	• ANTT	• Federal Gov.	O
	• DENATRAN	• Federal Gov.	O
	• DNIT	• Federal Gov.	O
	• DETRAN-RJ	• State Gov.	O
	• DER-RJ	• State Gov.	O
	• SECONSERVA	• Municipal Gov.	X
	• CET-RIO	• Municipal Gov.	O
Private	• CCR PONTE	• Road Concessionaire	O
	• Autopista Flminense	• Road Concessionaire	O
	• CCR VIA LAGOS	• Road Concessionaire	O
	• ROTA116	• Road Concessionaire	O
	• LAMSA	• Road Concessionaire	O
Transit Agencies/Other Transit Providers			
Public	• CENTRAL-SETRANS	• State	O
	• RIO TORIHOS-SETRANS	• State	O
	• DETRO-SETRANS	• State	O
	• CODERTE-SETRANS	• State	O
	• AMTU-SETRANS	• State	O
	• SETRANS	• State	O
	• SMTR	• Municipality	O
	• COR	• Municipality (Control Center)	O
	• NITTRANS	• Municipality(Other Municipalities)	O
Syndicate/ Consortium	• Rio Onibus	• Inner City Bus Company Syndicate	O
	• Central Coop etc.	• Taxi Company Cooperative	O
Private	• Super VIA	• Train and Cable Car O/M Concessionaire	O
	• METRO	• Subway O/M Concessionaire	O
	• CCR Barcas	• Ferry O/M Concessionaire	O
	• Private Bus Companies (208)	• Bus Concessionaire	O
	• Socicam	• Bus Terminal O/M Operator	O
	• Taxi Companies	• Taxi Operator	O
	• Rio Card TI/ Rio Card Cartoes	• IC Card Company	X
Public Safety Agencies			
Public	• Civil Defense-SEDEC	• State Gov.	O
	• SAMU-CBMERJ	• State Gov. -Ambulance-	O
	• BOMBEIRO-CBMERJ	• State Gov. -Fire, Rescue-	O
	• SESEG	• State Gov. -CICC- Police	O
	• Civil Defense-SMSDC	• Municipal Gov.	O
Other Agency Department			
Other Agency Department	• ABNT	• National Standardization Agency	O
	• Ministry of Communication	• Federal Ministry	O
	• ANATEL	• Frequency Management	O
	• INEA-SEA	• State Gov. Environmental Monitoring	O
	• SIMERJ-SEDEC	• State Gov. Weather Monitoring	O
	• SMAC	• Municipal Gov. Air Pollution Monitoring	O
	• AGETRANSP	• Concessionaire Monitoring	O
	• FETRANSPOR	• Association of Syndicate for Bus Companies	O
Fleet Operators			
Syndicate	• Syndicargo	• Syndicate of Fleet Operators	O
Private	• Utilissimo Tranportes LTDA etc.	• Fleet Operator	O
Travelers			
Travelers/Visitors	• Commuters, residents	• Individual	X
	• Tourists/Visitors etc.		X
Private Sector			
Other Related Companies	• Local TV and Radio Stations		X
	• Automobile Industry etc.		X
Others			
Others	• University		X
	• Military etc.		X

Source: JICA Study Team

4) ITS Services

The ITS services which are referred to in the interviews were determined according to the ITS Service Domain from ISO as shown in Figure 5-75 below. In this survey, services are focused on the domains which are related to each organization type as indicated in Table 5-4.

Source: JICA Study Team

Figure 5-75 ITS Service Domains

Table 5-4 ITS Services Referred to in the Interview

Service Domain	ITS Services Referred to in the Interview				
	Traffic/Transport Agencies	Transit Agencies/ Other Transit Providers	Public Safety Agencies	Other Agency Department	Fleet Operators
1. Traveler Information		O			
2. Traffic Management and Operations	O	O			
3. Vehicle Services	X	X	X	X	X
4. Freight Transport					O
5. Public Transport		O			
6. Emergency			O		
7. Transport-related Electronic Payment	O	O			
8. Road Transport-related Personal Safety		O			
9. Weather and Environmental Conditions Monitoring				O	
10. Disaster Response Management and Coordination			O		
11. National Security			O		
12. ITS Data Management	O	O	O	O	O

Source: JICA Study Team

5.2.2 Survey Results

The ITS needs of each stakeholder, which were obtained through interviews, are shown in Table 5-5.

Table 5-5 ITS Needs of Each Stakeholder

Agencies	Name	ITS Needs
Traffic/Transportation Agencies		
Public/ Governmental Company	ANTT	➢ Plan to build CCO in ANTT to monitor concession road operation ➢ To make ITS equipment of concessionaires compatible with each other
	DENATRAN	➢ Implementation of SINRAV and SINIAV
	DNIT	➢ To install weigh-in motion sensors ➢ Plan to introduce fines for speed violations via speed monitoring
	DETRAN-RJ	➢ To implement SINRAV ➢ To match OCR data and license registration data
	DER-RJ	➢ Plan to build a new control center ➢ To centralize collected data on the road (CCTV, detector, and OCR)
	CET-RIO	➢ Plan to install more adaptive signal controls ➢ Plan to exchange information between other bodies
Private	CCR PONTE	➢ To exchange CCTV data between CET and CCR Ponte (tried once in 2007 but failed) ➢ Accidents occur almost every day ➢ The pavement sensor is not online ➢ Toll gate is congested because of the lack of ETC lanes
	Autopista Flminense	➢ None
	Road concessionaires CCR VIA LAGOS ROTA116 LAMSA	➢ OCR data is collected manually (CCR via Lagos) ➢ Infrastructure monitoring is not enough (LAMSA)
Transit Agencies/Other Transit Providers		
Public	CENTRAL-SETRANS	➢ None
	RIO TORIHOS-SETRANS	➢ To monitor the condition of construction effectively ➢ To encourage people to use rail more (by investing in network development)
	DETRO-SETRANS	➢ Plan to develop an online data collection system from buses ➢ Plan to send CCTV data of buses to CICC
	CODERTE-SETRANS	➢ To collect data online and in real time from bus terminals ➢ To improve the service at bus terminals by changing to a concession contract such as with NOVO Rio
	AMTU-SETRANS	➢ To integrate operation systems between transportation modes ➢ Plan to manage transportation system at the metropolitan region level
	SETRANS	➢ To integrate operation systems between transportation modes ➢ To provide better user services
	SMTR	➢ To build hub and spoke transport network (rail/metro and bus) ➢ To improve traffic conditions in the area of Barra da Tijuca
	COR	➢ Disaster management ➢ Plan to provide information on traffic conditions

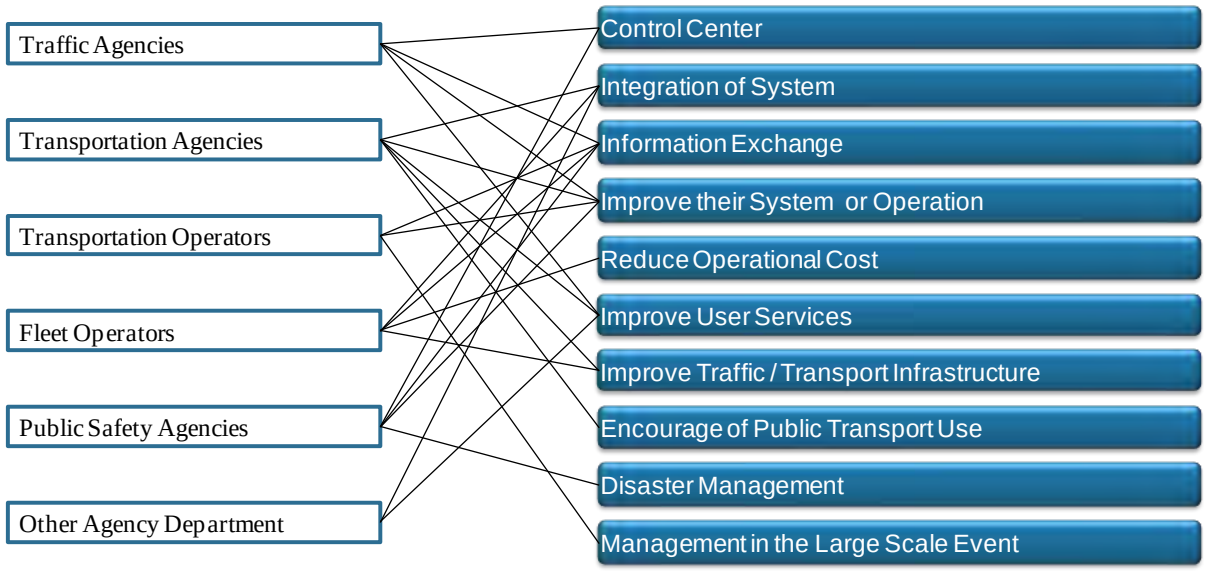
		(travel time) by using taxi GPS data
	NITTRANS	➢ To reduce the demand for automobiles ➢ To develop a BRS system ➢ To monitor bus locations via GPS in CCO ➢ To provide users, especially users between Rio and Niteroi, information on traffic and public transport
Syndicate/ Consortium	Rio Onibus	➢ To share bus line updates between SMTR and bus companies ➢ GPS data sometimes fail to be transmitted ➢ Plan to share CCTV data from CET-Rio ➢ Plan to fine bus companies after bus location monitoring system is validated
	Central Coop	➢ Disconnection between taxi and control center due to shadow areas of private mobile services ➢ Plan to install electronic vouchers to reduce costs
Private	Super VIA	➢ To exchange information between other transport agencies
	METRO	➢ None
	CCR Barcas	➢ To send data to AGETRANSP automatically ➢ To share data on traffic/transport conditions in order to provide better transportation services
	Private Bus Companies (208)	-
	Socicam	➢ Information on arrival time and location of buses are not obtained ➢ Plan to develop the NOVO Rio Terminal as an exchange terminal among bus, metro, and LRT ➢ Plan for operations regarding security and tourism matters during large-scale events
	Taxi Companies	➢ Same as Central Coop
Public Safety Agencies		
Public	Civil Defense-SEDEC	➢ Prepare the procedure of operations in CICC
	SAMU-CBMERJ	➢ Plan to establish the SAMU Operation Center and the BOMBEIRO Operation Center together in CICC ➢ Plan to get permission to control CCTV of CET-Rio in case of emergency ➢ Plan to improve ambulance monitoring system (classification of ambulances, and estimation of travel times of ambulances) ➢ They are testing the introduction of GPS on ambulances on the outskirts of Rio de Janeiro City ➢ Need for a reliable communications network in case of large-scale events ➢ To make a procedure for contact between ambulance and operations center
	BOMBEIRO-CBMERJ	➢ Same as SAMU
	SESEG	➢ Plan to build CCO for security purposes ➢ To share CCTV data and OCR data among traffic/transport operators ➢ To use the same protocol for information exchange
	Civil Defense-SMSDC	➢ Plan to be integrated in CICC
Other Agency Departments		
Other Agency Department	ABNT	➢ Plan to build ITS national standards
	Ministry of Communication	➢ To spread digital TV broadcasting ➢ Plan to use analog TV frequency
	ANATEL	➢ None
	INEA-SEA	➢ Plan to analyze the relation between traffic data and air conditions ➢ Building their own wireless network instead of GMS ➢ Plan to increase the number of rain gauges
	SIMERJ-SEDEC	➢ None
	SMAC	➢ None

	AGETRANSP	➢ To install more cameras at stations ➢ To process information from concessionaires automatically ➢ To integrate the systems used by concessionaires via SITRANS ➢ To integrate bus services with other public transportation services ➢ To reduce complaints from users
	FETRANSPOR	➢ The timetable and location data of buses are not provided
Fleet Operators		
Syndicate	Syndicargo	➢ Integration of port/airport operations and truck operations ➢ For trucks to receive weather, roadway, and travel time information and have GPS communications in real time
Private	Utilissimo Tranportes LTDA	➢ Increase of operating costs due to traffic regulations ➢ Plan to install GPS for backup of the current fleet management system
	CUPELLO TRANSPORTES LTDA.	➢ To realize environmental and economical sustainability ➢ Improvement of road network for freight transport ➢ They need to change technology based on the contract ➢ Freight operating system has not been integrated due to differences among systems ➢ Increase of operating costs

Source: JICA Study Team

5.2.3 Summary

Interviews with about 40 stakeholders were conducted. The ITS needs of transportation agencies are summarized in Figure 5-76.



Source: JICA Study Team

Figure 5-76 ITS Needs of Transportation Agencies

CHAPTER 6 FRAMEWORK SETTING FOR THE INTELLIGENT TRANSPORT SYSTEMS MASTER PLAN OF RIO DE JANEIRO METROPOLITAN AREA

It is important to develop an ITS architecture for the Rio de Janeiro Metropolitan Area considering the following:

1. Rising economic activities and urbanization have led to significant congestion on transportation networks;
2. Transportation networks are more complex;
3. Organizations are more interrelated and information exchange is more essential;
4. Systems are more interconnected and interdependent; and
5. Travelers expect consistent services.

Against this background of increasing need for “integration” in the Rio de Janeiro Metropolitan Area, the ITS architecture will be prepared to provide an entire framework of ITS and better communication.

In this chapter, the JICA Study Team set an entire framework for developing the ITS architecture of Rio de Janeiro Metropolitan Area by referring to existing ITS architectures around the world. It is a basic concept for formulating an ITS master plan, as shown in Chapter 7.

6.1 REVIEW AND ANALYSIS OF ITS ARCHITECTURES IN MAJOR COUNTRIES

6.1.1 Review and Analysis of ITS Architectures in Major Countries

It is necessary to review the ITS architectures in other countries in order to develop the ITS architecture of Rio de Janeiro in Brazil. The ITS architectures in major developed countries, such as Japan, the United States, and Europe, are reviewed as basic information for reference in the preparation of the ITS architecture plan for the Rio de Janeiro Metropolitan Area. The ITS architectures in major countries are listed in Table 6-1 below.

Table 6-1 ITS Architectures in Major Countries

Name of ITS Architecture	Country	Outline	Year (1st Edition)
System Architecture for ITS in Japan	Japan	- Formulated by the five ministries involved - Organized by nine development areas and 21 user services	1999
National ITS Architecture	United States	- Formulated by the Federal Highway Administration - Organized by eight development areas and 33 user services - More focused on public transportation - Used as framework for regional ITS architecture	2012
ITS FRAME Architecture	Europe	- Initiated by the European Commission for formulation - Organized by ten major functions and 46 subfunctions - Prepared as framework architecture commonly used across different countries to secure compatibility	2000
ITS Architecture for Canada	Canada	- Formulated by Transport Canada - Prepared considering the U.S. National ITS Architecture	1999
Reference Model Architecture for the ITS Sector (TS14813 series)	ISO/TC204 /ABNT	- Prepared as reference architecture for countries/regions to formulate their architectures - Reflected by the ITS architectures of major countries including Japan, the United States, Europe, China, Korea, Australia, etc.	1999/2010

Source: JICA Study Team

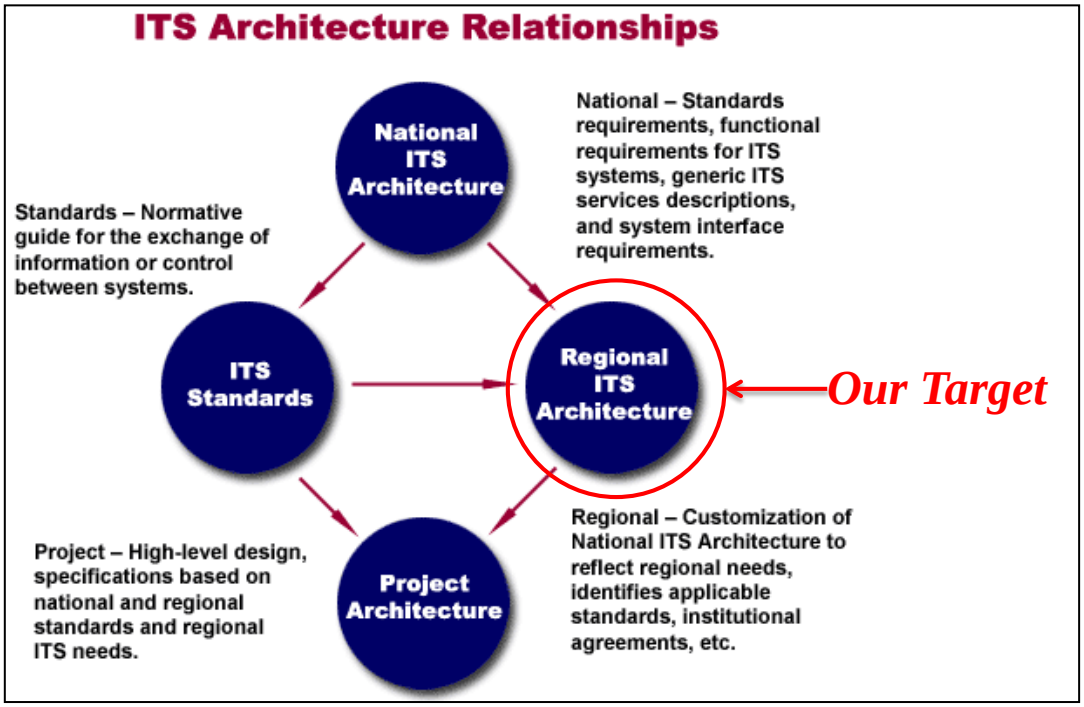
6.1.2 Analysis of the Structure of ITS Architecture

(1) Overall Outline

Based on the review, the ITS architecture can be defined as follows:

- ✓ A framework within which a system can be built;
- ✓ What the elements of the system do;
- ✓ What information can be exchanged between them;
- ✓ "What" must be done, not "how" it will be done; and
- ✓ The systems and the interconnections and information exchanges between these systems.

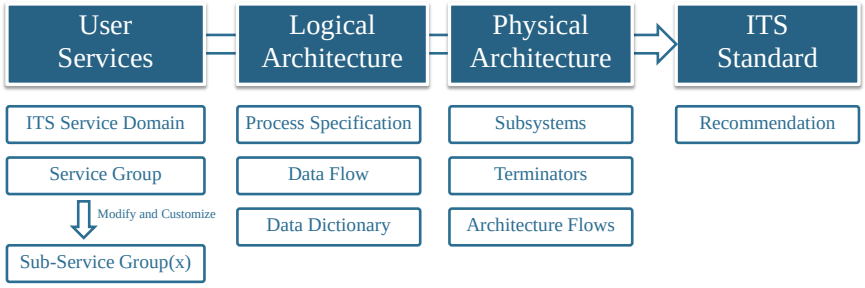
According to the National ITS Architecture of the U.S., the relationships of ITS architectures are summarized in Figure 6-1 below.



Source: Research and Innovative Technology Administration (RITA)

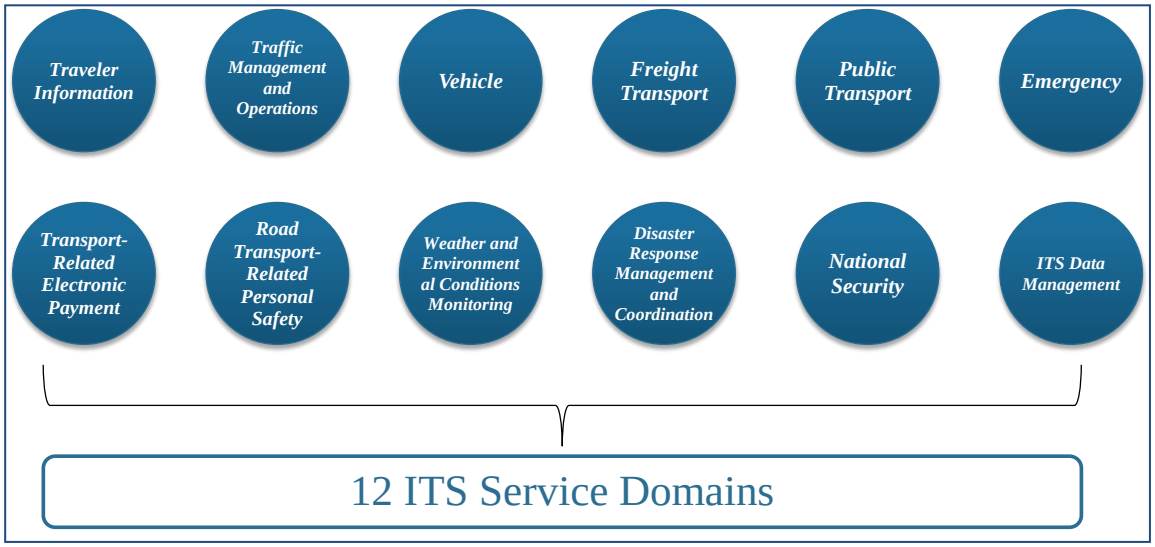
Figure 6-1 ITS Architecture Relationships

The general composition of an ITS architecture includes the following: (i) user services or service domain that shall be defined from several backgrounds like regional issues, transportation issues, etc., (ii) logical architecture, formulated based on (i), which defines the functions or processes needed to deliver the required user services, and (iii) physical architecture, which defines where functions are performed and their interconnections. The following Figures 6-2 to 6-9 show the general composition and roles of ITS architecture, and the definitions of logical and physical architectures.



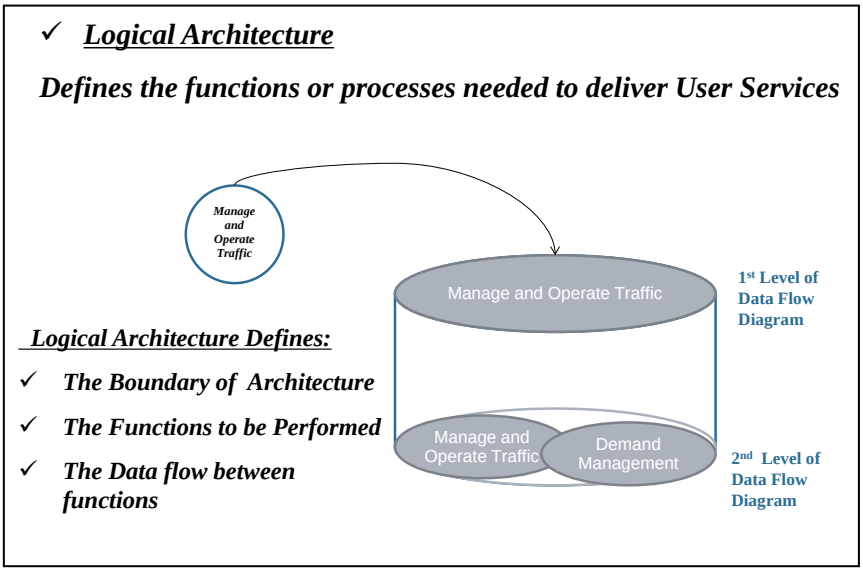
Source: JICA Study Team

Figure 6-2 General Composition of ITS Architecture



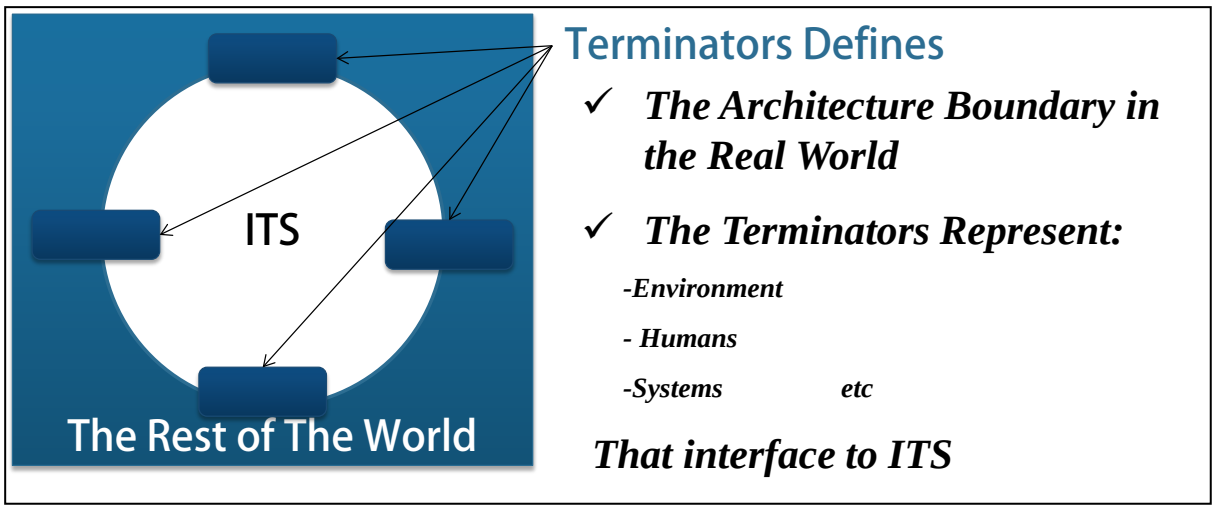
Source: JICA Study Team

Figure 6-3 User Service Example – ISO Reference Model



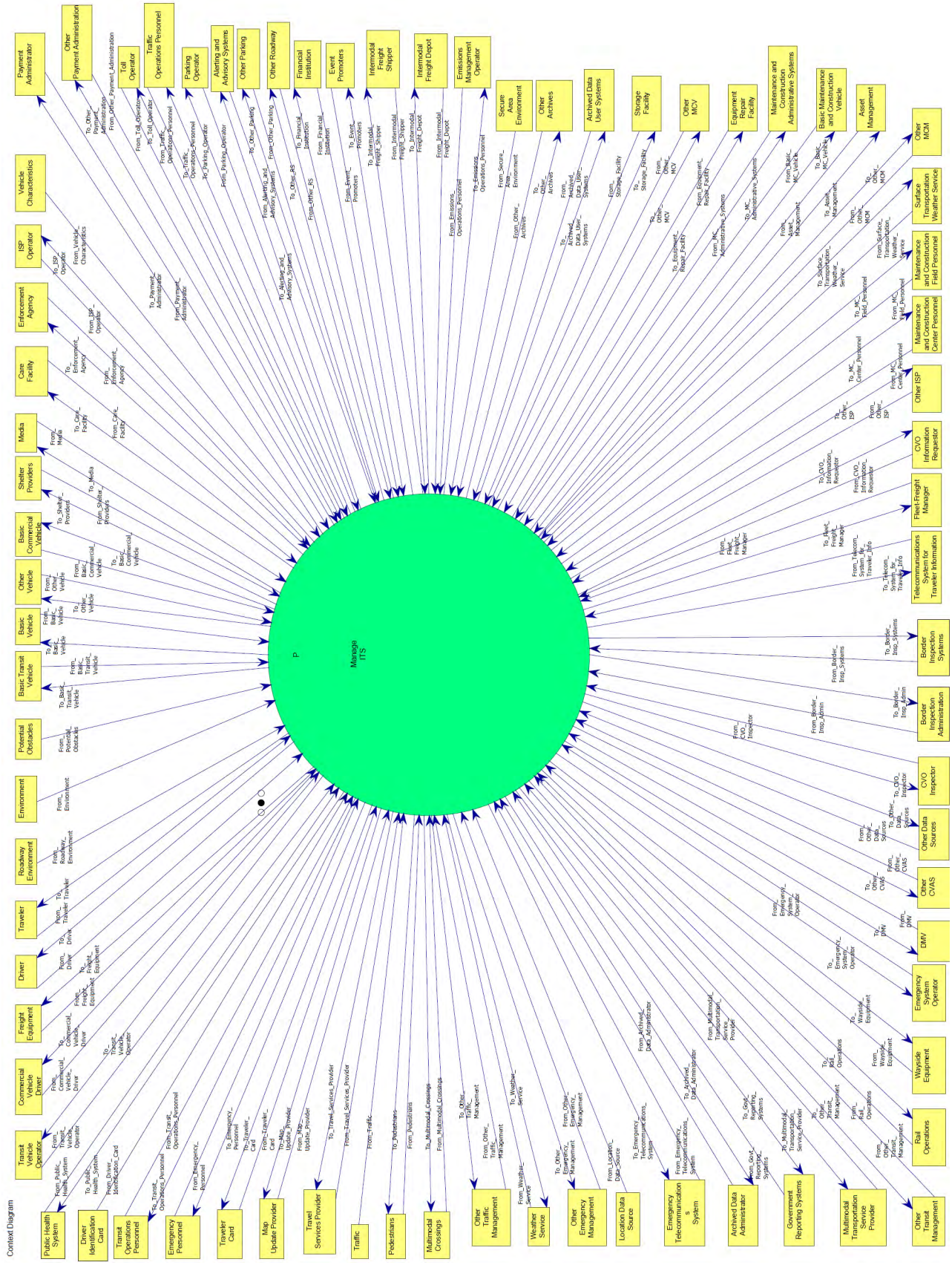
Source: JICA Study Team

Figure 6-4 Definition of Logical Architecture (1/2)



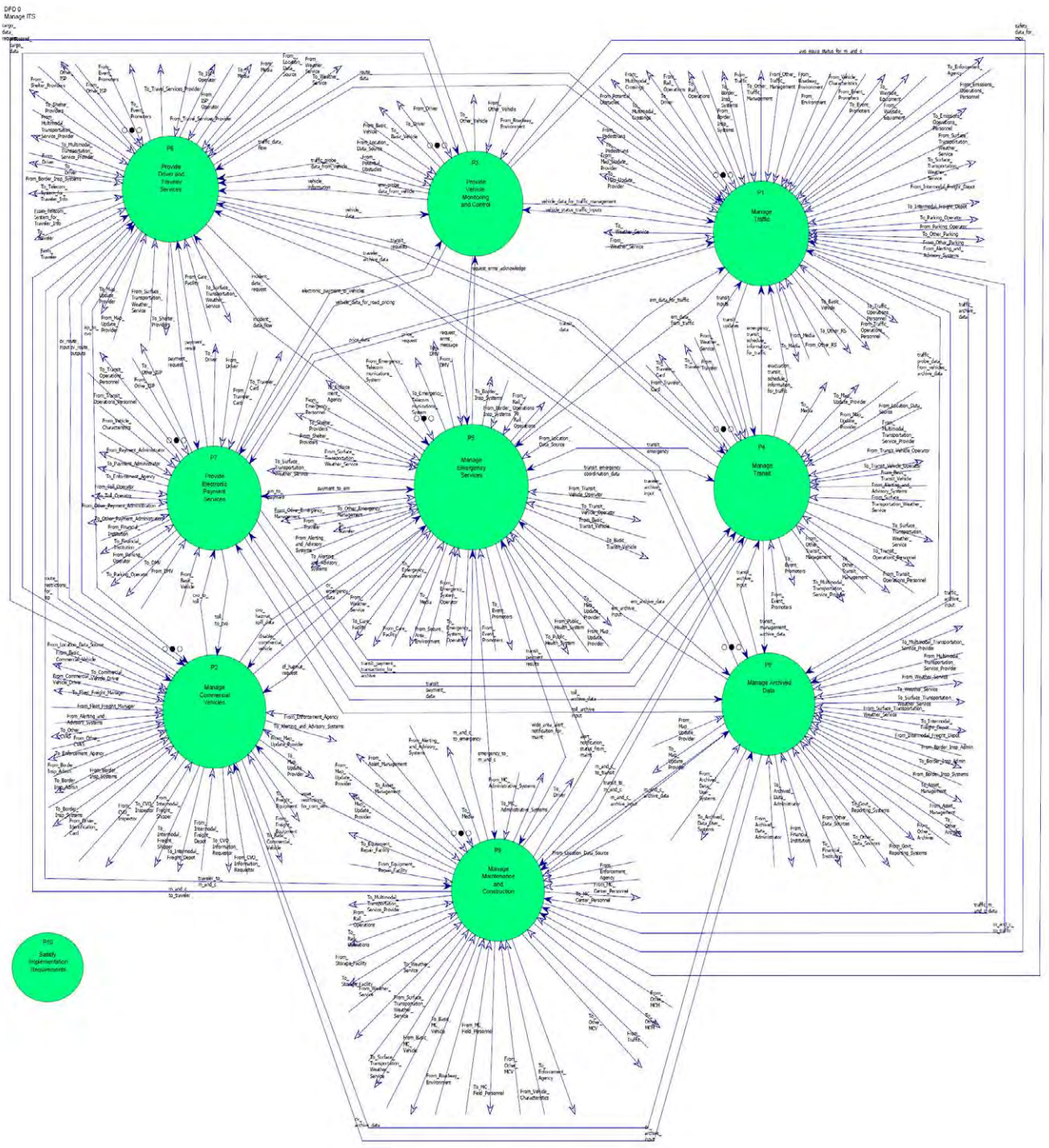
Source: JICA Study Team

Figure 6-5 Definition of Logical Architecture (2/2)



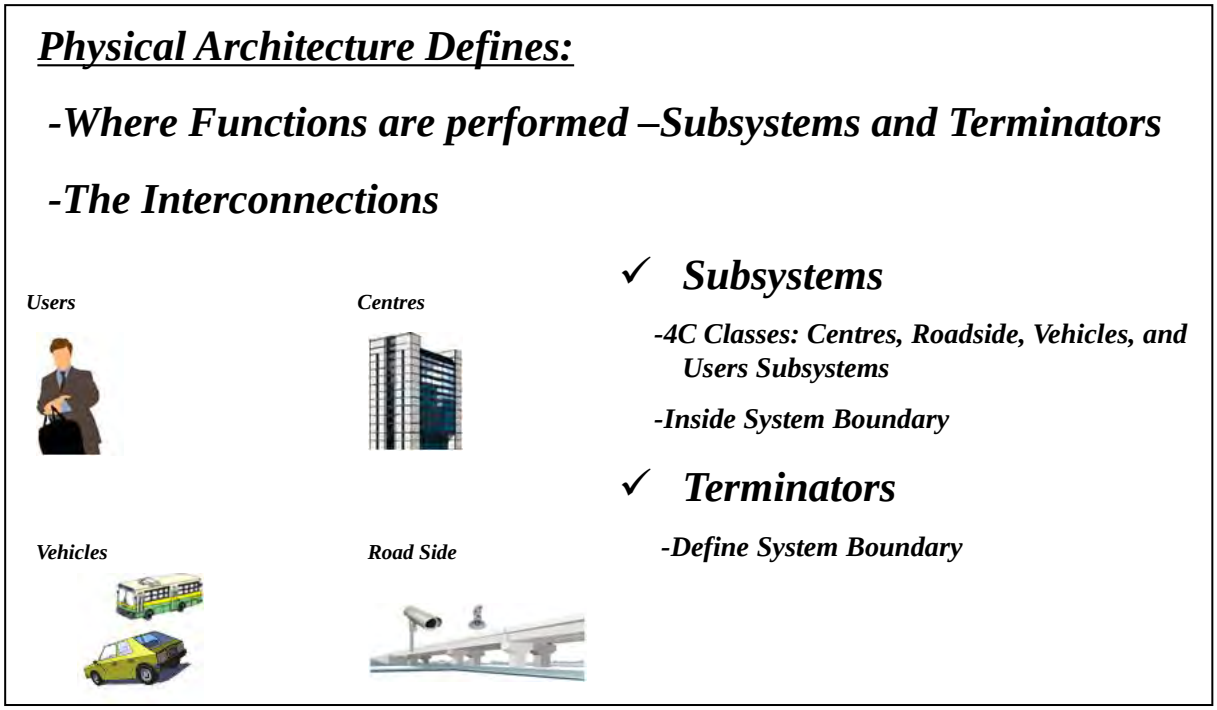
Source: National ITS Architecture of the U.S.

Figure 6-6 Highest-Level Logical Architecture



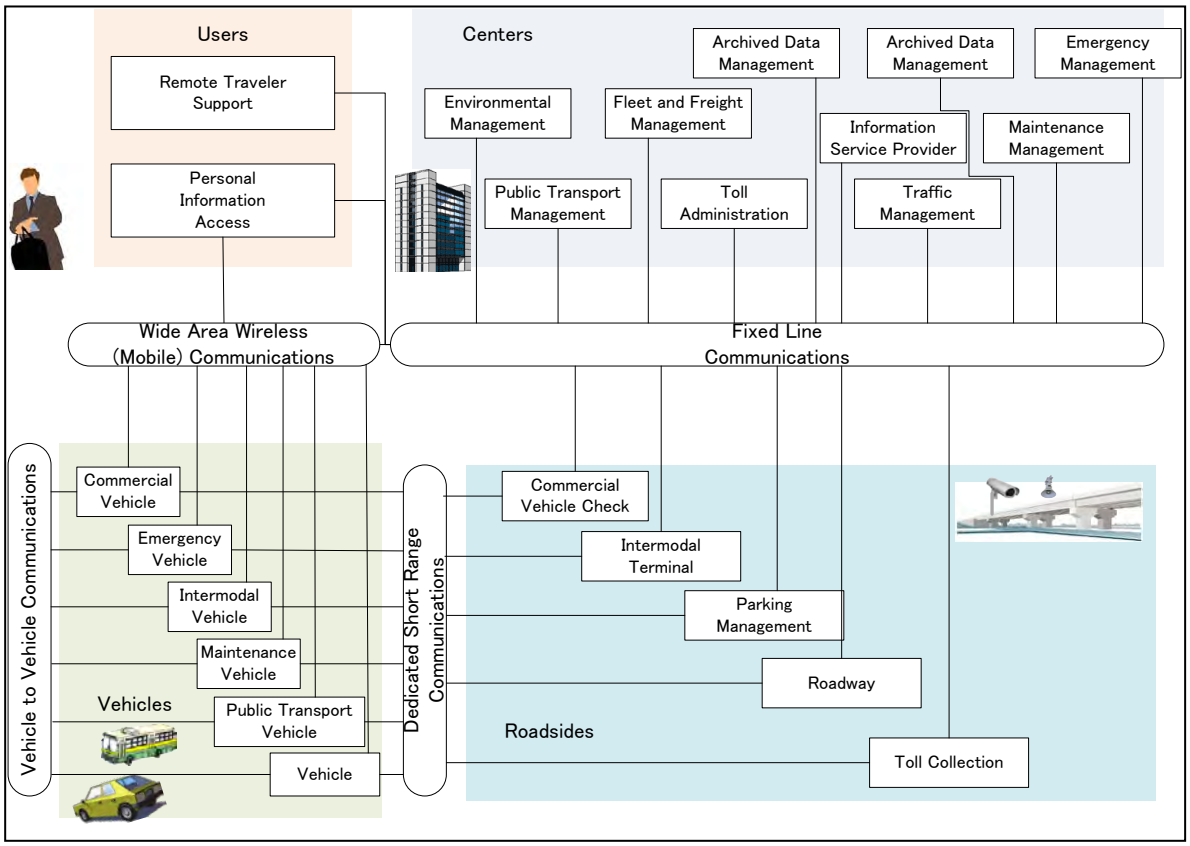
Source: National ITS Architecture of the U.S.

Figure 6-7 High-Level Logical Architecture



Source: JICA Study Team

Figure 6-8 Definition of Physical Architecture



Source: National ITS Architecture of the U.S. modified by the JICA Study Team

Figure 6-9 High-Level Physical Architecture

Table 6-2 below shows the summary of the results of the review of the ITS architectures of different countries. The National ITS Architecture of the U.S. is comparatively well developed and the world's newest ITS architecture because it is updated frequently. All other architectures except FRAME, which is the E.U. ITS architecture, are not updated. In addition, the user services of the U.S. architecture are aligned with the ISO 14813 reference model. The Canadian ITS architecture is similar to the U.S. architecture because there is an agreement between the U.S. and Canada for the development of ITS architecture. The Japanese ITS architecture was developed in 1999 but it is not updated.

Table 6-2 ITS Architecture Outline

Country	U.S.A.	Canada	Japan	E.U.	ISO 14813
Name/Year	National ITS Architecture/1999-Current Version 7. 2012 January	ITS Architecture for Canada/1999	Japanese National ITS Architecture/1999	The FRAME Architecture /2000-Current Version 4.1 2011	Reference Model Architecture/2007
Structure	3 Layers (Institutional Transportation Communications) Main Architecture===== User Services Logical Architecture Physical Architecture Service Packages Standards	User Services and User Services Requirements Logical Architecture Physical Architecture Equipment Packages Service Packages	User Services Logical Architecture Physical Architecture Standards	User Needs Functional Architecture Physical Architecture Communication Architecture	Service Domain -Service Groups As a Reference to whoever want to develop architecture
No. User Services	8 Service Area 97 Service Package	9 User Service Bundle 37 User Services	9 Development Areas 21 User Services 56 Specific User Services 172 Sub-Services	9 Principal Functional Area 43 Sub Functional Area 187 Sub-Sub Functional Area	12 Service Domains 49 Service Groups 143 Service Example
Summary	The most sophisticated ITS architecture in the world. Old Version of the U.S. Architecture 6.0 was aligned with the ISO 14813. The architecture is well developed, revised frequently and covered wide area.	Similar to the U.S. It's adaptive the U.S. Architecture.	This Architecture has adopted the object-oriented method. This method makes it easier for future alteration and expansion. BUT it is not revised so far.	This is defined by the user needs and functional view point. The "User Needs" of each group was described all aspects of task-wise such as objective, planning, activation and so on.	This is designed to assist the integration of services into cohesive architecture, assist interoperability and with common data definition. The definition of different services varying levels of detail. Because services and the respective domains should be useful for the nation preparing ITS architecture.

Source: JICA Study Team

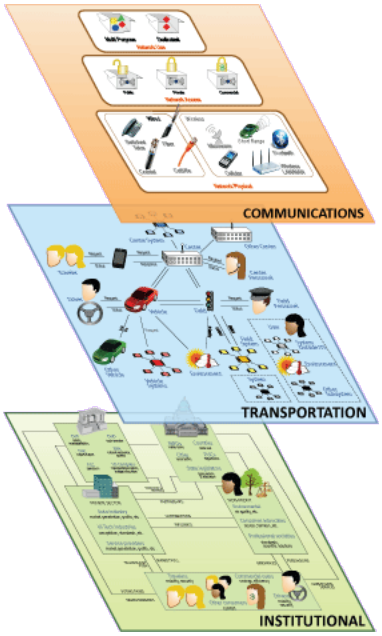
This section can be summarized as follows:

- ✓ The ITS architecture defines the entire framework of ITS;
- ✓ In developing regional architecture, national architecture is necessary;
- ✓ There is not so much difference in the general composition of ITS architecture;
- ✓ The National ITS Architecture of the U.S. is aligned with the ISO reference model; and
- ✓ The Brazilian Technical Standards Association (*Associação Brasileira de Normas Técnicas*: ABNT) defines the ISO reference model as a standard for the development of ITS architecture in Brazil.

(2) Analysis of ITS Architecture for Each Country

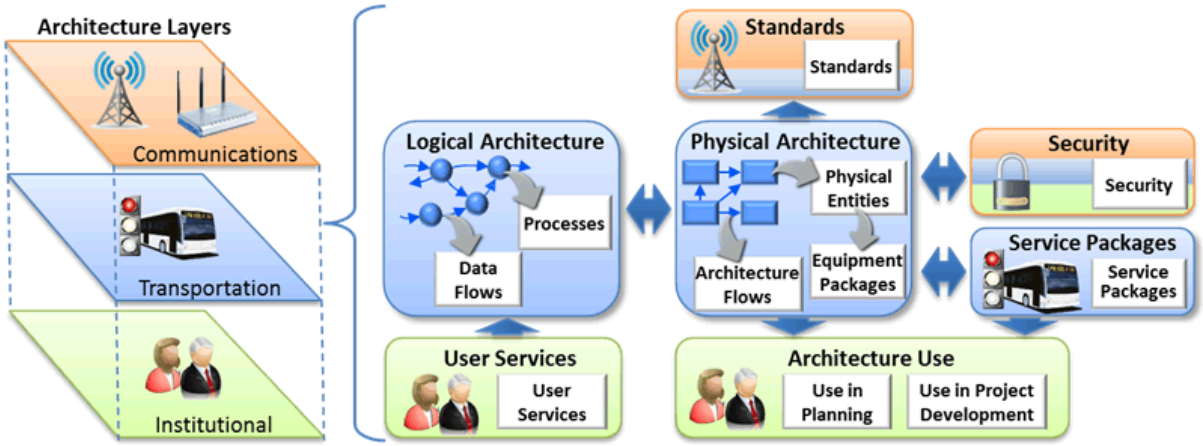
1) The U.S. Architecture

The National ITS Architecture of the U.S. was recently updated and the current version is Version 7.0. It is often updated to catch up with current issues and ITS-related technology. According to the National ITS Architecture website, the latest Version 7.0 provides a framework for planning, programming, and implementing ITS. The architecture framework is comprised of two technical layers, namely, transportation layer and communication layer, which must operate in the context of an institutional layer. Figure 6-10 below shows the layers of the U.S. ITS architecture while Figure 6-11 shows the transportation layer.



Source: National ITS Architecture Website (http://www.iteris.com/itsarch/)

Figure 6-10 Layers of the U.S. National ITS Architecture



Source: National ITS Architecture Website (http://www.iteris.com/itsarch/)

Figure 6-11 Transportation Layer

The U.S. ITS architecture defines the following:

- ✓ Functions that are required for ITS (e.g., gathering of traffic information or requesting a route);
- ✓ Physical entities or subsystems where these functions reside (e.g., the field or the vehicle); and
- ✓ Information flows and data flows that connect these functions and physical subsystems together into an integrated system.

The user services of the U.S. ITS architecture are comprised of eight user service bundles and 33 user services which are aligned with the ISO14813-1 reference model. Apart from that, the architecture is based on process-oriented methodology, and is extremely detailed and maintained regularly.

2) ITS Architecture of Canada

The Border Information Flow Architecture (BIFA) is a modified version of the U.S. National ITS Architecture developed jointly by the Federal Highway Administration (FHWA) and Transport Canada. Its purpose is to support the planning, development, and implementation of ITS and other technology-based solutions at the U.S.-Canada border (see http://www.iteris.com/itsarch/bifa/).

The ITS Architecture of Canada (http://www.tc.gc.ca/innovation/its/eng/architecture.htm) is based on the U.S. National ITS Architecture, with some modifications to cover the “special” conditions found in Canada. The architecture is due to be updated soon. It has also spawned a joint architecture (BIFA) for use in the implementation of ITS at the Canada-U.S. border crossings (see above).

3) Japanese Architecture

To promote the application of information technologies on roads, traffic, and vehicles, the five related government bodies (National Police Agency, Ministry of International Trade and Industry, Ministry of Transport, Ministry of Posts and Telecommunications, and Ministry of Construction) jointly finalized the Comprehensive Plan for ITS in Japan in July 1996, which is based on the Basic Guidelines for the Promotion of an Advanced Information and Telecommunications Society.

In August 1999, the five government bodies organized a draft copy entitled “System Architecture for ITS”. Subsequently, the draft was released so as to collect opinions from a broad range of industrial and academic sectors and to actively address the information overseas.

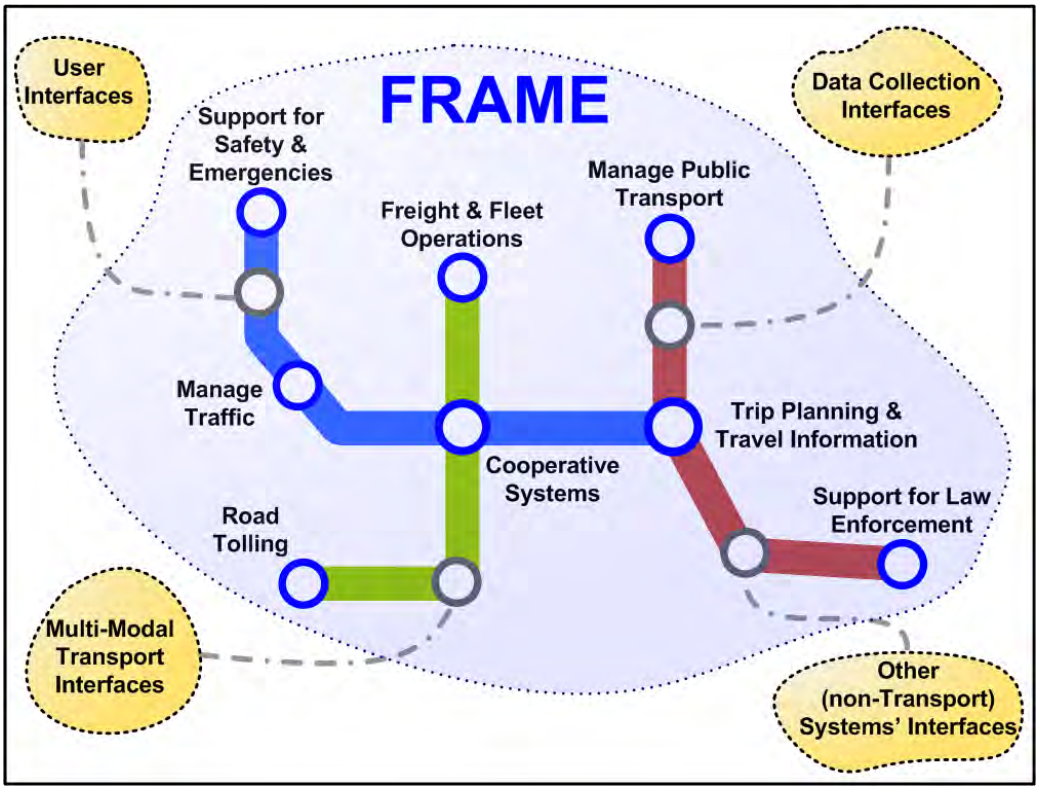
The composition of the Japanese architecture is quite similar to the architecture of other countries. It has user services, logical, and physical architectures. It also consists of process-oriented methodology, similar to the European and U.S. architectures. However, it is not maintained; therefore, it does not reflect the current condition of ITS in Japan.

The user services of the Japanese architecture consist of 9 development areas, 21 user services, 56 specific user services and 172 subservices.

4) European ITS Frame Architecture

According to its website (http://www.frame-online.net), the FRAME Architecture comprises the top level requirements and functionality, or the Use Cases, for almost all the ITS applications and services that have been considered for implementation in the European Union. It is at such a level that it can be used as a reference by all ITS architects, and is intended to be the foundation for building the other types of architecture that will be necessary. It will enable them to guarantee compliance at the interfaces of other systems so that seamless services can be provided to cross-border travelers, and so that an open European market of compatible components can be established.

The coverage area of FRAME is shown in Figure 6-12 below.



Source: FRAME Website (http://www.frame-online.net/)

Figure 6-12 Composition of the FRAME Architecture

The purpose of the FRAME Architecture is to provide a starting point for the development of national and project-based ITS architectures for supporting the increased complexity of ITS implementations across Europe. If used at the start of the ITS implementation process, an ITS architecture based on the FRAME Architecture can reduce the cost and time to completion. This is because the FRAME Architecture enables a large number of different and sometimes complex implementation scenarios to be explored and potential problems to be identified before anything has been purchased or detailed design work has started.

5) ISO 14813-1 Reference Model for ITS Service Domains

The International Standard Organization (ISO) developed a technical committee for intelligent transport systems in 1992 called TC 204. The scope of TC 204 is the standardization of information, communication, and control systems in the field of urban and rural surface transportation. It includes intermodal and multimodal aspects, traveler information, traffic management, public transport, commercial transport, emergency services, and commercial services in the field of ITS.

The ISO 14813-1:2007 provides a definition of the primary services and application areas that can be provided to ITS users. Those with a common purpose can be collected together in ITS service domains, and within these, there can be a number of ITS service groups for particular parts of the domain. The ISO 14813-1:2007 identifies 12 service domains, within which numerous groups are defined. Within this framework, there are varying levels of detail related to the definition of different services. These details differ from nation to nation, depending on whether the specific national architecture building blocks are based directly on services or on groups of functions.

6) ABNT

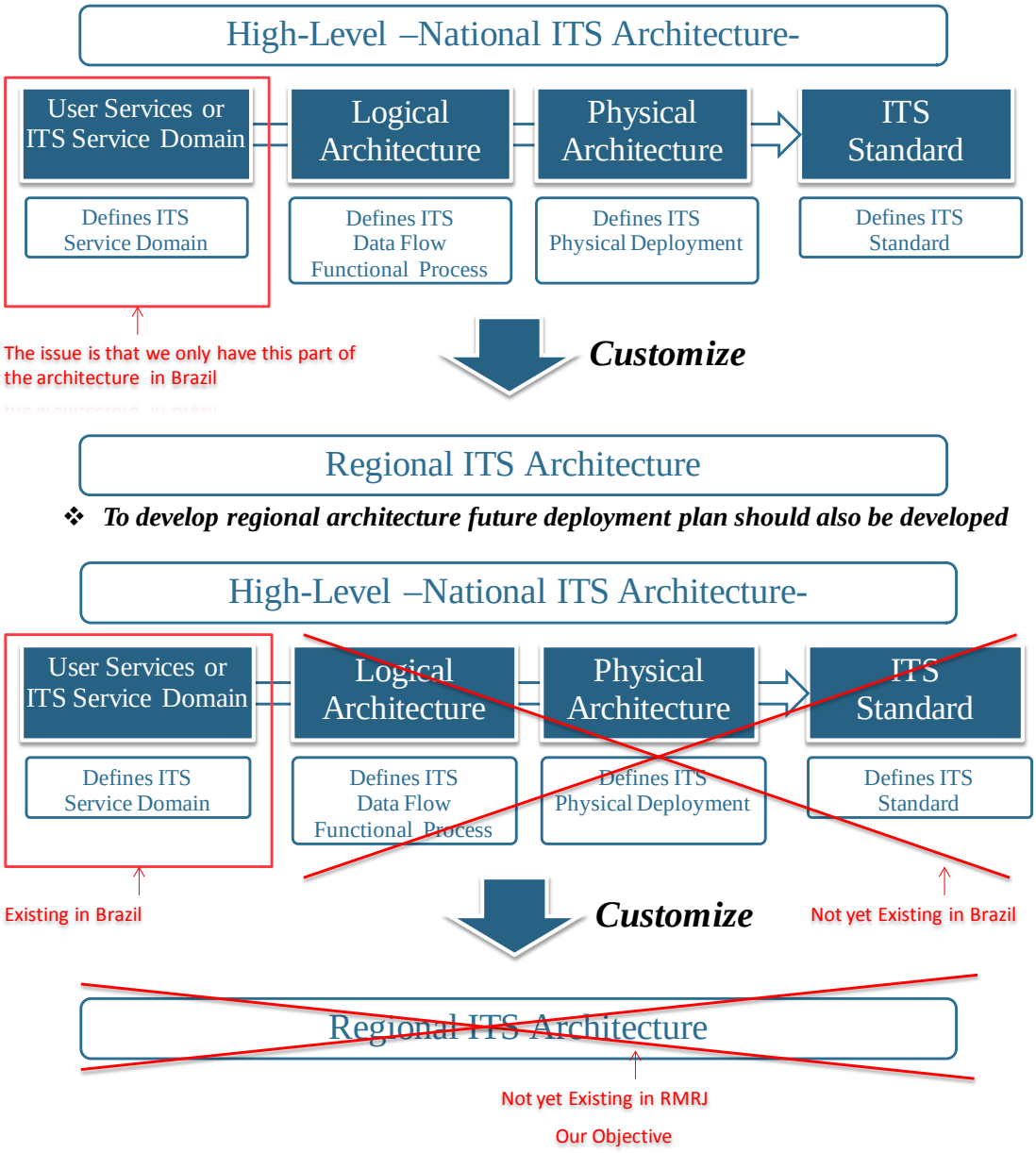
The ABNT was created in 1940 as a non-profit organization engaged in the preparation of national standards. It has set the ISO reference model architecture(s) described above for the ITS sector of Brazil as of August 2010. Therefore, it is necessary to consider ISO 14813-1:2007 as reference to develop the ITS architecture and master plan of Brazil.

6.2 FRAMEWORK SETTING FOR THE ITS MASTER PLAN OF RIO DE JANEIRO METROPOLITAN AREA

6.2.1 Analysis of Current Conditions

According to the ABNT, the Brazilian government has set the reference model architecture(s) for the ITS sector in Brazil as of August 2010. The ABNT defines the standard that must be followed in Brazil. However, this reference model was translated from the ISO reference model, which is an imperfect ITS architecture due to the lack of logical and physical architectures. Therefore, it is important to refer to the U.S. national ITS architecture for developing the regional ITS architecture.

The current situation can be summarized in Figure 6-13 below.



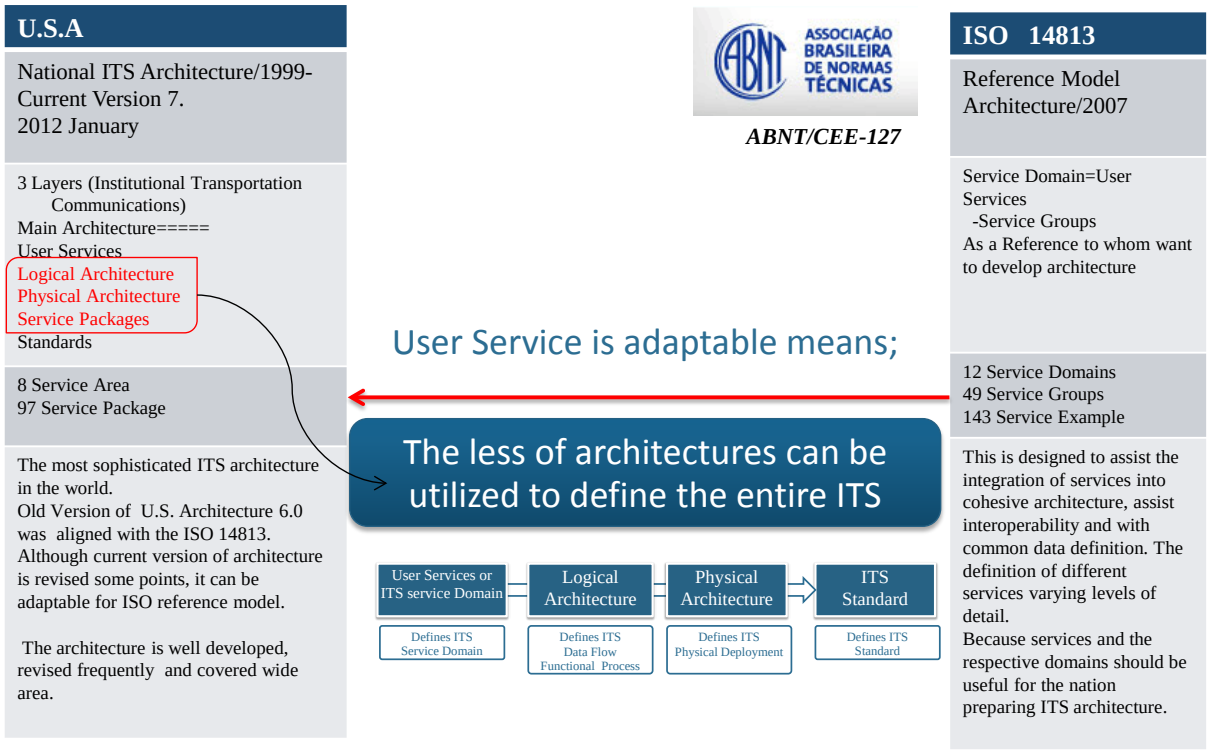
Source: JICA Study Team

Figure 6-13 Current Condition of ITS Architecture in Brazil

In order to set the framework for an ITS master plan, the ITS architecture of other countries shall be referred to and utilized. Hence, in the next section, the JICA Study Team has conducted a consistency check between the U.S. ITS architecture and the ISO reference model.

6.2.2 Framework Setting for the Development of the ITS Master Plan of Rio de Janeiro Metropolitan Area

As it has been described several times in the preceding sections, the National ITS Architecture of the U.S. is aligned with the ISO reference model. On the other hand, the ABNT, which is the organization supervising the national standards of Brazil, set a standard for ITS user services for developing the ITS in Brazil. This has been translated from the ISO reference model. In accordance with this prerequisite, the JICA Study Team conducted a consistency check between the ISO reference model and the National ITS Architecture of the U.S. in order to utilize and adopt the latter as an entire framework.



Source: JICA Study Team

Figure 6-14 Consistency Check between the ISO Reference Model and the National ITS Architecture of the U.S.

The following Table 6-3 shows the results of the consistency check between the ISO reference model and the National ITS Architecture of the U.S.

The table clearly describes that the user services of the National ITS Architecture of the U.S. and the ISO reference model are completely consistent. Therefore, the National ITS Architecture of the U.S. is set as an entire ITS system framework for developing the ITS master plan of the Metropolitan Region of Rio de Janeiro (*Região Metropolitana do Rio de Janeiro*: RMRJ).

For detailed explanations of both architectures, please refer to their websites.

Table 6-3 Consistency Check between the ISO Reference Model and the National ITS Architecture of the U.S.

No.	ITS User Services	No.	Service Group Bundles	Adaptive Check to ISO
1	Travel And Traffic Management	1.1	Pre-trip Travel Information	1.1 9.1 9.2
		1.2	En-route Driver Information	1.2
		1.3	Route Guidance	1.3 1.4
		1.4	Ride Matching And Reservation	1.6
		1.5	Traveler Services Information	1.6
		1.6	Traffic Control	2.1 8.2 8.3 8.4
		1.7	Incident Management	2.2 8.2 8.3
		1.8	Travel Demand Management	2.3
		1.9	Emissions Testing And Mitigation	2.5
		1.10	Highway Rail Intersection	None
2	Public Transportation Management	2.1	Public Transportation Management	5.1
		2.2	En-route Transit Information	1.2
		2.3	Personalized Public Transit	5.2
		2.4	Public Travel Security	8.1
3	Electronic Payment Services	3.1	Electronic Payment Services	7.1 7.2
4	Commercial Vehicle Operations	4.1	Commercial Vehicle Electronic Clearance	4.1
		4.2	Automated Roadside Safety Inspection	4.3
		4.3	On-board Safety And Security Monitoring	4.4 6.2
		4.4	Commercial Vehicle Administrative Processes	4.2
		4.5	Hazardous Materials Security And Incident Response	4.8
		4.6	Freight Mobility	4.5 4.6 4.7
5	Emergency Management	5.1	Emergency Notification And Personal Security	6.1 11.1 11.2
		5.2	Emergency Vehicle Management	6.3 6.4
		5.3	Disaster Response And Evacuation	10.1 10.2 10.3
6	Advanced Vehicle Safety Systems	6.1	Longitudinal Collision Avoidance	3.3
		6.2	Lateral Collision Avoidance	3.3
		6.3	Intersection Collision Avoidance	3.3
		6.4	Vision Enhancement For Crash Avoidance	3.1
		6.5	Safety Readiness	3.4
		6.6	Pre-crash Restraint Deployment	3.5
		6.7	Automated Vehicle Operation	3.2
7	Information Management	7.1	Archived Data	1.5 12.1 12.2 12.3 12.4 12.5 12.6
8	Maintenance And Construction Management	8.1	Maintenance And Construction Management	2.4

Source: JICA Study Team

CHAPTER 7 FORMULATION OF THE INTELLIGENT TRANSPORT SYSTEM MASTER PLAN OF RIO DE JANEIRO

7.1 DEFINITION OF THE ITS MASTER PLAN DEVELOPMENT POLICY

It is quite important for the ITS Master Plan of Rio de Janeiro Metropolitan Area to develop a unified policy. The main purpose of the ITS master plan is to integrate all existing systems to secure interoperability between stakeholders and to enhance the efficiency of transport systems. Considering these characteristics of ITS, the policy of the ITS master plan shall follow the existing strategic plans for Rio de Janeiro state and municipal government.

There are two related plans: one is the Strategic Plan of the State Government, and the other one is the Transport Strategic Plan of the Rio de Janeiro Municipal Government. The JICA Study Team conducted a review of these related plans and set a unified policy for the ITS Master Plan of Rio de Janeiro Metropolitan Area.

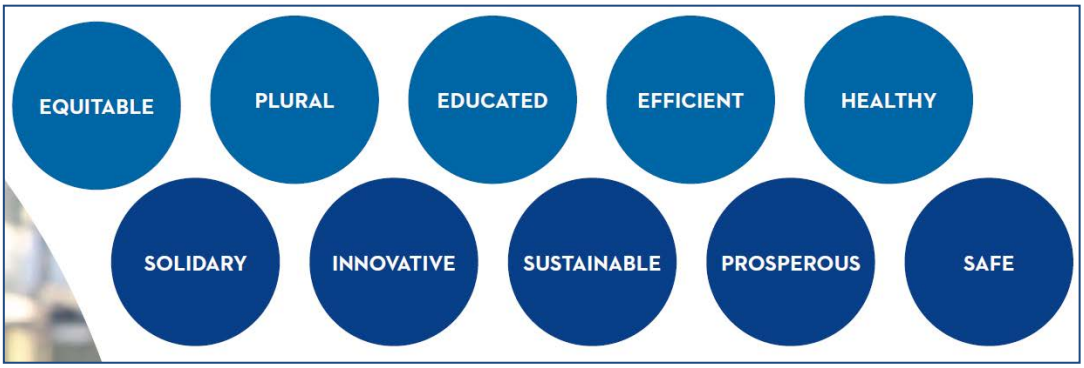
7.1.1 Strategic Plan 2012-2031

The Strategic Plan 2012-2031 is the plan for the strategic development of the state of Rio de Janeiro from 2012-2031 which includes the following:

1. Context and Trends;
2. Vision of Rio de Janeiro for 2031;
3. Scenarios and Forecasts;
4. Long-term Sectorial Challenges;
5. Sectorial Strategies; and
6. Programmed Sectorial Investments.

It also describes the role of agencies for long-term development. Budget allocation is also mentioned in the plan.

In Chapter 3, Vision of Rio de Janeiro for 2031, ten essential aspects for future development are clearly described in Figure 7-1.



Source: Strategic Plan, State Government of Rio de Janeiro, 2012-2031

Figure 7-1 Ten Essential Aspects for Future Development of Rio de Janeiro State

In setting a policy for ITS master plan, it is quite important to consider the ten essential aspects for future development and to broadly cover the issues of the regional characteristics of the Rio de Janeiro State and Metropolitan Area.

7.1.2 Transport Strategic Plan for Rio 2016 Olympic and Paralympic Games

This plan is the transport strategic plan for Rio 2016 Olympic and Paralympic Games. The mission of this plan is as follows:.

Rio 2016, in partnership with the three levels of government, is totally committed to delivering transport services of the highest level of safety, comfort, quality reliability, and efficiency to all games clients, while minimizing the impact on the citizens of Rio.

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

The objectives of the strategy are listed below.

1. To develop and maintain a client service culture as the highest priority.
2. To construct transport infrastructure and systems that support urban development and leave a lasting legacy.
3. To deliver superior service levels to all games clients in terms of safety, comfort, quality, reliability, and efficiency.
4. To incorporate lessons learned and best practices from previous games.
5. To implement innovative transport solutions and proven technology, adapted to Rio's environment.
6. To integrate environmental and sustainability planning in the Olympic transport.
7. To ensure fully accessible and inclusive games for people with restricted mobility.
8. To build an integrated transport team, with all partners sharing a common mission.
9. To capitalize on the extended experience of Rio de Janeiro and Brazil in organizing major sports and other events.
10. To ensure effective responses to all incidents and emergencies.

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

According to the Transport Strategic Plan for Rio 2016, the essential aspects and keywords of the short-term ITS projects for achieving the success of the Olympic Games are summarized as follows:

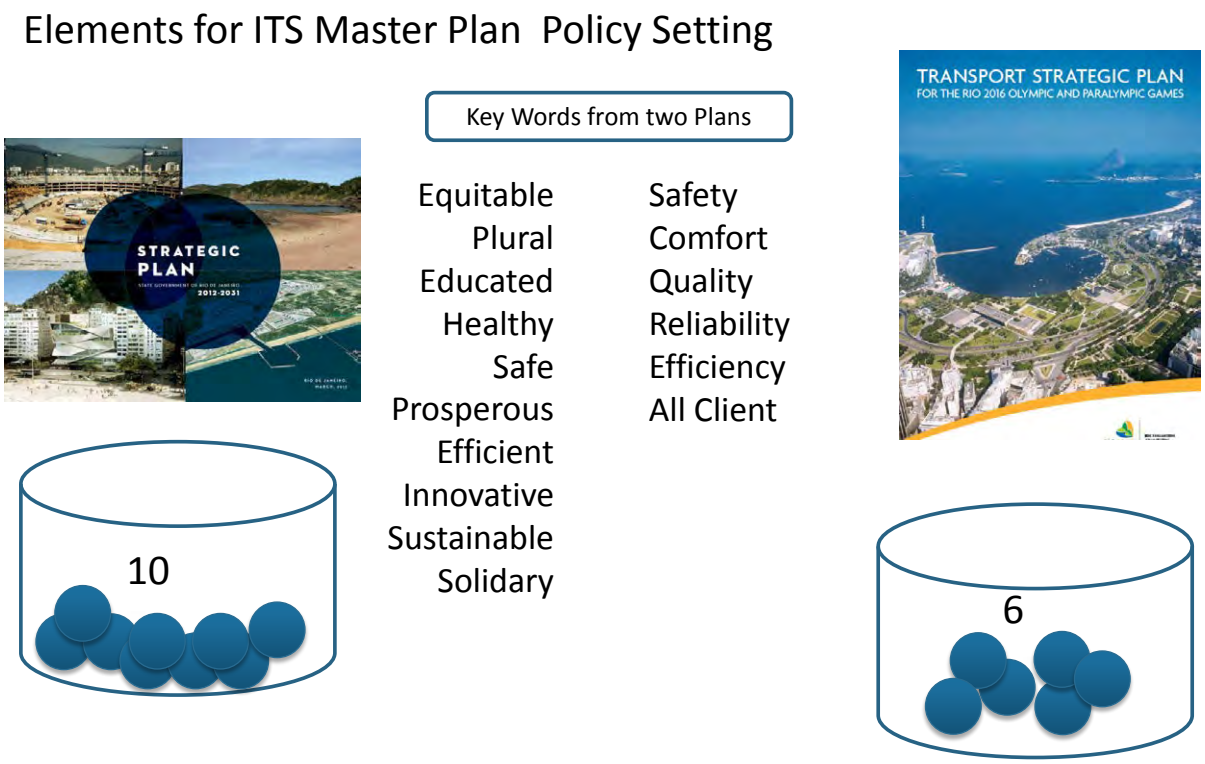
- ✓ Safety
- ✓ Comfort
- ✓ Quality
- ✓ Reliability
- ✓ Efficiency

To all clients and users

7.1.3 Policy Setting for the ITS Master Plan of Rio de Janeiro Metropolitan Area

After reviewing the preceding related plans, essential elements were extracted as keywords for setting the policy. These elements and keywords consist of the main objectives and related plans, which shall be utilized and followed as policy of the ITS master plan.

Results of the review are summarized below.



Source: JICA Study Team

Figure 7-2 Summary of Essential Aspects and Keywords for Setting a Policy for ITS Master Plan

Considering these reviews, the JICA Study Team set up the policy for the ITS Master Plan of Rio de Janeiro Metropolitan Area by factorizing the meaning of essential aspects and keywords and verifying the ITS cover area in general.

The ITS master plan sets out the following policies:

1. ***Promote efficient system management and operation;***
2. ***Enhance the integration and connectivity of the transportation system;***
3. ***Promote and enhance the environmental and economic sustainable development;***
4. ***Develop the economic diversity of the metropolitan area by enhancing productivity and efficiency; and***
5. ***Increase the safety and security of the transportation system.***

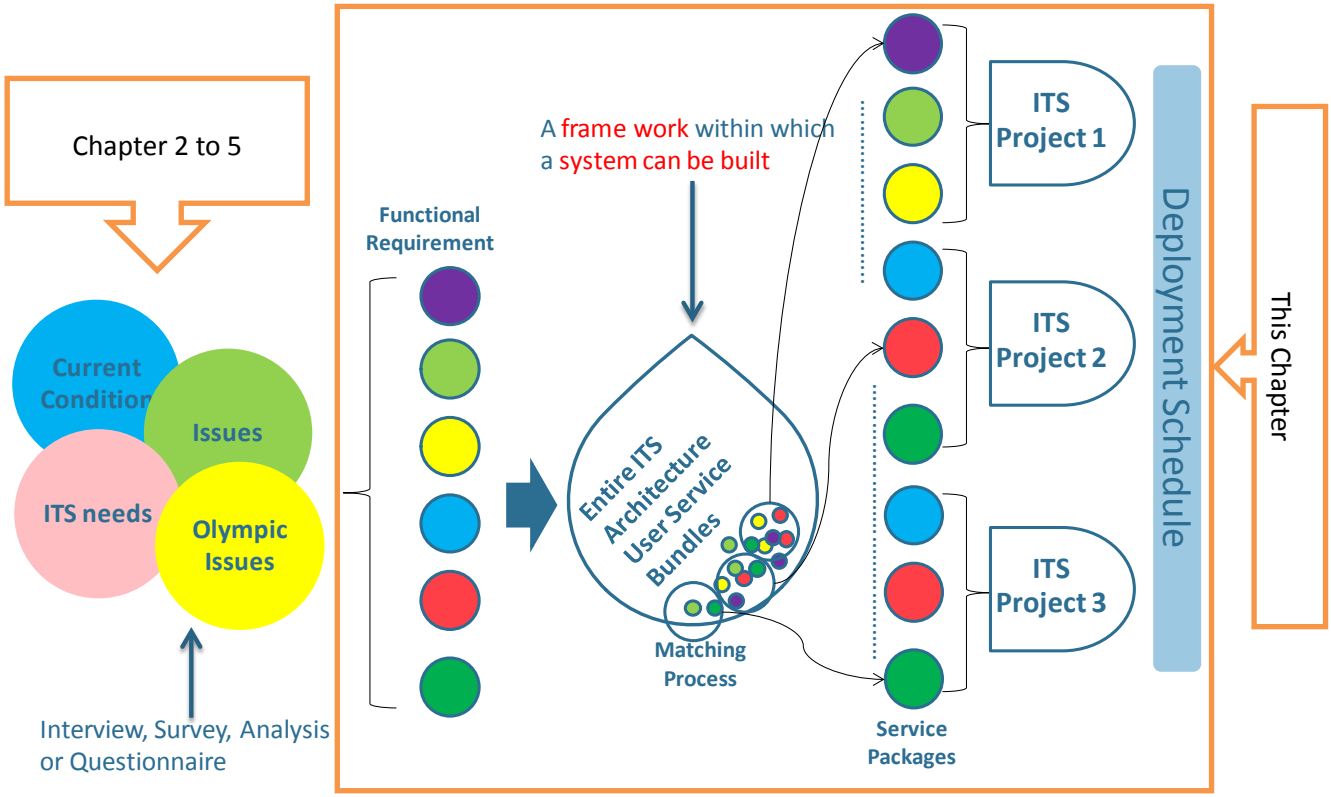
The development policy of the ITS master plan shall include a wide range of perspectives, characteristics, and user needs to achieve sustainable development. Based on this policy, components of the ITS master plan, such as ITS projects, deployment plans, and a selection of short-term projects are studied.

7.2 FORMULATION OF THE ITS MASTER PLAN OF RIO DE JANEIRO

The ITS master plan shall include short- and long-term system deployment to utilize existing systems and integrate all transport-related systems as information exchange. The contents of the ITS master plan is as follows:

1. ITS projects architecture (conceptual design for ITS projects);
2. ITS deployment schedule; and
3. Short-term projects and its schedule in detail.

The study flow on the formulation of the ITS master plan is shown in Figure 7-3 below.



Source: JICA Study Team

Figure 7-3 ITS Master Plan Study Flow

7.2.1 Clarification of Functional Requirement

Identifying the required system functions is an important step in building up the ITS master plan. From Chapters 2 to 4, the current conditions and issues were realized by conducting data analysis such as statistics, geometry data, current and future traffic/transportation/ transit situation, infrastructure development conditions, and the Olympic Games situation. In Chapter 5, ITS needs are clarified through stakeholder's interviews and questionnaires for normal users.

Considering the current condition, issues, and needs of ITS, the required system functions are identified. The required system functions can be defined as "A statement that specifies WHAT a system must do". The statement should use formal "shall" language and specify a function in terms that the stakeholders, particularly the system implementers, will understand. In the National ITS Architecture, functional requirements have been defined for each equipment package that focuses on the high-level requirements that support regional integration.

In this study, functional requirements are studied based on the current condition, issues, and ITS needs, which are described in Figure 7-4 shown in the next page.

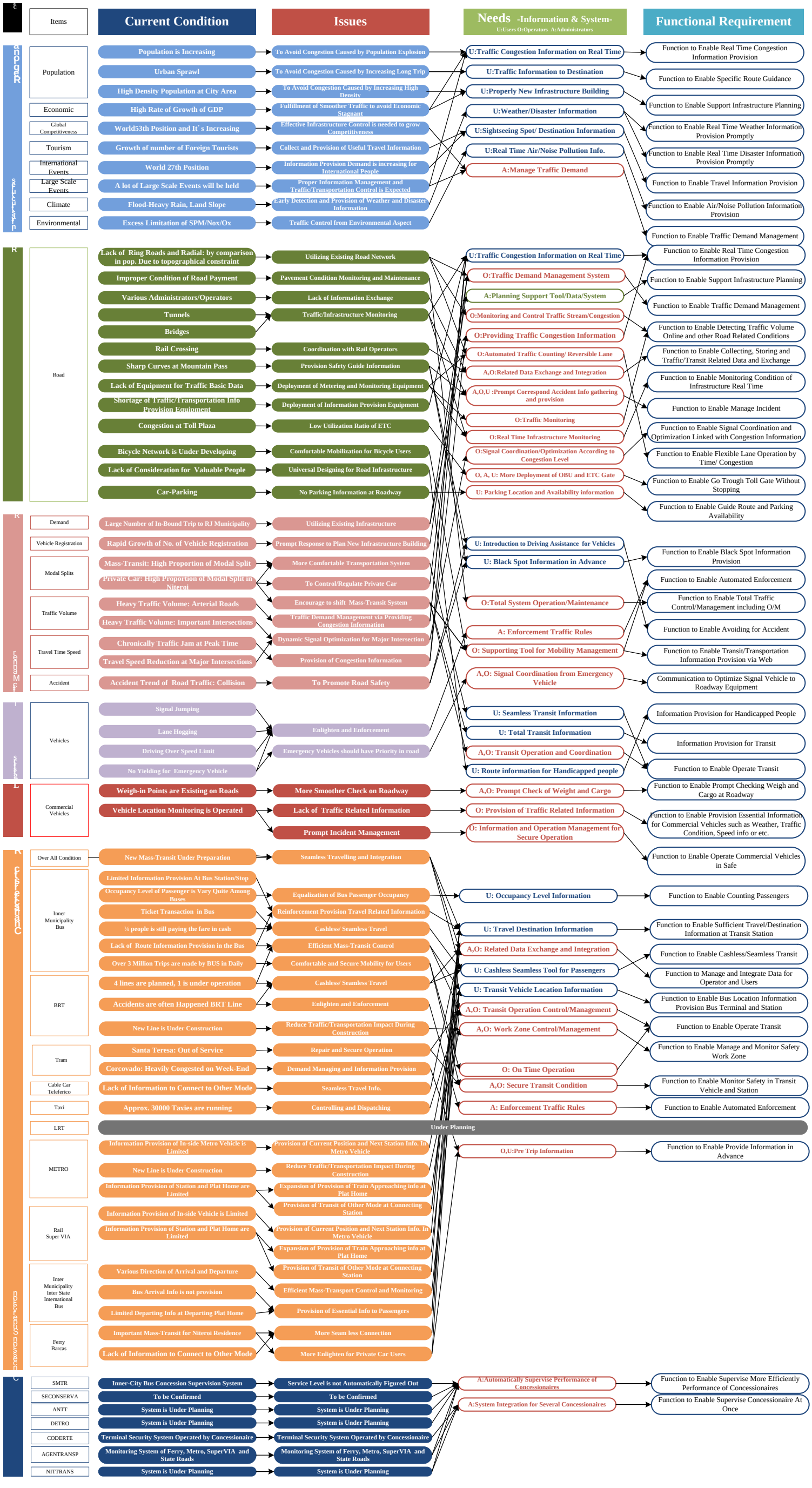


Figure 7-4 Matching Process Source: JICA Study Team

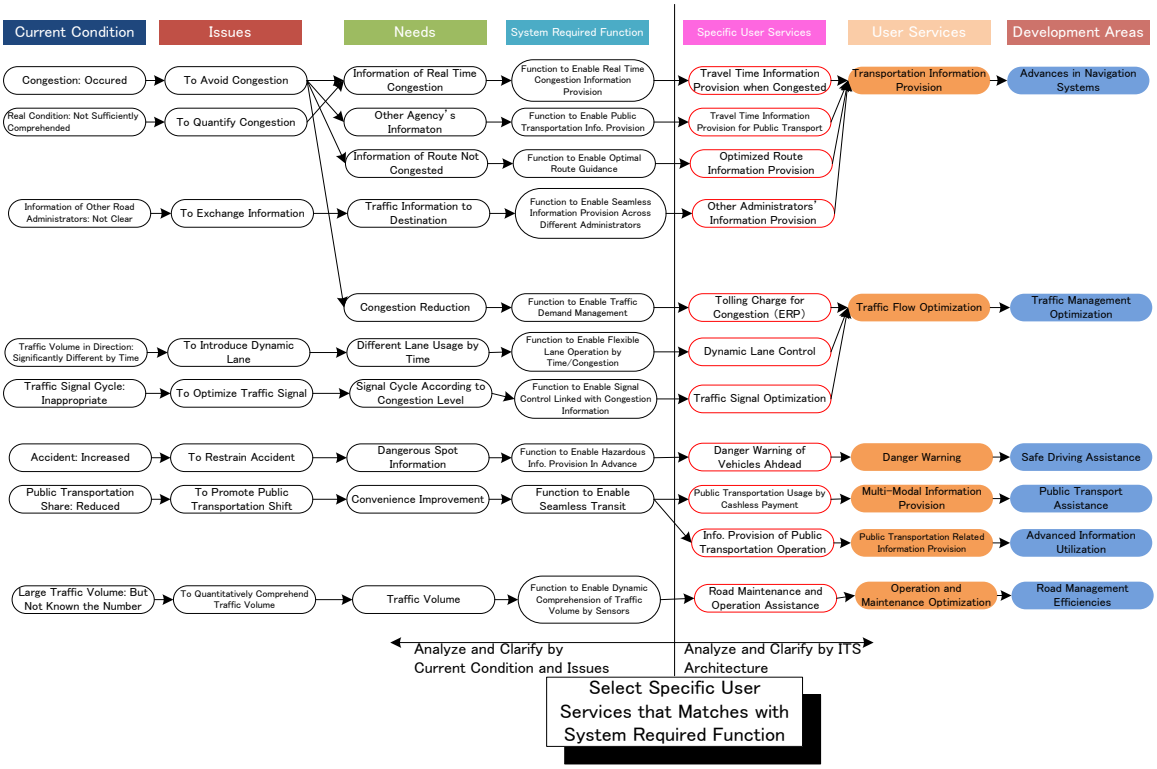
7.2.2 Matching with User Services

User services document what ITS should do from the user's perspective. A broad range of users are considered, including the traveling public as well as many different types of system operators. User services, including the corresponding user service requirements, form the basis for the National ITS Architecture development efforts. The initial user services were jointly defined by the United States Department of Transportation (USDOT) and Intelligent Transportation Society of America (ITS America) with significant stakeholder input which are documented in the National Program Plan. The concept of user services allows system or project definition to begin by establishing the high-level services that will be provided to address identified problems and needs. New or updated user services have been and will continue to be satisfied by the National ITS Architecture over time.

Source: The National ITS Architecture 7.0

The matching process shall be considered as a check of coherency of the logical aspect for developing the ITS master plan because the referred architecture is formulated in the U.S.

However, in general, architecture defines the entire framework of ITS but does not define the details of ITS. From this perspective, the National ITS Architecture 7.0 can be utilized as a framework of the ITS master plan development. Figure 7-5 below shows the outline of the matching process between functional requirement and user services. Figure 7-6 on the next page shows the results of the matching process which illustrate the relationship of the current condition to user services and its bundles.



Source: JICA Study Team

Figure 7-5 Outline of the Matching Process

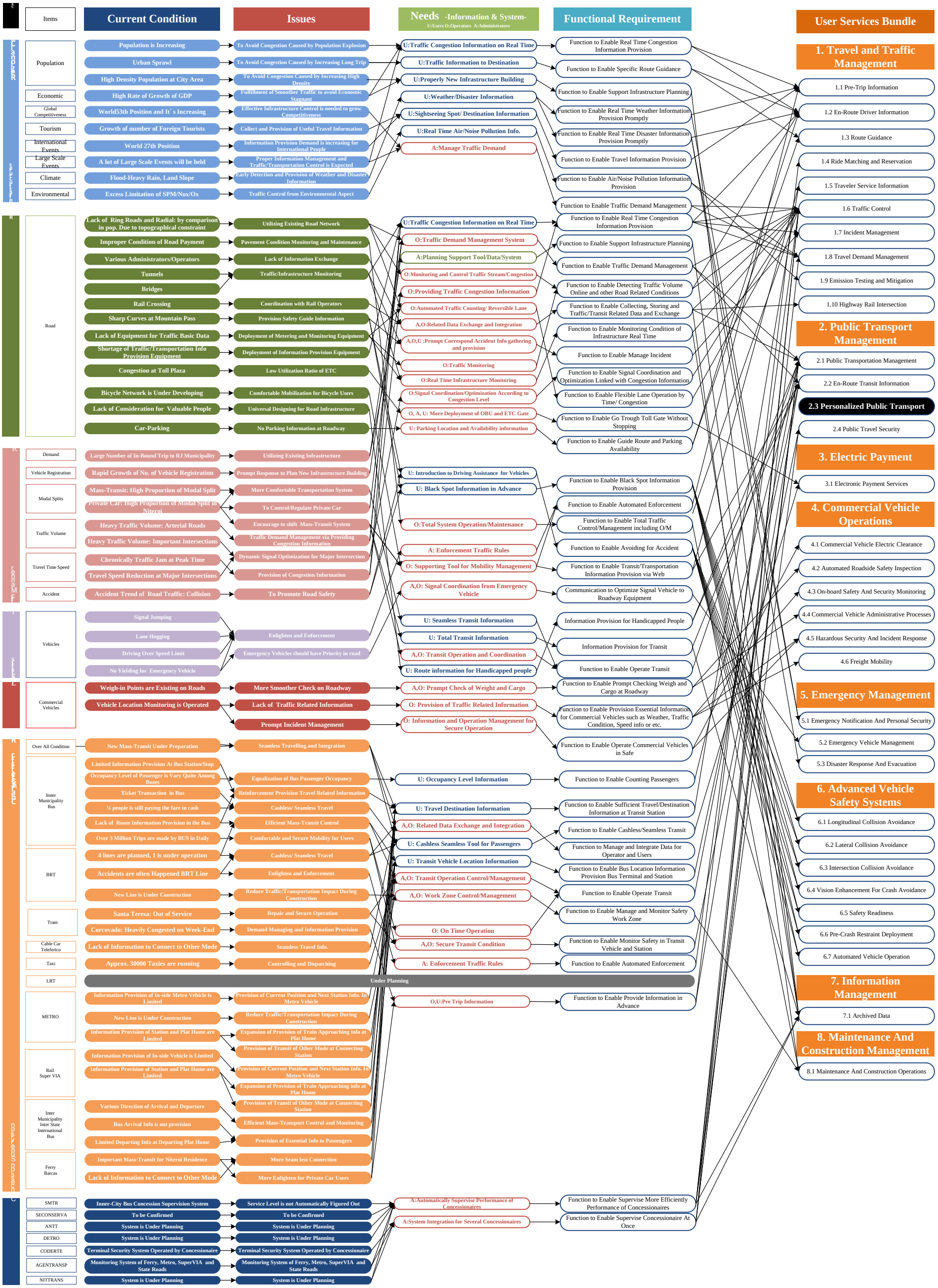


Figure 7-6 Results of the Matching Process Source: JICA Study Team

The matching process results show that only one user service; 2.3 Personalized Public Transport, which is bundled under Public Transport Management is not matched from the needs and functional requirements because the public transport network, especially the bus transport, widely covers the Rio de Janeiro municipal area. In addition, the survey on ITS needs was conducted in an urban area only. Due to this project circumstances, user service 2.3 Personalized Public Transport will not be considered in the ITS master plan and architecture of the Rio de Janeiro Metropolitan Area.

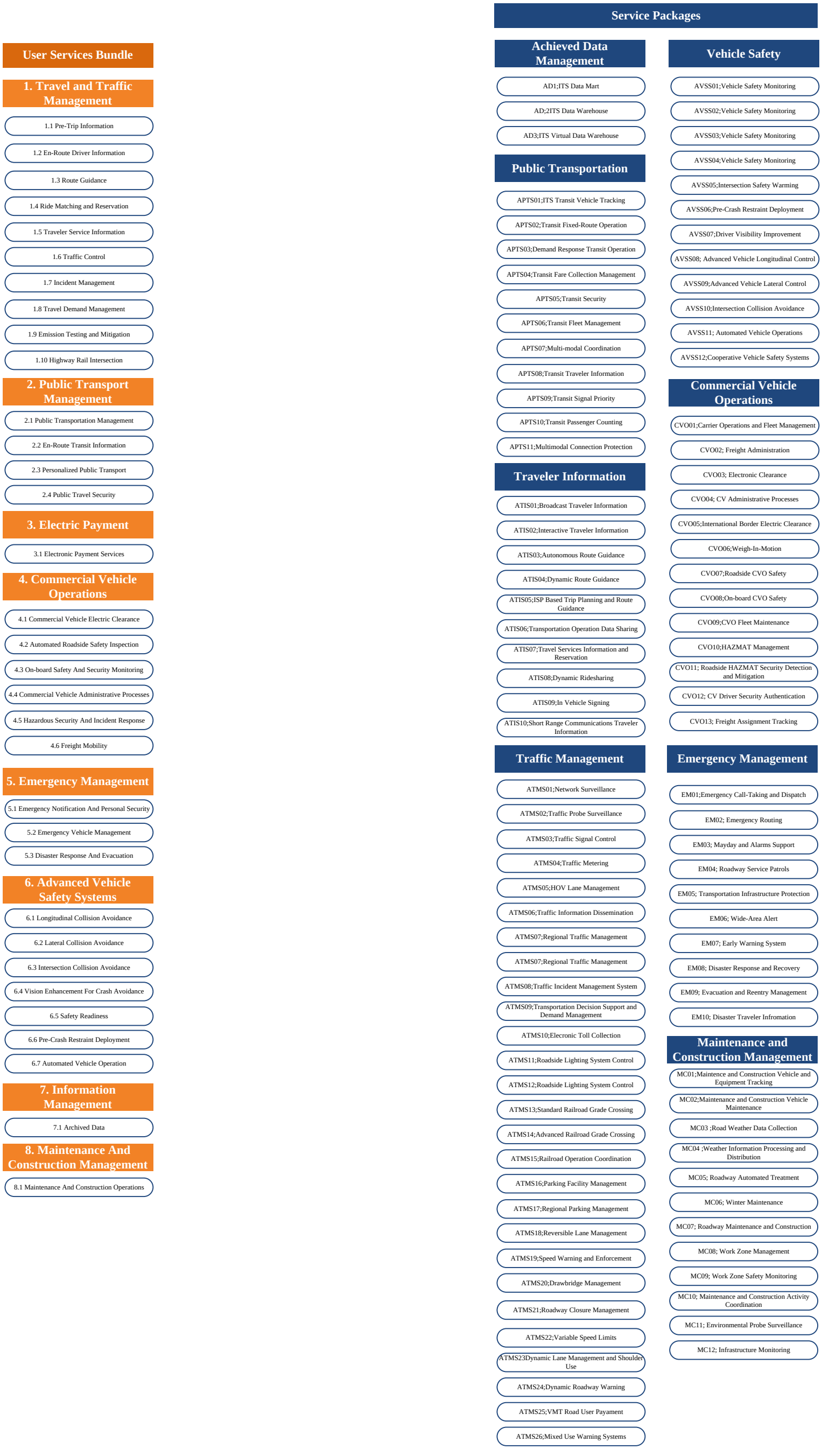
However, the other user services and bundles are adapted to the ITS needs and functional requirements of the Rio de Janeiro Metropolitan Area.

7.2.3 Clarification of Relationship between User Service Bundles and Service Packages

The service packages, formerly known as market packages, provide an accessible, service-oriented perspective to the National ITS Architecture. They are tailored to fit, separately or in combination, real world transportation problems and needs. Service packages collect together one or more equipment packages that must work together to deliver a given ITS service and the architecture flows that connect them and other important external systems. In other words, they identify the pieces of physical architecture that are required to implement a particular ITS service. Service packages implemented through projects (or groups of projects, a.k.a. programs) and in transportation planning, are directly related to ITS strategies used to meet regional goals and objectives.

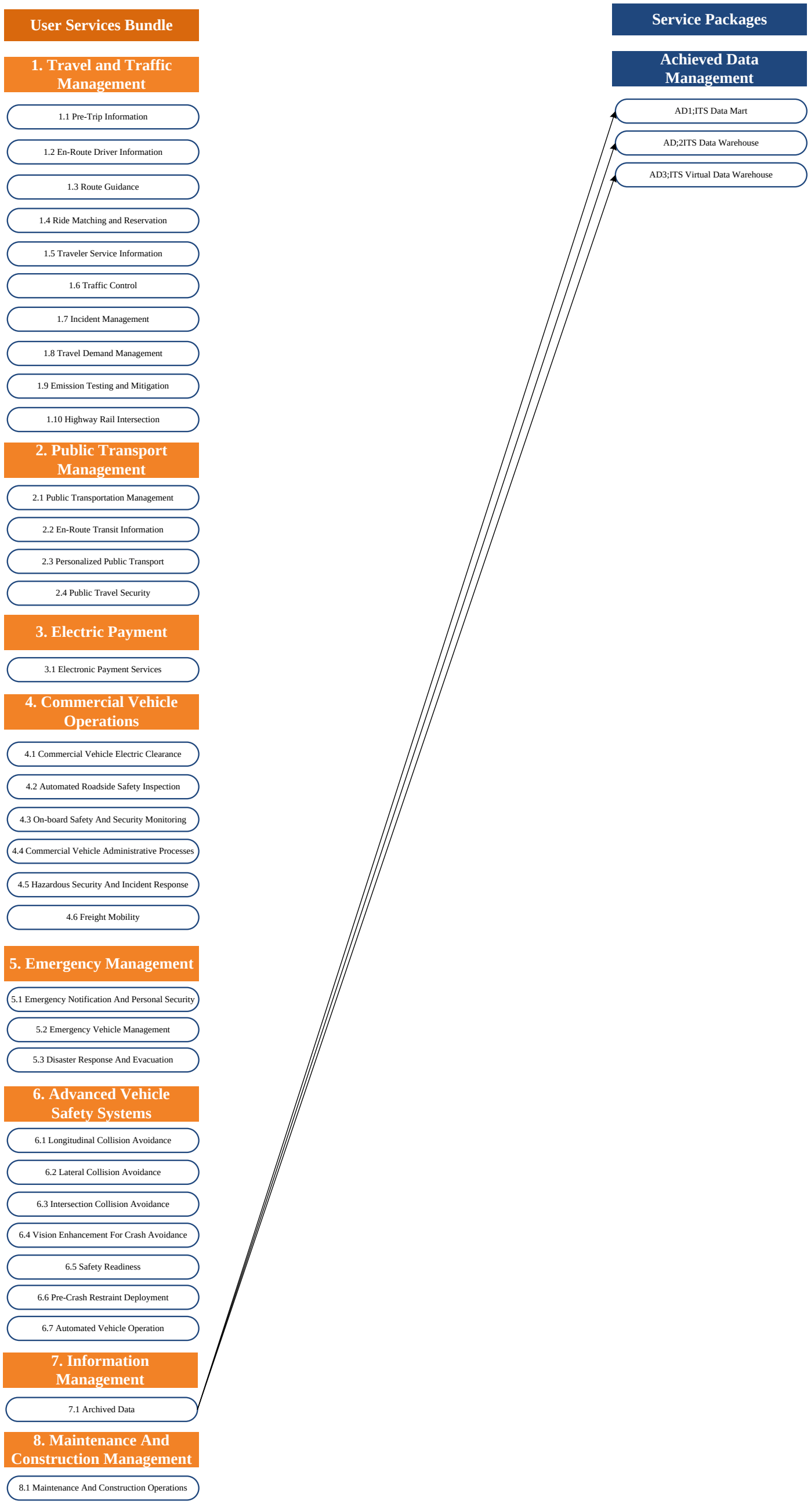
Source: The National ITS Architecture 7.0

It is quite important to understand the relativity of user services and services packages for developing a comprehensive ITS master plan, which can describe the connectivity of existing systems in the real world and ideal form from user perspective. Figure 7-7 to Figure 7-15 in the following pages (sausage diagrams) show the relativity between user service bundles and service packages. To know more about user services and service packages, please go to the website of The National ITS Architecture 7.0 found on: http://www.iteris.com/itsarch/.



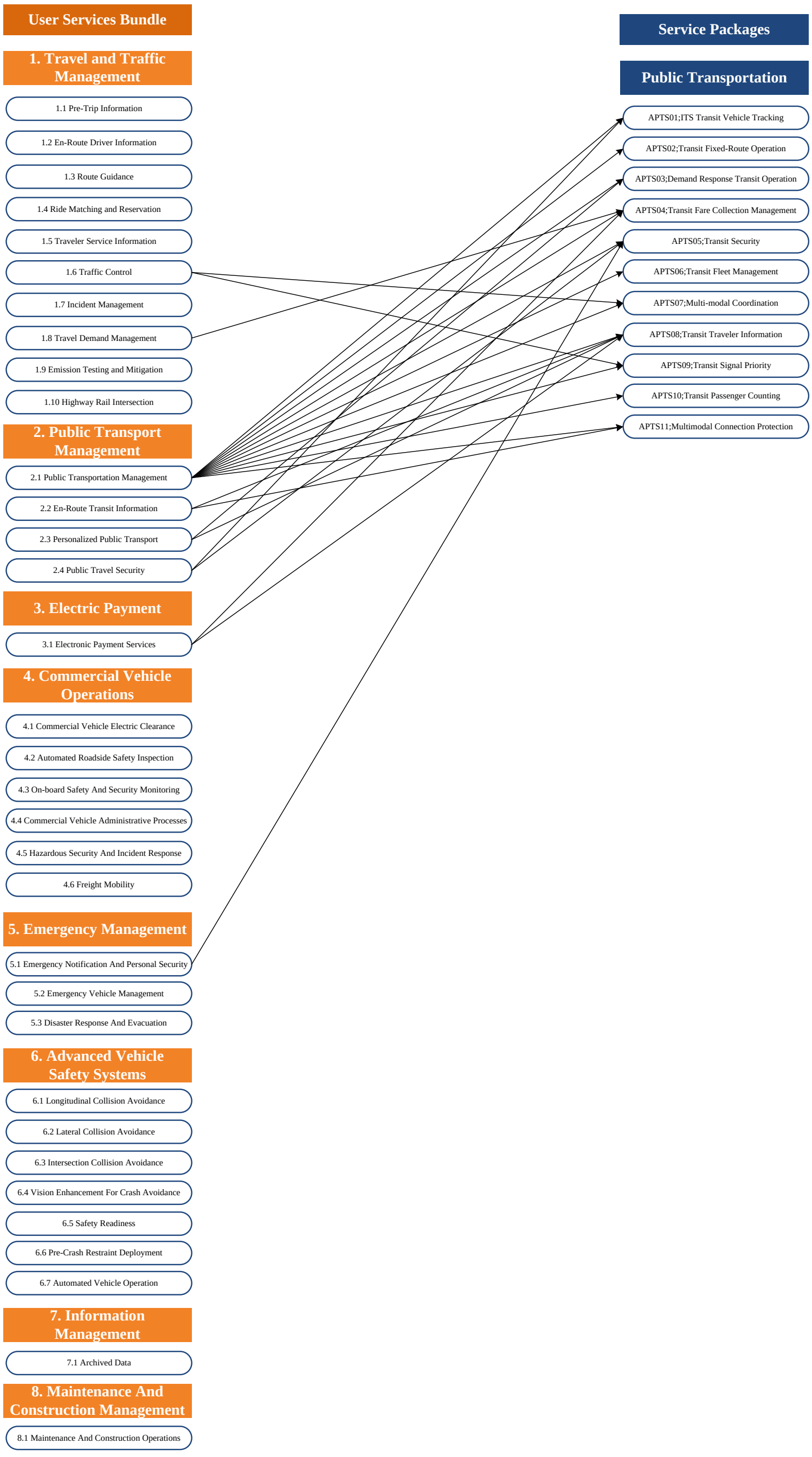
Source: JICA Study Team

Figure 7-7 User Service Bundles and Service Packages



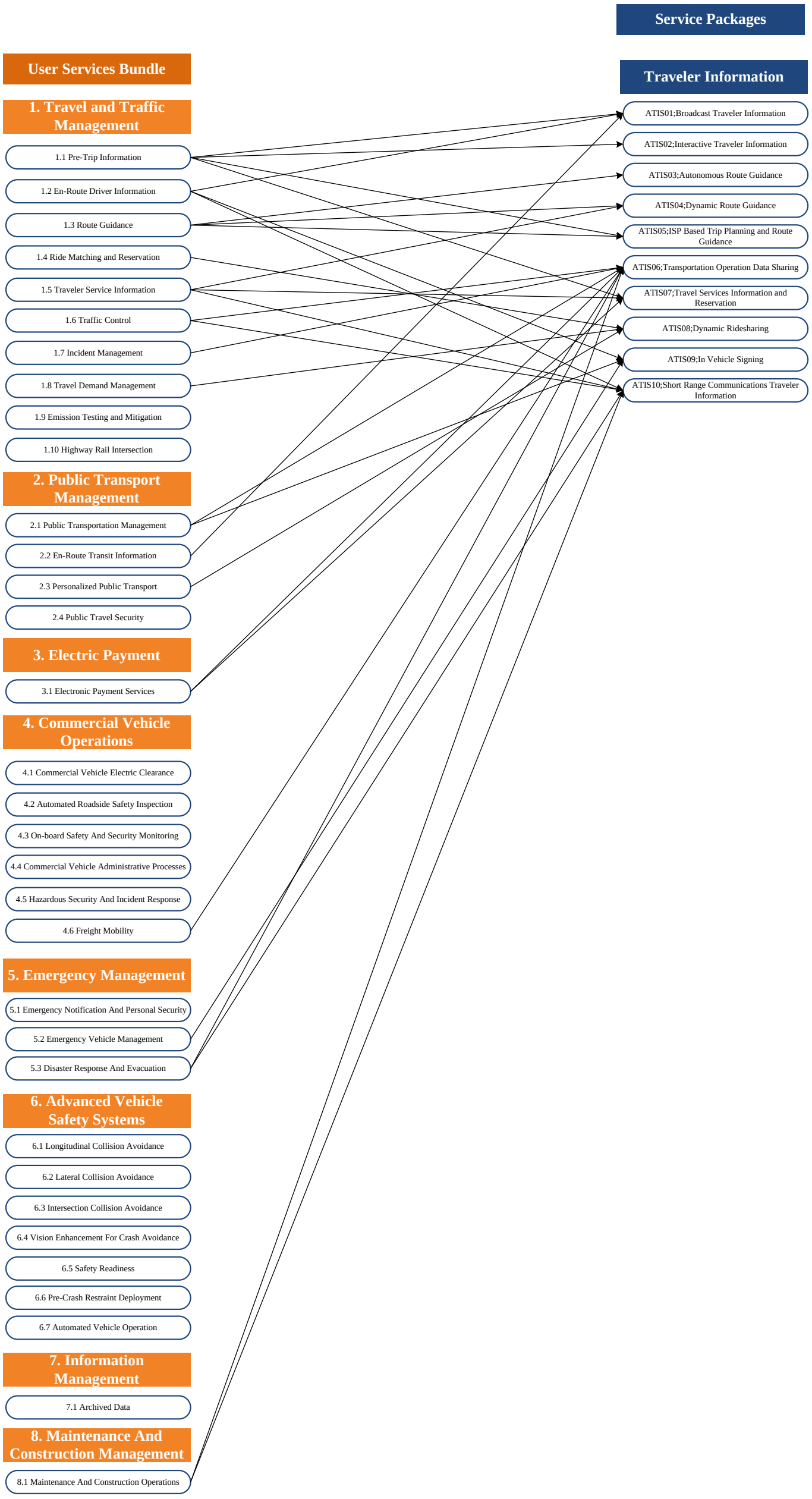
Source: JICA Study Team

Figure 7-8 Relativity of User Service Bundles and Service Packages (1/8)



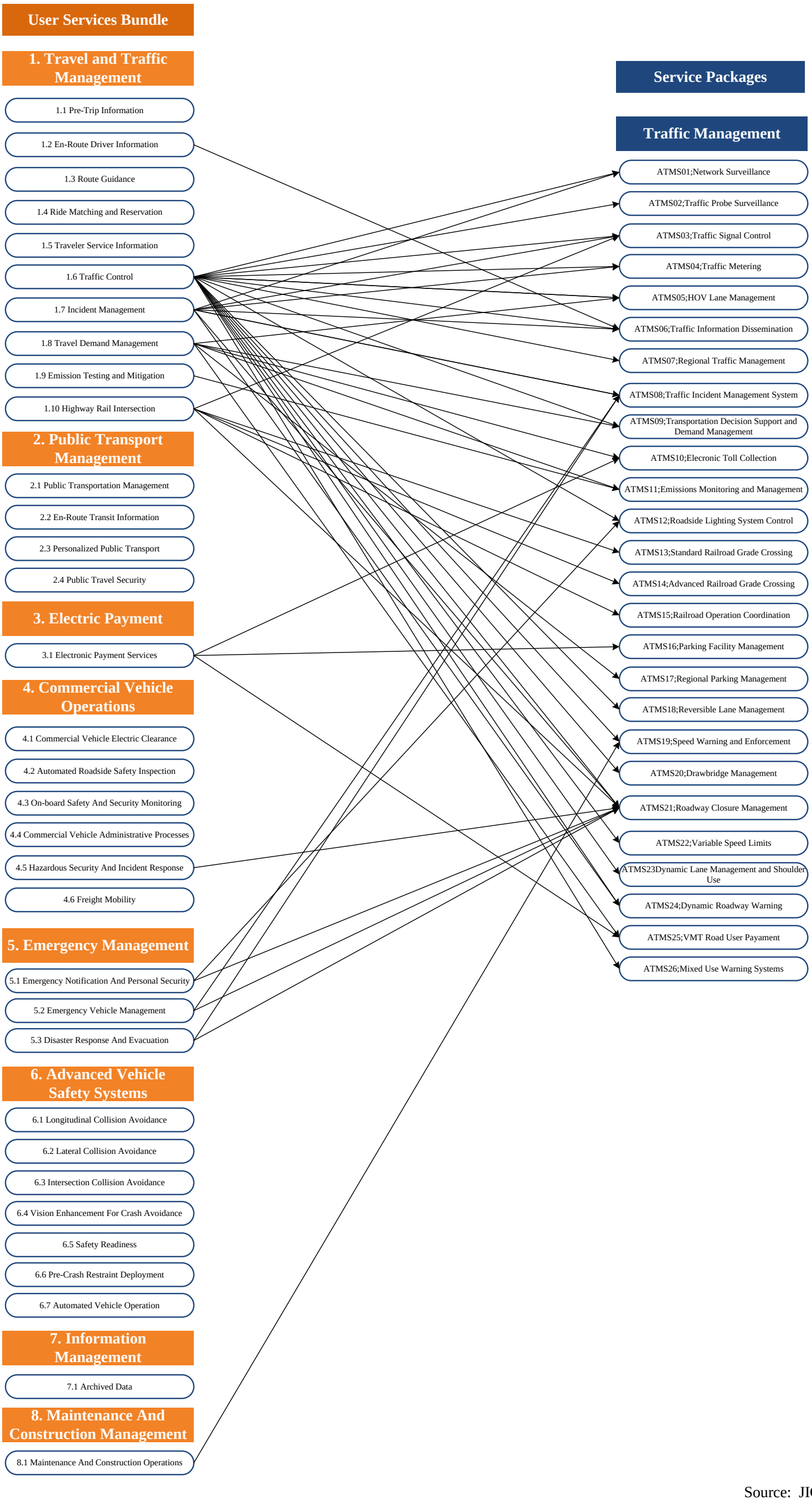
Source: JICA Study Team

Figure 7-9 Relativity of User Service Bundles and Service Packages (2/8)



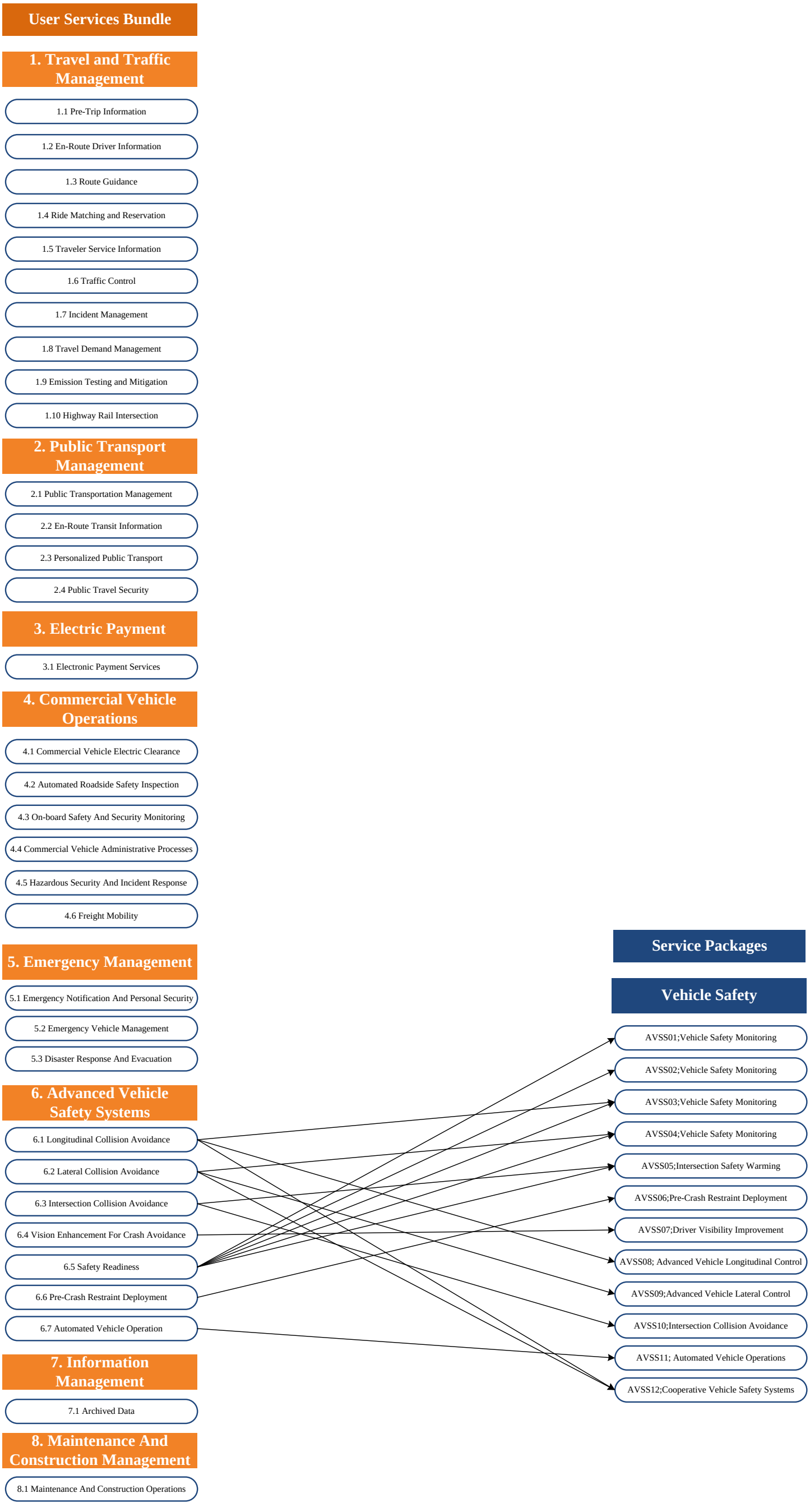
Source: JICA Study Team

Figure 7-10 Relativity of User Service Bundles and Service Packages (3/8)



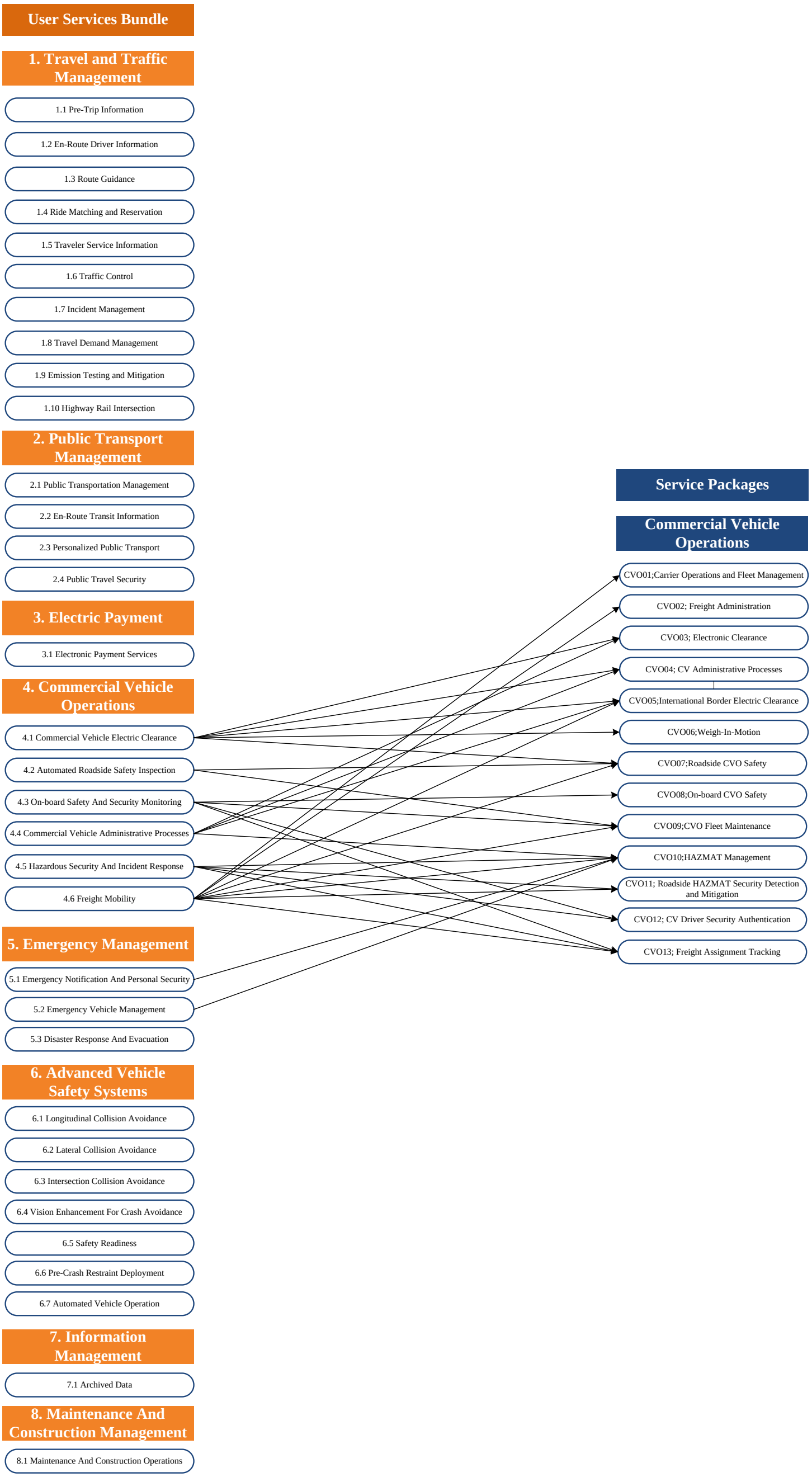
Source: JICA Study Team

Figure 7-11 Relativity of User Service Bundles and Service Packages (4/8)



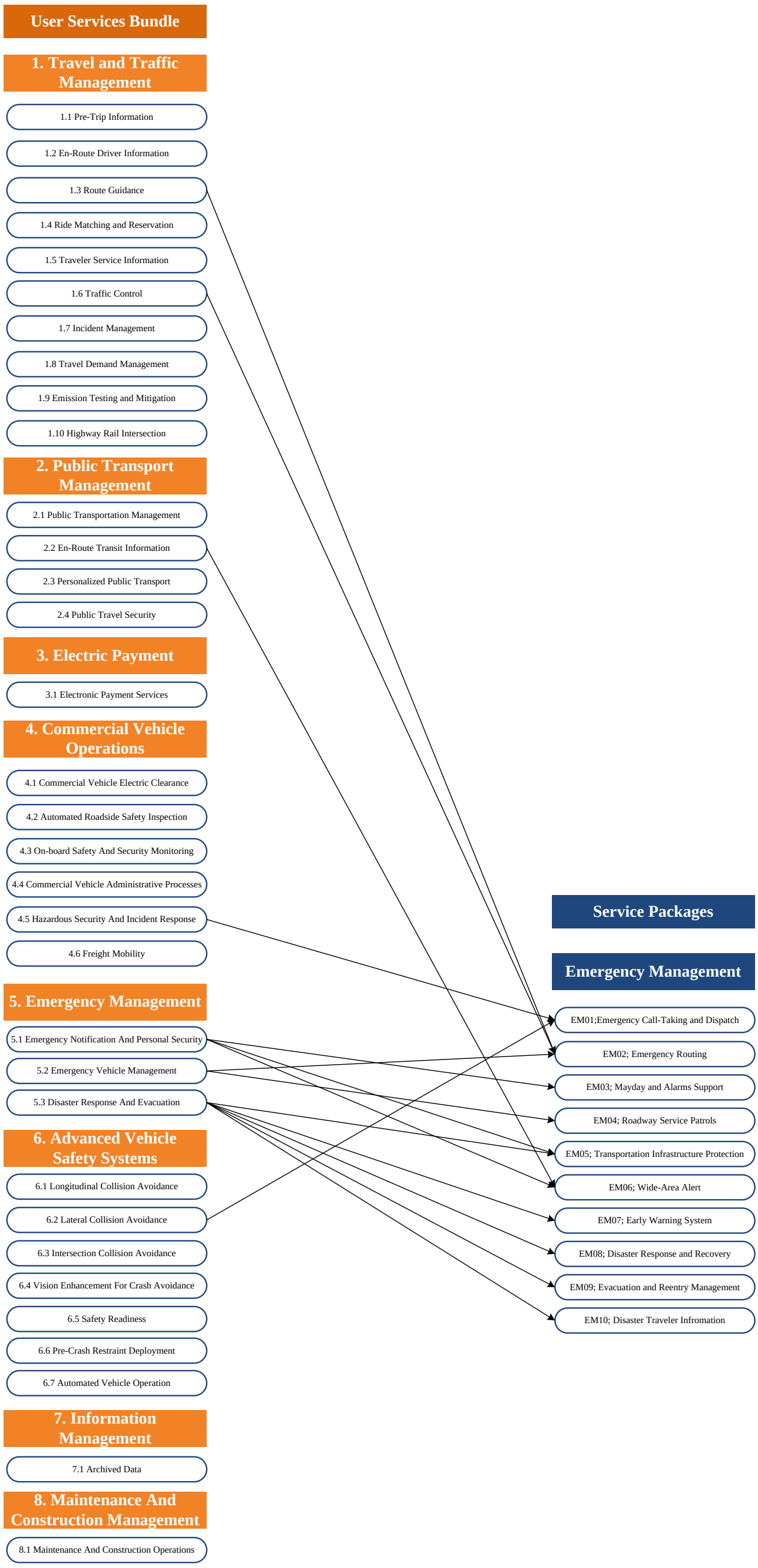
Source: JICA Study Team

Figure 7-12 Relativity of User Service Bundles and Service Packages (5/8)



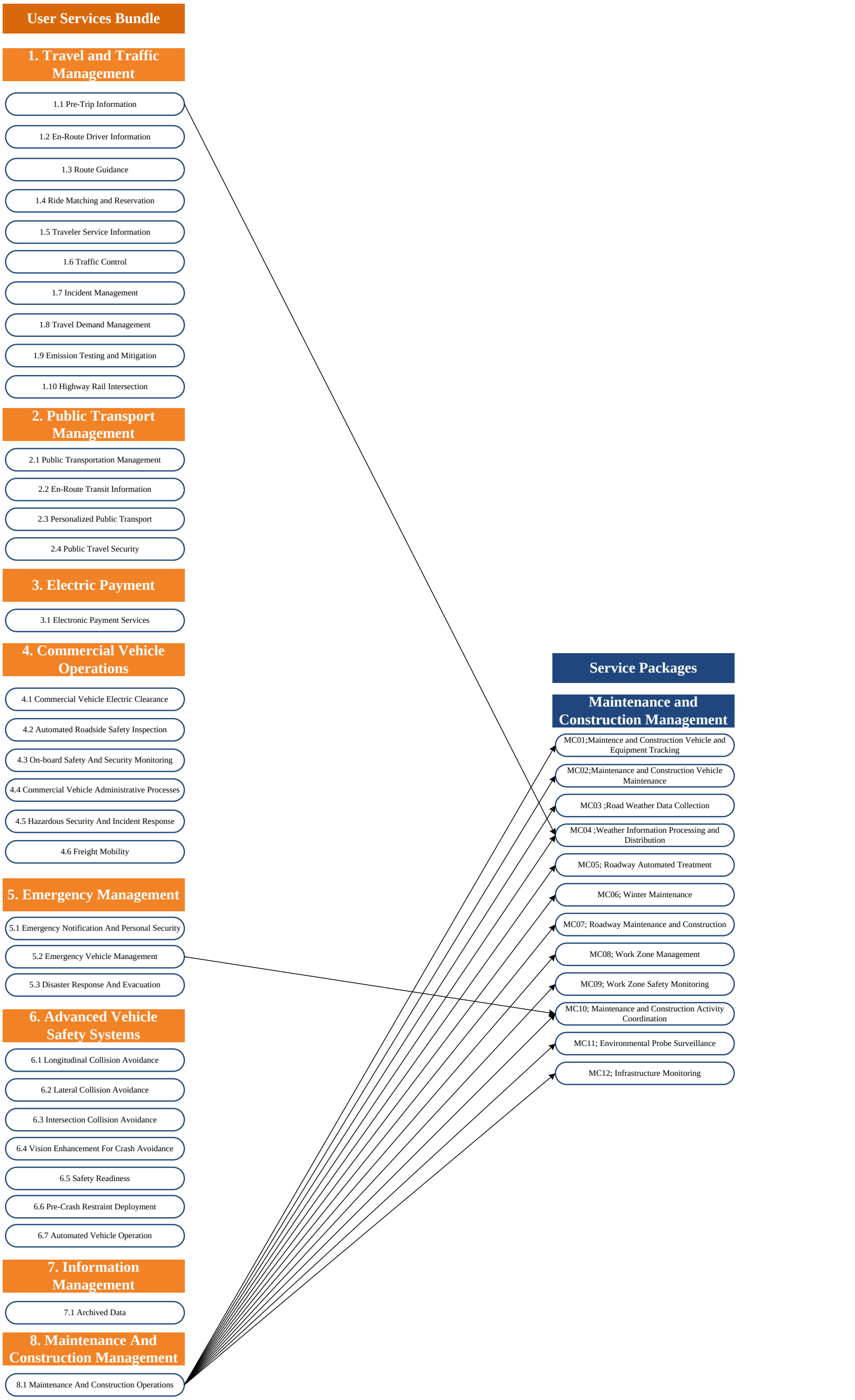
Source: JICA Study Team

Figure 7-13 Relativity of User Service Bundles and Service Packages (6/8)



Source: JICA Study Team

Figure 7-14 Relativity of User Service Bundles and Service Packages (7/8)



Source: JICA Study Team

Figure 7-15 Relativity of User Service Bundles and Service Packages (8/8)

7.2.4 Conceptual Design for ITS Projects

(1) Study on Essential ITS Projects for Rio de Janeiro Metropolitan Area

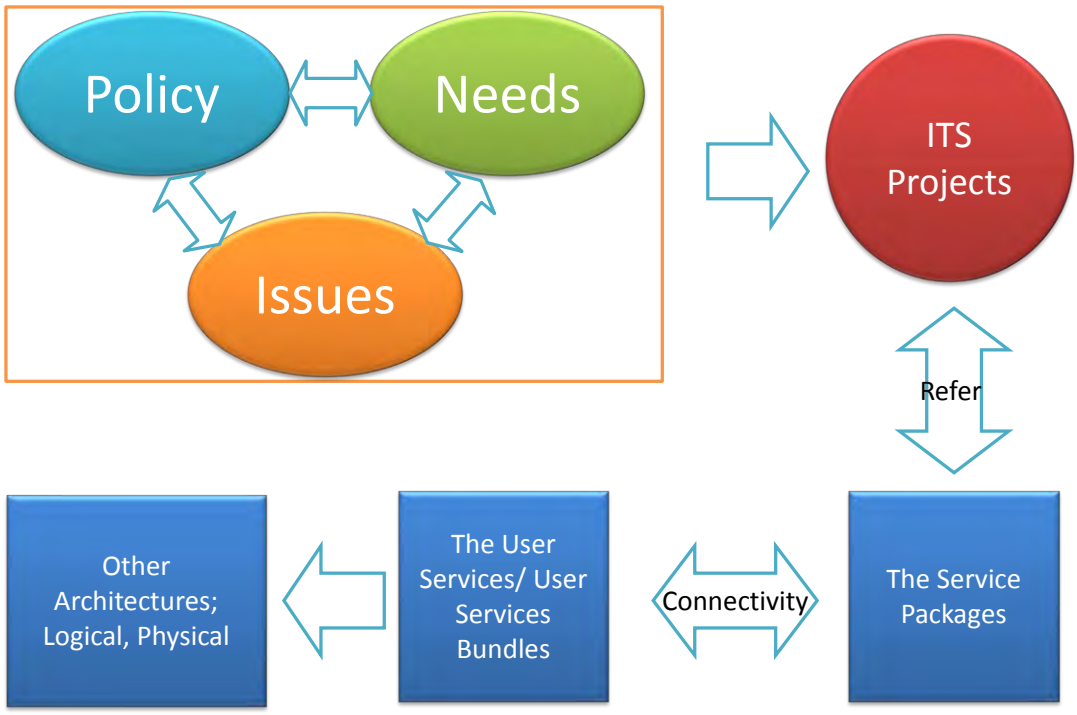
There are three perspectives which shall be considered to build up ITS projects for Rio de Janeiro Metropolitan Area as follows:

1. Policy of ITS Master Plan,
2. Current Condition and Issues, and
3. ITS Needs.

In addition, the keywords for further development of the ITS field in Rio de Janeiro Metropolitan Area is the following:

1. Integration,
2. Information Exchange,
3. Utilization,
4. Dissemination, and
5. Cooperation (Interoperability).

The coverage of ITS projects shall focus on these aspects. Furthermore, it shall be adaptive to ITS architecture such as service packages, user services and bundles. Figure 7-16 below shows the developing process of ITS projects for Rio de Janeiro Metropolitan Area.



Source: JICA Study Team

Figure 7-16 Developing Process of ITS Projects

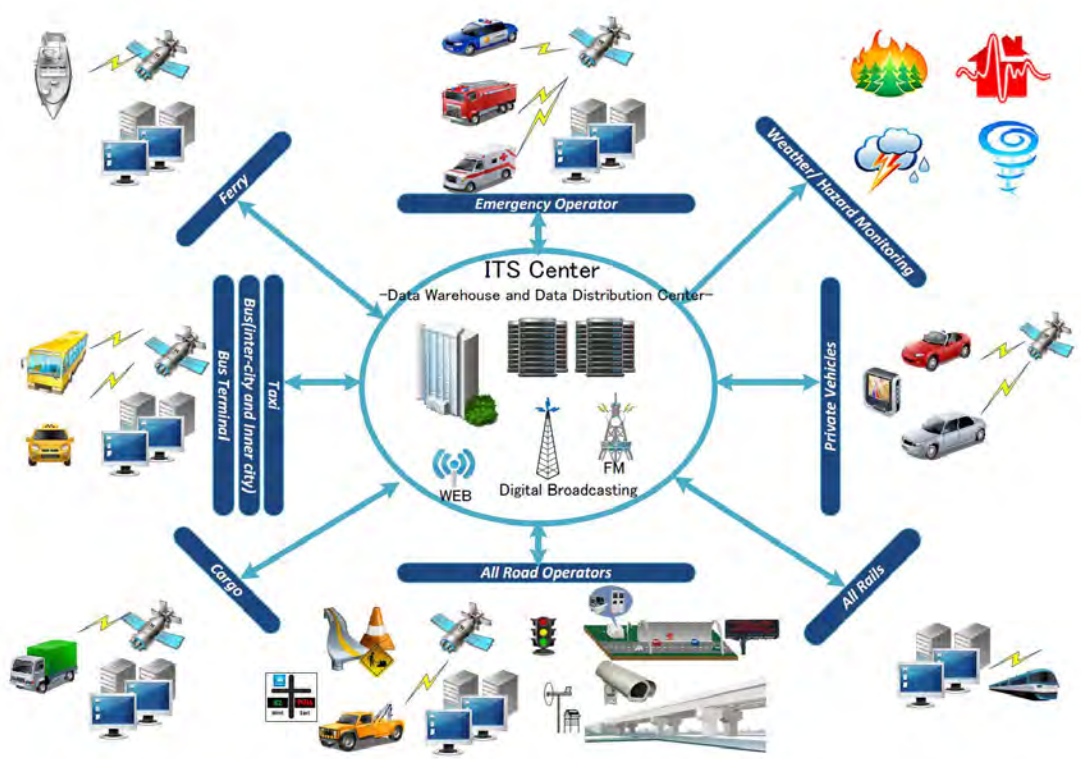
(2) Conceptual Design for ITS Projects

Considering the circumstances, the JICA Study Team prepared 13 ITS projects, which are shown below.

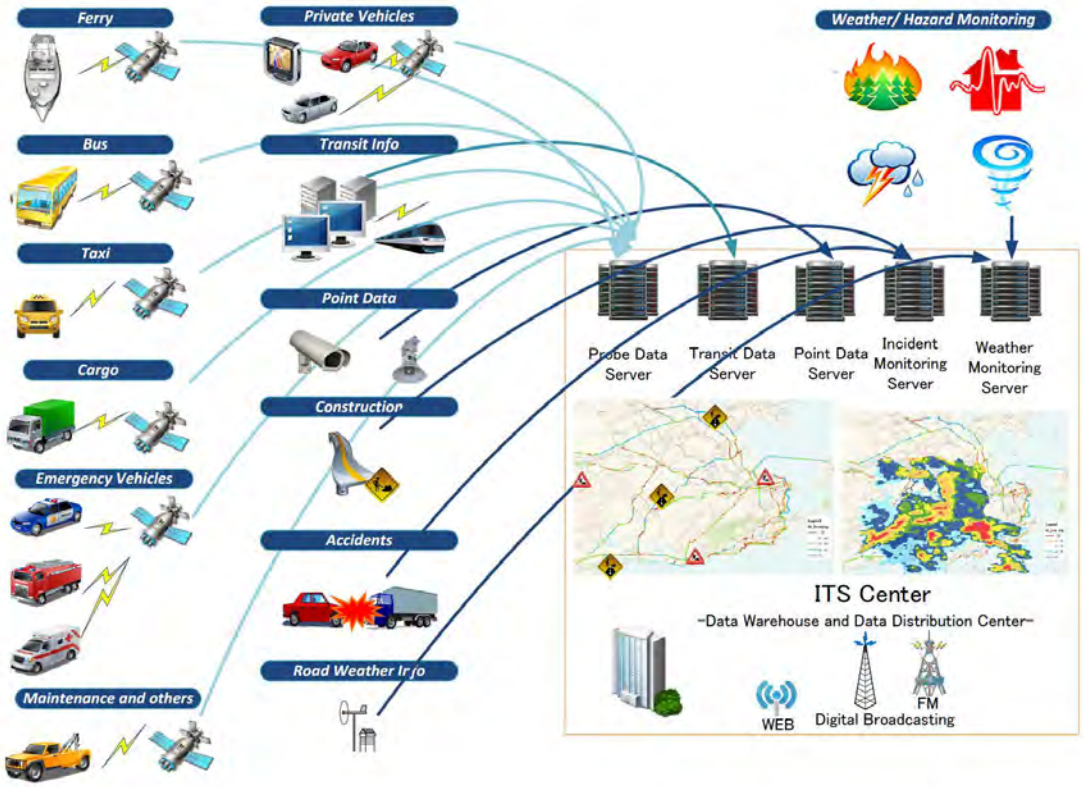
Table 7-1 ITS Projects

No.	ITS Project Name
1	ITS Center
2	Real Time Traffic/Transport Condition Information Processing
3	Olympic Security and Transport Coordination Center
4	Bus Condition Information Provision
5	Dissemination of On-board Unit for More Integrated Transport
6	Information Exchange of Road Operators
7	Information Exchange via ITS Center between Municipalities
8	Improvement of Traffic/Transit Operational Center with Essential ITS Equipment in Rio de Janeiro Municipal Area
9	Improvement of Traffic/Transit Operational Center with Essential ITS Equipment in Other Municipal Areas in RMRJ
10	Emergency Vehicle Operating Management
11	Commercial Vehicle Operation and Management
12	Advanced Vehicle Safety Systems
13	Deployment of X-band Radars

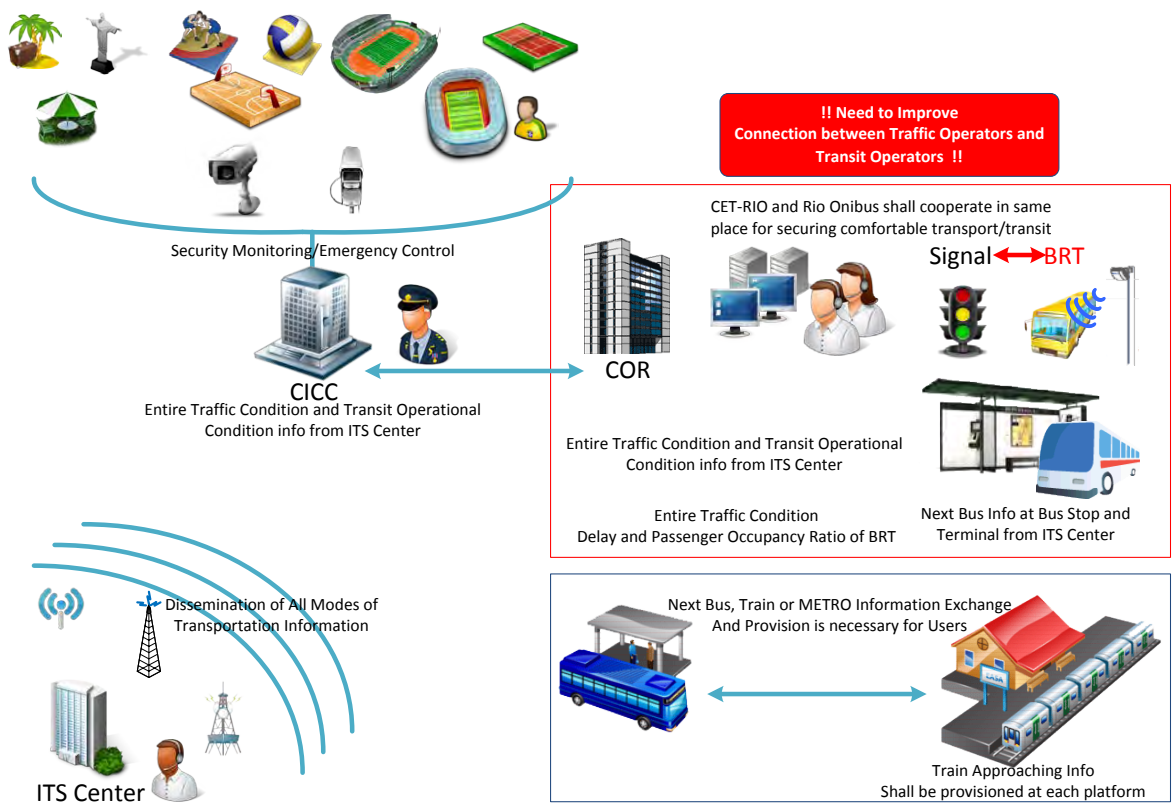
Source: JICA Study Team

ITS Project Name	1. ITS Center - for Information Integration and Dissemination
Objectives	To integrate all transport/transit-related information into one place. To process useful information for all stakeholders. To disseminate information to everyone through media.
Graphic	
Target Area (Area to be applied)	Rio de Janeiro Metropolitan Area
Required System	1. Information Exchange System 2. ITS Center Building (COR (*Centro de Operações da Prefeitura do Rio*: Operation Center of Rio de Janeiro) or CICC (*Centro Integrado de Comando e Controle*: Center for Integrated Command and Control) or New building)
Rough Order of Magnitude Estimate	R$59.900.000/¥2,371,000,000
Implementation Period	From short term to long term: Stepwise development
ITS Service Packages Reference No.	AD area, ATIS area, ATMS06, and ATMS09
Remarks	Intense and quick development shall be done in the short term for Olympics preparation. After the Olympic Games, it shall expand and improve in a stepwise manner along with other related system development.

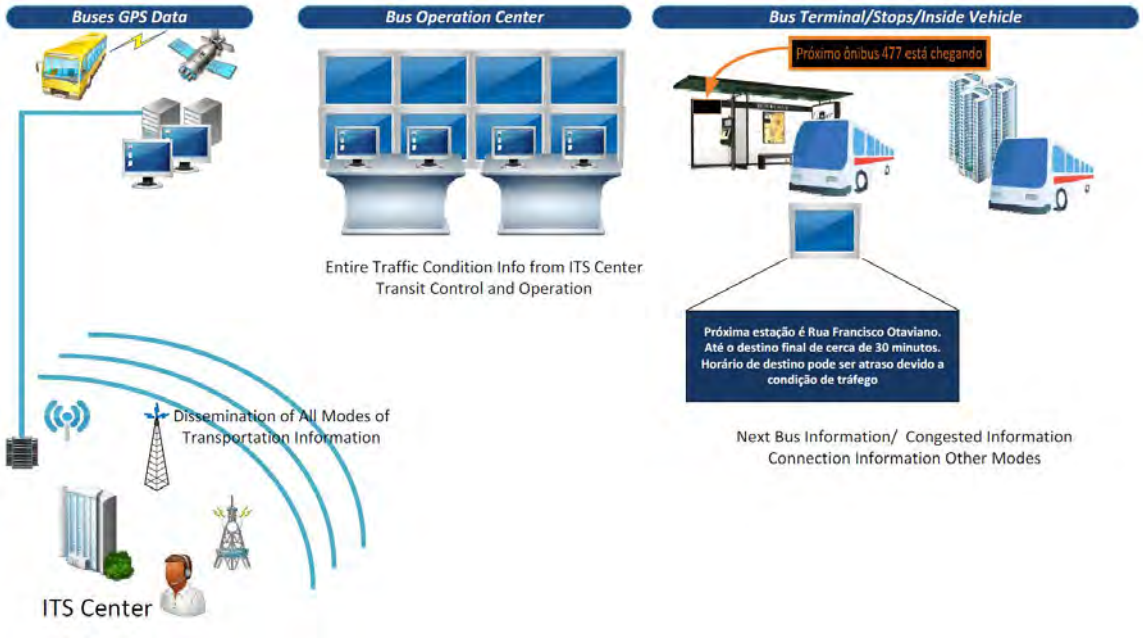
Source: JICA Study Team

ITS Project Name	2. Real Time Traffic/Transport Condition Information Processing
Objectives	To gather and process information to monitor the actual real time condition of Rio de Janeiro Metropolitan Area.
Graphic	
Target Area (Area to be applied)	Rio de Janeiro Metropolitan Area
Required System	1. Probe Data System 2. Transit Data System 3. Point Data System 4. Incident Monitoring System 5. Weather Monitoring System
Rough Order of Magnitude Estimate	R$45.900.000/¥1,815,000,000
Implementation Period	Short term: Rio de Janeiro municipal area Long term: Stepwise development
ITS Service Packages Reference No.	AD area, ATIS area, ATMS06, and ATMS09
Remarks	For the fulfillment of traffic/transit management, real time traffic/transit data shall be gathered, processed, and supervised intensively. Weather and disaster information is also important.

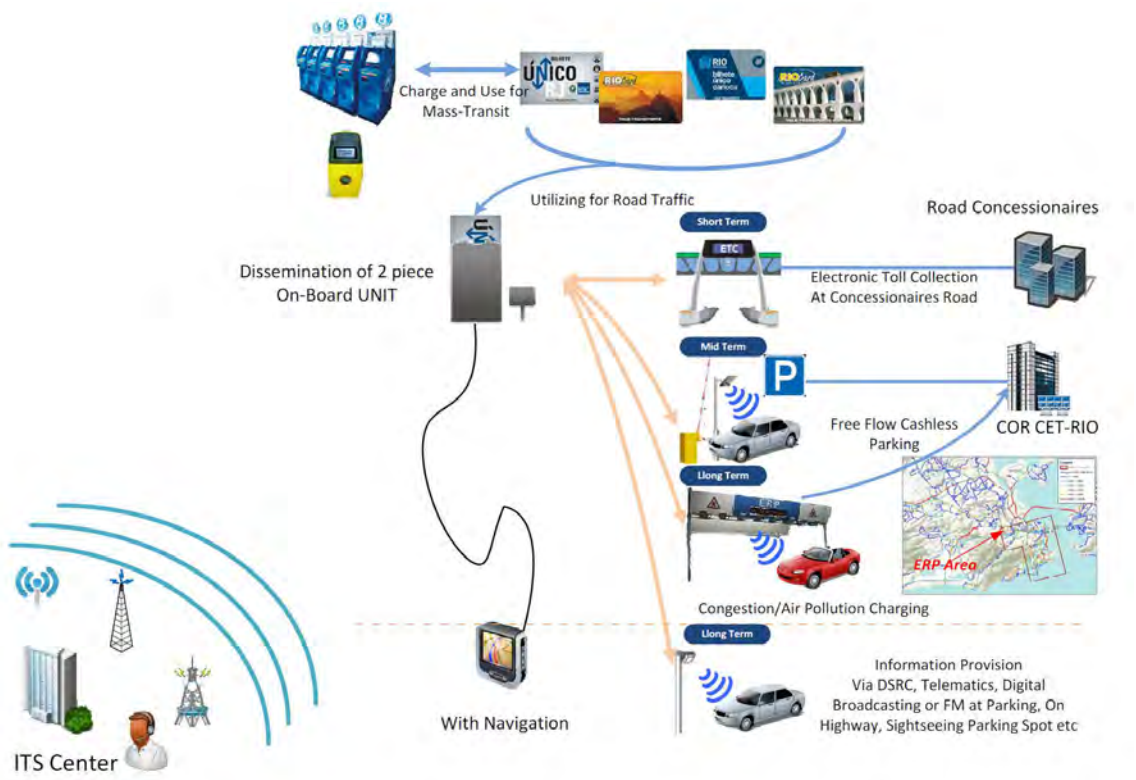
Source: JICA Study Team

ITS Project Name	3. Olympic Security and Transport Coordination Center
Objective	To expand and improve the functions of existing ITS equipment for smoother and smarter transportation and transit.
Graphic	
Target Area (Area to be applied)	Rio de Janeiro municipal area
Required System	1. System Integration for Olympic Security and Transport Coordination 2. Information Exchange System
Rough Order of Magnitude Estimate	R$48.900.000/¥1,936,000,000
Implementation Period	Short term
ITS Service Packages Reference No.	ATIS01, APTS 05,06,07,08,09,10 and 11, ATMS06, and EM area
Remarks	Integration of traffic/transit and security for the success of the Olympic Games. The project shall be commenced immediately.

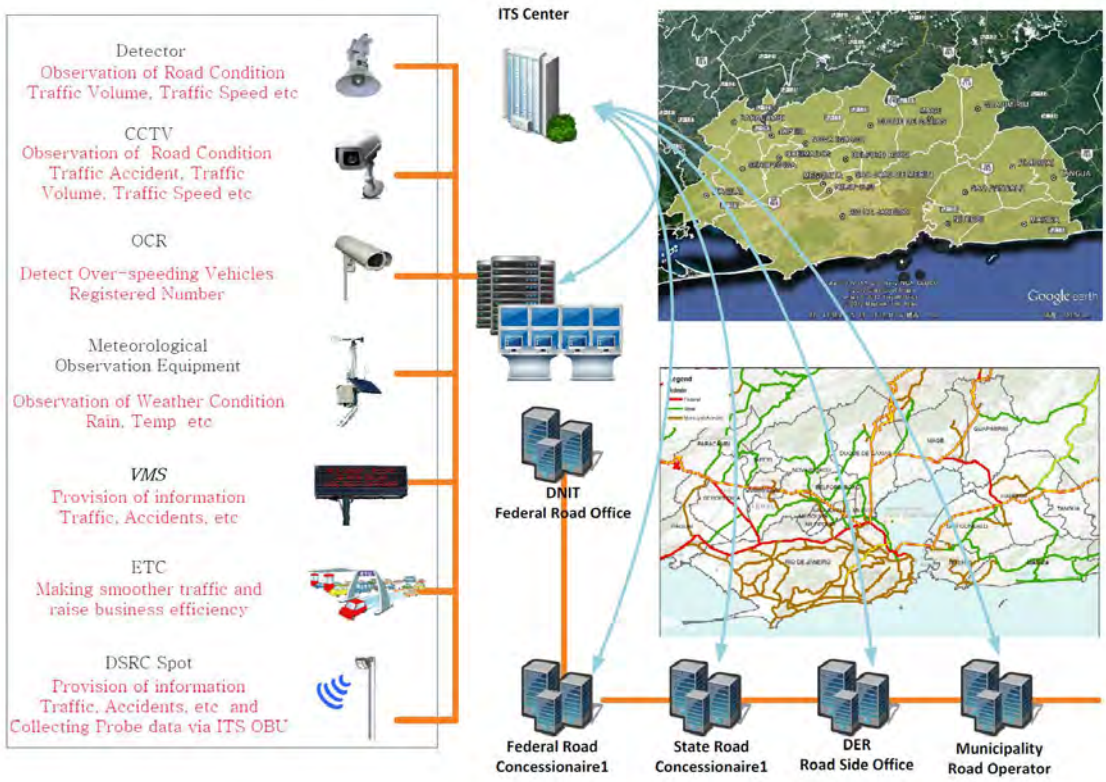
Source: JICA Study Team

ITS Project Name	4. Bus Condition Information Provision
Objectives	To enhance passenger satisfaction.
Graphic	
Target Area (Area to be applied)	Rio de Janeiro municipal area to Metropolitan Region of Rio de Janeiro (*Região Metropolitana do Rio de Janeiro*: RMRJ)
Required System	1. Bus Condition Provision System - Bus Information Panel for Bus Stop (500 bus stops) - Information Display in Bus Terminal (44 bus terminals) - Information Display in Bus (3000 buses) - Bus Operation Center (3 bus operation centers) - GPS for Bus (8000 buses)
Rough Order of Magnitude Estimate	R$122.300.000/¥4,840,000,000
Implementation Period	Short term: Rio de Janeiro municipal area Long term: Other municipalities and inter buses
ITS Service Packages Reference No.	APTS05,06,07,08,09,10 and 11
Remarks	Bus arrival information is useful to every bus user. This project is also important to the spectators of Olympic Games. Deployment planning shall be done more precisely before installing equipment at each bus stop.

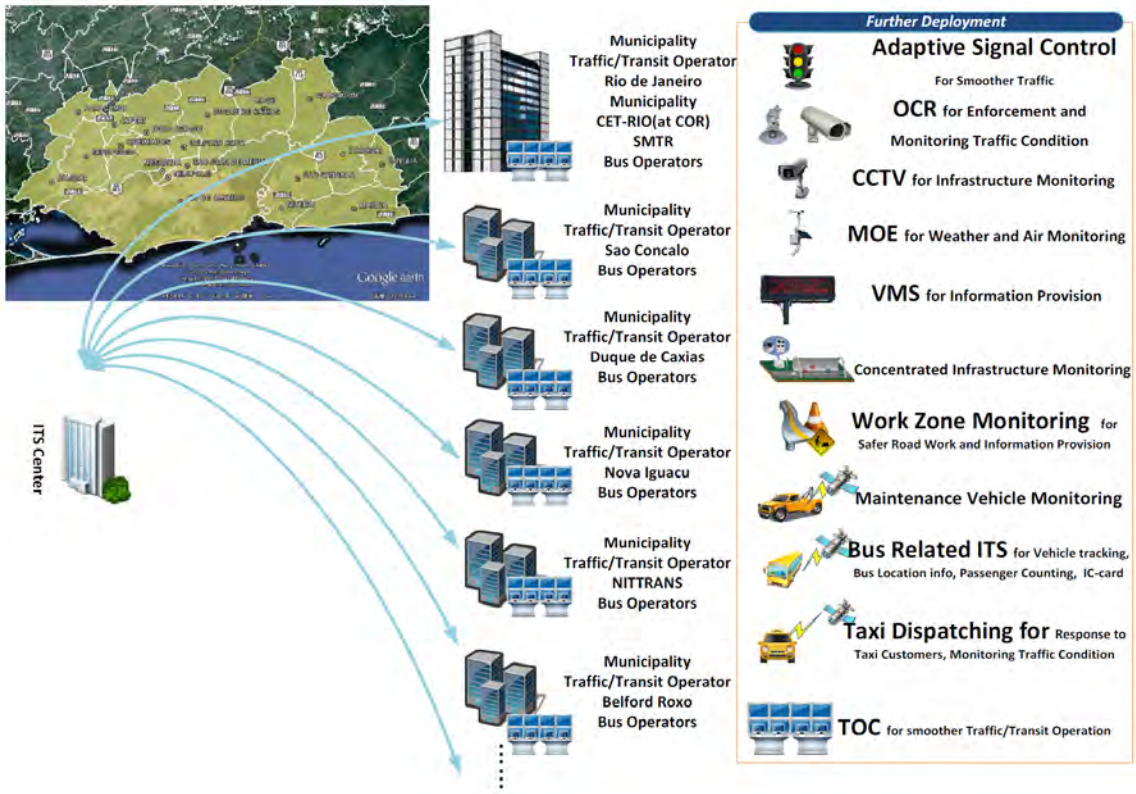
Source: JICA Study Team

ITS Project Name	5. Dissemination of On-Board Unit for More Integrated Transport
Objectives	To reduce congestion at the toll gates. To manage traffic demand. To enhance further the connectivity of all modes of transport.
Graphic	
Target Area (Area to be applied)	Rio de Janeiro Metropolitan Area
Required System	1. Electronic Toll Collection (ETC) System (8 locations) 2. Free-flow Cashless System (50 parking areas) 3. Electronic Road Pricing (ERP) System (35 locations) 4. On-board Unit (OBU) (200,000 vehicles)
Rough Order of Magnitude Estimate	R$344.900.000/¥13,643,000,000
Implementation Period	Short term: OBU Dissemination, ETC promotion of utilization, parking dedicated short-range communications (DSRC) electronic payment and integration of integrated circuit (IC)-Card. Long term: ERP and DSRC information dissemination.
ITS Service Packages Reference No.	ATMS10, ATIS04, and 10
Remarks	It is important to disseminate the on-board unit for further utilization of traffic/transport information systems.

Source: JICA Study Team

ITS Project Name	6. Information Exchange of Road Operators
Objectives	To connect road operators in terms of traffic information. To enhance essential information provision for road users. To ensure smoother traffic flow.
Graphic	
Target Area (Area to be applied)	Rio de Janeiro Metropolitan Area
Required System	1. Information Exchange System
Rough Order of Magnitude Estimate	R$24.500.000/¥968,000,000
Implementation Period	From medium to long term
ITS Service Packages Reference No.	AD1,2,3 ATIS06 ATMS01,02,04,06,07,08,10,23
Remarks	Highway-related information shall be exchanged to manage and control traffic. Other essential equipment shall be installed on federal and state government roads.

Source: JICA Study Team

ITS Project Name	7. Information Exchange via ITS Center Between Municipalities
Objectives	To monitor traffic and transit for more secure transport. To control traffic and transit for smoother transport.
Graphic	
Target Area (Area to be applied)	Rio de Janeiro Metropolitan Area
Required System	1. Information Exchange System
Rough Order of Magnitude Estimate	R$58.100.000/¥2,299,000,000
Implementation Period	Short term: Rio de Janeiro municipalities Medium to long term: Other municipalities in RMRJ
ITS Service Packages Reference No.	AD1,2,3 ATIS06, ATMS06
Remarks	All municipalities share information and computerized data are processed at ITS Center. After processing, the centers of all municipalities in RMRJ can receive traffic/transit-related information via ITS Center.

Source: JICA Study Team

ITS Project Name	8. Improvement of Traffic/Transit Operational Center with Essential ITS Equipment in Rio de Janeiro municipal area
Objectives	To expand and improve the functions of existing ITS equipment for smoother and smarter transportation and transit.

Graphic

Target Area (Area to be applied)	Rio de Janeiro municipal area	
Required System	1. Adaptive Signal Control (400 intersections) 2. VMS (24 sets) 3. CCTV (3 sets) 4. OCR (68 sets) 5. Parking Availability Information Provision (10 systems)	6. MOE (5 sets) 7. Dynamic Lane Management (10 locations) 8. Taxi Dispatching System(10 systems) 9. Rail Crossing Management (11 sets)
Rough Order of Magnitude Estimate	R$229.900.000/¥9,094,000,000	
Implementation Period	Short term: Data integration and adaptive signal expansion and variable message sign (VMS) Medium term: Others	
ITS Service Packages Ref No.	ATMS area, MC area, AD1, APTS01,02,04,05,06,07,08,09,10 and 11	
Remarks	System integration, new VMSs, and data utilization are necessary.	

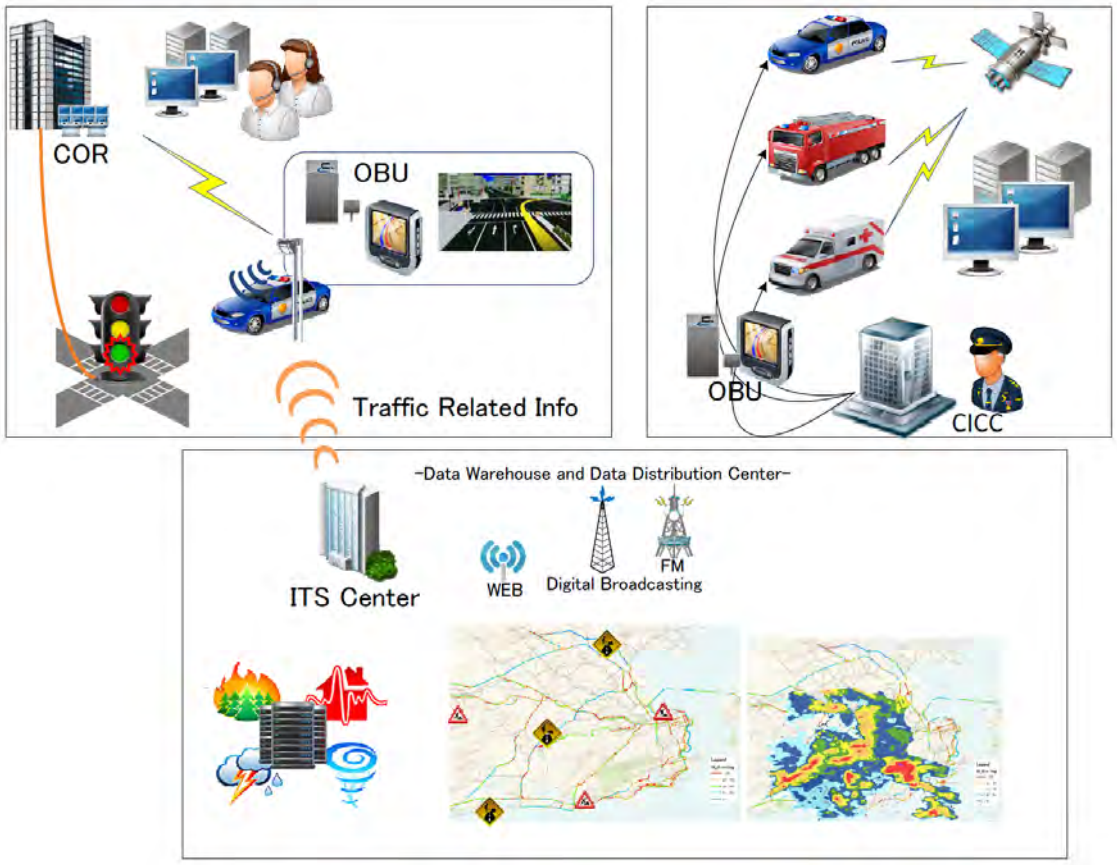
Source: JICA Study Team

ITS Project Name	9. Improvement of Traffic/Transit Operational Center with Essential ITS Equipment in Other Municipal Areas in RMRJ
Objectives	To expand and improve the functions of existing ITS equipment for smoother and smarter transportation and transit.

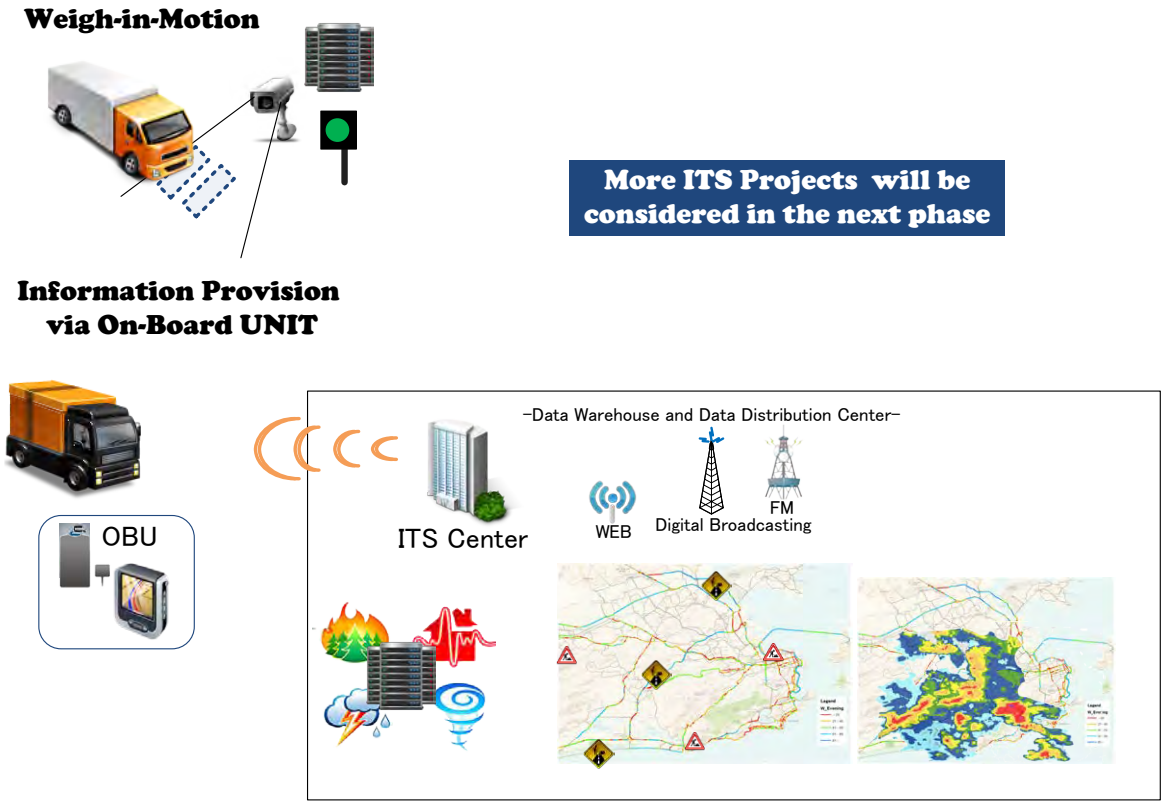
Graphic

Target Area (Area to be applied)	Rio de Janeiro Metropolitan Area	
Required System	1. Adaptive Signal Control (150 intersections) 2. VMS (47 sets) 3. CCTV (15 sets) 4. OCR (29 sets)	5. MOE (13 sets) 6. Dynamic Lane Management (10 locations) 7. Taxi Dispatching System (5 systems) 8. Rail Crossing Management (92 sets)
Rough Order of Magnitude Estimate	R$234.800.000/¥9,289,000,000	
Implementation Period	From medium term to long term	
ITS Service Packages Reference No.	ATMS area, MC area, AD1, APTS01,02,04,05,06,07,08,09,10, and11	
Remarks	Objective cities shall be determined by considering the trend of population increase and production of OD (Origin-Destination).	

Source: JICA Study Team

ITS Project Name	10. Emergency Vehicle Operating Management
Objectives	To prioritize all emergency vehicles for quicker emergency response.
Graphic	
Target Area (Area to be applied)	Rio de Janeiro Metropolitan Area
Required System	1. Traffic Light Prioritizing System for Emergency Vehicles (for 200 vehicles)
Rough Order of Magnitude Estimate	R$18.500.000/¥733,000,000
Implementation Period	Short term
ITS Service Packages Reference No.	ATIS10,ATMS06,08, AVSS12 and EM area especially EM02
Remarks	CICC will be in charge of the emergency and hazardous information management center. CICC, the core of emergency management, and the traffic/transit center and ITS Center shall coordinate several systems for a more efficient operation.

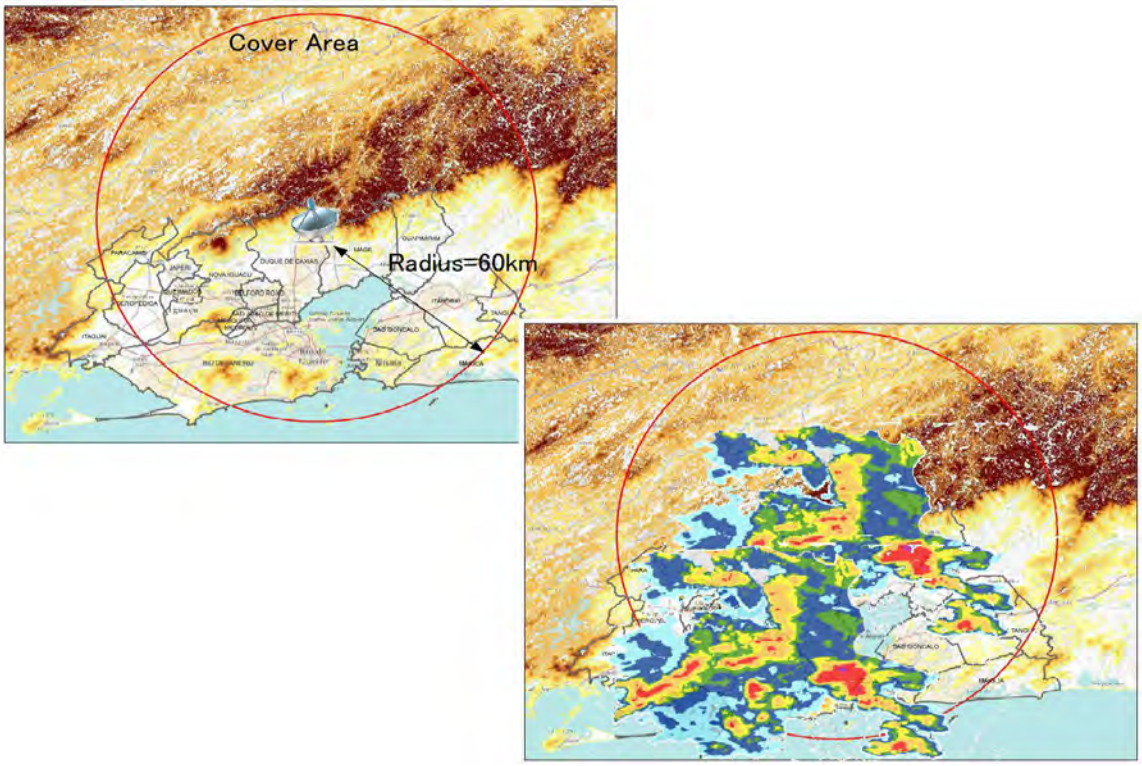
Source: JICA Study Team

ITS Project Name	11. Commercial Vehicle Operation and Management
Objectives	To enhance automated monitoring for overloaded commercial vehicles. To disseminate traffic-related information for more efficient logistics.
Graphic	
Target Area (Area to be applied)	Rio de Janeiro Metropolitan Area
Required System	1. Weigh-in-Motion (WIM) System 2. On-Board Unit (OBU) to obtain traffic/transport-related information
Rough Order of Magnitude Estimate	R$17.600.000/¥696,000,000 WIM in 6 locations and OBU for 1000 vehicles
Implementation Period	From medium to long term
ITS Service Packages Reference No.	Commercial Vehicle Operation (CVO) Service Area
Remarks	The need for information, operation, and supervision shall be clarified more clearly and precisely in January (in the next assignment of the JICA Study Team)

Source: JICA Study Team

ITS Project Name	12. Advanced Vehicle Safety Systems
Objectives	To prevent traffic accidents. To ensure more driving comfort.
Graphic	 
Target Area (Area to be applied)	Rio de Janeiro Metropolitan Area
Required System	1. Vehicle to Roadway Communication System 2. Vehicle to Vehicle Communication System
Rough Order of Magnitude Estimate	Depends on the industrial car maker's technological development
Implementation Period	Depends on the industrial car maker's technological development
ITS Service Packages Reference No.	AVSS01 to 12
Remarks	Depends on the industrial car maker's technological development

Source: JICA Study Team

ITS Project Name (Actually not ITS Project)	13. Deployment of X-Band Radars
Objectives	To grasp more accurate nimbus condition real-time. To get a date for more precise simulation and weather forecasting. To provide information for transportation-related agencies, entities and concessionaires. To prepare for hazardous incidents in advance.
Graphic	
Target Area (Area to be applied)	Rio de Janeiro Metropolitan Area
Required System	A) X-Band Radar for Rainfall Measurement
Rough Order of Magnitude Estimate	R$4.600.000/¥182,000,000
Implementation Period	Implementation shall be coordinated with the development policy of weather monitoring in RMRJ.
ITS Service Packages Reference No.	Part of ATIS01 (as terminator), MC03,04,06,07, and 11
Remarks	C-band radar has a wide area for rainfall observation. X-band MP radar has an even tougher observation area and is narrower than the C-band radar, but can detect rainfall conditions more precisely. In addition, the X-band radar has an information delivery cycle of 1 min.

Source: JICA Study Team