CHAPTER 11
ITS MASTER PLAN IN METROMANILA

11.1 OBJECTIVE OF ITS SERVICES

Seven objectives of ITS services to achieve development visions and to solve traffic problems were identified. The objectives of the ITS services in relation to traffic problems and targets for ITS service are illustrated in **Figure 11.1-1**. Seven ITS development areas were developed to achieve the objectives of ITS services.

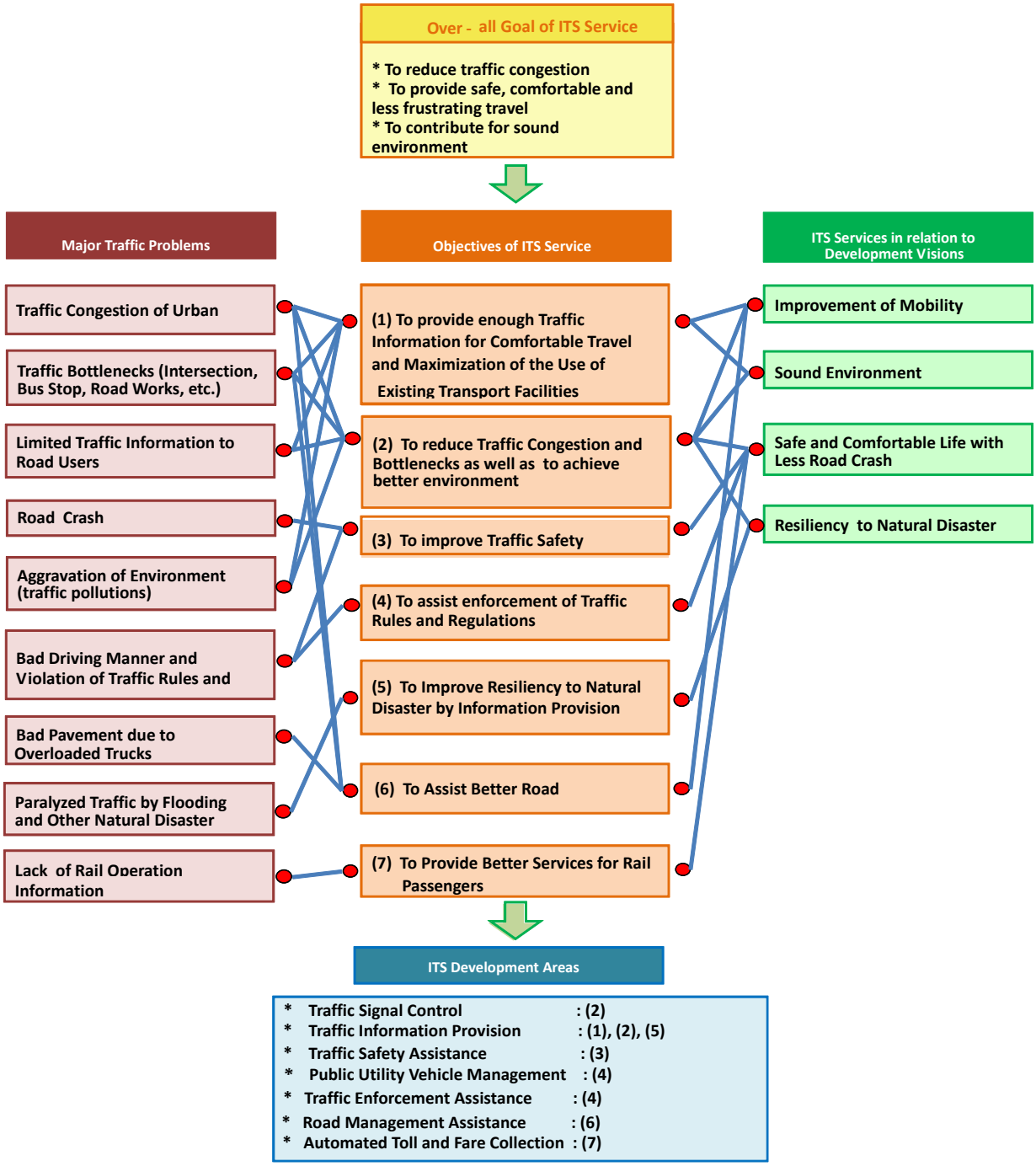
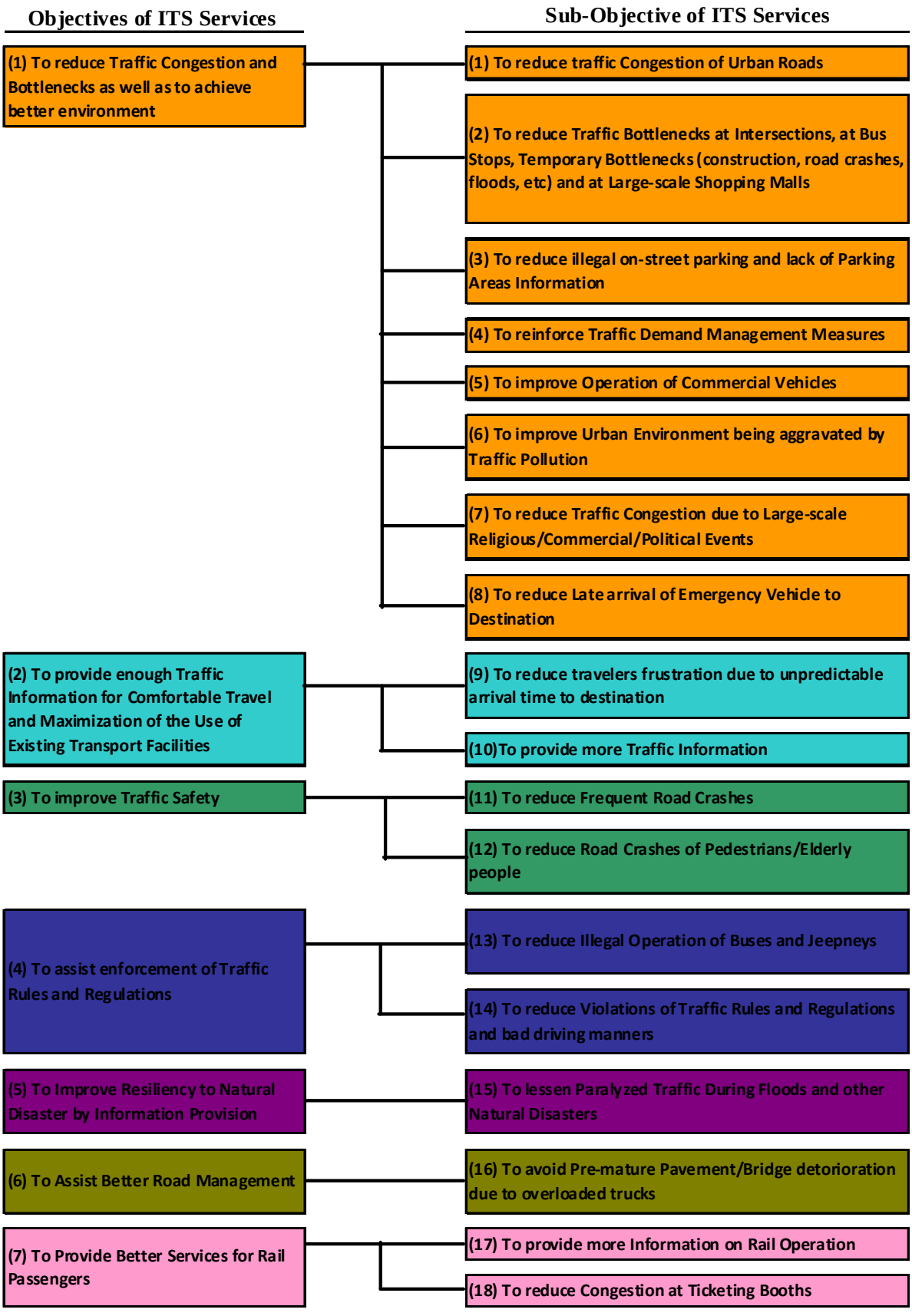


FIGURE 11.1-1 OBJECTIVES OF ITS SERVICES AND ITS DEVELOPMENT AREA FOR METRO MANILA

The objectives of ITS Services were further broken down into sub-objectives as shown below:

Metro Manila



11.2 ITS DEVELOPMENT AREA AND ITS USER SERVICES

Seven (7) ITS development areas were further divided into twenty one (21) user-service for Metro Manila.

METRO MANILA

ITS Development Areas	ITS User Service
1. Traffic Signal Control	(1) **Advance Traffic Control System at Intersections** to improve traffic efficiency at intersections (2) **Emergency Vehicle Priority System** for safer lives of people
2. Traffic Information Provision	(3) **Upgrading of Traffic Information Collection and Provision System on real-time basis** for faster and comfortable travel and to maximize the use of existing road facilities (4) **Events Information Provision System** to reduce traffic congestion at and around event sites (5) **Route Guidance System to direct drivers to less congested routes** to maximize the use of existing road facilities (6) **Information Provision System for Temporary Traffic Bottlenecks** to achieve less frustrating trips and to reduce traffic congestion at temporary traffic bottlenecks (7) **Traffic Management System at Large-scale Shopping Malls** to reduce localized traffic congestion (8) **Parking Space Information Provision System** to improve traffic flow in CBDs and for better road user service (9) **Commercial Vehicles Location System** for more orderly trips of commercial vehicles
3. Traffic Safety Assistance	(10) **Danger Warning System** to reduce road crashes to improve traffic safety (11) **Pedestrian Safety Support System** to reduce road crashes (12) **Weather Condition and Prediction Information Provision System** for safer travel and to improve resiliency to natural disaster.
4. PUV Management	(13) **Bus operation Monitoring and Control System** to reduce traffic congestion at bus stops and to eliminate illegal bus operations (14) **Rail Operation Information Provision System** for better passenger services
5. Traffic Enforcement Assistance	(15) **Traffic Rules Surveillance and Control System** to achieve smooth traffic flow and to reduce road crashes (16) **On-street Parking Control** to improve traffic capacity for smoother traffic flow (17) **Over Speeding Control System** reduce road crashes (18) **Overloaded Truck Control System** to provide better surfaced roads.
6. Road Management	(19) **Upgrading of Road Condition Information Collection** to improve Road Management and to Secure Service Level
7. Toll/Fare Collection	(20) **Road Pricing System** to reduce cars on the roads for smoother traffic flow (21) **Common Ticketing System** for easier transfer.

Major objectives/sub-objectives and ITS development areas/ITS user services were related each other in a matrix form as shown in **Table 11.2-1** for Metro Manila.

TABLE 11.2-1 BASIC ITS SERVICE FOR METRO MANILA

Major Objectives of ITS Service (7)	Sub-objectives (18)		ITS User Services (21)	Traffic Signal Control		Traffic Information Provision							Traffic Safety Assistance			PUV Management		Traffic Enforcement Assistance				Road Management		Toll/Fare Collection
				(1) Advanced Traffic Control System at Intersections to improve traffic efficiency at intersections	(2) Emergency Vehicle Priority System for safer lives of people.	(3) Upgrading of Traffic Information Collection and Provision System on real-time basis for faster and comfortable travel and to maximize the use of existing road facilities	(4) Events Information Provision System to reduce traffic congestion at and around event sites.	(5) Route guidance System to direct drivers to less congested route to maximize the use of existing road facilities	(6) Information Provision System of Temporary Traffic Bottlenecks to achieve less frustrated trips and to reduce traffic congestion at temporary traffic bottleneck	(7) Traffic Management System at Large-scale Shopping Malls to reduce localized traffic congestion.	(8) Parking Space Information Provision system to improve traffic flow in CBDs and for better road user service.	(9) Commercial Vehicles Location System for more orderly trips of commercial vehicles	(10) Danger Warning system to reduce Road Crashes to improve traffic safety.	(11) Pedestrian Safety Support System to reduce road crashes.	(12) Weather Condition and Prediction Information Provision System for safer travel and to improve resiliency to natural disaster.	(13) Bus operation Monitoring and Control System te reduce traffic congestion at bus stops and to eliminate illegal bus operation	(14) Rail Operation Information Provision System for better passenger services.	(15) Traffic Rules Surveillance and Control System to achieve smooth traffic flow and to reduce road crashes.	(16) On-street Parking Control to improve traffic capacity for smoother traffic flow.	(17) Over Speeding Control System to reduce road crashes	(18) Overloaded Truck Control System to provide better surfaced roads.	(19) Upgrading of Road Condition Information Collection to Improve Road Management and to Secure Service Level	(20) Road Pricing System to reduce cars on the roads for smoother traffic flow.	(21) Common Ticketing System for easier transfer
Traffic Congestion/ Bottleneck	(1) To reduce traffic Congestion of Urban Roads			●		●	●	●	●	●	●	●					●		●	●				●	
	(2) To reduce Traffic Bottlenecks	• At Intersections		●	●	●		●																	
		• At Bus Stops				●		●			●						●								
		• Temporary Bottlenecks (construction, road crashes, floods, etc)				●		●	●																
		• At Large-scale Shopping Malls				●	●	●		●															
	(3) To reduce Illegal on-street parking and lack of Parking Areas Information																			●					
	(4) To reinforce Traffic Demand Management Measures					●		●		●	●				●		●							●	
	(5) To improve Operation of Commercial Vehicles											●													
	(6) To improve Urban Environment being aggravated by Traffic Pollution			●		●	●	●	●	●	●	●					●		●	●				●	
	(7) To reduce Traffic Congestion due to Large-scale Religious/Commercial/Political Events						●																		
	(8) To reduce Late arrival of Emergency Vehicles to Destination			●	●	●		●																	
Traffic Information	(9) To reduce travelers frustration due to unpredictable arrival time to destination					●		●																	
	(10) To provide more Traffic Information					●	●	●	●				●				●								
Traffic Safety	(11) To reduce Frequent Road Crashes												●	●					●		●				
	(12) To reduce Road Crashes of Pedestrians/Elderly people													●											
Enforcement	(13) To reduce Illegal Operation of Buses and Jeepneys																●								
	(14) To reduce Violations of Traffic Rules and Regulations and bad driving manners																		●						
Resiliency	(15) To lessen Paralyzed Traffic During Floods and other Natural Disasters					●		●	●						●										
Road Management	(16) To avoid Pre-mature Pavement/Bridge Deterioration due to overloaded trucks																					●	●		
For Rail Passenger	(17) To provide more Information on Rail Operation																	●							
	(18) To reduce Congestion at Ticketing Booths																								●

11.3 TOTAL SYSTEM ARCHITECTURE

11.3.1 Objectives for Developing the System Architecture[1]

The system architecture for ITS is an "overall scheme of ITS" that shows the overall structure (the framework) of the system based on the system's constituent elements and their interrelationships. In other words, the system architecture outlines the overall configuration of the system. It is indispensable for designing and developing a system comprising numerous elements that function as a whole.

The objectives for developing the system architecture are as follow:

(1) Efficient Construction of an Integrated System

An integrated system

- A concise system ⟶ allows diversified usage.
- Integrated operators and judgments performed by the system (since systems for measurement, control and others have been integrated) ⟶ reduces burden on the users.

Efficient construction of ITS

- Information and functions to be shared among constituent systems ⟶ avoids double investment
- Procurement of equipment from several vendors ⟶ enables cost optimization

(2) Maintenance of the system expandability

Facilitates to change and add information and functions
Facilitates to add new user services and systems

(3) Promotion of domestic and international standardization

Comparison of current standardization activities and candidate areas of standardization, and clarification of areas not yet considered or duplicated ⟶ enables schematic standardization activities that consider the priority of items to be standardized.

11.3.2 Integrated ITS System Architecture

The proposed Integrated ITS System Architecture for the long term is shown in **Figure 11.3-1** for Metro Manila.

[1] Source "ITS Handbook 1999-2000" supervised by the Ministry of Construction

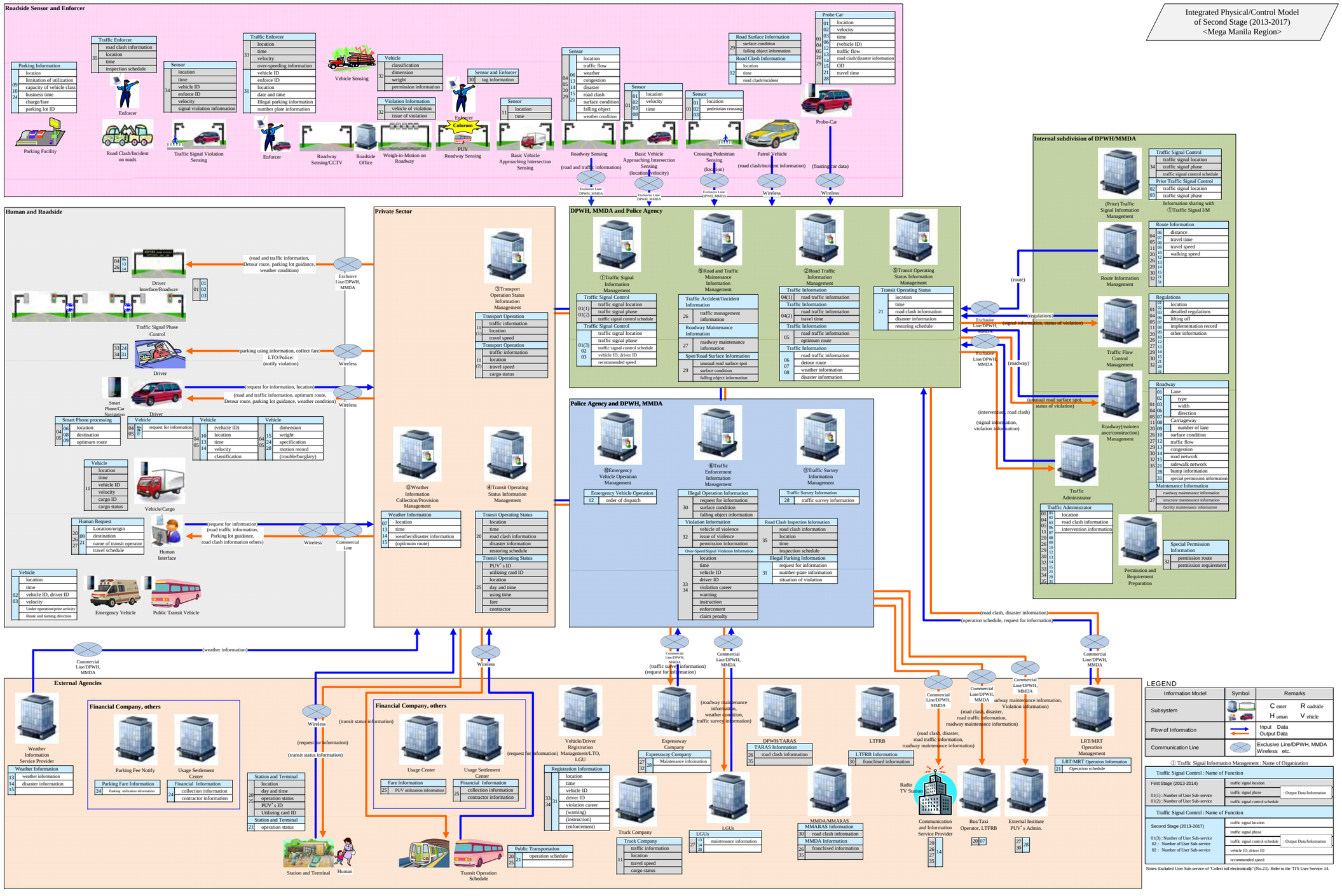


FIGURE 11.3-1 INTEGRATED ITS ARCHITECTURE FRO LONG-TERM: METRO MANILA

11.4 OVERALL CONFIGURATION OF ITS SERVICES

Based on the existing transport problems and Metro Manila development visions, seven objectives of ITS services were identified. For the realization of the seven objectives of ITS services, seven ITS development areas were proposed in previous section. The seven objectives of ITS Services were further broken down into 18 sub-objectives. In relation to the 18 sub-objectives, the seven ITS development areas were further divided into 21 ITS user services. To achieve the twenty-one (21) ITS user services, 35 sub-user services were proposed (see **Figure 11.4-1**). The composition of the 35 sub-user services is shown in **Figure 11.4-2**.

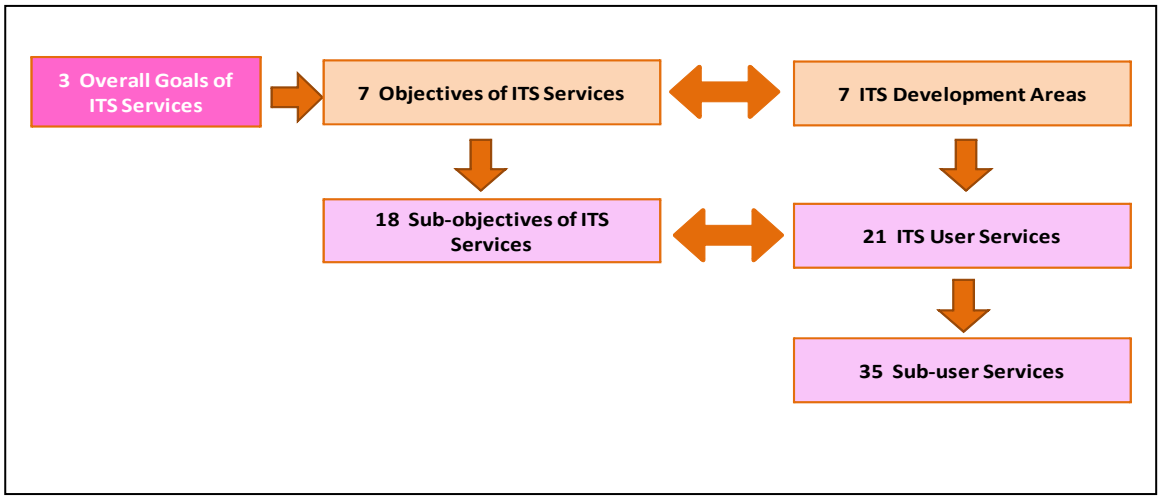


FIGURE 11.4-1 COMPOSITION OF ITS SERVICES: METRO MANILA

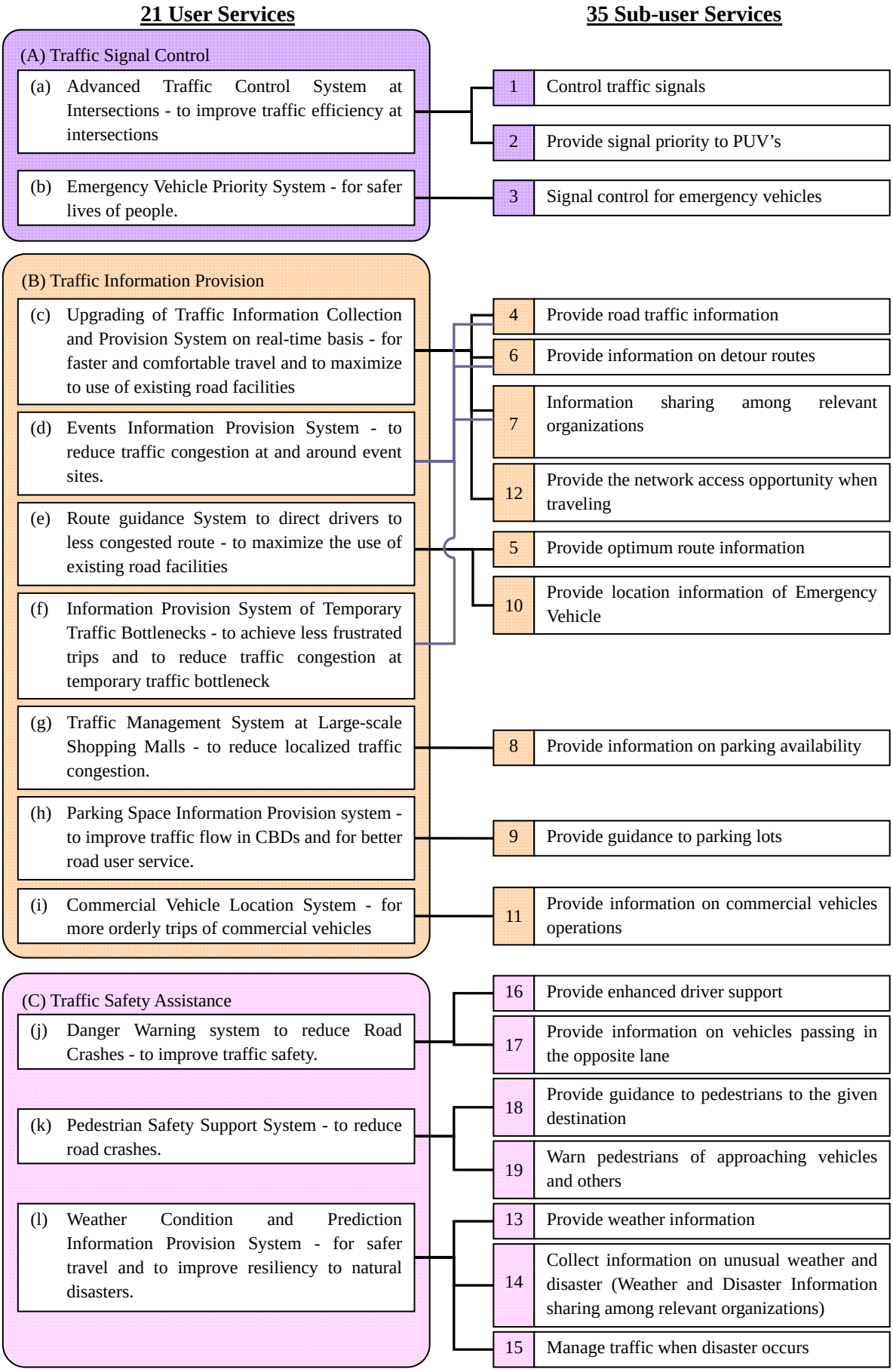


FIGURE 11.4-2 (1/2) COMPOSITION OF SUB-USER SERVICES: METRO MANILA

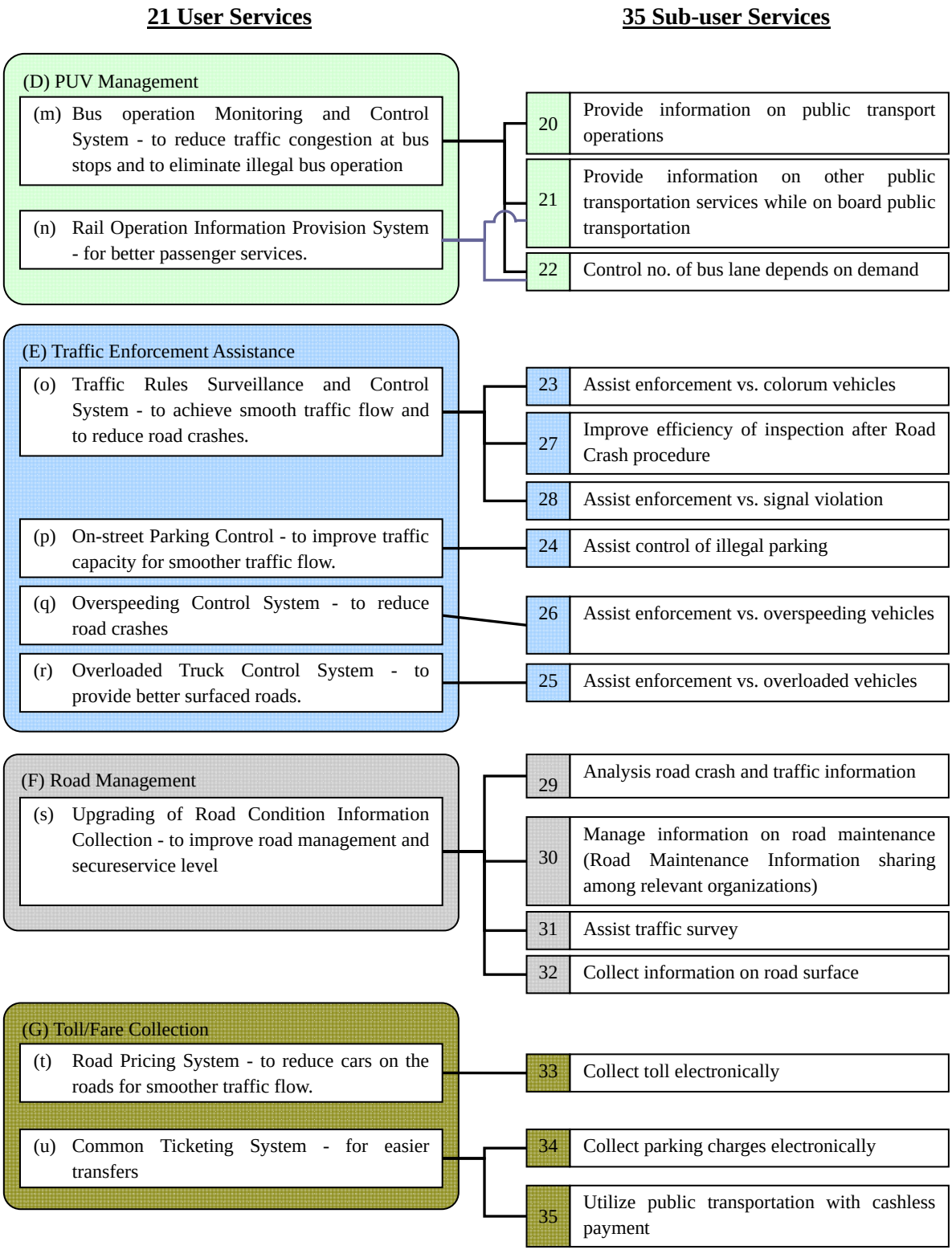
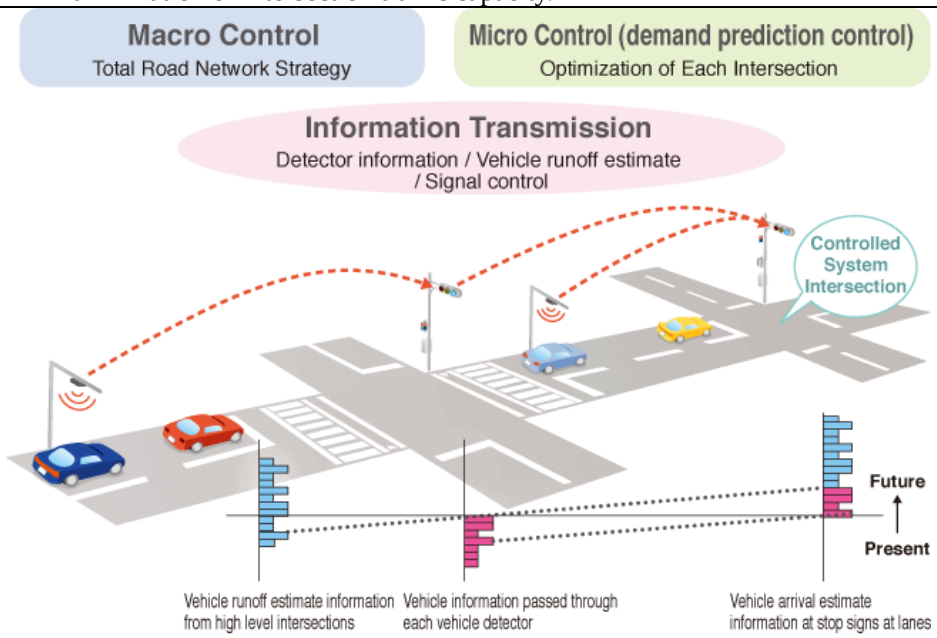


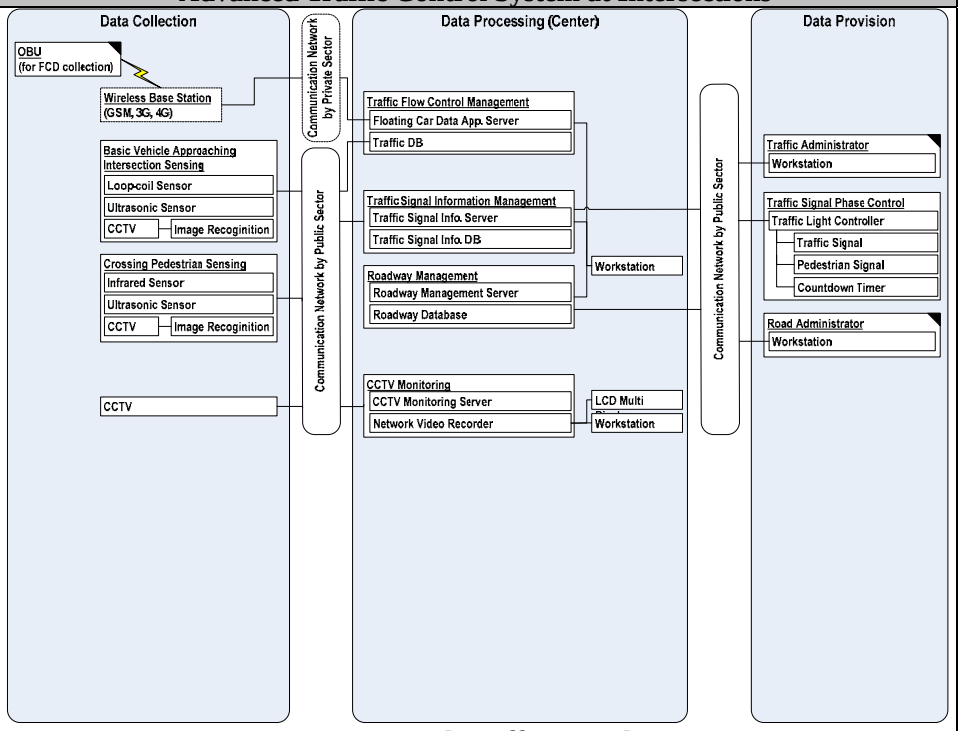
FIGURE 11.4-2 (2/2) COMPOSITION OF SUB-USER SERVICES: METRO MANILA

11.5 ITS USER SERVICES FOR METRO MANILA

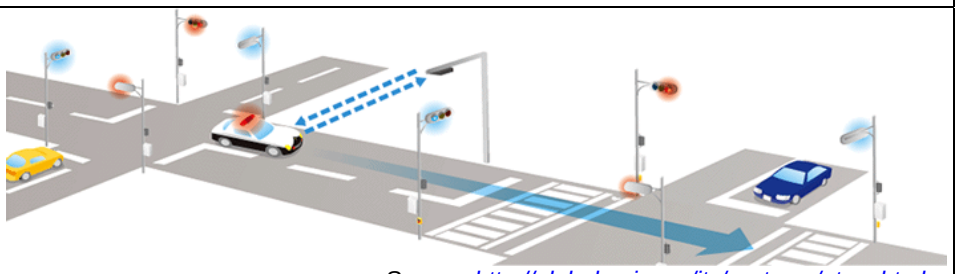
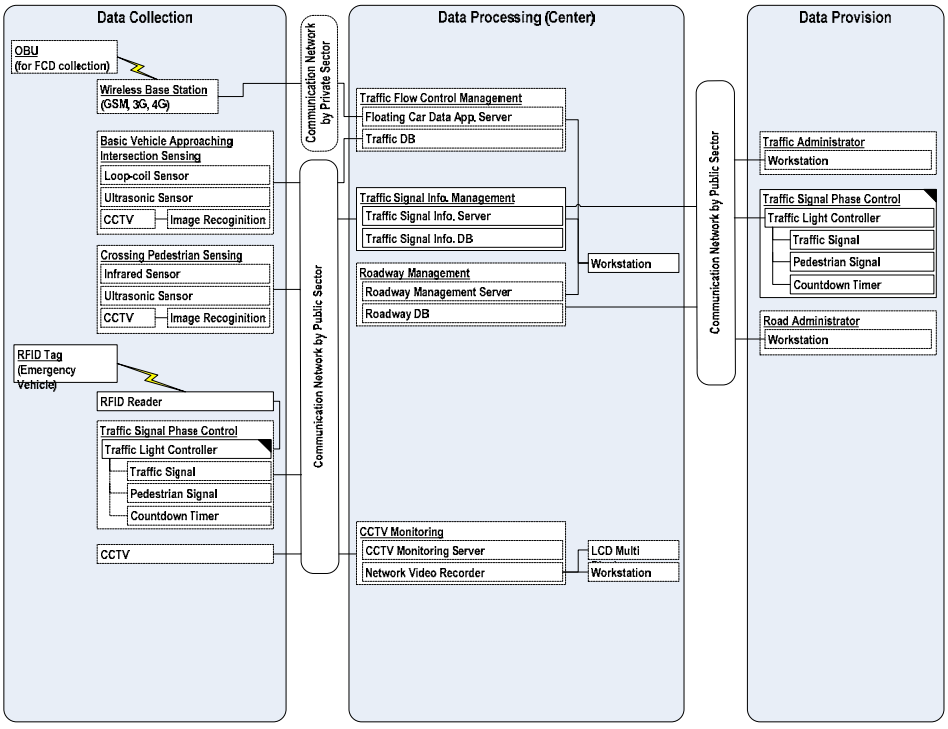
In this sub-section, the outline of "ITS User Service" is described. Sub-user services detail information is described in **Annex 11.1**.

11.5.1 Advanced Traffic Control System at Intersections

ITS User Services	Advanced Traffic Control System at Intersections
1) Sub-user Service (3 sub-user services)	• Control traffic signal • Provide signal priority to PUVs
2) Objectives of the Service	• To improve traffic efficiency at intersections – Delay time at intersection to be reduced – Traffic queue length to be reduced • To reduce traffic pollutions – Green-house-gas (GHG) emissions to be reduced. • To improve traffic safety for vehicle passengers and pedestrians • To reduce transport cost • Vehicle operating cost and travel time cost to be reduced.
3) Measures to achieve the objectives	• Real-time traffic demand will be collected by traffic detectors and also from floating car information. • Based on real-time traffic demand of each approach to an intersection, optimum signal parameter or green time allocation will be determined for maximization of intersection traffic capacity.
4) Image of the System	 *Source:http://global-sei.com/its/systems/itcs.html*
5) Typical System Configuration	• **Data Collection**: Volume and speed from vehicle sensors (image recognition sensors, loop coil, ultrasonic wave, or infrared rays). Floating car data from vehicle. CCTV • **Data Processing (Center)**: Traffic flow control management, traffic signal information management, roadway management and CCTV monitoring • **Data Provision**: Traffic administrator, Traffic signal phase control and Road administrator

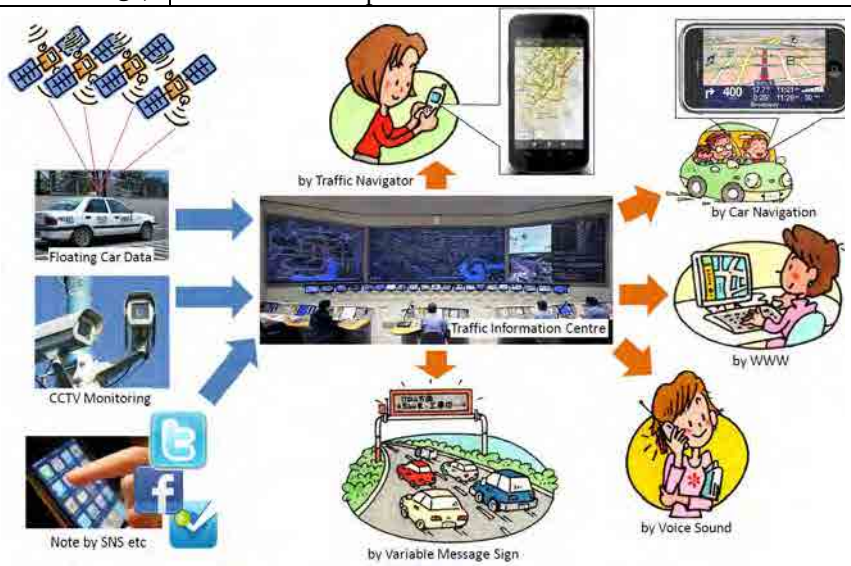
ITS User Services	Advanced Traffic Control System at Intersections
	 **01 Control Traffic Signal**
6) Area Coverage	• Existing 436 signal controlled intersections plus additional 100 intersections which are currently not signal-controlled in Metro Manila.
7) Responsible Agency and its Implementation Plan	• Metropolitan Manila Development Authority (MMDA) • Phase-1: 85 Intersections. The contractor was already selected and this phase will be completed by middle of 2013. • Phase-2: 120-130 intersections. MMDA requested Php 300 Million for 2013 Budget. • Phase-3: 221-231intersections • MMDA has no plan for additional intersections • Additional intersections are recommended to be included in Phase-3.
8) Related Agencies	• Department of Public Works and Highways (DPWH) • Local Government Units • Private Developers that are managing traffic signal control for intersections within their development areas such as Global City.
9) Effects and Impacts of the System	• Travel Time Savings • Time Savings Cost • CO2 Reduction • Smooth traffic flow will be achieved which will contribute to reduction of traffic congestion and improvement of environment. • Road users will enjoy psychologically comfortable travel. • Traffic safety will be improved due to smooth traffic flow.

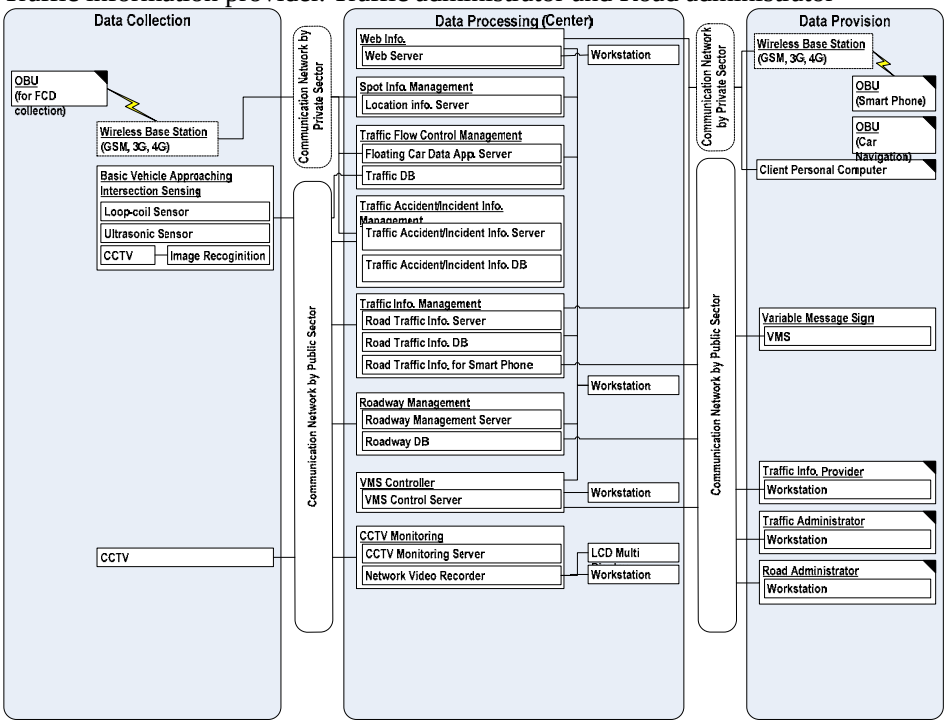
11.5.2 Emergency Vehicle Priority System

ITS User Services	Emergency Vehicle Priority System
1) Sub-user Service	3. Signal control for emergency vehicles.
2) Objectives of the Service	• To save lives of people by sending an ambulance car to the site and immediately transporting affected people to a hospital. • To minimize the spread of fire by sending fire trucks to the place for quick response to a fire.
3) Measures to achieve the objectives	• Priority green time at intersections is provided for the route of emergency vehicles and traffic lane of these vehicles is opened for non-stop travel.
4) Image of the System	 *Source: http://global-sei.com/its/systems/utms.html*
5) Typical System Configuration	• **Data Collection**: Volume and speed from vehicle sensors (image recognition sensors, loop coil, ultrasonic wave, or infrared rays). Floating car data from vehicle. CCTV、RFID Tag, RFID Reader, Traffic Signal Phase Control • **Data Processing (Center)**: Traffic flow control management, traffic signal information management, roadway management and CCTV monitoring • **Data Provision**: Traffic administrator, Traffic signal phase control and Road administrator  **03 Provide control for emergency vehicles**
6) Area Coverage	• Within Metro Manila • Areas to be covered will be gradually expanded to Metro Manila periphery.
7) Responsible Agency and its Implementation Plan	• Metropolitan Manila Development Authority (MMDA) • Feasibility Study of BRT System is being undertaken by DOTC and MMDA. Decision on BRT route is not made yet.

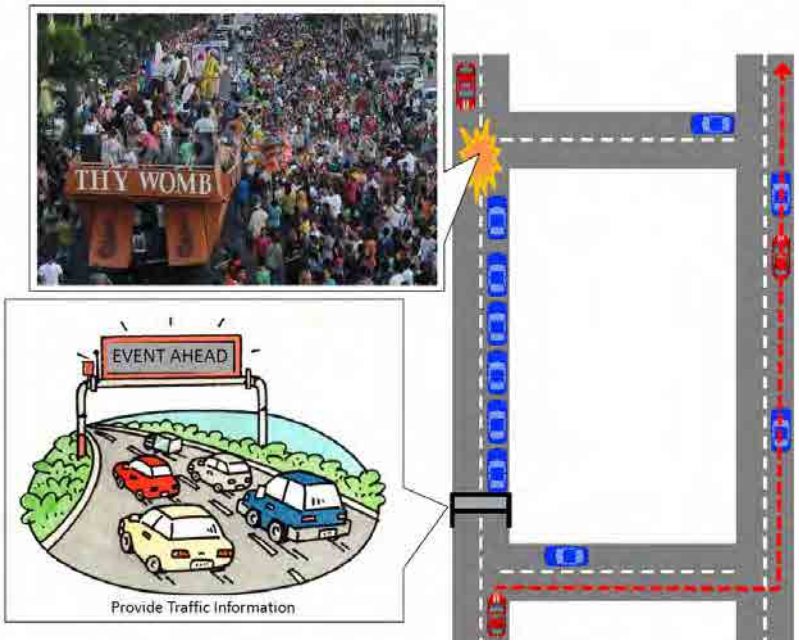
ITS User Services	Emergency Vehicle Priority System
8) Related Agencies	• Fire Department, Ambulance Sections, and Traffic Enforcers of Local Government Units (LGUs) • Hospitals • Philippine National Police (PNP)
9) Effects and Impacts of the System	• To save lives of critically sick persons. • To reduce spread of fire. • To immediately act on criminals/incidents.

11.5.3 Upgrading of Traffic Information Collection and Provision

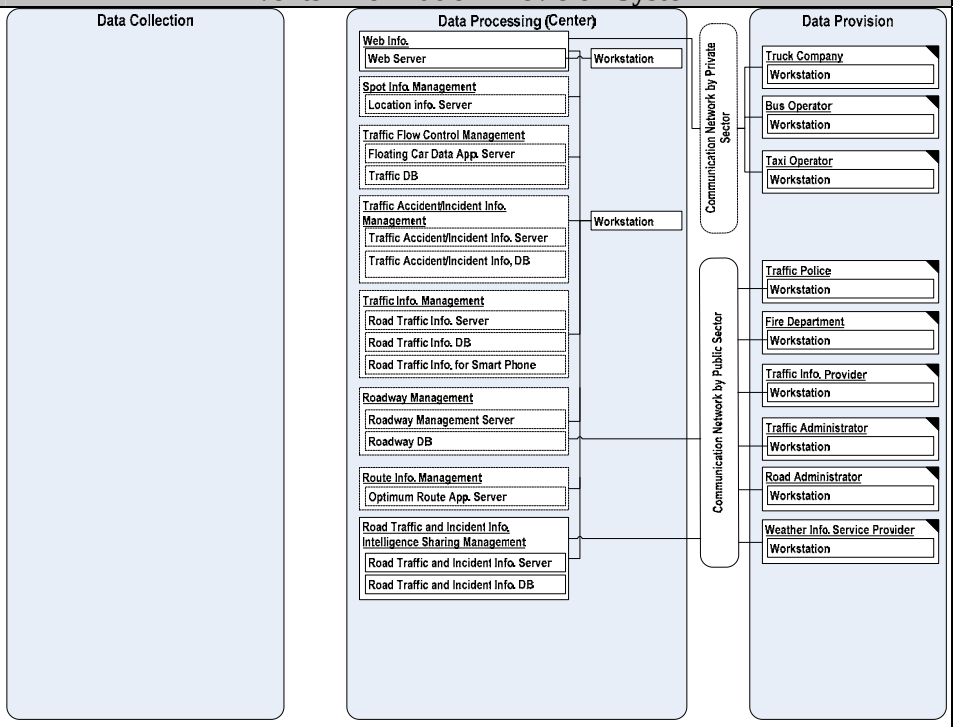
ITS User Services	Upgrading of Traffic Information Collection and Provision System	
1) Sub-user Service	4. Provide road traffic information. 6. Provide information of detour route. 7. Information sharing among relevant organization 12. Provide network access opportunity when traveling.	
2) Objectives of the Service	By providing traffic information, achieve the following; • Faster and comfortable or less frustrating travel • Maximize the use of existing road facility by guiding travelers to less congested road. • Improve traffic safety • Improve environmental condition by reducing green gas emissions • Improve international competitiveness	
3) Measures to achieve the objectives	Through – Internet – Smart Phone – TV – Radio	• Traffic congestion level (light, medium, heavy) on Map • Traffic congestion increasing or decreasing • Visual traffic condition by CCTV screen capture, video live streaming • Traffic queue – head (beginning) and tail (end) locations • Travel time from A to B • Urban rail operation status • Fire location • Prediction of traffic congestion during Holidays such as Holy Week, All Saints' Day, etc. based on historical data
	Through – VMS – Mobile Phone (text message)	• Traffic congestion level • Traffic queue – head (beginning) and tail (end) locations • Travel time to major destination • Urban rail operation status
4) Image of the System		

ITS User Services	Upgrading of Traffic Information Collection and Provision System
5) Typical System Configuration	**Data Collection**: Volume and speed from vehicle sensors (image recognition sensors, loop coil, ultrasonic wave, or infrared rays). Floating car data from vehicle. CCTV **Data Processing (Center)**: Web info, Spot info management, Traffic flow control management, Traffic accident/incident info management Traffic info management, Roadway management VMS controller **Data Provision**: OBU (Car navigation, smart phone), VMS, PC (via internet), Traffic information provider. Traffic administrator and Road administrator  **04 Provide road traffic information**
6) Area Coverage	• Metro Manila • Then, expanded to Metro Manila periphery.
7) Responsible Agency and its Implementation Plan	• Metropolitan Manila Development Authority (MMDA) • MMDA launched the MMDA-TV5 Metro Manila Traffic Navigator (TNAV) in 2011. • MMDA is upgrading TNAV to Automated Traffic Navigator (ATNAV) which will be launched in 2013.
8) Related Agencies	<u>For Traffic Information Supply</u> • Toll road operators (Skyway is already providing information to MMDA. NLEX and other operators are also needed to coordinate with MMDA.) • Local Government Units can provide CCTV data. • DOTC and LRTA can provide rail operation information • PNP should provide road traffic accident data <u>For Traffic Information Supply</u> • TV and radio companies (some companies are already provided.) • IT companies (some companies are already provided.)
9) Effects and Impacts of the System	• To reduce traffic congestion. • To fully utilize all existing road facilities. • To allow comfortable travel with less frustration.

11.5.4 Events Information Provision System

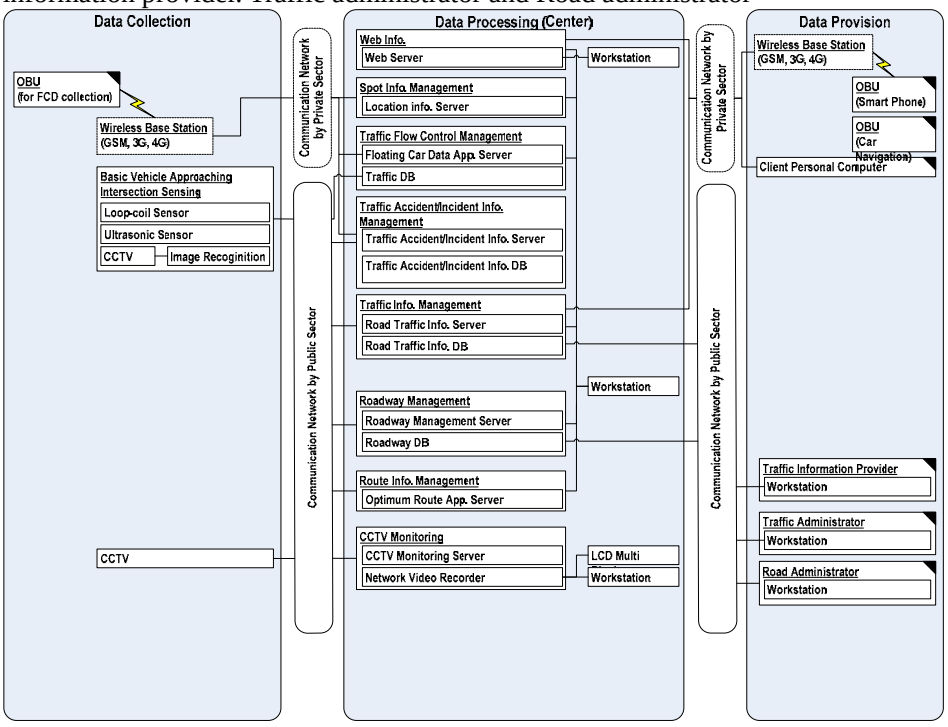
<table>
<tr><th>ITS User Services</th><th colspan="2">Events Information Provision System</th></tr>
<tr><td>1) Sub-user Service</td><td colspan="2">4. Provide road traffic information.
6. Provide information of detour.
7. Information sharing among relevant organization</td></tr>
<tr><td>2) Objectives of the Service</td><td colspan="2">• To reduce traffic congestion at and around event sites..</td></tr>
<tr><td rowspan="2">3) Information to be Provided</td><td>Through
– Internet
– Smart phone
– TV</td><td>• Information on political or religious gatherings, demonstrations, parades, fiestas and other events (time and day(s) of events)
• Roads closed or partial closure of roads
• Traffic regulation (no. of lanes closed)
• Possible detour roads</td></tr>
<tr><td>Through
– VMS
– Mobile phone (text message)
– Radio</td><td>• Events information
• Traffic regulation
• Possible detour routes</td></tr>
<tr><td>4) Image of the System</td><td colspan="2"> 

Source: http://global-sei.com/its/systems/utms.html</td></tr>
<tr><td>5) Typical System Configuration</td><td colspan="2">Data Processing (Center): Web info, Spot info management, Traffic flow control management, Traffic accident/incident info management Traffic info management, Roadway management, Route info Management and Road traffic and incident info. Intelligence sharing management
Data Provision: Truck company, Bus operator Taxi operator, Traffic police, Fire department, Traffic info provider, Traffic administrator, Road administrator and Weather info service provider</td></tr>
</table>

ITS User Services	Events Information Provision System
	 **07_Provide road traffic information and others**
6) Area Coverage	• Metro Manila • Then, expanded to Mega Manila
7) Responsible Agency and its Implementation Plan	• Metropolitan Manila Development Authority (MMDA) • Some information are already provided by MMDA
8) Related Agencies	• Political and religious groups, concerned LGUs, police department and others shall provide necessary information to MMDA.
9) Effects and Impacts of the System	• Road users can be prepared for the events and schedule to select appropriate route or start their trip ahead or delay their trip to avoid traffic congestion.

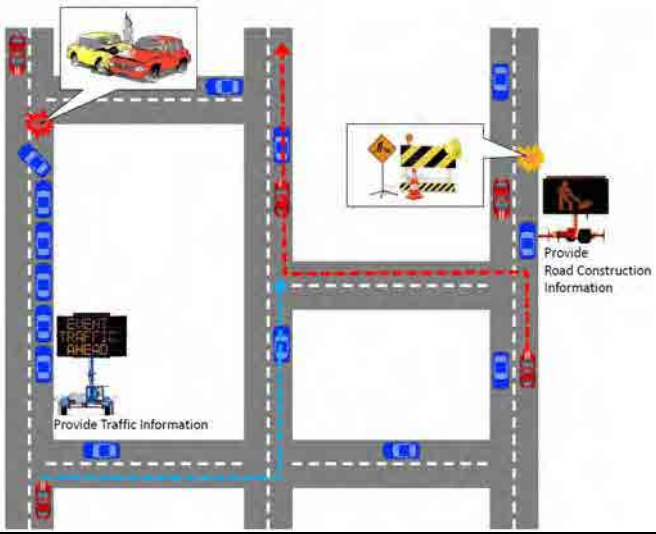
11.5.5 Route Guidance System

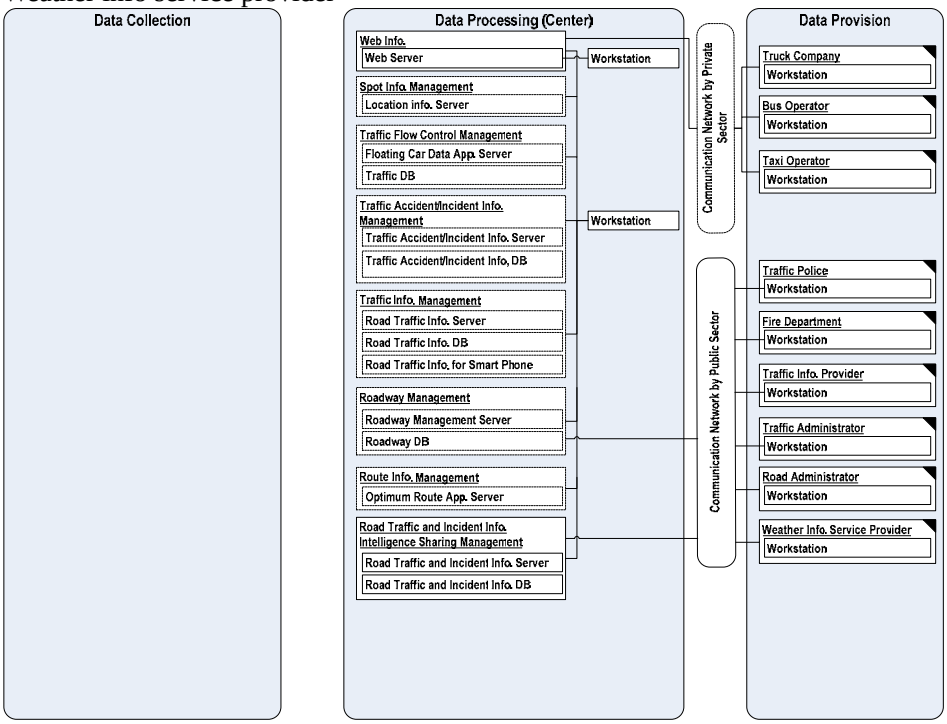
ITS User Services	Route Guidance System	
1) Sub-user Service	5. Provide optimum route information. 10.Provide location information system of emergency vehicles.	
2) Objectives of the Service	By guiding travelers to less congested routes; • To achieve maximum utilization of the existing road facility. • To achieve comfortable (less frustrating) travel. • To save waste time (early arrival or late arrival can be reduced).	
3) Information to be Provided	Through – Internet – Smart Phone – TV – Radio	• Shortest routes in distance from A to B on map • Shortest routes in travel time for 2-3 alternative routes from A to B on map. • Estimated arrival time for above on map
	Through – VMS – Mobile Phone (text message)	• Shortest route in distance • Shortest routes in travel time for 2-3 alternative routes on map • Estimated arrival time for above

ITS User Services	Route Guidance System	
	Through – OBU (car navigation, smart phone)	• Route guidance during driving • Possible re-routing routes based on latest incidents/events information
4) Image of the System	 *Source: MMDA*	
5) Typical System Configuration	**Data Collection**: Volume and speed from vehicle sensors (image recognition sensors, loop coil, ultrasonic wave, or infrared rays). Floating car data from vehicle. CCTV **Data Processing (Center)**: Web info, Spot info management, Traffic flow control management, Traffic accident/incident info management Traffic info management, Roadway management, Road info management and CCTV monitoring **Data Provision**: OBU (Car navigation, smart phone), PC (via internet), Traffic information provider. Traffic administrator and Road administrator  **05 Provide optimum route information**	
6) Area Coverage	• Metro Manila • Then, expanded to Metro Manila periphery.	

ITS User Services	Route Guidance System
7) Responsible Agency and its Implementation Plan	• Metropolitan Manila Development Authority (MMDA) • ATNAV will include this system.
8) Related Agencies	• DPWH • LGUs
9) Effects and Impacts of the System	• To achieve maximum utilization of existing road facilities. • To save time cost of not only travelers but also other people who are waiting for appointment. • To reduce traffic congestion. • To allow comfortable travel with less frustration.

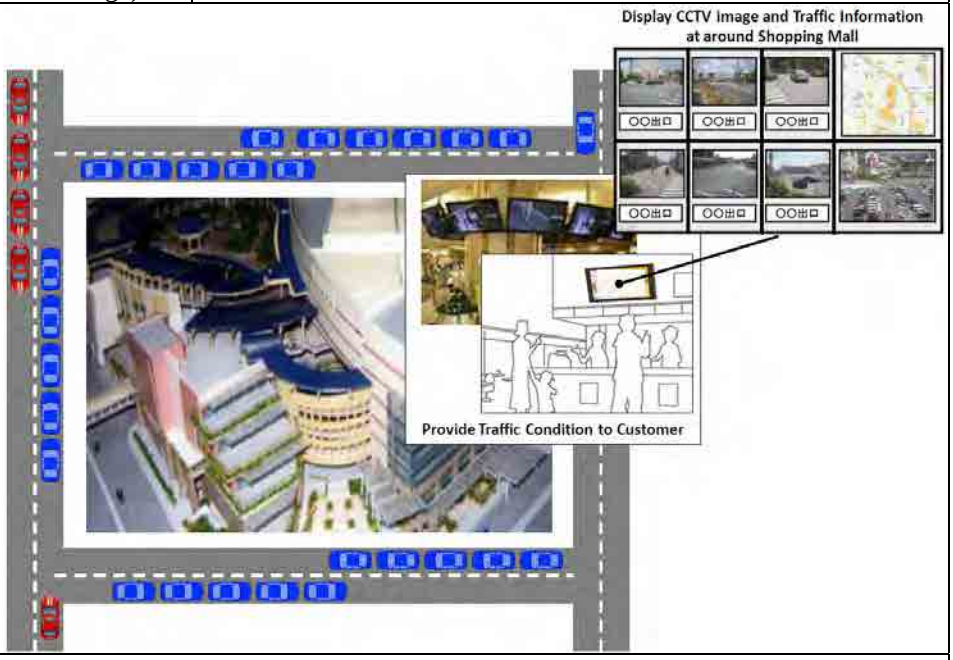
11.5.6 Information Provision System of Temporary Traffic Bottleneck

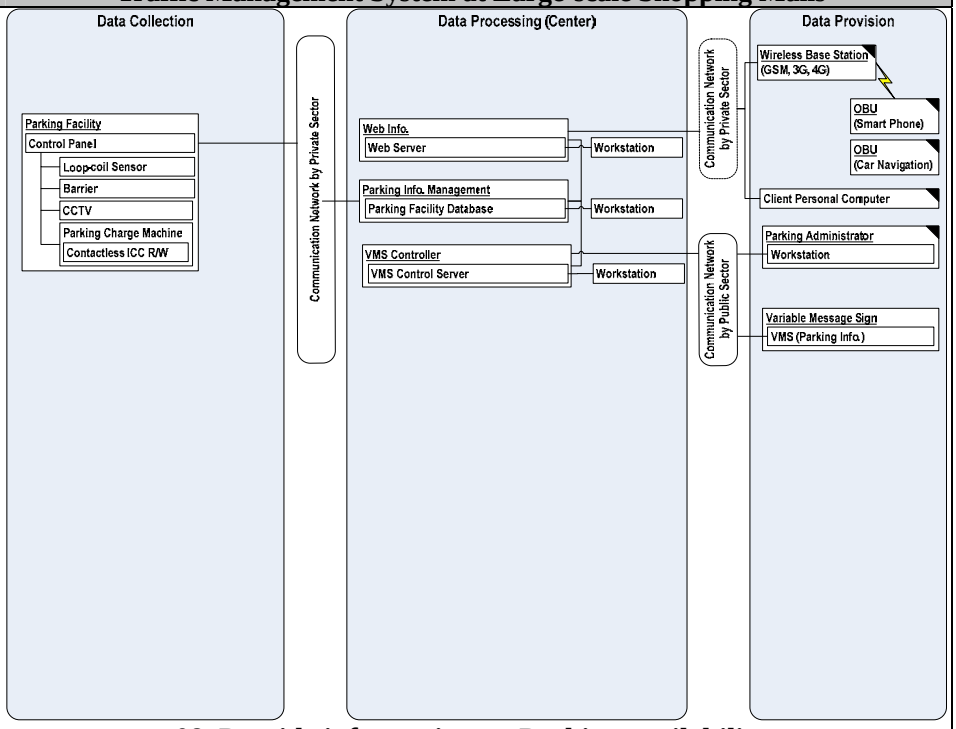
ITS User Services	Information Provision System of Temporary Traffic Bottleneck	
1) Sub-user Service	4. Provide road traffic information. 6. Provide information of detour. 7. Information sharing among relevant organizations	
2) Objectives of the Service	By providing temporary traffic bottleneck information (such as road crash, road works, flooded section, etc.) to road users; • To reduce excessive traffic congestion of a route where incident happened (road users will select another route). • To achieve less frustrating travel.	
3) Information to be Provided	Through – Internet – Smart Phone – TV	• Temporary bottlenecks information: (1) Traffic accident (2) Road work (construction and maintenance) (3) Road digging for underground utility (4) flooded section • Expected time to finish removal of accident (1) • Beginning and end of road works for (2) and (3) • Flood depth and if passable or not passable for (4) • No. of lanes closed out of X-lane for all incidents • Visual traffic condition by CCTV screen capture, video live streaming.
	Through – VMS – Mobile Phone (text message) – Radio	• Location of temporary bottleneck • No. of lanes closed and duration
4) Image of the System		

ITS User Services	Information Provision System of Temporary Traffic Bottleneck
5) Typical System Configuration	**Data Processing (Center)**: Web info, Spot info management, Traffic flow control management, Traffic accident/incident info management, Traffic info management, Roadway management, and Road traffic and incident info intelligence sharing management **Data Provision**: Truck company, Bus operator Taxi operator, Traffic police, Fire department, Traffic info provider, Traffic administrator, Road administrator and Weather info service provider  **07_Provide road traffic information and others**
6) Area Coverage	• Metro Manila • Then, expanded to Metro Manila periphery.
7) Responsible Agency and its Implementation Plan	• Metropolitan Manila Development Authority (MMDA) • ATNAV which will be launched in 2013 covers some of the information.
8) Related Agencies	Information is provided to MMDA by various agencies; • Location, period, lane closure, etc. of road construction work and road maintenance work by DPWH. • Location, period duration of removal of road crash by Police Department • Location, period, lane closure, etc. of public utility installation/replacement work by Public Utility Companies • Flooded section, passable or impassable, flood depth increasing or decreasing, etc by DPWH, MMDA, LGUs, road users and nearby residents
9) Effects and Impacts of the System	• To reduce aggravation of spot traffic congestion. • To save traffic cost. • To support comfortable travel with less frustration.

11.5.7 Traffic Management System at Large-scale Shopping Malls

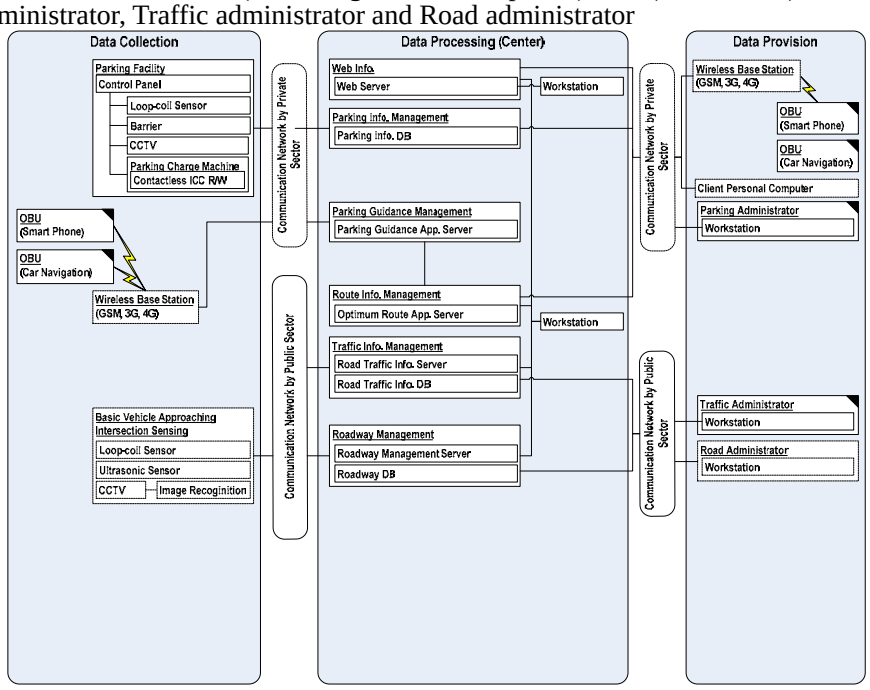
ITS User Services	Traffic Management System at Large-scale Shopping Malls
1) Sub-user Service	8.Provide information on parking availability.

ITS User Services	Traffic Management System at Large-scale Shopping Malls	
2) Objectives of the Service	• To reduce localized traffic congestion	
3) Information to be Provided	Through – Internet – Smart Phone	• Location and availability of parking space • Traffic regulation in the area • Route guidance to parking space • Rail operation information
	Through – VMS – Mobile Phone (text message)	• Location and availability of parking space • Rail operation information
4) Image of the System		
5) Typical System Configuration	**Data Collection**: Parking Facility(Control panel, Loop-coil, Barrier, CCTV, Parking charge machine) **Data Processing (Center)**: Web info, Parking info management and VMS controller **Data Provision**: OBU (Car navigation, smart phone), PC (via internet),VMS and Parking administrator	

ITS User Services	Traffic Management System at Large-scale Shopping Malls
	 **08_Provide information on Parking availability**
6) Area Coverage	• At seven (7) CBDs; Bay Area CBD, Makati CBD, Global City CBD, Ortigas CBD, Eastwood CBD, EDSA North CBD, Cubao CBD
7) Responsible Agency and its Implementation Plan	• Metropolitan Manila Development Authority (MMDA) in collaboration with large-scale shopping mall management companies • So far, MMDA has no plan for this ITS user service.
8) Related Agencies	• Shopping Mall developers • LGUs concerned
9) Effects and Impacts of the System	• To reduce local traffic congestion • People can enjoy shopping without worrying about means of transportation

11.5.8 Parking Space Information Provision System

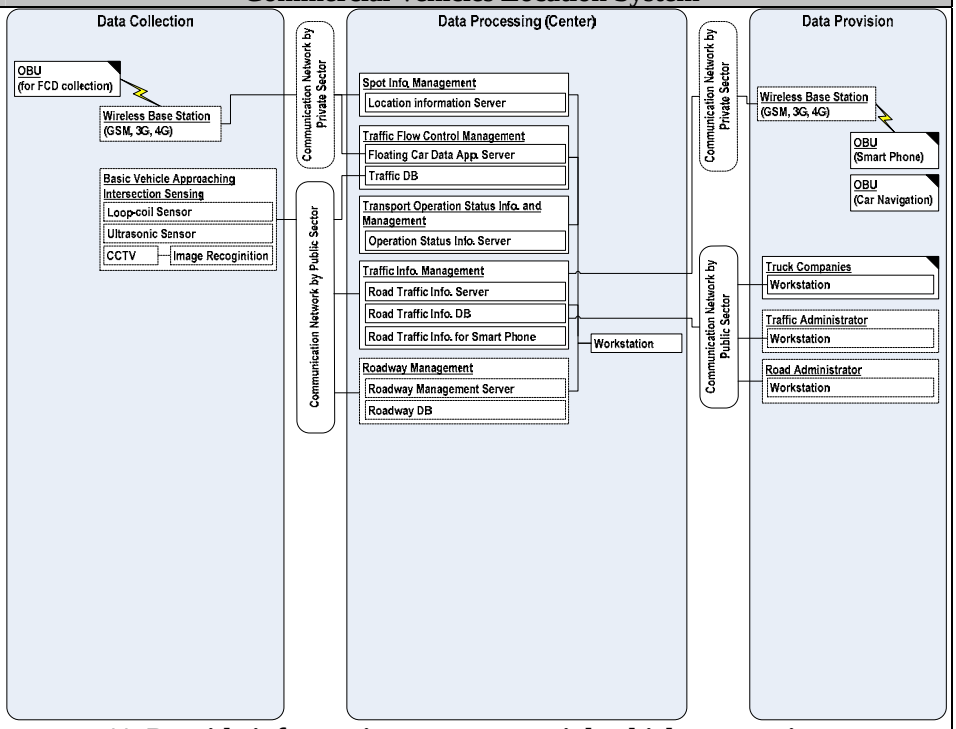
ITS User Services	Parking Space Information Provision System	
1) Sub-user Service	9. Provide guidance to parking lots.	
2) Objectives of the Service	• To improve traffic flow in CBDs and also for providing better road user service.	
3) Information to be Provided	Through – Internet – Smart Phone	• Location of parking space • Availability of parking space • Route guidance to parking space
	Through – VMS – Mobile Phone (text message)	• Location of parking space • Availability of parking space

ITS User Services	Parking Space Information Provision System
4) Image of the System	   *Source:* *http://www.brt.cl/san-francisco-and-medellin-win-2012-sustainable-transport-award/*
5) Typical System Configuration	**Data Collection**: Parking Facility(Control panel, Loop-coil, Barrier, CCTV, Parking charge machine) OBU(Smart phone, Car navigation) **Data Processing (Center)**: Web info, Parking info management, Parking guidance management, Route info management, Traffic info management and Roadway management **Data Provision**: OBU (Car navigation, smart phone), PC (via internet), Parking administrator, Traffic administrator and Road administrator  **09_Provide guidance to Parking lot**

ITS User Services	Parking Space Information Provision System
6) Area Coverage	• Metro Manila
7) Responsible Agency and its Implementation Plan	• MMDA and Parking Lot/Facility Operating Companies
8) Related Agencies	• LGUs concerned
9) Effects and Impacts of the System	• To reduce local traffic congestion • To eliminate illegal parking

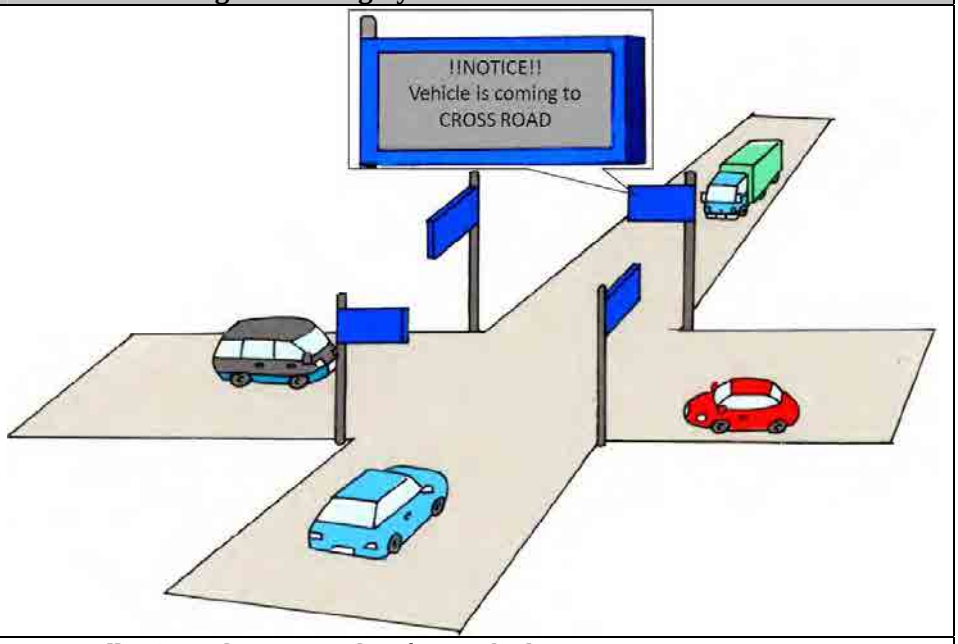
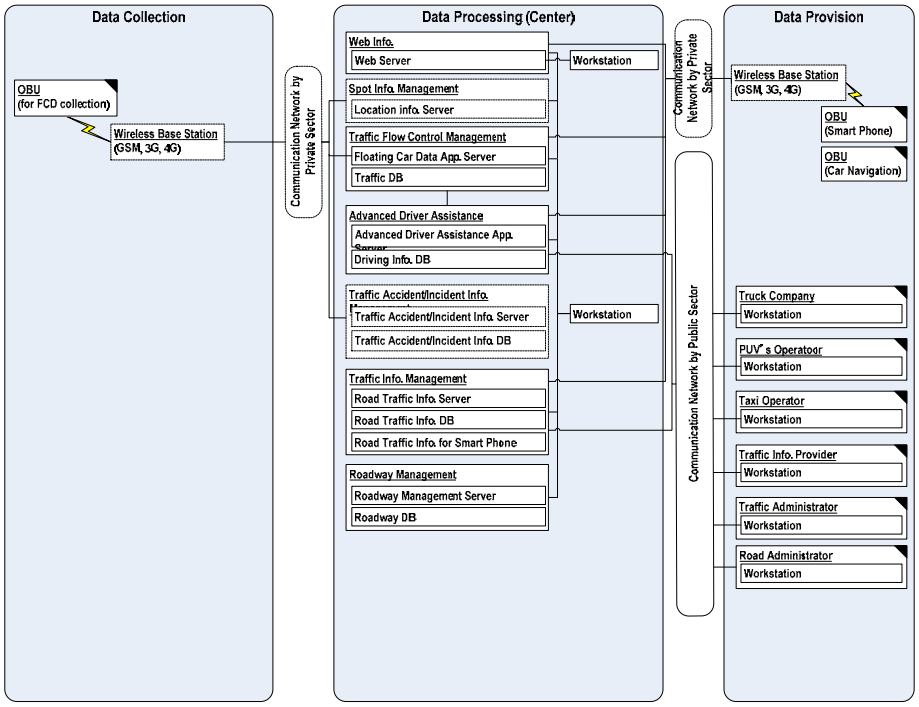
11.5.9 Commercial Vehicles Location System

ITS User Services	Commercial Vehicles Location System
1) Sub-user Service	11. Provide information on commercial vehicles operation.
2) Objectives of the Service	• To achieve orderly and efficient trips to commercial trips so as to reduce trips of commercial vehicles. • To assist operation of commercial vehicles and efficient movement of goods.
3) Measures to Achieve the Objectives	• Movements of commercial vehicles and goods at real time will be collected by on-board GPS and tags of goods. • Traffic conditions will be collected from other sources of information. • Times required for delivery and the optimum routes for delivery will be informed to the drivers, so that goods will be delivered on time with less travel time.
4) Image of the System	 *Source: http://www.simmetria.ie/Sample%20Screenshots.htm*
5) Typical System Configuration	**Data Collection**: Vehicle sensors (image recognition sensors, loop coil, ultrasonic wave, or infrared rays) Floating car data from vehicle. CCTV **Data Processing (Center)**: Spot info management, Traffic flow control management, Transport operation status info and management, Traffic info management Roadway management **Data Provision**: OBU (Car navigation, smart phone), Truck Company, Traffic administrator and Road administrator

ITS User Services	Commercial Vehicles Location System
	 **11_Provide information on commercial vehicles operations**
6) Area Coverage	• Metro Manila • Then, expanded to Mega Manila
7) Responsible Agency and its Implementation Plan	• Private trucking companies.
8) Related Agencies	• Traffic information will be provided by MMDA.
9) Effects and Impacts of the System	• Truck trips can be reduced. • Commodity delivery can be accurate and reduce complaints from clients.

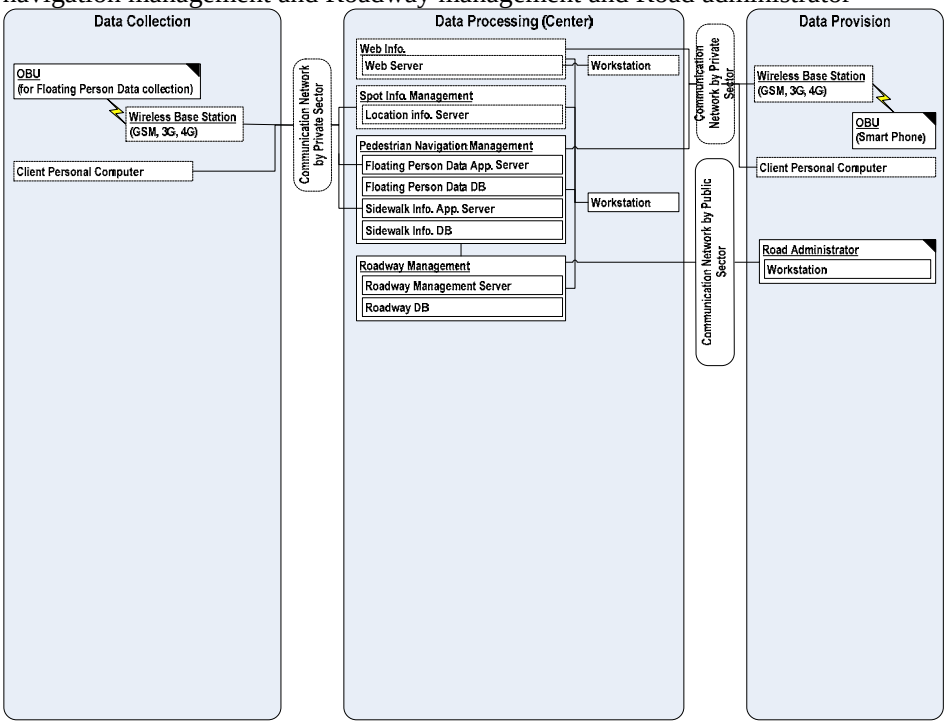
11.5.10 Danger Warning System

ITS User Services	Danger Warning System to Reduce Road Crashes
1) Sub-user Service	16. Provide enhanced driver support. 17. Provide information on vehicles passing in the opposite lane.
2) Objectives of the Service	• To improve traffic safety.
3) Measures to achieve the objectives	• Warnings such as proximity of oncoming traffic in poor forward-view condition, lane departure, inter-vehicular distance, etc. are informed to a driver.

ITS User Services	Danger Warning System to Reduce Road Crashes
4) Image of the System	
5) Typical System Configuration	**Data Collection**: Floating car data from vehicle **Data Processing (Center)**: Web info, Spot info management, Traffic flow control management, Advanced Driver Assistance, Traffic accident /incident info management Traffic info management, Roadway management **Data Provision**: OBU (Car navigation, smart phone), Truck Company, PUV's Company, Traffic information provider. Traffic administrator and Road administrator  **16_Provide Enhanced Driver Support**
6) Area Coverage	• Metro Manila
7) Responsible Agency and its Implementation Plan	• No plan yet.
8) Related Agencies	• Automobile makers

ITS User Services	Danger Warning System to Reduce Road Crashes
9) Effects and Impacts of the System	• Traffic safety is improved.

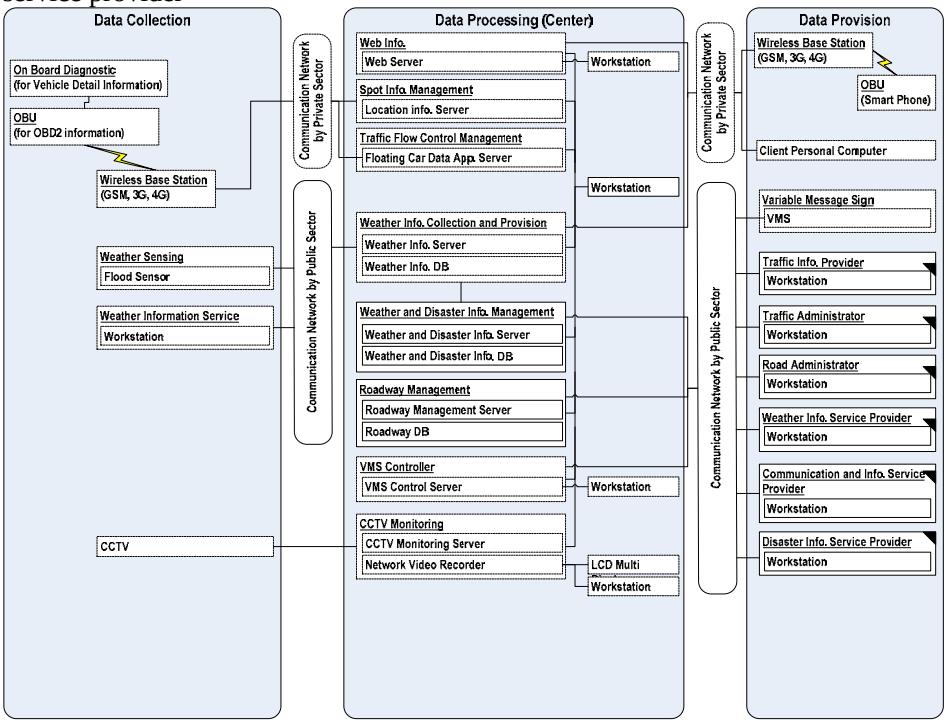
11.5.11 Pedestrian Safety Support System

ITS User Services	Pedestrian Safety Support System
1) Sub-user Service	18. Warn pedestrians of approaching vehicles and others. 19. Provide guidance to pedestrians to the given destination.
2) Objectives of the Service	• To improve traffic safety of pedestrians.
3) Measures to Achieve the Objectives	• Employs mobile terminals, etc. for caution against oncoming vehicles to pedestrians. • Information on sidewalk condition, etc. is provided to pedestrians.
4) Image of the System	 Warn Pedestrians of approaching vehicles  Warn Disability persons of approaching vehicles
5) Typical System Configuration	**Data Collection**: OBU(for Floating Person Data Collection) **Data Processing (Center)**: Web info, Spot info management, Pedestrian navigation management and Roadway management and Road administrator  **18_Provide guidance to pedestrian to the given destination**
6) Area Coverage	• Metro Manila
7) Responsible Agency and its	• Metropolitan Manila Development Authority (MMDA)

ITS User Services	Pedestrian Safety Support System
Implementation Plan	• MMDA has no plan for this service.
8) Related Agencies	• DPWH • LGUs concerned
9) Effects and Impacts of the System	• Accidents related to pedestrians reduced.

11.5.12 Weather/Natural Disaster Information Provision System

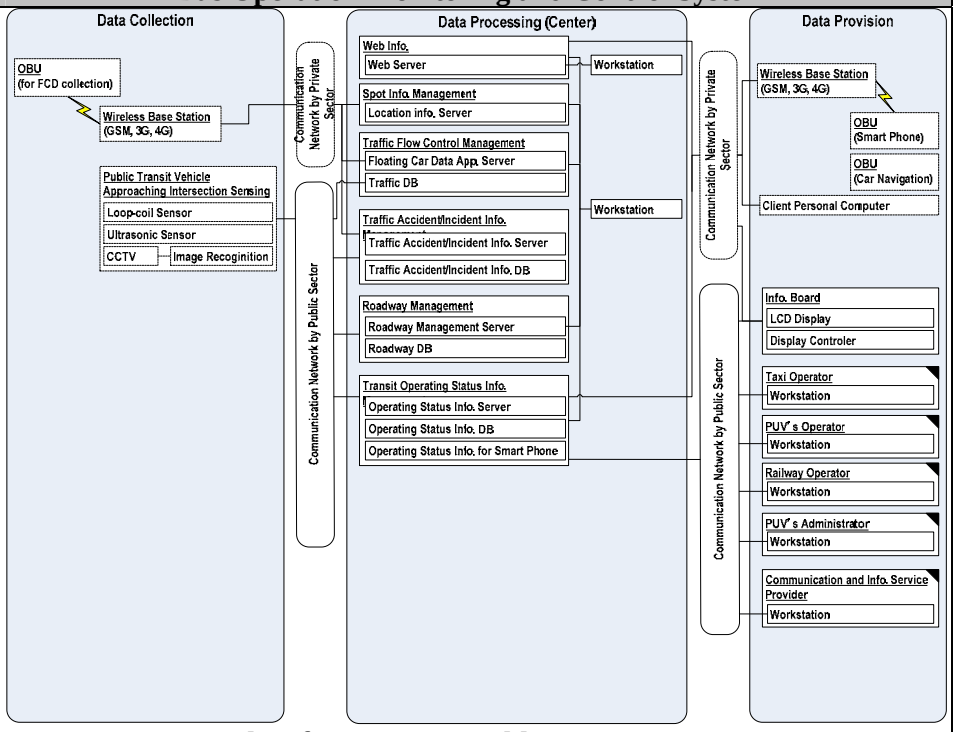
ITS User Services	Weather/Natural Disaster Information Provision System	
1) Sub-user Service	13. Provide weather information. 14. Collect information on unusual weather and disaster (weather and disaster information sharing among relevant organizations). 15. Manage traffic when disaster occurs.	
2) Objectives of the Service	• To assure safer travel during weather changes. • To improve resiliency to natural disaster.	
3) Information to be Provided	Through – Internet – Smart phone – TV	• Weather condition and prediction. • Typhoon, heavy rain, earthquake and other natural disaster information. • Evacuation order by LGUs and evacuation location. • Impassable roads. • Evacuation and relief operation routes. • Visual disaster condition by CCTV images and TV company video. • Assistance needed from the public.
	Through – VMS – Mobile phone (test message) – Radio	• Road passable or not • Occurrence of natural disaster • Passable routes from A to B
4) Image of the System		
5) Typical System Configuration	**Data Collection**: weather sensing, weather information service provider, CCTV **Data Processing (Center)**: Web info, Spot info management, Weather info collection and provision, Weather and Disaster info management, Roadway management, VMS controller and CCTV monitoring	

ITS User Services	Weather/Natural Disaster Information Provision System
	Data Provision: OBU (Car navigation, smart phone), VMS, PC (via internet), Traffic information provider. Traffic administrator, Road administrator, Weather info service provider, Communication and info service provider and Disaster info service provider  **14_Collect information on unusual weather and disaster**
6) Area Coverage	• Metro Manila • Then, expanded to Mega Manila
7) Responsible Agency and its Implementation Plan	• Metropolitan Manila Development Authority (MMDA) • So far, no plan.
8) Related Agencies	Information is provided to MMDA by various agencies; • Weather condition and weather prediction by PAGASA. • Information on tropical storms, typhoons and heavy rains by PAGASA. • Information on earthquakes, volcanic eruption, etc., by PHILVOLCS and DOST. • Evacuation order, location on evacuation center by LGUs. • Roads passable or impassable by DPWH, LGUs, road users, and residents.
9) Effects and Impacts of the System	• To improve resiliency to natural disaster. • To support rescue operation. • To support relief operation. • To support traffic safety.

11.5.13 Bus Operation Monitoring and Control System

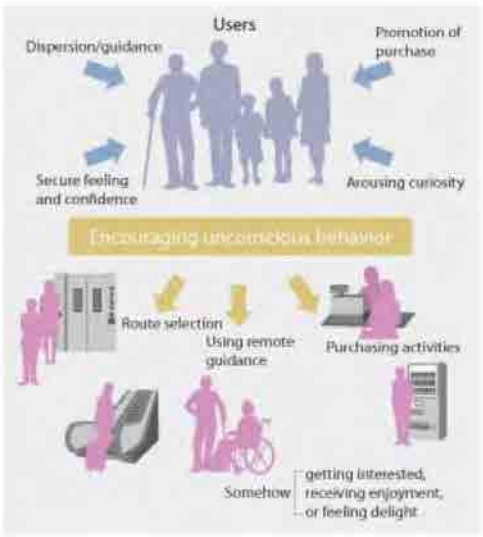
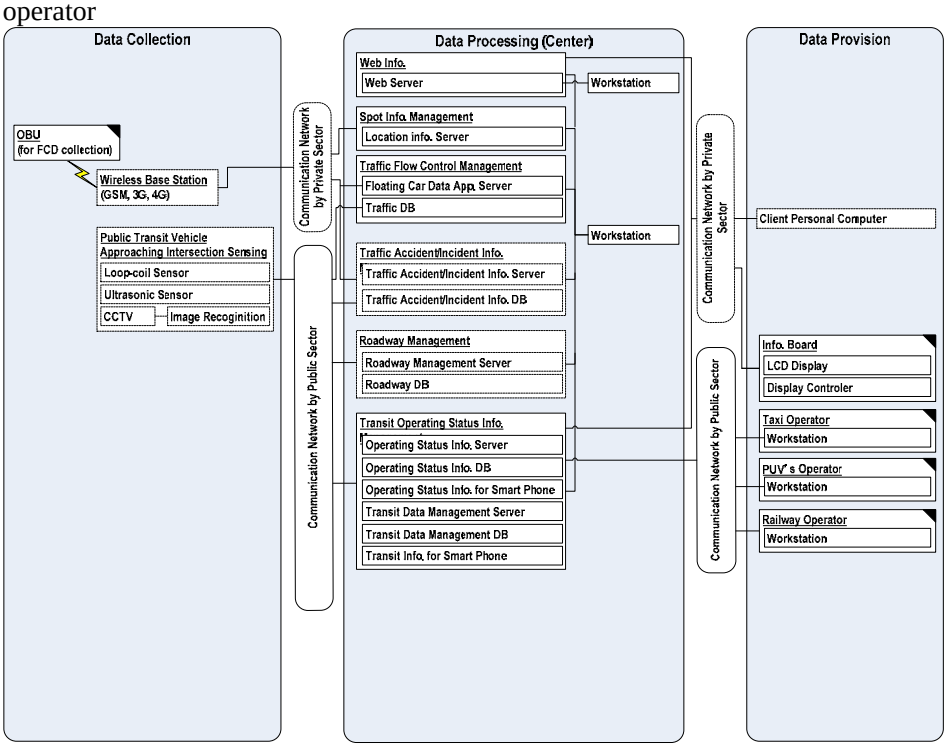
ITS User Services	Bus Operation Monitoring and Control System
1) Sub-user Service	20. Provide information on public transport operations. 21. Provide information on other public transportation service while on board public transportation. 22. Control no. of bus lane depends on demand.
2) Objectives of the Service	• To reduce traffic congestion at bus stops. • To eliminate illegal bus operations.

ITS User Services	Bus Operation Monitoring and Control System
	• To provide information of bus operation to passengers for better passenger service.
3) Measures to Achieve the Objectives	• To monitor buses by CCTV at bus stops to control their over-staying at bus stops. • To monitor illegal bus operations such as buses without a franchise by CCTV, trip cutting, etc., and remove such buses on the road. • To provide bus passengers information on bus arrival times utilizing GPS information.
4) Image of the System	**Bus Management System**  Source: MMDA
5) Typical System Configuration	**Data Collection**: Public transport vehicle sensors (image recognition sensors, loop coil, ultrasonic wave,). Floating car data from PUV. CCTV **Data Processing (Center)**: Web info, Spot info management, Traffic flow control management, Roadway management, and Transit operating status info management **Data Provision**: OBU (Car navigation, smart phone), PC (via internet), info Board Public Transport Company, Railway operator, PUV administrator and Communication info service provider

ITS User Services	Bus Operation Monitoring and Control System
	 **20_Provide information on public transport operations**
6) Area Coverage	• Metro Manila
7) Responsible Agency and its Implementation Plan	• Metropolitan Manila Development Authority (MMDA) • MMDA will start illegal bus monitoring in early 2013.
8) Related Agencies	• Vehicle registration database from Land Transportation Office (LTO), DOTC. • Franchise database from Land Transportation Franchising and Regulatory Board (LTFRB), DOTC. • Accident information by the Philippine National Police (PNP). • Bus companies.
9) Effects and Impacts of the System	• Illegal bus operations minimized. • Traffic congestion at bus stops reduced. • Bus passengers enjoy useful information for them and comfortable travel.

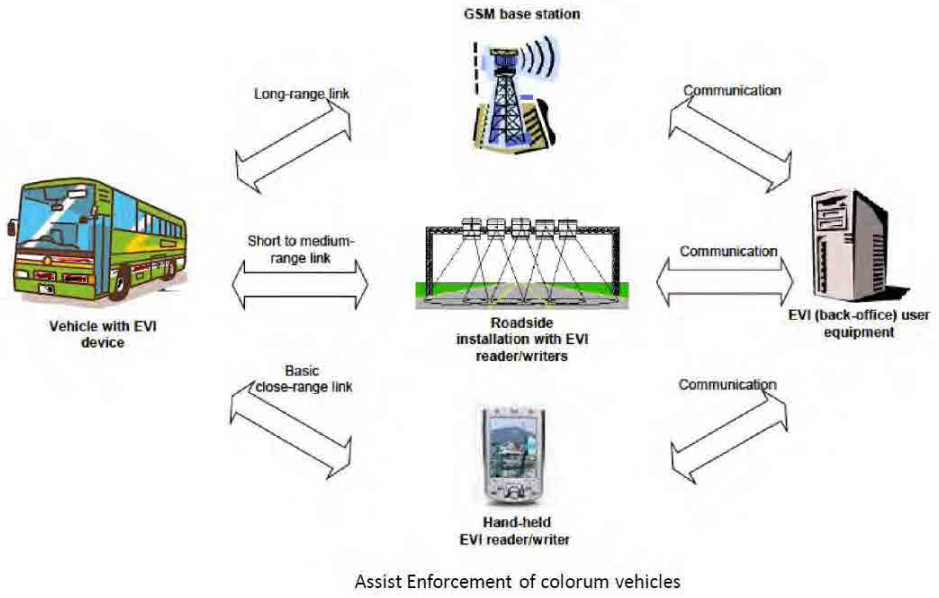
11.5.14 Rail Operation Information System

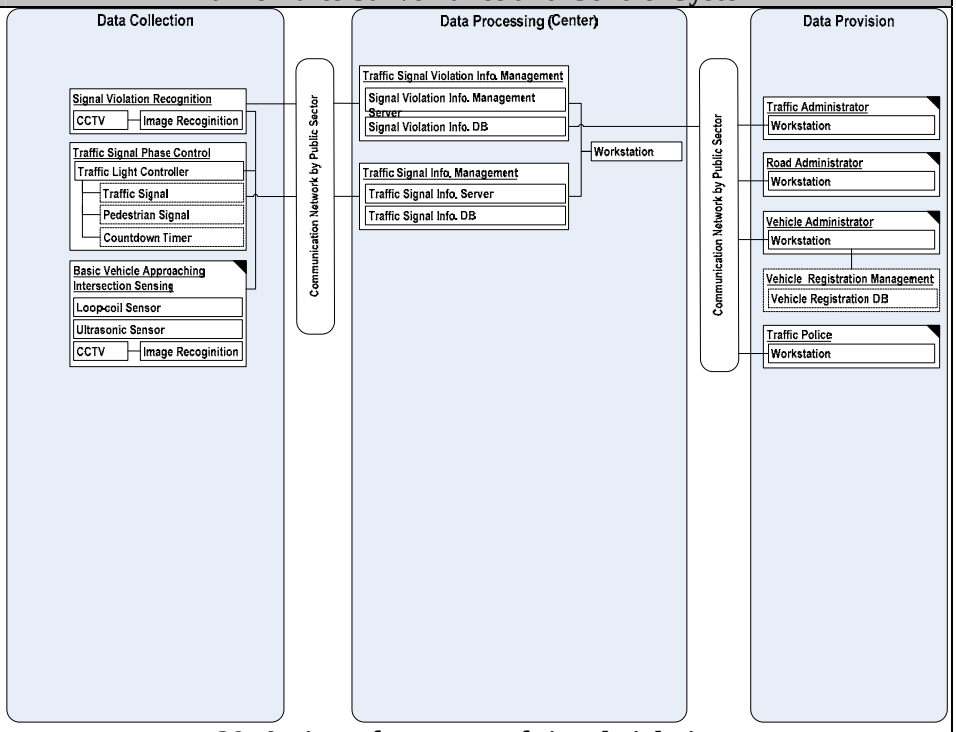
ITS User Services	Rail Operation Information System	
1) Sub-user Service	20. Provide information on public transport operations 21. Provide information on other public transportation services while on board public transportation.	
2) Objectives of the Service	• To provide better services for rail passengers. • To reduce congestion at rail stations – Passengers will start their travel earlier or later than usual so as to avoid congestion at rail stations. – Passengers may select other mode of transport.	
3) Information to be Provided	Through – Internet – Smart phone – TV	• Waiting time at stations. • If there is any restriction to enter the station. • Operation condition if there is any delay or suspension of operation due to some problems or incidents.

ITS User Services	Rail Operation Information System
4) Image of the System	  *Source: http://www.hitachi.co.in/ics/smart_and_smooth/index.html*
5) Typical System Configuration	**Data Collection**: Public transport vehicle sensors (image recognition sensors, loop coil, ultrasonic wave,). Floating car data from PUV. CCTV **Data Processing (Center)**: Web info, Spot info management, Traffic flow control management, Traffic accident/incident info management, Roadway management, and Transit operating status info management **Data Provision**: PC (via internet), info Board Public Transport Company, Railway operator  **21_Provide information on other public transportation service while on board public transportation**
6) Area Coverage	• Metro Manila
7) Responsible Agency and its Implementation Plan	• Metropolitan Manila Development Authority (MMDA) • MMDA is already providing some information.
8) Related Agencies	• LRTA shall provide necessary information on LRT-1 and LRT-2 to MMDA. • DOTC shall provide necessary information on MRT-3 to MMDA

ITS User Services	Rail Operation Information System
9) Effects and Impacts of the System	• Concentration of rail passengers can be spread. • Rail passengers will enjoy comfortable travel. • Rail passengers can select another mode of travel.

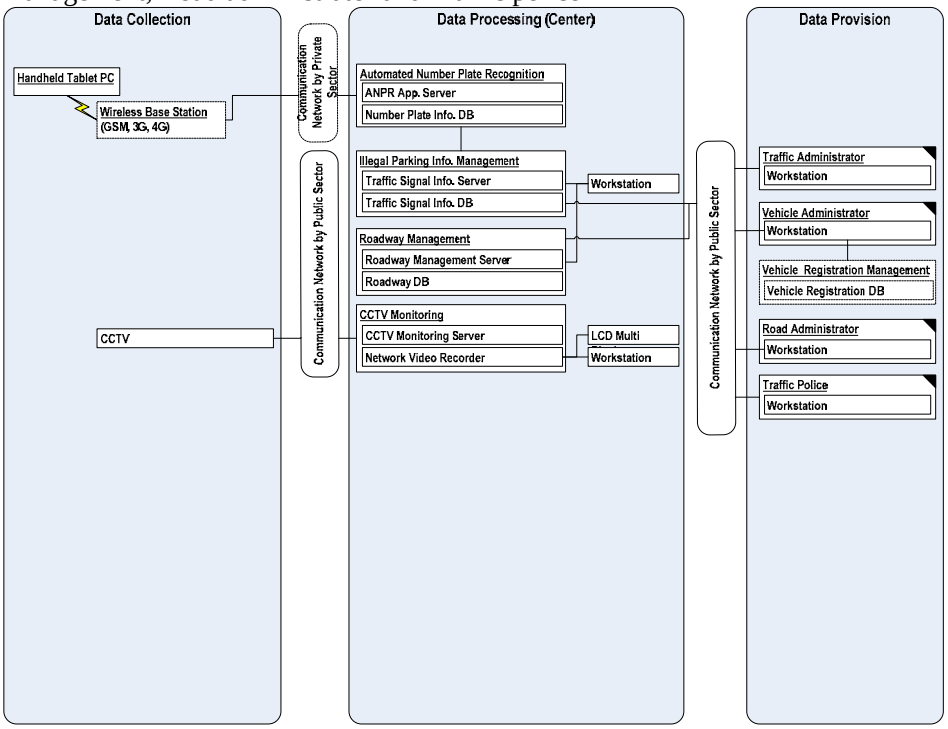
11.5.15 Traffic Rules Surveillance and Control System

ITS User Services	Traffic Rules Surveillance and Control System
1) Sub-user Service	23. Assist enforcement of colorum vehicles. 27. Improve efficiency of inspection after road crash. 28. Assist enforcement of traffic rules violation.
2) Objectives of the Service	• To achieve smooth traffic flow. • To improve traffic safety. • To reduce period of temporary traffic bottleneck.
3) Measures to Achieve the Objectives	• Automated surveillance and crackdown of illegal activities by visual evidence.
4) Image of the System	
5) Typical System Configuration	**Data Collection**: Signal violation recognition, Traffic signal phase control and vehicle sensors (image recognition sensors, loop coil, ultrasonic wave, or infrared rays) CCTV **Data Processing (Center)**: Traffic signal violation info management and traffic signal info management **Data Provision**: Traffic administrator, Road administrator, Vehicle administrator, Vehicle registration management and Traffic police

ITS User Services	Traffic Rules Surveillance and Control System
	 **28_Assist enforcement of signal violation**
6) Area Coverage	• Metro Manila
7) Responsible Agency and its Implementation Plan	• Metropolitan Manila Development Authority (MMDA) • MMDA has no plan for this system yet.
8) Related Agencies	• Vehicle registration database from LTO. • Franchise database from LTFRB. • LGU enforcers concerned.
9) Effects and Impacts of the System	• Traffic flow is streamlined. • Travel speed is improved. • Traffic safety is improved.

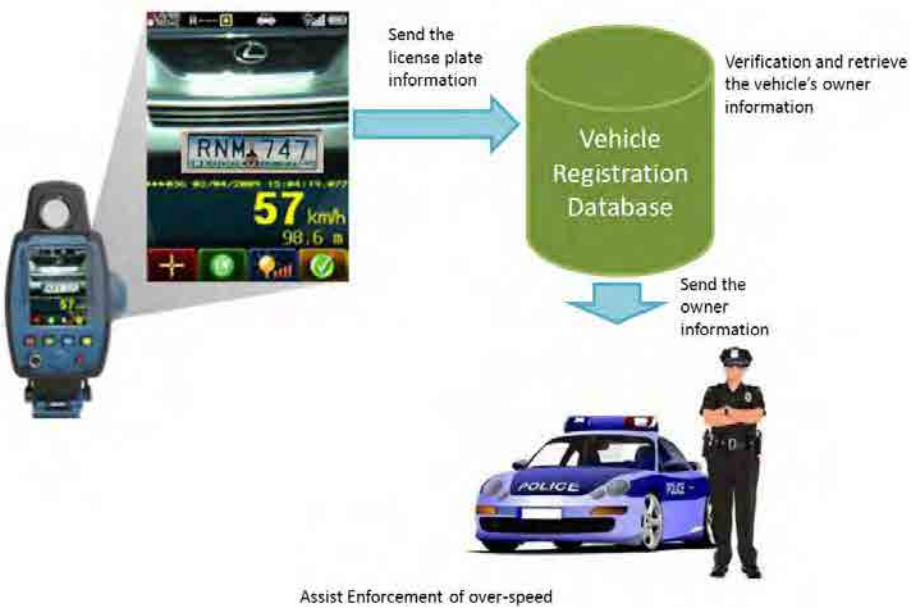
11.5.16 On-street Parking Control System

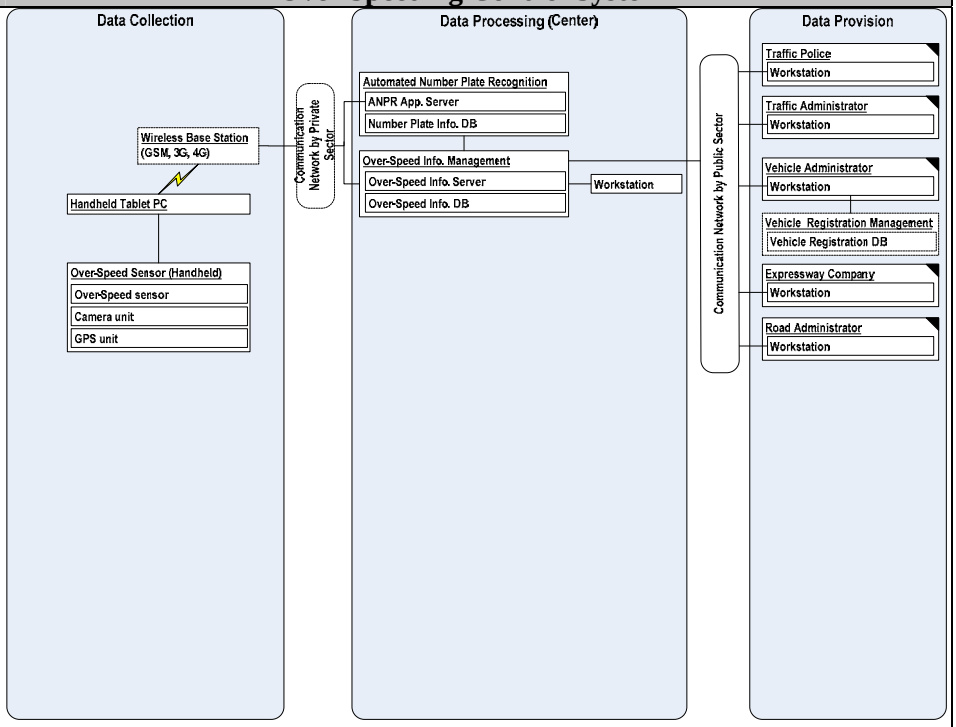
ITS User Services	On-street Parking Control System
1) Sub-user Service	24. Assist control of illegal parking.
2) Objectives of the Service	• To improve traffic capacity of roads for smoother traffic flow. • To eradicate road-side friction.
3) Measures to Achieve the Objectives	• Illegal parking is identified and recorded automatically by handy equipment.

ITS User Services	On-street Parking Control System
4) Image of the System	 *Source: http://casio.jp/business/case/ht/04/*
5) Typical System Configuration	**Data Collection**: Tablet PC. CCTV **Data Processing (Center)**: Automated number plate recognition, Illegal parking info management, Roadway management, CCTV monitoring **Data Provision**: Traffic administrator, Vehicle administrator, Vehicle registarion management, Road administrator and Traffic police  **24_Assist efficiency of illegal parking**
6) Area Coverage	• Metro Manila
7) Responsible Agency and its Implementation Plan	• Metropolitan Manila Development Authority (MMDA) • MMDA has no plan for this system yet.
8) Related Agencies	• Vehicle registration database from LTO. • LGUs concerned

ITS User Services	On-street Parking Control System
9) Effects and Impacts of the System	• Road capacity is increased. • Traffic congestion is reduced.

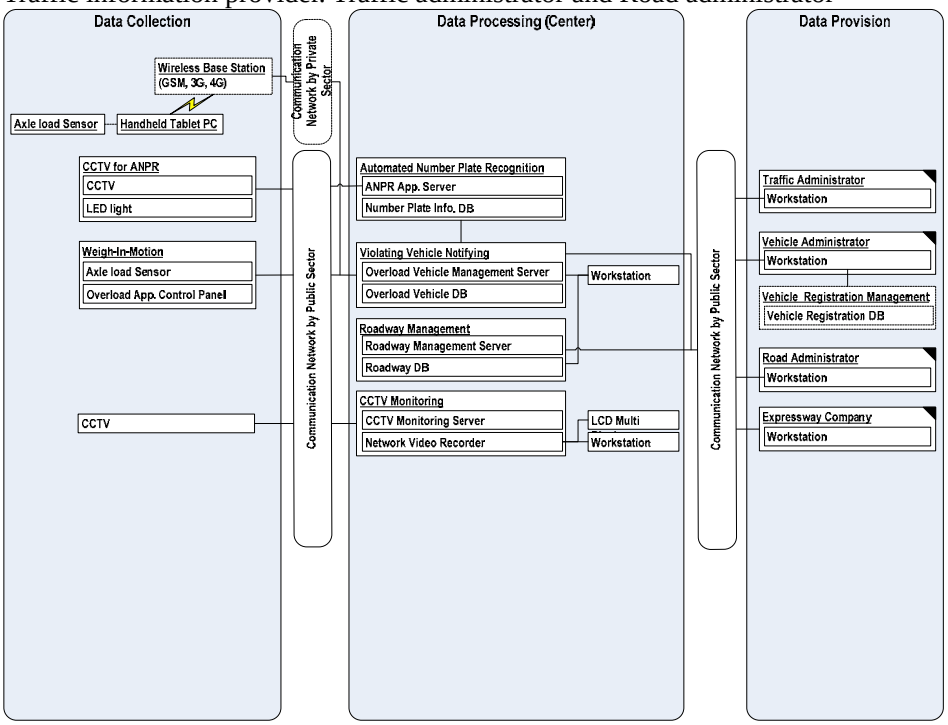
11.5.17 Over Speeding Control System

ITS User Services	Over Speeding Control System
1) Sub-user Service	26.Assist enforcement against over-speeding vehicles.
2) Objectives of the Service	• To reduce serious road crashes.
3) Measures to Achieve the Objectives	• Overspeeding vehicle will be identified by over-speeding sensor with camera and instantly identify vehicle owner. • Overspeeding record will be sent to the police department with the evidence. • Overspeeding record will be stored in the database which will identify repeaters of over-speeding violators.
4) Image of the System	 *Source: http://www.lasertech.com/TruCAM-Laser-Speed-Gun.aspx*
5) Typical System Configuration	**Data Collection**: Over Speed sensors and PC Tablet Data Processing **(Center):** Automated Number Plate Recognition, Over-speed information management **Data Provision**: Traffic Police, Traffic administrator, Vehicle registration administrator, Expressway company and Road administrator

ITS User Services	Over Speeding Control System
	 **26_Assist enforcement vs. over-speeding vehicles**
6) Area Coverage	• Metro Manila
7) Responsible Agency and its Implementation Plan	• Metropolitan Manila Development Authority (MMDA) • MMDA has no plan for this system yet.
8) Related Agencies	• Vehicle registration database from LTO. • LGUs concerned.
9) Effects and Impacts of the System	• Fatal road crash reduced.

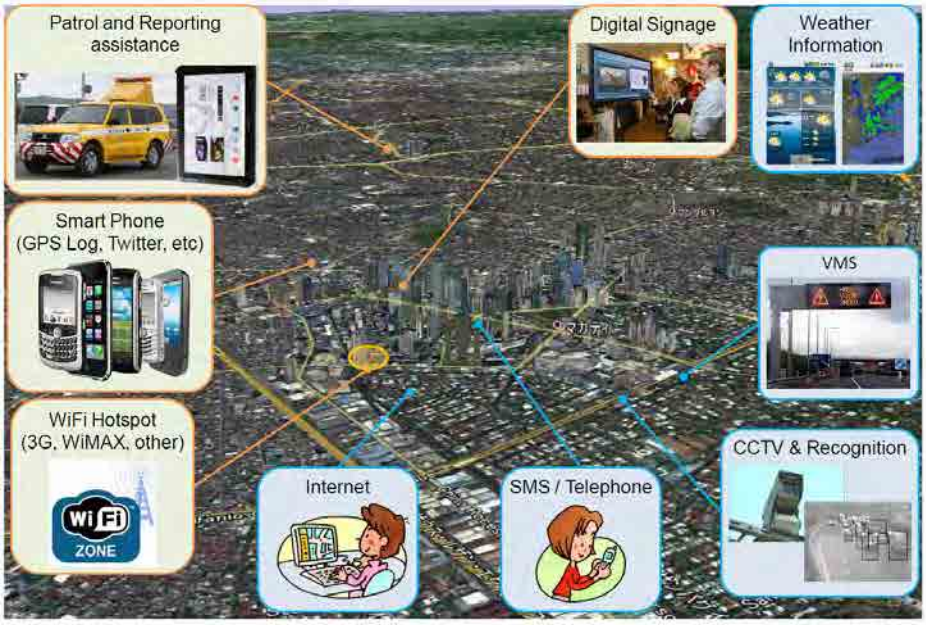
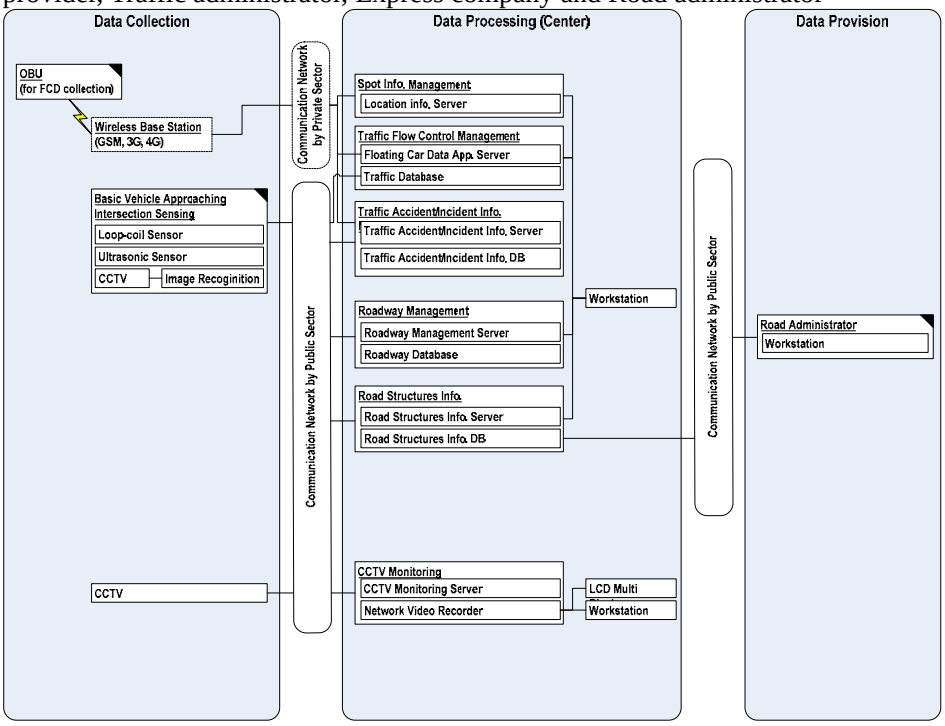
11.5.18 Overloaded Truck Control System

ITS User Services	Overloaded Truck Control System
1) Sub-user Service	25.Assist enforcement against overloaded vehicles.
2) Objectives of the Service	• To prevent pre-mature pavement and bridge deterioration. • To provide better surfaced roads for smooth travel.
3) Measures to Achieve the Objectives	• Weigh-in-motion equipment weighs axle load and automatically identifies overloaded trucks.
4) Image of the System	 Assist Enforcement of overloaded

ITS User Services	Overloaded Truck Control System
5) Typical System Configuration	**Data Collection**: Axle load sensor, CCTV, Weigh in motion **Data Processing (Center):** Center server, traffic control center **Data Provision**: OBU (Car navigation, smart phone), VMS, PC(via internet), Traffic information provider. Traffic administrator and Road administrator  **25_Assist enforcement of overloaded vehicles**
6) Area Coverage	• Metro Manila
7) Responsible Agency and its Implementation Plan	• Department of Public Works and Highways (DPWH) • DPWH has no plan for this system yet.
8) Related Agencies	• LTO deputizes DPWH personnel in the presence of PNP personnel who can confiscate a vehicle plate or driver's license. • Toll expressway operators
9) Effects and Impacts of the System	• Pre-mature pavement/bridge deterioration minimized. • Better surface road provided.

11.5.19 Upgrading of Road Condition Information Collection System

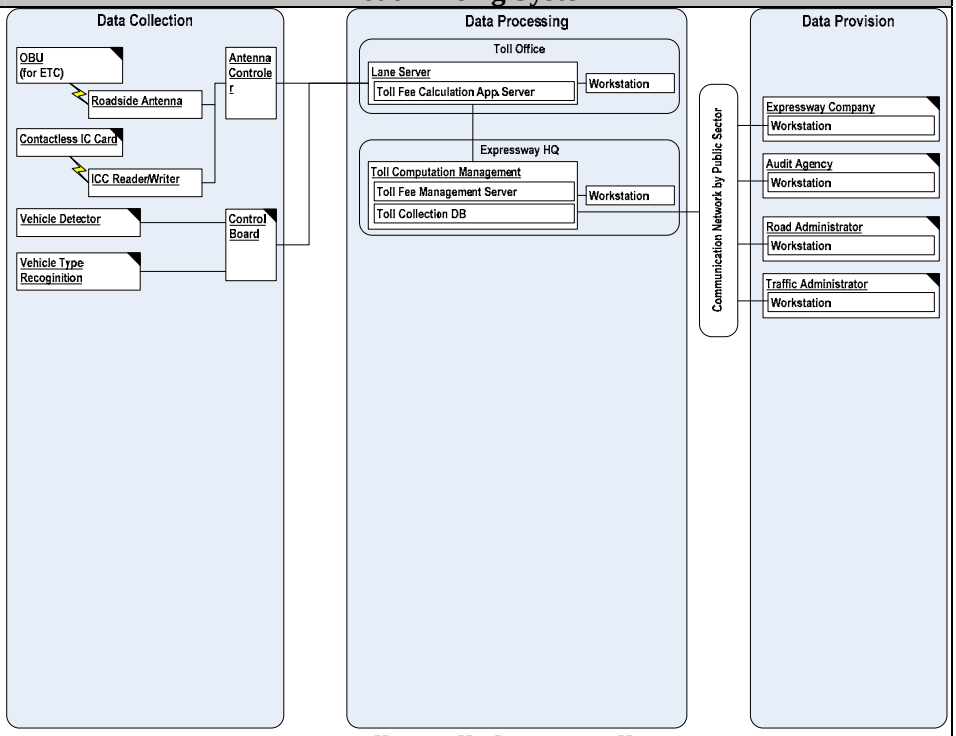
ITS User Services	Upgrading of Road Condition Information Collection System
1) Sub-user Service	29. Analysis road crash and traffic information 30. Manage information on road maintenance (Road Maintenance Information sharing among relevant organization) 31. Assist traffic survey. 32. Collect information on road surface condition
2) Objectives of the Service	• To assist improvement of road management for provision of better roads. • To secure level of service.
3) Measures to Achieve the Objectives	• Accurate and updated information necessary for road maintenance will be automatically collected.

ITS User Services	Upgrading of Road Condition Information Collection System
4) Image of the System	
5) Typical System Configuration	**Data Collection**: vehicle sensors (image recognition sensors, loop coil, ultrasonic wave, or infrared rays) Floating car data from vehicle. CCTV **Data Processing (Center)**: Center server, traffic control center **Data Provision**: Traffic Police, Fire Station, MARAS, TARAS Traffic information provider, Traffic administrator, Express company and Road administrator  **32_Collect information on road surface**
6) Area Coverage	• National Roads within Metro Manila • Then, expanded to Mega Manila
7) Responsible Agency and its Implementation Plan	• Department of Public Works and Highways (DPWH) • DPWH has no plan to adopt this system yet.
8) Related Agencies	• Road users.

ITS User Services	Upgrading of Road Condition Information Collection System
9) Effects and Impacts of the System	• Road surface condition improved, which will improve travel speed and reduce vehicle operating cost and time cost.

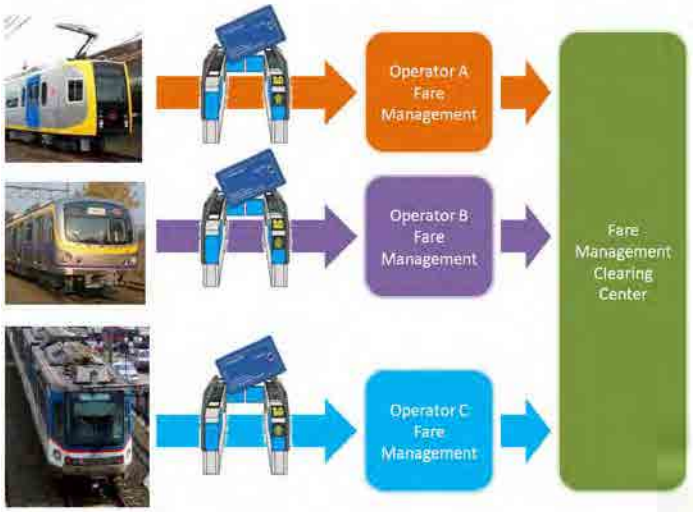
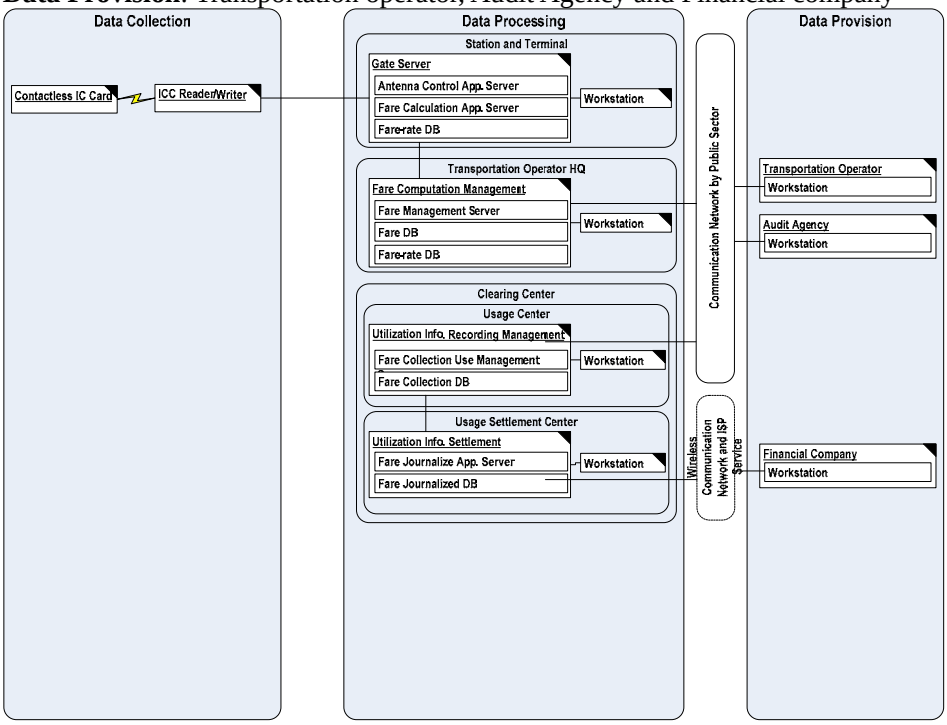
11.5.20 Road Pricing System

ITS User Services	Road Pricing System
1) Sub-user Service	33. Collect toll/charge electronically.
2) Objectives of the Service	• To reduce cars on the roads for smoother traffic flow.
3) Measures to Achieve the Objectives	• Cars entering into the specified area will be automatically identified and charged cordon pricing.
4) Image of the System	 *Source:* *http://www.mhi.co.jp/en/technology/business/tsat/its/index.html*
5) Typical System Configuration	**Data Collection**: OBU(for ETC), IC card, Vehicle Detector, Vehicle Type Recognition **Data Processing**: Lane Server, Toll Computation Management **Data Provision**: Audit Agency Road Administrator and Traffic Administrator's Workstation

ITS User Services	Road Pricing System
	 **33_Collect toll electronically**
6) Area Coverage	• Selected area or corridor(s) in Metro Manila
7) Responsible Agency and its Implementation Plan	• Jointly by DOTC and MMDA • Both agencies have no concrete plan yet.
8) Related Agencies	• Vehicle registration database of LTO.
9) Effects and Impacts of the System	• Cars within the specified area reduced and traffic congestion reduced.

11.5.21 Common Ticketing System

ITS User Services	Common Ticketing System
1) Sub-user Service	34. Collecting parking charges electronically. 35. Utilize public transportation with cashless payment.
2) Objectives of the Service	• To make easier transfer from one rail system to another.
3) Measures to Achieve the Objectives	• Automated cashless payment of fare will be done by contactless card for all rail stations.

ITS User Services	Common Ticketing System
4) Image of the System	
5) Typical System Configuration	**Data Collection**: IC card, ICC Reader/Writer **Data Processing**: Gate Server, Fare Computation management, Clearing center **Data Provision**: Transportation operator, Audit Agency and Financial company  **35_Utilized Public Transportation with cashless payment**
6) Area Coverage	• LRT-1, LRT-2, and MRT-3 in Metro Manila
7) Responsible Agency and its Implementation Plan	• Department of Transportation and Communication (DOTC) • DOTC plans to implement this system as a PPP project. • DOTC completed a feasibility study. • DOTC advertized the project for pre-qualification of bidders on Dec. 17, 2012
8) Related Agencies	• LRTA
9) Effects and Impacts of the System	• Congestion at rail station reduced. • Rail passenger can enjoy cashless payment not only for rail fare but also for other payments at restaurants, etc.

11.6 PRIORITY OF PROPOSED ITS SERVICES

The priority of ITS Services was evaluated from the Government's viewpoint and the road users' viewpoint. Both views were integrated to determine the overall priority.

(1) Priority from the Viewpoint of the Government

High Priority (10 points)	:	The implementing agency has started the service or will soon start the service.
Medium Priority (8 points)	:	The implementing agency is seriously considering the implementation and studying the services for implementation in the near future.
Low Priority (5 points)	:	The implementing agency has no plan to implement the service yet.

(2) Road Users' Priority

Road users were interviewed to identify the following:

- Traffic Problems
- ITS measures to be implemented

High Priority (10 points)	:	50% or more responded it is a problem or ITS measures to be implemented.
Medium Priority (8 points)	:	25% to 50% responded it is a problem or ITS measures to be implemented.
Low Priority (5 points)	:	Less than 25% responded it is a problem or ITS measures to be implemented. Or no answer by respondents.

(3) Overall Priority

The points of (1) and (2) above will be added, and the overall priority was determined as follows:

High Priority	:	18 or 20 points
Medium Priority	:	16 points
Low Priority	:	10 or 13 points

Table 11.6-1 shows priority of ITS services of Metro Manila.

TABLE 11.6-1 IMPLEMENTATION PRIORITY OF ITS USER SERVICE: METRO MANILA

ITS User Service	Government's Agency Priority			Road User's Priority			Total Point	Overall Priority		
	High (10)	Medium (8)	Low (5)	High (10)	Medium (8)	Low (5)		High	Medium	Low
1. Advanced Traffic Control System at Intersection	○			○			20	○		
2. Emergency Vehicle Priority System			○		○		13			○
3. Upgrading of Traffic Information Collection and Provision System	○			○			20	○		
4. Route Guidance System	○			○			20	○		
5. Information Provision System of Temporary Traffic Bottlenecks	○			○			20	○		
6. Traffic Management System at Large-Scale Shopping Malls		○		-	-	-	13			○
7. Parking Space Information Provision System		○		-	-	-	13			○
8. Weather/Natural Disaster Information Provision System	○				○		18	○		
9. Commercial Vehicles Location System	○			-	-	-	15		○	
10. Events Information Provision System	○			○			20	○		
11. Rail Operation Information Provision System		○				○	13			○
12. Danger Warning System			○	-	-	-	10			○
13. Pedestrian Safety Support System			○		○		13			○
14. Bus Operation Monitoring and Control System	○					○	15		○	
15. Traffic Rules Surveillance and Control System	○			○			20	○		
16. On-street Parking Control System		○		-	-	-	13			○
17. Over Speeding Control System	○			-	-	-	15		○	
18. Overloaded Truck Control System	○			-	-	-	15		○	
19. Upgrading of Road Condition Information Collection System		○		○			18	○		
20. Road Pricing System			○	-	-	-	10			○
21. Common Ticketing System	○			-	-	-	15		○	

Government's Agency's Priority

High:	Government started or will start. (10 points)
Medium:	Government is studying. (8 points)
Low:	No plan yet. (5 points)

Road User's Priority

High:	50% or more (10 points)
Medium:	25% to 50% (8 points)
Low:	Less than 25% (5 points)
- :	No answer (5 points)

Overall Priori

High:	Over 18 poin
Medium:	15-17 points
Low:	Less than 14

11.7 IMPLEMENTATION SCHEDULE AND COST

Based on the overall priority and time required to arrive at a consensus among Government agencies/private sector companies, the implementation schedule was proposed as shown in **Table 11.7-1** for Metro Manila.

TABLE 11.7-1 IMPLEMENTATION SCHEDULE: METRO MANILA

ITS System				Implementing Agency	Present Status	Implementation Schedule		
						Short-Term (2013-2014)	Medium-Term (2015-2019)	Long-Term (2020-2030)
Traffic Signal Control	(1)	Advanced Traffic Control System at Intersections	Phase-I (85 Intersections)	MMDA	Contractor selected.	System Development →	Upgrading →	→
			Phase-II (120-130 Intersections)	MMDA	Fund being arranged.	System Development →	→	Upgrading →
			Phase-III (221-231 Intersections)	MMDA			System Development →	Upgrading →
	(2)	Emergency Vehicle Priority System		MMDA			System Development →	Upgrading →
Traffic Information Provision	(3)	Upgrading of Traffic Information Collection and Provision System on real-time basis		MMDA	First generation (TNAV) is in service.	2nd Gen. ATNAV →	3rd Generation →	4th Generation →
	(4)	Route guidance System to direct drivers		MMDA	Being developed.	System Development →	Upgrading →	Upgrading →
	(5)	Information Provision System of Temporary Traffic Bottlenecks		MMDA	Partially in service.	System Development →	Upgrading →	Upgrading →
	(6)	Traffic Management System at Large-scale Shopping Malls		MMDA/Private Developer			System Development →	Upgrading →
	(7)	Parking Space Information Provision system		MMDA/Private Developer			System Development →	Upgrading →
	(8)	Weather Condition and Prediction Information Provision System		MMDA			System Development →	Upgrading →
	(9)	Commercial Vehicles Location System		MMDA Trucking Companies			System Development →	Upgrading →
	(10)	Events Information Provision System		MMDA	Partially in service.	System Development →	Upgrading →	Upgrading →
	(11)	Rail Operation Information Provision System		MMDA	Partially in service.	System Development →	Upgrading →	Upgrading →
Traffic Safety Assistance	(12)	Danger Warning system to reduce Road Crashes		MMDA				System Development →
	(13)	Pedestrian Safety Support System		MMDA				System Development →
PUV Management	(14)	Bus operation Monitoring and Control System		MMDA	Being developed.	System Development →	Upgrading →	Upgrading →
				Bus Companies			System Development →	Upgrading →
Traffic Enforcement Assistance	(15)	Traffic Rules Surveillance and Control System		MMDA		System Development →	→	Upgrading →
	(16)	On-street Parking Control		MMDA			System Development →	Upgrading →
	(17)	Over Speeding Control System		MMDA			System Development →	Upgrading →
Road Management	(18)	Overloaded Truck Control System		DPWH	Conventional Method		System Development →	Upgrading →
	(19)	Upgrading of Road Condition Information Collection		DPWH	Conventional Method		System Development →	Upgrading →
Toll/Fare Collection	(20)	Road Pricing System		DOTC/MMDA				System Development →
	(21)	Common Ticketing System		DOTC	To be implemented by PPP. Project advertized.	System Development →	→	Upgrading →
Estimated Cost (Million Php)						1183	4970	1131

11.7.1 COST ESTIMATE FOR METRO MANILA ITS

The Project Cost has been estimated for Metro Manila ITS Integration Project and Operation and maintenance cost.

The Project Cost consists of Center equipment costs including installation cost, Center Software costs and Roadside Equipment costs were estimated for each sub-services.

(1) Base Condition for Cost Estimate

Cost Estimate for Administration Cost and Physical Contingency are estimated percentage of Civil Work cost as following;

- Administration Cost – 3.5%
- Physical Contingency – 5%
- Exchange Rate of Project Cost Estimates is used US$ 1.00-Peso 40.75-Yen 95 or Peso 1.00-Yen 2.33 as of April 2013.

(2) Condition of Unit Price

The Civil Work Cost estimate is composed

i) Cost of Equipment :
The cost of equipment is based on quotation from supplier and

ii) Cost of Installation :
Installation of equipment cost is used assumed 15% of equipment cost.

(3) Indirect Costs

According to the Department Order No. 29/2011 of DPWH, the indirect cost consider as following conditions;

i) Mobilization and demobilization (0.1 % of direct cost)
ii) Value Added Tax (VAT):12% of total Direct and Indirect Cost.

Table 11.7-2 shows the major equipment items (center, roadside and vehicle), unit price and quantity.

TABLE 11.7-2 MEGA ITS EQUIPMENTS UNIT PRICE AND QUANTITY IN METRO MANILA

Major Equipment		Unit Price (PHP)	Quantity
Centre Equipment			
	Application Server	10,187,500	139
	Database Server	10,187,500	44
	Workstation	256,725	16
	Network Video Recorder	694,800	3
	LCD Monitor (Multi Type)	94,459	12
Roadside Equipment			
	Pedestrian Detector (Image Recognition type)	1,488,856	3672
	CCTV Camera (FIX Type)	282,883	2328
	Image Recognition Processor	1,091,828	2328
	Traffic Signal (LED Lamp)	387,103	3672
	Traffic Light Controller	248,143	1863
	Pedestrian Signal	198,514	7344
	Countdown Timer	277,920	3672
	CCTV Camera (PTZ Type)	282,883	1553
	RFID Reader (with Gantry)	17,930	3672
	VMS Type A (with Gantry)	7,444,282	81
	WiMAX Base Station	611,250	113
	VMS Type B (Warning)	6,947,997	180
	Inforamation Board	248,143	40
	CCTV (ANPR)	282,883	22
	LED Light for Overloaded	124,071	22
	Weight-in-Motion	1,630,000	11
	Axle load sensor	7,444,282	11
	Roadside Antena for Toll Collection	1,222,500	104
	Over-Speed Sensor	24,814	100
	3D Laser Scanner	2,977,713	9
	VMS Type C (Parking)	2,481,427	50
	Control Panel for Parking System	407,500	50
	Toll barrier for Parking System	671,968	100
	VMS Type D (Lane Guidance)	2,481,427	32
Vehicle Equipment			
	Patrol Car GPS Unit	4,075	6
	RFID Tag for Bus Location	611	1000

11.7.2 PROJECT COST FOR METRO MANILA AREA

Summary of Project Cost for Metro Manila ITS Project is shown in **Table 11.7-3, Table 11.7-4 and Table 11.7-5**.

TABLE 11.7-3 PROJECT COST FOR 1ST STAGE OF METRO MANILA ITS

Unit: Php

PAY ITEM NO.	DESCRIPTION	QUANTITY	UNIT	Unit Cost	Civil Work Cost	COST COMPONENT		
						Foreign Currency (FC)	Local Currency (LC)	TAXES
A	**Traffic Signal Control System**							
SPL A1	Control Traffic Signal - 1	1.00	Ls	709,845,266.81	709,845,266.81	518,187,044.77	106,476,790.02	85,181,432.02
SPL A2	Signal Priority to PUV's		Ls		-	-	-	-
SPL A3	Control for emergency vehicles		Ls		-	-	-	-
	SUB-TOTAL (PART A)				**709,845,266.81**	**518,187,044.77**	**106,476,790.02**	**85,181,432.02**
B	**Road Traffic Information Provision System**							
SPL B1	Road traffic information		Ls		-	-	-	-
SPL B2	Optimum route information		Ls		-	-	-	-
SPL B3	Information of detour		Ls		-	-	-	-
SPL B4	road traffic informaiton and others		Ls		-	-	-	-
SPL B5	Information on parking availability		Ls		-	-	-	-
SPL B6	Guidance to parking lot		Ls		-	-	-	-
SPL B7	Location information of patrol vehicles		Ls		-	-	-	-
SPL B8	Information on commercial vehicles		Ls		-	-	-	-
SPL B9	Access to the Network Information when Traveling		Ls		-	-	-	-
	SUB-TOTAL (PART B)				**-**	**-**	**-**	**-**
C	**Traffic Safety Assistance System**							
SPL C1	Weather information		Ls		-	-	-	-
SPL C2	unusual weather and disaster		Ls		-	-	-	-
SPL C3	Manage traffic when disaster occurs		Ls		-	-	-	-
SPL C4	Enhanced driver support		Ls		-	-	-	-
SPL C5	Vehicle passing in the opposite lane		Ls		-	-	-	-
SPL C6	Guidance to pedestrian to the given destination		Ls		-	-	-	-
SPL C7	Pedestrian of approaching vehicles and others		Ls		-	-	-	-
	SUB-TOTAL (PART C)				**-**	**-**	**-**	**-**
D	**Public Utility Vehicle Management System**							
SPL D1	Information on public transport operations	1.00	Ls	201,264,209.25	201,264,209.25	146,922,872.75	30,189,631.39	24,151,705.11
SPL D2	Information on other public transportation service while on board public transportation	1.00	Ls	63,724,564.75	63,724,564.75	46,518,932.27	9,558,684.71	7,646,947.77
SPL D3	Control bus lane dynamically	1.00	Ls	186,313,001.65	186,313,001.65	136,008,491.20	27,946,950.25	22,357,560.20
	SUB-TOTAL (PART D)				**451,301,775.65**	**329,450,296.22**	**67,695,266.35**	**54,156,213.08**
E	**Automated Toll and Fare Collection System**							
SPL E1	Assist enforcement of colorum vehicles	1.00	Ls	40,591,421.38	40,591,421.38	29,631,737.60	6,088,713.21	4,870,970.57
SPL E2	Assist efficiency of illegal parking		Ls		-	-	-	-
SPL E3	Assist enforcement of overloaded vehicles		Ls		-	-	-	-
SPL E4	Assist enforcement of over-speedvehicles		Ls		-	-	-	-
SPL E5	Improve conduction after road crush procedure	1.00	Ls	64,438,201.16	64,438,201.16	47,039,886.85	9,665,730.17	7,732,584.14
SPL E6	Assist enforcement of signal violation	1.00	Ls	212,060,980.84	212,060,980.84	154,804,516.01	31,809,147.13	25,447,317.70
	SUB-TOTAL (PART E)				**317,090,603.38**	**231,476,140.46**	**47,563,590.51**	**38,050,872.41**
F	**Road Management System**							
SPL F1	Manage traffic when under incidental traffic conditions		Ls		-	-	-	-
SPL F2	Manage information on road maintenance		Ls		-	-	-	-
SPL F3	Assist traffic survey		Ls		-	-	-	-
SPL F4	Collect information on road surface		Ls		-	-	-	-
	SUB-TOTAL (PART F)				**-**	**-**	**-**	**-**
G	**Traffic Enfocement Assistance System**							
SPL G1	Collect tollelectronically		Ls		-	-	-	-
SPL G2	Collect parking charges electronically	1.00	Ls	238,958,896.50	238,958,896.50	174,439,994.45	35,843,834.48	28,675,067.58
SPL G3	Utilized public transportation with cashless payment	1.00	Ls	165,504,250.50	165,504,250.50	120,818,102.87	24,825,637.58	19,860,510.06
	SUB-TOTAL (PART G)				**404,463,147.00**	**295,258,097.31**	**60,669,472.05**	**48,535,577.64**
	TOTAL				**1,882,700,792.84**	**1,374,371,578.77**	**282,405,118.93**	**225,924,095.14**

TABLE 11.7-4 PROJECT COST FOR 2ND STAGE OF METRO MANILA ITS

Unit: Php

PAY ITEM NO.	DESCRIPTION	QUANTITY	UNIT	Unit Cost	Civil Work Cost	COST COMPONENT		
						Foreign Currency (FC)	Local Currency (LC)	TAXES
A	**Traffic Signal Control System**							
SPL A1	Control Traffic Signal - 1	1.00	Ls	3,546,651,052.24	3,546,651,052.24	2,589,055,268.13	531,997,657.84	425,598,126.27
SPL A2	Signal Priority to PUV's	1.00	Ls	71,725,633.69	71,725,633.69	52,359,712.59	10,758,845.05	8,607,076.04
SPL A3	Control for emergency vehicles	1.00	Ls	72,316,101.19	72,316,101.19	52,790,753.87	10,847,415.18	8,677,932.14
	SUB-TOTAL (PART A)				**3,690,692,787.11**	**2,694,205,734.59**	**553,603,918.07**	**442,883,134.45**
B	**Road Traffic Information Provision System**							
SPL B1	Road traffic information	1.00	Ls	215,199,450.08	215,199,450.08	157,095,598.55	32,279,917.51	25,823,934.01
SPL B2	Optimum route information	1.00	Ls	31,567,028.25	31,567,028.25	23,043,930.62	4,735,054.24	3,788,043.39
SPL B3	Information of detour	1.00	Ls	33,324,139.73	33,324,139.73	24,326,622.00	4,998,620.96	3,998,896.77
SPL B4	road traffic informaiton and others	1.00	Ls	33,618,750.00	33,618,750.00	24,541,687.50	5,042,812.50	4,034,250.00
SPL B5	Information on parking availability	1.00	Ls	166,703,971.25	166,703,971.25	121,693,899.01	25,005,595.69	20,004,476.55
SPL B6	Guidance to parking lot	1.00	Ls	100,355,514.00	100,355,514.00	73,259,525.22	15,053,327.10	12,042,661.68
SPL B7	Location information of patrol vehicles	1.00	Ls	36,529,889.25	36,529,889.25	26,666,819.15	5,479,483.39	4,383,586.71
SPL B8	Information on commercial vehicles	1.00	Ls	9,925,711.81	9,925,711.81	7,245,769.62	1,488,856.77	1,191,085.42
SPL B9	Access to the Network Information when Traveling	1.00	Ls	129,970,658.00	129,970,658.00	94,878,580.34	19,495,598.70	15,596,478.96
	SUB-TOTAL (PART B)				**757,195,112.36**	**552,752,432.02**	**113,579,266.85**	**90,863,413.48**
C	**Traffic Safety Assistance System**							
SPL C1	Weather information	1.00	Ls	61,016,042.65	61,016,042.65	44,541,711.13	9,152,406.40	7,321,925.12
SPL C2	unusual weather and disaster	1.00	Ls	28,779,687.50	28,779,687.50	21,009,171.88	4,316,953.13	3,453,562.50
SPL C3	Manage traffic when disaster occurs	1.00	Ls	1,927,576.88	1,927,576.88	1,407,131.12	289,136.53	231,309.23
SPL C4	Enhanced driver support		Ls		-	-	-	-
SPL C5	Vehicle passing in the opposite lane		Ls		-	-	-	-
SPL C6	Guidance to pedestrian to the given destination		Ls		-	-	-	-
SPL C7	Pedestrian of approaching vehicles and others		Ls		-	-	-	-
	SUB-TOTAL (PART C)				**91,723,307.03**	**66,958,014.13**	**13,758,496.05**	**11,006,796.84**
D	**Pablic Utility Vehicle Management System**							
SPL D1	Information on public transport operations		Ls		-	-	-	-
SPL D2	Information on other public transportation service while on board public transportation		Ls		-	-	-	-
SPL D3	Control bus lane dynamically		Ls		-	-	-	-
	SUB-TOTAL (PART D)				-	-	-	-
E	**Automated Toll and Fare Collection System**							
SPL E1	Assist enforcement of colorum vehicles		Ls		-	-	-	-
SPL E2	Assist efficiency of illegal parking	1.00	Ls	33,618,750.00	33,618,750.00	24,541,687.50	5,042,812.50	4,034,250.00
SPL E3	Assist enforcement of overloaded vehicles	1.00	Ls	240,473,867.40	240,473,867.40	175,545,923.20	36,071,080.11	28,856,864.09
SPL E4	Assist enforcement of over-speedvehicles	1.00	Ls	41,808,033.00	41,808,033.00	30,519,864.09	6,271,204.95	5,016,963.96
SPL E5	Improve conduction after road crush procedure		Ls		-	-	-	-
SPL E6	Assist enforcement of signal violation		Ls		-	-	-	-
	SUB-TOTAL (PART E)				**315,900,650.40**	**230,607,474.79**	**47,385,097.56**	**37,908,078.05**
F	**Road Management System**							
SPL F1	Manage traffic when under incidental traffic conditions	1.00	Ls	9,925,701.63	9,925,701.63	7,245,762.19	1,488,855.24	1,191,084.20
SPL F2	Manage information on road maintenance	1.00	Ls	38,319,833.00	38,319,833.00	27,973,478.09	5,747,974.95	4,598,379.96
SPL F3	Assist traffic survey	1.00	Ls	28,525,000.00	28,525,000.00	20,823,250.00	4,278,750.00	3,423,000.00
SPL F4	Collect information on road surface	1.00	Ls	38,319,833.00	38,319,833.00	27,973,478.09	5,747,974.95	4,598,379.96
	SUB-TOTAL (PART F)				**115,090,367.63**	**84,015,968.37**	**17,263,555.14**	**13,810,844.12**
G	**Traffic Enfocement Assistance System**							
SPL G1	Collect tollelectronically		Ls		-	-	-	-
SPL G2	Collect parking charges electronically		Ls		-	-	-	-
SPL G3	Utilized public transportation with cashless payment		Ls		-	-	-	-
	SUB-TOTAL (PART G)				-	-	-	-
	TOTAL				**4,970,602,224.53**	**3,628,539,623.90**	**745,590,333.68**	**596,472,266.94**

TABLE 11.7-5 COST FOR 3RD STAGE OF METRO MANILA ITS

Unit: Php

PAY ITEM NO.	DESCRIPTION	QUANTITY	UNIT	Unit Cost	Civil Work Cost	COST COMPONENT		
						Foreign Currency (FC)	Local Currency (LC)	TAXES
A	**Traffic Signal Control System**							
SPL A1	Control Traffic Signal - 1		Ls		-	-	-	-
SPL A2	Signal Priority to PUV's		Ls		-	-	-	-
SPL A3	Control for emergency vehicles		Ls		-	-	-	-
	SUB-TOTAL (PART A)				-	-	-	-
B	**Road Traffic Information Provision System**							
SPL B1	Road traffic information	1.00	Ls	528,806,666.03	528,806,666.03	386,028,866.20	79,320,999.90	63,456,799.92
SPL B2	Optimum route information		Ls		-	-	-	-
SPL B3	Information of detour		Ls		-	-	-	-
SPL B4	road traffic informaiton and others		Ls		-	-	-	-
SPL B5	Information on parking availability		Ls		-	-	-	-
SPL B6	Guidance to parking lot		Ls		-	-	-	-
SPL B7	Location information of patrol vehicles		Ls		-	-	-	-
SPL B8	Information on commercial vehicles		Ls		-	-	-	-
SPL B9	Access to the Network Information when Traveling		Ls		-	-	-	-
	SUB-TOTAL (PART B)				**528,806,666.03**	**386,028,866.20**	**79,320,999.90**	**63,456,799.92**
C	**Traffic Safety Assistance System**							
SPL C1	Weather information		Ls		-	-	-	-
SPL C2	unusual weather and disaster		Ls		-	-	-	-
SPL C3	Manage traffic when disaster occurs		Ls		-	-	-	-
SPL C4	Enhanced driver support	1.00	Ls	31,006,430.50	31,006,430.50	22,634,694.27	4,650,964.58	3,720,771.66
SPL C5	Vehicle passing in the opposite lane	1.00	Ls	219,947,065.50	219,947,065.50	160,561,357.82	32,992,059.83	26,393,647.86
SPL C6	Guidance to pedestrian to the given destination	1.00	Ls	70,959,645.75	70,959,645.75	51,800,541.40	10,643,946.86	8,515,157.49
SPL C7	Pedestrian of approaching vehicles and others	1.00	Ls	112,832,715.75	112,832,715.75	82,367,882.50	16,924,907.36	13,539,925.89
	SUB-TOTAL (PART C)				**434,745,857.50**	**317,364,475.98**	**65,211,878.63**	**52,169,502.90**
D	**Pablic Utility Vehicle Management System**							
SPL D1	Information on public transport operations		Ls		-	-	-	-
SPL D2	Information on other public transportation service while on board public transportation		Ls		-	-	-	-
SPL D3	Control bus lane dynamically		Ls		-	-	-	-
	SUB-TOTAL (PART D)				-	-	-	-
E	**Automated Toll and Fare Collection System**							
SPL E1	Assist enforcement of colorum vehicles		Ls		-	-	-	-
SPL E2	Assist efficiency of illegal parking		Ls		-	-	-	-
SPL E3	Assist enforcement of overloaded vehicles		Ls		-	-	-	-
SPL E4	Assist enforcement of over-speedvehicles		Ls		-	-	-	-
SPL E5	Improve conduction after road crush procedure		Ls		-	-	-	-
SPL E6	Assist enforcement of signal violation		Ls		-	-	-	-
	SUB-TOTAL (PART E)				-	-	-	-
F	**Road Management System**							
SPL F1	Manage traffic when under incidental traffic conditions		Ls		-	-	-	-
SPL F2	Manage information on road maintenance		Ls		-	-	-	-
SPL F3	Assist traffic survey		Ls		-	-	-	-
SPL F4	Collect information on road surface		Ls		-	-	-	-
	SUB-TOTAL (PART F)				-	-	-	-
G	**Traffic Enfocement Assistance System**							
SPL G1	Collect tollelectronically	1.00	Ls	167,065,953.50	167,065,953.50	121,958,146.06	25,059,893.03	20,047,914.42
SPL G2	Collect parking charges electronically		Ls		-	-	-	-
SPL G3	Utilized public transportation with cashless payment		Ls		-	-	-	-
	SUB-TOTAL (PART G)				**167,065,953.50**	**121,958,146.06**	**25,059,893.03**	**20,047,914.42**
	TOTAL				**1,130,618,477.03**	**825,351,488.23**	**169,592,771.55**	**135,674,217.24**

(1) Spare Equipment List

Exchange Rate : $ 1.0 = Php 40.75

Description	Unit	Unit Rate	Quantity	Spear Cost Php
Centre Equipment				
Application Server	pcs	10,187,500.00	1.00	10,187,500.00
Database Server	pcs	10,187,500.00	1.00	10,187,500.00
Workstation	pcs	256,725.00	1.00	256,725.00
Network Video Recorder	pcs	694,787.50	1.00	694,787.50
Roadside Equipment				
Information Board	pcs	248,126.75	7.00	1,736,887.25
VMS (Lane Guidance)	pcs	2,481,389.75	1.00	2,481,389.75
3D Laser Scanner	pcs	2,977,724.75	1.00	2,977,724.75
CCTV Camera (FIX Type)	pcs	282,886.50	3.00	848,659.50
Image Recognition Processor	pcs	1,091,814.75	3.00	3,275,444.25
Traffic Light Controller	pcs	248,126.75	1.00	248,126.75
Roadside Antena	pcs	1,222,500.00	2.00	2,445,000.00
Antena Controller	pcs	483,702.50	2.00	967,405.00
IC-card R/W	pcs	17,930.00	2.00	35,860.00
Total				**36,343,009.75**

(2) Operation and Maintenance cost and Spare Equipment List for 2nd Stage

1) Operation and Maintenance Cost

Exchange Rate : $ 1.0 = Php 40.75

Description	Unit	Unit Rate Php	Quantity	Total Cost Php/5Years	Annual Cost Php/yr
Spare of the Equipment cost	Lot	78,037,309.50	1.00	78,037,309.50	15,607,461.90
Software License	Php/yr	46,956.00	235.00	11,034,660.00	2,206,932.00
Maintenance for Software(10% of TC)	Php/yr	44,657,061.92	5.00	223,285,309.58	44,657,061.92
Traffic Information Service (Internet connection)	Php/mo	40,750.00	60.00	2,445,000.00	489,000.00
Radio Frequency License	Php/yr	122,250.00	5.00	611,250.00	122,250.00
Telecomunication Charge	Php/yr	285,250.00	5.00	1,426,250.00	285,250.00
Electricity	Kwh	10.00	7,200,000.00	72,000,000.00	14,400,000.00
Staff Cost	each/mo	45,000.00	3,600.00	162,000,000.00	32,400,000.00
Running Cost for Office	m2	100.00	60,000.00	6,000,000.00	1,200,000.00
O&M Management (5% of above cost)	Ls	27,841,988.95	1.00	27,841,988.95	5,568,397.79
				584,681,768.03	**116,936,353.61**

2) Spare Equipment List

Exchange Rate : $ 1.0 = Php 40.75

Description	Unit	Unit Rate	Quantity	Spear Cost Php
Centre Equipment				
Application Server	pcs	10,187,500.00	1.00	10,187,500.00
Database Server	pcs	10,187,500.00	1.00	10,187,500.00
Workstation	pcs	256,725.00	1.00	256,725.00
Network Video Recorder	pcs	694,787.50	1.00	694,787.50
LCD Monitor	pcs	94,458.50	1.00	94,458.50
Roadside Equipment				
Image Recognition Processor	pcs	1,091,814.75	10.00	10,918,147.50
Traffic Signal	pcs	387,125.00	12.00	4,645,500.00
Traffic Light Controller	pcs	248,126.75	9.00	2,233,140.75
Pedestrian Signal	pcs	198,534.00	24.00	4,764,816.00
Countdown Timer	pcs	277,915.00	12.00	3,334,980.00
CCTV Camera (PTZ Type)	pcs	282,886.50	4.00	1,131,546.00
RFID Reader (with Gantry)	pcs	17,930.00	24.00	430,320.00
VMS (with Gantry)	pcs	7,444,291.50	1.00	7,444,291.50
CCTV Camera (FIX Type)	pcs	282,886.50	1.00	282,886.50
VMS (Parking)	pcs	2,481,430.50	2.00	4,962,861.00
Control Panel	pcs	407,500.00	2.00	815,000.00
Base Station	pcs	611,250.00	4.00	2,445,000.00
CCTV (ANPR)	pcs	282,886.50	1.00	282,886.50
LED Light	pcs	124,083.75	1.00	124,083.75
Weight-in-Motion	pcs	1,630,000.00	1.00	1,630,000.00
Tablet PC	pcs	3,123,487.50	1.00	3,123,487.50
CCTV (PTZ Type)	pcs	282,886.50	1.00	282,886.50
Axle load sensor	pcs	7,444,291.50	1.00	7,444,291.50
Handheld Tablet PC	pcs	24,816.75	6.00	148,900.50
Over-Speed Sensor	pcs	24,816.75	6.00	148,900.50
RFID Tag	pcs	611.25	30.00	18,337.50
OBU	pcs	4,075.00	1.00	4,075.00
Total				**78,037,309.50**

(3) Operation and Maintenance cost and Spare Equipment List for 3rd Stage

1) Operation and Maintenance Cost

Exchange Rate : $ 1.0 = Php 40.75

Description	Unit	Unit Rate Php	Quantity	Total Cost Php/11Years	Annual Cost Php/yr
Spare of the Equipment cost	Lot	144,815,760.75	1.00	144,815,760.75	13,165,069.16
Software License	Php/yr	46,956.00	517.00	24,276,252.00	2,206,932.00
Maintenance for Software(10% of TC)	Php/yr	48,048,646.11	11.00	528,535,107.21	48,048,646.11
Traffic Information Service (Internet connection)	Php/mo	40,750.00	132.00	5,379,000.00	489,000.00
Radio Frequency License	Php/yr	122,250.00	11.00	1,344,750.00	122,250.00
Telecomunication Charge	Php/yr	285,250.00	11.00	3,137,750.00	285,250.00
Electricity	Kwh	10.00	17,424,000.00	174,240,000.00	15,840,000.00
Staff Cost	each/mo	50,000.00	7,920.00	396,000,000.00	36,000,000.00
Running Cost for Office	m2	100.00	132,000.00	13,200,000.00	1,200,000.00
O&M Management (5% of above cost)	Ls	64,546,431.00	1.00	64,546,431.00	5,867,857.36
				1,355,475,050.96	**123,225,004.63**

2) Spare Equipment List

Exchange Rate : $ 1.0 = Php 40.75

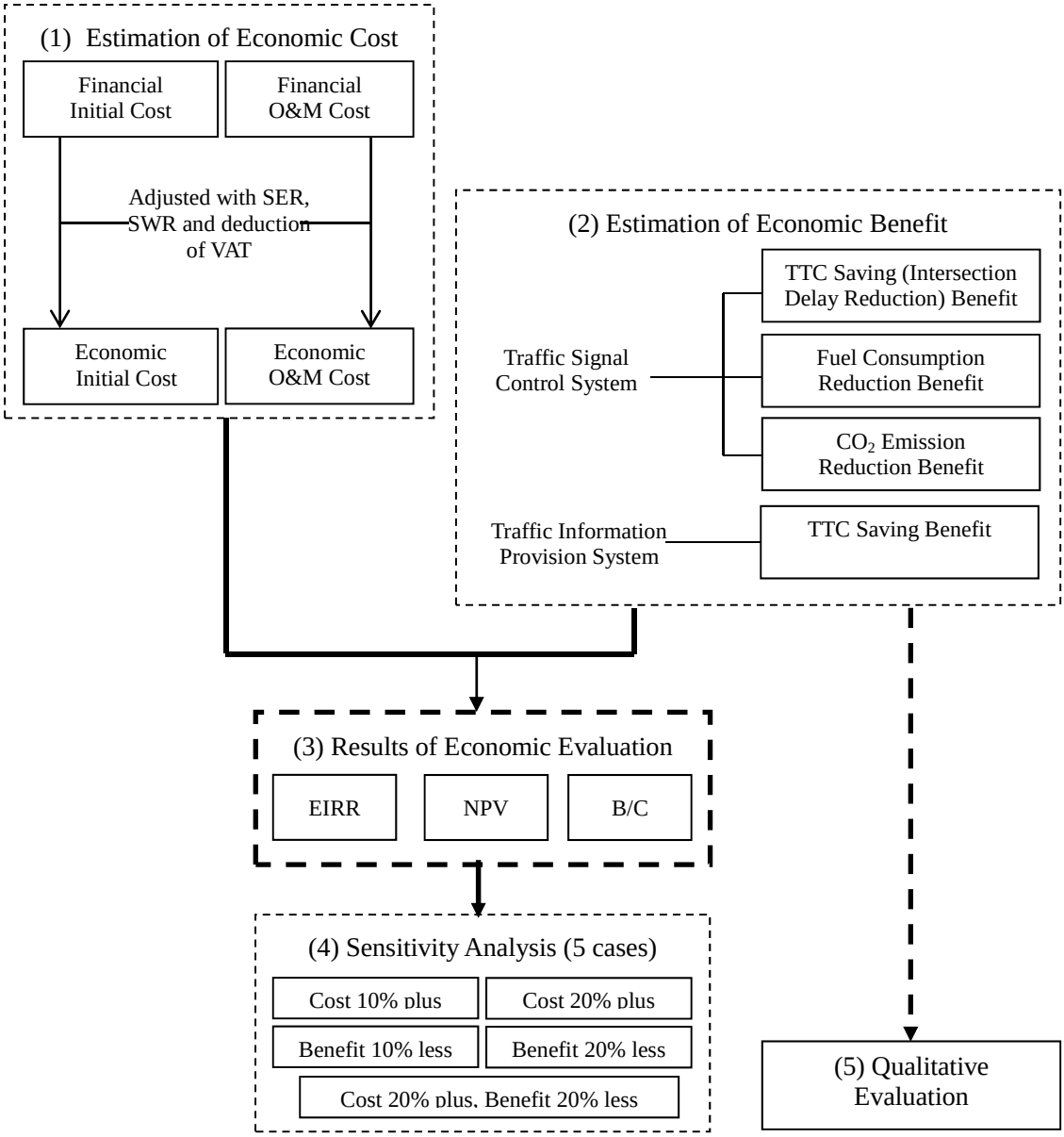
Description	Unit	Unit Rate	Quantity	Spear Cost Php
Centre Equipment				
Application Server	pcs	10,187,500.00	3.00	30,562,500.00
Database Server	pcs	10,187,500.00	3.00	30,562,500.00
Roadside Equipment				
Image Recognition Processor	pcs	372,210.50	39.00	14,516,209.50
Traffic Signal	pcs	387,125.00	36.00	13,936,500.00
Traffic Light Controller	pcs	248,167.50	9.00	2,233,507.50
Pedestrian Signal	pcs	198,534.00	72.00	14,294,448.00
Countdown Timer	pcs	277,915.00	36.00	10,004,940.00
CCTV Camera (PTZ Type)	pcs	282,886.50	9.00	2,545,978.50
VMS (Warning)	pcs	6,947,997.25	3.00	20,843,991.75
CCTV (FIX Type)	pcs	282,886.50	3.00	848,659.50
Infrared Sensor	pcs	1,488,842.00	3.00	4,466,526.00
Total				**144,815,760.75**

11.8 ECONOMIC EVALUATION OF MASTER PLAN

11.8.1 Methodology

(1) Framework and Workflow of Economic Evaluation

The framework and workflow of economic evaluation on the Metro Manila Master Plan are reflected in the following flow chart.



Source: JICA Study Team

FIGURE 11.8-1 FRAMEWORK AND WORKFLOW OF ECONOMIC EVALUATION OF METRO MANILA MASTER PLAN

(2) Basic Concepts and Assumptions

1) Approach of Economic Evaluation by ITS Development Area

The purpose of economic evaluation in this study is to determine whether or not the proposed master plans or pilot projects are economically viable, but the approach adopted here is not strictly confined to quantitative method owing to the difficulty to quantify the benefit with regard to certain areas of ITS system introduction such as traffic safety assistance, PUV management, traffic enforcement and road management. For investment in these areas, the economic viability will have to be judged through an approach of qualitative evaluation.

Nevertheless, with respect to development in the areas of traffic signal control and traffic information provision in the Metro Manila Master Plan, the approach of quantitative evaluation is applicable. Also, the cost items of all the ITS development areas are relevant to the approach of quantitative evaluation. The following table shows the application of approach by ITS development area.

TABLE 11.8-1 APPROACH OF ECONOMIC EVALUATION OF METRO MANILA MASTER PLAN

ITS Development Area	Cost Evaluated Quantitatively	Benefit Evaluated Quantitatively	Benefit Evaluated Qualitatively
1) Traffic Signal Control	●	●	●
2) Traffic Information Provision	●	●	●
3) Traffic Safety Assistance	●		●
4) PUV Management	●		●
5) Traffic Enforcement	●		●
6) Road Management	●		●
7) Toll/Fare Collection	●		●

Source: JICA Study Team

Areas for Economic Evaluation

2) Application of Shadow Prices in the Context of the Philippines

Shadow price as a more popular term for economic price is applied to the economic evaluation of a project, which includes specifically two rates known as Shadow Exchange Rate (SER) and Shadow Wage Rate (SWR). In the Philippines, the values of these two shadow prices used in this study are illustrated in the following table. In addition, VAT (12%) needs to be deducted from all the cost items in the case of economic evaluation as this portion is counted as the revenue of the national economy.

TABLE 11.8-2 VALUES OF SHADOW PRICES AND THEIR APPLICABILITY TO THE MASTER PLANS

Name	Value	Applicability to This Study
SER	20% above official FOREX rate	● The exchange rate to convert the financial cost of equipment of foreign currency portion into that of economic price
SWR	60% of current wage rate	● The rate to convert the cost value of unskilled labor among financial cost of the master plans into that of economic price

Source: "ICC Project Evaluation Procedures and Guidelines" (NEDA)

3) Indicators of Economic Evaluation

As a common practice in infrastructure projects, the following three indicators are adopted to evaluate the economic viability of the Metro Manila Master Plan.

- Net Present Value (NPV)

  NPV is used as an indicator to forecast the future cash flow of a project whereby to judge the viability of investment on this project, which is estimated by subtracting the present value of cost from that of the benefit of a project as shown by the formula below, with the result of 0 and above, i.e. NPV≧0 being regarded acceptable.

$$NPV = \sum_{n=0}^{n} \left\{ \frac{B_n}{(1+r)^n} \right\} - \sum_{n=0}^{n} \left\{ \frac{C_n}{(1+r)^n} \right\}$$

(Where, n=number of year, B_n=benefit in n year, C_n=cost in n year, r=discount rate)

- Economic Internal Rate of Return (EIRR)

  IRR is the discount rate when the value of NPV becomes 0. In the case of EIRR, it is required to surpass the value of Social Discount Rate (SDR) of a country where the proposed project is to be implemented. Accordingly, the value of EIRR for the master plan is required to exceed the value of 15%, i.e. EIRR≧15%.

- Benefit-cost Ratio (B/C)

  B/C is another indicator to judge the viability of investment on a project, which is considered acceptable when the value of B/C is 1 and above, i.e. B/C≧1.

$$B/C = \sum^{n} \left\{ \frac{B_n}{(1+r)^n} \right\} / \sum_{n=0}^{n} \left\{ \frac{C_n}{(1+r)^n} \right\}$$

4) Other Basic Assumptions

- Social Discount Rate (SDR)

  SDR, reflecting the true opportunity cost of capital, estimated to be 15% in the Philippines by NEDA[2], is adopted as the discount rate to calculate the present value of cost and benefit, and is regarded the hurdle rate for the EIRR to be acceptable.

- Period Subject Evaluation

  The period subject to evaluation is assumed to be from the year of 2013 to 2030, spanning the following three stages:

  1st Stage: 2013-2014
  2nd Stage: 2015-2019
  3rd Stage: 2020-2030

[2] "ICC Project Evaluation Procedures and Guidelines" (NEDA)

11.8.2 Economic Cost of Metro Manila Master Plan

(1) Initial Cost

1) Financial Cost

The initial cost of the Metro Manila Master Plan consists of costs of the following 7 categories of ITS system. In addition, a physical contingency cost which is assumed to be 5% of the total of base cost is also included.

- Traffic Signal Control System
- Traffic Information Provision System
- Traffic Safety System
- PUV Management System
- Public Enforcement Assistance System
- Road Management System
- Toll/Fare Collection System

Based on the implementation schedule of the master plan, the initial cost items entailed by ITS development in respective areas can be listed with the breakdown of foreign currency portion and local currency portion as well as their disbursement at respective stages as indicated in **Table 11.8-3**. As all the values of these cost items are quoted in market price, they are regarded financial costs.

TABLE 11.8-3 FINANCIAL COST OF INITIAL INVESTMENT (UNIT: PHP 1,000)

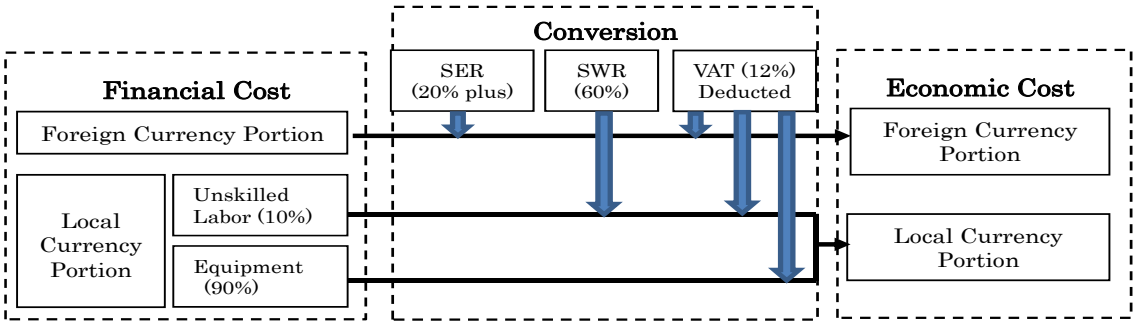
No.	Category of ITS System	1st Stage (2013-2014)				2nd Stage (2015-2019)				3rd Stage (2020-2030)			
		Total	Foreign Currency	Local Currency	Taxes	Total	Foreign Currency	Local Currency	Taxes	Total	Foreign Currency	Local Currency	Taxes
1	Traffic Signal Control	709,845	518,187	106,477	85,181	3,690,693	2,694,206	553,604	442,883	0	0	0	0
2	Traffic Information Provision	0	0	0	0	757,195	552,752	113,579	90,863	528,807	386,029	79,321	63,457
3	Traffic Safety Assistance	0	0	0	0	91,723	66,958	13,758	11,007	434,746	317,365	65,212	52,170
4	PUV Management	451,302	329,450	67,695	54,156	0	0	0	0	0	0	0	0
5	Traffic Enforcement Assistance	317,091	231,476	47,564	38,051	315,901	230,608	47,385	37,908	0	0	0	0
6	Road Management	0	0	0	0	115,090	84,016	17,264	13,811	0	0	0	0
7	Toll/Fare Collection	404,463	295,258	60,669	48,536	0	0	0	0	167,066	121,958	25,060	20,048
8	**Base Cost (Item 1 ~7)**	**1,882,701**	**1,374,372**	**282,405**	**225,924**	**4,970,602**	**3,628,539**	**745,590**	**596,472**	**1,130,619**	**825,352**	**169,593**	**135,674**
9	Physical Contingency (5% of Item 8)	94,135	68,719	14,120	11,296	248,530	181,427	37,280	29,824	56,531	41,268	8,480	6,784
Total (Item 8 + 9)		**1,976,836**	**1,443,090**	**296,525**	**237,220**	**5,219,132**	**3,809,966**	**782,870**	**626,296**	**1,187,150**	**866,619**	**178,072**	**142,458**

Source: JICA Study Team

2) Conversion to Economic Cost

The above-mentioned values of financial cost need to be converted into that of the economic cost when conducting the economic evaluation, and the way of conversion from financial cost to economic cost is described below and illustrated by the following chart.

- The Shadow Exchange Rate (SER) which is 20% higher than the official rate is used to convert the items of foreign currency portion from dollar into Peso.
- The Shadow Wage Rate (SWR) which is 60% of current wage rate is used to convert the unskilled worker cost (10% of the local currency portion) into economic price.
- The value of VAT (12%) is deducted from all the cost items.



Source: JICA Study Team

FIGURE 11.8-2 PROCESS OF CONVERTING THE INITIAL COST FROM FINANCIAL TO ECONOMIC VALUE

The results of the above-mentioned process of conversion from financial cost to economic cost are indicated in the table below.

TABLE 11.8-4 ECONOMIC COST OF INITIAL INVESTMENT (UNIT: PHP 1,000)

No.	Category of ITS System	1st Stage (2013-2014)			2nd Stage (2015-2019)			3rd Stage (2020-2030)		
		Total	Foreign Currency	Local Currency	Total	Foreign Currency	Local Currency	Total	Foreign Currency	Local Currency
1	Traffic Signal Control	685,710	621,824	63,886	3,565,209	3,233,047	332,162	0	0	0
2	Traffic Information Provision	0	0	0	731,450	663,303	68,148	510,828	463,235	47,593
3	Traffic Safety Assistance	0	0	0	88,604	80,349	8,255	419,965	380,837	39,127
4	PUV Management	435,958	395,341	40,617	0	0	0	0	0	0
5	Traffic Enforcement Assistance	306,310	277,772	28,538	305,160	276,729	28,431	0	0	0
6	Road Management	0	0	0	111,177	100,819	10,358	0	0	0
7	Toll/Fare Collection	390,711	354,310	36,402	0	0	0	161,386	146,350	15,036
8	**Base Cost (Item 1 ~7)**	**1,818,689**	**1,649,246**	**169,443**	**4,801,602**	**4,354,247**	**447,354**	**1,092,178**	**990,422**	**101,756**
9	Physical Contingency (5% of Item 8)	90,934	82,462	8,472	240,080	217,712	22,368	54,609	49,521	5,088
Total (Item 8 + 9)		**1,909,624**	**1,731,708**	**177,915**	**5,041,682**	**4,571,960**	**469,722**	**1,146,787**	**1,039,943**	**106,843**

Source: JICA Study Team

The implementation schedule of the master plan with values of annual disbursement of the initial cost is displayed in the following table. It is needed to point out that, in addition to the above-mentioned initial cost, the cost of upgrading for all the 7 ITS systems are also taken into account here, which are assumed to take place 10 years after the initial installation of the respective systems.

TABLE 11.8-5 IMPLEMENTATION SCHEDULE AND INITIAL COST OF METRO MANILA MASTER PLAN (ECONOMIC COST)

No.	Category of ITS System	Eco. Cost (Php.million)	1st Stage (2013-2014)		2nd Stage (2015-2019)					3nd Stage (2020-2030)										
			2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1	Traffic Signal Control	4,463	360	360	749	749	749	749	749											
	Traffic Signal Control (upgrading)	4,463											360	360	749	749	749	749	749	
2	Traffic Information Provision	1,304			154	154	154	154	154	49	49	49	49	49	49	49	49	49	49	49
	Traffic Information Provision (upgrading)	817													154	154	154	154	154	49
3	Traffic Safety Assistance	534			19	19	19	19	19	40	40	40	40	40	40	40	40	40	40	40
	Traffic Safety Assistance (upgrading)	145													19	19	19	19	19	40
4	PUV Management	458	229	229																
	PUV Management (upgrading)	458											229	229						
5	Traffic Enforcement Assistance	642	161	161	64	64	64	64	64											
	Traffic Enforcement Assistance (upgrading)	642											161	161	64	64	64	64	64	
6	Road Management	117			23	23	23	23	23											
	Road Management (upgrading)	117													23	23	23	23	23	
7	Toll/Fare Collection	580	205	205						15	15	15	15	15	15	15	15	15	15	15
	Toll/Fare Collection (upgrading)	426											205	205						15
Total		**15,166**	**955**	**955**	**1,009**	**1,009**	**1,009**	**1,009**	**1,009**	**104**	**104**	**104**	**1,059**	**1,059**	**1,113**	**1,113**	**1,113**	**1,113**	**1,113**	**208**

Source: JICA Study Team

(2) Operation and Maintenance (O&M) Cost

1) Financial Cost

The O&M cost of the Metro Manila Master Plan includes the following categories:

- Spare of Equipment
- Software License
- Maintenance for Software
- Traffic Information Service (Internet Connection)
- Radio Frequency License
- Telecommunication Charge
- Electricity
- Staff Cost
- Running Cost for Office Operation
- O&M Management (5% of the above cost)
- Physical Contingency (5% of the above cost)

Among them, the category of Spare of Equipment is assumed to be relevant to the foreign currency portion, while the eight categories covering those from Software License to Running Cost for Office Operation are of the local currency portion. The values of financial cost are indicated in **Table 11.8-7**.

2) Conversion to Economic Cost

To convert the values of financial cost of O&M into economic cost, the shadow prices of SER and SWR are respectively applied to the items of Spare of Equipment and Staff Cost, while VAT (12%) is deducted from all the items. The specific way of conversion for respective items is illustrated in the following table.

TABLE 11.8-6 THE WAY OF PRICE ADJUSTMENT APPLIED TO RESPECTIVE O&M COST ITEMS

O&M Cost Item	SER (20% plus)	SWR (60%)	VAT (12%) Deducted
1.Spare of Equipment	●		●
2.Software License			●
3.Maintenance for Software			●
4.Traffic Information Service			●
5.Radio Frequency License			●
6.Telecommunication Charge			●
7.Electricity			●
8.Staff Cost		●	●
9.Running Cost for Office Operation			●

Source: JICA Study Team

The economic values for respective O&M cost items are figured out through the above process

of adjustment. The values of O&M cost to be paid out in the 1st stage, 2nd stage and 3rd stage in terms of both financial cost and economic cost are as follows.

TABLE 11.8-7 FINANCIAL COST AND ECONOMIC COST OF O&M
(UNIT: PHP. 1,000)

Categories	Financial Cost of O&M			Economic Cost of O&M		
	1st Stage (2013-2014)	2nd Stage (2015-2019)	3rd Stage (2020-2030)	1nd Stage (2013-2014)	2rd Stage (2015-2019)	3th Stage (2020-2030)
1. Spare of the Equipment cost	36,343	78,037	144,816	38,378	82,407	152,926
2. Software License	4,414	11,035	24,276	3,884	9,711	21,363
3. Maintenance for Software(10% of TC)	44,950	223,285	528,535	39,556	196,491	465,111
4. Traffic Information Service (Internet connection)	978	2,445	5,379	861	2,152	4,734
5. Radio Frequency License	245	611	1,345	216	538	1,184
6. Telecommunication Charge	571	1,426	3,138	502	1,255	2,761
7. Electricity	21,600	72,000	174,240	19,008	63,360	153,331
8. Staff Cost	57,600	162,000	396,000	30,413	85,536	209,088
9. Running Cost for Office Operation	2,400	6,000	13,200	2,112	5,280	11,616
10. O&M Management (5% of above cost)	8,455	27,842	64,546	6,747	22,336	51,106
11. Physical Contingency (5% of above cost)	8,878	29,234	67,774	7,084	23,453	53,661
Total	**186,434**	**613,915**	**1,423,249**	**148,760**	**492,519**	**1,126,880**

Source: JICA Study Team

11.8.3 Quantifiable Economic Benefit of Metro Manila Master Plan

As previously indicated, the benefit brought forth by the introduction of ITS systems contains the quantifiable part as well as the unquantifiable part. This section is devoted to the evaluation of the quantifiable part consisting of the following 2 kinds of benefits:

- Traffic Signal Control Improvement Benefit
- Traffic Information Provision Benefit

(1) Traffic Signal Control Improvement Benefit

To be more specific, the introduction of traffic signal control system is expected to generate the following 3 items of benefits, i.e. travel time cost (TTC) saving benefit (through signalized intersection delay reduction), fuel consumption reduction benefit, and CO_2 emission reduction benefit.

1) TTC Saving Benefit

Traffic signal can be improved by readjusting the allocation of green interval and reducing the cycle length of traffic signal. This will reduce the delay time of a vehicle passing an intersection. Therefore, the installation of traffic signal control system to be conducted in the Metro Manila Master Plan is expected to generate benefit which can be quantified through the process described as follows.

- Estimation of Average Delay Reduction through Traffic Signal Control Improvement
  Based on a traffic survey conducted at selected intersections within Metro Manila Region by the Study Team, the average time delay reduction at an intersection in Metro Manila Region achieved by readjusting the allocation of green interval and reducing the cycle length of traffic signal is estimated to be 11,457 hours/year, taking into account the average traffic volume. The way of estimation is indicated in the table below.

TABLE 11.8-8 AVERAGE DELAY REDUCTION THROUGH SIGNAL CONTROL IMPROVEMENT

Item	Number of Intersection	Delay Reduction by Green Interval Readjustment (hours/year)	Delay Reduction by Cycle Length Reduction (hours/year)	Total of Time Saving at Intersection (hours/year)
Result of Traffic Survey	85	59,689	914,150	973,839
Estimation Based on the Above	1	702	10,755	11,457

Source: JICA Study Team

- Estimation of Average Delay Reduction Benefit of Signal Control Improvement in Terms of Money

The average delay reduction benefit of signal control in terms of money, i.e. the TTC saving benefit, can be worked out using the above result and the value of unit TTC estimated to be 7.8 peso/minute/PCU by the JICA Study Team in a similar project[3]. The result is 5,362,000 peso/year at an average intersection as indicated in the table below.

TABLE 11.8-9 AVERAGE DELAY REDUCTION BENEFIT OF SIGNAL CONTROL IN TERMS OF MONEY

Item	Number of Intersection	TTC Saving Benefit by Green Interval Readjustment (1,000 peso/year)	TTC Saving Benefit by Cycle Length Reduction (1,000 peso/year)	TTC Saving Benefit at Average Intersection (1,000 peso/year)
Result of Traffic Survey	85	27,935	427,821	455,756
Estimation Based on the Above	1	329	5,033	5,362

Source: JICA Study Team

- Implementation Schedule of Traffic Signal Control System Installation and Annual TTC Saving Benefit taking into Account Traffic Volume Increase

[3] "Final Report of Preparatory Survey for Expressway Projects in Mega Manila Region" (Nov. 2012)

a) Implementation Schedule of Traffic Signal Control System Installation

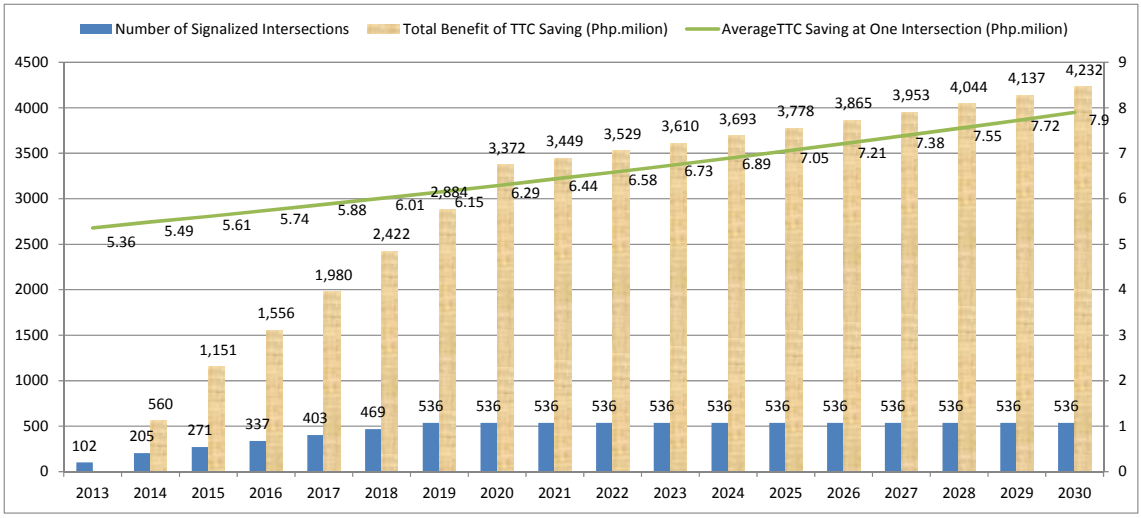
It is expected that under the Metro Manila Master Plan, 205 intersections within the Metro Manila Region will be signalized in the 1st stage (2013-2014), which is to be followed by the installation of traffic signal control systems in the other 331 intersections during the 2nd stage (2015-2019).

b) Estimation of Future Trend Traffic Volume Increase

According to a previous study by a JICA study team[4], the vehicle trips in Metro Manila in the year 2030 is expected to increase by a factor of 1.62 compared to that of 2009. Based on this, the annual growth rate of traffic volume in this region is estimated to be 2.3% during the same period.

c) Generation of Annual Benefit of TTC Saving

Based on the above preconditions, the annual benefit of TTC saving throughout the project period can be expected to be generated in a way illustrated in the following diagram.



Source: JICA Study Team

FIGURE 11.8-3 CHANGE OF NUMBER OF SIGNALIZED INTERSECTIONS AND ANNUAL BENEFIT OF TTC SAVING (METRO MANILA MASTER PLAN)

With the average annual benefit of TTC saving at an intersection expected to increase from Php.5.36 million in 2013 to Php.7.9 million in 2030, the total annual TTC saving benefit is estimated to grow from Php.560 million in 2014 to Php.4,232 million in 2030. It is worth noting that, as the installation of a new traffic signal system usually requires a period of test operation to allow for trial and error, a time-lag of one year between the installation of the system and the generation of benefit is assumed to appear.

[4] "The Study of Master Plan on High Network Development in the Republic of the Philippines" by CTI Engineering International CO. LTD (July, 2010)

2) Fuel Consumption Reduction Benefit

The fuel consumption reduction benefit also stems from the delay reduction through introduction of traffic signal control system, which reduces vehicles' idling time whereby saving their fuel consumption. The following passages explain how the benefit of fuel consumption reduction generated through idling time saving is estimated

- Estimation of Traffic Volume Composition by Vehicle Type

The average composition of traffic volume by vehicle type at intersections is estimated through traffic survey conducted by the Study Team, with the results indicated below.

TABLE 11.8-10 AVERAGE TRAFFIC VOLUME COMPOSITION BY VEHICLE TYPE

Vehicle Type	Passenger Car	Jeepney	Large Bus & Truck	Total
Share (%)	82.56	8.86	8.58	100.00

Source: JICA Study Team

- Assumption of Conversion Factor for Idling Time Fuel Consumption Calculation

As there are no existing data relevant to conversion factor of idling time fuel consumption in the Philippines, the values used in this study as indicated below are assumed with reference to the data issued by Japan's Ministry of the Environment.

TABLE 11.8-11 CONVERSION FACTORS OF IDLING TIME FUEL CONSUMPTION BY VEHICLE TYPE

Vehicle Type	Fuel consumption in 10 minutes of idling time (liter)	Fuel consumption in 60 minutes of idling time (liter)
Passenger Car (Gasoline)	0.14	0.84
Jeepney (Diesel)	0.15	0.90
Large Bus & Truck (Diesel)	0.26	1.56

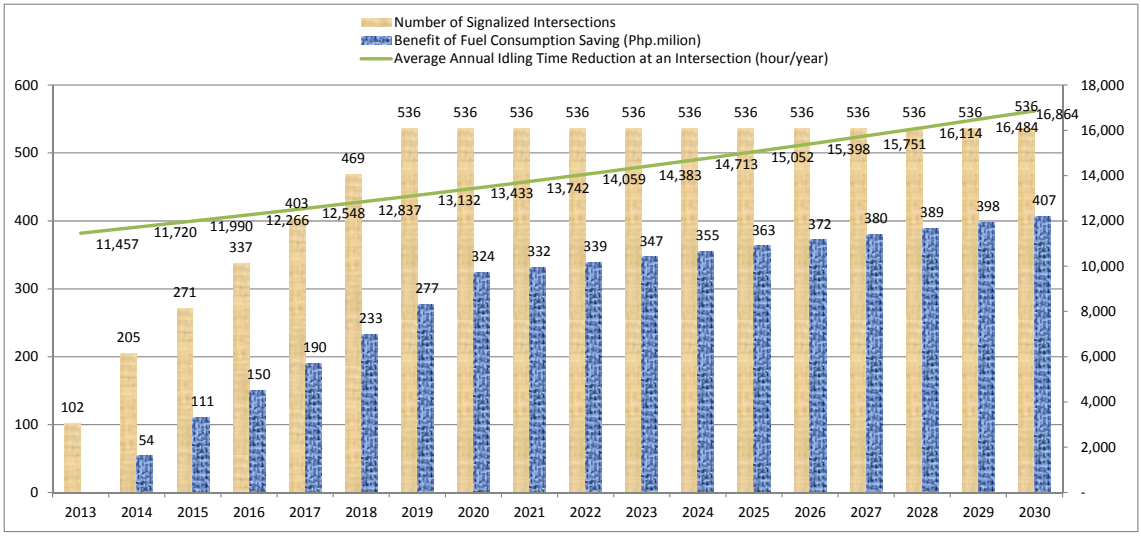
Note: In the case of jeepney, fuel consumption in idling time is assumed to be the same as that of medium-sized truck.

Source: JICA Study Team (With reference to the data of Japan's Ministry of the Environment)

- Calculation of Benefit Generated Annually by Reducing Vehicle Idling Time Fuel Consumption

Based on the above results of estimation and assumption together with the values of average fuel prices as of February 27 (Gasoline 52.184peso/liter, Diesel 41.462peso/liter), taking into account also the annual growth rate of traffic volume (2.3%), the benefit generated annually by reducing fuel consumption during idling time through traffic signal control improvement can be calculated as shown by the following diagram.

With the average annual idling time reduction at an intersection growing from 11,457 hours in 2013 to 16,864 hours in 2030, the benefit of fuel consumption reduction is expected to increase from Php.54 million in 2014 to Php.407 million in 2030.



Source: JICA Study Team

FIGURE 11.8-4 CHANGE OF NUMBER OF SIGNALIZED INTERSECTIONS AND ANNUAL BENEFIT FROM THE SAVING OF FUEL CONSUMPTION DURING IDLING TIME (METRO MANILA MASTER PLAN)

3) CO_2 Emission Reduction Benefit

The reduction of vehicles' idling time by introducing the traffic signal control system not only results in the saving of fuel consumption, but also yields the benefit of CO_2 emission reduction. This benefit is estimated through the following process.

- Estimation of Traffic Volume Composition by Vehicle Type

The data of average traffic volume composition by vehicle type at intersections indicated in **Table 11.8-10** is applicable here.

- Assumption of Conversion Factor for Idling Time CO_2 Emission Calculation

TABLE 11.8-12 CONVERSION FACTORS OF IDLING TIME CO_2 EMISSION BY VEHICLE TYPE

Vehicle Type	CO2 Emission in 10 minutes of idling time (g)	CO2 Emission in 60 minutes of idling time (g)
Passenger Car (Gasoline)	90	540
Jeepney (Diesel)	107	642
Large Bus & Truck (Diesel)	190	1,140

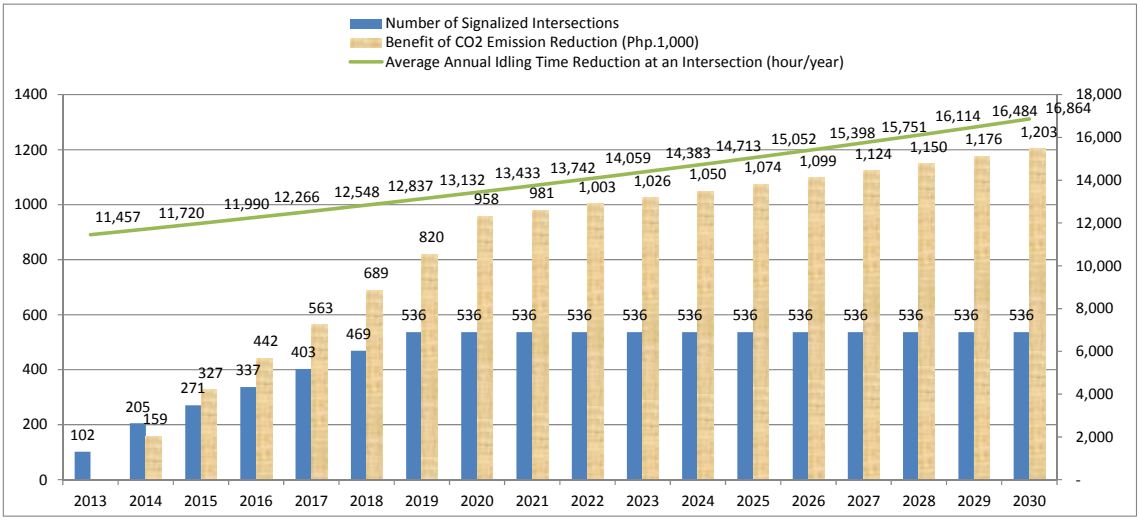
Source: JICA Study Team (With reference to the data of Japan's Ministry of the Environment)

For the same reason as what has been previously explained regarding the conversion factors for idling time fuel consumption, the values used in the calculation here as indicated above are assumed with reference to the data issued by Japan's Ministry of the Environment.

- Calculation of Benefit Generated Annually by Reducing Vehicle Idling Time CO_2 Emission

In addition to the above estimation and assumption, the price of CO_2 is also needed for the calculation here. In this study, the unit price of CO_2 is assumed to be 4.18 euro/t, which is the price issued in the Website "Point Carbon" as of March 23, 2013. Using the exchange rate of Euro for Peso on the same date (Euro 1 = Php. 53.03), the benefit of CO_2 emission reduction throughout the project period can be worked out as shown by the following diagram.

The total benefit of CO_2 reduction is expected to increase from Php.159,000 in 2014 to Php.1,203,000 in 2030. It is worthy of mentioning that owing to the slumping international carbon emission trading market, the price of CO_2 emission reduction has sharply declined from its peak in 2008 when the price of EUA nearly reached 30 euro/t[5]. As a result, the CO_2 emission reduction benefit in terms of money for this project looks negligibly small.



Source: JICA Study Team

FIGURE 11.8-5 CHANGE OF NUMBER OF SIGNALIZED INTERSECTIONS AND ANNUAL BENEFIT FROM CO_2 EMISSION REDUCTION (METRO MANILA MASTER PLAN)

(2) Traffic Information Provision Benefit

As the benefit accruing from the provision of traffic information is reflected in the reduction of TTC, the passage below is focused on evaluation of TTC saving benefit.

[5] The price of EUA (European Union Allowances, defined as one EU Allowance Unit of one ton of CO_2) was 29.38 euro/t as of July 1, 2008.

1) TTC Saving Benefit

The TTC saving benefit yielded from the introduction of traffic information provision system can be estimated by referring to the existing impact evaluation examples including that of introduction of VICS (Vehicle Information and Communication System) in Japan. According to the example in Japan, the average ratio of travel time reduction is estimated to be 4% of total travel time. With reference to this example, the traffic information provision benefit of the Metro Manila Master Plan is estimated in the way described below.

- Estimation of Vehicle Traveling Time Saved Annually by Introducing the Traffic Information Provision System

According to the traffic survey conducted by the JICA Study Team, the total vehicle traveling hours in an average weekday for the Metro Manila Region is 1,102,646 vehicle hours/day, while the morning peak time is assumed to be the time frame when the system functions adequately and the vehicle hours within this time frame is estimated to account for 28% of that of the whole day (Morning Peak Ratio). In addition, assuming the weekdays in a year to be 250 days and taking this together with the values mentioned above into consideration, the vehicle traveling hours saved annually by introducing the traffic information provision system can be figured out with the formula below:

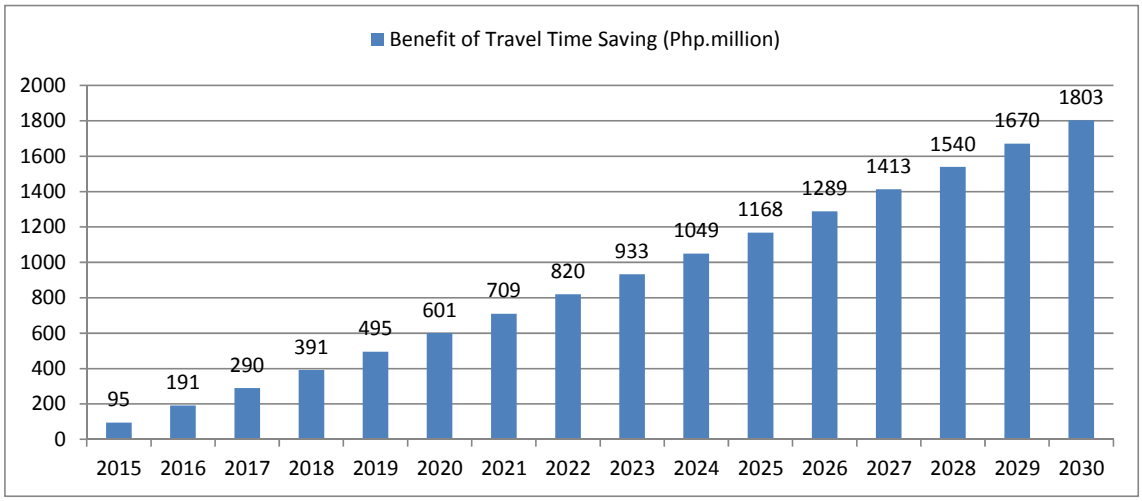
Annual saving of vehicle traveling hours = 1,102,646 * 28% * 250 days * 4% = 3.1 million hours/year

- Estimation of Annual Vehicle Traveling Time Saving Benefit in Terms of Money

Based on the above result, annual vehicle traveling time saving benefit accruing from the provision of traffic information in terms of money is estimated to be 1,445 million peso/year by using the afore-mentioned TTC value (7.8 peso/minute/PCU).

But, the following two factors needs to be considered: Firstly, as the above value of benefit is assumed not to be fully realized until the year of 2030 when the investment on this system is expected to complete, an incremental generation of benefit year by year is assumed to happen and continue throughout the project period. Secondly, in light of the annual growth rate of traffic volume (2.3%) as previously mentioned, the value of this benefit in 2030 is expected to increase to 1,803 million peso/year.

Thus, the annual TTC saving benefit yielded from the introduction of traffic information provision system can be worked out and illustrated by the following diagram.



Source: JICA Study Team

FIGURE 11.8-6 ANNUAL TTC SAVING BENEFIT ACCRUING FROM THE INTRODUCTION OF TRAFFIC INFORMATION PROVISION SYSTEM (METRO MANILA MASTER PLAN)

11.8.4 Results of Economic Evaluation

Based on the values of all the cost items and quantifiable benefit items, major results of economic evaluation of the Metro Manila Master Plan are figured out as follows.

TABLE 11.8-13 MAJOR RESULTS OF ECONOMIC EVALUATION OF THE METRO MANILA MASTER PLAN

EIRR (%)	NPV (Php.million)	B/C
59.0	10,377	2.8

Source: JICA Study Team

The calculation table with values of cost-benefit stream is presented below. Needless to say that, as the benefit items taken into account are confined only to the quantifiable items, the actual performance of the Metro Manila Master Plan should be much better than the values indicated in the above table when the impacts of those unquantifiable benefit items are also considered. Therefore, it can be concluded that the economic performance of this project is expected to be exceptionally good in that, even when the unquantifiable benefit items are not included, the EIRR value is till well over the SDR value (15%).

TABLE 11.8-14 COST-BENEFIT STREAM (METRO MANILA MASTER PLAN) (UNIT: PHP. MILLION)

Year	Cost									Benefit					Net Economic Benefit
	Initial Cost							O&M Cost	Total Cost	Traffic Signal Control			Traffic Information Provision (TTC Saving)	Total Benefit	
	Traffic Signal Control	Traffic Information Provision	Traffic Safety Assistance	PUV Management	Traffic Enforcement Assistance	Road Management	Toll/Fare Collection			TTC Saving	Fuel Consumption Reduction	CO_2 Emission Reduction			
2013	360	0	0	229	161	0	205	74	1029	0	0	0	0	0	(1029)
14	360	0	0	229	161	0	205	74	1029	560	54	0	0	614	(415)
15	749	154	19	0	64	23	0	99	1108	1,151	111	0	95	1,357	249
16	749	154	19	0	64	23	0	99	1108	1,556	150	0	191	1,897	789
17	749	154	19	0	64	23	0	99	1108	1,980	190	1	290	2,461	1,353
18	749	154	19	0	64	23	0	99	1108	2,422	233	1	391	3,047	1,939
19	749	154	19	0	64	23	0	99	1108	2,884	277	1	495	3,657	2,549
20	0	49	40	0	0	0	15	102	206	3,372	324	1	601	4,298	4,092
21	0	49	40	0	0	0	15	102	206	3,449	332	1	709	4,491	4,285
22	0	49	40	0	0	0	15	102	206	3,529	339	1	820	4,689	4,483
23	360	49	40	229	161	0	220	102	1161	3,610	347	1	933	4,891	3,730
24	360	49	40	229	161	0	220	102	1161	3,693	355	1	1,049	5,098	3,937
25	749	203	59	0	64	23	15	102	1215	3,778	363	1	1,168	5,310	4,095
26	749	203	59	0	64	23	15	102	1215	3,863	372	1	1,289	5,525	4,310
27	749	203	59	0	64	23	15	102	1215	3,953	380	1	1,413	5,747	4,532
28	749	203	59	0	64	23	15	102	1215	4,044	389	1	1,540	5,974	4,759
29	749	203	59	0	64	23	15	102	1215	4,137	398	1	1,670	6,206	4,991
30	0	98	80	0	0	0	30	102	310	4,232	407	1	1,803	6,443	6,133
														EIRR=	59.025%
														NPV(Php million)=	10,377
														Present value of cost=	5,911
														Present value of benefit=	16,288
														B/C=	2.8

Source: JICA Study Team

11.8.5 Sensitivity Analysis

The sensitivity of the project to potential risks is verified by assuming the following 5 cases:

- Case 1: 10% plus of cost
- Case 2: 20% plus of cost
- Case 3: 10% less of benefit
- Case 4: 20% less of benefit
- Case 5 20% plus of cost and 20% less of benefit

The results of sensitivity analysis on the 5 cases are summed up in the following table, which shows that, even under the strictest conditions assumed in Case 5, the EIRR value of this project is still well above the SDR value.

TABLE 11.8-15 PROJECT SENSITIVITY IN 5 CASES (METRO MANILA MASTER PLAN)

	Base	Case 1	Case 2	Case 3	Case 4	Case 5
EIRR (%)	59.0	53.3	48.5	52.7	46.3	37.6
NPV (Php. million)	10,277	9,786	9,191	8,750	7,119	5,933
B/C	2.8	2.5	2.3	2.5	2.2	1.8

Source: JICA Study Team

11.8.6 Qualitative Evaluation

With respect to the unquantifiable benefit, major items can be classified by type of beneficiary as seen from Table 11.8.6-1, and the benefits generated by respective ITS user services are indicated in **Table 11.8-16**

TABLE 11.8-16 MAJOR QUALITATIVE BENEFIT ITEMS BY TYPE OF BENEFICIARY (METRO MANILA MASTER PLAN)

Type of Beneficiary	Qualitative Benefit Item
The Whole Country	● Benefit of tourism promotion
	● Benefit of business promotion
General Road Users	● Benefit of faster moving traffic flow in the overall road network
	● Benefit of traffic accidents reduction
	● Benefit of death toll reduction in traffic accidents
	● Benefit of users' psychological comfort
Local Residents	● Benefit of better transport service enjoyed by local residents
Road and traffic Managers	● Benefit of traffic regulation manpower cost reduction
	● Benefit of road maintenance cost reduction
	● Benefit of capacity building for road management agencies

Source: JICA Study Team

TABLE 11.8-17 QUALITATIVE EVALUATION OF UNQUANTIFIABLE BENEFIT ITEMS (METRO MANILA MASTER PLAN)

ITS Development Area	ITS User Services	Benefit for the whole Country		Benefit for General Road Users				Benefit for Local Residents	Benefit for Road and Traffic Managers		
		Tourism Promotion	Business Promotion	Faster Moving Traffic flow	Traffic Accident Reduction	Death Toll Reduction in Traffic Accidents	Users' Psychological Comfort	Better transport Service for Local Residents	Manpower Cost Reduction	Road Maintenance Cost Reduction	Capacity Building for Management Agencies
1. Traffic Signal Control System	(1) **Advanced Traffic Control System at Intersections** to improve traffic efficiency at intersections			●	●				●		
	(2) **Emergency Vehicle Priority System** for safer lives of people					●					
2. Traffic Information and Provision System	(3) **Upgrading of Traffic Information Collection and Provision System on Real-time Basis** for faster and comfortable travel and to maximize the use of existing road facilities	●					●				
	(4) **Route Guidance System to Direct Driver to Less Congested Route** to maximize the use of existing road facilities			●	●				●		
	(5) **Information Provision System of Temporary Traffic Bottlenecks** to achieve less frustrated trips and to reduce traffic congestion at temporary traffic bottlenecks			●	●				●		
	(6) **Traffic Management System at Large-scale Shopping Malls** to reduce localized traffic congestion		●	●	●				●		
	(7) **Parking Space Information Provision System** to improve traffic flow in CBDs and for better road user service		●	●	●				●		
	(8) **Weather Condition and Prediction Information Provision System** for safer travel and to improve resiliency to natural disaster				●						
	(9) **Commercial Vehicles Location System** for more orderly trips of commercial vehicles	●						●			
	(10) **Events Information Provision System** to reduce traffic congestion at and around event sites			●	●				●		
	(11) **Rail Operation Information Provision System** for better passenger services	●						●			
3. Traffic Safety Assistance System	(12) **Danger Warning System** to reduce road crashes to improve traffic safety			●	●						
	(13) **Pedestrian Safety Support System** to reduce road crashes			●	●						
4. Public Utility Vehicle Management System	(14) **Bus Operation Monitoring and Control System** to reduce traffic congestion at bus stops and to eliminate illegal bus operation			●					●		
5. Traffic Enforcement Assistance	(15) **Traffic Rules Surveillance and Control System** to achieve smooth traffic flow and to reduce road crashes			●	●				●		
	(16) **On-street Parking Contro**l to improve traffic capacity for smoother traffic flow			●					●		
	(17) **Over Speeding Control System** to reduce road crashes			●	●				●		
	(18) **Overloaded Truck Control System** to provide better surfaced roads			●	●					●	
6. Road Management System	(19) **Upgrading Road Condition Information Collection** to improve road management and secure service level										●
7. Toll/Fare Collection System	(20) **Road Pricing System** to reduce cars on the roads for smoother traffic flow			●							
	(21) **Common Ticketing System** for easier transfer	●						●			

Source: JICA Study Team

CHAPTER 12
ITS MASTER PLAN IN MEGA MANILA

12.1 OBJECTIVE OF ITS SERVICES

Seven objectives of ITS services to achieve development visions and to solve traffic problems were identified. The objectives of the ITS services in relation to traffic problems and targets for ITS service are illustrated in **Figure 12.1-1**. Seven ITS development areas were developed to achieve the objectives of ITS services.

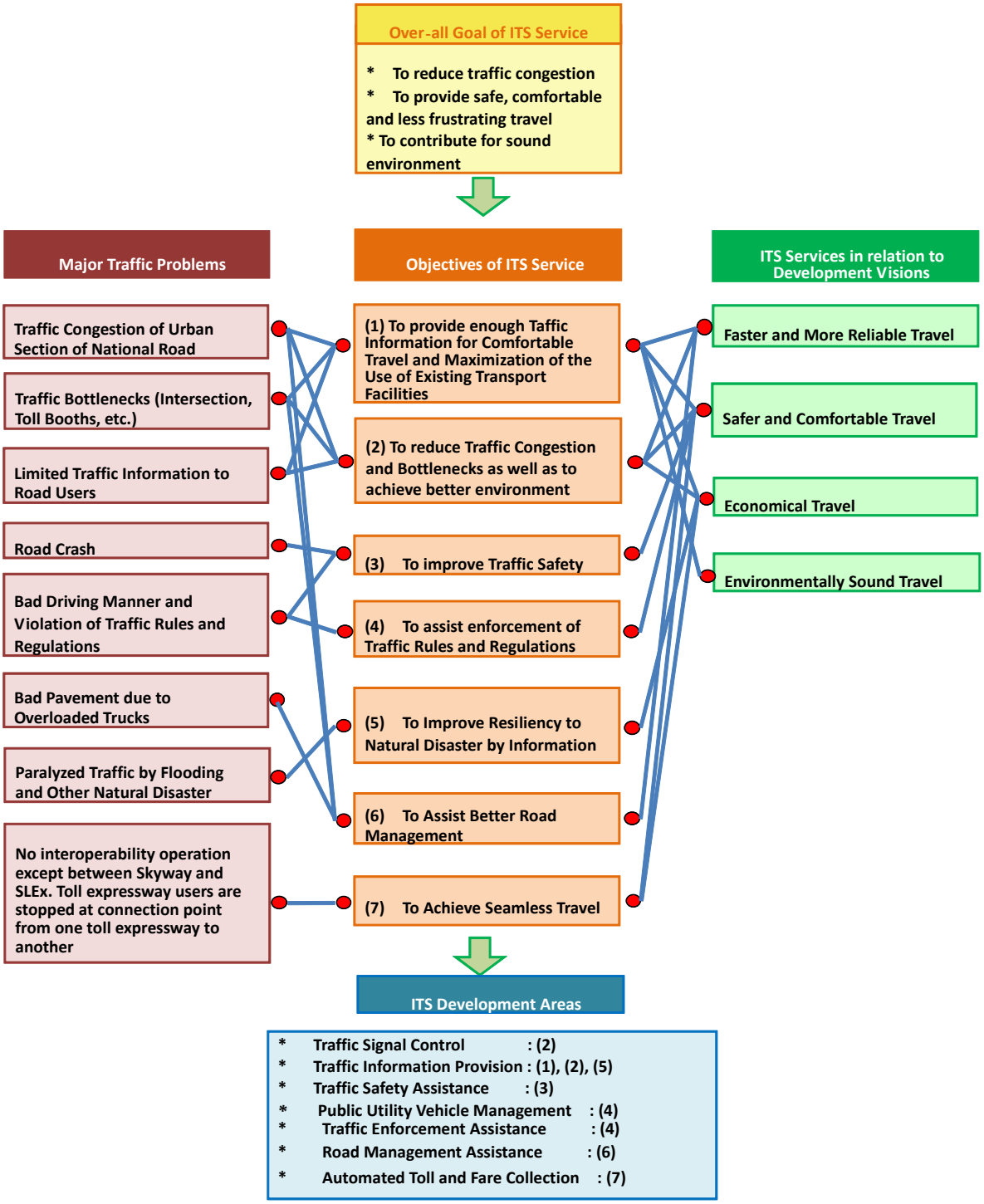
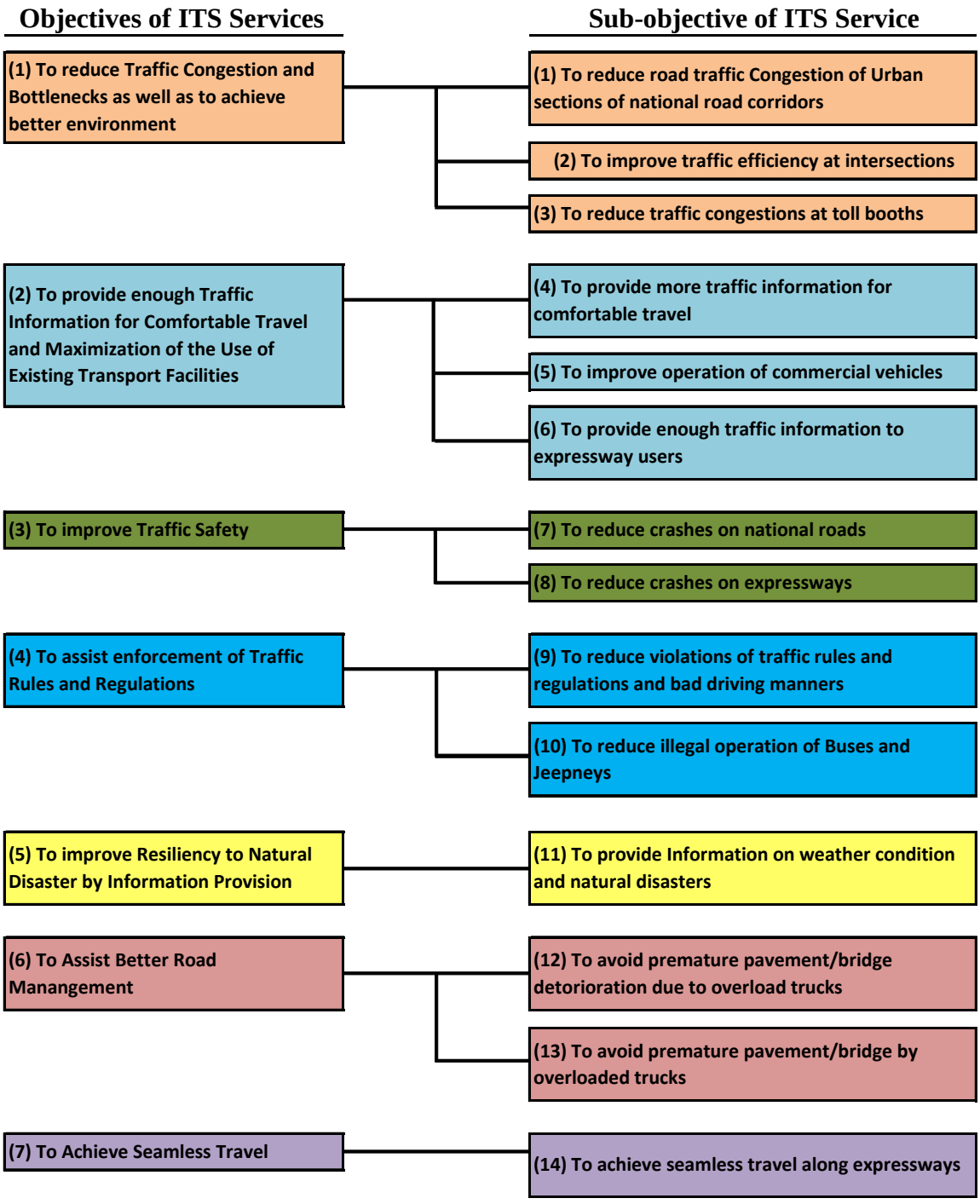


FIGURE 12.1-1 OBJECTIVES OF ITS SERVICES AND ITS DEVELOPMNET AREA FOR MEGA MANILA REGION

The objectives of ITS Services were further broken down into sub-objectives as shown below:

Mega Manila



12.2 ITS DEVELOPMENT AREA AND ITS USER SERVICES

Seven (7) ITS development areas were further divided into thirteen (13) user-service for Mega Manila.

MEGA MANILA

ITS Development Areas	ITS User Service
1. Traffic Signal Control	(1) **Advance Traffic Control System** at Intersections to improve traffic safety
2. Traffic Information Provision	(2) **Traffic Information Collection and Provision System** on real-time basis for faster and comfortable travel (3) **Standardization and Integration of Traffic Information and Provision System** for comfortable and reliable travel throughout the toll expressways (4) **Commercial Vehicles Location System** to efficiently manage cargo movements
3. Traffic Safety Assistance	(5) **Danger warning System** to reduce road crashes to improve traffic safety (6) **Weather Condition and Prediction Information Provision System** for safer travel and to improve resiliency to natural disasters
4. PUV Management	(7) **Bus Operation Monitoring and Control System** for illegal bus operations
5. Traffic Enforcement Assistance	(8) **Traffic Rules Surveillance and control System** to achieve smooth traffic flow and to reduce road crashes (9) **Overloaded Truck System** to provide better surfaced roads (10) **Overspeeding Control System** to improve traffic safety
6. Road Management	(11) **Upgrading of Road Condition Information Collection** to improve road management and to secure service level
7. Toll/Fare Collection	(12) **Inter-operability System** to achieve seamless travel on toll expressways (13) **Standardization of Toll Collection System** to promote ETC and/or non-cash payment toll collection and interoperability

Major objectives/sub-objectives and ITS development areas/ITS user services were related each other in a matrix form as shown in **Table 12.2-1** for Mega Manila.

TABLE 12.2-1 BASIC ITS SERVICE FOR MEGA MANILA

Major Objectives of ITS Measures to Achieve Development Visions (7)	Sub-objectives (14)	(1) Advanced Traffic Control System at Intersections to improve traffic safety	(2) Traffic Information Collection and Provision System on real-time basis for faster and comfortable travel	(3) Standardization and Integration of Traffic Information and Provision System for comfortable and reliable travel throughout the toll expressway	(4) Commercial vehicles Location System to efficiently manage cargo movements	(5)Danger Warning System to reduce Road Crashes to improve traffic safety	(6) Weather Condition and Prediction Information Provision System for safer travel and to improve resiliency to natural	(7) Bus Operation Monitoring and Control System for illegal bus operations	(8) Traffic Rules Surveillance and Control System to achieve smooth traffic flow and to reduce road crashes	(9) Overloaded Truck Control System to provide better surfaced roads	(10) Overspeeding Control System to improve traffic safety	(11) Upgrading of Road Condition Information Collection to Improve Road Management and to Secure Service Level	(12) Inter-operability System to achieve seamless travel on all toll expressways	(13) Standardization of Toll Collection System to promote ETC and/or non-cash payment toll collection and interoperability
		Traffic Signal Control	Traffic Information Provision			Traffic Safety Assistance		PUV Management	Traffic Enforcement Assistance			Road Management	Automated Toll and Fare Collection	
		ITS User Services (13)												
(1) To reduce Traffic Congestion and Bottlenecks as well as to achieve better environment	(1) To reduce road traffic Congestion of Urban sections of national road corridors	●	●						●					
	(2) To improve traffic efficiency at intersections	●							●					
	(3) To reduce traffic congestions at toll booths					●								●
(2) To provide enough Traffic Information for Comfortable and Maximization of the Use of Existing Transport Facilities	(4) To provide more traffic information for comfortable travel		●			●	●							
	(5) To improve operation of commercial vehicles				●									
	(6) To provide enough traffic information to expressway users		●	●										●
(3) To Improve Traffic Safety	(7) To reduce road crashes on national roads					●			●		●			
	(8) To reduce road crashes on expressways					●			●		●			
(4) To assist enforcement of Traffic Rules and Regulations	(9) To reduce violations of traffic rules and regulations and bad driving manners								●					
	(10) To reduce illegal operation of Buses and Jeepneys							●						
(5) To Improve Resiliency to Natural Disaster by Information Provision	(11) To provide information on weather condition and natural disasters		●				●							
(6) To Assist Better Road Management	(12) To avoid premature pavement/bridge detorioration due to overload trucks									●		●		
	(13) To avoid premature pavement/bridge by overloaded trucks									●		●		
(7) To Achieve Seamless Travel along expressways	(14) To achieve seamless travel along expressways			●									●	●

12.3 TOTAL SYSTEM ARCHITECTURE

12.3.1 Objectives for Developing the System Architecture[1]

The system architecture for ITS is an "overall scheme of ITS" that shows the overall structure (the framework) of the system based on the system's constituent elements and their interrelationships. In other words, the system architecture outlines the overall configuration of the system. It is indispensable for designing and developing a system comprising numerous elements that function as a whole.

The objectives for developing the system architecture are as follow:

(1) Efficient Construction of an Integrated System

- An integrated system
  - A concise system ⟶ allows diversified usage.
  - Integrated operators and judgments performed by the system (since systems for measurement, control and others have been integrated) ⟶ reduces burden on the users.
- Efficient construction of ITS
  - Information and functions to be shared among constituent systems ⟶ avoids double investment
  - Procurement of equipment from several vendors ⟶ enables cost optimization

(2) Maintenance of the system expandability

- Facilitates to change and add information and functions
- Facilitates to add new user services and systems

(3) Promotion of domestic and international standardization

- Comparison of current standardization activities and candidate areas of standardization, and clarification of areas not yet considered or duplicated ⟶ enables schematic standardization activities that consider the priority of items to be standardized.

12.3.2 Integrated ITS System Architecture

The proposed Integrated ITS System Architecture for the long term is shown in **Figure 12.3-1** for Mega Manila.

[1] Source "ITS Handbook 1999-2000" supervised by the Ministry of Construction

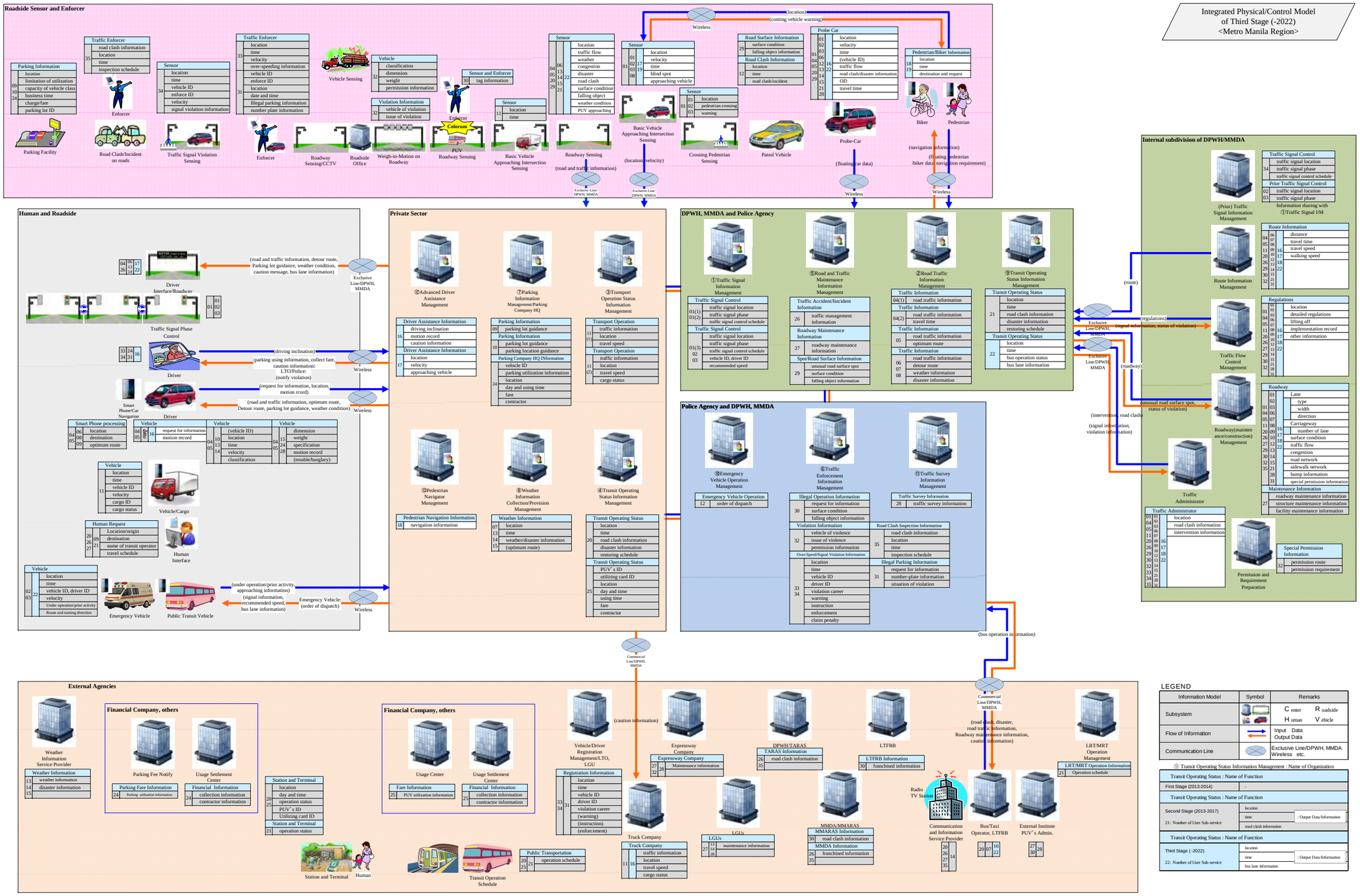


FIGURE 12.3-1 INTEGRATED ITS ARCHITECTURE FRO LONG-TERM: MEGA MANILA

12.4 OVERALL CONFIGURATION OF ITS SERVICES

Based on the existing transport problems and regional development visions, seven objectives of ITS Services were identified. For the realization of the seven objectives, seven ITS development areas were proposed in previous section. The seven objectives were further broken down into 14 sub-objectives. In relation to the 14 sub-objectives, the seven ITS development areas were further divided into 13 ITS user services. To achieve the 13 ITS user services, 23 sub-user services were proposed (see **Figure 12.4-1**). The composition of the 23 sub-user services is shown in **Figure 12.4-2.**

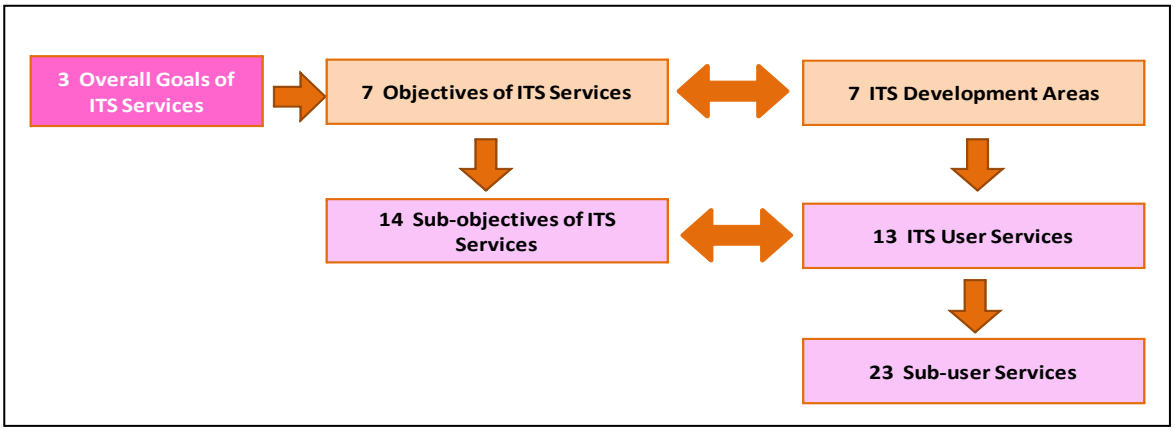


FIGURE 12.4-1 COMPOSITION OF ITS SERVICES: MEGA MANILA

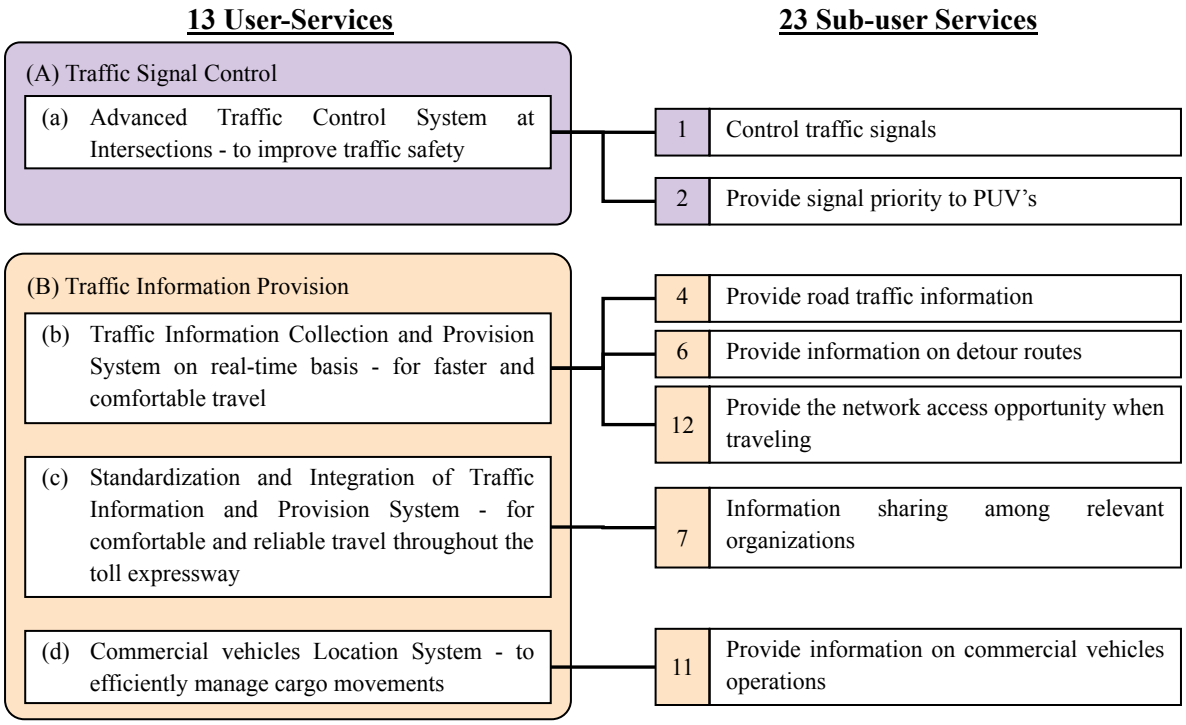


FIGURE 12.4-2 (1/2) COMPOSITION OF SUB-USER SERVICES: MEGA MANILA

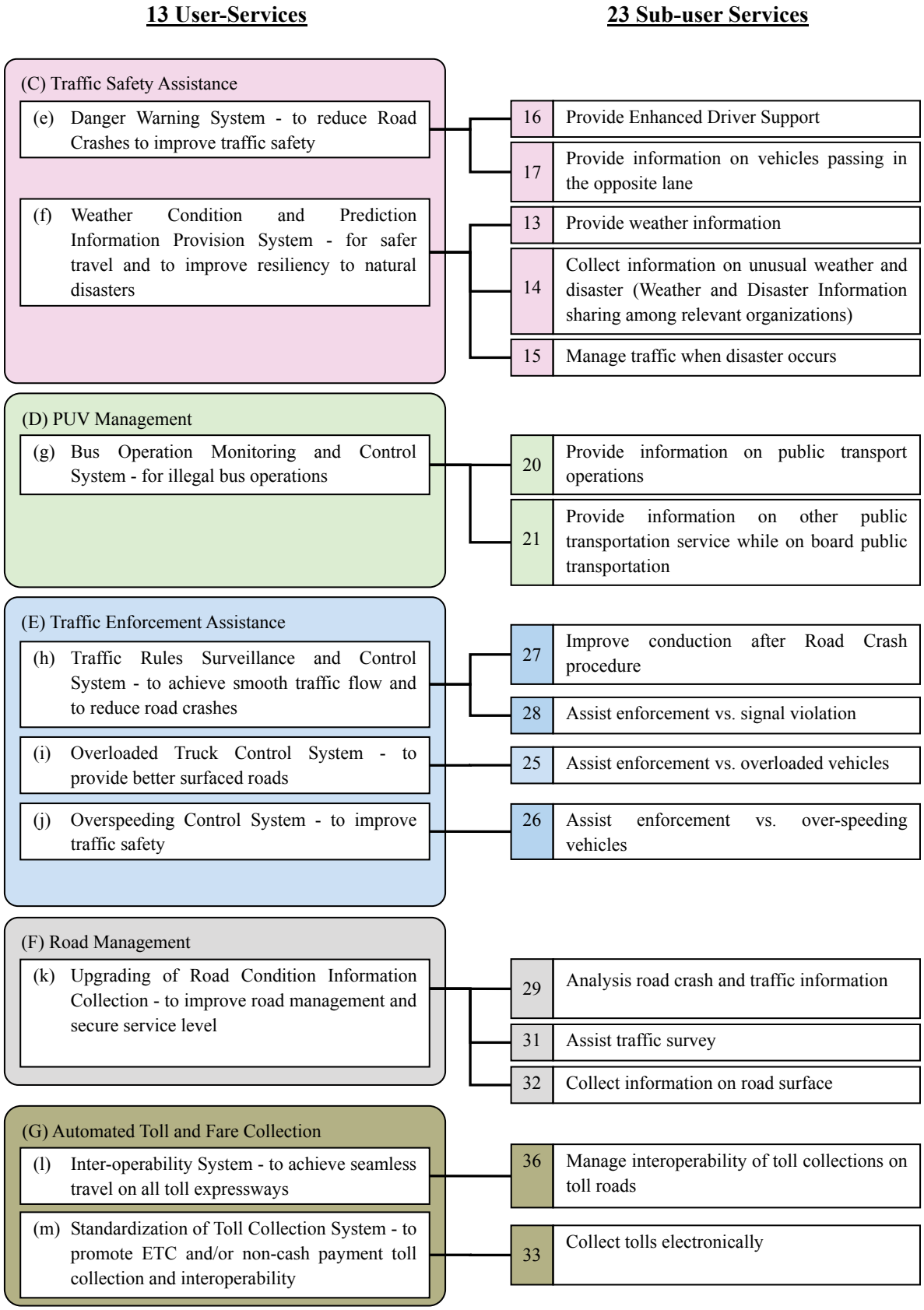
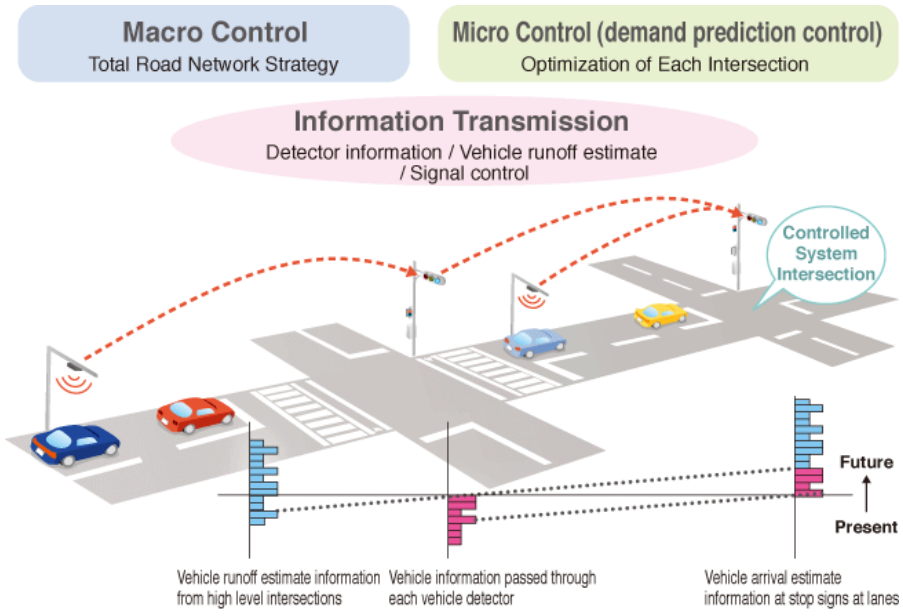


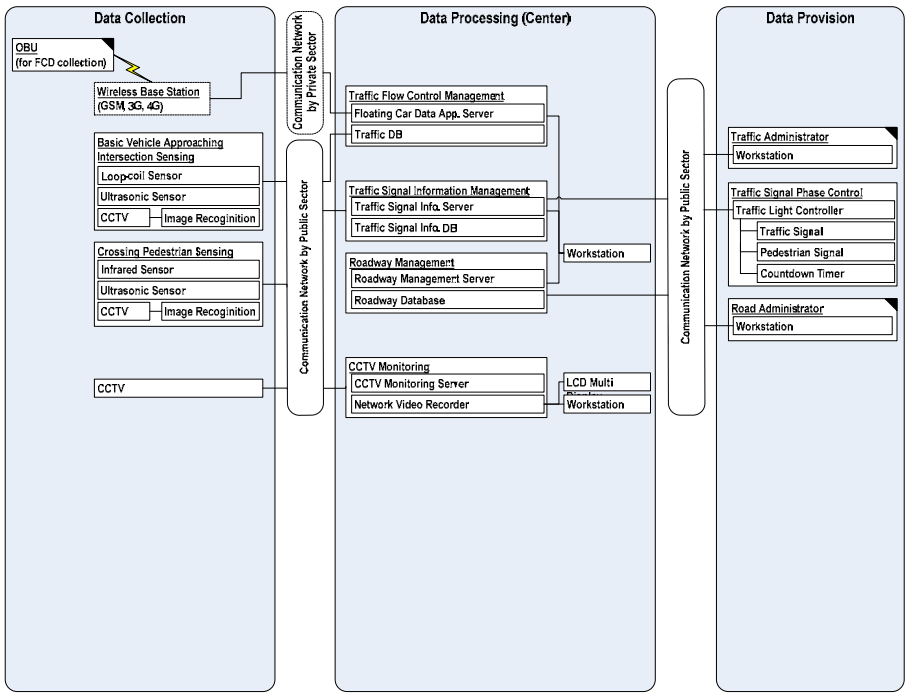
Figure 12.4-2 (2/2) COMPOSITION OF SUB-USER SERVICES: MEGA MANILA

12.5 ITS USER SERVICES FOR MEGA MANILA

In this sub-section, the outline of "ITS User Service" is described. Sub-user services detail information is described in **Annex 11.1**.

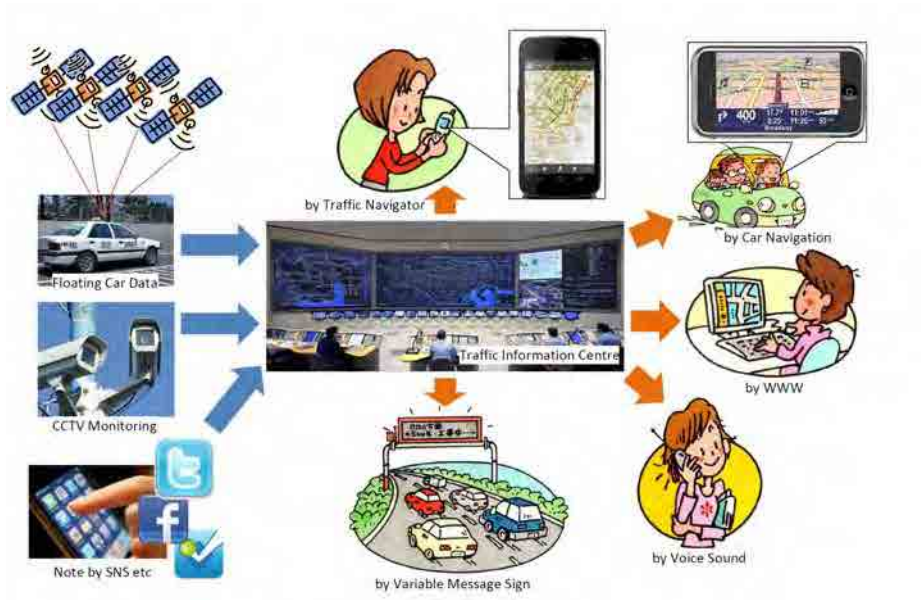
12.5.1 Advanced Traffic Control System at Intersections

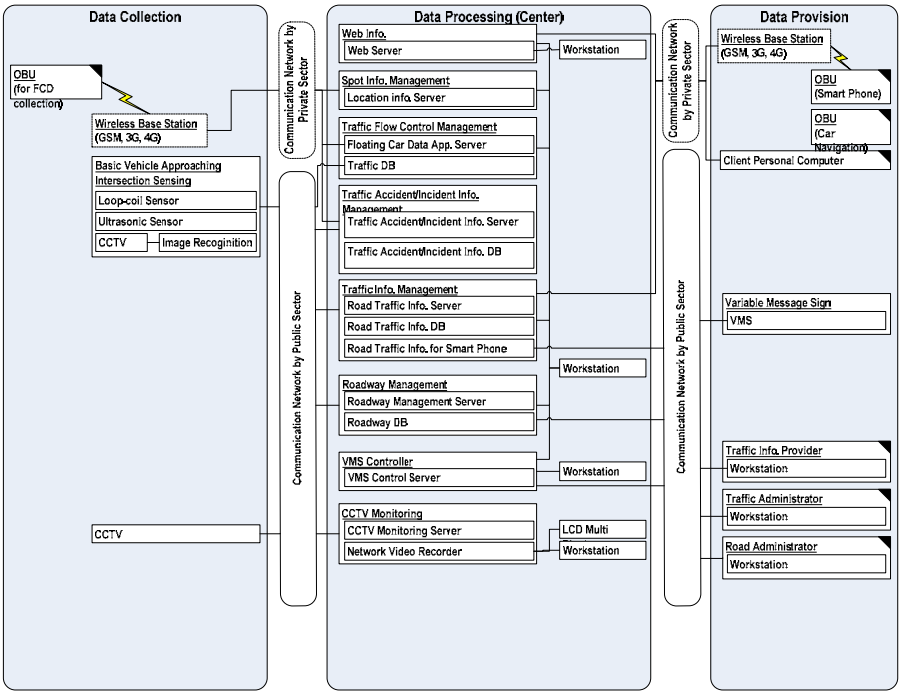
ITS User Services	Advanced Traffic Control System at Intersections
1) Sub-user Service (2 sub-user services)	1.Control Traffic Signal 2.Provide Signal Priority to PUV's
2) Objectives of the Service	• To improve traffic efficiency at intersections – Delay time at intersection to be reduced – Traffic queue length to be reduced • To reduce traffic pollutions – Green-house-gas (GHG) emissions to be reduced. • To improve traffic safety for vehicle passengers and pedestrians • To reduce transport cost – Vehicle operating cost and travel time cost to be reduced. • To allow smooth travel of public utility vehicles (PUV's)
3) Measures to achieve the objectives	• Real-time traffic demand will be collected by traffic detectors and also from floating car information. • Based on real-time traffic demand of each approach to an intersection, optimum signal parameter or green time allocation will be determined for maximization of intersection traffic capacity. • Priotiry green time at intersection is provided for PUV's for smooth travel
4) Image of the System	 *Source:http://global-sei.com/its/systems/itcs.html*
5) Typical System Configuration	**Data Collection**: Volume and speed from vehicle sensors (image recognition sensors, loop coil, ultrasonic wave, or infrared rays) Floating car data from vehicle. CCTV **Data Processing (Center)**: Traffic flow control management, traffic signal information management, roadway management and CCTV monitoring **Data Provision**: Traffic administrator, Traffic signal phase control and Road

ITS User Services	Advanced Traffic Control System at Intersections
	administrator  **01 Control Traffic Signal**
6) Area Coverage	• Signal controlled intersections plus additional intersections which are currently not signaled controlled along national roads in the Mega Manila Region
7) Responsible Agency	• Department of Public Works and Highways (DPWH)
8) Related Agencies	• Local Government Units, who are managing traffic signal control for intersections within urbanized area. • Metropolitan Manila Development Authority (MMDA) within Metro Manila • DOTC for PUV's related matters • PUV operating company
9) Effects and Impacts of the System	• Travel Time Savings • Time Savings Cost • CO2 Reduction • Fuel Reduction Cost • Smooth traffic flow will be achieved, which will contribute to reduction of traffic congestion. • Road users will enjoy psychologically comfortable travel. • Traffic safety will be improved due to smooth traffic flow.

12.5.2 Traffic Information Collection and Provision System

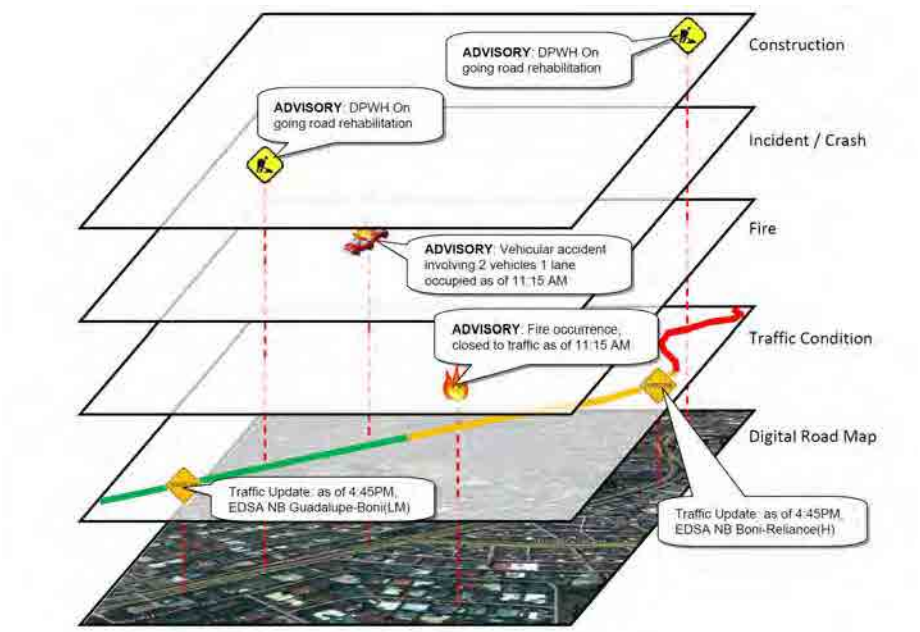
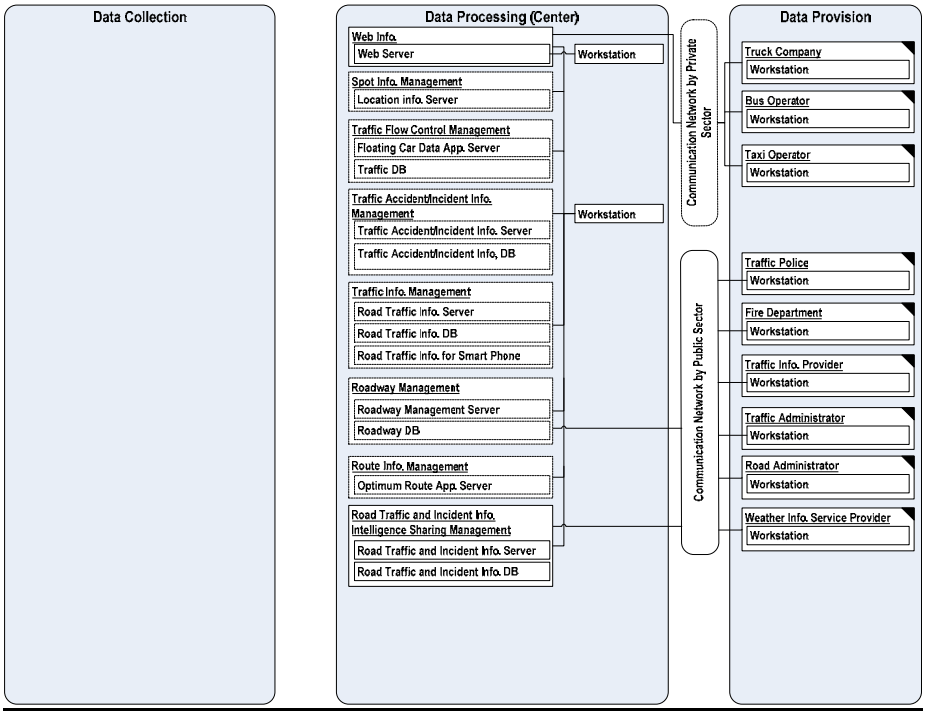
ITS User Services	Traffic Information Collection and Provision System
1) Sub-user Service (4 sub-user services)	4.Provide road traffic information 6.Provide information of detour 7. Information sharing among relevant organizations 12.Provide the network access opportunity when travelling
2) Objectives of the Service	By providing traffic information, achieve the following; • Faster and comfortable or less frustrating travel • Maximize the use of existing road facility by guiding travelers to less

<table>
<tr><th>ITS User Services</th><th colspan="2">Traffic Information Collection and Provision System</th></tr>
<tr><td></td><td colspan="2">congested road.
• Improve traffic safety
• Improve environmental condition by reducing green gas emissions
• Improve international competitiveness</td></tr>
<tr><td rowspan="2">3) Measures to achieve the objectives</td><td>Through
– Internet
– Smart Phone
– TV
– Radio</td><td>Traffic congestion level (light, medium, heavy) on Map
Traffic congestion increasing or decreasing
Visual traffic condition by CCTV screen capture, video live streaming
Traffic queue – head (beginning) and tail (end) locations
Travel time from A to B
Fire Location
Prediction of traffic congestion during Holidays, such as Holy Week, All Saints' Day, etc. based on historical data</td></tr>
<tr><td>Through
– VMS
– Mobile Phone (text message)</td><td>Traffic congestion level
Traffic queue – head (beginning) and tail (end) locations
Travel time to major destination</td></tr>
<tr><td>4) Image of the System</td><td colspan="2"> 
</td></tr>
<tr><td>5) Typical System Configuration</td><td colspan="2">Data Collection: Volume and speed from vehicle sensors (image recognition sensors, loop coil, ultrasonic wave, or infrared rays) Floating car data from vehicle. CCTV
Data Processing (Center): Web info, Spot info management, Traffic flow control management, Traffic accident/incident info management Traffic info management, Roadway management VMS controller
Data Provision: OBU (Car navigation, smart phone), VMS, PC (via internet), Traffic information provider. Traffic administrator and Road administrator</td></tr>
</table>

ITS User Services	Traffic Information Collection and Provision System
	 **04 Provide read traffic information**
6) Area Coverage	• National road and expressway in Mega Manila Region
7) Responsible Agency and its Implementation Plan	• Department of Public Works and Highways (DPWH) • DPWH will install a traffic control center and five (5) CCTV along North Manila Road in 2013.
8) Related Agencies	<u>For Traffic Information Supply</u> • Toll road operators • Local Government Units can provide CCTV data. • DOTC can provide rail operation information • PNP should provide road traffic accident data. <u>For Traffic Information Supply</u> • TV and radio companies • IT companies
9) Effects and Impacts of the System	**<u>Benefit of psychological comfort enjoyed by road users</u>** • The introduction of Traffic Information Collection and Provision System will provide the road users with information including traffic conditions and advisories, general public transportation information, toll and parking information, incident information, highway maintenance and construction information, and air quality and weather information, thus ensuring a smooth and comfortable travel for them.

12.5.3 Standardization and Integration of Traffic Information and Provision System

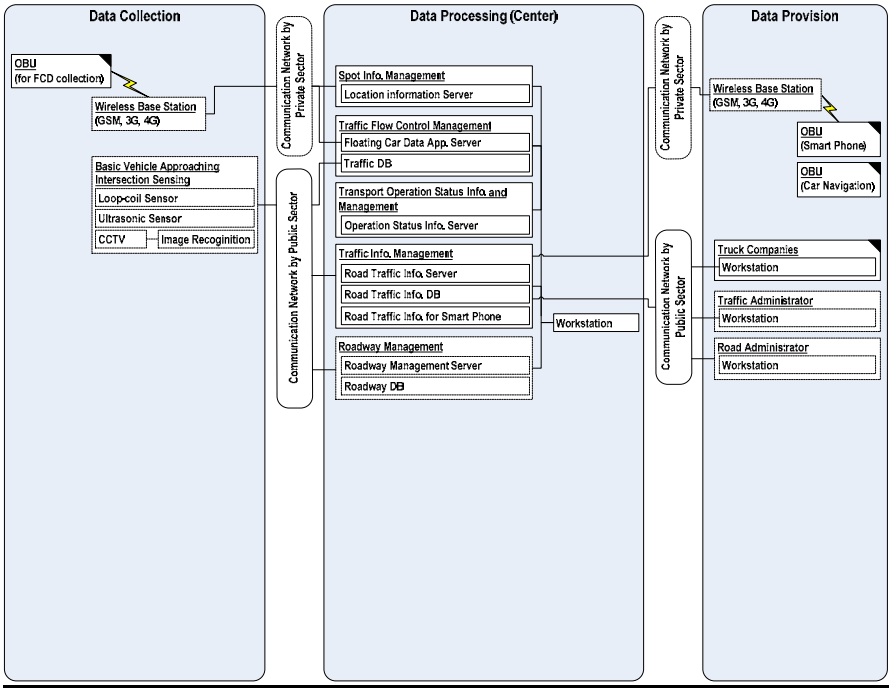
ITS User Services	Standardization and Integration of Traffic Information and Provision System
1) Sub-user Service	7. Information sharing among relevant organizations
2) Objectives of the Service	• To be comfortable and reliable travel throughout the toll expressway. • To share among relevant organization
3) Measures to achieve the objectives	• To enable safe and comfortable driving through maximum use of existing highway assets, the service involves sharing various information, such as that concerning individual public offices, private companies and traffic-related information among pertinent organizations. In addition, it will be able to access to general information networks, such as on-road internet usage and support to realize the advanced information-communication society.

ITS User Services	Standardization and Integration of Traffic Information and Provision System
4) Image of the System	 **Image of integrated traffic information on map**
5) Typical System Configuration	**Data Processing (Center):** Web info, Spot info management, Traffic flow control management, Traffic accident/incident info management Traffic info management, Roadway management **Data Provision:** OBU (Car navigation, smart phone), VMS, PC (via internet), Traffic information provider. Traffic administrator and Road administrator  **07 Provide traffic information and others**
6) Area Coverage	• Mega Manila Region
7) Responsible Agency	• Third Party or Department of Public Works and Highways (DPWH) Metropolitan Manila Development Authority (MMDA)
8) Related Agencies	DOTC, PAGASA, PHIVOCS, LGUs Toll operators and Private company(Logistics..)

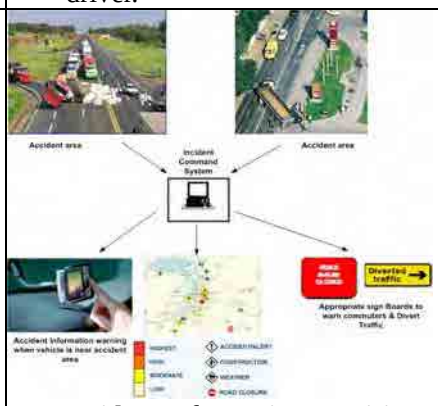
ITS User Services	Standardization and Integration of Traffic Information and Provision System
9) Effects and Impacts of the System	**Benefit of business promotion** The introduction of this system will improve business environment by ensuring reliable information service regarding the whole road network, thus contributing to the promotion of business and investment **Benefit of motorist promotion** This system will also attract more motorists traveling by cars through provision of necessary information to ensure comfortable and reliable travel within the whole road network, thus contributing to the promotion of motorists.

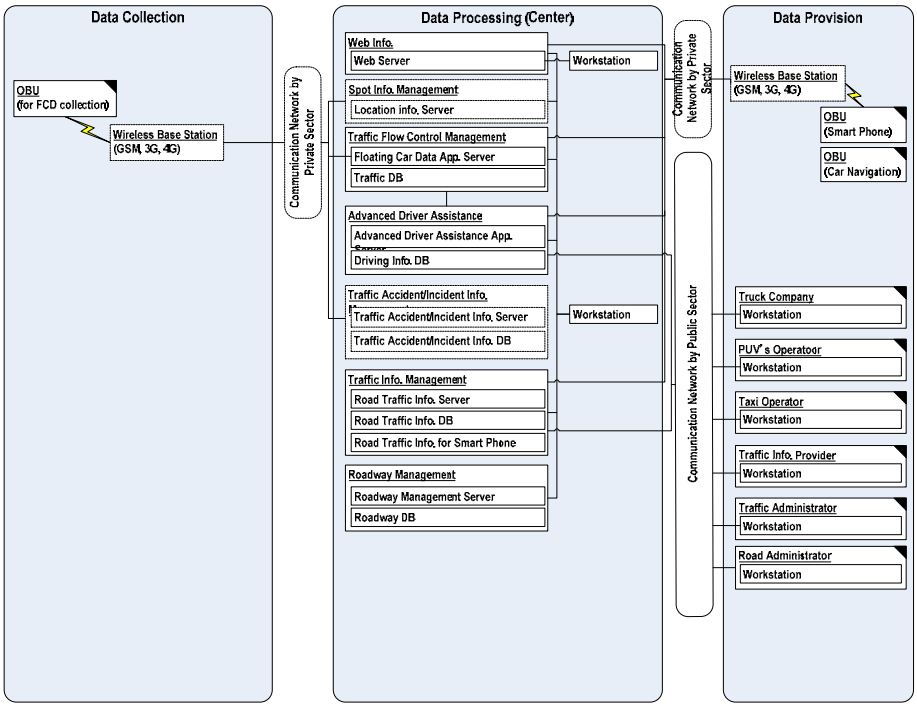
12.5.4 Commercial Vehicles Location System

ITS User Services	Commercial Vehicles Location System
1) Sub-user Service	11.Provide information on commercial vehicles operations
2) Objectives of the Service	• To achieve orderly and efficient trips to commercial trips so as to reduce trips of commercial vehicles. • To assist operation of commercial vehicles and efficient movement of goods.
3) Measures to achieve the objectives	• Movements of commercial vehicles and goods at real time will be collected by on-board GPS and tags of goods. • Traffic conditions will be collected from other sources of information. • Times required for delivery and the optimum routes for delivery will be informed to the drivers, so that goods will be delivered on time with less travel time.
4) Image of the System	 出典：http://www.simmetria.ie/Sample%20Screenshots.htm **Location information management of commercial vehicles**
5) Typical System Configuration	**Data Collection**: Vehicle sensors (image recognition sensors, loop coil, ultrasonic wave, or infrared rays) Floating car data from vehicle. CCTV **Data Processing (Center)**: Spot info management, Traffic flow control management, Transport operation status info and management, Traffic info management Roadway management **Data Provision**: OBU (Car navigation, smart phone), Truck Company, Traffic administrator and Road administrator

ITS User Services	Commercial Vehicles Location System
	 **11 Provide information on commercial vehicles operations**
6) Area Coverage	• Mega Manila Region
7) Responsible Agency	• Private trucking companies.
8) Related Agencies	• Department of Public Works and Highways(DPWH) for national roads • Toll operators • Department of Transportation and Communication(DOTC)
9) Effects and Impacts of the System	• Truck trips can be reduced. • Commodity delivery can be accurate and reduce complaints from clients.

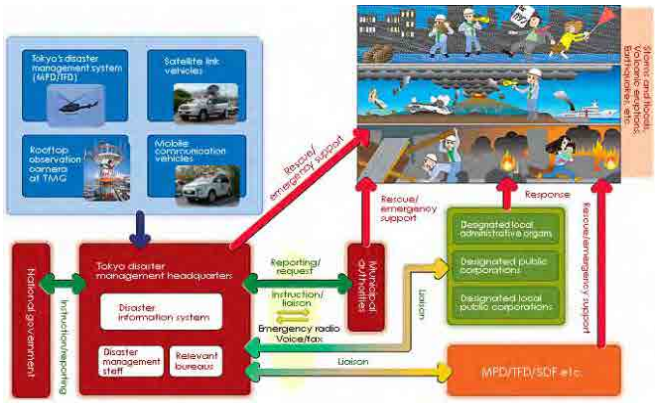
12.5.5 Danger Warning System

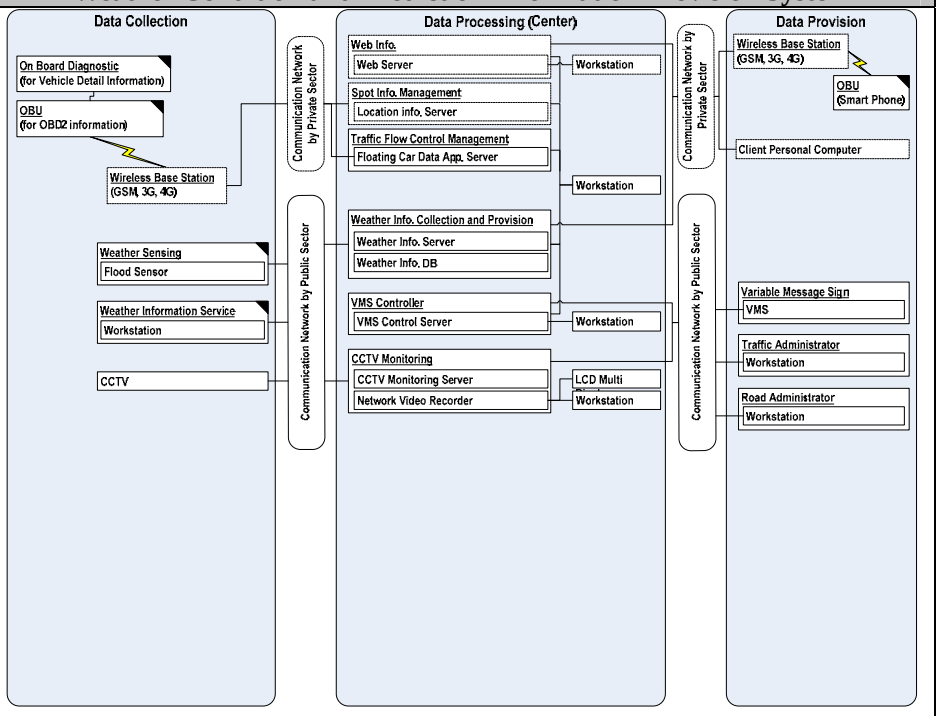
ITS User Services	Danger Warning System	
1) Sub-user Service (2 sub-user services)	16.Provide enhanced driver support 17.Provide information on vehicles passing in the opposite lane	
10) Objectives of the Service	• To improve traffic safety.	
11) Measures to achieve the objectives	• Warnings such as proximity of oncoming traffic in poor forward-view condition, lane departure, inter-vehicular distance, etc. are informed to a driver.	
2) Image of the System	 **Fast Incident Information Provision System**	 **Information provision on vehicles passing in the opposite lane**

ITS User Services	Danger Warning System
3) Typical System Configuration	**Data Collection**: Floating car data from vehicle **Data Processing (Center)**: Web info, Spot info management, Traffic flow control management, Advanced Driver Assistance, Traffic accident /incident info management Traffic info management, Roadway management **Data Provision**: OBU (Car navigation, smart phone), Truck Company, PUV's Company, Traffic information provider. Traffic administrator and Road administrator  **16 Provide enhanced driver support**
4) Area Coverage	• Mega Manila Region
5) Responsible Agency	• LGU Traffic Enforcers • Police for investigation and recording of traffic accidents
6) Related Agencies	• Department of Public Works and Highways(DPWH) for national roads • Expressway Companies for expressways • Department of Transportation and Communication (DOTC)
7) Effects and Impacts of the System	**Road crash reduction benefit** • By preventing the occurrence of road crashes, this system will contribute to the reduction of social loss incurred by road crashes. **Benefit of faster moving traffic flow in the overall road network** • The prevention of road crash will ensure the overall traffic efficiency in the entire road network .resulting in faster travel speed.

12.5.6 Weather Condition and Prediction Information Provision System

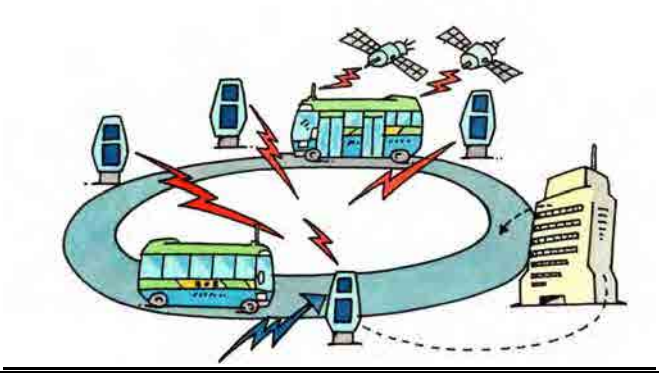
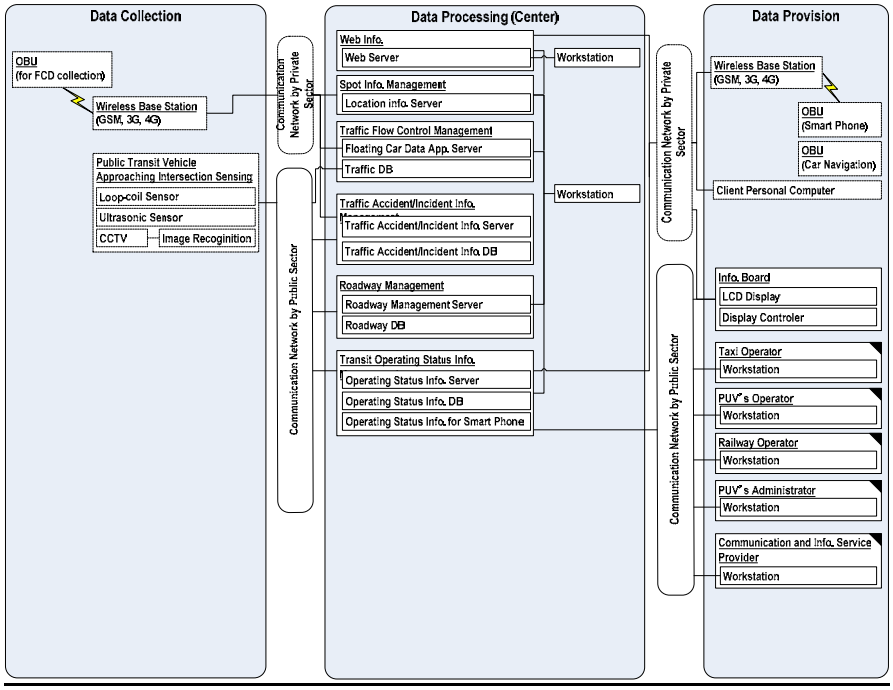
ITS User Services	Weather Condition and Prediction Information Provision System	
1) Sub-user Service (3 sub-user services)	13.Provide weather information 14.Collect information on unusual weather and disaster 15.Manage traffic when disaster occurs	
10) Objectives of the Service	• To assure safer travel during weather changes. • To improve resiliency to natural disaster.	
11) Information to be Provided	Through – Internet – Smart phone – TV	• Weather condition and prediction. • Typhoon, heavy rain, earthquake and other natural disaster information. • Evacuation order by LGUs and evacuation location.

ITS User Services	Weather Condition and Prediction Information Provision System	
		• Impassable roads. • Evacuation and relief operation routes. • Visual disaster condition by CCTV images and TV company video. • Assistance needed from the public.
	Through – VMS – Mobile phone (test message) – Radio	• Road passable or not • Occurrence of natural disaster • Passable routes from A to B
2) Image of the System	 **Traffic monitoring system during flood situation**  **Traffic management system when disaster occurs**	
3) Typical System Configuration	**Data Collection**: weather sensing, weather information service provider, CCTV **Data Processing (Center)**: Web info, Spot info management, Weather info collection and provision, Weather and Disaster info management, Roadway management, VMS controller and CCTV monitoring **Data Provision**: OBU (Car navigation, smart phone), VMS, PC(via internet), Traffic information provider. Traffic administrator, Road administrator, Weather info service provider, Communication and info service provider and Disaster info service provider	

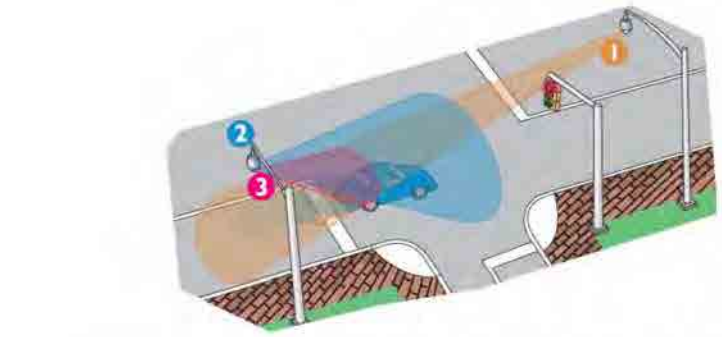
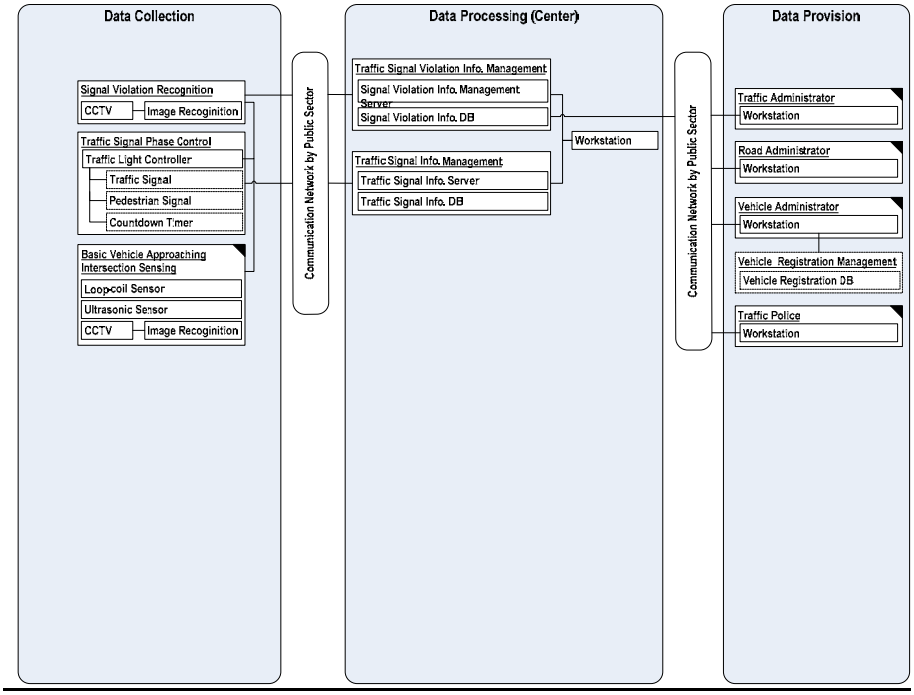
ITS User Services	Weather Condition and Prediction Information Provision System
	 **13 Provide weather information**
4) Area Coverage	• Mega Manila Region
10) Responsible Agency	• Department of Public Works and Highways (DPWH) • So far, no plan.
11) Related Agencies	Information is provided to DPWH by various agencies; • Weather condition and weather prediction by PAGASA. • Information on tropical storms, typhoons and heavy rains by PAGASA. • Information on earthquakes, volcanic eruption, etc., by PHILVOLCS and DOST. • Evacuation order, location on evacuation center by LGUs. • Roads passable or impassable by road users, LGUs, and residents.
12) Effects and Impacts of the System	• To improve resiliency to natural disaster. • To support rescue operation. • To support relief operation. • To support traffic safety.

12.5.7 Bus Operation Monitoring and Control System

ITS User Services	Bus Operation Monitoring and Control System
1) Sub-user Service (2 sub-user services)	20.Provide information on public transport operations 21.Provide information on other public transportation service while on board public transportation
2) Objectives of the Service	• To manage efficiency bus operation • To control for illegal bus operation
3) Measures to achieve the objectives	• This system, for the purpose of both resolution of traffic congestion and effective crackdowns against illegally travelling buses in areas surrounding bus stops, collects information regarding operational bus service conditions. In addition, this system performs automated crackdowns through the use of tagging, image processing, etc.

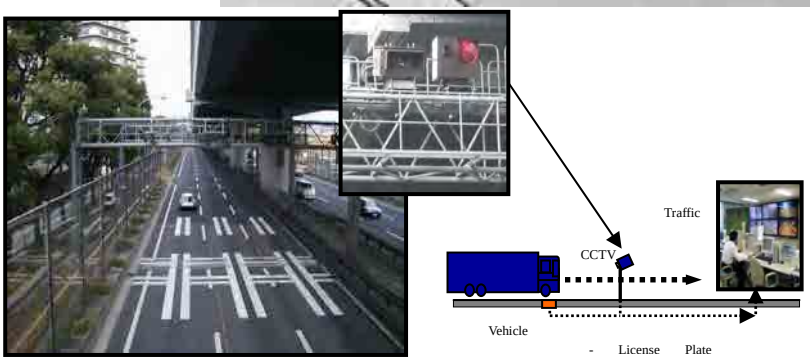
ITS User Services	Bus Operation Monitoring and Control System
4) Image of the System	
5) Typical System Configuration	**Data Collection**: vehicle sensors (image recognition sensors, loop coil, ultrasonic wave, or infrared rays) Floating car data from PUV. CCTV **Data Processing (Center):**Web info, Spot info management, Traffic flow control management, Traffic accident/incident info, Roadway management, and Transit operating status info management **Data Provision**: OBU (Car navigation, smart phone), VMS, PC(via internet), Public Transport Company, Traffic information provider. Traffic administrator and Road administrator  **20 Provide information on public transport operations**
6) Area Coverage	• Mega Manila Region
7) Responsible Agency	• LGU Traffic Enforcers • Department of Transportation and Communication(DOTC) • Land Transportation Franchising and Regulatory Board
8) Related Agencies	• Land Transportation Office (LTO) • Department of Public Works and Highways(DPWH) • Bus Companies
9) Effects and Impacts of the System	**<u>Benefit of faster moving traffic flow in the overall road network</u>** Regulation of illegal bus operation by this system will help to reduce congestions at bus stops and ensure the overall traffic efficiency in the entire road network, resulting in faster travel speed. **<u>Benefit of reducing cost of manpower for illegal bus operation regulation</u>** The system, by eliminating the illegal bus operation, will contribute to the reduction of cost of manpower deployed to regulate the bus operation.

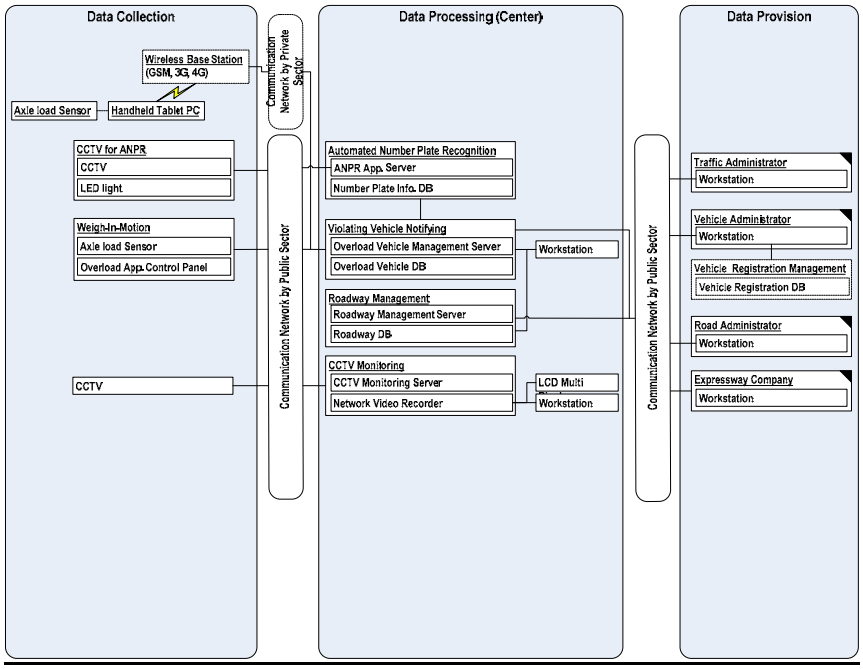
12.5.8 Traffic Rules Surveillance and Control System

ITS User Services	Traffic Rules Surveillance and Control System
1) Sub-user Service (2 sub-user services)	27.Improve conduction after road crash procedure 28.Assist enforcement of signal violation
10) Objectives of the Service	• To achieve smooth traffic flow. • To improve traffic safety. • To reduce period of temporary traffic bottleneck.
11) Measures to achieve the objectives	• Automated surveillance and crackdown of illegal activities by visual evidence.
2) Image of the System	 1 The Tracking Camera predicts if a vehicle will run the red light based on time and speed, and triggers the Signal and Enforcement Cameras to record images 2 The Signal Camera records images of the vehicle approaching and entering the intersection from behind, with a clear view of the signal ahead 3 The Enforcement Camera records close-up photographs of the rear licence plate on the vehicle after it has entered the intersection Assist Enforcement of Signal Violation
3) Typical System Configuration	**Data Collection**: Signal violation recognition, Traffic signal phase control and vehicle sensors (image recognition sensors, loop coil, ultrasonic wave, or infrared rays) CCTV **Data Processing (Center)**: Traffic signal violation info management and traffic signal info management **Data Provision**: Traffic administrator, Road administrator, Vehicle administrator, Vehicle registration management and Traffic police  **28 Assist enforcement of signal violation**

ITS User Services	Traffic Rules Surveillance and Control System
4) Area Coverage	• Mega Manila Region
5) Responsible Agency	• LGU Traffic Enforcers
6) Related Agencies	• Land Transportation Office (LTO) • Department of Public Works and Highways (DPWH) for national roads • Expressway Companies for expressways • Department of Transportation and Communication (DOTC)
7) Effects and Impacts of the System	**Benefit of faster moving traffic flow in the overall road network** The system will ensure the overall traffic efficiency in the entire road network, resulting in faster travel speed. **Road crash reduction benefit** The system will also reduce social loss incurred by road crashes through reduction of road crashes. **Traffic regulation manpower cost reduction benefit** The system will reduce the cost of deploying traffic officers for regulation.

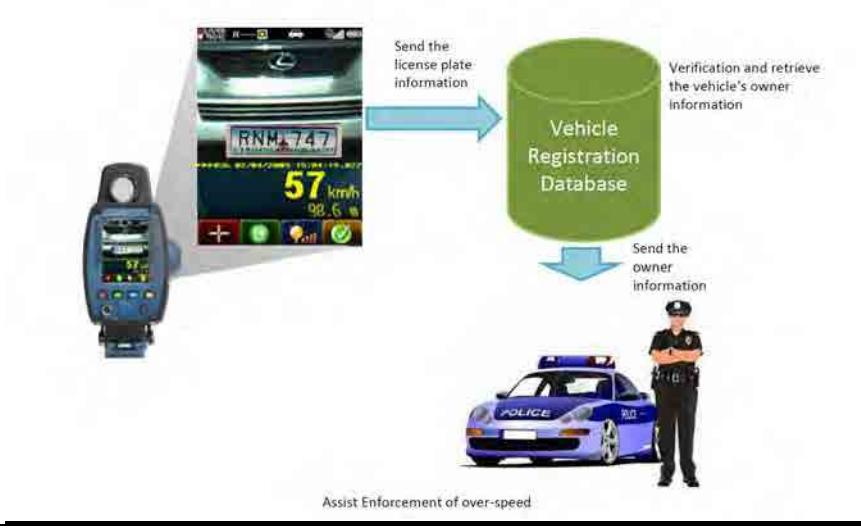
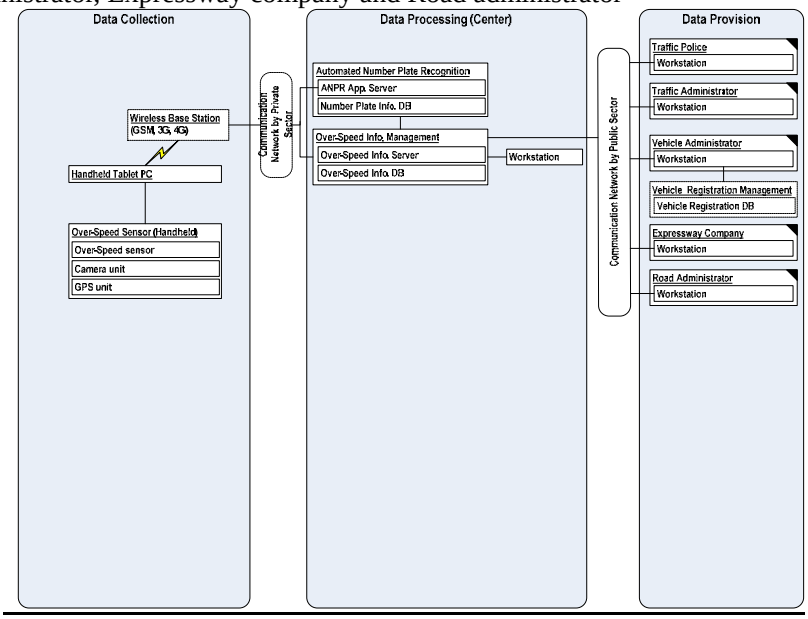
12.5.9 Overloaded Truck Control System

ITS User Services	Overloaded Truck Control System
1) Sub-user Service	25.Assist enforcement of overloaded vehicles
10) Objectives of the Service	• To prevent pre-mature pavement and bridge deterioration. • To provide better surfaced roads for smooth travel.
11) Measures to achieve the objectives	• Weigh-in-motion equipment weighs axle loads and automatically identifies overloaded trucks.
2) Image of the System	  **Weigh in motion in arterial road**
3) Typical System Configuration	**Data Collection**: Axle load sensor, CCTV, Weigh in motion **Data Processing (Center):** Center server, traffic control center

ITS User Services	**Overloaded Truck Control System**
	Data Provision: OBU (Car navigation, smart phone), VMS, PC(via internet), Traffic information provider. Traffic administrator and Road administrator  **25.Assist enforcement of overloaded vehicles**
4) Area Coverage	• Mega Manila Region
12) Responsible Agency	• Department of Public Works and Highways (DPWH) • DPWH has no plan for this system yet.
13) Related Agencies	• LTO deputizes DPWH personnel in the presence of PNP personnel who can confiscate a vehicle plate or driver's license.
14) Effects and Impacts of the System	• Pre-mature pavement/bridge deterioration minimized. • Better surface road provided.

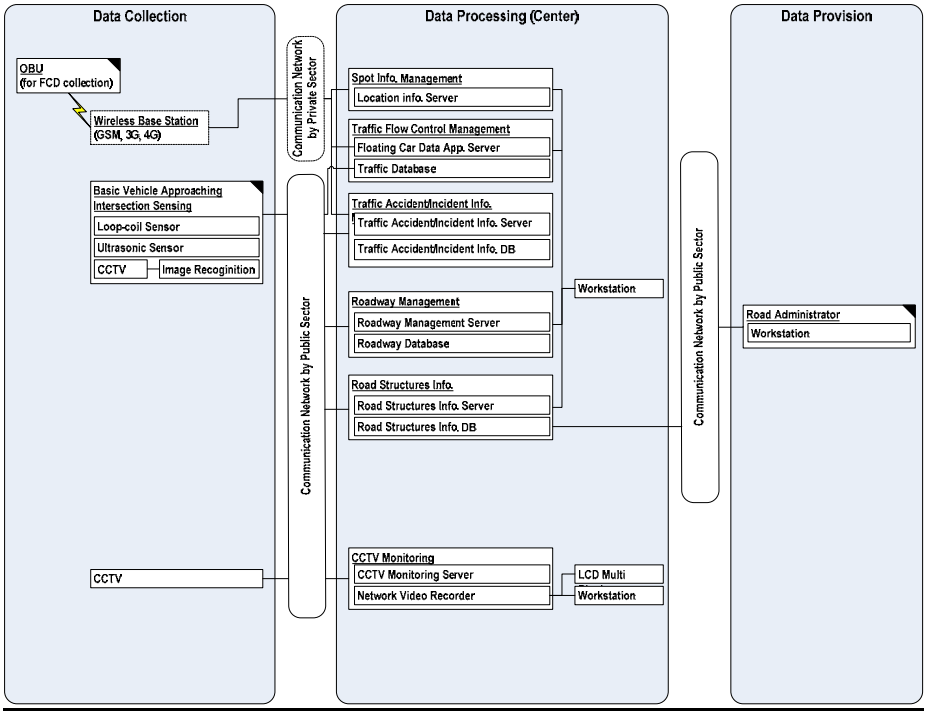
12.5.10 Overspeeding Control System

ITS User Services	**Overspeeding Control System**
1) Sub-user Service	26.Assist enforcement against overspeeding vehicles
8) Objectives of the Service	• To reduce serious road crashes.
9) Measures to achieve the objectives	• Overspeeding vehicle will be identified by overspeeding sensor with camera, which will instantly identify vehicle owner. • Overspeeding record will be sent to the traffic enforcement agency with the evidence. • Overspeeding record will be stored in the database which will identify repeaters of over-speeding violators.

ITS User Services	Overspeeding Control System
2) Image of the System	
3) Typical System Configuration	**Data Collection**: Overspeed sensors and PC Tablet Data Processing **(Center):** Automated Number Plate Recognition, Over-speed information management **Data Provision**: Traffic Police, Traffic administrator, Vehicle registration administrator, Expressway company and Road administrator  **26 Assist enforcement vs. overspeeding vehicles**
4) Area Coverage	• Mega Manila Region
5) Responsible Agency	• Land Transportation Office (LTO) • LGU Traffic Enforcers • Expressway Companies for expressways
6) Related Agencies	• Department of Transportation and Communication(DOTC) • Department of Public Works and Highways(DPWH) for national roads
7) Effects and Impacts of the System	**<u>Road Crash reduction benefit</u>** • The system will reduce social loss incurred by road crashes resulted from overspeeding. **<u>Benefit of faster moving traffic flow in the overall road network</u>** • By reducing congestion resulted from road crashes, the system will ensure the overall traffic efficiency in the entire road network **<u>Traffic regulation manpower cost reduction benefit</u>** • The system will reduce the cost of deploying traffic officers for regulation

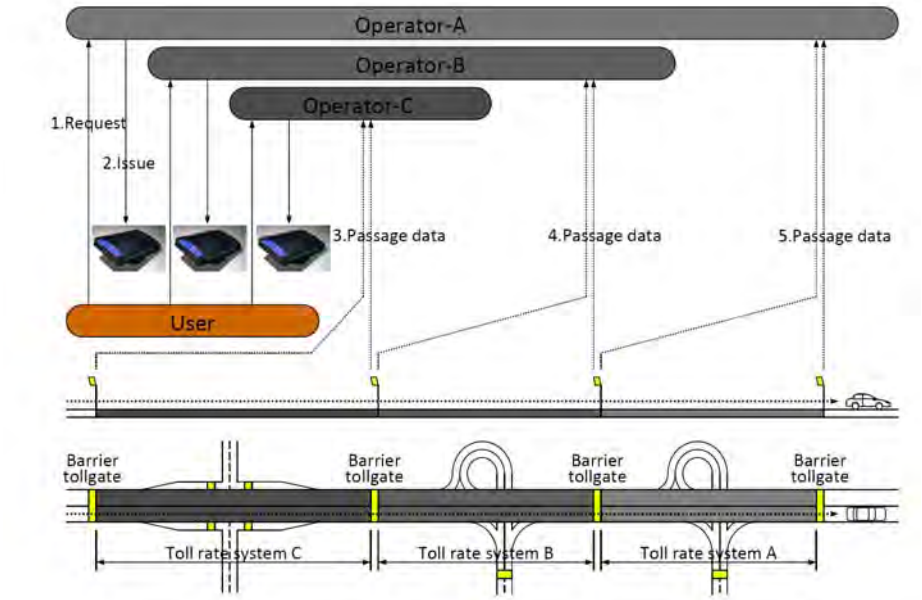
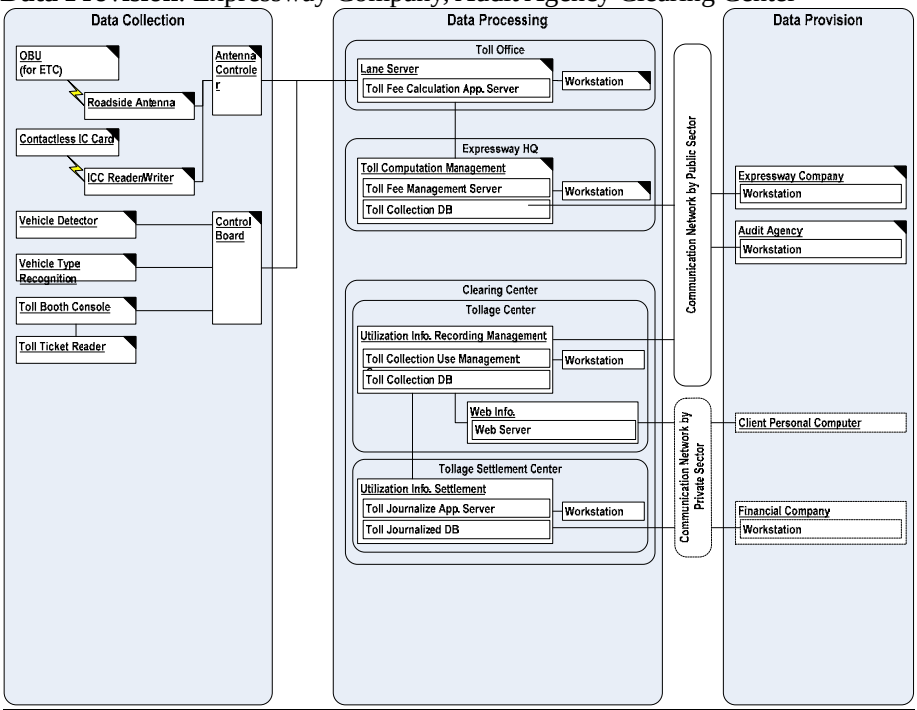
12.5.11 Upgrading of Road Condition Information Collection

ITS User Services	Upgrading of Road Condition Information Collection System
1) Sub-user Service (3 sub-user services)	29. Analysis road crash and traffic information 31.Assist traffic survey 32.Collect information on road surface
5) Objectives of the Service	• To assist improvement of road management for provision of better roads. • To secure level of service.
6) Measures to achieve the objectives	• Accurate and updated information necessary for road maintenance will be automatically collected.
2) Image of the System	
3) Typical System Configuration	**Data Collection**: vehicle sensors (image recognition sensors, loop coil, ultrasonic wave, or infrared rays) Floating car data from vehicle. CCTV **Data Processing (Center)**: Center server, traffic control center **Data Provision**: Traffic Police, Fire Station, MARAS, TARAS Traffic information provider, Traffic administrator, Express company and Road administrator

ITS User Services	Upgrading of Road Condition Information Collection System
	 **32 Collect information on road surface**
4) Area Coverage	• National roads within Mega Manila
5) Responsible Agency	• Department of Public Works and Highways (DPWH) • DPWH has no plan to adopt this system yet.
6) Related Agencies	• Department of Transportation and Communication (DOTC) • Road users
7) Effects and Impacts of the System	• Road surface condition improved, which will improve travel speed, and reduce vehicle operating cost and time cost.

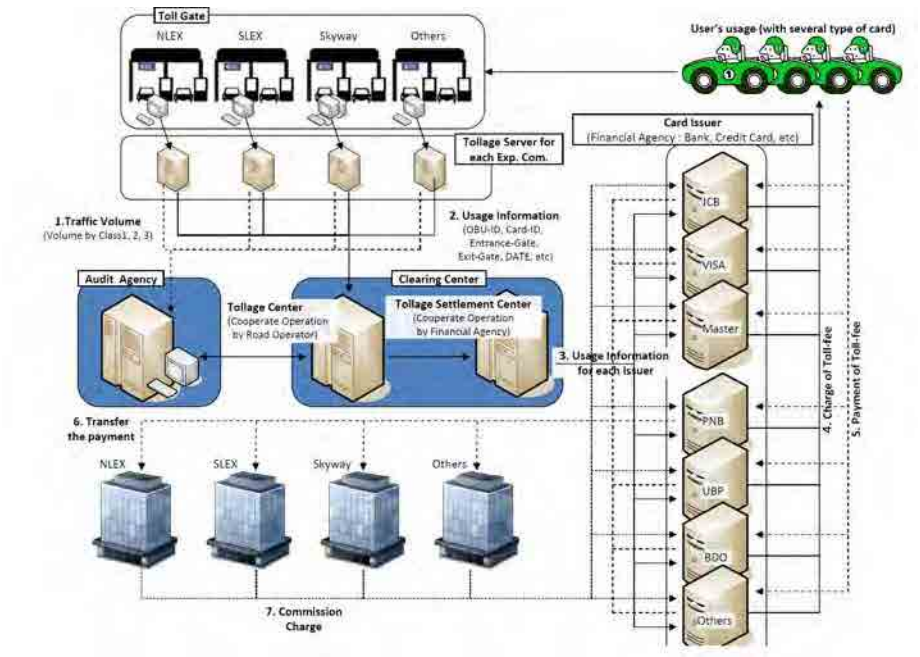
12.5.12 Inter-operability System

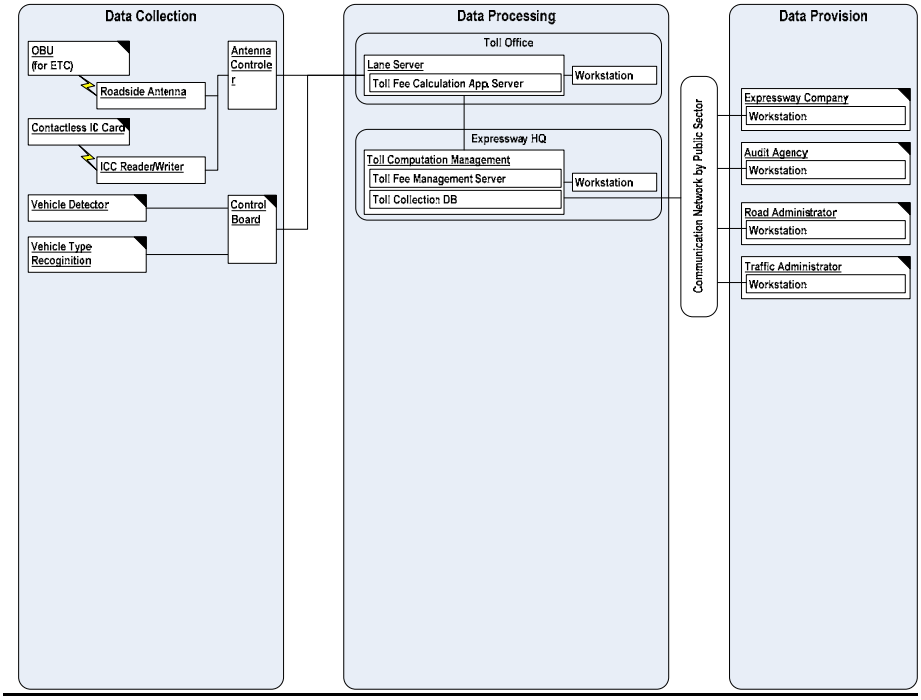
ITS User Services	Inter-operability System
1) Sub-user Service	36.Manage inter operability of toll collection on toll road
2) Objectives of the Service	• To improve the convenience of toll user • To mitigate traffic congestion at toll gate
3) measure to achieve the objectives	To support the use of smooth traffic among different expressways, this system is developed for management of a unified toll collection that targets all road users (not only ETC users but also cash users).

ITS User Services	Inter-operability System
4) Image of the System	
5) Typical System Configuration	**Data Collection**: OBU(for ETC), IC card, Vehicle Detector, Vehicle Type Recognition **Data Processing**: Lane Server, Toll Computation Management **Data Provision**: Expressway Company, Audit Agency Clearing Center  **36 Manage interoperability of toll collection on toll road**
6) Area Coverage	• Expressways in the Philippines.
7) Responsible Agency	• Toll Regulatory Board(TRB) • Expressway Companies
8) Related Agencies	• Department of Public Works and Highways (DPWH) • Department of Transportation and Communication (DOTC)
9) Effects and Impacts of the System	**<u>Benefit of business promotion</u>** • The introduction of this system will improve business environment by ensuring seamless transportation on the toll expressway by logistics companies as well as other business sectors, thus contributing to the

ITS User Services	Inter-operability System
	promotion of business and investment. **Benefit of motorist promotion** • This system will also attract more tourists traveling by cars by ensuring seamless and comfortable travel within the whole road network on the toll expressway, thus contributing to the promotion of motorist.

12.5.13 Standardization of Toll Collection System

ITS User Services	Standardization of Toll Collection System
2) Sub-user Service	33.Collect toll electronically
3) Objectives of the Service	• To improve the convenience of toll user • To mitigate traffic congestion at toll gate
4) measure to achieve the objectives	• The service provides electronic toll payment utilizing wireless communication technology, automatic vehicle class identification and toll fee calculation. It also provides the common electronic toll collection system with different toll operators.
5) Image of the System	
6) Typical System Configuration	**Data Collection**: OBU(for ETC), IC card, Vehicle Detector, Vehicle Type Recognition **Data Processing**: Lane Server, Toll Computation Management **Data Provision**: Expressway Company, Audit Agency Road Administrator and Traffic Administrator's Workstation

ITS User Services	Standardization of Toll Collection System
	 **33 Collect toll electronically**
7) Area Coverage	• Expressways in the Philippines.
8) Responsible Agency	• Toll Regulatory Board (TRB) • Toll road operators
9) Related Agencies	• Department of Public Works and Highways(DPWH) • Department of Transportation and Communication(DOTC)
10) Effects and Impacts of the System	**Benefit of business promotion** • The introduction of this system will improve business environment by ensuring seamless transportation on the toll expressway by logistics companies as well as other business sectors, thus contributing to the promotion of business and investment. **Benefit of motorist promotion** • This system will also attract more tourists traveling by cars by ensuring seamless and comfortable travel within the whole road network on the toll expressway, thus contributing to the promotion of motorist.

12.6 PRIORITY OF PROPOSED ITS SERVICES

The priority of ITS Services was evaluated from the Government's viewpoint and the road users' viewpoint. Both views were integrated to determine the overall priority.

(1) Priority from the Viewpoint of the Government

High Priority (10 points)	:	The implementing agency has started the service or will soon start the service.
Medium Priority (8 points)	:	The implementing agency is seriously considering the implementation and studying the services for implementation in the near future.
Low Priority (5 points)	:	The implementing agency has no plan to implement the service yet.

(2) Road Users' Priority

Road users were interviewed to identify the following:

- Traffic Problems
- ITS measures to be implemented

High Priority (10 points)	:	50% or more responded it is a problem or ITS measures to be implemented.
Medium Priority (8 points)	:	25% to 50% responded it is a problem or ITS measures to be implemented.
Low Priority (5 points)	:	Less than 25% responded it is a problem or ITS measures to be implemented. Or no answer by respondents.

(3) Overall Priority

The points of (1) and (2) above will be added, and the overall priority was determined as follows:

High Priority	:	18 or 20 points
Medium Priority	:	16 points
Low Priority	:	10 or 13 points

Table 12.6-1 shows priority of ITS services of Mega Manila.

TABLE 12.6-1 IMPLEMENTATION PRIORITY OF ITS USER SERVICE: MEGA MANILA

ITS User Service	Government's Agency Priority			Road User's Priority			Total Point	Overall Priority			Remarks
	High (10)	Medium (8)	Low (5)	High (10)	Medium (8)	Low (5)		High	Medium	Low	
1. Advanced Traffic Control System at Intersection	○			○			20	○			DPWH started
2. Traffic Information Collection and Provision System	○				○		18	○			DPWH is studying
3. Standardization and Integration of Traffic Information and Provision System	○				○		18	○			
4. Commercial Vehicles Location System		○		-	-	-	13			○	Private Sector
5. Danger Warning System			○			○	10			○	
6. Weather/natural disaster Information Provision System	○				○		18	○			
7. Bus Operation Monitoring and Control System		○				○	13			○	Private Sector
8. Traffic Rules Surveillance and Control System		○		○			18	○			
9. Overloaded Truck Control System	○			-	-	-	15		○		DPWH concerns this issue
10. Overspeeding Control System	○			○			20	○			Toll road operators
11. Upgrading Road Condition Information Collection System			○	○			15		○		DPWH is doing by conventional methods
12. Interoperability System of Expressways		○		○			18	○			Toll road operators
13. Standardization of Toll Collection System	○			○			20	○			Toll road operators

Government's Agency's Priority

High: Government started or will start. (10 points)
Medium: Government is studying. (8 points)
Low: No plan yet. (5 points)

Road User's Priority

High: 50% or more (10 points)
Medium: 25% or 50% (8 points)
Low: Less than 25% (5 points)
- : No answer (5 points

Overall Priority

High: Over 18 points
Medium: 15-17 points
Low: Less than 14 points

12.7 IMPLEMENTATION SCHEDULE AND COST

Based on the overall priority and time required to arrive at a consensus among Government agencies/private sector companies, the implementation schedule was proposed as shown in **Table 12.7-1** for Mega Manila.

TABLE 12.7-1 IMPLEMENTATION SCHEDULE: MEGA MANILA

ITS System			Implementing Agency	Present Status	Implementation Schedule		
					Short-Term (2013-2014)	Medium-Term (2015-2019)	Long-Term (2020-2030)
Traffic Signal Control	(1)	Advanced Traffic Control System at Intersections	DPWH	DPWH implemented along Manila North Road	Selection of Corridors	System Development for Selected Corridor	Upgrading
Traffic Information Provision	(2)	Traffic Information Collection and Provision System on real-time basis	DPWH	DPWH plans to introduce along Manila North Road	System Development for MNR	System Development for Other Corridor	Upgrading
	(3)	Standardization and Integration of Traffic Information and Provision System	DPWH, TRB, Toll Road Operators	Toll road operators adopt different standards	Create Concensus among Agencies/Companies	System Development	Upgrading
	(4)	Commercial vehicles Location System	Trucking Companies			System Development	Upgrading
Traffic Safety Assistance	(5)	Danger Warning system to reduce Road Crashes	DPWH			System Development	Upgrading
	(6)	Weather Condition and Prediction Information Provision System	DPWH, Toll Road Operators			System Development	Upgrading
PUV Management	(7)	Bus operation Monitoring and Control System	Bus Companies				System Development → Upgrading
Traffic Enforcement Assistance	(8)	Traffic Rules Surveillance and Control System	DPWH/LGUs			System Development	Upgrading
	(9)	Overloaded Truck Control System	DPWH	DPWH adopts conventional ways at present.		System Development	Upgrading
	(10)	Over Speeding Control System	DPWH, LGUs, PNP, Toll Road Operators		System Development		Upgrading
Road Management	(11)	Upgrading of Road Condition Information Collection	DPWH	DPWH adopts conventional ways at present.		System Development	Upgrading
Automated Toll and Fare Collection	(12)	Inter-operability System	DPWH, TRB, Toll Road Operators	Skyway - SLEX is implementing.	Create Concensus among Agencies/Companies	System Development	Upgrading
	(13)	Standardization of Toll Collection System	DPWH, TRB, Toll Road Operators	Toll road operators adopt different system	Create Concensus among Agencies/Companies	System Development	Upgrading
Estimated Cost (Million Php)					216	4438	577

12.7.1 COST ESTIMATE FOR MEGA MANILA ITS

The Project Cost has been estimated for Mega Manila ITS Integration Project and Operation and maintenance cost.

The Project Cost consists of Center equipment costs including installation cost, Center Software costs and Roadside Equipment costs were estimated for each sub-services.

(1) Base Condition for Cost Estimate

Cost Estimate for Administration Cost and Physical Contingency are estimated percentage of Civil Work cost as following;

- Administration Cost – 3.5%
- Physical Contingency – 5%
- Exchange Rate of Project Cost Estimates is used US$ 1.00-Peso 40.75-Yen 95 or Peso 1.00-Yen 2.35 as of April 2013.

(2) Condition of Unit Price

The Civil Work Cost estimate is composed

i) Cost of Equipment :
The cost of equipment is based on quotation from supplier and

ii) Cost of Installation :
Installation of equipment cost is used assumed 15% of equipment cost.

(3) Indirect Costs

According to the Department Order No. 29/2011 of DPWH, the indirect cost consider as following conditions;

i) Mobilization and demobilization (0.1 % of direct cost)
ii) Value Added Tax (VAT):12% of total Direct and Indirect Cost.

The major equipment items (center, roadside and vehicle) are the same as **Table 11.7-1** shown in **chapter 11.7.2.**

12.7.2 SUMMARY OF PROJECT COST FOR MEGA MANILA ITS PROJECT

Summary of Project Cost for Mega Manila ITS Project is shown in **Table 12.7-2, Table 12.7-3 and Table 12.7-4.**

TABLE 12.7-2 PROJECT COST FOR 1ST STAGE OF MEGA MANILA ITS

Unit: Php

PAY ITEM NO.	DESCRIPTION	QUANTITY	UNIT	Unit Cost	Civil Work Cost	COST COMPONENT		
						Foreign Currency (FC)	Local Currency (LC)	TAXES
A	**Traffic Signal Control System**							
SPL A1	Control Traffic Signal - 1		Ls		-	-	-	-
SPL A2	Signal Priority to PUV's		Ls		-	-	-	-
	SUB-TOTAL (PART A)				-	-	-	-
B	**Road Traffic Information Provision System**							
SPL B1	Road traffic information	1.00	Ls	16,014,750.00	16,014,750.00	11,690,767.50	2,402,212.50	1,921,770.00
SPL B3	Information of detour		Ls		-	-	-	-
SPL B4	road traffic informaiton and others		Ls		-	-	-	-
SPL B8	Information on commercial vehicles		Ls		-	-	-	-
	SUB-TOTAL (PART B)				**16,014,750.00**	**11,690,767.50**	**2,402,212.50**	**1,921,770.00**
C	**Traffic Safety Assistance System**							
SPL C1	Weather information		Ls		-	-	-	-
SPL C2	unusual weather and disaster		Ls		-	-	-	-
SPL C3	Manage traffic when disaster occurs		Ls		-	-	-	-
SPL C4	Enhanced driver support		Ls		-	-	-	-
SPL C5	Vehicle passing in the opposite lane		Ls		-	-	-	-
	SUB-TOTAL (PART C)				-	-	-	-
D	**Pablic Utility Vehicle Management System**							
SPL D1	Information on public transport operations		Ls		-	-	-	-
SPL D2	Information on other public transportation service while on board public transportation		Ls		-	-	-	-
	SUB-TOTAL (PART D)				-	-	-	-
E	**Automated Toll and Fare Collection System**							
SPL E3	Assist enforcement of overloaded vehicles		Ls		-	-	-	-
SPL E4	Assist enforcement of over-speedvehicles	1.00	Ls	66,769,905.98	66,769,905.98	48,742,031.36	10,015,485.90	8,012,388.72
SPL E5	Improve conduction after road crush procedure	1.00	Ls	132,925,870.41	132,925,870.41	97,035,885.40	19,938,880.56	15,951,104.45
SPL E6	Assist enforcement of signal violation		Ls		-	-	-	-
	SUB-TOTAL (PART E)				**199,695,776.39**	**145,777,916.76**	**29,954,366.46**	**23,963,493.17**
F	**Road Management System**							
SPL F1	Manage traffic when under incidental traffic conditions		Ls		-	-	-	-
SPL F2	Manage information on road maintenance		Ls		-	-	-	-
SPL F3	Assist traffic survey		Ls		-	-	-	-
	SUB-TOTAL (PART F)				-	-	-	-
G	**Traffic Enfocement Assistance System**							
SPL G1	Collect tollelectronically		Ls		-	-	-	-
SPL G4	Interoperability of toll collection on toll road		Ls		-	-	-	-
	SUB-TOTAL (PART G)				-	-	-	-
	TOTAL				**215,710,526.39**	**157,468,684.26**	**32,356,578.96**	**25,885,263.17**

TABLE 12.7-3 PROJECT COST FOR 2ND STAGE OF MEGA MANILA ITS

Unit: Php

PAY ITEM NO.	DESCRIPTION	QUANTITY	UNIT	Unit Cost	Civil Work Cost	COST COMPONENT		
						Foreign Currency (FC)	Local Currency (LC)	TAXES
A	**Traffic Signal Control System**							
SPL A1	Control Traffic Signal - 1	1.00	Ls	755,327,431.88	755,327,431.88	551,389,025.27	113,299,114.78	90,639,291.83
SPL A2	Signal Priority to PUV's	1.00	Ls	9,532,769.75	9,532,769.75	6,958,921.92	1,429,915.46	1,143,932.37
	SUB-TOTAL (PART A)				**764,860,201.63**	**558,347,947.19**	**114,729,030.24**	**91,783,224.20**
B	**Road Traffic Information Provision System**							
SPL B1	Road traffic information	1.00	Ls	665,860,309.73	665,860,309.73	486,078,026.10	99,879,046.46	79,903,237.17
SPL B3	Information of detour	1.00	Ls	32,090,625.00	32,090,625.00	23,426,156.25	4,813,593.75	3,850,875.00
SPL B4	road traffic informaiton and others	1.00	Ls	65,185,778.25	65,185,778.25	47,585,618.12	9,777,866.74	7,822,293.39
SPL B8	Information on commercial vehicles	1.00	Ls	63,134,097.25	63,134,097.25	46,087,890.99	9,470,114.59	7,576,091.67
	SUB-TOTAL (PART B)				**826,270,810.23**	**603,177,691.46**	**123,940,621.53**	**99,152,497.23**
C	**Traffic Safety Assistance System**							
SPL C1	Weather information	1.00	Ls	78,908,613.78	78,908,613.78	57,603,288.06	11,836,292.07	9,469,033.65
SPL C2	unusual weather and disaster	1.00	Ls	28,779,687.50	28,779,687.50	21,009,171.88	4,316,953.13	3,453,562.50
SPL C3	Manage traffic when disaster occurs	1.00	Ls	10,118,500.06	10,118,500.06	7,386,505.05	1,517,775.01	1,214,220.01
SPL C4	Enhanced driver support	1.00	Ls	31,006,430.50	31,006,430.50	22,634,694.27	4,650,964.58	3,720,771.66
SPL C5	Vehicle passing in the opposite lane	1.00	Ls	124,236,032.75	124,236,032.75	90,692,303.91	18,635,404.91	14,908,323.93
	SUB-TOTAL (PART C)				**273,049,264.59**	**199,325,963.15**	**40,957,389.69**	**32,765,911.75**
D	**Pablic Utility Vehicle Management System**							
SPL D1	Information on public transport operations		Ls		-	-	-	-
SPL D2	Information on other public transportation service while on board public transportation		Ls		-	-	-	-
	SUB-TOTAL (PART D)				**-**	**-**	**-**	**-**
E	**Automated Toll and Fare Collection System**							
SPL E3	Assist enforcement of overloaded vehicles	1.00	Ls	76,921,961.63	76,921,961.63	56,153,031.99	11,538,294.24	9,230,635.40
SPL E4	Assist enforcement of over-speedvehicles		Ls		-	-	-	-
SPL E5	Improve conduction after road crush procedure		Ls		-	-	-	-
SPL E6	Assist enforcement of signal violation	1.00	Ls	621,817,214.61	621,817,214.61	453,926,566.67	93,272,582.19	74,618,065.75
	SUB-TOTAL (PART E)				**698,739,176.24**	**510,079,598.65**	**104,810,876.44**	**83,848,701.15**
F	**Road Management System**							
SPL F1	Manage traffic when under incidental traffic conditions		Ls		-	-	-	-
SPL F2	Manage information on road maintenance	1.00	Ls	76,639,666.00	76,639,666.00	55,946,956.18	11,495,949.90	9,196,759.92
SPL F3	Assist traffic survey	1.00	Ls	28,525,000.00	28,525,000.00	20,823,250.00	4,278,750.00	3,423,000.00
	SUB-TOTAL (PART F)				**105,164,666.00**	**76,770,206.18**	**15,774,699.90**	**12,619,759.92**
G	**Traffic Enfocement Assistance System**							
SPL G1	Collect tollelectronically	1.00	Ls	1,663,431,503.75	1,663,431,503.75	1,214,304,997.74	249,514,725.56	199,611,780.45
SPL G4	Interoperability of toll collection on toll road	1.00	Ls	106,416,750.50	106,416,750.50	77,684,227.87	15,962,512.58	12,770,010.06
	SUB-TOTAL (PART G)				**1,769,848,254.25**	**1,291,989,225.60**	**265,477,238.14**	**212,381,790.51**
	TOTAL				**4,437,932,372.93**	**3,239,690,632.24**	**665,689,855.94**	**532,551,884.75**

TABLE 12.7-4 PROJECT COST FOR 3RD STAGE OF MEGA MANILA ITS

Unit: Php

PAY ITEM NO.	DESCRIPTION	QUANTITY	UNIT	Unit Cost	Civil Work Cost	COST COMPONENT		
						Foreign Currency (FC)	Local Currency (LC)	TAXES
A	**Traffic Signal Control System**							
SPL A1	Control Traffic Signal - 1		Ls		-	-	-	-
SPL A2	Signal Priority to PUV's		Ls		-	-	-	-
	SUB-TOTAL (PART A)				-	-	-	-
B	**Road Traffic Information Provision System**							
SPL B1	Road traffic information	1.00	Ls	542,163,040.88	542,163,040.88	395,779,019.84	81,324,456.13	65,059,564.91
SPL B3	Information of detour		Ls		-	-	-	-
SPL B4	road traffic informaiton and others		Ls		-	-	-	-
SPL B8	Information on commercial vehicles		Ls		-	-	-	-
	SUB-TOTAL (PART B)				**542,163,040.88**	**395,779,019.84**	**81,324,456.13**	**65,059,564.91**
C	**Traffic Safety Assistance System**							
SPL C1	Weather information		Ls		-	-	-	-
SPL C2	unusual weather and disaster		Ls		-	-	-	-
SPL C3	Manage traffic when disaster occurs		Ls		-	-	-	-
SPL C4	Enhanced driver support		Ls		-	-	-	-
SPL C5	Vehicle passing in the opposite lane		Ls		-	-	-	-
	SUB-TOTAL (PART C)				-	-	-	-
D	**Pablic Utility Vehicle Management System**							
SPL D1	Information on public transport operations	1.00	Ls	11,709,064.25	11,709,064.25	8,547,616.90	1,756,359.64	1,405,087.71
SPL D2	Information on other public transportation service while on board public transportation	1.00	Ls	3,722,145.75	3,722,145.75	2,717,166.40	558,321.86	446,657.49
	SUB-TOTAL (PART D)				**15,431,210.00**	**11,264,783.30**	**2,314,681.50**	**1,851,745.20**
E	**Automated Toll and Fare Collection System**							
SPL E3	Assist enforcement of overloaded vehicles		Ls		-	-	-	-
SPL E4	Assist enforcement of over-speedvehicles		Ls		-	-	-	-
SPL E5	Improve conduction after road crush procedure		Ls		-	-	-	-
SPL E6	Assist enforcement of signal violation		Ls		-	-	-	-
	SUB-TOTAL (PART E)				-	-	-	-
F	**Road Management System**							
SPL F1	Manage traffic when under incidental traffic conditions	1.00	Ls	19,851,413.44	19,851,413.44	14,491,531.81	2,977,712.02	2,382,169.61
SPL F2	Manage information on road maintenance		Ls		-	-	-	-
SPL F3	Assist traffic survey		Ls		-	-	-	-
	SUB-TOTAL (PART F)				**19,851,413.44**	**14,491,531.81**	**2,977,712.02**	**2,382,169.61**
G	**Traffic Enfocement Assistance System**							
SPL G1	Collect tollelectronically		Ls		-	-	-	-
SPL G4	Interoperability of toll collection on toll road		Ls		-	-	-	-
	SUB-TOTAL (PART G)				-	-	-	-
	TOTAL				**577,445,664.31**	**421,535,334.95**	**86,616,849.65**	**69,293,479.72**

12.7.3 OPERATION AND MAINTENANCE COST FOR MEGA MANILA AREA

Operation and Maintenance Cost were estimated for each stage of Mega Manila Area as shown below

(1) Operation and Maintenance cost and Spare Equipment List for 1st Stage

OPERATION AND MAINTENANCE COST

Exchange Rate : $ 1.0 = Php 40.75

Description	Unit	Unit Rate Php	Quantity	Total Cost Php/2Years	Annual Cost Php/yr
Spare of the Equipment cost	Lot	32,747,922.50	1.00	32,747,922.50	16,373,961.25
Software License	Php/yr	46,956.00	62.00	2,911,272.00	1,455,636.00
Maintenance for Software(10% of TC)	Php/yr	14,983,493.01	2.00	29,966,986.02	14,983,493.01
Traffic Information Service (Internet connection)	Php/mo	40,750.00	24.00	978,000.00	489,000.00
Radio Frequency License	Php/yr	122,250.00	2.00	244,500.00	122,250.00
Telecomunication Charge	Php/yr	285,250.00	2.00	570,500.00	285,250.00
Electricity	Kwh	10.00	1,440,000.00	14,400,000.00	7,200,000.00
Staff Cost	each/mo	40,000.00	960.00	38,400,000.00	19,200,000.00
Running Cost for Office	m2	100.00	19,200.00	1,920,000.00	960,000.00
O&M Management (5% of above cost)	Ls	6,106,959.03	1.00	6,106,959.03	3,053,479.51
				128,246,139.55	**64,123,069.77**

SPARE EQUIPMENT LIST

Exchange Rate : $ 1.0 = Php 40.75

Description	Unit	Unit Rate	Quantity	Spear Cost Php
Centre Equipment				
Application Server	pcs	10,187,500.00	1.00	10,187,500.00
Database Server	pcs	10,187,500.00	1.00	10,187,500.00
Workstation	pcs	256,725.00	1.00	256,725.00
Network Video Recorder	pcs	694,787.50	1.00	694,787.50
Roadside Equipment				
Information Board	pcs	248,126.75	5.00	1,240,633.75
VMS (Lane Guidance)	pcs	2,481,389.75	1.00	2,481,389.75
3D Laser Scanner	pcs	2,977,724.75	1.00	2,977,724.75
CCTV Camera (FIX Type)	pcs	282,886.50	2.00	565,773.00
Image Recognition Processor	pcs	1,091,814.75	2.00	2,183,629.50
Traffic Light Controller	pcs	248,126.75	1.00	248,126.75
Roadside Antena	pcs	1,222,500.00	1.00	1,222,500.00
Antena Controller	pcs	483,702.50	1.00	483,702.50
IC-card R/W	pcs	17,930.00	1.00	17,930.00
Total				**32,747,922.50**

(2) Operation and Maintenance cost and Spare Equipment List for 2nd Stage

1) Operation and Maintenance Cost

Exchange Rate : $ 1.0 = Php 40.75

Description	Unit	Unit Rate Php	Quantity	Total Cost Php/5Years	Annual Cost Php/yr
Spare of the Equipment cost	Lot	64,016,171.75	1.00	64,016,171.75	12,803,234.35
Software License	Php/yr	46,956.00	155.00	7,278,180.00	1,455,636.00
Maintenance for Software(10% of TC)	Php/yr	29,771,374.61	5.00	148,856,873.05	29,771,374.61
Traffic Information Service (Internet connection)	Php/mo	40,750.00	60.00	2,445,000.00	489,000.00
Radio Frequency License	Php/yr	122,250.00	5.00	611,250.00	122,250.00
Telecomunication Charge	Php/yr	285,250.00	5.00	1,426,250.00	285,250.00
Electricity	Kwh	10.00	4,800,000.00	48,000,000.00	9,600,000.00
Staff Cost	each/mo	45,000.00	2,400.00	108,000,000.00	21,600,000.00
Running Cost for Office	m2	100.00	48,000.00	4,800,000.00	960,000.00
O&M Management (5% of above cost)	Ls	19,271,686.24	1.00	19,271,686.24	3,854,337.25
Routine Maintenance				**404,705,411.04**	**80,941,082.21**

2) Spare Equipment List

Exchange Rate : $ 1.0 = Php 40.75

Description	Unit	Unit Rate	Quantity	Spear Cost Php
Centre Equipment				
Application Server	pcs	10,187,500.00	1.00	10,187,500.00
Database Server	pcs	10,187,500.00	1.00	10,187,500.00
Workstation	pcs	256,725.00	1.00	256,725.00
Network Video Recorder	pcs	694,787.50	1.00	694,787.50
LCD Monitor	pcs	94,458.50	1.00	94,458.50
Roadside Equipment				
Image Recognition Processor	pcs	1,091,814.75	6.00	6,550,888.50
Traffic Signal	pcs	387,125.00	8.00	3,097,000.00
Traffic Light Controller	pcs	248,126.75	6.00	1,488,760.50
Pedestrian Signal	pcs	198,534.00	16.00	3,176,544.00
Countdown Timer	pcs	277,915.00	8.00	2,223,320.00
CCTV Camera (PTZ Type)	pcs	282,886.50	3.00	848,659.50
RFID Reader (with Gantry)	pcs	17,930.00	15.00	268,950.00
VMS (with Gantry)	pcs	7,444,291.50	1.00	7,444,291.50
CCTV Camera (FIX Type)	pcs	282,886.50	1.00	282,886.50
VMS (Parking)	pcs	2,481,430.50	1.00	2,481,430.50
Control Panel	pcs	407,500.00	1.00	407,500.00
Base Station	pcs	611,250.00	2.00	1,222,500.00
CCTV (ANPR)	pcs	282,886.50	1.00	282,886.50
LED Light	pcs	124,083.75	1.00	124,083.75
Weight-in-Motion	pcs	1,630,000.00	1.00	1,630,000.00
Tablet PC	pcs	3,123,487.50	1.00	3,123,487.50
CCTV (PTZ Type)	pcs	282,886.50	1.00	282,886.50
Axle load sensor	pcs	7,444,291.50	1.00	7,444,291.50
Handheld Tablet PC	pcs	24,816.75	4.00	99,267.00
Over-Speed Sensor	pcs	24,816.75	4.00	99,267.00
RFID Tag	pcs	611.25	20.00	12,225.00
OBU	pcs	4,075.00	1.00	4,075.00
Total				**64,016,171.75**

(3) Operation and Maintenance cost and Spare Equipment List for 3rd Stage

1) Operation and Maintenance Cost

Exchange Rate : $ 1.0 = Php 40.75

Description	Unit	Unit Rate Php	Quantity	Total Cost Php/11Years	Annual Cost Php/yr
Spare of the Equipment cost	Lot	126,010,776.75	1.00	126,010,776.75	11,455,525.16
Software License	Php/yr	46,956.00	341.00	16,011,996.00	1,455,636.00
Maintenance for Software(10% of TC)	Php/yr	32,032,430.74	11.00	352,356,738.14	32,032,430.74
Traffic Information Service (Internet connection)	Php/mo	40,750.00	132.00	5,379,000.00	489,000.00
Radio Frequency License	Php/yr	122,250.00	11.00	1,344,750.00	122,250.00
Telecomunication Charge	Php/yr	285,250.00	11.00	3,137,750.00	285,250.00
Electricity	Kwh	10.00	11,616,000.00	116,160,000.00	10,560,000.00
Staff Cost	each/mo	50,000.00	5,280.00	264,000,000.00	24,000,000.00
Running Cost for Office	m2	100.00	105,600.00	10,560,000.00	960,000.00
O&M Management (5% of above cost)	Ls	44,748,050.54	1.00	44,748,050.54	4,068,004.59
Routine Maintenance				**939,709,061.43**	**85,428,096.49**

2) Spare Equipment List

Exchange Rate : $ 1.0 = Php 40.75

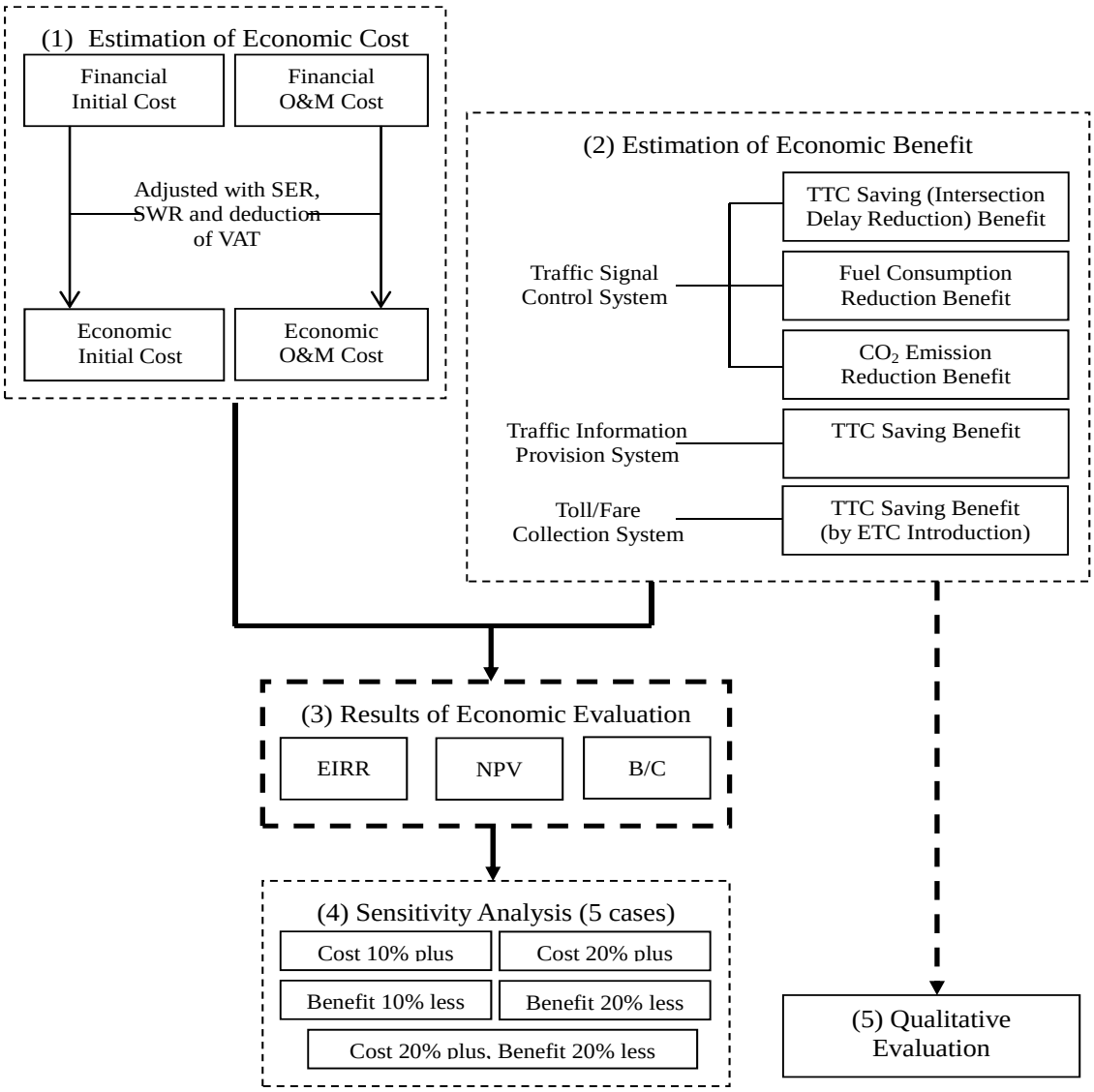
Description	Unit	Unit Rate	Quantity	Spear Cost Php
Centre Equipment				
Application Server	pcs	10,187,500.00	3.00	30,562,500.00
Database Server	pcs	10,187,500.00	3.00	30,562,500.00
Roadside Equipment				
Image Recognition Processor	pcs	372,210.50	27.00	10,049,683.50
Traffic Signal	pcs	387,125.00	24.00	9,291,000.00
Traffic Light Controller	pcs	248,167.50	6.00	1,489,005.00
Pedestrian Signal	pcs	198,534.00	48.00	9,529,632.00
Countdown Timer	pcs	277,915.00	24.00	6,669,960.00
CCTV Camera (PTZ Type)	pcs	282,886.50	6.00	1,697,319.00
VMS (Warning)	pcs	6,947,997.25	3.00	20,843,991.75
CCTV (FIX Type)	pcs	282,886.50	3.00	848,659.50
Infrared Sensor	pcs	1,488,842.00	3.00	4,466,526.00
Total				**126,010,776.75**

12.8 ECONOMIC EVALUATION OF MASTER PLAN

12.8.1 Methodology

(1) Framework and Workflow of Economic Evaluation

The framework and workflow of economic evaluation on the Mega Manila Master Plan are reflected in the following flow chart.



Source: JICA Study Team

FIGURE 12.8-1 FRAMEWORK AND WORKFLOW OF ECONOMIC EVALUATIONOF MEGA MANILA MASTER PLAN

(2) Basic Concepts and Assumptions

1) Reference to the Metro Manila Master Plan

The basic concepts and assumptions adopted in the Mega Manila Master Plan includes approach of economic evaluation by ITS development area, application of shadow prices, indicators of economic evaluation, and other basic assumptions. As these are the same as those used in the previous section regarding the Metro Manila Master Plan, description of this part is skipped here so as to avoid repetition.

2) Inclusion of ETC Benefit in Quantitative Economic Evaluation

But, regarding the approach of economic evaluation applied to respective ITS development areas, as ETC system is scheduled to be introduced under the Mega Manila Master Plan and the benefit resulted from this input is regarded to be quantifiable, the benefit items evaluated quantitatively in the case of Mega Manila Master Plan should also include ITS development area of Toll/Fare Collection System, which is excluded in the case of Metro Manila Master Plan as ETC system is not expected to be introduced in that case. The table below reflects this change compared to the previous **Table 12.8-1**.

TABLE 12.8-1 APPROACH OF ECONOMIC EVALUATION OF MEGA MANILA MASTER PLAN

ITS Development Area	Cost Evaluated Quantitatively	Benefit Evaluated Quantitatively	Benefit Evaluated Qualitatively
1） Traffic Signal Control	●	●	●
2） Traffic Information Provision	●	●	●
3) Traffic Safety Assistance	●		●
4) PUV Management	●		●
5) Traffic Enforcement	●		●
6) Road Management	●		●
7) Toll/Fare Collection	●	●	●

Source: JICA Study Team

Areas for Economic Evaluation

12.8.2 Economic Cost of Mega Manila Master Plan

(1) Initial Cost

1) Financial Cost

Just the same as that of the Metro Manila Master Plan, the initial cost of the Mega Manila Master Plan also consists of costs of the following 7 categories of ITS system. Also, a physical contingency cost which is assumed to be 5% of the total base cost is included

- Traffic Signal Control System
- Traffic Information Provision System
- Traffic Safety System
- PUV Management System
- Public Enforcement Assistance System
- Road Management System
- Toll/Fare Collection System

On the basis of the implementation schedule of the master plan, the financial cost of initial investment items commensurate with the introduction of respective ITS system are presented with the breakdown of foreign currency portion and local currency portion as well as their disbursement at respective stages as follows..

TABLE 12.8-2 FINANCIAL COST OF INITIAL INVESTMENT (UNIT: PHP 1,000)

No.	Category of ITS System	1st Stage (2013-2014)				2nd Stage (2015-2019)				3rd Stage (2020-2030)			
		Total	Foreign Currency	Local Currency	Taxes	Total	Foreign Currency	Local Currency	Taxes	Total	Foreign Currency	Local Currency	Taxes
1	Traffic Signal Control	0	0	0	0	764,860	558,348	114,729	91,783	0	0	0	0
2	Traffic Information Provision	16,015	11,691	2,402	1,922	826,271	603,178	123,941	99,153	542,163	395,779	81,324	65,060
3	Traffic Safety Assistance	0	0	0	0	273,049	199,326	40,957	32,766	0	0	0	0
4	PUV Management	0	0	0	0	0	0	0	0	(15,431)	(11,265)	(2,315)	(1,852)
5	Traffic Enforcement Assistance	199,696	145,778	29,954	23,964	698,739	510,079	104,811	83,849	0	0	0	0
6	Road Management	0	0	0	0	105,165	76,770	15,775	12,620	19,851	14,491	2,978	2,382
7	Toll/Fare Collection	0	0	0	0	1,769,848	1,291,989	265,477	212,382	0	0	0	0
8	**Base Cost (Item 1 ~7)**	**215,711**	**157,469**	**32,357**	**25,885**	**4,437,932**	**3,239,690**	**665,690**	**532,552**	**562,014**	**410,270**	**84,302**	**67,442**
9	Physical Contingency (5% of Item 8)	10,786	7,873	1,618	1,294	221,897	161,985	33,284	26,628	28,101	20,514	4,215	3,372
Total (Item 8 + 9)		**226,497**	**165,342**	**33,974**	**27,180**	**4,659,829**	**3,401,675**	**698,974**	**559,179**	**590,115**	**430,784**	**88,517**	**70,814**

Note: The values in ( ) are of private investment, and are excluded from the economic evaluation.

Source: JICA Study Team

2) Conversion to Economic Cost

The values of financial cost are then converted into that of the economic cost for the purpose of economic evaluation, and the specific way adopted here to convert the financial cost values into that of the economic cost is entirely the same as what has been described in the previous chapter with regard to the Metro Manila Master Plan. As a result of the conversion, the values of

economic cost are reflected in the following table.

TABLE 12.8-3 ECONOMIC COST OF INITIAL INVESTMENT (UNIT: PHP 1,000)

No.	Category of ITS System	1st Stage (2013-2014)			2nd Stage (2015-2019)			3rd Stage (2020-2030)			Grand Total (2013-2030)		
		Total	Foreign Currency	Local Currency	Total	Foreign Currency	Local Currency	Total	Foreign Currency	Local Currency	Total	Foreign Currency	Local Currency
1	Traffic Signal Control	0	0	0	738,855	670,017	68,837	0	0	0	738,855	670,017	68,837
2	Traffic Information Provision	15,470	14,029	1,441	798,178	723,813	74,364	523,729	474,935	48,795	1,337,378	1,212,777	124,600
3	Traffic Safety Assistance	0	0	0	263,765	239,191	24,574	0	0	0	263,765	239,191	24,574
4	PUV Management	0	0	0	0	0	0	(14,907)	(13,518)	(1,389)	(14,907)	(13,518)	(1,389)
5	Traffic Enforcement Assistance	192,906	174,934	17,973	674,982	612,095	62,887	0	0	0	867,888	787,029	80,859
6	Road Management	0	0	0	101,589	92,125	9,465	19,176	17,389	1,787	120,765	109,514	11,251
7	Toll/Fare Collection	0	0	0	1,709,673	1,550,387	159,286	0	0	0	1,709,673	1,550,387	159,286
8	**Base Cost (Item 1 ~7)**	**208,377**	**188,963**	**19,414**	**4,287,042**	**3,887,628**	**399,414**	**542,906**	**492,324**	**50,581**	**5,038,325**	**4,568,916**	**469,409**
9	Physical Contingency (5% of Item 8)	10,419	9,448	971	214,352	194,381	19,971	27,145	24,616	2,529	251,916	228,446	23,470
Total (Item 8 + 9)		**218,796**	**198,411**	**20,385**	**4,501,394**	**4,082,010**	**419,385**	**570,051**	**516,940**	**53,110**	**5,290,241**	**4,797,361**	**492,880**

Note: The values in ( ) are of private investment, and are excluded from the economic evaluation.

Source: JICA Study Team

The implementation schedule of the master plan with values of annual disbursement of initial cost in economic price is displayed in the following table. In addition to the above-mentioned initial cost, the cost of upgrading for all the 7 ITS systems assumed to take place 10 years after the initial installation of the respective systems are also taken into consideration.

TABLE 12.8-4 IMPLEMENTATION SCHEDULE AND INITIAL COST OF MEGA MANILA MASTER PLAN (ECONOMIC COST)

No.	Category of ITS System	Eco. Cost (Php.million)	1st Stage (2013-2014)		2nd Stage (2015-2019)					3nd Stage (2020-2030)										
			2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1	Traffic Signal Control	776			155	155	155	155	155											
	Traffic Signal Control (upgrading)	776													155	155	155	155	155	
2	Traffic Information Provision	1,404	8	8	168	168	168	168	168	50	50	50	50	50	50	50	50	50	50	50
	Traffic Information Provision (upgrading)	904											8	8	168	168	168	168	168	50
3	Traffic Safety Assistance	277			55	55	55	55	55											
	Traffic Safety Assistance (upgrading)	277													55	55	55	55	55	
4	PUV Management	(15)								(15)										
	PUV Management (upgrading)	(15)																		(15)
5	Traffic Enforcement Assistance	911	101	101	142	142	142	142	142											
	Traffic Enforcement Assistance (upgrading)	911											101	101	142	142	142	142	142	
6	Road Management	107			21	21	21	21	21											
	Road Management (upgrading)	107													21	21	21	21	21	
7	Toll/Fare Collection	1,795			359	359	359	359	359											
	Toll/Fare Collection (upgrading)	1,795													359	359	359	359	359	
Total		**10,040**	**109**	**109**	**900**	**900**	**900**	**900**	**900**	**50**	**50**	**50**	**159**	**159**	**950**	**950**	**950**	**950**	**950**	**100**

Note: The values in ( ) are of private investment, and are excluded from the economic evaluation.

Source: JICA Study Team

(2) Operation and Maintenance (O&M) Cost

With regard to the O&M cost of the Mega Manila Master Plan, the cost items and the way in which the financial cost of respective items is converted into economic cost are the same as that of the Metro Manila Master Plan evaluated in the previous chapter. The values of O&M cost to be paid out in the 1st stage, 2nd stage and 3rd stage in terms of both financial cost and economic cost are reflected in the table below.

TABLE 12.8-5 FINANCIAL COST AND ECONOMIC COST OF O&M
(UNIT: PHP. 1,000)

Item	Financial Cost of O&M			Economic Cost of O&M		
	1st Stage (2013-2014)	2nd Stage (2015-2019)	3rd Stage (2020-2030)	1nd Stage (2013-2014)	2rd Stage (2015-2019)	3th Stage (2020-2030)
1. Spare of the Equipment cost	32,748	64,016	126,011	34,582	67,601	133,068
2. Software License	2,911	7,278	16,012	2,562	6,405	14,091
3. Maintenance for Software(10% of TC)	29,967	148,857	352,357	26,371	130,994	310,074
4. Traffic Information Service (Internet connection)	978	2,445	5,379	861	2,152	4,734
5. Radio Frequency License	245	611	1,345	216	538	1,184
6. Telecomunication Charge	571	1,426	3,138	502	1,255	2,761
7. Electricity	14,400	48,000	116,160	12,672	42,240	102,221
8. Staff Cost	38,400	108,000	264,000	20,275	57,024	139,392
9. Running Cost for Office	1,920	4,800	10,560	1,690	4,224	9,293
10. O&M Management (5% of above cost)	6,107	19,272	44,748	4,987	15,622	35,841
11. Physical Contingency (5% of above cost)	6,412	20,235	46,986	5,236	16,403	37,633
Total	**134,659**	**424,940**	**986,696**	**109,952**	**344,456**	**790,290**

Source: JICA Study Team

12.8.3 Quantifiable Economic Benefit of Mega Manila Master Plan

This section is intended for the evaluation of the quantifiable economic benefit of the Mega Manila Master Plan, which consists of benefits generated by the introduction of traffic signal control system, traffic information provision system and the toll/fare collection system as highlighted below.

- Traffic Signal Control Improvement Benefit
- Traffic Information Provision Benefit
- Toll/Fare Collection System Introduction Benefit

(1) Traffic Signal Control Improvement Benefit

As described in the previous section regarding the Metro Manila Master Plan, the introduction of traffic signal control system is expected to generate the 3 kinds of benefits, including TTC saving benefit, fuel consumption reduction benefit, and CO_2 emission reduction benefit.

1) TTC Saving Benefit

The installation of traffic signal control system to be conducted in the Mega Manila Master Plan is expected to generate benefit which can be quantified through the following process.

- Estimating the Value of Traffic Signal Control Improvement Benefit

The values of traffic signal control improvement benefit at average intersection are assumed to be the same as that of the Metro Manila Region. Accordingly, the following two values revealed in the previous **Table 11.8-8** and **Table 11.8-9** are utilized here.

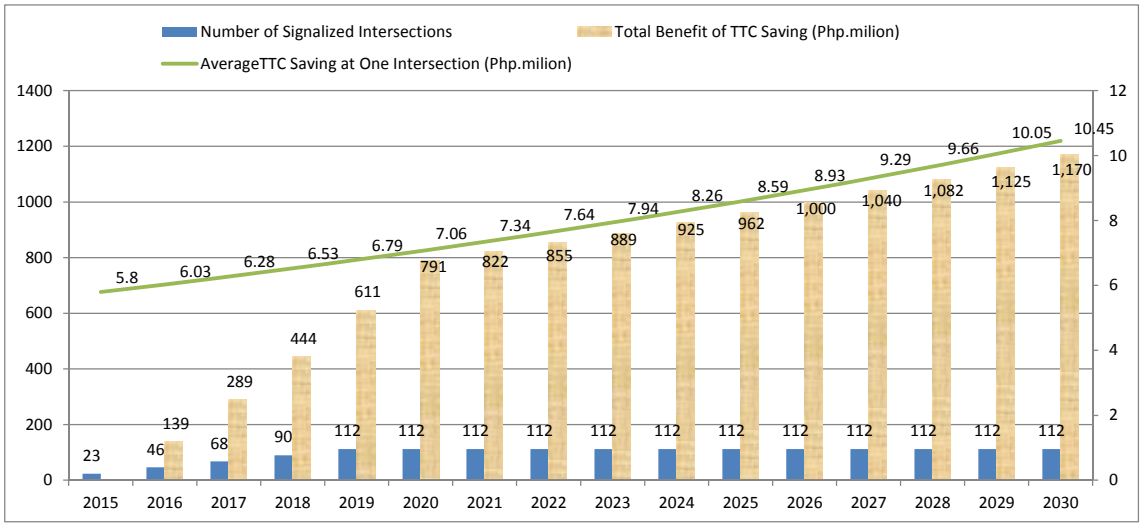
a) The value of average delay reduction at an intersection: 11,457hour/year
b) The above value in terms of money: 5,362,000 peso/year

- Implementation Schedule of Traffic Signal Control System Installation and Annual TTC Saving Benefit Taking into Account Traffic Volume Increase

According to the implementation schedule of the Mega Manila Master Plan, a total of 112 intersections will be signalized within 5 years of the 2nd stage (2015-2019), during which it is assumed that traffic signal control system will be introduced in 22 to 23 intersections each year.

In addition, in view of the larger potential of traffic volume increase in Mega Manila Region as compared to that of Metro Manila Region, the average annual growth rate of traffic volume throughout the project period is estimated to be 4%.

On the basis of the above preconditions and assumption, the TTC saving benefit arising from the reduction of delay time at intersections annually is expected to be yielded in a way illustrated in the diagram below. With the average annual benefit of TTC saving at an intersection expected to increase from Php.6.03 million in the year of 2013 to Php.10.45 million in 2030, the total annual TTC saving benefit is estimated to grow from Php.139 million in 2014 to Php.1,070 million in 2030.



Source: JICA Study Team

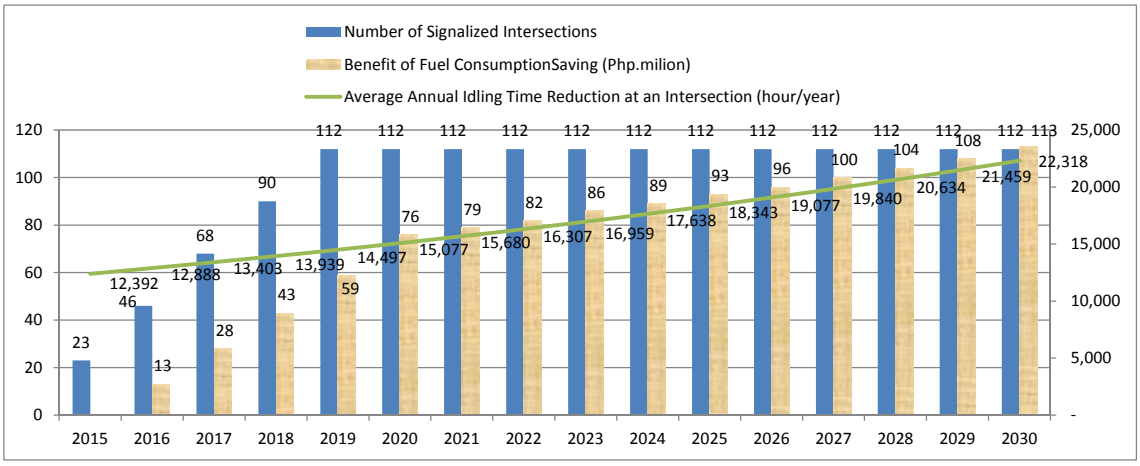
FIGURE 12.8-2 CHANGE OF NUMBER OF SIGNALIZED INTERSECTIONS AND ANNUAL BENEFIT FROM DELAY TIME SAVING (MEGA MANILA MASTER PLAN)

2) Fuel Consumption Reduction Benefit

With respect to the fuel consumption reduction benefit yielded from the saving of vehicles' idling time through traffic signal control improvement, the process of estimation is the same as what has been explained in the previous chapter regarding the Metro Manila Master Plan.

By using the above-mentioned value of average time delay reduction at an intersection, the number of intersections to be signalized during the project period, the values of average traffic volume composition by vehicle type and conversion factors of idling time fuel consumption by vehicle type indicated respectively in **Table 11.8-10** and **Table 11.8-11**, and the values of fuel prices as well as the estimated growth rate of traffic volume throughout the project period (4%), the benefit generated annually can be figured out as shown by the following diagram.

With the average annual idling time reduction at an intersection growing from 12,392 hours in 2015 to 22,318 hours in 2030, the benefit of fuel consumption reduction is expected to increase from Php.13 million in 2016 to Php.113 million in 2030.



Source: JICA Study Team

FIGURE 12.8-3 CHANGE OF NUMBER OF SIGNALIZED INTERSECTIONS AND ANNUAL BENEFIT FROM THE SAVING OF FUEL CONSUMPTION DURING IDLING TIME (MEGA MANILA MASTER PLAN)

3) CO2 Emission Reduction Benefit

The benefit of CO_2 emission reduction deriving from the introduction of traffic signal control system can also be estimated in the same way as what has been conducted in the previous chapter. However, as the values of this benefit are too tiny to be spoken of, discussion regarding this part is omitted here.

(2) Traffic Information Provision Benefit

With respect to the benefit resulted from the provision of traffic information, the evaluation is also focused on the TTC saving benefit.

1) TTC Saving Benefit

As seen from the previous chapter, the benefit accruing from the provision of traffic information is estimated by referring to the existing example of Japan, in which the average reduction ratio of travel time with provision of traffic information is estimated as 4.0%. With reference to this example, the traffic information provision benefit of the Mega Manila Master Plan is estimated as follows.

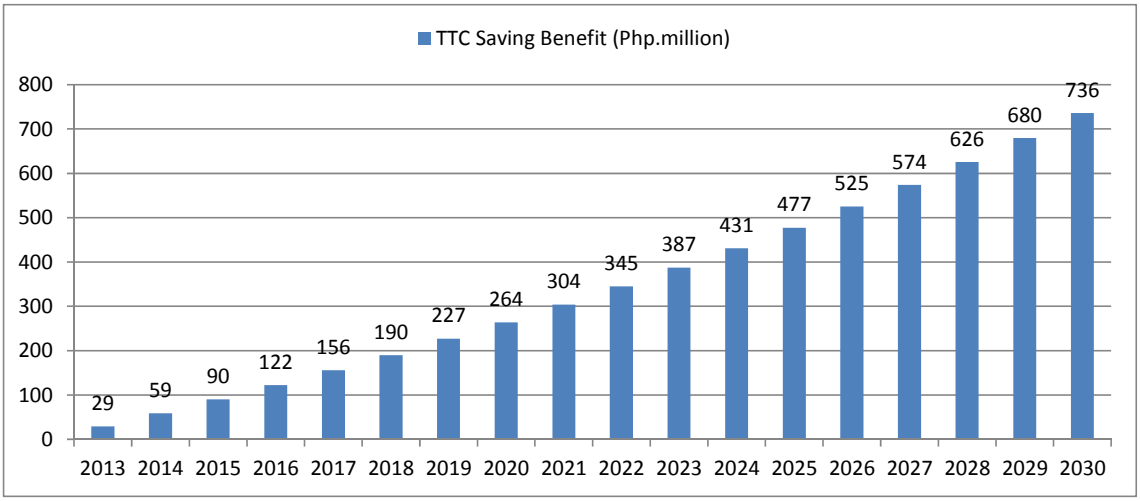
- Estimation of Vehicle Traveling Time Saved Annually by Introducing the Traffic Information Provision System

According to the traffic survey conducted by the JICA Study Team, the total vehicle traveling hours in an average weekday within the Mega Manila Region is 110,346 vehicle hours/day, while the number of weekdays in a year is assumed to be 250 days. Taking all this into consideration, the vehicle traveling hours saved annually by introducing the traffic information provision system can be worked out in the way indicated below:

Annual saving of vehicle traveling hours = 110,346 * 250 days * 4%
= 1,103,000 hours/year

- Estimation of Annual Vehicle Traveling Time Saving Benefit in Terms of Money

Based on the above result, annual vehicle traveling time saving benefit in terms of money accruing from the provision of traffic information is estimated to be 516.4 million peso/year by using the afore-mentioned unit TTC value (7.8 peso/minute/PCU). Assuming this to be the goal of 2030 when the investment on the traffic information provision system is expected to complete finally and considering the annual growth rate of 4% throughout the project period, this kind of benefit is expected to be generated in a way illustrated by the following diagram. The annual TTC saving benefit deriving from traffic information provision is expected to increase from Php.29 million in 2013 to Php.736 million in 2030.



Source: JICA Study Team

FIGURE 12.8-4 TTC SAVING BENEFIT ACCRUING FROM THE INTRODUCTION OF TRAFFIC INFORMATION PROVISION SYSTEM (MEGA MANILA MASTER PLAN)

(3) Toll/Fare Collection System Introduction Benefit

As the toll/fare collection system here refers to the ETC system, this benefit is understood as TTC saving benefit through ETC introduction in this study.

1) TTC Saving Benefit through ETC Introduction

Under the Mega Manila Master Plan, ETC system is expected to be introduced into 3 expressways of the Mega Manila Region, i.e. the Subic-Clark-Tarlac Expressway (SCTEX), the Manila-Cavite Expressway (CAVITEX) and the Southern Tagalog Arterial Road (STAR Tollway). Therefore, evaluation study of ETC introduction benefit is confined to these 3 expressways, and estimation of this benefit is conducted through the following process.

- Estimation of Total Annual Traffic Volume

Based on the result of survey by the Study Team, the values of traffic volume in the above 3 expressways are respectively 10,000 vehicles/day, 11,000 vehicles/day and 9,000 vehicles/day, which amount to a total of 7,500,000 vehicles/year with the assumption that there are 250 days relevant in a year. The way of calculation is as follows:

Total annual Traffic Volume in the 3 Expressways = (10,000+11,000+9,000)*250 = 7,500,000vehicles/year

- Estimation of Average Waiting Time Reduction at Toll Gates

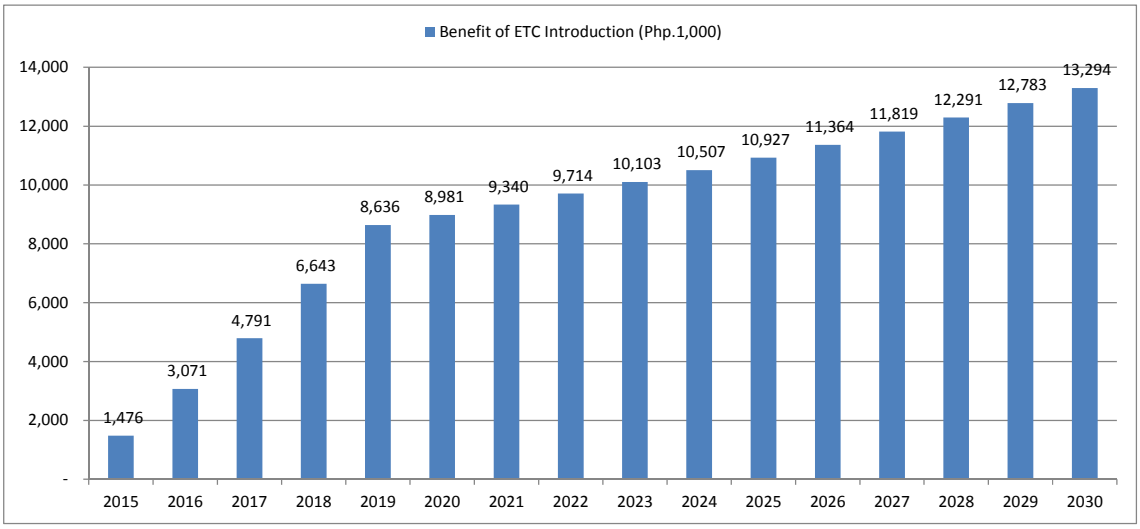
According to the result of a survey conducted by the Traffic Regulation Board (TRB), motorists normally spend at least 12 seconds at a toll gate when paying the toll fare in cash, while transection by e-tap card will only entail 5 seconds. Therefore, the introduction of ETC system is expected to reduce the average waiting time at a toll gate by 7 seconds.

- Estimation of Annual Benefit Accruing from the Reduction of Waiting Time at Toll Gates in Terms of Money

By utilizing the afore-mentioned TTC value (7.8 peso/minute/PCU) and the above results of estimation, the annual benefit accruing from the reduction of waiting time at toll gates in terms of money can be calculated in the following way:

Annual Benefit of Waiting Time Reduction at Toll Gates= 7,500,000*7*(7.8/60) =6,825,000 Php/year

On the basis of the above result of calculation, the implementation schedule of ETC system installation (to be implemented within the 5 years of the 2nd stage from 2015 to 2019) and the anticipation of the 4% annual growth rate of traffic volume, the annual benefit is expected to be generated as illustrated in the following diagram. The TTC saving benefit deriving from ETC system introduction is expected to increase from Php.1,476,000 in 2015 to Php.13,294,000 in 2030.



Source: JICA Study Team

FIGURE 12.8-5 WAITING TIME SAVING BENEFIT ACCRUING FROM THE INTRODUCTION OF ETC SYSTEM (MEGA MANILA MASTER PLAN)

12.8.4 Results of Economic Evaluation

With the values of all the cost items and quantifiable benefit items, major results of economic evaluation of the Mega Manila Master Plan are yielded as follows.

TABLE 12.8-6 MAJOR RESULTS OF ECONOMIC EVALUATION OF THE METRO MANILA MASTER PLAN

EIRR (%)	NPV (Php.million)	B/C
18.5	412	1.11

Source: JICA Study Team

As seen from the above table, EIRR is 18.5%, surpassing the value of SDR (15%), while NPV appears a positive value and B/C value is higher than 1. All these indicators prove the viability of the project. Moreover, as the project contains also a great proportion of unquantifiable benefits, the economic viability should be considered far better than the above quantitative result when taking into consideration all the unquantifiable benefits.

The calculation table with values of cost-benefit stream is presented below.

TABLE 12.8-7 COST-BENEFIT STREAM (MEGA MANILA MASTER PLAN) (UNIT: PHP. MILLION)

Year	Cost									Benefit						Net Economic Benefit
	Initial Cost							O&M Cost	Total Cost	Traffic Signal Control			Traffic Information Provision (TTC Saving)	ETC Introduction (TTC Saving)	Total Benefit	
	Traffic Signal Control	Traffic Information Provision	Traffic Safety Assistance	PUV Management	Traffic Enforcement Assistance	Road Management	Toll/Fare Collection			TTC Saving	Fuel consumption Reduction	CO_2 Emission Reduction				
2013	0	8	0	0	101	0	0	55	164	0	0	0	29	0	29	-135
14	0	8	0	0	101	0	0	69	178	0	0	0	59	0	59	-119
15	155	168	55	0	142	21	359	69	969	0	0	0	90	1	91	-878
16	155	168	55	0	142	21	359	69	969	139	13	0	122	3	277	-692
17	155	168	55	0	142	21	359	69	969	289	28	0	156	5	478	-491
18	155	168	55	0	142	21	359	69	969	444	43	0	190	7	684	-285
19	155	168	55	0	142	21	359	72	972	611	59	0	227	9	906	-66
20	0	50	0	(15)	0	0	0	72	122	791	76	0	264	9	1,140	1,018
21	0	50	0	0	0	0	0	72	122	822	79	0	304	9	1,214	1,092
22	0	50	0	0	0	0	0	72	122	855	82	0	345	10	1,292	1,170
23	0	58	0	0	101	0	0	72	231	889	86	0	387	10	1,372	1,141
24	0	58	0	0	101	0	0	72	231	925	89	0	431	11	1,456	1,225
25	155	218	55	0	142	21	359	72	1,022	962	93	0	477	11	1,543	521
26	155	218	55	0	142	21	359	72	1,022	1,000	96	0	525	11	1,632	610
27	155	218	55	0	142	21	359	72	1,022	1,040	100	0	574	12	1,726	704
28	155	218	55	0	142	21	359	72	1,022	1,082	104	0	626	13	1,825	803
29	155	218	55	0	142	21	359	72	1,022	1,125	108	0	680	13	1,926	904
30	0	100	0	(16)	0	0	0	72	172	1,170	113	0	736	13	2,032	1,860
															EIRR=	18.491%
															NPV(Php million)=	412
															Present value of cost=	3,586
															Present value of benefit=	3,998
															B/C=	1.11

Source: JICA Study Team

12.8.5 Sensitivity Analysis

The sensitivity of the project to potential risks is verified by assuming the following 5 cases:

- Case 1: 10% plus of cost
- Case 2: 20% plus of cost
- Case 3: 10% less of benefit
- Case 4: 20% less of benefit
- Case 5 20% plus of cost and 20% less of benefit

The results of sensitivity analysis on the 5 cases are summed up in the following table.
With the exception of Case 1, the four cases ranging from Case 2 to Case 5 will result in the project's degradation to the unfeasible level.

TABLE 12.8-8 PROJECT SENSITIVITY IN 5 CASES (MEGA MANILA MASTER PLAN)

	Base	Case 1	Case 2	Case 3	Case 4	Case 5
EIRR (%)	18.5	15.4	13.2	14.4	11.4	6.0
NPV (Php.million)	412	55	-235	-62	-388	-1,035
B/C	1.11	1.01	0.94	0.98	0.89	0.76

Source: JICA Study Team

12.8.6 Qualitative Evaluation

With respect to the unquantifiable benefit, major items can be classified by type of beneficiary as seen from **Table 12.8-9**, and the benefits generated by respective ITS user services are indicated in **Table 12.8-10**.

TABLE 12.8-9 MAJOR QUALITATIVE BENEFIT ITEMS BY TYPE OF BENEFICIARY (MEGA MANILA MASTER PLAN)

Type of Beneficiary	Qualitative Benefit Item
The Whole Country	● Benefit of tourism promotion
	● Benefit of business promotion
General Road Users	● Benefit of faster moving traffic flow in the overall road network
	● Benefit of traffic accidents reduction
	● Benefit of better operation by logistics service suppliers
	● Benefit of users' psychological comfort
Road and traffic Managers	● Benefit of traffic regulation manpower cost reduction
	● Benefit of road maintenance cost reduction
	● Benefit of capacity building for road management agencies

Source: JICA Study Team

TABLE 12.8-10 QUALITATIVE EVALUATION OF UNQUANTIFIABLE BENEFIT ITEMS (MEGA MANILA MASTER PLAN)

ITS Development Area	ITS User Services	Benefit for the whole Country		Benefit for General Road Users				Benefit for Road and Traffic Managers		
		Tourism Promotion	Business Promotion	Faster Moving Traffic flow	Traffic Accident Reduction	Better Operation by Logistics Service Suppliers	Users' Psychological Comfort	Manpower Cost Reduction	Road Maintenance Cost Reduction	Capacity Building for Management Agencies
1. Traffic Signal Control System	(1) **Advanced Traffic Control System** at Intersections to improve traffic safety			●	●			●		
2. Traffic Information and Provision System	(2) **Traffic Information Collection and Provision System** on real-time basis for faster and comfortable travel	●					●			
	(2) Weather Condition and Prediction Information Provision System for safer travel and to improve resiliency to natural disaster				●					
	(3) **Commercial Vehicles Location System** to efficiently manage cargo movement		●			●				●
	(4) Standardization and Integration of Traffic Information and Provision System for comfortable and reliable travel throughout the toll expressway	●	●							
3. Traffic Safety Assistance System	(6) **Danger Warning System** to reduce Road Crashes to improve traffic safety			●	●					
4. Public Utility Vehicle Management System	(7) **Bus Operation Monitoring and Control System** for illegal bus operation			●				●		
5. Traffic Enforcement Assistance	(8) **Traffic Rules Surveillance and Control System** to achieve smooth traffic flow and to reduce road crashes			●	●			●		
	(9) **Overloaded Truck Control System** to provide better surfaced roads			●	●				●	
	(10) **Over Speeding Control System** to improve traffic safety			●	●			●		
6. Road Management System	(11) **Upgrading Road Condition Information Collection** to improve road management and to secure service level									●
7. Toll/Fare Collection System	(12) **Inter-operability System** to achieve seamless travel on toll expressways	●	●							
	(13) **Standardization of Toll Collection System** to promote ETC and/or non-cash payment toll collection and interoperability	●	●							

Source: JICA Study Team

CHAPTER 13
MEASURES FOR SUSTAINABLE ITS DEVELOPMENT

13.1 WHAT TO BE DONE FOR ITS PROMOTION

For successful implementation of the Master Plan, various aspects need to be considered as follows;

- Creation of strong body for ITS Promotion
- Institutional Arrangements: each agency has its own mandate. Sometimes several agencies have similar mandates, thus these agencies need to coordinate with each other and also share information to avoid overlapped information collection as well as to utilize information effectively.
- Education of Drivers/Pedestrians and Strict Enforcement
- Capacity Development of Agencies Concerned
- Promotion of Private Sector Initiative
- Measures to Cope with Fast Development of IT and ITS Technologies
- Development of Communication Infrastructure

13.2 CREATION OF STRONG BODY FOR ITS PROMOTION

13.2.1 Japan's Case

In order to promote ITS in Japan, the Japanese Government created the following body directly under the Prime Minister.

FIGURE 13.2-1 JAPAN'S CASE

13.2.2 Application of Japan's Case to the Philippines

Similar body as Japan should be also created in the Philippines for promotion of ITS.

FIGURE 13.2-2 CREATION OF STRONG BODY FOR ITS PROMOTION

13.3 TRAFFIC INFORMATION COLLECTION AND PROVISION SYSTEM

13.3.1 Japan's Case

Various agencies collect and provide traffic information. In consideration of jurisdiction of each agency, information is integrated at one body and provided to the public.

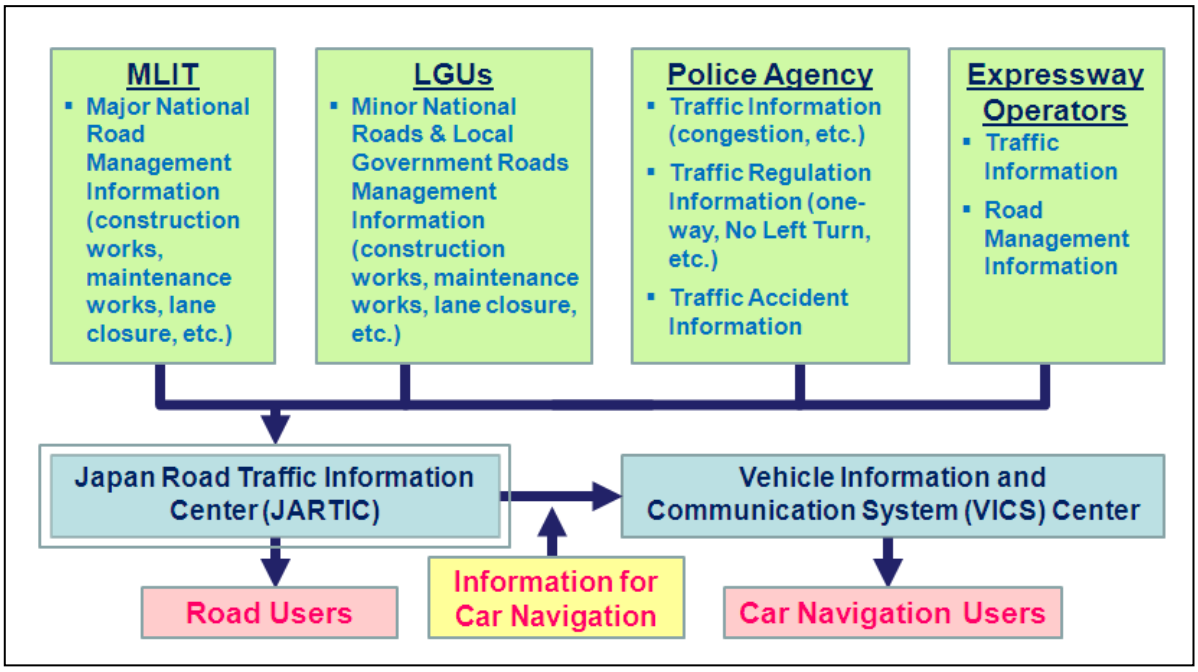


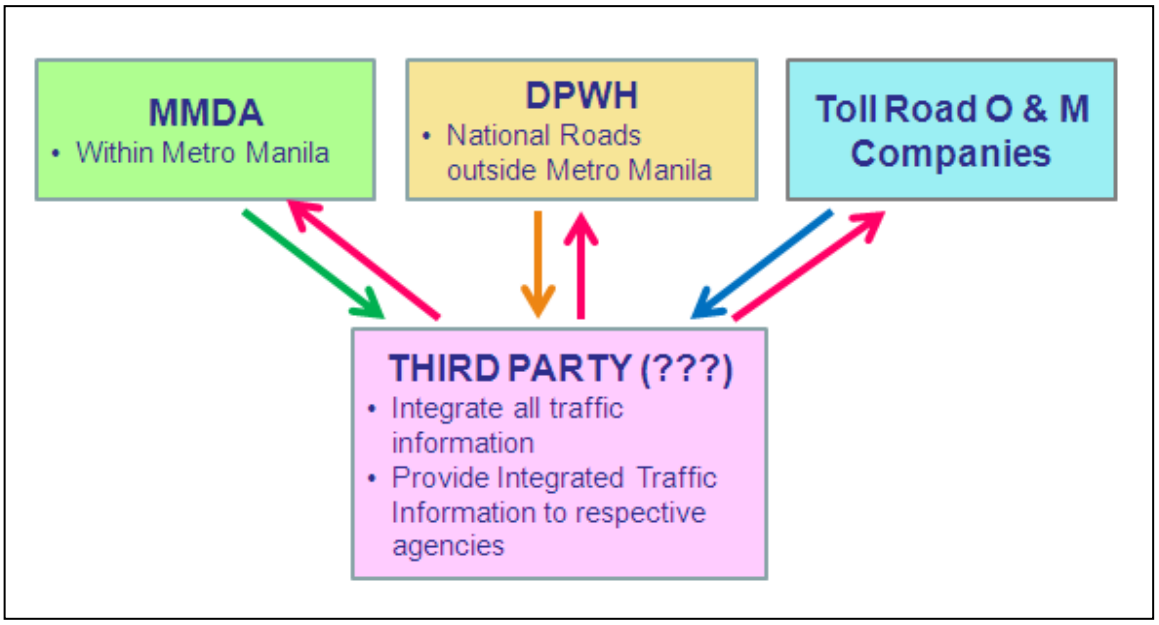
FIGURE 13.3-1 JAPAN'S CASE FOR TRAFFIC INFORMATION AND PROVISION SYSTEM

13.3.2 Integration of Traffic Information in the Philippines

Current responsibility for traffic information collection and provision system in the Philippines is as follows;

MMDA: within Metro Manila
DPWH: National roads outside Metro Manila
Toll Road O & M Companies: respective toll road in-charge

Since socio-economic activities are expanding outside Metro Manila, all traffic information should be integrated by "one body" which maybe MMDA or "a third party" and integrated traffic information should be fed back to respective agency for proper sharing of traffic information.



Source: JICA Study Team

FIGURE 13.3-2 PROPOSED INSTITTUTIONAL ARRANGEMENT OF TRAFFIC INFORMATION AND PROVISION SYSTEM

13.4 PUBLIC TRANSPORT MONITORING SYSTEM

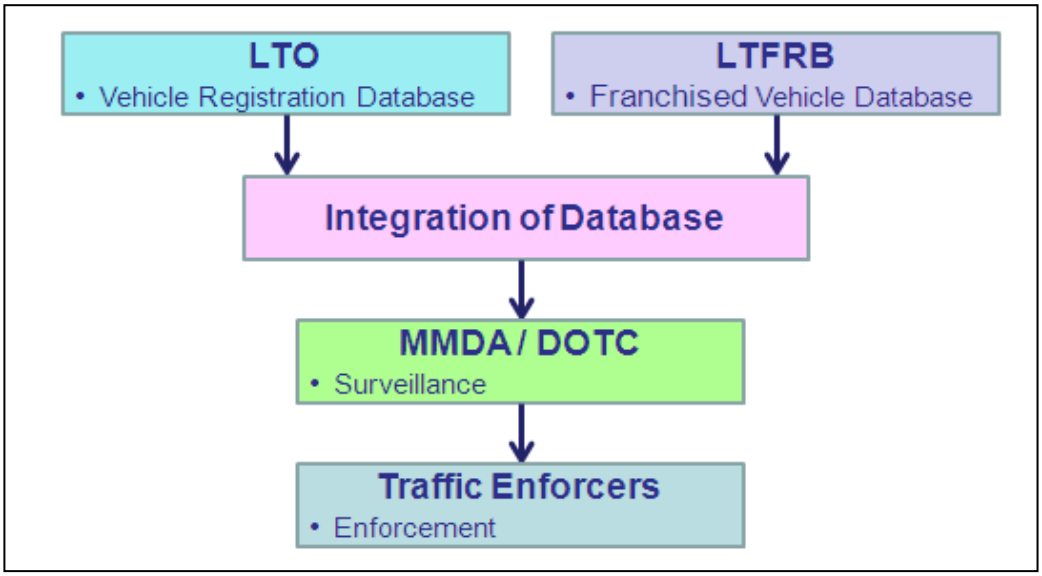
Current responsibility of concerned agencies is as follows:

Land Transportation Office (LTO): vehicle registration

Land Transportation Franchising Regulatory Board (LTFRB): Issuance of franchise for public transport

MMDA and DOTC: Surveillance of operation of franchised public transport

Traffic Enforcer deputized by LTO and LTFRB: Enforcement



Source: JICA Study Team

FIGURE 13.4-1 PROPOSED INSTITTUTIONAL ARRANGEMENT OF PUBLIC MONITORING SYSTEM

13.5 OVERLOAD TRUCK CONTROL SYSTEM

Current responsibility of concerned agencies is as follows:

- Weighing
  - Done by DPWH for National Roads.
  - Done by Toll Road Operator for Toll Road.
- Stopping truck to weigh trucks
  - For National Roads, usually done by DPWH personnel deputized by LTO, but in the presence of PNP personnel.
  - For Toll Road, done by Toll Road traffic deputized by LTO.
- Apprehension
  - For National Roads, usually done by DPWH personnel deputized by LTO, in the presence of PNP personnel. The vehicle plate or driver's license is confiscated, a Temporary Operator's Permit (TOP) is issued to the driver, and a copy of the TOP is turned over to LTO for imposition of penalties.
  - For Toll Road, done by Toll Road traffic personnel deputized by LTO. The vehicle plate or driver's license is confiscated, a Temporary Operator's Permit (TOP) is issued to the driver, and a copy of the TOP is turned over to LTO for imposition of penalties. The truck is escorted out through the nearest expressway exit.

Close collaboration among agencies concerned is required to efficiently perform this system.

13.6 TRAFFIC RULES SURVEILLANCE AND CONTROL SYSTEM

The following are authorized to perform this function:

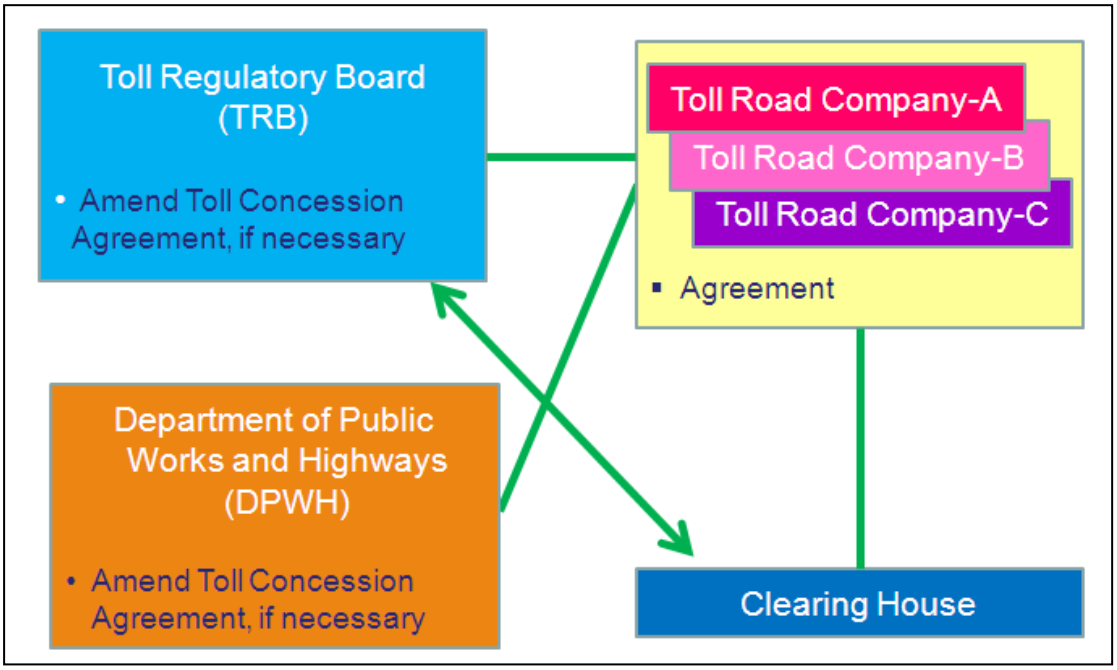
- MMDA for National and Local Roads within Metro Manila – by virtue of the MMDA charter (RA 7924)
- LGU for National and Local Roads within the city/municipality – by virtue of the Local Government Code and City/Municipal Ordinances.
- LTO for all roads throughout the country – by virtue of the Land Transportation and Traffic Code (RA 4136) and the LTO charter (EO 125, series of 1987).
- Highway Patrol Group (part of PNP) and other PNP personnel – if deputized by LTO.

Close collaboration among agencies concerned is required to efficiently undertake this system.

13.7 TOLL ROAD INTEROPERABILITY SYSTEM

In order to realize this system, all toll road operators must agree to this system under the guidance of Toll Regulatory Board (TRB) and DPWH. If necessary, toll concession agreement or

supplemental toll operation agreement will be amended to recover additional investment on the part of toll road operators.



Source: JICA Study Team

FIGURE 13.7-1 PROPOSED INSTITTUTIONAL ARRANGEMENT OF TOLL ROAD INTEROPERABILITY SYSTEM

13.8 EDUCATION OF DRIVERS AND PEDESTRIANS AND STRICT ENFORCEMENT

Sixty-two (62%) of road users pointed out that "Driver's Behavior" is serious traffic problem and 71% of road users suggested that "Strict Enforcement of Traffic Rules/Regulations" is one of the priority solution for reduction of traffic congestion. Although this Master Plan recommends ITS solutions for improvement of traffic safety and enforcement, ITS services alone will not solve traffic problems. It must be accompanied by 3Es, i.e. Engineering, Enforcement and Education.

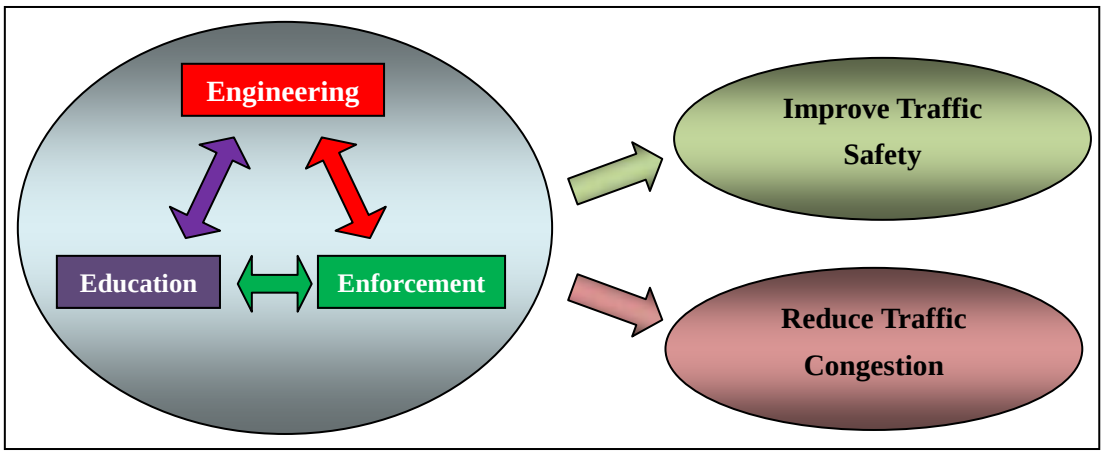


FIGURE 13.8-1 3E COMPONENT TO ASSIST ITS INTRODUCTION

13.8.1 Education of Drivers and Pedestrians

DOTC together with related agencies such as DPWH, MMDA, LGUs, PNP-HPG, DILG, UP-NCTS is implementing "Philippine Road Safety Action Plan (PRSAP) 2011-2020. PRSAP consists of five (5) pillars and fifteen (15) sectors as shown in **Table 13.8-1.**

TABLE 13.8-1 FIVE PILLARS OF PRSAP

Pillar 1: Improve Road Safety Management

- Coordination and Management on Road Safety (Sector 1)
- Road Crash Data System (Sector 2)
- Road Safety Funding (Sector 3)
- Traffic Legislation (Sector 10)
- Road Safety Research (Sector 13)
- Road Crash Costing (Sector 14)

Pillar 2: Safer Road

- Improvement of Hazardous Location (Sector 5)
- Safe Planning and Design of Roads (Sector 4)

Pillar 3: Safer Vehicles

- Vehicle Safety Standards (Sector 9)

Pillar 4: Safer Road Users

- Road Safety Education for Children (Sector 7)
- Driver Training and Testing (Sector 7)
- Road Safety Publicity Campaigns (Sector 8)
- Traffic Police and Law Enforcement (Sector 11)
- Private Sector and Community Involvement (Sector 15)

Pillar 5: Improve Trauma Care and Rehabilitation

- Emergency Assistance to Road Crashes Victims (Sectors 12)

Sectors 7and 8 of Pillar 4 highlights education of drivers and children and include the following;

- Youth for environment and safety (YES) movement caravans
- Revise the license issuance system through mandatory requirement road safety training for new and professional drivers, conductors as a pre-requisite for licensing
- Obligate a percentage of license fees for driver training and capacity enhancement

- Development of training and testing modules for motor cycle riders and drivers skills raters
- Set-up test facilities including driving simulator
- Establish a merit/demerit system appended to drivers licenses which can be a basis for penalties, trainings, insurance purposes, license revocation
- Comprehensive education on public road use and road ethics
- Defensive driving seminar on a public road use and road ethics

Above program should be further strengthened and all drivers and pedestrians should be educated to strictly follow traffic rules and regulations.

13.8.2 Traffic Enforcement

Traffic enforcement is also quite important to achieve smooth traffic flow and traffic safety. PRSAP has the following programs;

- Increase number of traffic discipline zones
- Sustained enforcement on traffic laws especially on anti-overloading and over-speeding campaigns
- Clearing of sidewalks of obstruction
- Prohibition of bicycles and tricycles and unauthorized modes of transport on national roads
- Require cyclists to wear safety gear
- Continue professionalization program for traffic law enforcers
- Acquisition of equipment and supplies for field enforcement
- Increase patrol visibility and deployment of deputized law enforcement officers especially in identified black spots
- Investigation of road crashes to determine causes and propose corrective measures.

Above program should be further strengthened.

At present, it is during off-peak hours that the enforcers are expected to strictly enforce the rules, including apprehensions and ticketing, as this process will significantly cause or add to congestion. With the utilization of ITS equipments/devices, strict traffic enforcement during traffic peak hours can be possible without adding traffic congestion.

13.9 CAPACITY DEVELOPMENT OF AGENCIES CONCERNED

Most ITS projects started since 2010, thus history of ITS projects is not long and experiences obtained from implemented projects are not much yet. While IT technology as well as ITS technology are progressing rapidly. Capacity development of agencies concerned is an urgent

need.

One of the most effective ways of capacity development is through implementing ITS projects. On-the-job training can be done through implementing projects.

Another aspect will be coordination and cooperation of agencies concerned and also private sector and academic sector. All sectors should exchange ideas on new technologies being adopted or to be adopted, latest as well as planned technology and technologies in the overseas countries. This function can be done by ITS-Philippines which is to be established in the near future.

(1) DPWH

DPWH's primary policy and thought is still road facility expansion/improvement oriented. How to efficiently utilize existing facility is still the second thought. Since demand for facility expansion/improvement is still quite high, therefore, this approach is understandable.

However, traffic problems are becoming serious year by year in the periphery of Metro Manila; DPWH should be ready to act on mitigation of traffic problems in these areas.

Capacity development is recommended through the following measures;

- On-the-job training through implementation of projects recommended by this Master Plan
- Coordination and cooperation with MMDA
- Active participation to the activities of ITS-Philippines which will be organized in the near future
- Constant coordination with ITS-related private companies

(2) MMDA

MMDA is the most advanced agency in the field of traffic information collection and provision system, intersection traffic control system and PUV monitoring system. Areas needed for capacity development are as follows;

- Optimum route search technology utilizing information from floating cars and cloud source data
- MMDA is highly depending on subjective evaluation which is currently correct direction; however, time will come to do objective evaluation of traffic condition to provide more accurate information.
- To achieve above two issues, MMDA may request JICA to dispatch a long-term ITS specialist for daily consultation with him.

(3) DOTC

Capacity of DOTC staff needs to be developed through the implementation of on-going/near future projects such as;

- Updating of database of vehicle registration
- Common ticketing system for LRT-1, LRT-2 and MRT-3.

13.10 MEASURES TO COPE WITH FAST DEVELOPMENT OF IT AND ITS

Development of IT and ITS technologies is quite and fast. Also life of TS equipment is not so long (3-7 years). Therefore, systems introduce must be upgrade periodically. At the same time, this Master Plan should be periodically updated, say every 5 years. The project cycle of ITS project is shown in **Figure 13.10-1**.

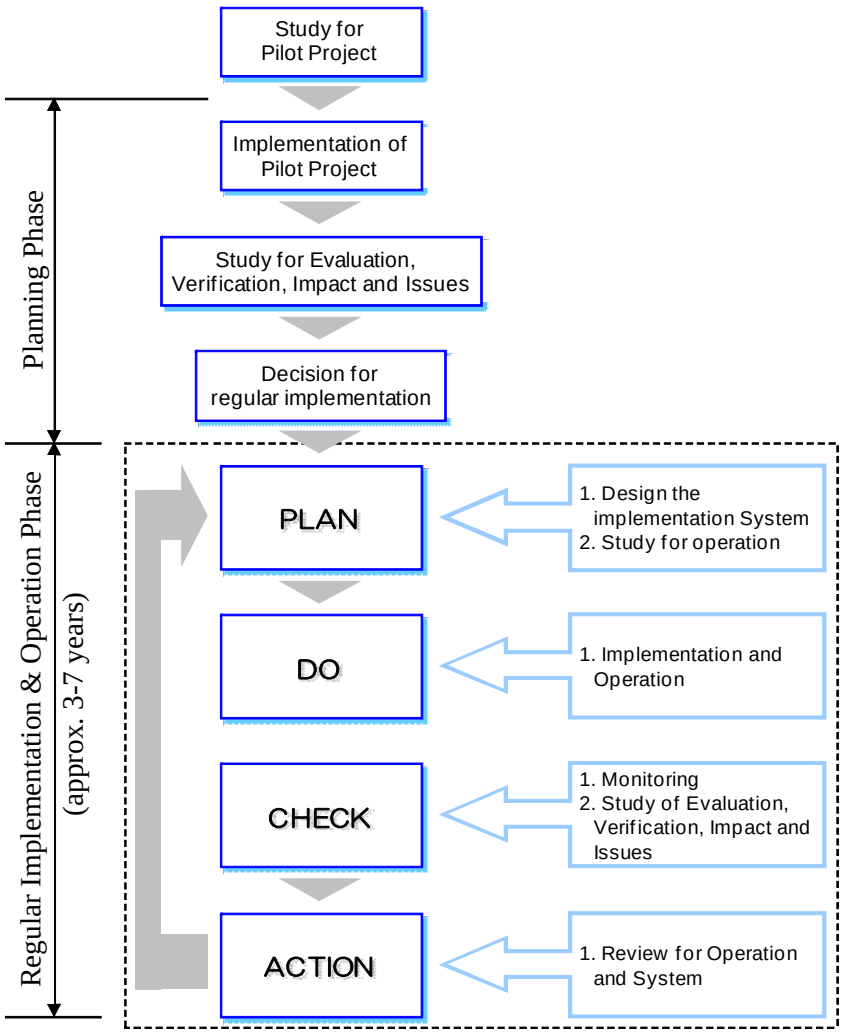


FIGURE 13.10-1 PROJECT CYCLE OF ITS PROJECT

To cope with such circumstances, one of the ways is to treat ITS services as a business or an

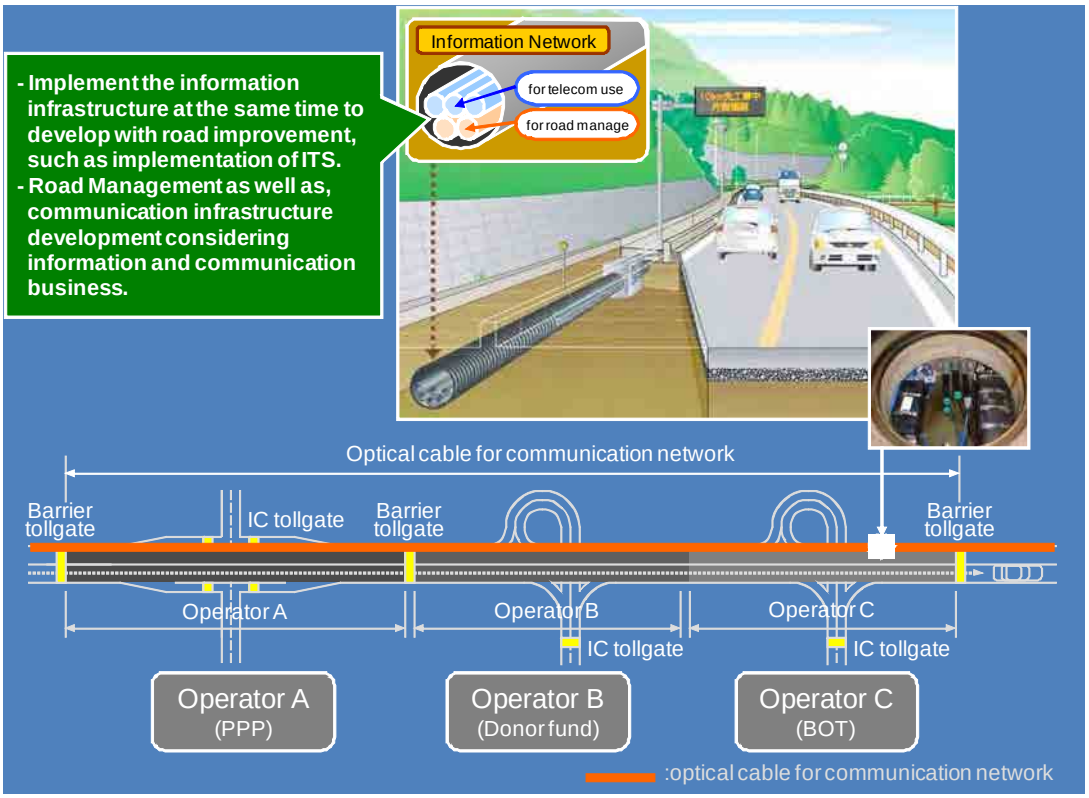
income generating project. Two examples are shown below:

Example-1: Optical Fiber Cable or Its Duct Lease Business

DPWH or Expressway operators will construct a duct for optical fiber cable or install optical fiber cable along national roads or expressways. DPHW or Expressway operators can lease a part of optical fiber cable or a part of duct to the private companies such as tele-communication companies. Revenue from lease fee can be used for up-grading of ITS services.

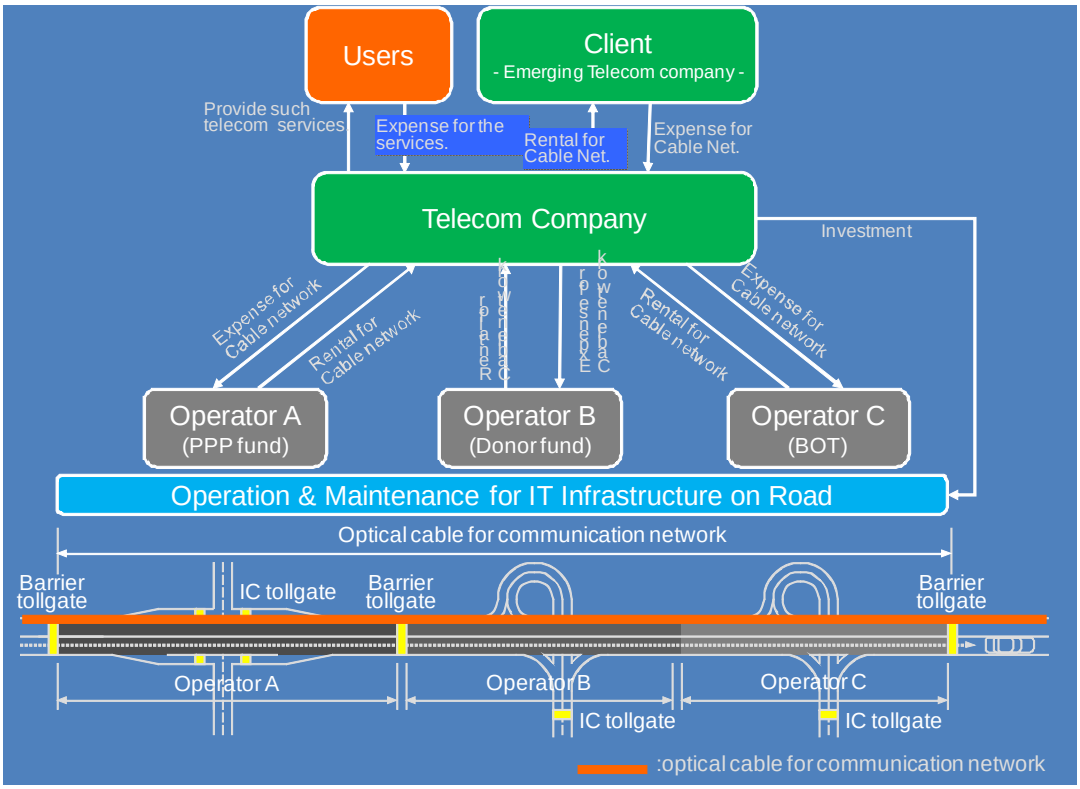
Example-2: Floating Car Data Selling Business

A company which collects traffic and other information from floating cars will be established. A company will collect various data from floating cars and process data in accordance with needs of other private companies such as driving school, logistics company, taxi company, insurance company etc.. Processed data will be sold to said private companies needed data. For Government agencies, processed data will be provide free of charge.



Source: JICA Study Team

FIGURE 13.10-2 CONSTRUCTION OF OPTIC FIBER CABLE DUCTS FOR BUSINESS BY DPWH OR EXPRESSWAY COMPANY



Source: JICA Study Team

FIGURE 13.10-3 BUSINESS MODEL: LEASE OF OPTIC FIBER CABLE DUCT

Driving Image

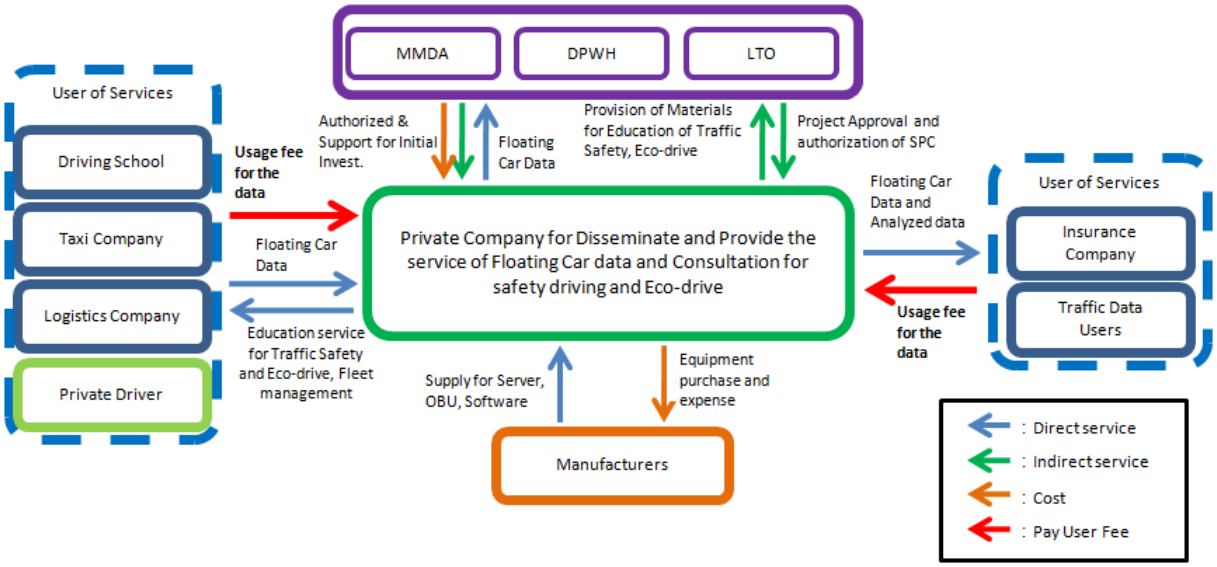
Driving Speed

Floating Car Data

Assessment of Driving Technique

Source: Data Tech

FIGURE 13.10-4 DATA COLLECTION FROM FLOATING DATA



Source: JICA Study Team

FIGURE 13.10-5 BUSINESS MODEL: SELLING OF DATA COLLECTED BY FLOATING CAR

13.11 PROMOTION OF PRIVATE SECTOR INITIATIVE

Introduction of ITS technology by the private sector will benefit to them such as;

- Bus Operation Monitoring and Control System
  - Bus company can monitor operation of buses at real-time.
  - If some buses is delayed in operation or have some problems during operation, the company can prepare to dispatch another bus.
  - By informing passengers the arrival time of buses, the company can attract more passengers.
- Commercial Vehicle Location System
  - By observing truck movements at real-time, Truck Company can assure of arrival time of commodities to their clients without delay. The company will gain trust from the clients.
  - By observing traffic congestion/temporary traffic bottleneck, the company can instruct the drivers the optimum route to be selected, so that delivery of commodities can be efficient.
  - The company can plan efficient delivery route so that trucks can reduce the number of trips.

The Government should advocate the private companies to adopt such ITS services as much as possible so as to contribute for mitigation of traffic congestion.

The Automobile Makers are trying to develop safe driving devices/systems, some of which are as follows;

- Equipment to avoid rear-end collision
- System to detect vehicles/persons coming from cross roads and/or pedestrians on the carriageway
- System to prevent drivers from falling asleep while driving
- System to detect persons/pedestrians ahead
- System to detect whether a driver drank alcohol or not.

Above devices/system will definitely promote traffic safety. The Government should assist for promotion of above devices/systems.

As mentioned in Section 13.10, ITS technology can be a business for a private sector.

ITS-Philippines can be a good organization to promote ITS technology and its application for a private sector.

13.12 DEVELOPMENT OF COMMUNICATION INFRASTRUCTURE

Communication infrastructure needs to be developed in order to adequately implement proposed ITS services.

(1) Current Situation of and Policy of Information and Communication of Infrastructure in the Philippines

Current penetration of broadband is only 1.89% per 100 inhabitants. The fixed-line household penetration is only 7.04% of the nationwide, 26.44% in Metro Manila.

The Department of Science and Technology (DOST) established a policy that “Internet Opportunities for All People” in the Philippine Digital Strategy. Following goals are set for realization of the policy for the information and communication infrastructure;

- Average Prices for basic broadband Internet to reduce at least 5% annually
- Investment in infrastructure expansion, especially into rural areas to increase 10% annually
- 80% of households to have access to 2Mbps

(2) Information and Communication Infrastructure in DPWH and MMDA

In DPWH, the communication line has been established between the Regional Offices and the Central Office, but the capacity is only 2.048kbps. DPWH has also decided to develop the line

between District Offices and the Regional Offices, with the capacity of 514kbps. These lines are leased from the private telecommunication companies; therefore DPWH has to pay running costs.

MMDA has its own communication network by using WiMAX (IEEE 802.16-2004), it has secured the communication capacity of up to 74.81 Mbps technically.

(3) Information and Communication Infrastructure in the Development of Future ITS

The information and communication network is the foundation for developing ITS. In particular, IP cameras will be widely utilized for surveillance and observation of traffic condition of roads and so on. The image data transmitting requires the large capacity of information and communication line, compared to the text data. Therefore, the information and communication infrastructure development is the basis and essential for ITS.

CHAPTER 14
SELECTION OF PILOT PROJECTS FOR FEASIBILITY STUDY

14.1 PILOT PROJECT SELECTION CRITERIA

Succeeding the formulation of the Master Plan, feasibility studies for selected pilot projects will be undertaken by this Study.

The criteria for selecting the pilot projects were established as follows:

PILOT PROJECT SELECTION CRITERIA

- High Priority Projects
- Adoption of latest/new applicable ITS Technology
- High impacts on reduction of traffic congestion, promotion of safety and environmental improvement
- Possible application of Japan's ODA

14.2 RECOMMENDED PILOT PROJECTS FOR F/S

Based on these criteria, the following six (6) pilot projects are recommended for feasibility studies:

- Phase III of Metro Manila Traffic Signal Control Project
- Experimental Project of Traffic Signal Control
- Metro Manila Route Guidance System
- RFID-based Bus Travel Time Information Provision System
- Traffic Information Provision System along Manila North Road(MNR)/North Luzon Expressway(NLEX) Corridor
- Standardization of ETC System for Toll Roads

Table 14.2-1 shows the matrix related each recommended project and these criteria.

TABLE 14.2-1 RECOMMENDED PILOT PROJECT FOR F/S AND SELECTION CRITERIA MARIX

Study Area	ITS System Proposed in Master Plan	Recommended Pilot Project for F/S	Selection Criteria			
			High Priority Project	Latest/new Applicable ITS Technology	High Impacts on Traffic Congestion, Safety and Environment	Possible Application for Japan's ODA
Metro Manila	(1) Advanced Traffic Control System at Intersection	(1) Phase III of Metro Manila Traffic Signal Control Project	○ High	○	○	◎ Candidate for ODA Project
		(2) Experimental Project of Traffic Signal Control	○ High	○	○	◎ Candidate for Technical Assistance
	(4) Route Guidance system to direct drivers	(3) Metro Manila Route Guidance System	○ High	◎ Utilizing Floating Car Data	○	◎ Candidate for Technical Assistance
	(3) Upgrading Traffic Information Collection and Provision System on Real-time Basis	(4) RFID-based EDSA Bus Travel Time Provision System	○ High	○ Information Provision to Public Transport Passenger	○	◎ Candidate for Technical Assistance
Mega Manila	(2) Traffic Information and Provision System on Real-time Basis	(5) Traffic Information Provision System along Manila North Road/North Luzon Expressway Corridor	○ High	△	○	◎ Candidate for Technical Assistance
	(3) Standardization of Toll Collection System	(6) Standardization of ETC System for Toll Roads	○ High	△	○	–

Source: JICA Study Team

(1) Phase III of Metro Manila Traffic Signal Control Project

MMDA is implementing a Traffic Signal Control Project with the following schedule:

Phase I : 85 Intersections. Contractor was already selected and this phase is scheduled to be completed in 2013.

Phase II : 201 intersections. MMDA is requesting the Government to allocate Php 525 Million in the 2013 National Budget.

Phase III : Remaining intersections (150 intersections) and 212 new signalized intersections. Cost is estimated at about PhP 1,743 Million.

Since Phase I is already under implementation and Phase II is in the stage of budgeting, therefore, only Phase III can be candidate for a feasibility study. If MMDA wishes, this project can be a candidate for Japan's Yen Loan.

(2) Experimental Project of Traffic Signal Control

To identify the experimental project site, field survey was conducted by study team.
Five candidate project site is shown in **Figure 14.2-1**.

1) Alabang-Zapote Road
2) E. Rodriguez Ave.
3) Shaw Blvd.
4) Taft Ave.
5) Bicutan and Sucat intersection

Source: JICA Study Team

FIGURE 14.2-1 CANDIDATE EXPERIMENTAL PROJECT SITE

Based on the field survey and hearing from MMDA Traffic Engineering Center, experimental project site is recommended as **Bicutan and Sucat Intersection** shown in **Table 14.2-2**.

This project is proposed to be implemented as an "experimental project" of JICA Technical Assistance, subject to approval of MMDA and JICA.

This system proposed the latest information collection equipment and floating car/crowed source data may be introduced for better traffic control.

TABLE 14.2-2 FIELD SURVEY RESULT OF CANDIDATE TRAFFIC SIGNAL PROJECT SITE

Candidate Site	Field Survey and Review Result	
Alabang-Zapote Road	There were very heavy traffic congestions along road. Though there were many traffic congestion causes such as jeepneys loading and unloading, many jaywalkers and many vehicles from/to roadside buildings. Since the replacement of some old signal controllers has been started by LGU requirement, it does not prefer for selecting the experimental project site.	Not recommended
E Rodriguez Ave	Heavy traffic congestions were not seen along this road. All installed traffic signal was new LED ramps, which is not needed the replacement of equipment. Also the issues of present corridor signal control were not seen. Since it may not have big impact for traffic condition, this site is not selected as the experimental project site.	Not recommended
Shaw Blvd	The bottleneck was the intersection of Shaw Blvd. and EDSA, which signalized intersection, will be replaced in Phase-1 Project. If traffic signals are installed along Shaw Blvd in this experimental project, it is necessary to coordinate with phase-1 signal system. Without disclosure of phase-1 signal system, it is impossible to compatible with phase-1 signal system.	Not recommended
Taft Ave.	It is expected that traffic condition will be good if advanced signal controller are installed. These intersections are controlled by signal as not only corridor control but also area traffic control by SCATS. Since presently it is difficult to compatible signal model with SCATS, if new signal controlled system along this road, it may become worse traffic condition in total.	Not recommended
Bicutan and Sucat intersection	Presently these two sites are un-signalized intersections. These sites are two intersections located near due to diamond type interchange of SLEX/ Skyway. Especially intersections shape are six approaches composed of SLEX/Skyway Interchange, main road and service road. Eight to ten enforcers are usually controlling traffic at each intersection on whole day. Since un-signalized complicated intersection may be difficult to control manually for consideration of traffic smooth and safety, it is recommended to install the advanced traffic control system.	***Recommended***

Alabang-Zapote Road

E Rodriguez Ave(4-lane)

Shaw Blvd(6-lane)

Taft Ave.

Source: JICA Study Team

FIGURE 14.2-2 PHOTO OF FIELD SURVEY FOR TRAFFIC SIGNAL CONTROL

(3) Metro Manila Route Guidance System

MMDA is developing "Route Guidance System" utilizing floating car and crowd source information. A feasibility study will highlight the system to select the optimum route in terms of travel time. It will also select second and third optimum routes for the convenience of road users. A feasibility study will also recommend how to improve the accuracy of travel time estimates.

(4) RFID-based EDSA Bus Travel Time Information Provision System

This system intends to provide travel time information to bus passengers along EDSA and is the top priority project of MMDA. Rail passengers can also utilize this information, thus public transport passengers can be provided with modal choice information along EDSA. This system will be integrated in the Automated Traffic Navigation System (ATNAV) which is the second generation of the present Traffic Navigation System (TNAV).

This project is intended to be implemented by JICA technical assistance if both JICA and MMDA will agree on it as an experimental project.

(5) Traffic Information System along Manila North Road/North Luzon Expressway

The project intends to provide traffic information on the Manila North Road and the North Luzon Expressway which are running almost parallel with each other. Information provided will support road users to decide which road to be selected; thus, the two roads will be efficiently utilized, (e.g., when the Manila North Road is congested, road users may select the North Luzon Expressway, or vice versa).

This project is intended to be implemented by JICA technical assistance if all parties (DPWH, NLEX Operator, and JICA) agree on it as the experimental project.

(6) Standardization of ETC System for Toll Roads

ETC users must be increased to reduce traffic congestion at toll gates. One of the problems preventing the increase of ETC users is that toll road operators are adopting different ETC systems and a road user needs to buy an on-board-unit of each toll road operator. The ETC system must be standardized, and a clearing house needs to be established.

A feasibility study will recommend ETC standards and establishment of a clearing house.

CHAPTER 15
PHASE III OF METRO MANILA TRAFFIC SIGNAL CONTROL PROJECT

15.1 INTRODUCTION

15.1.1 Background

MMDA is currently operating the traffic signal control system at **436** intersections, which were introduced more than 10 years ago and became obsolete. Even spare parts for the system are no longer available.

MMDA decided to upgrade all the traffic signal control system of intersections: Metro Manila Traffic Signal Control Project. The project is implemented in 3 phases as follows:

Phase I : Upgrading of traffic signal control system at **85** intersections. The contractor was already selected and started the work. It is expected that Phase I is completed within 2013. The Project includes the development of Traffic Control Center. Phase I is estimated to be **300 Million Php**. All major intersections were selected, thus there are scattered at various areas in Metro Manila.

Phase II : Upgrading of the traffic signal control system at **201** intersections mainly located in Quezon City and a part of Manila City. MMDA already secured a national budget for Phase II of **525 Million Php.**

Phase III : Upgrading of traffic signal control system at the remaining **150** intersections which are mainly located in Manila City. The Study Team recommended to include installation of traffic signal control system at **212** intersections which remain at present as non-signalized intersections. A total of **362** intersections will be signal-controlled under this phase.

Since Phase I is on-going and Phase II is ready for implementation, this Chapter confirms feasibility of Phase III Project.

15.1.2 Objectives of the Project

The Project aims at the following:

1) To improve traffic flow at intersections.

– Intersections are major traffic bottlenecks, causing travel delay and additional consumption of fuels.

2) To improve environmental conditions.
   – Contribution for less emission of CO_2.

3) To improve traffic safety.
   – Reduction of road crushes.

15.2 PROJECT OUTLINE

15.2.1 Types of Intersection Signalization

There are two (2) types of work as follows;

- Upgrading of existing traffic signal control system ……. 150 intersections
- Signalization of currently non-signalized intersection …….. 212 intersections of which locations are shown in **Annex 15.1.**

(1) Upgrading of Existing Traffic Signal Control System

Although Phase I adopts loop-coil type of traffic detector, it is recommended to adopt image recognition type of traffic detector. Loop-coil type which is embedded for each lane in the pavement is easily damaged or destroyed by pavement repair/reconstruction work, while image recognition type which is installed overhead and can cover at least four (4) lanes is recommended.

(2) Signalization of Currently Non-signalized Intersection

For this type of work, the following works need to be implemented together with signalization;

– Improvement of intersection geometry including installation of exclusive left turn lane.
– Shifting of Jeepney loading/unloading zone.
– Alteration of U-turn operation.

Other works are the same as 1) above.

15.2.2 Equipment To Be Used

List of equipments to be used, unit price of each equipment and quantities for 362 intersections are shown in **Table 15.2-1.**

TABLE 15.2-1 EQUIPMENT TO BE USED

Equipment Name	Unit Price (Php)	Qty. for 362 Intersections
Traffic Signal (LED Lamp)	57,458	2,722
Traffic Light Controller (to be connected with Traffic Center)	306,399	362
Pedestrian Signal	38,305	1,342
Countdown Timer	26,814	713
Vehicle Detector (Image Recognition Type)	191,484	1,361
Layer 2 Switch (Network Equipment)	200,000	223
Switching Hub (Network Equipment)	24,300	2
Optical Network Unit (Network Equipment)	102,947	223

Note:

It is assumed that the Traffic Control Center prepared in Phase I has enough capacity to accommodate access from Phase III intersections.

Source: JICA Study Team

15.3 ESTIMATED COST

(1) Traffic Signal Installation Cost

Traffic signal installation cost at the 362 intersections was estimated at Php 1,072.75 Million as shown in **Table 15.3-1.**

(2) Annual Operation and Maintenance Cost

Annual operation and maintenance cost was estimated at Php 38.66 Million as shown in **Table 15.3-2.**

TABLE 15.3-1 PHASE-3 TRAFFIC SIGNAL INSTALLATION COST

Item	Unit	Quantity	Unit Price (PHP)	Cost (PHP)	Cost by (PHP)		
					Foreign	Local	Tax
1. Traffic Signal							
3-leg Intersection (Replace)							
Traffic Signal	set	270	68,425	18,474,750	15,518,790	369,495	2,586,465
Traffic Light Controller	set	45	364,500	16,402,500	13,778,100	328,050	2,296,350
Pedestrian Signal	set	180	45,500	8,190,000	6,879,600	163,800	1,146,600
Countdown Timer	set	90	31,500	2,835,000	2,381,400	56,700	396,900
Vehicle Detector	set	135	224,000	30,240,000	25,401,600	604,800	4,233,600
Tuning & Setting	set	45	128,000	5,760,000	2,880,000	2,304,000	576,000
4-leg Intersection (Replace)							
Traffic Signal	set	840	68,425	57,477,000	48,280,680	1,149,540	8,046,780
Traffic Light Controller	set	105	364,500	38,272,500	32,148,900	765,450	5,358,150
Pedestrian Signal	set	560	45,500	25,480,000	21,403,200	509,600	3,567,200
Countdown Timer	set	280	31,500	8,820,000	7,408,800	176,400	1,234,800
Vehicle Detector	set	420	224,000	94,080,000	79,027,200	1,881,600	13,171,200
Tuning & Setting	set	105	128,000	13,440,000	6,720,000	5,376,000	1,344,000
3-leg Intersection (New Constraction)							
Traffic Signal	set	252	68,425	17,243,100	14,484,204	344,862	2,414,034
Traffic Light Controller	set	42	364,500	15,309,000	12,859,560	306,180	2,143,260
Pedestrian Signal	set	132	45,500	6,006,000	5,045,040	120,120	840,840
Countdown Timer	set	63	31,500	1,984,500	1,666,980	39,690	277,830
Vehicle Detector	set	126	224,000	28,224,000	23,708,160	564,480	3,951,360
Tuning & Setting	set	42	128,000	5,376,000	2,688,000	2,150,400	537,600
Construction (include Signal Mast	set	252	85,800	21,621,600	0	19,243,224	2,378,376
4-leg Intersection (New Constraction)							
Traffic Signal	set	1,360	68,425	93,058,000	78,168,720	1,861,160	13,028,120
Traffic Light Controller	set	170	364,500	61,965,000	52,050,600	1,239,300	8,675,100
Pedestrian Signal	set	560	45,500	25,480,000	21,403,200	509,600	3,567,200
Countdown Timer	set	280	31,500	8,820,000	7,408,800	176,400	1,234,800
Vehicle Detector	set	680	224,000	152,320,000	127,948,800	3,046,400	21,324,800
Tuning & Setting	set	170	128,000	21,760,000	10,880,000	8,704,000	2,176,000
Construction (include Signal Mast	set	680	85,800	58,344,000	0	51,926,160	6,417,840
2. Communication System							
Layer 2 SW	set	223	212,000	47,276,000	39,711,840	945,520	6,618,640
Switching Hub	set	2	25,800	51,600	5,160	41,280	5,160
Optical Network Unit	set	223	105,000	23,415,000	19,668,600	468,300	3,278,100
Optical Fiber	m	22,300	7,400	165,020,000	125,415,200	16,502,000	23,102,800
Grand Total				1,072,745,550	804,941,134	121,874,511	145,929,905

Source: JICA Study Team

TABLE 15.3-2 ANNUAL O&M OF PHASE III OF METRO MANILA TRAFFIC SIGNAL CONTROL PROJECT

Item	Unit	Unit Price (Php)	Quantity	Cost (Million Php)	Cost Component (Million Php)		
					Foreign	Local	Tax
Replacement of Equipment Parts (2% of Total Cost)	L.S.	21,455,000.00	1.00	21.455	16.091	2.360	3.004
Electricity	Php/ Year	7,200,000.00	1.00	7.200	-	6.428	0.772
Staff Cost	Month	500,000.00	12.00	6.000	-	5.375	0.625
Running Cost of Office	Month	80,000.00	12.00	0.960	-	0.875	0.085
Rental Fee of Optical Fiber Cable	Month	100,000.00	12.00	1.200	-	1.071	0.129
Management Cost (5% of above Cost)	-	-	-	1.841	-	1.644	0.197
Total O & M Cost per Year				**38.656**	**16.091**	**17.753**	**4.812**

Source: JICA Study Team

15.4 IMPLEMENTING AGENCY AND IMPLEMENTATION SCHEDULE

15.4.1 Implementing Agency

The implementing agency shall be the MMDA.

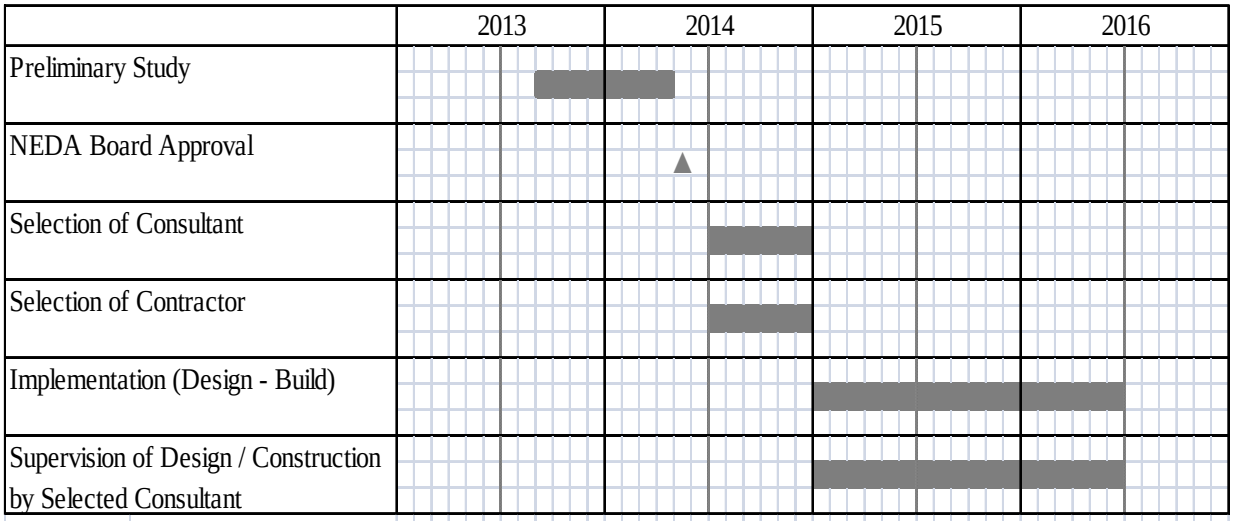
15.4.2 Implementation Schedule

MMDA has adopted “Design-Build” approach for Phase I and a consultant was not hired, since the nature of work is replacement of existing equipment with the advanced equipment.

Phase III involves traffic signal control system at currently non-signalized intersection, therefore, preliminary design to determine improvement of intersection geometry and communication connection, etc. will be required.

Implementation schedule is shown in **Table 15.4-1.**

TABLE 15.4-1 PROPOSED IMPLEMENTATION TABLE



Source: JICA Study Team

15.5 EFFECT AND IMPACT OF PROJECT

Impact of ITS introduction was conducted with respect to following 2 types:

1) Impact evaluation for installment of new traffic signal control systems in Metro Manila
2) Impact evaluation for improvement of existing traffic signal control systems in Metro Manila

15.5.1 Impact evaluation for installment of new traffic signal control systems in Metro Manila

(1) Evaluation Flowchart

The evaluation flowchart is shown as follows:

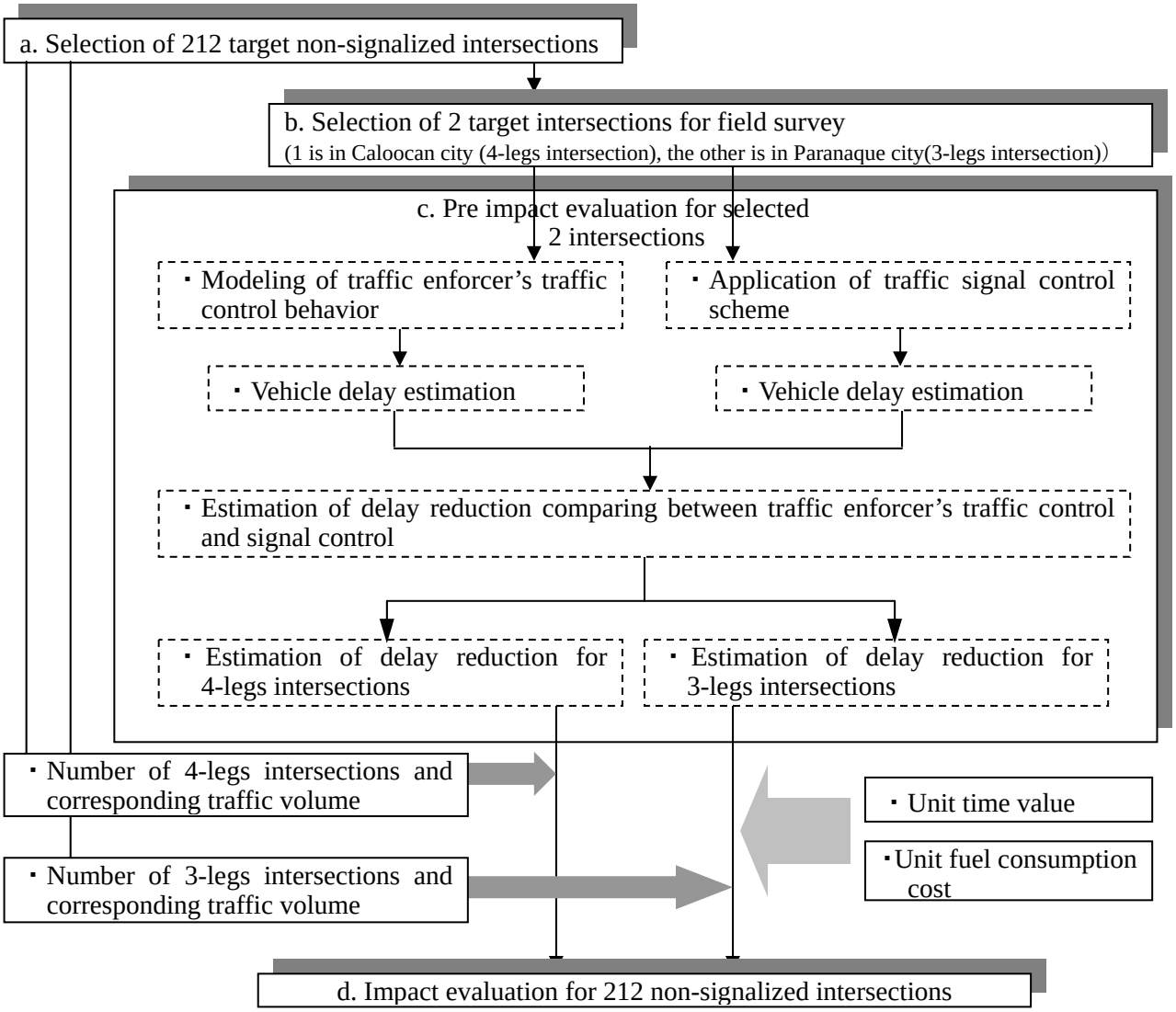


FIGURE 15.5-1 IMPACT EVALUATION FLOWCHART

(2) Selection of 212 target non-signalized intersections

Target intersections are non-signalized intersections located in Metro Manila region. The number of target intersections is 212 intersections as described at section 15.3.2. Among those intersections, 170 intersections are four-legs intersections and 42 intersections are three-legs intersections.

(3) Selection of 2 target intersections for field survey

2 intersections were selected as target intersections for field survey. 1 intersection is in Caloocan

city, specifically it is Camarin vs. Zabarte intersection as a four-legs intersection, the other is in Paranaque city, of which name is Alaban vs. ConchaCruz intersection as a three-legs intersection. As for these 2 non-signalized intersections, signal control scheme was hypothetically applied and effect of such signalization was evaluated.

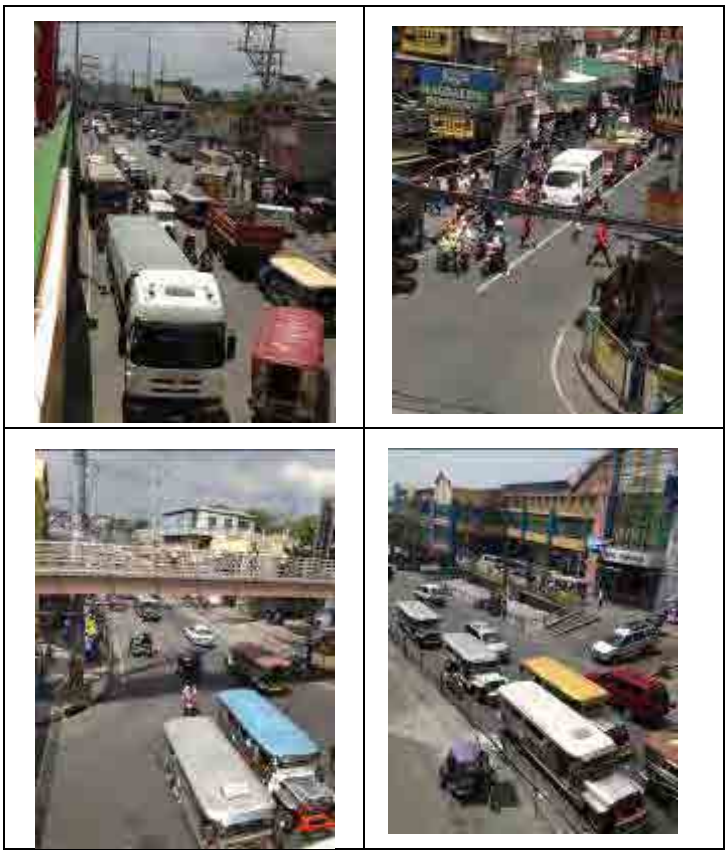


FIGURE 15.5-2 CAMARIN VS. ZABARTE INTERSECTION AS A FOUR-LEGS INTERSECTION

FIGURE 15.5-3 ALABANG VS. CONCHACRUZ INTERSECTION AS A T-FIGURE INTERSECTION

Traffic survey at the above 2 selected intersections was conducted. Survey items are traffic volume counting survey and parameter of traffic control performed by traffic enforcers stated as follows.

1) Traffic volume count survey at the intersections

Traffic survey was conducted:

By each lane
By each direction of traffic flow (going strait, right-turn and left-turn)
By each type of car (passenger vehicles, Jeepneys buses and trucks

2) Identification of parameter of traffic control performed by traffic enforcers

- Hypothetical traffic signal control survey was conducted:
  By hypothetical green interval for each traffic flow
- By hypothetical cycle length

(4) Pre impact evaluation for selected 2 intersections

1) Average delay estimation

Average delay was estimated by using of the practical formula which is shown in "Highway Capacity Manual (HCM) 2010". The formula is as follows:

$$d = 0.5C\,(1.0 - G/C)^2 / [\,1.0 - \min(1.0, X)G/C\,]$$

where:

d: average delay [sec./vehicle]
C: cycle length [sec.]
G: green interval [sec.]
X: $= q/c$
q: arrival traffic flow rate [vehicle/sec.]
c: $= NsG/C$
N: number of lanes
s : saturation flow rate, which is assumed as 0.5[vehicle/sec.]

2) Estimation of average reduced delay by hypothetical installment of traffic signal control system

According to above traffic survey results and HCM 2010 formula, the value of reduction of average delay was estimated as follows:

TABLE 15.5-1 ESTIMATION OF HYPOTHETICAL DELAY REDUCTION

Name of main road	Reduced Delay [sec/vehicle]
Camarin vs. Zabarte intersection (four-legs intersection)	0.74
Alaban-ConchaCruz (three-legs intersection)	1.23

(5) Impact evaluation for selected 212 intersections

1) Estimation of delay reduction for 212 target intersections

Delay reduction was estimated as to 212 intersections in Metro Manila, which is the targeted number of intersections for installment of new signal control system..

TABLE 15.5-2 DELAY REDUCTION THROUGH INSTALLATION OF TRAFFIC SIGNAL CONTROL SYSTEM

No.	Major Street	**A:** Number of Intersections [Phase III]	Field Survey Objective Road	**B : A**verage delay reduction [sec]	**A * B:** [sec.]	**C :** Estimated Traffic Volume [14hrs] *76% 0f daily traffic *) footnote	**A*B*C :** Total delay reduction [veh*hour/day]
1	Three-legs intersection related trunk roads	42	Alaban-ConchaCruz (T-figure intersection)	1.23	51.66	23,417	335.7
2	4-legs intersection related trunk roads	170	Camarin-Zabarte (4-legs intersection)	0.74	125.80	30,544	1,077.4
TOTAL		212	-	-	-	-	1,413.1

*) Traffic volume 6:00am - 8:00 pm in Metro Manila : 136,000 [veh], 8:00pm - 6:00am : 42,000 [veh]
136,000 / (135,000 + 42,000) = 76%

The following table shows the summary of the time saving impact in terms of “hours”.

TABLE 15.5-3 SUMMARY OF THE TIME SAVING IMPACT IN TERMS OF “HOURS”

Number of targeted intersections	Time saving	unit
212 intersections	100.9	[hrs./hour]
	1,413.1	[hrs./day]
	7,065.5	[hrs./week]
	353,275.3	[hrs/year]

The above time saving impact can be converted into monetary term by using of 7.8 [peso/minute/vehicle], which comes from DPWH. The time saving impact in terms of monetary term is shown in the following table.

TABLE 15.5-4 SUMMARY OF THE TIME SAVING IMPACT IN TERMS OF “PESO”

Number of targeted intersections	Time saving	unit
212 intersections	47.2	[1,000Peso./hour]
	661.3	[1,000peso./day]
	3,306.7	[1,000 Peso/week]
	165,332.8	[1,000 Peso/year]

15.5.2 Impact evaluation for improvement of existing traffic signal control systems in Metro Manila

(1) Evaluation Flowchart

The evaluation flowchart is shown as follows:

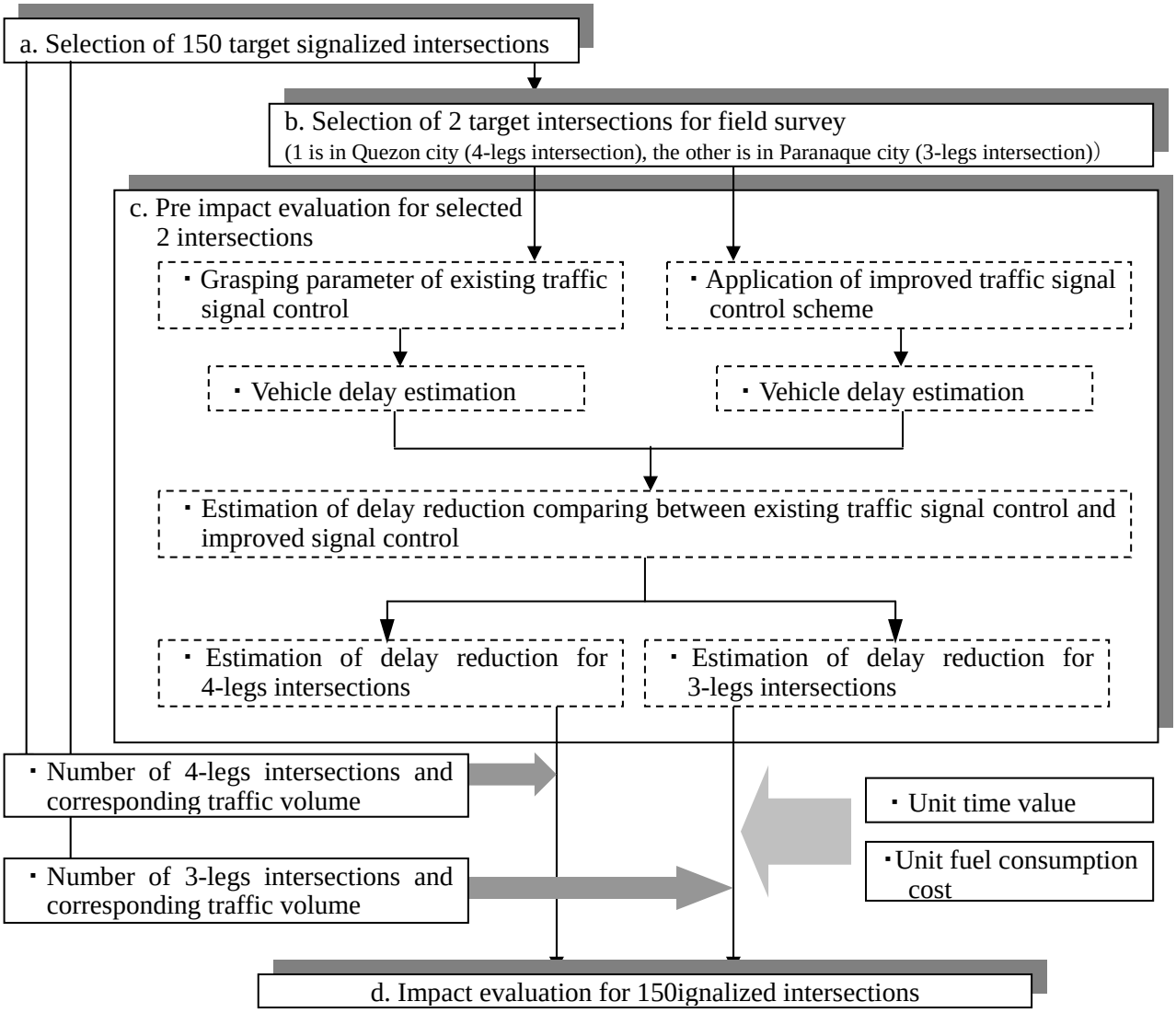


FIGURE 15.5-4 IMPACT EVALUATION FLOWCHART

(2) Selection of 151 target non-signalized intersections

Target intersections are existing signalized intersections located in Metro Manila region. The number of target intersections is 150 intersections as described at section 15.3.2. Among those intersections, 105 intersections are four-legs intersections and 45 intersections are three-legs intersections.

(3) Selection of 2 target intersections for field survey

2 signalized intersections were selected as target intersections for field survey. 1 intersection is in

Quezon city, specifically it is Quirino highway vs General Luis Rd. as a four-legs intersection, the other is in Paranaque city, of which name is Dr. A. Santos vs Angelina Canaynai Ave as a T-figure intersection. As for these 2 signalized intersections, signal control parameter which is now in operation was grasped and effect of improvement of such existing signal control was evaluated.

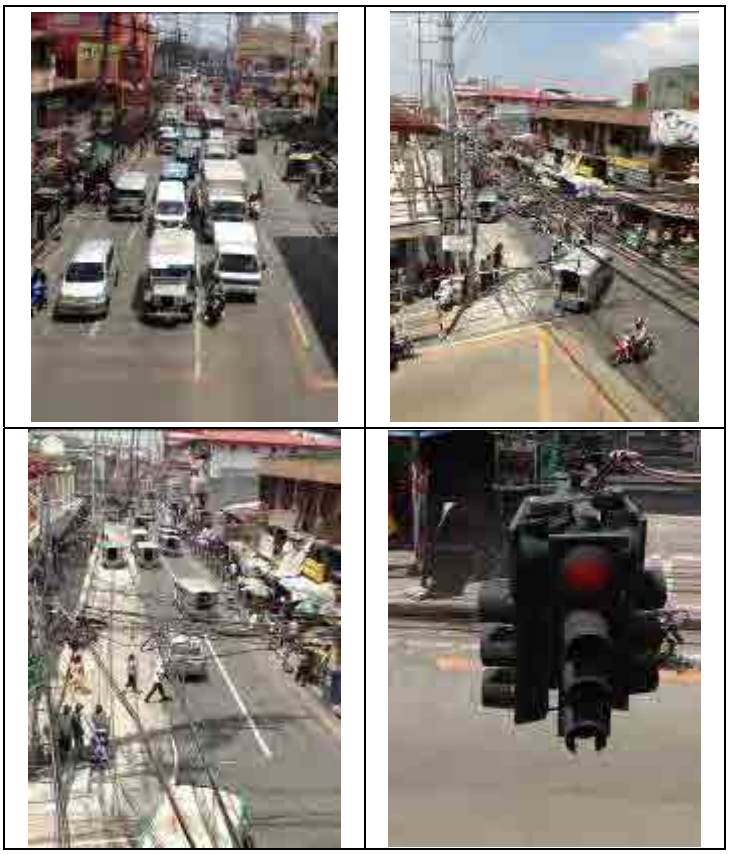


FIGURE 15.5-5 QUIRINO HIGHWAY VS GENERAL LUIS RD. AS A FOUR-LEGS INTERSECTION

FIGURE 15.5-6 DR. A. SANTOS VS ANGELINA CANAYNAI AVE INTERSECTION AS A THREE-LEGS INTERSECTION

Traffic survey at the above 2 selected intersections was conducted. Survey items are traffic volume counting survey and grasping parameter of existing traffic signal control stated as follows.

1) Traffic volume count survey at the intersections

Traffic survey was conducted:

By each lane
By each direction of traffic flow (going strait, right-turn and left-turn)
By each type of car (passenger vehicles, Jeepneys, buses and trucks

2) Identification of parameter of existing traffic signal control

Existing traffic signal control survey was conducted:

By green interval for each traffic flow
By cycle length

(4) Pre impact evaluation for selected 2 intersections

1) Average delay estimation

Average delay was estimated by using of the practical formula which is shown in "Highway Capacity Manual (HCM) 2010" as it was shown in the previous section 15.6.1.

2) Estimation of average reduced delay by improvement of existing traffic signal control

According to above traffic survey results and HCM 2010 formula, the value of reduction of average delay was estimated as follows:

TABLE 15.5-5 ESTIMATION OF DELAY REDUCTION

Name of main road	Reduced Delay [sec/vehicle]
Quirino highway vs General Luis Rd. (four-legs intersection)	3.13
Dr. A. Santos vs Angelina Canaynai Ave intersection (three-legs intersection)	2.00

(5) Impact evaluation for selected 150 intersections

1) Estimation of delay reduction for 150 target intersections

Delay reduction was estimated as to 150 intersections in Metro Manila, which is the targeted number of intersections for improvement of existing traffic signal control system..

TABLE 15.5-6 DELAY REDUCTION THROUGH IMPROVEMENT OF EXISTING TRAFFIC SIGNAL CONTROL SYSTEM

No.	Major Street	**A:** Number of Intersections [Phase III]	Field Survey Objective Road	**B : A**verage delay reduction [sec]	**A * B:** [sec.]	**C :** Estimated Traffic Volume [14hrs] *76% 0f daily traffic *) footnote	**A*B*C :** Total delay reduction [veh*hour/day]
1	Three-legs intersection related trunk roads	45	Dr. A. Santos vs Angelina Canaynai Ave intersection (three-legs intersection)	1.99	89.55	21,654	537.6
2	4-legs intersection related trunk roads	105	Quirino highway vs General Luis Rd. (4-legs intersection)	3.13	328.7	28,245	2,579.9
TOTAL		150	-	-	-	-	3,117.4

*) Traffic volume 6:00am - 8:00 pm in Metro Manila : 136,000 [veh], 8:00pm - 6:00am : 42,000 [veh]
136,000 / (135,000 + 42,000) = 76%

The following table shows the summary of the time saving impact in terms of "hours".

TABLE 15.5-7 SUMMARY OF THE TIME SAVING IMPACT IN TERMS OF "HOURS"

Number of targeted intersections	Time saving	unit
150 intersections	222.7	[hrs./hour]
	3,117.4	[hrs./day]
	15,587.2	[hrs./week]
	779,359.4	[hrs/year]

The above time saving impact can be converted into monetary term by using of 7.8 [peso/minute/vehicle], which comes from DPWH. The time saving impact in terms of monetary term is shown in the following table.

TABLE 15.5-8 SUMMARY OF THE TIME SAVING IMPACT IN TERMS OF "PESO"

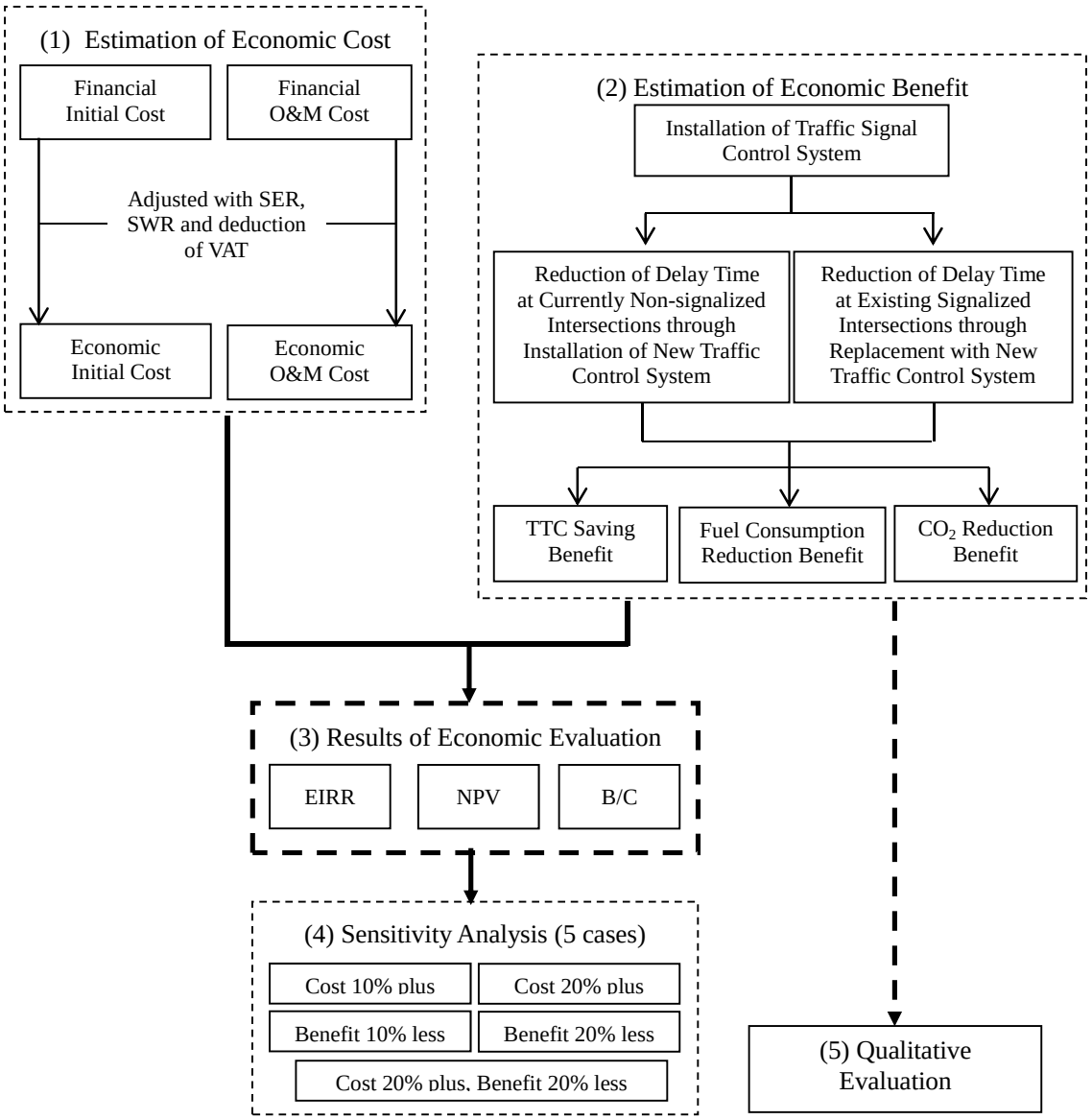
Number of targeted intersections	Time saving	unit
150 intersections	104.2	[1,000Peso./hour]
	1,459.0	[1,000peso./day]
	7,294.8	[1,000 Peso/week]
	364,740.2	[1,000 Peso/year]

15.6 ECONOMIC ANALYSIS

15.6.1 Methodology

(1) Framework and Workflow of Economic Evaluation

The framework and workflow of economic evaluation on the project of Phase III of Traffic Signal Control are illustrated in the following flow chart.



Source: JICA Study Team

FIGURE 15.6-1 FRAMEWORK AND WORKFLOW OF ECONOMIC EVALUATION OF PHASE III OF TRAFFIC SIGNAL CONTROL PROJECT

(2) Basic Concepts and Assumptions

1) Reference to the Metro Manila Master Plan

The basic concepts and assumptions adopted in the economic evaluation of this project include approach of quantitative and qualitative analysis, application of shadow prices, indicators of economic evaluation, and other basic assumptions. As all the basic concepts and most of the assumptions here are the same as those adopted previously in the section regarding the Metro Manila Master Plan, description of this part is omitted.

But the following 2 points need some extra explanation.

2) Economic Evaluation Focused on the Impact of Traffic Signal Control

As the scope of this pilot project is confined to the area of traffic signal control instead of covering all the 7 ITS development areas indicated in the Metro and Mega Manila Master Plans, the work of economic evaluation on this project is focused on analyzing the impact of introducing the traffic signal control system. To be more specific, the benefit of TTC saving brought about by signalizing the currently non-signalized intersections and replacing the existing signalized intersections with more advanced new signal control system, benefit of idling time fuel consumption reduction, and the benefit of CO_2 emission reduction are to be evaluated as quantifiable items. In addition, there are also benefits unquantifiable, to which the approach of qualitative analysis is applied.

3) Project Period Subject to the Evaluation

The period of this pilot project subject to the economic evaluation is assumed to be 10 years from 2015 to 2024.

15.6.2 Economic Cost of the Project

(1) Initial Cost

1) Financial Cost

The initial cost of this project consists of costs of the following 3 categories, including the physical contingency cost assumed to be 5% of the 2 basic cost categories.

- Traffic Signal
- Communication System
- Physical Contingency

The disbursement of initial investment cost is expected to start from the beginning of 2015 and to last till the middle of 2016 when the construction and installation work is expected to be completed. The financial cost of the initial investment by category is stated in the table with the breakdown of foreign currency portion, local currency portion as well as tax item including import tax and VAT

TABLE 15.6-1 FINANCIAL COST OF INITIAL INVESTMENT (UNIT: PHP.MILLION)

No.	Item	Total	Foreign	Local	Tax
1	Traffic Signal	837	620	104	113
1.1	3-leg Intersection (Replace)	82	67	4	11
	Equipment	(82)	(67)	(4)	(11)
	Labor	(0)	(0)	(0)	(0)
1.2	4-leg Intersection (Replace)	238	195	10	33
	Equipment	(238)	(195)	(10)	(33)
	Labor	(0)	(0)	(0)	(0)
1.3	3-leg Intersection (New Construction)	96	60	23	13
	Equipment	(74)	(60)	(4)	(10)
	Labor	(22)	(0)	(19)	(2)
1.4	4-leg Intersection (New Construction)	422	298	67	56
	Equipment	(364)	(298)	(15)	(50)
	Labor	(58)	(0)	(52)	(6)
2	Communication System	236	185	18	33
	Equipment	(236)	(185)	(18)	(13)
	Labor	(0)	(0)	(0)	(0)
3	**Total (Item1+2)**	**1,073**	**805**	**122**	**146**
4	Phisical Contigency (5% of Item 3)	54	40	6	7
Grand Total		**1,126**	**845**	**128**	**153**

Source: JICA Study Team

2) Conversion to Economic Cost

TABLE 15.6-2 ECONOMIC COST OF INITIAL INVESTMENT

No.	Item	Total	Foreign	Local
1	Traffic Signal	820	744	76
1.1	3-leg Intersection (Replace)	84	80	4
1.2	4-leg Intersection (Replace)	244	234	10
1.3	3-leg Intersection (New Construction)	87	72	15
1.4	4-leg Intersection (New Construction)	404	358	46
2	Communication System	240	222	18
3	**Total (Item1+2)**	**1,060**	**966**	**94**
4	Phisical Contigency (5% of Item 3)	53	48	5
Grand Total		**1,113**	**1,014**	**98**

Source: JICA Study Team

The values of financial cost are converted into that of the economic cost in the same way as what has been explained in the chapter regarding Metro Manila Master Plan. As a result of the conversion, the values of economic cost are yielded and reflected in the above table.

(2) Operation and Maintenance (O&M) Cost

With regard to the O&M cost of the project, the 7 cost items with values of annual amount are indicated in terms of both financial cost and economic cost as seen from the following table. The way in which the financial cost of respective items is converted into economic cost is the same as what has been adopted in the previous chapters.

TABLE 15.6-3 FINANCIAL COST AND ECONOMIC COST OF O&M

(UNIT: PHP. MILLION)

No	Item	Financial Cost				Economic Cost		
		Total	Foreign	Local	Tax	Total	Foreign	Local
1	Replacement of Equipment Parts	21.455	16.091	2.360	3.004	21.669	19.309	2.360
2	Electricity	7.200	0.00	6.428	0.772	6.428	0.00	6.428
3	Staff Cost	6.000	0.00	5.375	0.625	3.225	0.00	3.225
4	Running Cost of Office	0.960	0.00	0.875	0.085	0.875	0.00	0.875
5	Rental Fee of Optical Fiber Cable	1.200	0.00	1.071	0.129	1.071	0.00	1.071
6	Management Cost (5% of above Cost)	1.841	0.00	1.644	0.197	1.644	0.00	1.644
7	Physical Contingency	1.933	0.805	0.888	0.241	1.746	0.965	0.780
Total O & M Cost per Year		**40.589**	**16.896**	**18.641**	**5.053**	**36.658**	**20.275**	**16.383**

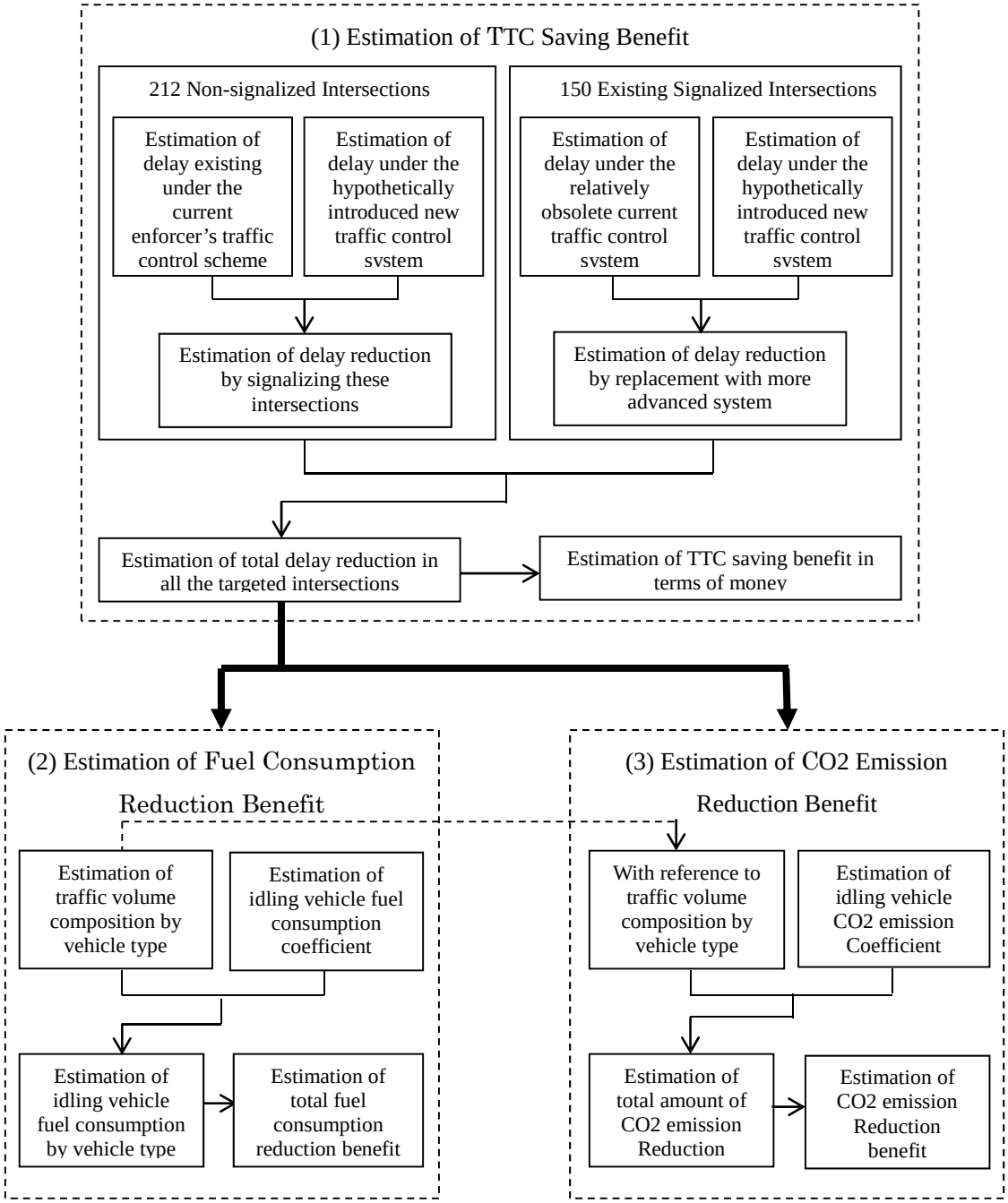
Source: JICA Study Team

15.6.3 Quantifiable Economic Benefit of the Project

The economic evaluation of this chapter is focused on analyzing the impact of traffic signal control system installation. For this purpose, the following 3 kinds of benefits are estimated.

- TTC saving benefit
- Fuel consumption reduction benefit
- CO_2 emission reduction benefit

The process in which the above-mentioned benefits are estimated is illustrated in the following flowchart.



Source: JICA Study Team

FIGURE 15.6-2 PROCESS OF BENEFIT ESTIMATION REGARDING THE IMPACT OF TRAFFIC SIGNAL CONTROL SYSTEM INSTALLATION

(1) Estimation of TTC Saving Benefit

In this project, the TTC saving benefit is expected to be generated by the installation advanced new traffic signal control system in two types of intersections, i.e. 212 currently non-signalized intersections and 150 existing signalized intersections. As shown by the above flowchart, this kind of benefit can be estimated through the following processes.

1) Estimation of Delay Reduction by Signalizing the 212 Currently Non-signalized Intersections

The work of estimation consists of 3 steps as indicated below:

- Estimation of delay existing under the current enforcer's traffic control scheme
- Estimation of delay under the hypothetically introduced new traffic control system
- Estimation of delay reduction by comparing the above two kinds of delay

2) Estimation of Delay Reduction by Replacing the 150 Existing Signalized Intersections with More Advanced Traffic Signal Control Systems

The following 3 steps of work are entailed:

- Estimation of delay under the relatively obsolete current traffic control system
- Estimation of delay under the hypothetically introduced more advanced system
- Estimation of delay reduction by comparing the above two kinds of delay

3) Estimation of Total Delay Reduction in All the Targeted Intersections

The total delay reduction in all the targeted intersections can thus be figured out based on results of the above two steps.

4) Estimation of TTC Saving Benefit in Terms of Money

By multiplying the above value of total delay reduction with the afore-mentioned unit TTC (7.8 peso/minute/PCU), the TTC saving benefit in terms of money can be worked out accordingly. The specific process of estimation with actual data acquired from the traffic survey conducted by the Study Team had already been described in previous sections, and the major results used in the economic evaluation are as follows:

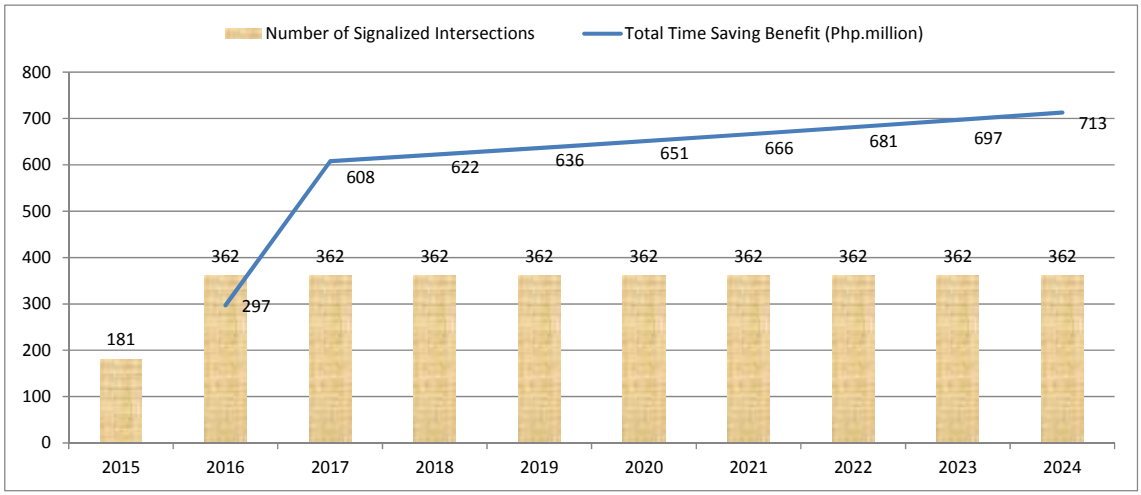
TABLE 15.6-4 TRAVEL TIME SAVING THROUGH DELAY REDUCTION AND TTC SAVING BENEFIT

Item	212 Non-signalized Intersections	150 Existing Signalized Intersections	Total
TT Saving in Terms of Hour (hours/year)	353,275	779,359	1,132,634
TTC Saving in Terms of Money (Php.1000/year)	165,323	364,740	530,063

Source: JICA Study Team

According to the implementation schedule of this project, the installation work will be started at the beginning of 2015 and completed at mid-2016, which is roughly looked upon as a two years period covering 2015 and 2016. To allow for a period of trial and error, the TTC saving benefit is assumed to come out partially in 2016 and be fully realized in 2017. Besides, the average annual growth rate of 2.3% for traffic volume in Metro Manila Region as mentioned previously is taken

into consideration in the evaluation. Therefore, the change of annual TTC saving benefit can be depicted by the following diagram based on the above results and readjustment.



Source: JICA Study Team

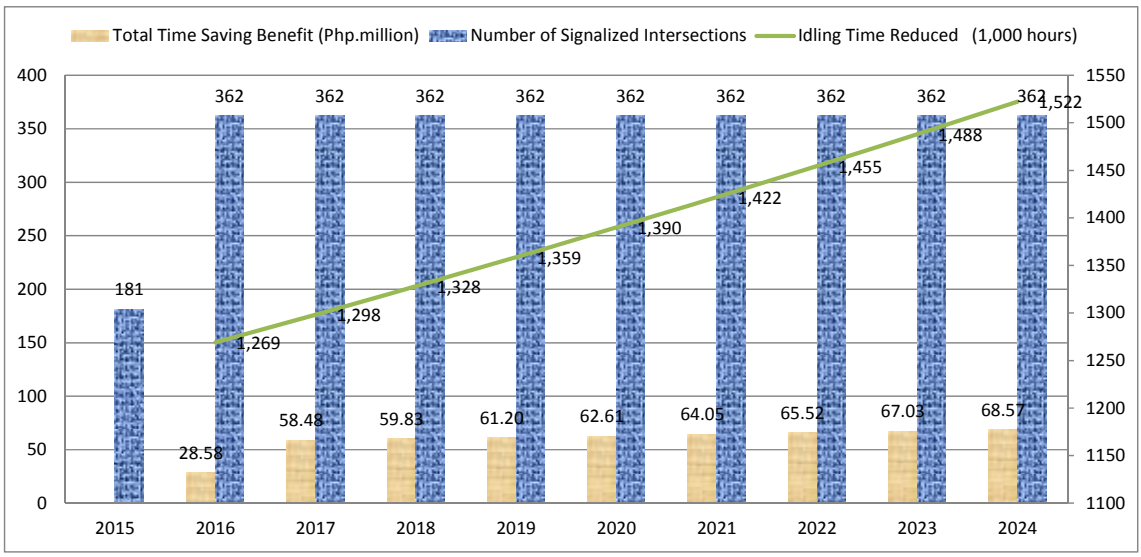
FIGURE 15.6-3 CHANGE OF ANNUAL BENEFIT OF TTC SAVING GENERATED BY THE PHASE III OF TRAFFIC SIGNAL CONTROL PROJECT

(2) Estimation of Fuel Consumption Reduction Benefit

By utilizing the above result of .TT saving through delay reduction, the fuel consumption reduction benefit can be estimated via the following 4 steps:

- Estimation of traffic volume composition by vehicle type with reference to the previous **Table 11.8-10**)
- Estimation of idling vehicle fuel consumption coefficient with reference to the previous **Table 11.8-11**)
- Estimation of idling vehicle fuel consumption by vehicle type based on the above results
- Estimation of total fuel consumption reduction benefit by multiplying the above results with fuel prices assumed in the previous Chapter 11.8.3.

In light of the implementation schedule and the necessary readjustment mentioned previously, the annual benefit of fuel consumption reduction is expected to come out in the way illustrated by the diagram below.



Source: JICA Study Team

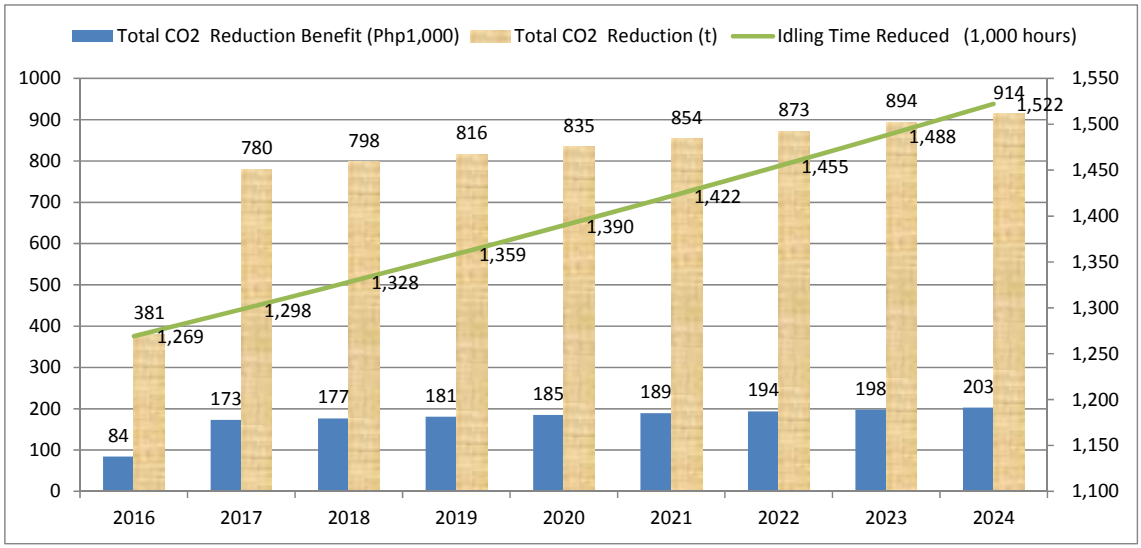
FIGURE 15.6-4 CHANGE OF ANNUAL BENEFIT OF FUEL CONSUMPTION REDUCTION BY THE PHASE III OF TRAFFIC SIGNAL CONTROL PROJECT

(3) Estimation of CO_2 Emission Reduction Benefit

Also by utilizing the afore-mentioned result of .TT saving through delay reduction and the values of vehicle type composition, the CO_2 emission reduction benefit can be estimated via the following 3 steps:

- Estimation of idling vehicle CO_2 emission Coefficient with reference to the previous **Table 11.8-12**
- Estimation of total amount of CO_2 emission Reduction using the above values
- Estimation of CO_2 emission Reduction benefit using the unit price of CO_2 assumed in the previous chapter 11.8.3

Based on the implementation schedule and the necessary readjustment mentioned previously, the annual benefit of CO_2 emission reduction is expected to come out in the way illustrated by the diagram below.



Source: JICA Study Team

FIGURE 15.6-5 CHANGE OF ANNUAL BENEFIT OF CO_2 EMISSION REDUCTION BY THE PHASE III OF TRAFFIC SIGNAL CONTROL PROJECT

15.6.4 Results of Economic Evaluation

On the basis of the values of all the cost items and quantifiable benefit items, major results of economic evaluation on this project are calculated and indicated in the table below.

TABLE 15.6-5 MAJOR RESULTS OF ECONOMIC EVALUATION OF THE PHASE III TRAFFIC SIGNAL CONTROL PROJECT

EIRR (%)	NPV (Php.million)	B/C
53.7	1,569	2.34

Source: JICA Study Team

As seen from the above table, EIRR exceeds the value of SDR (15%), and the values of NPV and B/C also exceed their respective threshold levels, showing that the project is economically viable. Moreover, as the project contains also unquantifiable benefits, the economic viability could be regarded better than the above quantitative result when taking into consideration all the unquantifiable benefits.

The calculation table with values of cost-benefit stream is presented below.

TABLE 15.6-6 COST-BENEFIT STREAM (PHASE III TRAFFIC SIGNAL CONTROL PROJECT) (UNIT: PHP. MILLION)

Year	Cost					Benefit				Net Economic Benefit
	Initial Cost			O&M Cost	Total Cost	Traffic Signal Control			Total Benefit	
	Traffic Signal Control System	Communication System	Physical Contingency			TTC Saving	Fuel Consumption Reduction	CO_2 Emission Reduction		
2015	410	120	26	37	593	0	0	0	0	(593)
16	410	120	26	37	593	297	28.58	0	326	(267)
17	0	0	0	37	37	608	58.48	0	666	629
18	0	0	0	37	37	622	59.82	0	682	645
19	0	0	0	37	37	636	61.20	0	697	660
20	0	0	0	37	37	651	62.61	0	714	677
21	0	0	0	37	37	666	64.05	0	730	693
22	0	0	0	37	37	681	65.52	0	747	710
23	0	0	0	37	37	697	67.03	0	764	727
24	0	0	0	37	37	713	68.57	0	782	745
									EIRR=	53.742%
									NPV(Php million)=	1,569
									Present value of cost=	1,090
									Present value of benefit=	2,658
									B/C=	2.4

Source: JICA Study Team

15.6.5 Sensitivity Analysis

The sensitivity of the project to potential risks is verified by assuming the following 5 cases:

- Case 1: 10% plus of cost
- Case 2: 20% plus of cost
- Case 3: 10% less of benefit
- Case 4: 20% less of benefit
- Case 5 20% plus of cost and 20% less of benefit

The results of sensitivity analysis on the 5 cases are summed up in the following table, which show that, even under the strictest conditions assumed in Case 5, the EIRR value of this project is still higher than the SDR value

TABLE 15.6-7 PROJECT SENSITIVITY IN 5 CASES
(PHASE III TRAFFIC SIGNAL CONTROL PROJECT)

	Base	Case 1	Case 2	Case 3	Case 4	Case 5
EIRR (%)	53.7	46.3	41.8	47.7	41.6	31.1
NPV (Php.million)	1,5149	1,359	1,248	1,302	1,038	717
B/C	2.4	2.0	1.9	2.2	2.0	1.5

Source: JICA Study Team

15.6.6 Qualitative Evaluation

In addition to the quantifiable benefits evaluated above, there are also several kinds of unquantifiable benefit worthy of mentioning. These benefits include faster moving traffic flow, saving of vehicle operation cost (VOC), reduction of CO_2 emission, traffic accident reduction and user's psychological comfort. Justifications for these benefits are as follows.

- Faster Moving Traffic Flow in the Overall Road Network of Metro Manila Region
  As the implementation of this project will reduce the delay time at a total of 362 intersections, this effect will significantly contribute to the faster moving traffic flow in the overall road network so as to reduce average driving time.in the whole of the Metro Manila Region.

- Effect of VOC Saving beyond That of the Targeted Areas
  As a result of the generation of the above benefit, the effect of VOC saving is expected to further extend to the areas covered by the overall road network, which is far beyond the areas of the 362 intersections targeted in this project.

- Effect of CO_2 Emission Reduction beyond That of the Targeted Areas
  By the same token, the benefit of CO_2 emission reduction is also expected to come out for all over the road network.

- Traffic Accident Reduction
  As the improvement of traffic efficiency will ease traffic congestion and chaos, this will in turn contribute to the reduction of occurrence probability of traffic accident and hence reduce the social loss resulted from the accidents.

- Saving of Manpower Cost in Traffic Enforcement
  By signalized the currently non-signalized intersections, the necessity for the road and traffic managing agencies to deploy many traffic enforcers on the roads can be expected to lessen significantly.

CHAPTER 16
TRAFFIC SIGNAL CONTROL AT BICUTAN AND SUCAT INTERSECTION

16.1 INTRODUCTION

16.1.1 Background

Since Bicutan and Sucat intersections connecting with Interchange (IC) of Skyway, they are very complicated intersections.

Currently these intersections are controlled by manually, no signalized intersection.
In order to improve the traffic situation at Bicutan and Sucat, the pre-feasibility study was conducted.

This project is one of the candidate “experimental project of traffic signal control” of JICA Technical Assistance.

Figure 16.1-1 LOCATION MAP OF PROPOSED PILOT PROJECT (BICUTAN AND SUCAT INTERSECTION)

16.1.2 Objective of the Project

The objectives of the Project are as follows:

- To improve traffic flow at intersections
  - Contributions of less vehicle delay and less fuel consumption
- To improve environmental conditions
  - Contribution of less emission of CO_2
- To improve traffic safety
  - Reduction of road crashes

16.2 PRESENT CONDITION OF PROJECT SITE

Bicutan IC and Sucat IC are interchanges of the diamond type. The intersection connected directly with the interchange is composed with very complicated shape and un-signalized. It happened in vehicle almost vehicle collision status cases that controlled by eight (8) to ten (10) traffic enforcers in each sites.

16.2.1 Road Traffic Condition

(1) Bicutan Intersection

Figure 16.2-1 shows the Bicutan intersection map.

There are two (2) intersections, east and west side. These distance is very short, only 70m.

- SM City Bicutan is located beside west-side intersection
- Pedestrian use by pedestrian deck
- PNR line is located beside east side intersection
- Short distance from/to toll gate intersection (70-120 m.)

FIGURE 16.2-1 BICUTAN INTERSECTION

The feature of intersection is shown below.

- West Side of Bicutan Intersection
  East-West Dona Soledad Avenue is comparatively large with the road of 6 lanes, and a service road runs side by side with the north and south. And there is a large shopping mall at the northwest corner. It is separating pedestrians and vehicles by a pedestrian bridge.

- East Side of Bicutan Intersection

  East-West General Santos Avenue is comparatively large with the road of 6 lanes, and a railway station and railway crossing exist on the east side. There is the service road only in the south side in parallel. A pedestrian bridge is installed in this intersection and is separating pedestrians and vehicles.

(2) Sucat Intersection

Figure 16.2-2 shows the intersection map.

- There are also two intersection and the distance is very short only 90m.
- Pedestrian deck is located only west side. Other direction, people use pedestrian crossing.
- Short distance from/to toll gate and intersections (60-90m).

- West Side of Sucat Intersection

  Sucat road of East-West directions is large, and service roads are composed with both direction. The pedestrian bridge to cross Sucat Road is arranged, but a service road and the IC entrance are in condition to be dangerous to a pedestrian only to have a pedestrian crossing.

- East Side of Sucat Intersection

  A service road of the south side is composed with the jeepney loading/unloading zone. There is not the pedestrian bridge, and not only crossing of a service road but also crossing of interchange is in a dangerous condition.

FIGURE 16.2-2 SUCAT INTERSECTION

(3) Present Traffic Situation

Traffic survey was conducted to identify present traffic condition of four intersections by Study Team.

This survey decided to collect traffic volume and the complicated number of times for 15minutes according to directional flow and vehicle type. The survey outline is shown in the following tables.

TABLE 16.2-1 SURVEY OUTLINE

Place	Date	Time	Method
Point A	March 5th	7:00 – 7:30 12:00 – 12:30	Record the image by video camera
Point B	March 5th	7:30 – 8:00 12:30 – 13:00	Record the image by video camera
Point C	March 5th	8:15 – 8:45 13:15 – 13:45	Record the image by video camera
Point D	March 5th	8:45 – 10:00 13:45 – 15:00	Manual Traffic Counts

(4) Result of Survey

The traffic volume according to the direction of each intersection is shown below. Detailed Traffic volume result is shown in **Annex 16.1**.

Highest traffic volume direction was East-West direction at Bicutan. At East side intersection, left turn traffic which entering interchange for Manila was high, 424 [vehicles/hour].

At Sucat, highest traffic volume direction was East-West direction. At East side intersection, left turn traffic which entering interchange for Manila was high, 552 [vehicles/hour]. The features of traffic flow at Sucat is almost same trend as that at Bicutan.

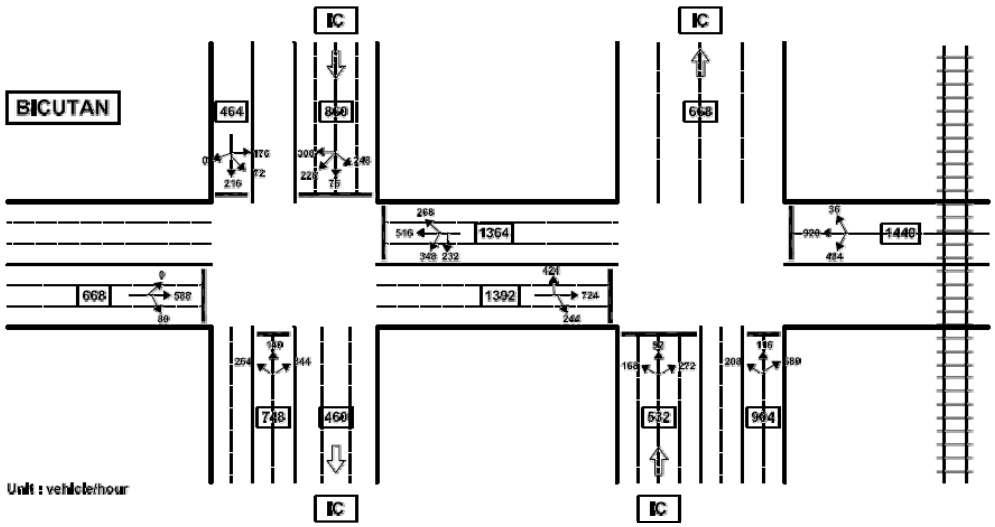


FIGURE 16.2-3 PEAK HOURTRAFFIC FLOW AT BICUTAN INERSECTION

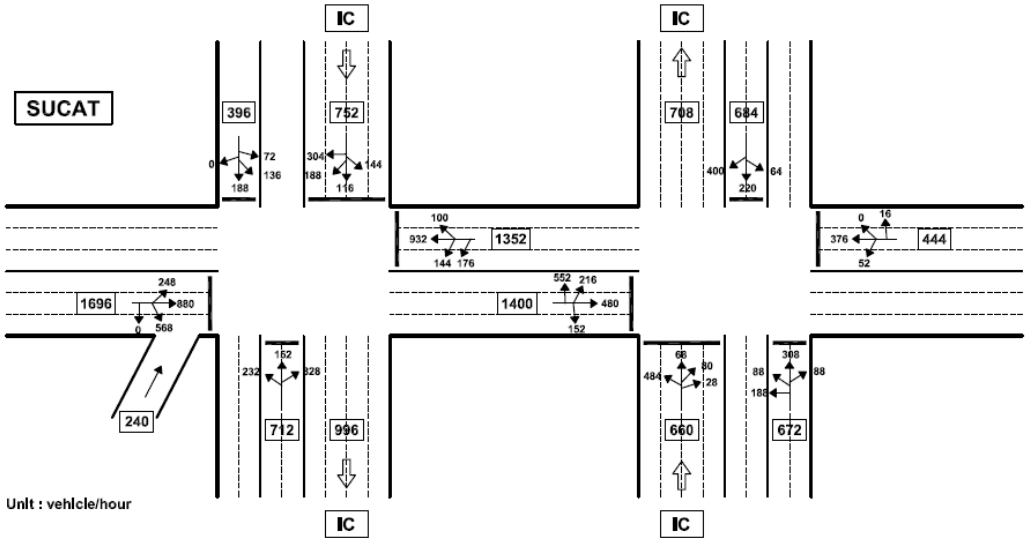


FIGURE 16.2-4 PEAK HOUR TRAFFIC FLOW AT HOURLY INERSECTION

16.3 CONCEPT FOR PROJECT

Concepts for this project are summarized as follows.

Independent Signal Control

This proposed traffic control system can be calculated optimum green time based on present traffic demand without connecting traffic center.
As these two intersections are located at far from neighbor's signalized intersections, it is not necessary to consider the corridor signal coordination. (Sucat intersection is 1.5 km far from neighbor's signalized intersection, Bicutan intersection is also more than 2km far)

As Japan's traffic signal system can both center control type and independent or local control, it is possible to utilize Japanese signal control technologies as experimental project.

Though traffic signal parameters were calculated by center in previous traffic control system, the current local signal controller will be able to calculate signal parameters by themselves due to drastic computer technology improvement. These technologies can be reduced the burdens in center system and center system can be composed as more sophisticated system. Trend of signal control system will transfer from Centralized control system to Distributed control system.

Improvement of Traffic Safety

Presently two sites have no traffic signal control; they were controlled by traffic enforcers. Since there are many kinds of traffic flows, it always occurred almost-vehicle-collision status then many vehicles stopped at intersections shown below. Though it was not seen traffic accident during field survey, it occurred almost-vehicle-collision status inside intersection once per one

minute.

Around eight (8) to ten (10) traffic enforcers are working during whole day, not only sunny day but also rainy day, strong windy day and etc.

It is desired that Bicutan and Sucat intersection should be controlled by traffic signal for improvement of traffic safety.

	
Traffic Confliction inside Bicutan Int.	**Traffic Confliction inside Sucat Int.**

FIGURE 16.3-1 ALMOST-VEHICLE-COLLISION STATUS AT BICUTAN AND SUCAT

Reduction of Vehicle Delay at Intersections

Currently traffic enforcers are relatively well controlling by manual.

As mentioned above, there are always many miss almost-vehicle collision status inside intersection. It is expected that signalized control can be reduced the vehicle delays due to less blocked.

There are some issues to consider adequate signal parameter.

- Two intersections are very close (Bicutan 70m, Sucat 90m). (see **Figure 16.3-2**)
- Due to short distance(= small waiting space) between stop-line and toll booth, it may affect expressway main during peak hours.(Bicutan70-120m,Sucat60-90 m) (see **Figure 16.3-2**)
- As many left turn traffic exists, it may affect opposite traffic flow.

In order to solve above issues, the following traffic operations are recommended.

- To control together for two intersections as one intersection.
- To consider optimum cycle time in order to minimize the queue vehicles at small waiting space. Cycle time length recommends shorter as much as possible.
- To provide adequate green time for equally vehicle delay of each direction.

・ To provide traffic actuated control based on vehicle detector's information. Detectors should be installed at interchange off-ramp site and left-turn lane at least.

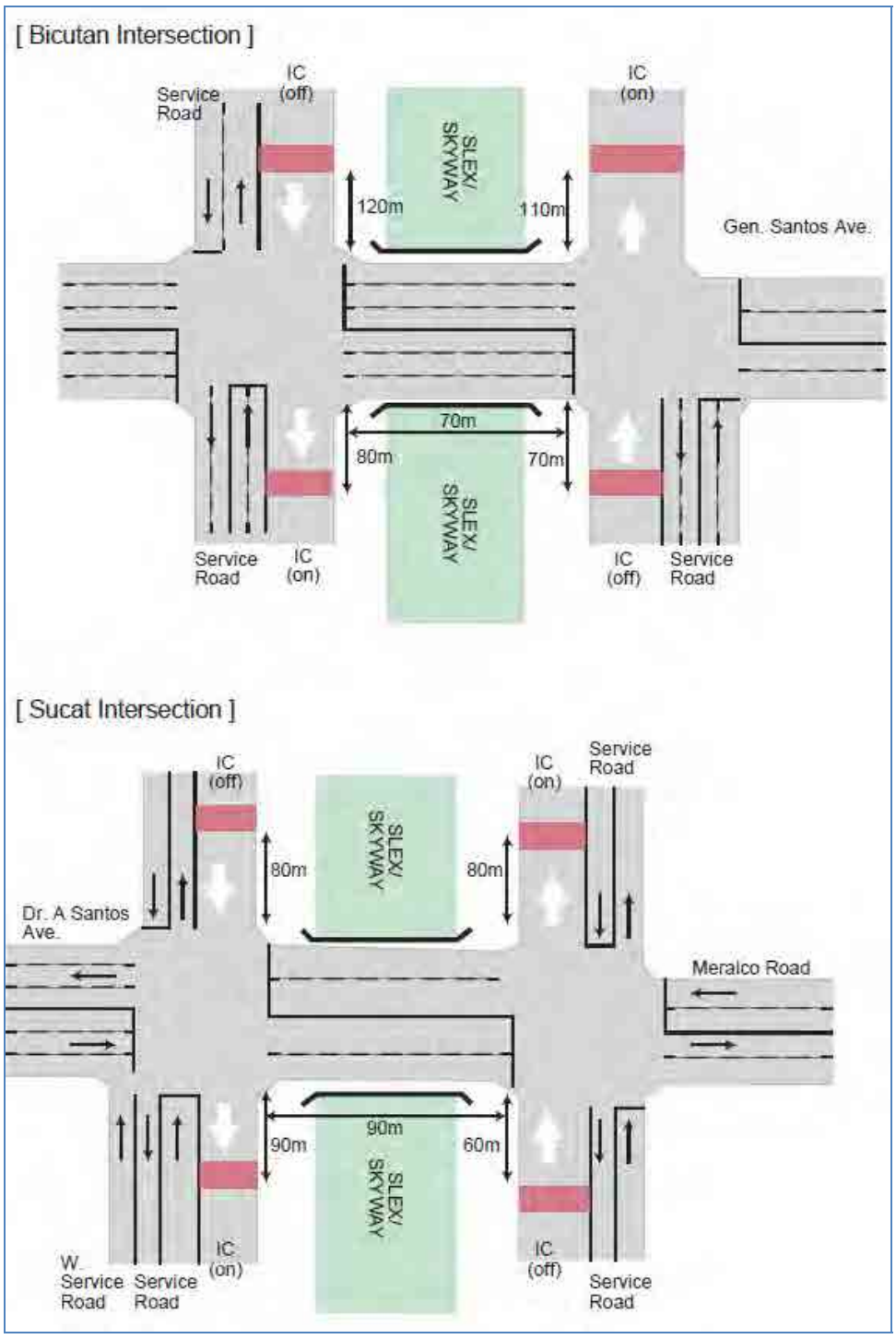


FIGURE 16.3-2 IMAGE OF BICUTAN AND SUCAT INTERSECTION LAYOUT

16.4 PROJECT OUTLINE

This project is proposed as the installation of the traffic signal in the intersection where there is high traffic and the complication in intersections layout. Two intersections will be operated as

together or controlled as one intersection. And the opening and shutting of the railway crossing should be considered of traffic control.

The signal control at this intersection performs isolated control not centralized control connected to the command center. The isolated signal control analyses the data which it got from a vehicle detector on the spot and can control a signal dynamically by making an optimum signal phase. In this way, two intersections that operated together can provide the signal control that was usually optimized by the situation of the intersection.

Traffic signal device has vertical three colors (Green, Yellow and Red) and arrow display and decides to install it in this side and depths side entering for each direction at the intersection. And all intersections install the vehicle detector of the image recognition type in the approach direction and collect traffic data. These data are used to automatically change a signal phase by time. Therefore the countdown timer is not installed. Because these intersections are un-signalized intersections presently, this project puts the pole and the ducts for cable connection together and installs it. The pedestrian signal device will be installed at pedestrian crossing of each intersection of Sucat.

A list of equipment required for each intersection and the system configuration of network for two intersections to operate together are shown below.

TABLE 16.4-1 EQUIPMENT REQUIRED FOR SIGNAL CONTROL SYSTEM ON INTERSECTION BESIDE IC

Equipment	Function
Roadside	
Traffic Signal	To indicate the signal of the go and the stop to do the traffic flow smoothly. The light device is composed with three colors of green, yellow and the red. Arrow
Traffic Light Controller	To implement the optimum signal control that there is not of the control delay to correspond to the change of the traffic flow by vehicle detectors.
Pedestrian Signal	To indicate the signal of the go and the stop for pedestrian. The light device is composed with two colors of green and the red at Sucat intersection
Vehicle Detector	Measurement of traffic volume, Occupancy.
Communication Network	
Layer 2 Switch	To connect each equipment to a optical fiber network.
Media Converter	To convert a signal mutually by connecting optical fiber cable and a copper cable.
Switching Hub	To relay the network in intranet.

List of equipments to be used, unit price of each equipment and quantities for Bicutan and Sucat are shown in **Table 16.4-2.**

TABLE 16.4-2 EQUIPMENTS TO BE USED

Equipment Name	Unit Price (PHP)	Qty. for Bicutan & Sucat
Traffic Signal (LED Lamp)	68,425	38
Traffic Light Controller	364,500	4
Pedestrian Signal	45,500	2
Vehicle Detector (Image Recognition Type)	224,000	19
Layer 2 Switch (Network Equipment)	212,000	2
Switching Hub (Network Equipment)	25,800	2
Media Converter (Network Equipment)	28,800	2

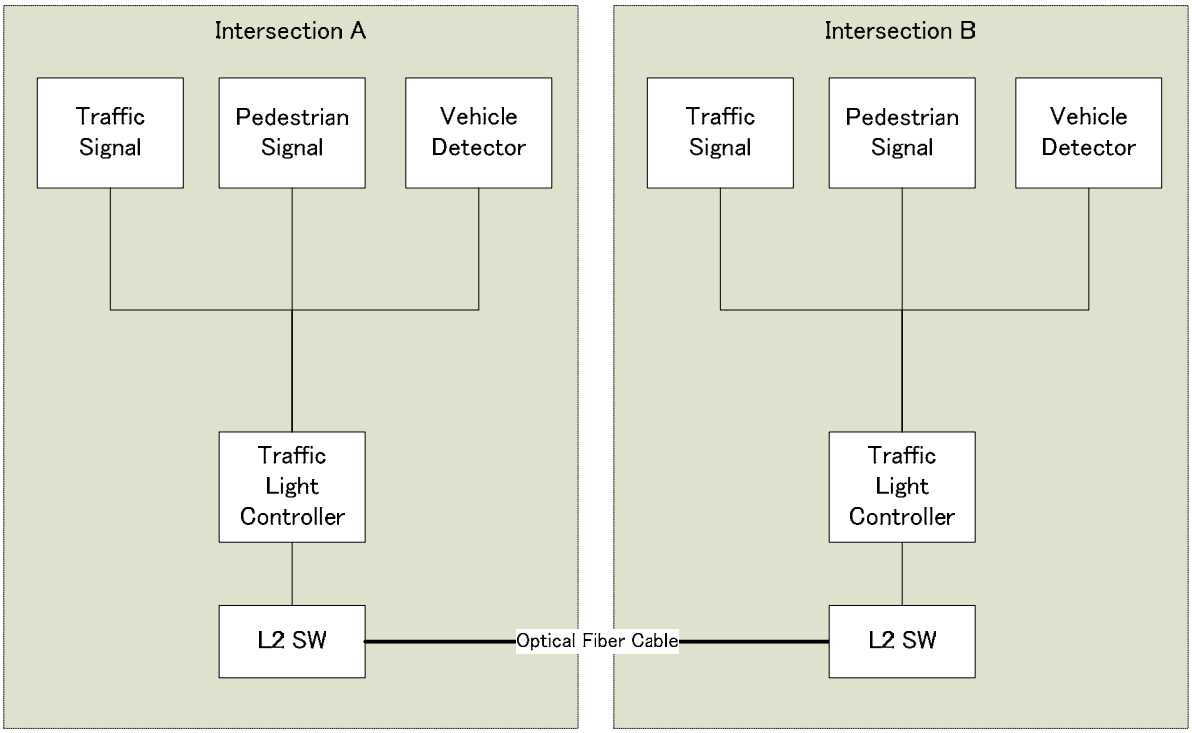


FIGURE 16.4-1 SYSTEM CONFIGURATION IMAGE FOR SIGNAL CONTROL SYSTEM (SUCAT)

The equipment arrangement plan of each intersection is shown in the following figures.

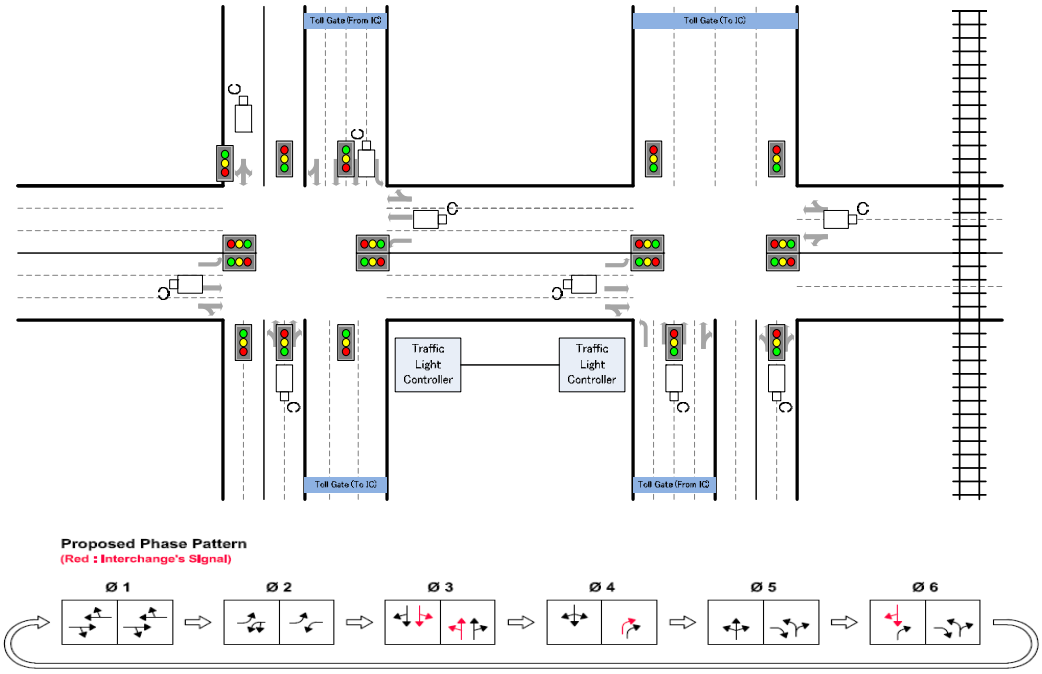


FIGURE 16.4-2 EQUIPMENT ARRANGEMENT PLAN FOR BICUTAN INTERSECTION

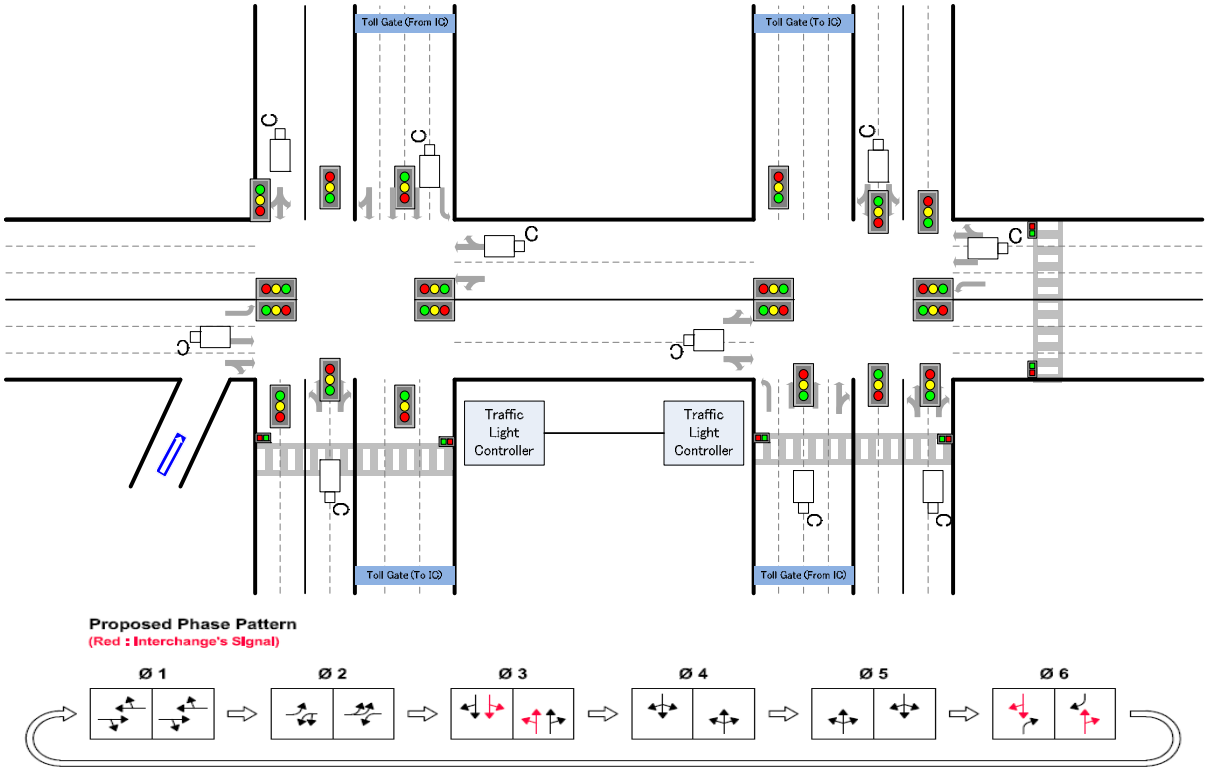


FIGURE 16.4-3 EQUIPMENT ARRANGEMENT PLAN FOR SUCAT INTERSECTION

16.5 IMPLEMENTATION SCHEDULE AND ANGENCY

16.5.1 Implementation Schedule

The all equipment which is proposed in this project needs the installations. Assumed installations are shown below;

1) Installation of Traffic Signal to the gantry
2) Installation of Vehicle Detector by image recognition to the gantry
3) Installation of gantry for traffic signal and vehicle detector
4) Installation of communication cable between two intersection

The experimental project will propose the traffic signal control system for smoothing traffic flow and traffic safety. Not only each component conforms to the specification but also the whole system is to be composed so as to function as one system.

This is proposed to be implemented as an “experimental project” of JICA Technical Assistance, Project

The project implementation schedule is shown in **Figure 16.5-1**.
Major Tasks are

1. Site Survey, Traffic Survey
2. Basic Design and
3. Specification Preparation
4. Traffic Micro Simulation
5. Contractor Selection
6. Installation and Signal Adjustment
7. Operation Training
8. Monitoring
9. Verification of Benefit

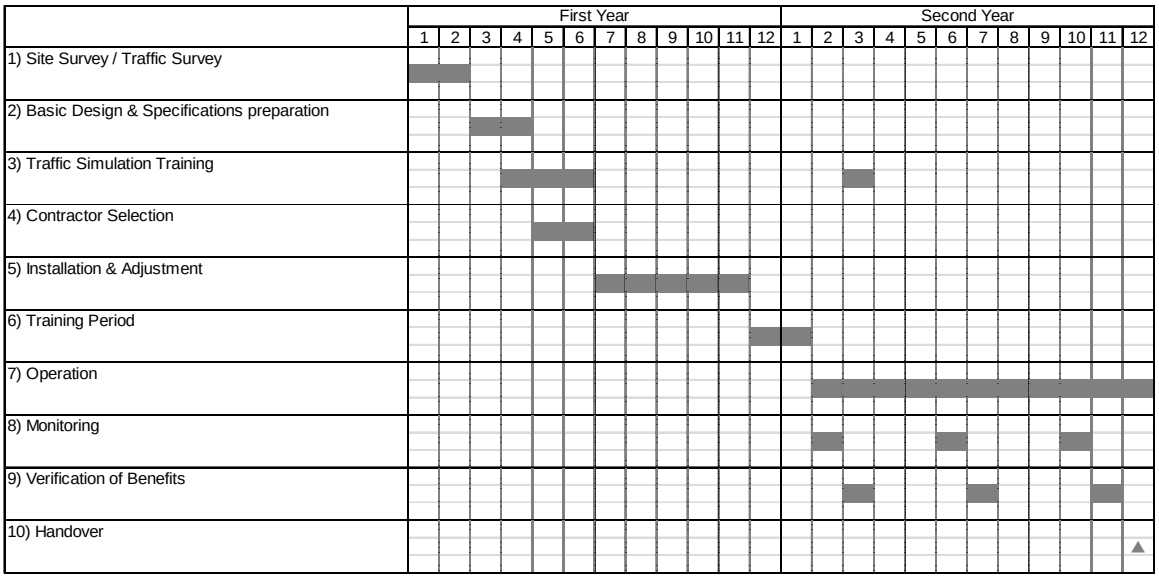


FIGURE 16.5-1 IMPLEMENTATION SCHEDULE

16.5.2 Implementing Agency

Implementing Agency is MMDA, Traffic Engineering Center (TEC)

To implement "experimental project" smoothly, the cooperation of Skyway O & M Company and Paranaque City will be necessary.

16.6 COST ESTIMATION FOR THE PROJECT

The Project Cost has been estimated for Pilot Project for Traffic Signal Control for Sucat and Bicutan intersection including Operation and Maintenance Cost.

The Project Cost consists of Traffic Signal Control System Equipment, and Communication System are estimated

The Total Project Cost is 7.55 Million Php for Sucat and 6.92 Million Php for Bicutan. The Annual Operation and Maintenance Cost is 2.63 Million Php for Sucat and 2.59 Million Php for Bicutan.

TABLE 16.6-1 PROJECT COST OF TRAFFIC SIGNAL CONTROL SYSTEM IN SUCAT

Item	Unit	Quantity	Unit Price (PHP)	Cost (PHP)	Cost by		
					Foreign	Local	Tax
1. Traffic Signal							
Sucat							
Traffic Signal	set	20	68,425	1,368,500	1,149,540	27,370	191,590
Traffic Light Controller	set	2	364,500	729,000	612,360	14,580	102,060
Pedestrian Signal	set	2	45,500	91,000	76,440	1,820	12,740
Vehicle Detector	set	10	224,000	2,240,000	1,881,600	44,800	313,600
Tuning & Setting	set	1	128,000	128,000	64,000	51,200	12,800
Construction (include Signal Mas	set	20	85,800	1,716,000	0	1,527,240	188,760
2. Communication System							
Layer 2 SW	set	2	212,000	424,000	356,160	8,480	59,360
Switching Hub	set	2	25,800	51,600	5,160	41,280	5,160
Media Converter	set	2	28,800	57,600	48,384	1,152	8,064
Optical Fiber	m	100	7,400	740,000	562,400	74,000	103,600
Grand Total				**7,545,700**	**4,756,044**	**1,791,922**	**997,734**

Source: JICA Study Team

TABLE 16.6-2 PROJECT COST OF TRAFFIC SIGNAL CONTROL SYSTEM IN BICUTAN

Item	Unit	Quantity	Unit Price (PHP)	Cost (PHP)	Cost by		
					Foreign	Local	Tax
1. Traffic Signal							
Bicutan							
Traffic Signal	set	18	68,425	1,231,650	1,034,586	24,633	172,431
Traffic Light Controller	set	2	364,500	729,000	612,360	14,580	102,060
Vehicle Detector	set	9	224,000	2,016,000	1,693,440	40,320	282,240
Tuning & Setting	set	1	128,000	128,000	64,000	51,200	12,800
Construction (include Signal Mas	set	18	85,800	1,544,400	0	1,374,516	169,884
2. Communication System							
Layer 2 SW	set	2	212,000	424,000	356,160	8,480	59,360
Switching Hub	set	2	25,800	51,600	5,160	41,280	5,160
Media Converter	set	2	28,800	57,600	48,384	1,152	8,064
Optical Fiber	m	100	7,400	740,000	562,400	74,000	103,600
Grand Total				**6,922,250**	**4,376,490**	**1,630,161**	**915,599**

Source: JICA Study Team

TABLE 16.6-3 ANNUAL OPERATION AND MAINTENANCE COST OF TRAFFIC SIGNAL CONTROL SYSTEM IN SUCAT

Item	Unit	Unit Price (Php)	Quantity	Cost (Million Php)	Cost Component (Million Php)		
					Foreign	Local	Tax
Replacement of Equipment Parts (2% of Total Cost)	L.S.	151,000.00	1.00	0.151	0.113	0.017	0.021
Electricity	Php/ Year	180,000.00	1.00	0.180	-	0.160	0.020
Staff Cost	Month	150,000.00	12.00	1.800	-	1.602	0.198
Running Cost of Office	Month	15,000.00	12.00	0.180	-	0.160	0.020
Rental Fee of Optical Fiber Cable	Month	15,000.00	12.00	0.180	-	0.160	0.020
Management Cost (5% of above Cost)	-	-	-	0.140	-	0.125	0.015
Total O & M Cost per Year				**2.631**	**0.113**	**2.224**	**0.294**

Source: JICA Study Team

TABLE 16.6-4 ANNUAL OPERATION AND MAINTENANCE COST OF TRAFFIC SIGNAL CONTROL SYSTEM IN BICUTAN

Item	Unit	Unit Price (Php)	Quantity	Cost (Million Php)	Cost Component (Million Php)		
					Foreign	Local	Tax
Replacement of Equipment Parts (2% of Total Cost)	L.S.	138,000.00	1.00	0.138	0.104	0.015	0.019
Electricity	Php/ Year	180,000.00	1.00	0.180	-	0.160	0.020
Staff Cost	Month	150,000.00	12.00	1.800	-	1.602	0.198
Running Cost of Office	Month	15,000.00	12.00	0.180	-	0.160	0.020
Rental Fee of Optical Fiber Cable	Month	15,000.00	12.00	0.180	-	0.160	0.020
Management Cost (5% of above Cost)	-	-	-	0.110	-	0.098	0.012
Total O & M Cost per Year				**2.588**	**0.104**	**2.196**	**0.289**

Source: JICA Study Team

16.7 EFFECT AND IMPACT OF PROJECT

Impact of introduction of signal control system was evaluated with respect to following 4 non-signalized intersections as BICTAN intersection No.1 and No.2, and SUCAT intersection No.1 and No.2

(1) Evaluation Flowchart

The evaluation flowchart is shown as follows:

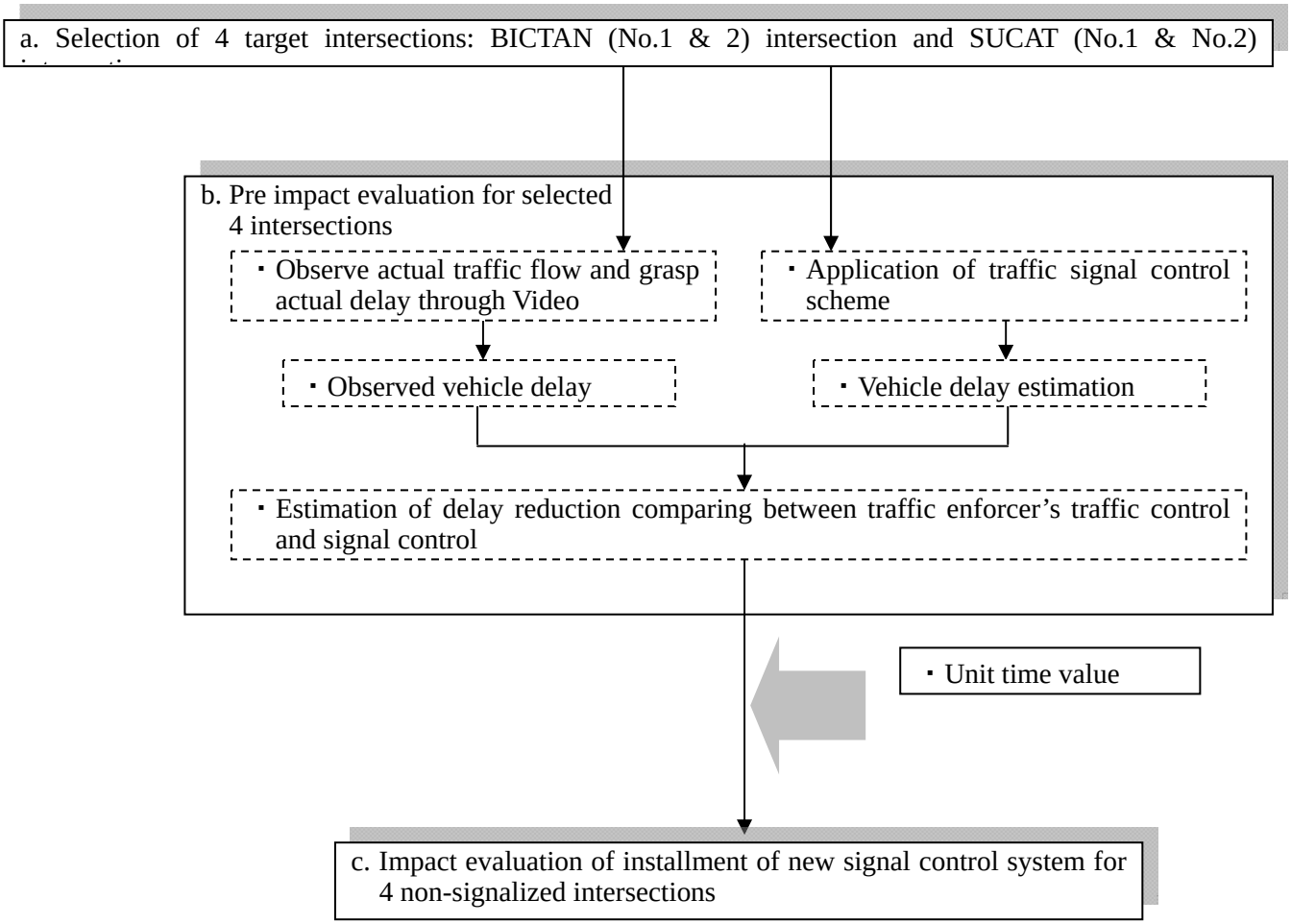


FIGURE 16.7-1 IMPACT EVALUATION FLOWCHART

(2) Conduct field survey

Traffic survey at the above 4 selected intersections was conducted. Survey items are traffic volume counting survey and parameter of traffic control performed by traffic enforcers stated as follows. Such traffic survey was conducted 2 time a day i.e., at morning peak hour and afternoon off-peak hour.

1) Traffic volume count survey at the intersections

Traffic survey was conducted:

By each lane

By each direction of traffic flow (going strait, right-turn and left-turn)

By each type of car (passenger vehicles, Jeepneys buses and trucks

2) Identification of parameter of traffic control performed by traffic enforcers

Hypothetical traffic signal control survey was conducted:

By hypothetical green interval for each traffic flow

By hypothetical cycle length

(3) Pre impact evaluation for selected 4 intersections

1) Average delay estimation

Average delay was estimated by using of the practical formula which is shown in "Highway Capacity Manual (HCM) 2010" as stated at the section 15.6.

$$d = 0.5C\,(1.0 - G/C)^2 / [\,1.0 - \min(1.0, X)G/C\,]$$

2) Estimation of delay reduction for 4 target intersections

Delay reduction was estimated as to BICUTAN and SUCAT intersection, which are the targeted intersections for installment of new signal control system. The following 2 tables show estimated delay reduction at both morning peak hour and afternoon off-peak hour.

TABLE 16.7-1 THE ESTIMATED AVERAGE DELAY REDUCTION AT MORNING PEAK HOUR

No.	Name of intersection	Observatory results of average actual delay [sec./veh.]	Estimated average delay obtained by hypothetical signal control [sec./veh.]	The amount of estimated average delay reduction [sec./veh.]
1	BICUTAN (No.1)	30.58	29.22	1.36
2	BICUTAN (No.2)	37.75	35.69	2.06
3	SUCAT (No.1)	29.88	29.58	0.30
4	SUCAT (No.2)	33.64	32.60	1.04

TABLE 16.7-2 THE ESTIMATED AVERAGE DELAY REDUCTION AT AFTERNOON OFF-PEAK HOUR

No.	Name of intersection	Observatory results of average actual delay [sec./veh.]	Estimated average delay obtained by hypothetical signal control [sec./veh.]	The amount of estimated average delay reduction [sec./veh.]
1	BICUTAN (No.1)	23.89	22.67	1.22
2	BICUTAN (No.2)	30.15	28.99	1.16
3	SUCAT (No.1)	26.46	25.20	1.26
4	SUCAT (No.2)	28.00	27.00	1.00

On the basis of the above results of estimation, delay reduction within one day (day-time 14 hours) was estimated as follows:

TABLE 16.7-3 DELAY REDUCTION THROUGH INSTALLATION OF TRAFFIC SIGNAL CONTROL SYSTEM

No.	Name of intersection	Delay reduction for morning peak hour (5 hours: from 6am to 11am) [veh*hour/5hours]	Delay reduction for daytime off-peak hour (9 hours) [veh*hour/9hours]	Total delay reduction for one day (14 hours) [veh*hour/day]
1	BICUTAN (No.1)	10.6	14.2	24.8
2	BICUTAN (No.2)	13.4	16.4	29.8
3	SUCAT (No.1)	3.0	18.0	21.0
4	SUCAT (No.2)	7.0	12.0	19.0
TOTAL		34.0	60.6	94.6

The following table shows the summary of the time saving impact in terms of “hours”.

TABLE 16.7-4 SUMMARY OF THE TIME SAVING IMPACT IN TERMS OF “HOURS”

Targeted intersections	Time saving	unit
BICUTAN + SUCAT intersection	6.4	[hrs./hour]
	94.6	[hrs./day]
	473.0	[hrs./week]
	18,920	[hrs/year]

The above time saving impact can be converted into monetary term by using of 7.8 [peso/minute/vehicle], which comes from DPWH. The time saving impact in terms of monetary term is shown in the following table.

TABLE 16.7-5 SUMMARY OF THE TIME SAVING IMPACT IN TERMS OF “PESO”

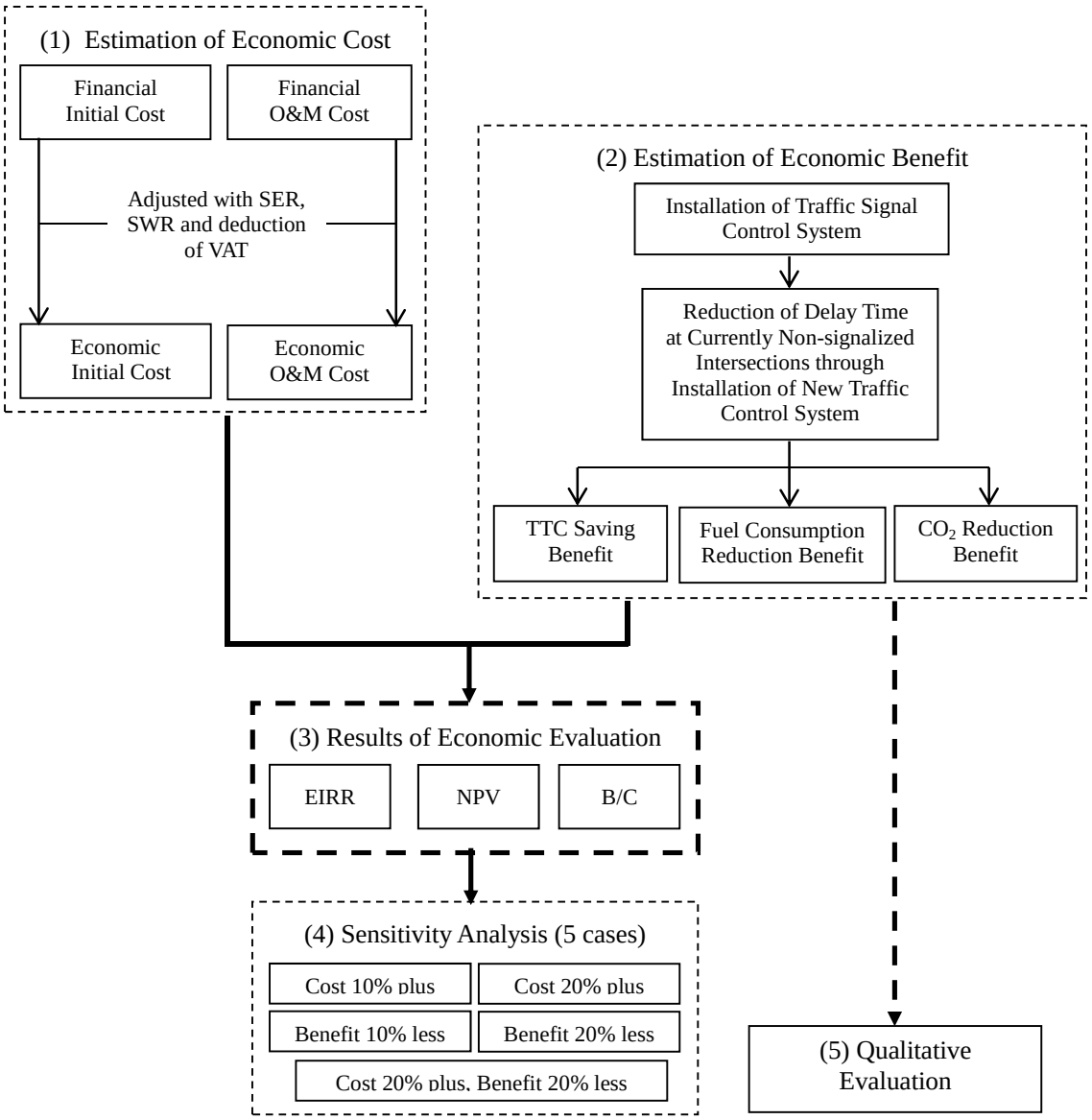
Targeted intersections	Time saving	unit
BICUTAN + SUCAT intersection	3.2	[1,000Peso./hour]
	44.2	[1,000peso./day]
	221.4	[1,000 Peso/week]
	8,854.6	[1,000 Peso/year]

16.8 ECONOMIC ANALYSIS

16.8.1 Methodology

(1) Framework and Workflow of Economic Evaluation

The framework and workflow of economic evaluation on the Project of Traffic Signal Control at Bicutan and Sucat intersection are illustrated in the following flow chart.



Source: JICA Study Team

FIGURE 16.8-1 FRAMEWORK AND WORKFLOW OF ECONOMIC EVALUATION OF THE PROJECT OF TRAFFIC SIGNAL CONTROL OF BICUTAN AND SUCAT INTERSECTION

(2) Basic Concepts and Assumptions

1) Reference to the Metro Manila Master Plan

As all the basic concepts and most of the assumptions here are the same as those adopted previously in Chapter 11, description of this part is omitted, with extra explanation regarding 3 points added below.

2) Economic Evaluation Focused on the Impact of Traffic Signal Control

The scope of this pilot project is confined to the area of traffic signal control, and the work of economic evaluation on this project is focused on analyzing the impact of installing traffic signal

control system at four currently non-signalized intersections along the Alabang-Zapote Road. In addition to the benefit of TTC saving, the benefit of idling time fuel consumption reduction and benefit of CO_2 emission reduction are to be evaluated as quantifiable items. In addition, there are also benefits unquantifiable, to which the approach of qualitative analysis is applied as what has been done in the previous chapters.

3) Project Period Subject to the Evaluation

The period of this pilot project subject to the economic evaluation is assumed to be 10 years from 2014 to 2023.

4) Consideration the Case of Dividing the Project into Two

This project is composed of two components, the Bicutan Component and the Sucat Component. As there is the possibility of implementing these two components separately, economic evaluation in this section is also conducted with regard to the respective components in addition to the evaluation dealing with them integrally.

16.8.2 Economic Cost of the Project

(1) Initial Cost

1) Financial Cost

The initial cost of this project consists of costs of the following 3 categories, including the physical contingency cost assumed to be 5% of the 2 basic cost categories.

- Traffic Signal
- Communication System
- Physical Contingency

The disbursement of initial investment cost as well as the construction and installation work is expected to be conducted and completed in the year of 2014. The financial cost of the initial investment by category is stated in the table with the breakdown of foreign currency portion, local currency portion as well as tax item.

TABLE 16.8-1 FINANCIAL COST OF INITIAL INVESTMENT

(Unit: Php.Million)

No.	Item	Total	Foreign	Local	Tax
1	Traffic Signal	11.921	7.188	3.172	1.561
1.1	Bicutan	5.648	3.404	1.505	0.739
	Equipment	(4.108)	(3.404)	(0.130)	(0.574)
	Labor	(1.540)	(0)	(1.375)	(0.165)
1.2	Sucat	6.273	3.784	1.667	0.822
	Equipment	(4.563)	(3.784)	(0.140)	(0.639)
	Labor	(1.710)	(0)	(1.527)	(0.183)
2	Communication System	2.546	1.944	0.250	0.352
	Equipment	(2.546)	(1.944)	(0.250)	(0.352)
	Labor	(0)	(0)	(0)	(0)
3	**Total (Item1+2)**	**14.467**	**9.132**	**3.422**	**1.913**
4	Physical Contigency (5% of Item 3)	0.723	0.457	0.171	0.096
Grand Total		**15.190**	**9.589**	**3.593**	**2.009**

Source: JICA Study Team

2) Conversion to Economic Cost

The values of financial cost are converted into that of the economic cost in the same way as what has been explained in the chapter regarding Metro Manila Master Plan. As a result of the conversion, the values of economic cost are yielded and reflected in the table below.

TABLE 16.8-2 ECONOMIC COST OF INITIAL INVESTMENT

(Unit: Php.Million)

No.	Item	Total	Foreign	Local
1	Traffic Signal	10.637	8.626	2.011
1.1	Bicutan	5.040	4.085	0.955
1.2	Sucat	5.597	4.541	1.056
2	Communication System	2.583	2.333	0.250
3	**Total (Item1+2)**	**13.220**	**10.958**	**2.261**
4	Physical Contigency (5% of Item 3)	0.661	0.548	0.113
Grand Total		**13.881**	**11.506**	**2.374**

Source: JICA Study Team

3) Economic Cost of Initial Investment for the Two Separate Components

In the case of implementing the two components separately, their respective economic costs of initial investment are as follows:

- Bicutan

TABLE 16.8-3 ECONOMIC COST OF INITIAL INVESTMENT (BICUTAN)

(Unit: Php.Million)

No.	Item	Total	Foreign	Local
1	Traffic Signal	5.040	4.085	0.955
2	Communication System	1.291	1.166	0.125
3	**Total (Item1+2)**	**6.331**	**5.251**	**1.080**
4	Physical Contigency (5% of Item 3)	0.317	0.263	0.054
Grand Total		**6.648**	**5.514**	**1.134**

Source: JICA Study Team

- Sucat

TABLE 16.8-4 ECONOMIC COST OF INITIAL INVESTMENT (SUCAT)

(Unit: Php.Million)

No.	Item	Total	Foreign	Local
1	Traffic Signal	5.597	4.541	1.056
2	Communication System	1.291	1.166	0.125
3	**Total (Item1+2)**	**6.888**	**5.707**	**1.181**
4	Physical Contigency (5% of Item 3)	0.344	0.285	0.059
Grand Total		**7.233**	**5.993**	**1.240**

Source: JICA Study Team

(2) Operation and Maintenance (O&M) Cost

1) O&M Cost of the Project as a Whole

With regard to the O&M cost of the project, the 7 cost items with values of annual amount are indicated in terms of both financial cost and economic cost as seen from the following table. The way in which the financial cost of respective items is converted into economic cost is the same as what has been adopted in the previous chapters.

TABLE 16.8-5 FINANCIAL COST AND ECONOMIC COST OF O&M

(Unit: Php.Million)

No	Item	Financial Cost				Economic Cost		
		Total	Foreign	Local	Tax	Total	Foreign	Local
1	Replacement of Equipment Parts	0.289	0.217	0.032	0.040	0.291	0.260	0.031
2	Electricity	0.360	0.00	0.320	0.040	0.321	0.00	0.321
3	Staff Cost	3.600	0.00	3.204	0.396	1.922	0.00	1.922
4	Running Cost of Office	0.360	0.00	0.320	0.040	0.321	0.00	0.321
5	Rental Fee of Optical Fiber Cable	0.360	0.00	0.320	0.040	0.321	0.00	0.321
6	Management Cost (5% of above Cost)	0.251	0.00	0.223	0.028	0.223	0.00	0.223
7	Physical Contingency	0.261	0.011	0.221	0.029	0.170	0.013	0.157
Total O & M Cost per Year		**5.481**	**0.228**	**4.640**	**0.613**	**3.570**	**0.273**	**3.296**

Source: JICA Study Team

2) O&M Cost for the Two Separate Components

When implementing the two components separately, their respective O&M costs in both economic and financial value are as follows:

- Bicutan

TABLE 16.8-6 O&M COST OF BICUTAN COMPONENT

(Unit: Php.Million)

No	Item	Financial Cost				Economic Cost		
		Total	Foreign	Local	Tax	Total	Foreign	Local
1	Replacement of Equipment Parts	0.138	0.104	0.015	0.019	0.140	0.125	0.015
2	Electricity	0.180	0.00	0.160	0.020	0.160	0.00	0.160
3	Staff Cost	1.800	0.00	1.602	0.198	0.961	0.00	0.961
4	Running Cost of Office	0.180	0.00	0.160	0.020	0.160	0.00	0.160
5	Rental Fee of Optical Fiber Cable	0.180	0.00	0.160	0.020	0.160	0.00	0.160
6	Management Cost (5% of above Cost)	0.110	0.00	0.098	0.012	0.098	0.00	0.098
7	Physical Contingency	0.129	0.005	0.110	0.014	0.084	0.006	0.078
Total O & M Cost per Year		**2.717**	**0.109**	**2.305**	**0.303**	**1.763**	**0.131**	**1.632**

Source: JICA Study Team

- Sucat

TABLE 16.8-7 O&M COSTS OF SUCAT COMPONENT

(Unit: Php.Million)

No	Item	Financial Cost				Economic Cost		
		Total	Foreign	Local	Tax	Total	Foreign	Local
1	Replacement of Equipment Parts	0.151	0.113	0.017	0.021	0.153	0.136	0.017
2	Electricity	0.180	0.00	0.160	0.020	0.160	0.00	0.160
3	Staff Cost	1.800	0.00	1.602	0.198	0.961	0.00	0.961
4	Running Cost of Office	0.180	0.00	0.160	0.020	0.160	0.00	0.160
5	Rental Fee of Optical Fiber Cable	0.180	0.00	0.160	0.020	0.160	0.00	0.160
6	Management Cost (5% of above Cost)	0.140	0.00	0.125	0.015	0.125	0.00	0.125
7	Physical Contingency	0.132	0.006	0.111	0.015	0.086	0.007	0.079
Total O & M Cost per Year		**2.763**	**0.119**	**2.335**	**0.309**	**1.805**	**0.142**	**1.662**

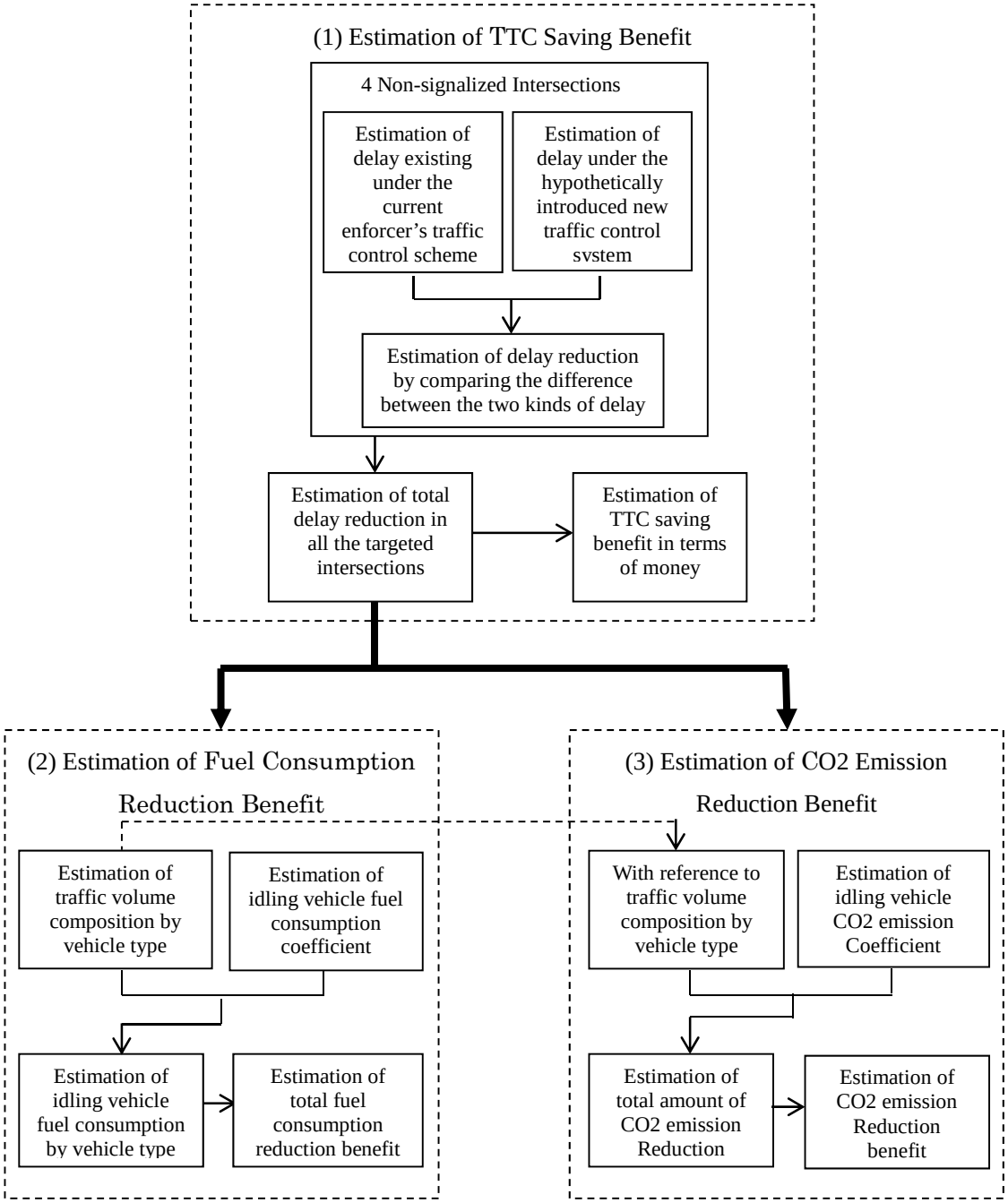
Source: JICA Study Team

16.8.3 Quantifiable Economic Benefit of the Project

The economic evaluation of this chapter is focused on analyzing the impact of traffic signal control system installation. For this purpose, the following 3 kinds of benefits are estimated.

- TTC saving benefit
- Fuel consumption reduction benefit
- CO_2 emission reduction benefit

The process in which the above-mentioned benefits are estimated is illustrated in the following flowchart.



Source: JICA Study Team

FIGURE 16.8-2 PROCESS OF BENEFIT ESTIMATION REGARDING THE IMPACT OF TRAFFIC SIGNAL CONTROL SYSTEM INSTALLATION

(1) Estimation of TTC Saving Benefit

In this project, the TTC saving benefit is expected to be generated by the installation advanced new traffic signal control system in 4 currently non-signalized intersections, 2 located in Bicutan, and 2 in Sucat. As shown by the above flowchart, this kind of benefit can be estimated through the following processes.

1) Estimation of Delay Reduction by Signalizing the 4 Currently Non-signalized Intersections

The work of estimation consists of 3 steps as indicated below:

- Estimation of delay existing under the current enforcer's traffic control scheme
- Estimation of delay under the hypothetically introduced new traffic control system
- Estimation of delay reduction by comparing the above two kinds of delay

2) Estimation of TTC Saving Benefit in Terms of Money

By multiplying the above value of delay reduction with the afore-mentioned unit TTC (7.8 peso/minute/PCU), the TTC saving benefit in terms of money can be worked out accordingly. The specific process of estimation with actual data acquired from the traffic survey conducted by the Study Team had already been described in the previous section, and the major results used in the economic evaluation are as follows:

TABLE 16.8-8 TRAVEL TIME SAVING THROUGH DELAY REDUCTION AND TTC SAVING BENEFIT

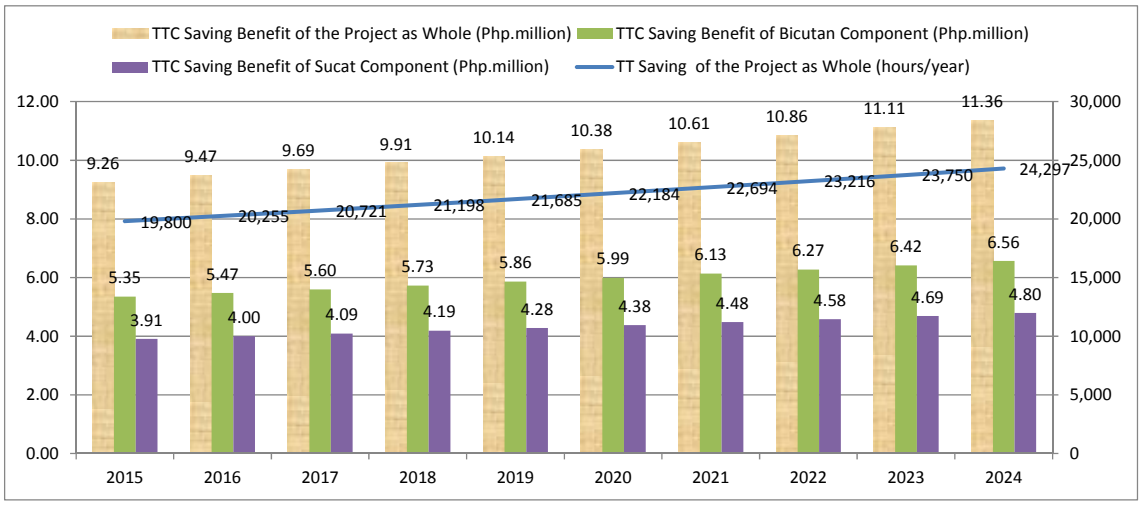
Item		Bicutan	Sucat	Total
TT Saving in Terms of Hour	(hours/day)	54.6	40.0	94.6
	(hours/year)	10,920	8,000	18,920.0
TTC Saving in Terms of Money	Php.1,000/day)	25.6	18.7	44.3
	Php.1,000/year)	5,111	3,744	8,854.6

Source: JICA Study Team

As seen from the table above, the TT saving in terms of hour as well as TTC saving benefit of the project as a whole and the respective components of Bicutan and Sucat are worked out separately.

According to the implementation schedule of this project, the installation work will be started and completed within the year of 2014; therefore, the TTC saving benefit is assumed to come out from the year of 2015 to allow for a period of trial and error. Moreover, the average annual growth rate of 2.3% for traffic volume in Metro Manila Region as mentioned previously is also taken into consideration in the evaluation.

As mentioned previously, in addition to economic evaluation on the project as a whole, evaluation on the respective components of Bicutan and Sucat separately is also needed.
Accordingly, the change of annual TTC saving benefit in the above-mentioned 3 cases can be illustrated by the following diagram.



Source: JICA Study Team

FIGURE 16.8-3 CHANGE OF ANNUAL BENEFIT OF TTC SAVING GENERATED BY THE PROJECT OF TRAFFIC SIGNAL CONTROL

(2) Estimation of Fuel Consumption Reduction Benefit

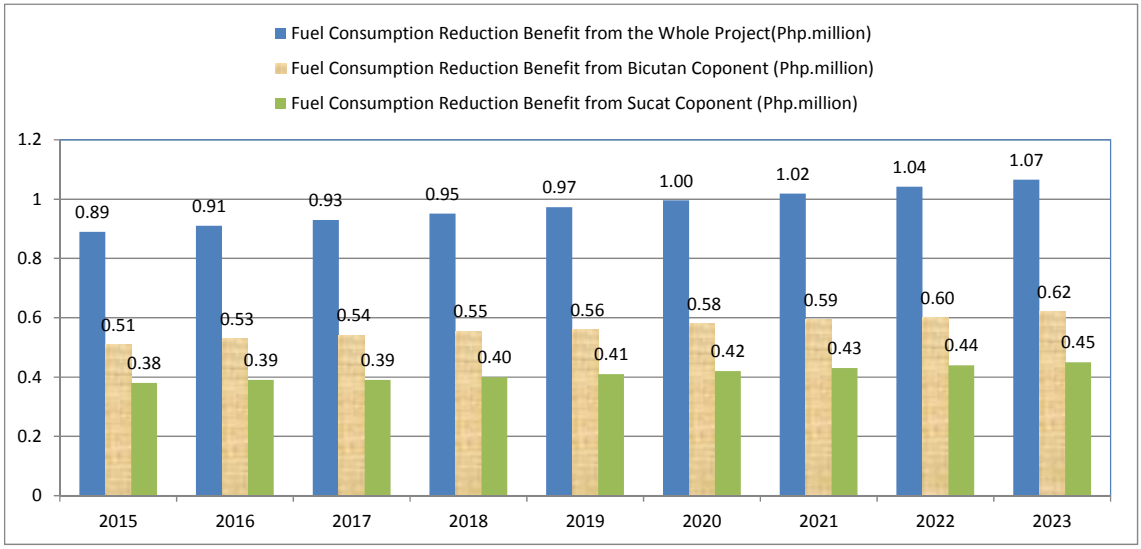
By utilizing the above result of .TT saving through delay reduction, the fuel consumption reduction benefit can be estimated in the same way as what was described in the section of 15.7. The results of estimation regarding the project as a whole and the respective components of Bicutan and Sucat are indicated in the table below.

TABLE 16.8-9 FUEL CONSUMPTION REDUCTION BENEFIT FROM THE PROJECT

Item		Bicutan	Sucat	Total
Fuel Consumtion Reduction Benefit	(Php.million/ year)	0.49	0.36	0.85

Source: JICA Study Team

In view of the implementation schedule and the necessary readjustment mentioned previously, the annual benefit of fuel consumption reduction is expected to come out in the way illustrated by the diagram below.



Source: JICA Study Team

FIGURE 16.8-4 CHANGE OF ANNUAL BENEFIT OF FUEL CONSUMPTION REDUCTION FROM THE PROJECT OF TRAFFIC SIGNAL CONTROL

(3) Estimation of CO_2 Emission Reduction Benefit

By utilizing the afore-mentioned result of .TT saving through delay reduction and the values of vehicle type composition, the CO_2 emission reduction benefit can be estimated in the way described previously in the section of 15.7.

The results of calculation show that the annual reduction of CO_2 emission for the project as a whole is expected to be .11.89 ton in 2015, which can be converted into the value of Php.2,636, including Php.1,521 from the Bicutan component and Php.1,115 from the Sucat component. However, as the values are negligibly small that they can hardly influence the results of economic evaluation, they are not taken into account in the calculation of EIRR.

16.8.4 Results of Economic Evaluation

(1) Results of the Project as a Whole

Based on the values of all the cost items and quantifiable benefit items, major results of economic evaluation on this project are calculated and indicated in the table below.

TABLE 16.8-10 MAJOR RESULTS OF ECONOMIC EVALUATION (BICUTAN-SUCAT)

EIRR (%)	NPV (Php.million)	B/C
38.4	15	1.5

Source: JICA Study Team

As seen from the above table, EIRR exceeds the value of SDR (15%), and the values of NPV and

B/C also exceed their respective threshold levels, showing that the project is economically viable (Also see **Table 16.8-13**). Moreover, as the project contains also unquantifiable benefits, the economic viability could be regarded better than the above quantitative result when taking into consideration all the unquantifiable benefits.

(2) Results of the Bicutan Component

TABLE 16.8-11 MAJOR RESULTS OF ECONOMIC EVALUATION (BICUTAN COMPONENT)

EIRR (%)	NPV (Php.million)	B/C
50.4	12	1.8

Source: JICA Study Team

When looking upon the Bicutan component as a stand-alone project, the results of economic evaluation is much better than the integral project including the Sucat component. Both the values of EIRR and B/C surpass that of the integral project. This is closely related to the lower initial cost and O&M cost of the Bicutan component as compared to that of the Sucat component. (Also see **Table 16.8-14**)

(3) Results of the Sucat Component

TABLE 16.8-12 MAJOR RESULTS OF ECONOMIC EVALUATION (SUCAT COMPONENT)

EIRR (%)	NPV (Php.million)	B/C
26.8	4	1.2

Source: JICA Study Team

Due to the above-mentioned reason, the results of economic evaluation on the Sucat component are far inferior to that of the Bicutan component. Still, the results themselves show that it is economically viable to implement the component as a stand-alone project, as all the results exceed the threshold values. (Also see **Table 16.8-15**)

TABLE 16.8-13 COST-BENEFIT STREAM (BICUTAN-SUCAT PROJECT)

(Unit: Php. Million)

Year	Cost					Benefit				Net Economic Benefit
	Initial Cost			O&M Cost	Total Cost	Traffic Signal Control			Total Benefit	
	Traffic Signal Control System	Communication System	Physical Contingency			TTC Saving	Fuel Consumption Reduction	CO_2 Emission Reduction		
2014	10.6	2.58	0.66	3.57	17	0	0	0	0	(17)
15	0	0	0	3.57	4	9.26	0.89	0	10	7
16	0	0	0	3.57	4	9.47	0.91	0	10	7
17	0	0	0	3.57	4	9.69	0.93	0	11	7
18	0	0	0	3.57	4	9.91	0.95	0	11	7
19	0	0	0	3.57	4	10.14	0.98	0	11	8
20	0	0	0	3.57	4	10.37	1.00	0	11	8
21	0	0	0	3.57	4	10.61	1.02	0	12	8
22	0	0	0	3.57	4	10.85	1.05	0	12	8
23	0	0	0	3.57	4	11.10	1.07	0	12	9
									EIRR=	38.429%
									NPV(Php million)=	15
									Present value of cost=	30
									Present value of benefit=	45
									B/C=	1.5

Source: JICA Study Team

TABLE 16.8-14 COST-BENEFIT STREAM (BICUTAN COMPONENT)

(Unit: Php. Million)

Year	Cost					Benefit				Net Economic Benefit
	Initial Cost			O&M Cost	Total Cost	Traffic Signal Control			Total Benefit	
	Traffic Signal Control System	Communication System	Physical Contingency			TTC Saving	Fuel Consumption Reduction	CO_2 Emission Reduction		
2014	5.0	1.29	0.32	1.76	8	0	0	0	0	(8)
15	0	0	0	1.76	2	5.35	0.51	0	6	4
16	0	0	0	1.76	2	5.47	0.53	0	6	4
17	0	0	0	1.76	2	5.60	0.54	0	6	4
18	0	0	0	1.76	2	5.73	0.55	0	6	5
19	0	0	0	1.76	2	5.86	0.56	0	6	5
20	0	0	0	1.76	2	5.99	0.58	0	7	5
21	0	0	0	1.76	2	6.13	0.59	0	7	5
22	0	0	0	1.76	2	6.27	0.60	0	7	5
23	0	0	0	1.76	2	6.41	0.62	0	7	5
									EIRR=	50.378%
									NPV(Php million)=	12
									Present value of cost=	15
									Present value of benefit=	26
									B/C=	1.8

Source: JICA Study Team

TABLE 16.8-15 COST-BENEFIT STREAM (SUCAT COMPONENT)

(Unit: Php. Million)

Year	Cost					Benefit				Net Economic Benefit
	Initial Cost			O&M Cost	Total Cost	Traffic Signal Control			Total Benefit	
	Traffic Signal Control System	Communication System	Physical Contingency			TTC Saving	Fuel Consumption Reduction	CO_2 Emission Reduction		
2014	5.60	1.29	0.34	1.81	9	0	0	0	0	(9)
15	0	0	0	1.81	2	3.92	0.38	0	4	2
16	0	0	0	1.81	2	4.01	0.39	0	4	3
17	0	0	0	1.81	2	4.10	0.39	0	4	3
18	0	0	0	1.81	2	4.19	0.40	0	5	3
19	0	0	0	1.81	2	4.29	0.41	0	5	3
20	0	0	0	1.81	2	4.39	0.42	0	5	3
21	0	0	0	1.81	2	4.49	0.43	0	5	3
22	0	0	0	1.81	2	4.59	0.44	0	5	3
23	0	0	0	1.81	2	4.70	0.45	0	5	3
									EIRR=	26.778%
									NPV(Php million)=	4
									Present value of cost=	15
									Present value of benefit=	19
									B/C=	1.2

Source: JICA Study Team

16.8.5 Sensitivity Analysis

The sensitivity to potential risks with regard to the whole project as well as the 2 subordinate components is verified by assuming the following 5 cases:

- Case 1: 10% plus of cost
- Case 2: 20% plus of cost
- Case 3: 10% less of benefit
- Case 4: 20% less of benefit
- Case 5 20% plus of cost and 20% less of benefit

The results of sensitivity analysis on the 5 cases for the project and the two components are summed up in the following tables.

(1) The Project as a Whole

The results show that, even under the strictest conditions assumed in Case 5, the EIRR value of this project is still higher than the SDR value

TABLE 16.8-16 PROJECT SENSITIVITY IN 5 CASES (BICUTAN-SUCAT PROJECT)

	Base	Case 1	Case 2	Case 3	Case 4	Case 5
EIRR (%)	38.4	32.5	28.6	31.9	25.1	16.2
NPV (Php.million)	15	12	10	11	6	1
B/C	1.5	1.4	1.3	1.4	1.2	1.0

Source: JICA Study Team

(2) The Bicutan Component

With regard to the Bicutan component, results of all the 5 cases are well above their respective threshold levels, showing that the economic viability of this component is unwavering.

TABLE 16.8-17 PROJECT SENSITIVITY IN 5 CASES (BICUTAN COMPONENT)

	Base	Case 1	Case 2	Case 3	Case 4	Case 5
EIRR (%)	50.4	43.6	37.8	43.0	35.3	24.4
NPV (Php.million)	12	10	9	9	6	3
B/C	1.8	1.6	1.5	1.6	1.4	1.2

Source: JICA Study Team

(3) The Sucat Component

As for the Sucat Component, it will be still economically viable in Case 1, 2 and 3, while Case 4

and 5 will drag it down the level below the threshold value.

TABLE 16.8-18 PROJECT SENSITIVITY IN 5 CASES (SUCAT COMPONENT)

	Base	Case 1	Case 2	Case 3	Case 4	Case 5
EIRR (%)	26.8	21.6	17.1	20.9	14.7	5.7
NPV (Php.million)	4	2	1	2	0	-3
B/C	1.2	1.1	1.0	1.1	0.995	0.8

Source: JICA Study Team

16.8.6 Qualitative Evaluation

In addition to the quantifiable benefits evaluated above, there are also several kinds of unquantifiable benefit worthy of mentioning. These benefits include faster moving traffic flow, saving of vehicle operation cost (VOC), reduction of CO_2 emission, traffic accident reduction and user's psychological comfort. Justifications for these benefits are as follows.

● Faster Moving Traffic Flow in the Overall Road Network of Metro Manila Region

As the implementation of this project will reduce the delay time at 4 intersections in Bictan and Sucat along the Alabang-Zapote Road, this effect will contribute to the faster moving traffic flow in the overall road network so as to reduce average driving time.in the whole of the Metro Manila Region.

● Effect of VOC Saving beyond That of the Targeted Areas

As a result of the generation of the above benefit, the effect of VOC saving is expected to further extend to the areas covered by the overall road network, which is beyond the areas of the 4 intersections targeted in this project.

● Effect of CO_2 Emission Reduction beyond That of the Targeted Areas

By the same token, the benefit of CO_2 emission reduction is also expected to come out for all over the road network.

● Traffic Accident Reduction

As the improvement of traffic efficiency will ease traffic congestion and chaos, this will in turn contribute to the reduction of occurrence probability of traffic accident and hence reduce the social loss resulted from the accidents.

● Saving of Manpower Cost in Traffic Enforcement

By signalized the currently non-signalized intersections, the necessity for the road and traffic managing agencies to deploy many traffic enforcers on the roads can be expected to lessen significantly.