CHAPTER 23
Traffic Management Plan

23. TRAFFIC MANAGEMENT PLAN

23.1. TRAFFIC SIGNAL CONTROL IMPROVEMENT PLAN

This section discusses a traffic signal control improvement plan by introducing the area traffic signal control system on near-saturated conditions in specified areas, this includes the synchronized system of traffic signals on major streets, the improvement plan of the signal phasing system with a green arrow for left-turn vehicles including the improvement of the intersections, the installation of traffic signal lights at non-signalized intersections with channelization systems, and the bus priority signal control system plan on the trunk busways.

23.1.1. NECESSITY AND OBJECTIVES

The necessity and objectives of the traffic signal control improvement plan are as follows:

a) The improvement of signal control is one of the ways in which the maximum use of existing road facilities and the increase of road capacities can be achieved. It is a cost effective method.
b) At present, during peak periods, traffic policemen manually control the signalized intersections on the major roads while the efficiency of traffic signal control can be elevated by the improvement of the traffic signal control system.
c) In order to achieve a smooth traffic flow along the major roads and in the specified heavy congested area, the technical improvement of the signal control system will be necessary through the introduction of a real time control system with traffic sensors in order to respond to unstable traffic fluctuations by time periods.
d) The most significant objective of the improvement of the traffic signal control system is to achieve the smooth flow of motor vehicle traffic. In addition, the traffic control system will aim at reducing air pollution and decreasing traffic accidents through the alleviation of traffic congestion.

23.1.2. FUNCTIONS

In accordance with the necessity and objectives, the improvement plan of the traffic signal control system for the study area requires the following functions:

a) Area wide and linear coordinated signal control function
The system should be able to respond to changes in traffic conditions based on vehicle detectors (sensors), and a manual control system can be operated in case of emergency conditions. The signal control system on near-saturated conditions in specified areas adopts the area traffic signal control system (referred to as the "ATC System"), for outside of the ATC System control area, the synchronized system of traffic signals on major streets will be adopted.
b) Bus priority signal control function
The system on the proposed trunk busway should be able to give the bus priority signal control, in order to realize punctual public transportation, improve convenience for bus users, and give priority to bus transportation. A vehicle detector is installed on the segregated trunk busway for detecting buses, and the vehicle sensor transfers bus information to the signal control unit at the local facilities. The signal control unit decides whether it should change the timing of the signal on the basis of preset timing and information received from the bus.
c) Information function
The system should be able to provide traffic condition information on display boards in the control room, the information should be able to be monitored by

vehicle detectors. The personnel in the control room can access the information.

d) Data-processing function
The signal control system should be able to compile and process the data obtained from the vehicle detectors at key intersections in order to update its statistics. Based on this function, it will be able to renew its signal control parameters as necessary and improve its control methods.

e) Monitoring function
The signal control system should be able to monitor local controllers and vehicle detectors, and keep a check on whether they are operating in accordance with the central computer commands.

23.1.3. INTERSECTIONS TO BE COVERED BY THE SIGNAL CONTROL SYSTEM

(1) Identified Intersection

Based on the plan locations defined in Chapter 16, intersections that are currently signalized and those that will be signalized were identified as intersections subject to control by the proposed signal control system. Intersections to be signalized consist of those being planned by the DMTU (including intersections to be created by the construction of planned roads), those which are considered to be installed traffic signal lights at non-signalized intersections, and the existing signalized intersections.

Figure 23.1-1 shows the signalized intersections in specified areas to be covered by the ATC System, the signalized intersections on 17 major roads to be covered by the synchronized system are shown in Figure 23.1-2, Figure 23.1-3, Figure 23.1-4, and Figure 23.1-5. As shown in Table 23.1-1, a total of 497 intersections were identified, of which 358 are already signalized and 139 will be newly signalized.

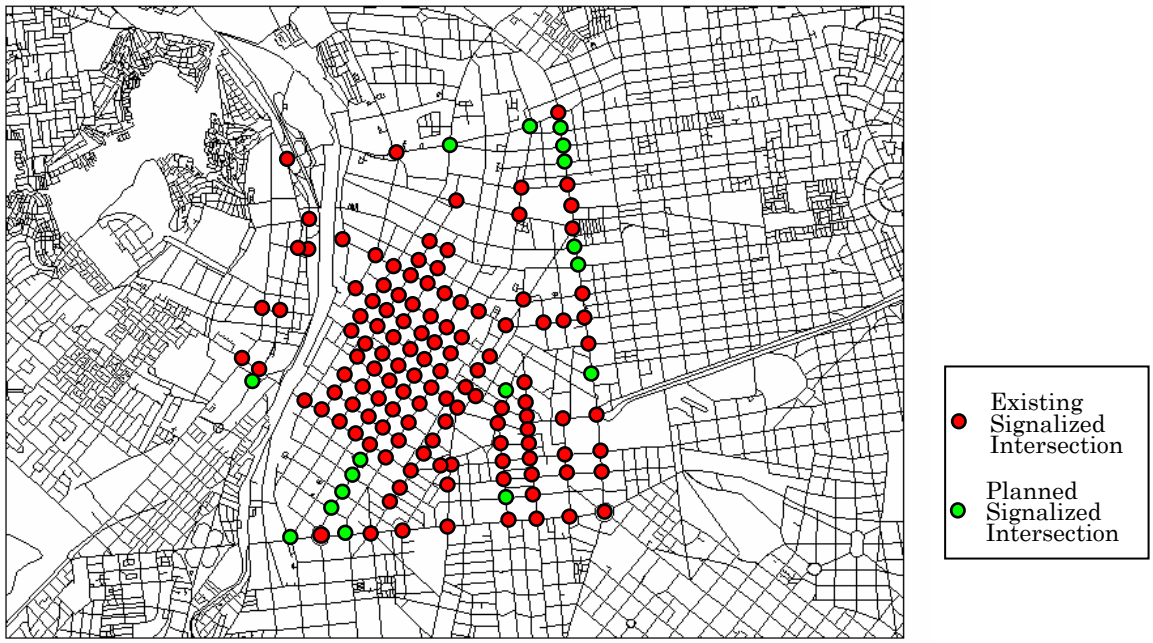


Figure 23.1-1 Signalized Intersections in Specified Areas to be Covered by the ATC System

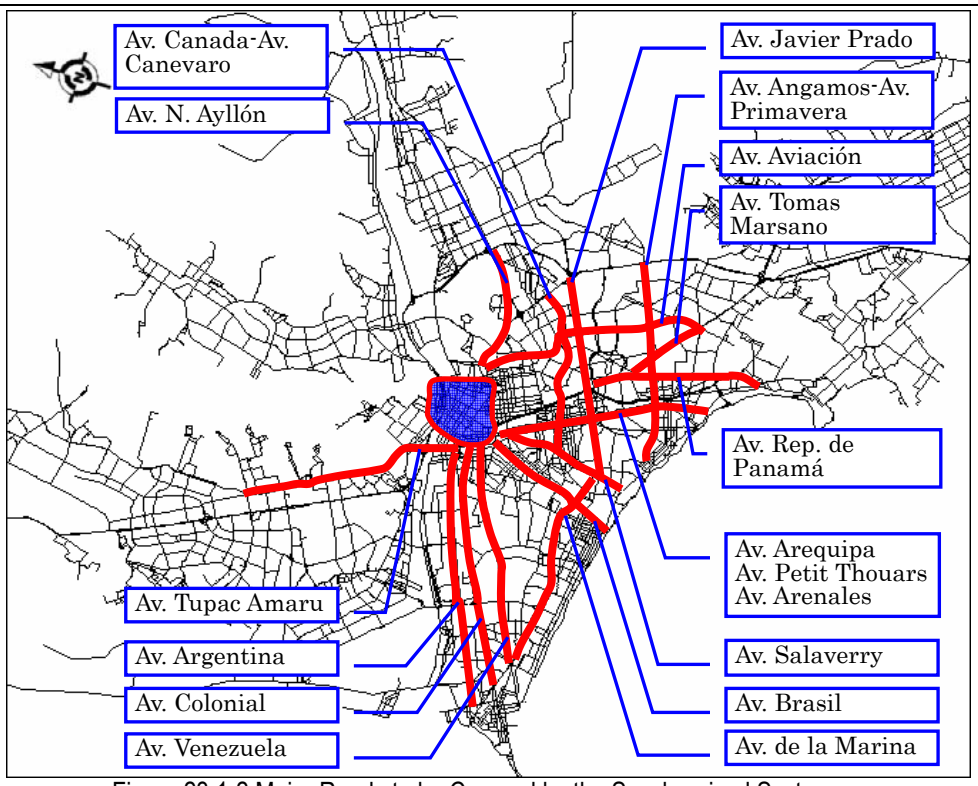


Figure 23.1-2 Major Roads to be Covered by the Synchronized System

Av. N. Ayllón, Av. Canadá-Av. Canevaro, Av. Javier Prado, Av. Angamos-Av. Primavera, Av. Aviación, Av. Tomas Marsano, Av. República de Panamá, Av. Arequipa, Av. Petit Thouars, Av. Arenales, and Av. Salaverry.

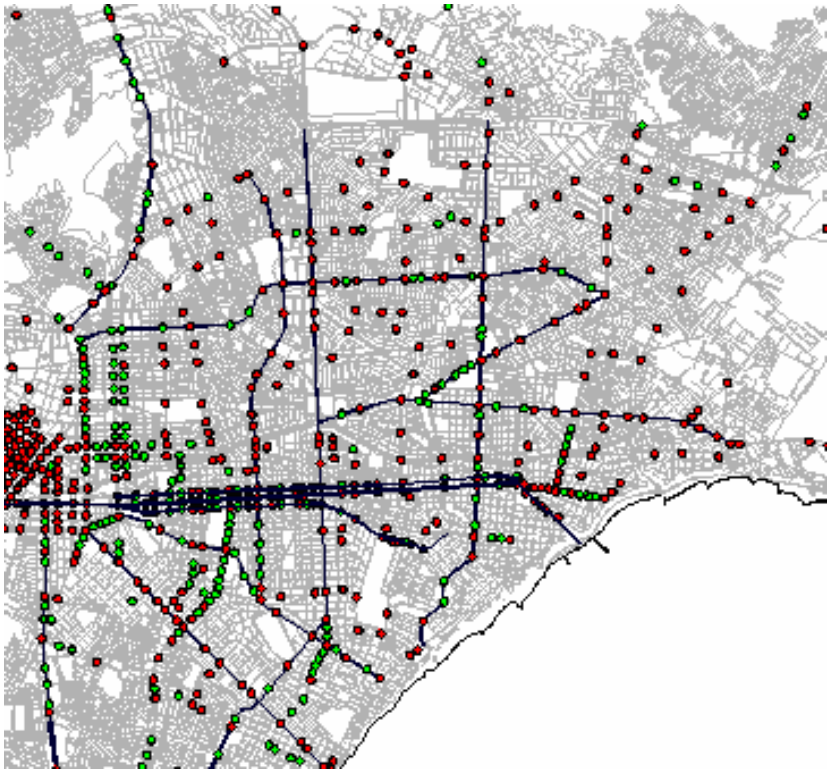


Figure 23.1-3 Signalized Intersections on Major Roads in the Southern part of the City to be Covered by the Synchronized System

Av. Salaverry, Av. Brasil, Av. La Marina, Av. Venezuela, Av. Colonial, and Av. Argentina.

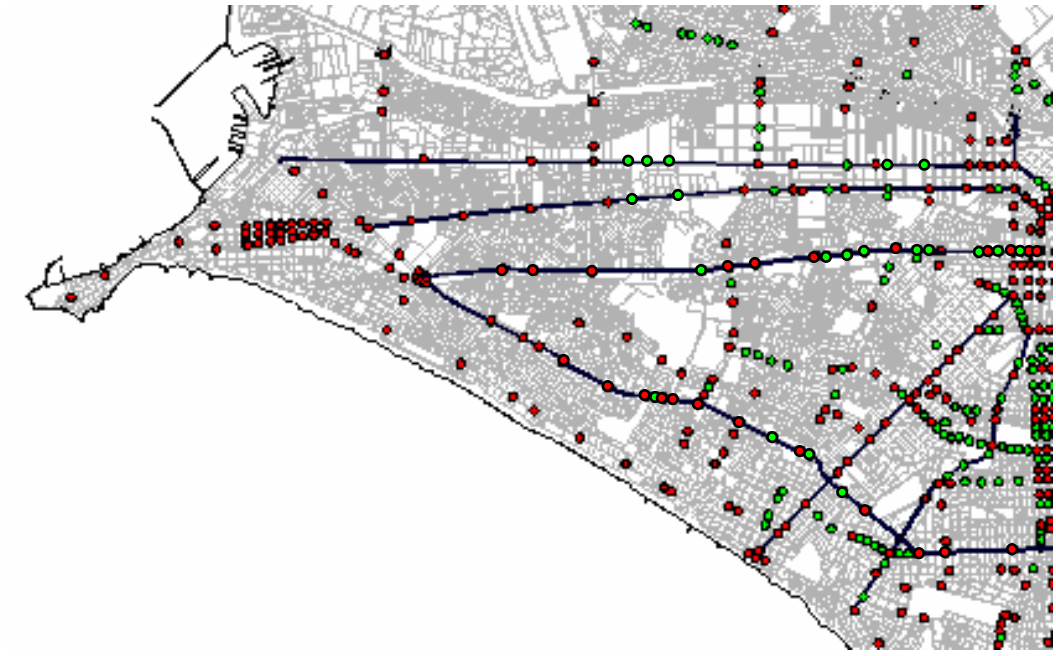


Figure 23.1-4 Signalized Intersections on Major Roads in the Western part of the City to be Covered by the Synchronized System

Av. Tupac Amaru

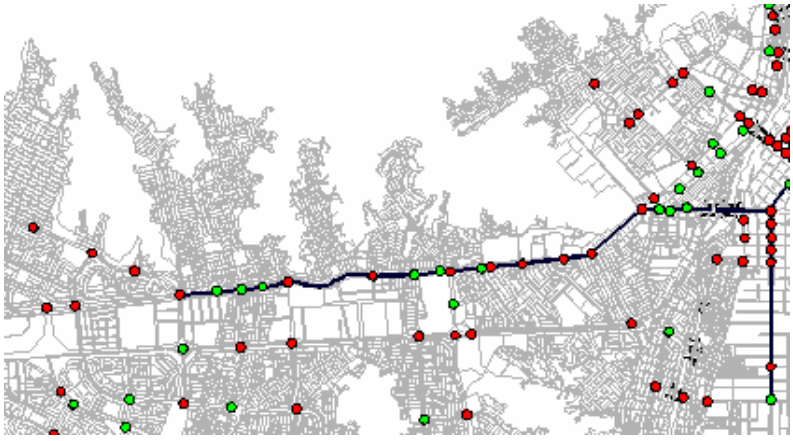


Figure 23.1-5 Signalized Intersections on Major Roads in the Northern part of the City to be Covered by the Synchronized System

Table 23.1-1 Identified Signalized Intersections

Year	System	Existing Signalized Intersection	Planned Signalized Intersection	Total
2010	ATC system	124	17	141
	Synchronized system	234	122	356
Total		358	139	497

Source: JICA Study Team

(2) Categorization of Signalized Intersections

The above-mentioned signalized intersections are divided into key intersections and ordinary intersections. A key intersection serves as the base point for determining the cycle, split and offset. In principal, the key intersection will be controlled based on the responsive system received from detectors.

23.1.4. BASIC CONTROL CONCEPT

In order to respond to unstable traffic fluctuations by time periods, the traffic control system for the study area adopts a traffic-response control system (real-time control system), which must be able to respond effectively to the different traffic conditions seen in the city, from under-saturated conditions to over-saturated conditions. As mentioned in the previous section, signalized intersections are divided into key intersections, which serve as focal points for signal controll in the overall network and ordinary intersections. These two groups will be controlled separately.

The traffic control system will automatically assess the saturation level of key intersections based on the on-line data received from detectors at these intersections, and will apply different control methods depending on the saturation degree. At the same time, control of ordinary intersections will be subordinated to that of neighboring key intersections.

(1) Basic Control Methods

When traffic demand is under-saturated, the aims of the system are not only to reduce delays and stops but also to make the traffic flow safe by moderating the speed of vehicles. Next, when traffic demand is nearly saturated, this system curbs congestion by improving the efficiency of green time at key intersections and maximizing the traffic capacity. The congestion alleviation control directly calculates the split and cycle length every certain minutes based on the queue and the traffic volumes calculated from the vehicle detector information. Finally, when traffic demand is over-saturated, this system runs priority control for competing traffic flows at key intersections. If congestion has exceeded a certain limit within a specific area such as the city center, this system controls the inflow to that area.

(2) Other Control Methods

Other control methods that must be included are: (a) left-actuated control, which can raise the efficiency of phases for left-turning traffic, in order to help maximize intersection capacity, (b) control to respond to spill backed conditions resulting in traffic accidents, and (c) scramble control of signal lights for ensuring a safe pedestrian environment and, creating a pedestrian-friendly facility. Since this is a signal control system giving priority to crossing pedestrians, the vehicular capacity at the intersections will decrease. Therefore, the implementation of scramble control must be adjusted for specified areas outside the field of area wide and linear coordinated signal control functions.

23.1.5. EQUIPMENT AND DEVICES

The equipment and devices required for the proposed traffic control system are as follows:

(1) Detectors

Detectors will be provided for the purpose of supplying data, in order to determine control parameters. The detectors supply raw data on traffic conditions at key intersections, which are necessary for determining signal control parameters such as cycle length, split and offset. These detectors will be positioned at points appropriate for obtaining such data.

There are two types of detectors as follows: (a) the loop-inductive type and (b) the ultrasonic type. The type that best fits the local environment will be chosen.

(2) Local Controllers

Local controllers will be installed at all intersections and linked to the control center on an on-line base. Their functions are to control traffic signals in an appropriate manner and to transmit data obtained from nearby detectors.

(3) Central Processing Unit

The central processing unit is comprised of the host computer and front-end processor.

1) Host Computer

The host computer calculates signal control parameters based on information supplied by detectors and in accordance with established control methods. It can communicate with operators via man-machine interfaces such as peripheral devices and wall map displays.

2) Front-End Processor

The front-end processor processes raw data received from detectors via local controllers and sends the processed data to the host computer. It also receives signal control parameters from the host computer, processes the data and sends it to the local controllers. By undertaking part of the high-speed real-time routine tasks required by a central processing unit, it helps raise the performance of the host computer.

(4) Bus Priority Signal Control System

A bus priority signal control system will be adopted. When a bus passes under vehicle detectors at the local facility, the vehicle detector transmits the signal detection to the local controller, the signal control unit sets a step of green extension or a step of red reduction. This means that buses do not have to stop or that the waiting time is shortened at intersections as much as possible.

(5) Man-Machine Interfaces

In addition to the host computer and front-end processor, the control center is equipped with various man-machine interfaces that allow communication between operators and the computer. The following man-machine interfaces are necessary.

a) Wall map display.
b) Operation consoles.
c) Graphic CRT.
d) Computer peripherals.
e) Others.

(6) Other Equipment

In order to raise the performance of the traffic control system, the following facilities are necessary for the system.

a) Uninterrupted power supply.
b) Air conditioner.
c) Modem and main distribution frame.
d) Radio broadcasting booth.
e) Radio telephone.

(7) Dual System

It is important to ensure that the control system is highly reliable, due to the strong dependence on road transport seen in the city. In particular, a failure of the system between the host computer and local controllers can have an extremely serious effect on transport activities in the city. Therefore, the following components on the system should have dual equipment.

a) Host computer.
b) Front-end processors.
c) Communication system between center and local controllers.

(8) Organization

In order to maintain a desirable condition of the system mentioned above, it is necessary to arrange the organization for system operation and maintenance.

With regards to operation, the appropriate operating organization should be established from the consideration of processing system area extension, grade up of system and coordination with the other organizations. An operating staff with sufficient technique and experience should be prepared. The following main activities are necessary for operation:

a) Signal planning and system area expansion.
b) Traffic survey.
c) Signal design.
d) System operation and control.

In terms of maintenance, a maintenance organization should be established in order to support regular maintenance and prevention of problems related to the system equipments. The following main activities are necessary for maintenance.

a) Inspection.
b) Trouble-shooting (Repairing).

23.1.6. FACILITY PLAN

(1) Intersection Improvement for Exclusive Left-Turn Lanes

The improvement of intersections should become necessary in accordance with the installation of the above-mentioned left-actuated control, which can raise the efficiency of phases for left-turning traffic (green arrow for left-turn vehicles), in order to help maximize intersection capacity. This also serves to improve the blocking of signalized intersections due to heavy left-turn vehicles.

An exclusive left-turn lane will be established at intersections with a high volume of left-turning traffic, in order to ensure the smooth flow of straight-through traffic and to process left-turning traffic more efficiently. The plan for the addition of lanes should be designed based on the following items:

a) Exclusive left-turn lane will be provided with left-turn pockets.

Left-turn pockets will be constructed either by cutting off the median and allotting the resulting space to the pocket or, where there is no median, by shifting the center line to the lane in the opposite direction.

The intersections are divided into two types such as a) Exclusive left-turn lane by cutting off the median and b) Exclusive left-turn lane by shifting the center line. The standard layout of each type is shown in Figure 23.1-6 and Figure 23.1-7.

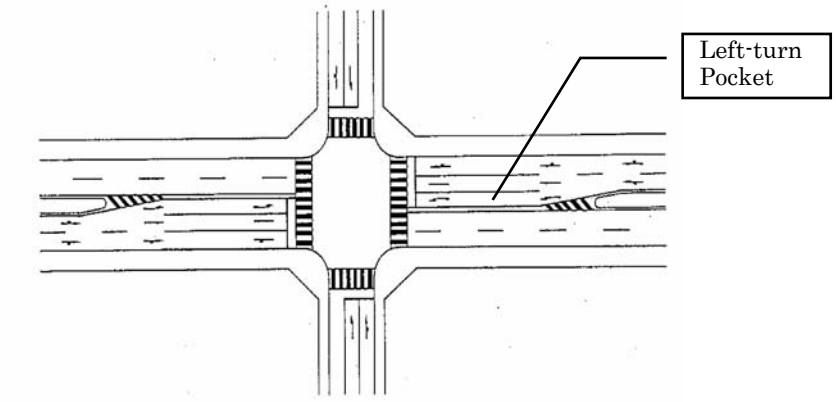


Figure 23.1-6 Exclusive Left-Turn Lane by Cutting off Median

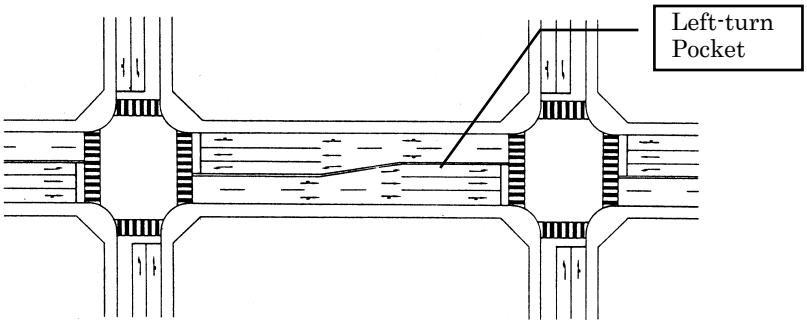


Figure 23.1-7 Exclusive Left-Turn Lane by Shifting Center Line

Left-turn lanes are effective to prevent left-turn accidents and to stop the capacity drop caused by the left-turn vehicles. However, the traffic congestions that occupy 2-lanes or 3-lanes, caused by waiting for left-turn vehicles, are seen at signalized intersections on major streets. This is because the length of left-turn lanes is insufficient. The appropriate length of left-turn lanes should be definitely provided according to the estimation of left-turn traffic volume.

Figure 23.1-8 Traffic Queue of Left Turning Traffic at Signalized Intersections

(2) Intersection Improvement for Installation of Traffic Signal Lights at Non-signalized Intersection

Based on the installation of traffic signal lights at non-signalized intersections mentioned above, the traffic channelization plan will be mainly executed in accordance with the following basic design standards.

a) Introduction of channelizing islands;
b) Improvement of the size of channelizing islands;
c) Landscape of channelizing islands;
d) Available width of channels;

e) Channelization by pavement markings;
f) Directional pavement markings;
g) Marking of pedestrian crossing;
h) Protection of pedestrians;
i) Improvement of corner cut-offs;
j) Minimization of the area of the intersection, and
k) Moving the flow of traffic as close as possible to right angles.

(3) Scramble Pedestrian Crossing at Signalized Intersection

In order to reduce crossing times for pedestrians, by minimizing the carriageway crossing distance, and contributing to pedestrian safety, an exclusive pedestrian phase is incorporated, it is equivalent to the all-red situation for vehicular traffic. The scramble pedestrian crossing at signalized intersections will be installed at the specified area outside the field of the area wide and linear coordinated signal control function. During the all red signal of the exclusive pedestrian phase, pedestrians can cross from all angles. Guideline markings, with a sort of crisscross shape, will be installed on the inside area of the intersection. In this section, the standard scramble crosswalk is shown in Figure 23.1-9.

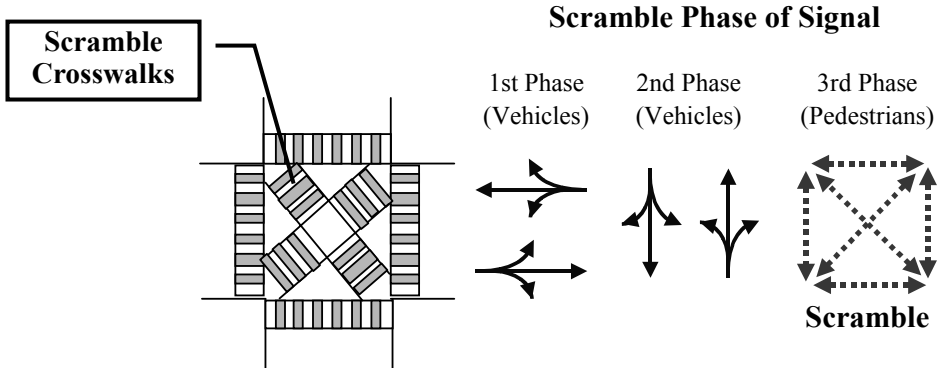


Figure 23.1-9 Standard Scramble Crosswalk

(4) Vehicle Detectors

1) Functions of Vehicle Detectors

Vehicle detectors fulfill various functions related to signal control, including those described below, by detecting the presence of motor vehicles for the collection of traffic data.

a) Detector for coordinated area and linear control in order to determine cycle length and offset pattern.
b) Detectors for split control.
c) Detectors for vehicle actuated control.
d) Detectors for congestion indication such as queue length.
e) Detectors for compiling traffic statistics.

2) Standard Location Plan of Vehicle Detectors

The standard location plan of detectors will be as follows, in accordance with the basic control methods.

a) Location of detectors for coordination, split control and flow-rate responsive control
Detectors for coordination, split control and flow-rate responsive control will be

placed at key intersections of sub-areas (see Figure 23.1-10). The standard location plan of these detectors is shown in Figure 23.1-11.

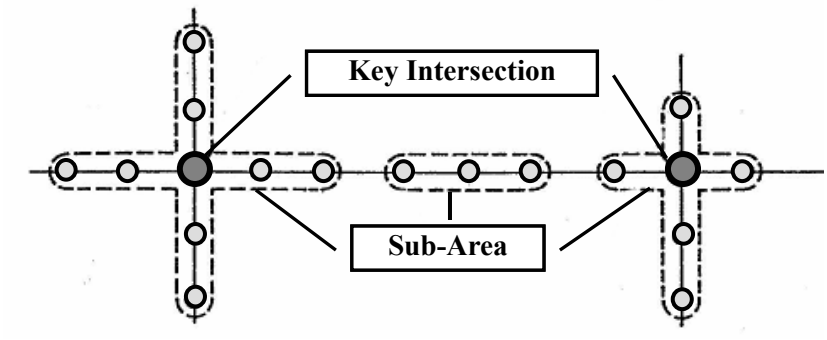


Figure 23.1-10 Key Intersections and Sub-Areas

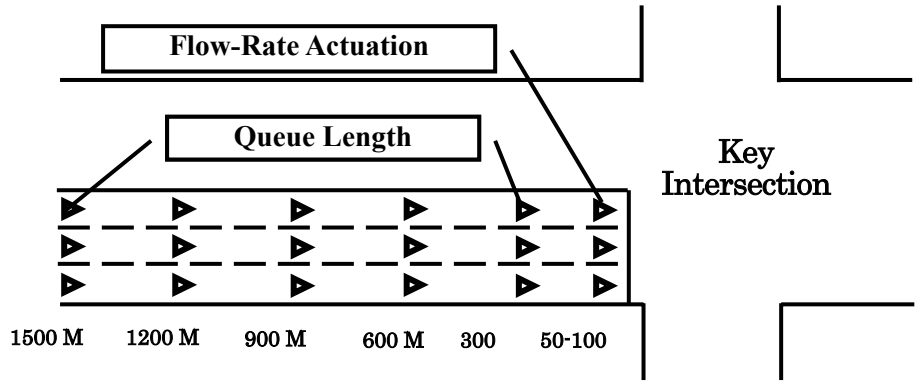


Figure 23.1-11 Standard Location Plan of Detectors for an Approach of Key Intersection

b) Location of Detectors for Left-Turn Actuation

Detectors for left-turn actuation will be placed on exclusive left-turn lanes. The standard location plan of these detectors is shown in Figure 23.1-12.

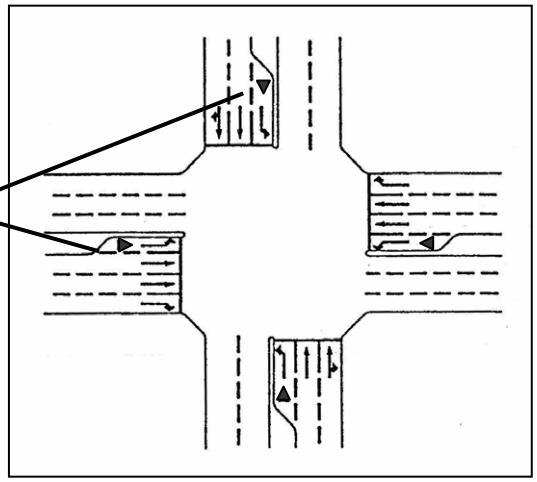


Figure 23.1-12 Standard Location Plan of Detectors for Left-Turn Actuation

c) Location of Detectors for Obtaining Traffic Statistics

Detectors for obtaining traffic statistics will be placed between intersections. The standard location plan for obtaining traffic statistics is shown in Figure 23.1-13.

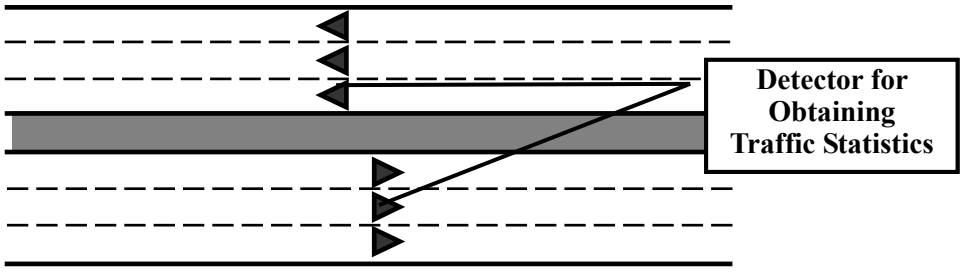


Figure 23.1-13 Standard Location Plan of Detectors for Obtaining Traffic Statistics

d) Location of Detectors for Bus Priority Signal Control System
Detectors for the bus priority traffic signal control system will be placed at the approach of intersections on the busway. The standard location plan for the bus priority signal control system is shown in Figure 23.1-14.

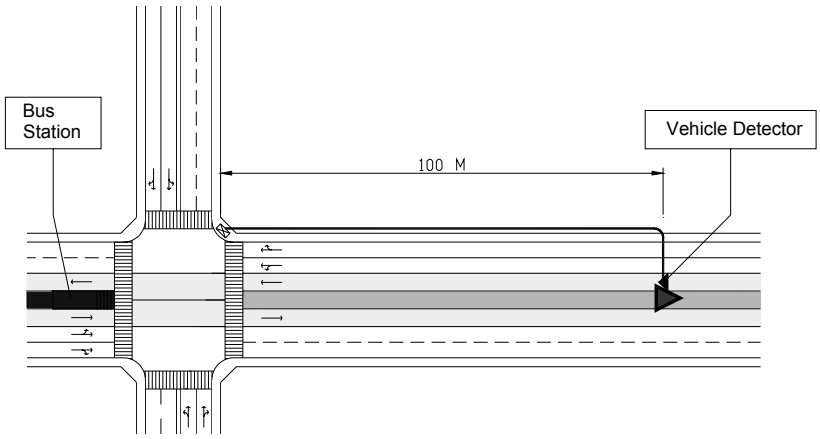


Figure 23.1-14 Standard Location Plan of Detectors for the Bus Priority Traffic Signal System

3) Number of Detectors Required for Control System

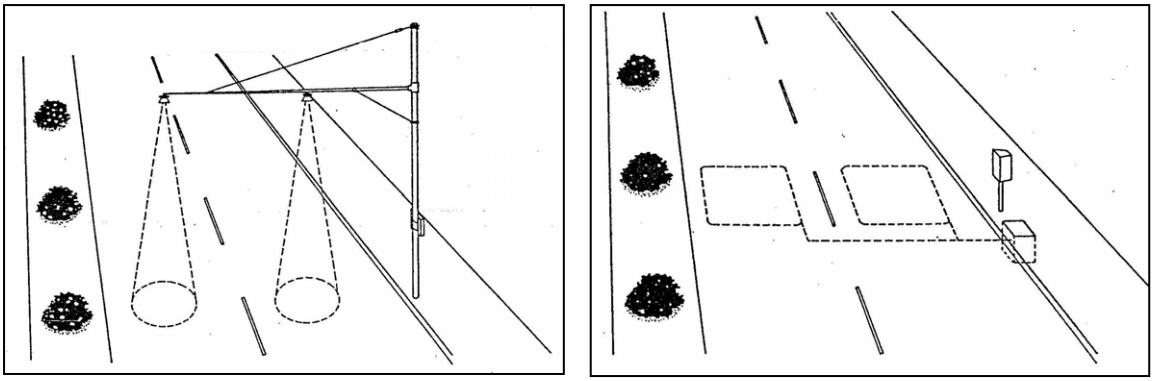
Based on the standard location plan of detectors by various functions, the approximate number of detectors required for the entire control system area is estimated at 13,600 units. Table 23.1-2 shows a breakdown of the number of detectors by functions.

Table 23.1-2 Number of Detectors by Functions

Area	Unit	Total
1. Traffic Control System	No.	2,600
2. Synchronized Control System	No.	11,000
Total	-	13,600

4) Types of Detectors

The two types of detectors will be considered as follows: a) inductive loop detector, and b) ultrasonic detector. Both are stable in performance and reasonable in price, and are used widely for these reasons. Figure 23.1-15 shows the various types of detectors.



Ultrasonic Type　　Loop Type

Figure 23.1-15 Type of Vehicle Detector

Selection between loop and ultrasonic detectors will be determined by taking into consideration the advantages of each and the special characteristics of locations. In principal, ultrasonic detectors will be chosen as follows:

a) In the fast-growing Lima Metropolitan Area, excavation works for underground utility installations occur frequently, and, if loop detectors are used, their loop coil feeder lines can be severed time and again in the process of such works.
b) Ultrasonic detectors require less time to install, which means that traffic restrictions need to be imposed for shorter times.

In addition, loop detectors will be allotted to the following locations.

a) Scenic streets: loop detectors are allotted to streets in which the scenic beauty must be preserved.
b) Wide streets: to use ultrasonic detectors, it is necessary to extend the boom (or arm) from the roadside and attach a transducer above the carriageway. Since the boom is long enough to cover only three lanes, loop detectors can be allotted to streets with four or more lanes in each direction. However, wherever there is a pedestrian bridge that can serve in place of the boom, an ultrasonic detector is allotted.
c) Luxuriant tree-lined streets: Since the presence of branches and leaves causes ultrasonic wave beams to bounce erratically, destabilizing the performance of ultrasonic detectors, loop detectors will be allotted to luxuriant tree-lined streets with thick covers of branches and leaves over the carriageway.

5) Standard Installation Plan for Detector and Cabinet

The standard installation plan for detector and cabinet is shown in Figure 23.1-16.

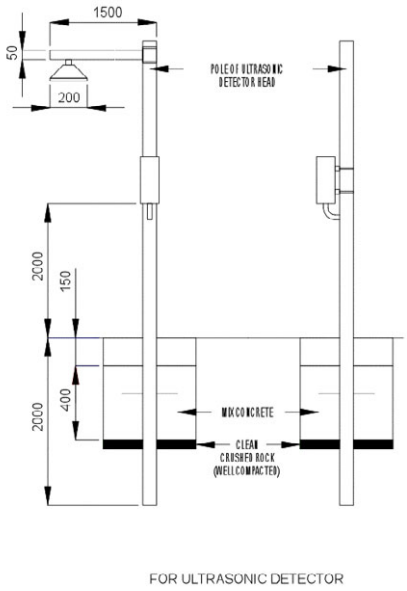


Figure 23.1-16 Standard Installation Plan for Detector and Cabinet

(5) Local Controllers of Traffic Signal

1) Function of Local Controllers of Traffic Signal

Local controllers of traffic signal share functions with the central computer, and fulfill the functions of a) on-line control, b) vehicle actuated control, c) backup, and d) manual control as follows;

a) On-Line Control
On-line traffic signals based on real-time conversions of control plans as they are sent from the control center.
b) Vehicle Actuated Control
Vehicle actuated control as flow-rate actuated control and left-turn actuated control will be adopted.
c) Backup
The backup function will be comprised of time-of-day control and flashing control.
d) Manual Control
Local controllers are designed under the assumption that the control system rarely requires the manual control. Intentional intervention from the control center takes the place of manual control.

2) Standard Installation Plan at Near Intersections

Standard local controllers related to near intersections will be defined as follows:

a) Renewal Equipments
Existing local controllers will be replaced with those for on-line control system.
b) Retained Equipments
Existing equipments related to the local controllers will be retained; they are signal poles, lights, hand-holes, and underground conduits. Figure 23.1-17 shows a standard installation plan for local controllers related to near intersections.

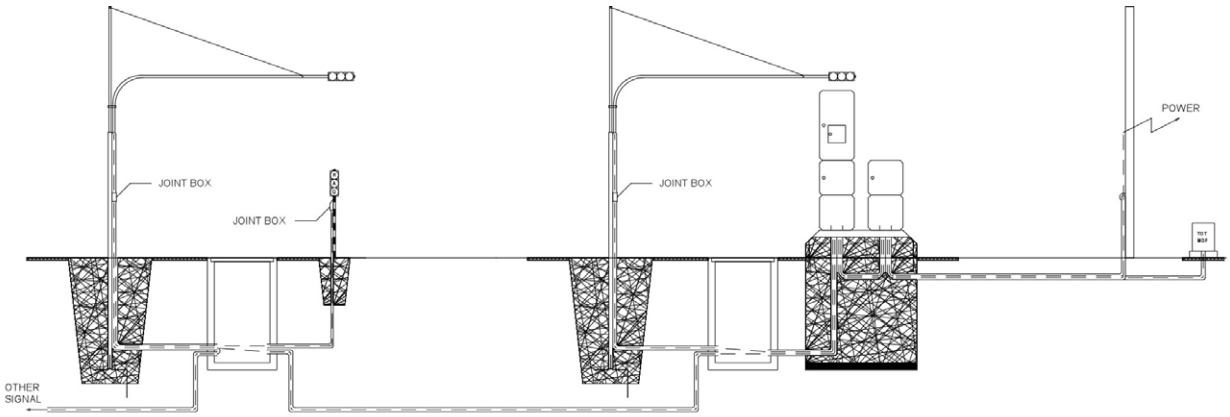


Figure 23.1-17 Standard Installation Plan for Local Controllers Related to Near Intersections

(6) Communication Network and Transmission System

1) Network Design

Based on the transmission demand volume and line reliability as given conditions, in order to ensure the reliability of the control system, it will be necessary to lease TDP (Telefónica del Perú)'s pulse code modulation (PCM) network as the system's exclusive line.

2) Transmission Equipment

The communication network will be composed of transmission equipment such as a) communication control unit (CCU), b) gathered modem, c) main distribution frame, and d) terminal transmitter-receiver (TTR). Figure 23.1-18 shows the communication network.

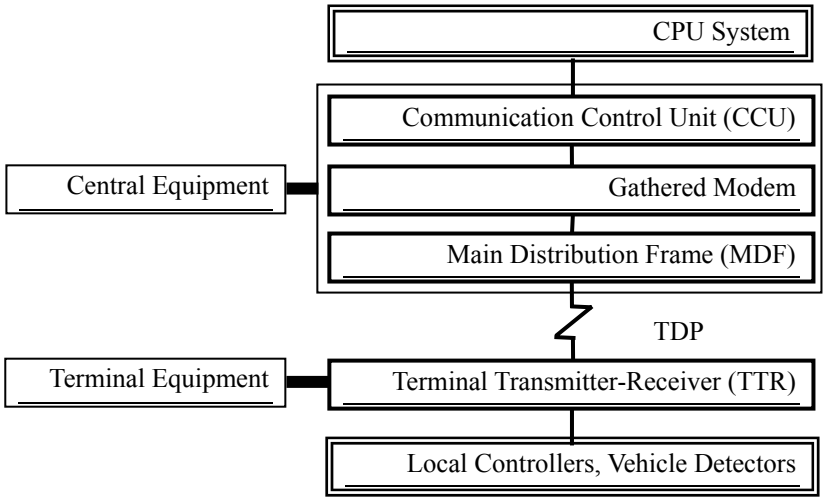


Figure 23.1-18 Communication Network of Transmission Equipment

The main functions of the transmission equipment are as follows:

a) Communication Control Unit (CCU)
The CCU converts parallel mode data received from the Central Processing Unit (CPU) into serial mode data in accordance with the transmission procedure, and converts serial mode data received from terminals into parallel mode data, while

checking for transmission errors at the same time, and relays the converted data to the CPU system.

b) Gathered Modem
The modems place serial signals generated by the CCU onto carrier waves, in order to transmit the signals over long distances through the lines. They also extract serial signals from carrier waves received from terminals and relay the signals to the CCU.

c) Main Distribution Frame (MDF)
The MDF serves to divide the central equipment lines between the areas under the responsibility of TDP and the Municipality. The MDF is composed of relay terminals for exclusive lines and equips each line with a protective device (PD), test switching device, and arrester.

d) Terminal Transmitter-Receiver (TTR)
The TTR, a compact unit that combines the functions of the CCU and modem, is a transmission device for terminals. It is built into the cabinet of a local controller or detector.

(7) Traffic Control Center

The traffic control center will be established in the building house of the DMTU. The traffic control center is composed of a control room and a computer room. Activities that take place in the control room include the reception of traffic data from all over the control area, decision-making concerning countermeasures appropriate to the situation at hand, instructions to related personnel, and notification of congestion information to drivers. The layout of the traffic control center is shown in Figure 23.1-19.

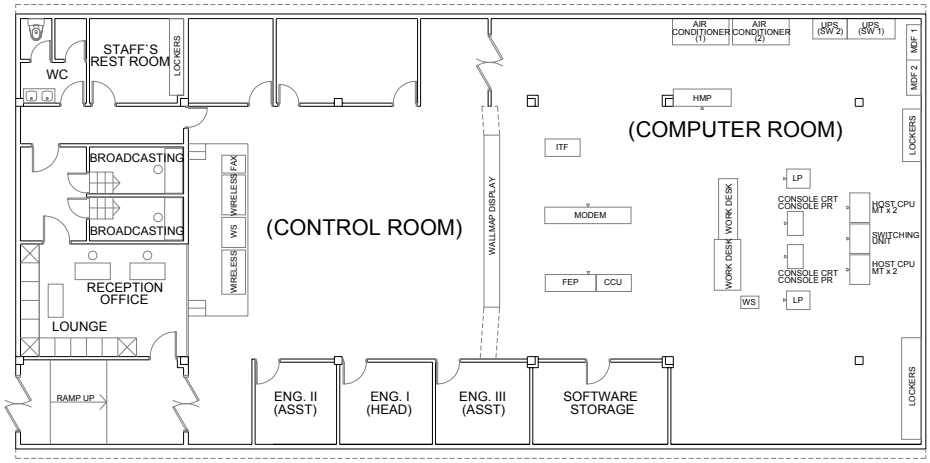


Figure 23.1-19 Layout of Traffic Control Center

(8) Man-Machine Interfaces

All of the various equipment used to obtain useful information from the traffic control system and to operate the traffic control system, in order to implement countermeasures, are called man-machine interfaces.

1) Display Equipment and Their Functions

The display equipment consists of a wall-map display and character CRT displays as follows:

a) Wall-Map Display
The wall-map display is used to show overall traffic conditions. Its panel size is roughly six meters high and six meters wide. A small scale is used to represent

roads in the central area of the Lima Metropolitan Area, and a large scale is used to represent those in the surrounding areas. The display panel is composed of mosaics with light indicators. The light indicators are comprised of degree of traffic congestion, queue length, on-site manual operation, intentional intervention from the traffic control center, incidents that limit the use of lanes, and temporary traffic restrictions.

b) Character CRT Displays
Traffic data received by the host computer can be retrieved via character CRT displays attached to operational workstations.

2) Workstations

The workstations are small computer sets linked to the host computer. They are used for multipurpose traffic control consoles. The major operations are a) intentional intervention for green band control and manual plan selection, b) incident input and cancellation, c) off-line job for operational records, traffic statistics and control plan renewal, and d) other communication equipment such as radio broadcasting booth, radiophones to traffic police, and telephone/facsimile machines, they are implemented by inputting the necessary instructions from the workstations located in front of the wall-map display.

(9) Central Processing Unit and Peripherals

In order to handle complicated tasks at fast speed, as well as to minimize throughout time from detectors to local controllers via the CPU and to obtain the necessary control capacity, a computer system with hierarchy architecture was chosen. Under this system, the workload will be shared by the host computer and front-end processors. A dual system will be chosen for the host computer, in order to implement backup and off-line job purposes. The equipment composition of hardware configuration is composed of the host computer and front-end processors.

23.1.7. COST ESTIMATES FOR TRAFFIC SIGNAL CONTROL IMPROVEMENT PLAN

The construction cost consists of equipment, construction, maintenance, and engineering costs. The construction cost by items is shown in Table 23.1-3. This includes the cost of improvement of intersection and traffic safety facilities.

Table 23.1-3 Project Cost for Traffic Signal Control Improvement Plan Including Improvement of Intersection and Traffic Safety Facilities

No.	Investment Items	Project Cost (x 1,000 US$)
1	Signal controller for planned intersection	2,400
2	Detectors and pole	16,823
3	Pole/lights/Cable for planned intersection	3,400
4	Marking and earth work (improvement of intersection)	500
5	Traffic safety facilities	500
6	Traffic control center with software/hardware	5,000
Total		28,623
Engineering Cost (Total x 10%)		2,862
Administration Cost (Total x 10%)		2,862
Contingencies Cost (Total x 15%)		4,293
Total		38,640

23.1.8. URGENT ACTION PLAN FOR TRAFFIC SIGNAL CONTROL SYSTEM

Based on the improvement study of the traffic signal control system, the urgent action plan for the synchronized signal system on Av. Arequipa, Av. Petit Thouars and Av. Arenales should be introduced due to the following identification.

(1) Identified Location for Synchronized Signal System

The location for introducing the synchronized signal system was identified based on the results of the travel time survey. Table 23.1-4 shows the average travel speed on major roads during peak periods. On major roads, the heavy traffic congestion indicating the lowest average travel speed was observed on Av. Arequipa, this is mainly caused by unsuitable traffic signal control systems, it is, therefore, proposed that the urgent improvement plan of synchronized signal control systems should be introduced. In accordance with the proposed action plan, Av. Arequipa, Av. Petit Thouars and Av. Arenales should be improved due to the competitive routes in the same direction.

Table 23.1-4 Average Travel Speed on Major Roads during Peak Periods

Major Roads	Length (km)	Average Travel Speed (km/h)		
		Morning Peak Inbound	Midday Peak Inbound	Evening Peak Outbound
1. Av. Javier Prado	20.1	30.4	40.1	30.7
2 Av. La Marina	10.8	20.5	33.8	26.4
3. Av. Argentina	10.4	24.4	22.2	28.4
4. Av. Aviación	8.5	22.6	17.8	17.2
5. Av. Tupac Amaru	21.7	30.8	38.5	27.2
6. Carretera Central-Av. Nicolás Ayllón	42.5	38.2	50.8	35.0
7. Av. Colonial	13.8	35.5	35.4	35.0
8. Av. República de Panamá-Av. Paseo de República	10.8	18.8	26.1	27.2
9. Av. Tomas Marsano-Av. Los Héroes-Av. Pachacútec	19.0	29.5	32.7	27.1
10. Av. Brasil	5.2	18.0	17.6	20.0
11. Av. Tacna-Av. Arequipa	11.5	17.3	15.8	16.5

(2) Identified Intersection

Based on above-mentioned plan location, intersections that are currently signalized and those that will be signalized were identified as intersections subject to control by the proposed signal control system. Figure 23.1-20 and Table 23.1-5 show the signalized intersections on major roads to be covered by the synchronized system, a total of 87 intersections were identified, of which 50 are already signalized.

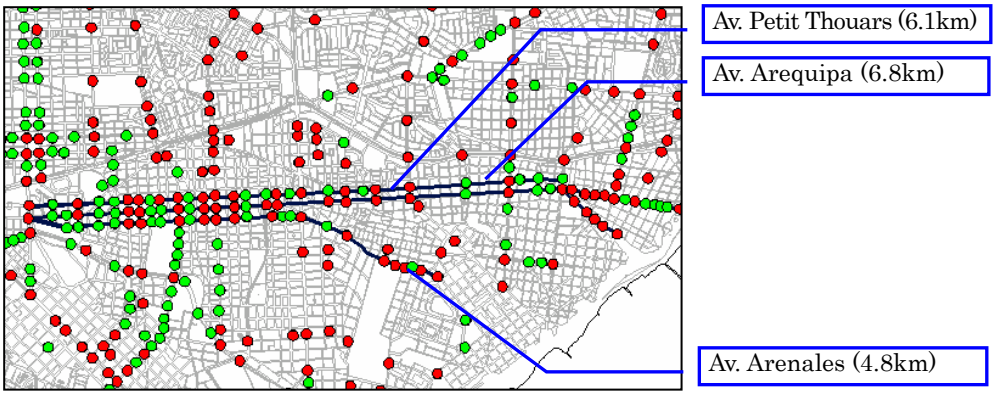


Figure 23.1-20 Signalized Intersections on Av. Arequipa, Av. Petit Thouars and Av. Arenales to be Covered by the Synchronized System

Table 23.1-5 Identified Signalized Intersections

Year	Existing Signalized Intersection	Planned Signalized Intersection	Total
2005	37	50	87

(3) Basic Control Methods

The same cycle length at neighboring intersections will enable both to operate together by setting up the offset timing. It enables vehicle to drive without stopping at the intersection in the sub area of the synchronized traffic signal system. The system sets a real time control by using the sensors at signal intersections, controlled by the centralized system of the traffic control center.

(4) Facilities

The equipment and devices required for the proposed traffic control system includes detectors, local controllers, central Processing unit (host computer, front-end processor), man-machine interfaces, and other equipment. The standard facilities plan refers to the above-mentioned facilities plan for the whole area.

(5) Cost Estimates

The construction cost consists of equipment, construction, maintenance, and engineering costs. The construction cost by items is shown in Table 23.1-6. This includes the cost of improvement of intersections and traffic safety facilities.

Table 23.1-6 Project Cost Estimates

No.	Investment Items	Project Cost (x 1,000 US$)
1	Signal controller for planned intersection	700
2	Detectors and pole	3,130
3	Pole/lights/Cable for planned intersection	900
4	Marking and earth work (improvement of intersection)	50
5	Traffic safety facilities	50
6	Traffic control center with software/hardware	2,000
Total		6,830
Engineering Cost (Total x 10%)		680
Administration Cost (Total x 10%)		680
Contingency Cost (Total x 15%)		1,020
Total		9,210

23.2. TRAFFIC SAFETY EDUCATION PROGRAMS

This section discusses that a traffic safety education plan focuses on traffic safety education for drivers, pedestrians and traffic trainers by introducing the institutional improvement, and increasing traffic safety education programs and campaign programs.

23.2.1. NECESSITY AND OBJECTIVES

The necessity and objectives of the traffic safety education plan are as follows:

1) Drivers/pedestrians should obey traffic signal/regulations and understand the merit to traffic safety. Improving the road/traffic facilities and implementing traffic safety measures including effective driver/pedestrian education programs can minimize the conflicts between vehicular traffic and pedestrians, which reduce the efficiency of the urban street network. Such measures and programs, if successfully implemented, will not only improve traffic flows but will also improve the safety, convenience, and comfort of both pedestrians and drivers.
2) Peruvian drivers, considered collectively, have been described as undisciplined through actions such as ignoring red traffic lights, making sudden and frequent lane changes without notice, ignoring speed limits, jumping queues, and blocking intersections. In particular, bus drivers are among the worst. Such driving behavior leads to a lower traffic capacity and the occurrence of traffic accidents.
3) In the analysis of the types and causes of accidents, 1) the pedestrian involved accidents generally show a high share, 2) the accidents are mainly caused by the wrong driving manners of road users. It is recommended that an effective traffic education programs and campaigns should be promoted to improve driver compliance with traffic laws and regulations.
4) The behavior of pedestrian's is also bad i.e. they cross streets at the middle sections of roads (jay-walking), and they walk along vehicle lanes to shortcut their journey. Appropriate pedestrian education programs are, therefore, required to improve pedestrian discipline.

23.2.2. PROGRAMS FOR TRAFFIC SAFETY EDUCATION

Based on the foregoing necessity and objectives due to the current issues, in conjunction with programs to address the "Engineering" and "Enforcement" issues, the following programs regarding education and safety will be strongly recommended. The traffic safety programs are identified in the areas of institutions and traffic education.

a) Institutional Improvement: strengthen National Council of Road Safety (CNSV).
b) Traffic Safety Education System Improvement: increase traffic safety education and campaign programs, and implement a pilot traffic safety program.

23.2.3. INSTITUTIONAL IMPROVEMENT

The National Council of Road Safety (CNSV) is responsible for the traffic safety education of road safety. However, the CNSV has been limited to its activities due to a small annual budget. In addition, human resources are required for the CNSV in order to develop the skills of the CNSV staff and enhance its institutional capacity. Also, the weak coordination between the Education, Engineering and Enforcement functions, in terms of traffic safety, hinders the effective operation. It is, therefore, recommended that the following institutional improvement be strengthened.

a) Sufficient financial resources (annual budget);
b) Human development, and

c) Coordination by introducing traffic accident monitoring systems (Traffic Safety Audit System).

23.2.4. INCREASE OF TRAFFIC SAFETY EDUCATION PROGRAMS AND CAMPAIGN PROGRAMS

The CNSV is aimed at performing the activities of traffic safety education and campaign programs. The plan of traffic education programs and campaigns is described below (see Table 23.2-1).

(1) Traffic Safety Education Programs

The programs at the CNSV will consist of four (4) levels.

1) Level 1: Seminars for Government-Employed Drivers and Public Entity Drivers

Level 1 includes seminars conducted by the CNSV's Public Education Team with the following six (6) different course modules for government-employed and public utility drivers.

a) Overview of the transportation and traffic state of the country;
b) Ethics, value formation, and road courtesy;
c) Responsibility of drivers;
d) Driving manners;
e) Traffic safety (defensive driving and basic troubleshooting); and
f) Traffic rules and regulations.

2) Level 2: Training of Trainers and Their Accreditation

Level 2 includes the training of trainers and their accreditation; to establish an adequate training staff, this training is also open to the private sector.

a) Organizing traffic safety education and promotion;
b) Guidelines for traffic safety education efficiency;
c) Role of Traffic Police and Traffic Enforcement;
d) Driver license system and driver school system, and
e) Reeducation system for traffic offenders.

3) Level 3: Seminars for Private Drivers

Level 3 includes seminars conducted by the CNSV's Private Education Team with the following six (6) different course modules for private drivers.

a) Overview of the transportation and traffic state of the country;
b) Ethics, value formation, and road courtesy;
c) Responsibility of drivers;
d) Driving manners;
e) Traffic safety (defensive driving and basic troubleshooting); and
f) Traffic rules and regulations.

4) Level 4: Development of Training Aids and Materials

Level 4 includes the development of training aids and materials; inexpensive and reproducible materials will be prepared for wide use.

a) Various textbooks for seminars;
b) A series of video programs for training on driving manner;
c) A weekly column published in a major newspaper reporting the traffic situation, and
d) Propaganda by TV spots and radio broadcasts.

(2) Organizing a Traffic Safety Campaign

A national traffic safety movement, such as a traffic safety campaign for the general public, should be conducted through the use of mass media, public participation, etc. The campaign will be composed of three (3) options as follows:

1) Option 1: Periodic Traffic Safety Campaign on the Street

Option 1 is the periodic traffic safety campaign; this campaign will be conducted twice a year for the purpose of spreading the idea of traffic safety among all the people and encouraging them to acquire the habit of observing traffic rules and manners. This campaign will be held for 7 to 10 days, emphasizing some slogans of road safety for prevention of traffic accidents. At the same time, traffic police conduct proper driving guidance and enforcement on the street, and the staff of the CNSV distributes pamphlets with information of basic reminders on traffic rules to pedestrians and drivers.

2) Option 2: Periodic Traffic Safety Campaign by Advertisement of Mass Media

Option 2 is the periodic traffic safety campaign through advertisement of mass media; a short television/radio commercial will be aired on prime time to foster proper driving. The scale of traffic safety campaigns by mass media will be constrained by financial resources; it is, therefore, recommended that the resources be supported by donations of private companies, such as automobile companies or auto clubs.

3) Option 3: Visiting Public Elementary Schools for Instruction

Option 3 is where the staff of traffic safety will conduct teach-ins and visit public elementary schools to instruct children on basic traffic signs, road safety and discipline.

(3) Countermeasures for Traffic Accidents

Since a traffic accident usually cannot be attributed to a single cause, effective safety measures require an approach from the standpoint of the so-called three (3) “Es”, i.e. Education, Enforcement and Engineering. The CNSV covers the following approach to plan traffic accident prevention measures:

a) Statistics of the traffic accident database;
b) Identification of hazardous locations;
c) Planning of countermeasures; and
d) Follow-up or after-care.

(4) A Pilot Traffic Safety Program

In order to examine and to identify the influence and effects of the proposed program, it is highly recommended that a pilot traffic safety program, by introducing the implementation of workshop and campaign propaganda, be conducted.

1) Methodology

Traffic safety education programs are comprised of the following 5 parts.

a) Organizing practical demonstration teams: staffing, activity assignment;
b) Scheduling of activities: periodic meetings, scheduling of each activity;
c) Preparation of educational material: texts, video films, lecture materials for workshop, design of pamphlet/sticker/uniform (T-shirts)/slogan for campaign/text paper;
d) Training education by workshops: lecture for users/local residents by Peruvian experts;
e) Execution of traffic safety campaign: campaign propaganda by mass media and

campaign on the streets by school students/staff, and

f) Impact study of workshop and campaign: participants in the workshop (before/after) and practical demonstration team.

The programs are classified into 3 levels including professional drivers, traffic trainers and the general public. Level 1 is a workshop for government-employed drivers/public utility drivers. This program is aimed at the professional drivers of public utilities. Level 2 is a workshop for training trainers such as traffic police. Level 3 is a traffic safety campaign for the general public. Each workshop will be conducted by using prepared material such as texts.

2) Organizing a Practical Demonstration Team

The practical demonstration team, which is composed of the CNSV and Traffic Police, will conduct the traffic safety education program and campaign. Based on the results of this program and campaign, the sustainable activities of the traffic safety education system will be conducted.

3) Action Plan of Workshop

a) Preparation of Educational Materials
In order to clarify the technique of traffic safety education and implementing method, texts for traffic safety education will be prepared by the practical demonstration team, which is comprised of target, contents and methods. The traffic safety workshop and campaign will be conducted by using the text. The text for Level 1 and Level 3 is comprised of 5 lectures such as ethics, responsibility of drivers, driving manners, traffic safety (defensive driving and basic troubleshooting), and traffic rules and regulations. The text for Level 2 is comprised of 5 lectures such as organizing traffic safety education and promotion, traffic safety education efficiency guideline, role of traffic police and traffic enforcement, driver license, and driver school. Table 23.2-1 shows a sample text for Level 1 and Level 3, and Table 23.2-2 shows a sample text for Level 2.

Table 23.2-1 A Sample Text for Level 1 and Level 3

Text for professional drivers of public utilities and private drivers		
Table of Contents	1. Ethics of driving	1. Basic driver attitude. 2. Obey traffic lights, Road signs and pavement markings. 3. Police has priority over all signaling. 4. The "Do Not" –rules when being on the road.
	2. Responsibility of drivers	1. Before driving. 2. Inspect the vehicle. 3. Drive in a safer and environmentally friendly environment. 4. The Basics of driving passenger-carrying vehicles.
	3. Safe driving	1. Getting started safely. 2. Basic rules for safe driving. 3. Pedestrians/cyclist have rights too. 4. Keep safe speed and distance. 5. Changing lanes and making turns. 6. Overtaking and passing. 7. Parking and stopping.
	4. Defensive driving and troubleshooting	1. General rules. 2. Traveling safely thorough intersections. 3. Danger spots and hazardous conditions. 4. Traffic accidents and breakdown.
	5. Traffic law and regulations	1. General regulations of traffic on roads. 2. Introduction of individual regulations.

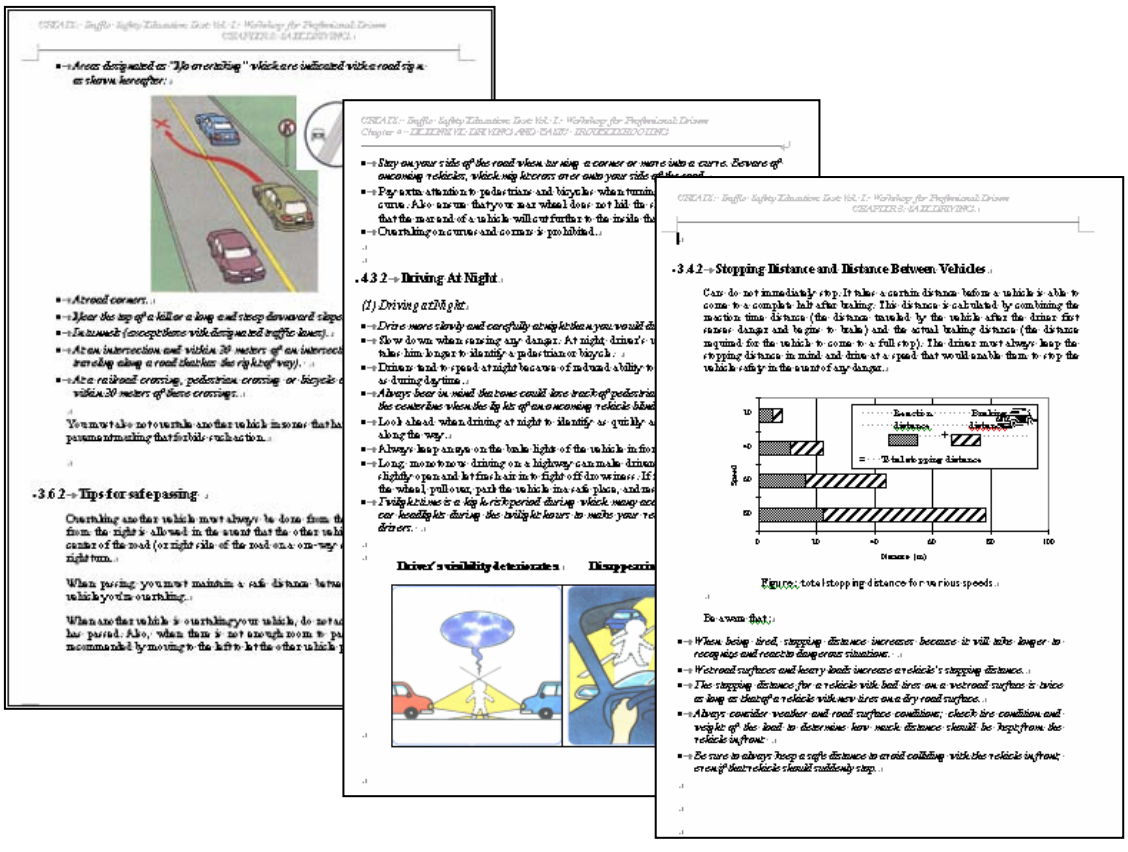
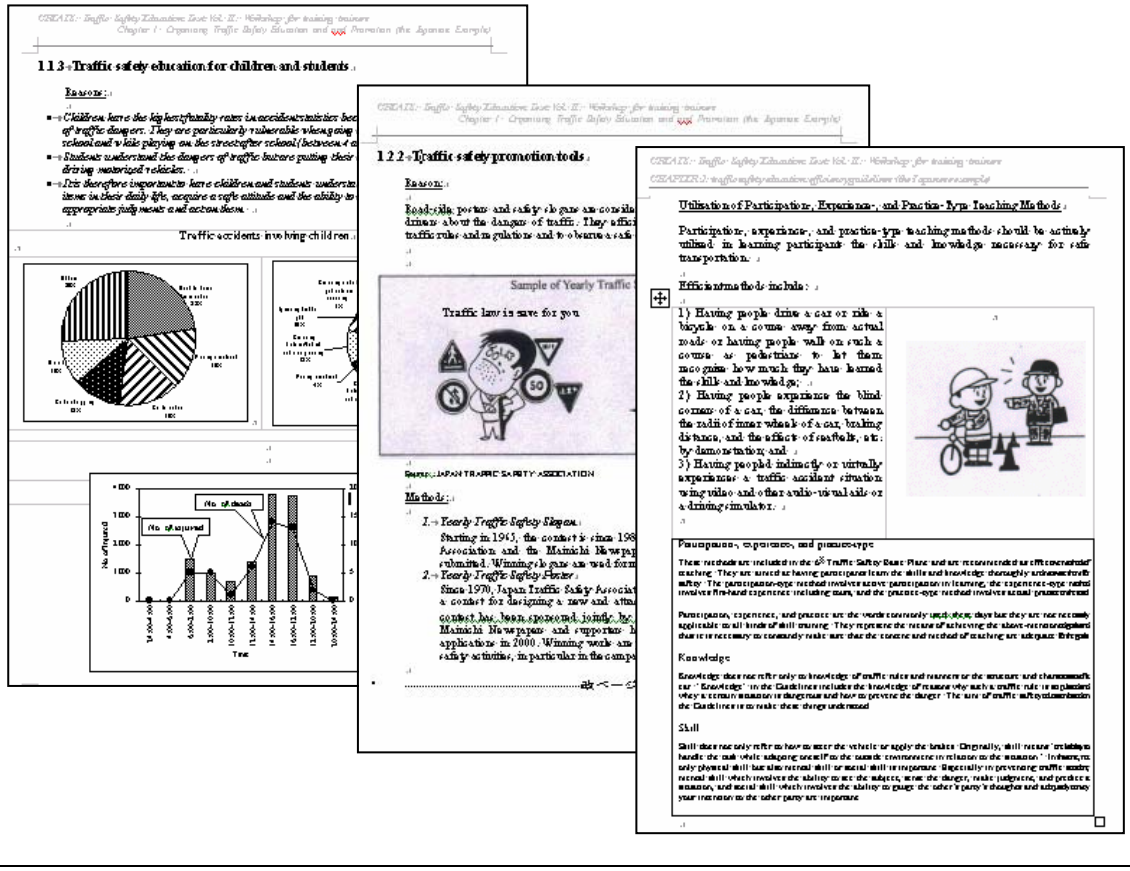


Table 23.2-2 A Sample Text for Level 2

Text for training trainers such as traffic police		
Table of Contents	1. Organizing traffic safety education promotion	1. Traffic safety education and promotion goals. 2. Traffic safety promotion activities. 3. Safe driving supervisor system.
	2. Traffic safety education efficiency guidelines	1. What is traffic safety education. 2. Role of the guidelines. 3. Providing traffic safety education. 4. Methodological approach.
	3. Role of traffic police and enforcement	1. Role of traffic police. 2. Role and structure of traffic police. 3. Comparing other countries and Peru.
	4. Driver's license	1. Classification and procedures. 2. Driver's license test. 3. Driver license and safe driving. 4. Driver management system. 5. Comparing other countries and Peru.
	5. Drivers school	1. Designated driver license school. 2. Others.



b) Execution of workshop
The workshop will be executed during 1 day, the lecture for road users will be implemented by Peruvian experts, total participants will be 300 persons.

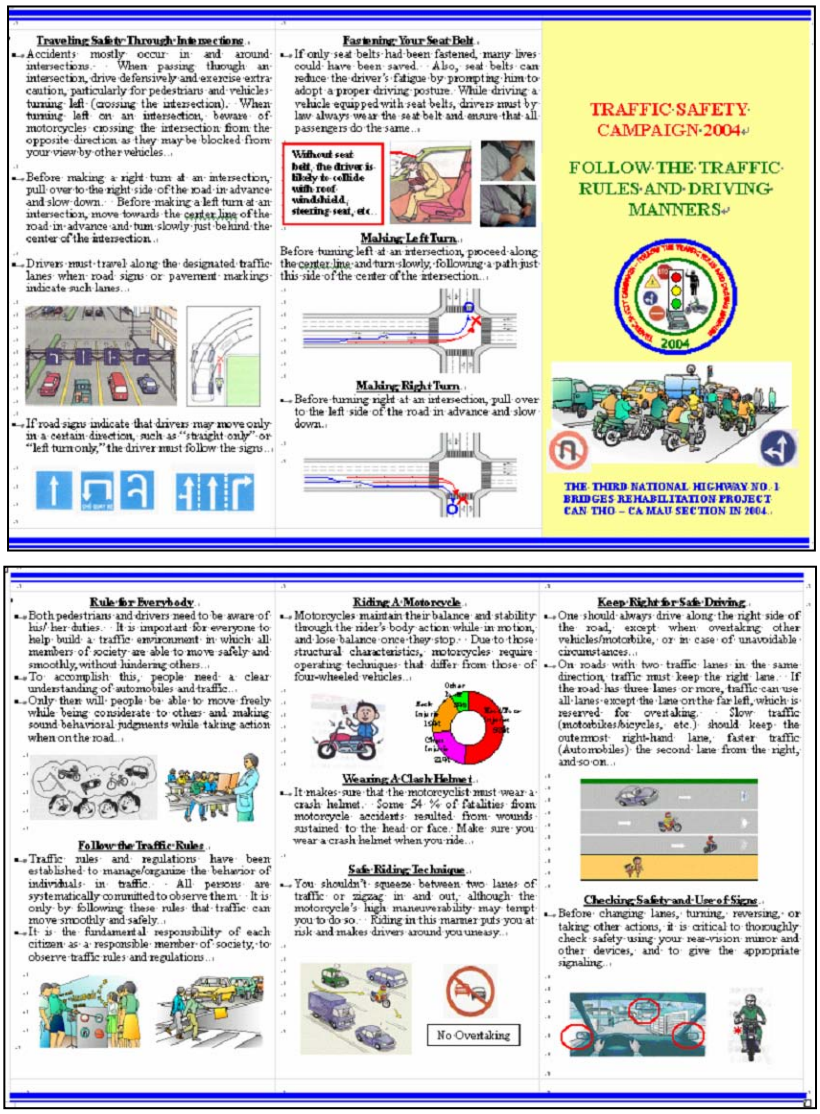
4) Action Plan of Campaign Propaganda

a) Propaganda by Mass Media
Campaign propaganda using mass media will be done. The type of mass media is

composed of 6 types such as TV spots, advertising of newspaper, radio broadcasts, streets banners, posters, and pamphlets.

b) Participation of School Students in the Campaign on the Street

At the signalized intersections, school students gather at the corner of the signalized intersection and distribute stickers and pamphlets to pedestrians and drivers. Figure 23.2-1 shows a sample pamphlet.



Source: JBIC Project in Vietnam 2004

Figure 23.2-1 A Sample Pamphlet

c) Driving guidance and Enforcement on Site by Traffic Police Officers

At the signalized intersection, traffic on each approach will be controlled and drivers will be guided on proper driving manner by traffic police officers. The main activities of traffic police officers are as follows: guiding drivers to stop their vehicles before the stop line, guiding drivers who are driving to use proper lanes, and guiding pedestrians to walk on designated pedestrian crossing.

Table 23.2-3 Programs for Traffic Safety Education

Program		Composition	Description	
1. Traffic Safety Education Programs	Level 1	Seminars for government-employed drivers and public entity drivers	Seminars conducted by CNSV's Public Education Team with 6 different modules for government-employed drivers and entity drivers.	• Overview of the transport and traffic state of the country • Ethics, value formation, and road courtesy • Responsibility of drivers • Driving manners • Traffic safety (defensive driving and basic troubleshooting) • Traffic rules and regulations
	Level 2	Training of trainers and their accreditation	Establishing an adequate base of training staff, this training is also open to the private sector.	• Organizing traffic safety education and promotion • Guidelines for traffic safety education efficiency • Role of Traffic Police and Traffic Enforcement • Driver license system and driver school system • Reeducation system for traffic offenders
	Level 3	Seminars for private drivers	Seminars conducted by CNSV's Private Education Team with 6 different modules for government-employed drivers and entity drivers.	• Overview on the transportation and traffic state of the country • Ethics, value formation, and road courtesy • Responsibility of drivers • Driving manners • Traffic safety (defensive driving and basic troubleshooting) • Traffic rules and regulations
	Level 4	Development of training aid and materials	Development of training aid and materials; inexpensive and reproducible materials will be prepared for wide use	• Various textbooks for seminars • A series of video programs for training on driving manners • A weekly column published in a major newspaper reporting on the traffic situation • Propaganda by TV spots and radio tapes
2. Organizing Traffic Safety Campaign	Option 1	Periodic traffic safety campaign on street	Campaign will be conducted two times per year for the purpose of spreading the idea of traffic safety among all the people and encouraging them to acquire the habit of observing traffic rules and manners.	• 7 to 10 days, once • Emphasizing some slogans • Traffic police conduct proper driving guidance and enforcement on the street • Staff of CNSV distributes pamphlets

	Option 2	Periodic traffic safety campaign by advertisement of mass media	Periodic traffic safety campaigns will be conducted through the advertisement of mass media	• Short television/radio commercials to foster proper driving will be aired on prime time • Campaign by mass media will be constrained by financial resources • Resources must be supported by donations of private companies such as automobile companies or auto clubs
	Option 3	Visiting public elementary schools for instruction	Staff of traffic safety will be conducting teach-ins and visiting public elementary schools to instruct children on basic traffic signs, road safety and discipline.	
3. Countermeasures for Traffic Accidents		Effective safety measures require an approach from the standpoint of the so-called three (3) "Es", i.e. Education, Enforcement and Engineering. CNSV covers the approach to planning traffic accident prevention measures.		• Statistics of traffic accident database • Identification of hazardous locations • Planning of countermeasures • Follow-up or after-care
4. A Pilot Traffic Safety Program	Action 1	Organizing Practical Demonstration Team	The practical demonstration team, which is composed of CNSV and Traffic Police, will conduct the traffic safety education program and campaign	• Based on the results of this program and campaign, the sustainable activities of the traffic safety education system will be conducted.
	Action 2	Action Plan of Workshop	A pilot traffic safety program, introducing the implementation of a workshop, will be conducted.	• Preparation of Educational Materials • Execution of work
	Action 3	Action Plan of Campaign Propaganda	A pilot traffic safety program, introducing the implementation of a campaign on the street, will be conducted	• Propaganda by Mass Media • Participation of School Students in the Campaign on the Street • Driving guidance and Enforcement on Site by Traffic Police Officers

23.2.5. COST ESTIMATES FOR TRAFFIC SAFETY EDUCATION PROGRAMS

The construction cost consists of equipment and engineering costs. The project cost by items is shown in Table 23.2-4.

Table 23.2-4 Project Cost for Traffic Safety Education Programs

No.	Investment Items	Project Cost (x 1,000 US$)
1	Equipments and educational materials	200
2	Mass media for propaganda	500
3	Expenses of personnel (experts)	300
4	Training course in other countries	200
Total		1,200
Engineering Cost (Total x 10%)		120
Administration Cost (Total x 10%)		120
Contingency Cost (Total x 15%)		180
Total		1,620

23.3. TRAFFIC ACCIDENT MONITORING PLAN (TRAFFIC SAFETY AUDIT SYSTEM)

This section discusses the establishment of a traffic accident monitoring system by using a traffic safety audit system in the study area. This is to monitor the traffic accidents by introducing a routine work from the database to countermeasures.

23.3.1. NECESSITY AND OBJECTIVES

The necessity and objectives of the traffic accident monitoring plan are as follows:

a) As pointed out in the analysis of accidents, the statistics for the analysis of traffic accidents is not sufficient. There is a lack of monitoring systems for traffic accidents and traffic safety countermeasures. Especially, in terms of database, an accident-recording sheet should be formatted in order to identify the collision diagram and hazardous black spot. These items are suitable to extract the traffic accidents pattern and presume the accident causes, and confirmation of problems should be followed up based on the detailed analysis. It is necessary to have a monitoring system for traffic safety, such as a routine work system for traffic accidents.
b) In order to establish a basic procedure of accident prevention measures, a traffic safety audit system (TSAS) should be introduced, which can generally be approached through the procedure from database to planning of countermeasures. In addition, in accordance with the development of TSAS, a development of human resources for technical experts is an important prerequisite for appropriate planning and rational safety measures.
c) Traffic accidents are caused by a combination of various factors. Any combination of the following factors may result in an accident: 1) road structure, traffic control and roadside conditions, 2) condition of vehicles, 3) physical and mental condition of drivers and pedestrians, and 4) environmental conditions such as weather and available light. Since traffic accidents generally cannot be attributed to a single cause, effective safety measures require an approach from the standpoint of the so-called three (3) E's, i.e. 'Education', 'Enforcement', and 'Engineering' by introducing the TSAS.

23.3.2. SYSTEM FUNCTION OF TSAS

In accordance with the objectives, the traffic safety audit system requires the following five (5) functions (see Figure 23.3-1):

a) Investigation and database system: study of accident statistics, and investigation of user's behavior
b) Analysis on hazardous locations and confirmation of problems: examination of accident records, collection of relevant materials, field investigation, extraction of frequent accident patterns, and presumption of accident causes.
c) Planning of measures: selection of measures corresponding to presumed causes, examination of applicability on measures, clarification of effects and side effects of measures, and examination of combination of measures.
d) Implementation of countermeasures: cost estimation for measures, examination of finance, consultation with concerned agencies, explanation to residents, decision on sequence of implementation, and implementation.
e) Follow-up system: measurement of effect of countermeasures, comparison before and after, campaign of traffic safety education, and strengthening of traffic enforcement by traffic police.

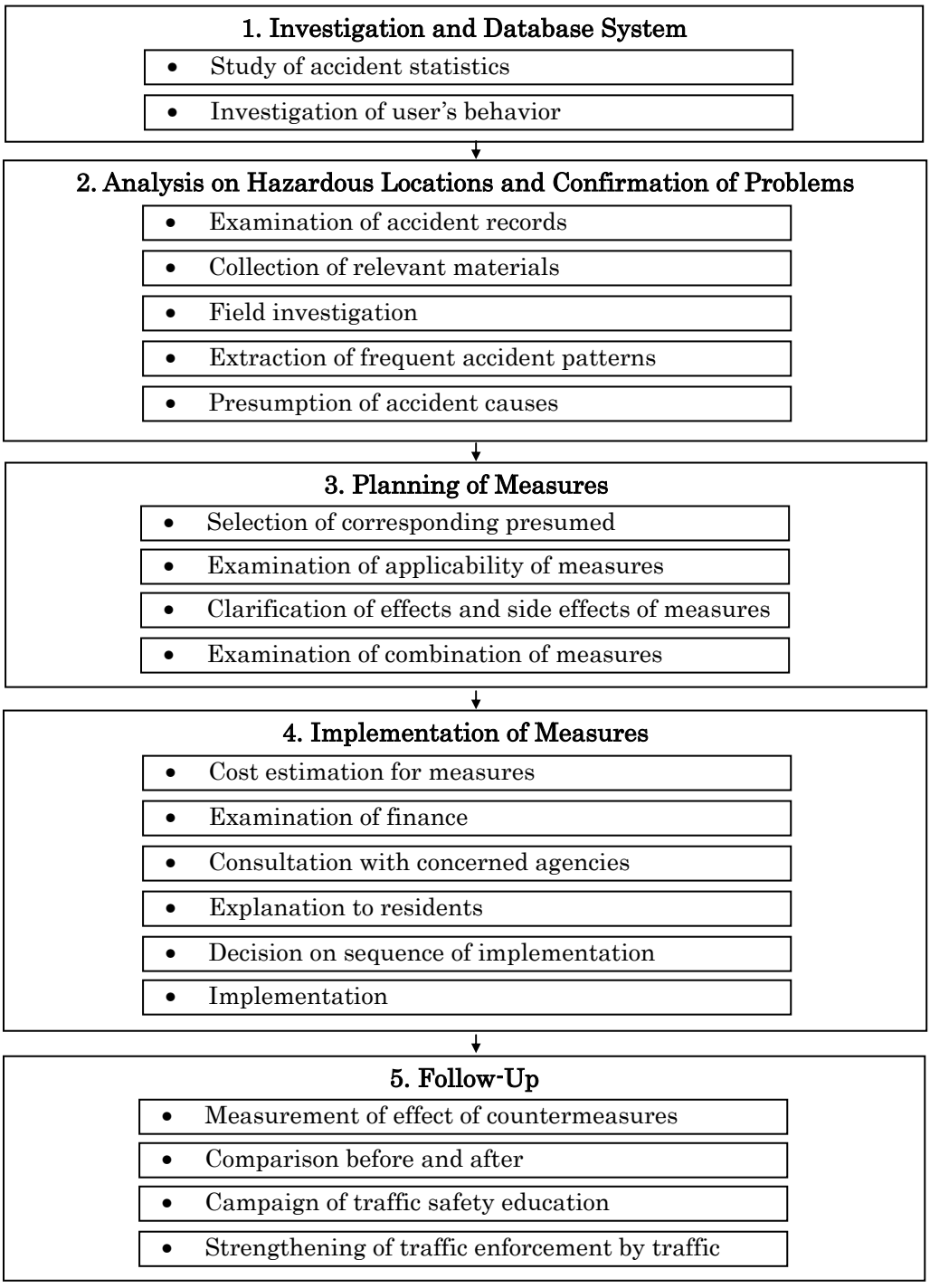


Figure 23.3-1 Procedure of Key Works for TSAS

As shown in Figure 23.3-1, a general approach to planning accident prevention measures should be followed, feedback should be made, if necessary, in finalizing the traffic safety plan. When the measures involve considerable alternation to the road structure and traffic movement, they should be put into operation after careful preparation, including consultation with road users, residents along the road and concerned governmental agencies. In the case where the safety plan is to become effective only upon its entire completion, attention should be paid to avoiding inconvenience caused by the implementation of the plan.

23.3.3. TASK DESCRIPTION

Key task descriptions for each function are shown as follows:

(1) Investigation and Database System

The task is to collect the basic information for the analysis of traffic accidents. The key tasks are, a) study of accident statistics, b) investigation of user's behavior. For the analysis of accidents, it is important to look into the traffic accident reporting, with the statements of the concerned drivers and pedestrians and the point of view of the police regarding the accidents. Therefore, the database of accident-recording sheets will be prepared suitably. The accident-recording sheet should generally include coded items explaining traffic accidents, and such data are important for statistics.

1) Study of Accident Statistic

a) Coded Items for Accident-Recording Sheets
The following coded items by category will be proposed in the formulation of accident-recording sheets (see Table 23.3-1).

Table 23.3-1 Coded Items by Category

Category	Major Items
1. Registration of report	Repot No., police station/officer name, and dispatch date.
2. Date and place of accident	Date, city zone of area, place, name of intersection, and specification of place.
3. Weather condition in accident	Clear, cloudy, foggy, and rain
4. Type of road	Avenue, street and route.
5. Road conditions	Parked vehicles, pavement, type of illumination, width of carriageway, existence of traffic light, curb parking regulation, existence of sidewalks, and allowed speed.
6. Type of accident	Against pedestrian (passing in front of vehicles, etc. 13 types), vehicles against vehicles (head-on collision, rear-end collision, etc. 9 types), only vehicles (overturn, collision to parked vehicle, etc. 8 types).
7. Type of vehicles	Involved 10 type by 1st/2nd involved vehicles, and patent of vehicles.
8. Movement of accident conditions	Vehicle movement, driving speed, and purpose of driving.
9. Drivers	Frequency of driving, registration of driving license, type of driving license, sex, and personal data of the persons involved.
10. Violation	Over speed, wrong direction, etc. 11 types by 1st/2nd involved vehicles.
11. Damage	Fatality, critical, and injury, part of injury, grade of casualties, materials.
12. Detail and sketch of the accident scene	Place conditions, collision diagram.
13. Report and observation	Comment by police.
14. Name of reporter and signature of traffic police director	Signature of report and supervisor.

b) Data Processing and Statistics
To analyze traffic accidents, the collection, accumulation, and analysis of various fundamental data, by location and by area, is essential. The statistics based on accident-recording sheets should be collected and accumulated. A database should be formulated and information supplied to those who are concerned with traffic accident prevention and improvement of traffic safety facilities. As a result of data processing, annual statistics of traffic accidents will be published periodically.

2) Investigation of User's Behavior

Traffic accident analysis is the basis for formulating appropriate traffic measures applicable in full to the real world. The following investigations of user behavior are important. As fieldwork, to observe and investigate user's behavior at the site will be carefully considered.

a) Right-turn and left-turn traffic: behavior and trace of vehicles on turning lane should be observed carefully. Key items for observation are the state of sand accumulation on the road surface, stopping positions of vehicles making a left-turn while waiting for the clearance of vehicles on the opposite through lane, and the positions of right-turn lane vehicles still waiting for a gap to occur between the pedestrians who are crossing the road.
b) Vehicle behavior: behavior of vehicles, which run through the intersection just at the moment of change in signal phase, should be observed carefully.
c) Behavior of pedestrians: head and tail of groups of pedestrians in observing/measuring their crossing speed, hastening behavior, and the remaining number of pedestrians at a given side.

(2) Analysis on Hazardous Locations and Confirmation of Problems

The task is to analyze accidents based on the pervious process. The key tasks are, a) examination of accident records, b) collection of relevant materials, c) field investigation, d) extraction of frequent accident patterns, and e) presumption of accident causes. In this section, the analysis by introducing a collision diagram focuses on the extraction of frequent accident patterns.

1) Examination of Accident Records

Based on the collection of data on traffic accidents occurred at and around hazardous locations, an interpretation of traffic accident records will be done. The following interpretation should be recommended.

a) Traffic accident report with the statements of drivers and pedestrians concerned, as well as the views of the police.
b) Key items of accident-recording sheets: type of accident, road and traffic conditions, state of traffic violation, outline of accident, heedlessness of secondary person involved, grade of responsibility, and sketch of scene with primary/secondary person involved.

2) Collection of Relevant Materials

In addition to the summary of traffic accidents records, it is necessary to summarize road and traffic conditions at and around the hazardous locations. The following interpretation should be recommended.

a) Road conditions should be summarized, such as road width, pedestrian crossing, stopping line of vehicles and lane marks, placement of guard fence, roadside conditions, traffic lights and signs, and bus stops.
b) The items related to traffic conditions should be summarized, such as traffic flow volume and pedestrian crossing traffic.
c) In addition, signal phase and traffic regulation should be summarized.

3) Field Investigation

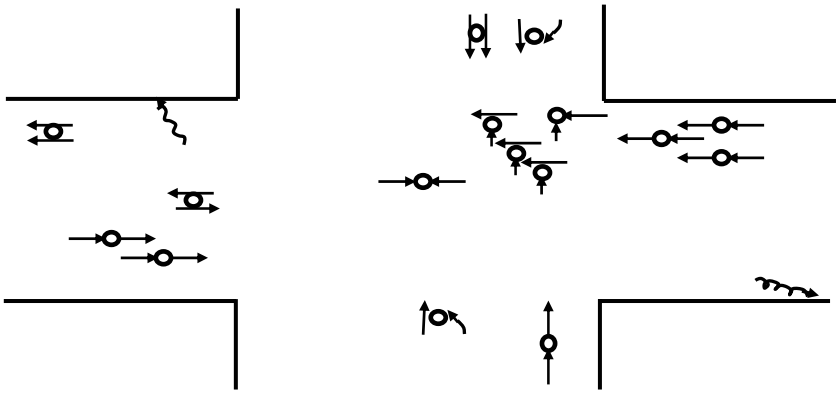
In order to understand the field conditions, an investigation of road and traffic conditions should be carried out. The important aspects of field investigation, at the outset, are to summarize the causes and effects of the accidents occurred, to rearrange data regarding

roadside conditions, to pick out traffic data necessary for the analysis, to review the traffic management scheme applied at the hazardous locations concerned, and, subsequently, to understand the general characteristics of the hazardous location. The following field investigation should be recommended.

a) Right-turn and left-turn traffic, vehicle behavior, pedestrian behavior, road condition (main and minor road), land use in proximity of location, and visibility of signal lights/signs and location.

4) Extraction of Frequent Accident Patterns

Collect data on traffic accidents that have occurred around the concerned hazardous location, and record this data in a sample collision diagram as shown in Figure 23.3-2. It is desirable to collect a lot of data, ranging over a long period, under the condition that road and traffic have not sustainability changed.



Driver Involved		Injury or Damage		Accident Type		Weather	
Symbol	Meaning	Symbol	Meaning	Symbol	Meaning	Symbol	Meaning
←	Vehicle (Forward)	●	Fatality	→←	Head-on collision	R	Raining
↔	Vehicle (Backward)			↑↑	Side-swipe at passing		
←– –	Motorcycle	⊗	Serious	↑↑	Side-swipe at overtaking	S	Snow
◁—	Bicycle			←→	Rear-end collision		
◁– –	Pedestrian	⊘	Injury	↑←	Right angle collision	W	Wet surface
⟸	Train			↑←	Side collision		
⊠	Parking/stopping vehicle	○	Physical damage	↖	Side collision at left-turn	F	Fog
				∿	Deviation from road		
				∿	Fall down before collision	I	Icy surface

Figure 23.3-2 A Sample of a Collision Diagram

5) Presumption of Accident Causes

Based on the analysis of field investigation, including the road/traffic conditions and extraction of frequent accident patterns, the accident causes at the hazardous locations will be presumed. Generally, the causes of traffic accidents will be indicated by accident patterns and road conditions.

(3) Planning Measures

The task is to plan measures based on the accident causes. The key tasks are, a) selection of measures corresponding to presumed causes, b) examination of applicability on measures, c) clarification of effects and side effects of measures, and d) examination of

combination of measures. In this section, the target hazardous location for planning measures will be assumed as an intersection.

1) Selection of Measures Corresponding to Presumed Causes

The improvement of an accident-prone intersection should be identified by the basic conditions of the intersection, such as the area of the intersection (sufficient or not) and actual traffic flow (smooth or complicated). These items are fundamental to minimize accidents and should be identified prior to detailed planning.

a) Primary countermeasures for optimizing the area of an intersection: 1) expansion of intersection corner, 2) channelization, 3) improvement of road markings (stop-line, pedestrian crossing, etc.), 4) adjustment of yellow and/or all-red interval times of signal split.
b) Primary countermeasures for achieving smooth traffic flow: 1) traffic regulation (one-way and left-turn prohibition), 2) revision of signal phase (introduction of exclusive left-turn phase, etc.), 3) channelization, and 4) separation of pedestrian flow (exclusive pedestrian crossing phase or pedestrian bridge).
c) An example of channelization is by road marking, which can reduce accidents at left-turns. An example in which the area of a multi-leg intersection is optimized and improved by channelization, which can reduce various types of accidents at right-angle collision, side collisions at left/right-turns, and pedestrian accidents at crossing.
d) Table 23.3-2 shows presumed countermeasures by type of accident.

Table 23.3-2 Presumed Countermeasures by Type of Accident

Countermeasures and Accident Types[1]	Vehicle-to-vehicle accident			Pedestrian accident	Bicycle accident
	Right angle collision	Side collision at left-turn	Rear-end collision at crossing		
1. New installation of traffic lights 1)	O	-	-	O	+
2. Addition of signal light for vehicles 2)	O		O	-	-
3. Exclusive left-turn phase (green arrow) 3)		O		O	+
4. “Stop” regulation (installation of signs and markings)	O	-	-	-	-
5. Improvement of visibility of “Stop” sign (illuminated sign)	+	-	-	-	-
6. Exclusive left-turn lane (change of center line) 4)	-	-	O	O	-
7. High skid resistant pavement at entrance of intersection 5)	-	-	O	-	

Source: The Planning and Design of At-Grade Intersections, Japan Society of Traffic Engineers

[1] Notes: O: Effective. +: It is sought effective, but has not been made clear as of yet. More follow-up surveys are necessary. -: The relationship between the accident type and countermeasures has not been clear.
1): There are some cases where rear-end collisions occur more often.
2): Side-collisions at left-turn increase.
3): Rear-end collisions increase.
4): Rear-end collisions increase.
5) The attention to the noise should be paid. Road surface conditions should be continuously maintained.

2) Examination of Applicability on Measures

Adequate countermeasures must be examined for preventing accidents according to the details of accidents. It is, however, regrettable that the present conditions, which affect many kinds of countermeasures at the intersection, are only rarely grasped. Therefore, based on the understanding of field conditions and the effects of measures, an examination of applicability on selected measures corresponding to presumed causes should be implemented carefully.

3) Clarification of Effects and Side Effects of Measures

Currently, some countermeasures are implemented simultaneously. In medical treatments, for example, just as the administration of medicines always has the problem of side effects, it is also necessary to pay attention to side effects and ripple effects without fall when implementing measures for preventing accidents. In some cases, there is transformation in accident type by measures for preventing accidents. Even though the measures are especially implemented to prevent one type of accident, not only this accident type but also other types must be compared. And sufficient study is necessary when other accident types increase even if that accident type decreases. This is because there are some cases in which measures give rise to bad influence; i.e. side effects of the implementation of measures.

4) Examination of Combination on Measures

Since Table 23.3-2 comprehensibly shows measures according to the type of accidents, a minute study is absolutely necessary because the best countermeasure for an accident type vary with many kinds of factors of each intersection and even the same countermeasure will have different effects depending on the spots or methods of adaptation.

(4) Implementation of Measures

The task is to implement the proposed measures based on selected planning measures. The key tasks are, a) cost estimation for measures, b) examination of finance, c) consultation with concerned agencies, d) explanation to residents, and e) implementation.

(5) Follow-Up

The task is to follow up the implemented measures. The key tasks are, 1) measurement of effects of countermeasures, 2) comparison of before/after surveys, and 3) execution of campaign and enforcement.

After implementation of measures, it is necessary to check in the after study whether or not measures are functioning as expected. Among evaluations for implemented measures, the main method is the comparison between the before-and-after studies for traffic accidents. The following main factors for evaluation will be recommended as shown in Table 23.3-3.

In addition, the follow-up for traffic safety education for drivers, pedestrians and traffic trainers by introducing the implementation of workshop and campaign propaganda will be executed.

Table 23.3-3 Main Factor for Evaluation Between Before-And-After Studies

Evaluation Items	Comparison Method	Factor
Comparison of number of accidents	Number of decrease	-
	Rate of decrease	All accidents, by accident type.
Comparison of accident rate	Difference in accident rate	-
	Rate of decrease in accidents	All accidents, by accident type.
Comparison of the degree of the damage	Decrease in number of casualties	Decrease in number of casualties of much greater damage than definite standard. Decrease in number of casualties of much greater damage than special standard (fatalities, etc.).
	Rate of decrease in degree of damage (number of casualties per accident, etc.)	-
Comparison of accident cost	Comparison with all accident costs.	-
	Comparison between investment in measures for preventing accidents and benefit of decrease in number of accidents	-

23.3.4. COST ESTIMATES FOR TRAFFIC ACCIDENT MONITORING SYSTEM (TRAFFIC SAFETY AUDIT SYSTEM)

The project cost consists of equipment and engineering costs. The project cost by items is shown in Table 23.3-4.

Table 23.3-4 Project Cost for Traffic Accident Monitoring System (Traffic Safety Audit System)

No.	Investment Items	Project Cost (x 1,000 US$)
1	Equipment and educational materials	1,000
2	Expenses of personnel (experts)	500
3	Training course in other countries (capacity building)	500
Total		2,000
Engineering Cost (Total x 10%)		200
Administration Cost (Total x 10%)		200
Contingencies Cost (Total x 15%)		300
Total		2,700

23.4. TRANSPORTATION DEMAND MANAGEMENT PLAN (TDM)

This section discusses the transportation demand management system (hereinafter refereed to as TDM) by introducing the staggered office and school hour control and the license-plate numbering control, in accordance with the strategic scheme of the public transport system.

23.4.1. NECESSITY AND OBJECTIVES

The necessity and objectives of the TDM plan are as follows:

a) Based on the analysis of current traffic condition, it is obvious that the road and public transport projects in the study area will be insufficient to meet the future traffic volume from the viewpoint of the traffic service level. The plan must consider how to create an attractive urban environment that is amenable to road users as well as pedestrians.
b) It is important to consider regulating the inflow of private vehicles with a public transport priority system and by increasing the use of public transport facilities. In order to maximize the investment effect of the projects, a TDM plan will be indispensable.
c) Many TDM techniques have been considered/implemented in major cities around the world. The measures of TDM are composed of growth management, license-plate numbering control, road pricing, auto-restricted zones, parking management, fuel tax, and, staggered office and school hour control, etc. Based on the merit of high cost performance, comparatively, it is highly recommended that the staggered office and school hour control and the license-plate numbering control be introduced for the Lima Metropolitan Area.

23.4.2. PLAN DESCRIPTION

(1) Staggered Office and School Hour Control

1) Control Method

The road network facility is not sufficient to accommodate the peak time demand, and traffic congestion is generated. The morning peak periods are from 6:00 a.m. to 9:00 p.m.. The trips during this peak period are mostly composed of “Going To Work” trips and “Going To School” trips. Under these circumstances, the staggered commuting hour system can lower the maximum demand volume by altering the position of the peak time. The measure can be easily implemented by governmental bodies. A staggered government commuting hour system will also have a positive effect for the enterprises and private bodies. The system for staggered office and school control is shown as follows:

a) Target trips: government bodies and private bodies within the designated area,
b) Staggered commuting hours: 7:00 a.m. - 8:00 a.m.

2) Plan Area

As shown in Figure 23.4-1, this plan will deal with the central area of the city, bordered by Av. Javier Prado, Via de Evitamiento, Río Rímac, and the city of Callao with heavy traffic congestion conditions indicating less than 10km/h of average travel speed, based on the analysis of the travel time survey.

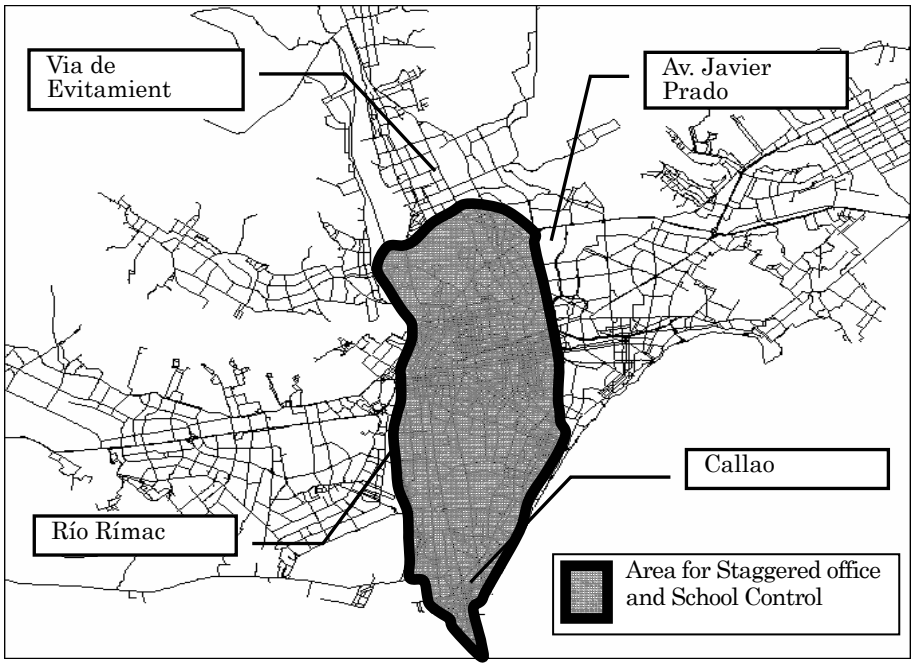


Figure 23.4-1 Plan Area for Staggered Office and School Control

3) Demand Control Impact

Assuming the TDM plan for current traffic conditions, traffic volume and the impact to the traffic flow will be analyzed through a study of traffic control and management. The impact of traffic demand control was reviewed through a comparison between the cases of "With" and "Without" such demand control.

Setting PT traffic zones in the central area, the effect of staggered commuting hours was forecasted for going to work and school trips in 2004. According to the forecast, out of approximately 563,670 trips during peak time (7:00 a.m. - 8:00 a.m.), staggered commuting is recommended for about 28 % or 159,340 trips, before or after peak time. Table 23.4-1 shows the decrease achieved by staggered office and school control in the central area.

Figure 23.4-2 shows the hourly attraction fluctuation of incoming volume of current offices and schools in the central area, bordered by Av. Javier Prado, Vía de Evitamiento, Río Rímac, and the city of Callao. The peak hour of trip volume is from 7:00 a.m. to 10:00 a.m., during which the volume is approximately 1,212,990 trips. Based on this, an average per hour trip frequency of 404,330 trips/hour is calculated, and the excess of the peak time trips will be assigned on different commuting hours.

Currently, it is impossible to assign the total average trips during peak periods. However, it is noted that the effect of calculation indicates a possibility for mitigation of traffic congestion by the staggered communicating control system. Furthermore, the feasibility study should be conducted, based on the plan of comprehensive staggered communicating control and the clarification of effects, in accordance with the overall coordination of relevant governmental bodies, universities and hospitals.

Table 23.4-1 Trip Decrease by Staggered Office and School Control

Central Area Trips			Object Attraction for Control	Decrease Rate of Peak Hour Attraction
7:00 a.m. - 10:00 a.m.	Average Hourly Volume	7:00 a.m. - 8:00 a.m.		
1,212,990	404,330	563,670	159,340	28%

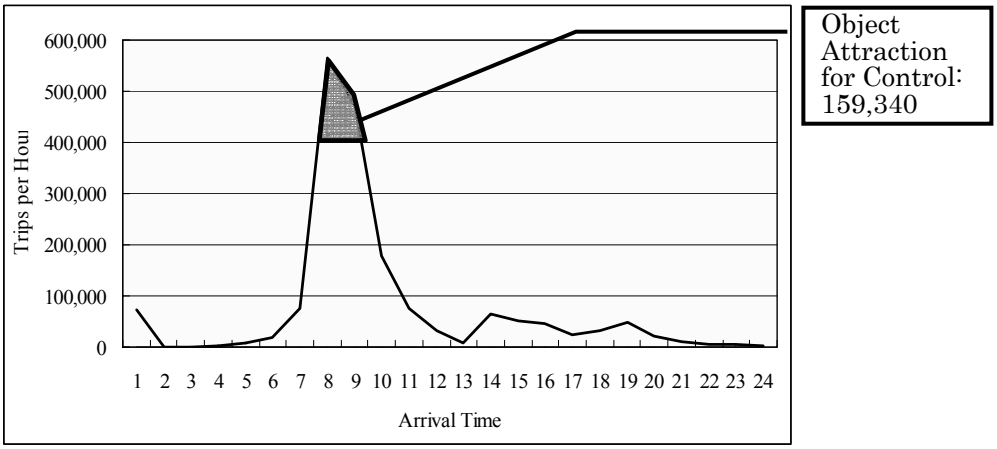


Figure 23.4-2 Hourly Attraction Fluctuation for Work/School Purpose in the Central Area

(2) License-Plate Numbering Control

This system restricts the use of private cars in the congested area of the city every other day depending on the number of the license plates. This system is applied to a limited area and is effective in a city such as Lima. However, in order to maintain this control system, it is necessary to have many policemen inspect the traffic. It may be expected that some people would attempt to acquire two different license plates for one car or modify plates, making it difficult to continue the system for along time. The main contents are described as below.

1) Control Method

In the central area of city, where the traffic is very heavy and congested during peak periods, all vehicles, except public transport entering this area, are presumed to be restricted by a license-plate number. This system considers several cases as follows:

a) Restriction of vehicles by plate number
Two alternatives are considered for the restriction of vehicles by plate number. Table 23.4-2 shows the alternatives for restriction of vehicles with plates according to the final number.

- Alternative 1: restriction of vehicles with plates in final number 1 and 2
In the case of assuming a reduction rate at 20% of the total entering private vehicles, vehicles with plates in final number 1 and 2 are not permitted to enter the controlled area on one working day, such as Monday, during peak periods, on the other hand, vehicles with plates in final number from 3 to 0 are permitted to enter the controlled area on the same day. This restriction rotates during the designated peak periods in the morning and in the afternoon.
- Alternative 2: restriction of vehicles with plates in final number 1, 2, 3 and 4
In the case of assuming a decrease rate at 40% of the total entering private

vehicles, vehicles with plates in final number 1, 2 3, and 4 are not permitted to enter the controlled area on one working day, such as Monday, during peak periods, on the other hand, vehicles with plates in final number from 5 to 0 are permitted to enter the controlled area on the same day.

Table 23.4-2 Alternative for Restriction of Vehicles with Plates in Final Number

Day	Alternative 1	Alternative 2
1. Monday	1-2	1-2-3-4
2. Tuesday	3-4	5-6-7-8
3. Wednesday	5-6	9-0-1-2
4. Thursday	7-8	3-4-5-6
5. Friday	9-0	7-8-9-0

b) Restriction of Time Periods
The restriction of time periods will be the following, based on the results of the hourly attraction fluctuation and other relevant traffic surveys.

- In the morning periods: 7:00 a.m. - 10:00 a.m.
- In the afternoon periods: 16:00 p.m. - 19:00 p.m.

c) Types of Vehicles for Restriction
All vehicles, except public transport entering this area, are presumed to be restricted, however, the following vehicle types will be excluded.

- Prohibition: Private passenger vehicles and small trucks.
- Exception of prohibition: Public transport such as bus, minibus, combi and taxi, company bus, school bus, and emergency vehicle.

2) Plan Location

As shown in Figure 23.3-1, this plan will deal with the central area of the city, bordered by Av. Javier Prado, Vía de Evitamiento, Río Rímac, and the city of Callao with heavy traffic congestion conditions, this area is the same as for the proposed staggered office and school hour control.

3) Introduction of Other City's License-Plate Numbering Control

This section introduces other city's license-plate numbering control, such as the city of Bogotá in the Republic of Colombia. Based on the Decree of the District administration, the license-plate numbering control has been implemented, under the name of "Peak and Plate". The system and effects of control are described below:

a) Major Contents of Control
This system restricts the use of private cars and public transport excepting trunk buses, feeder buses, inter urban long-distance buses, company buses, and school buses in the congested area of the whole city every other day.
Vehicles with plates in final number, as shown in Table 23.4-3, are not permitted to enter the city on one working day during peak periods. This restriction rotates during the designated peak periods in the morning (6:00 a.m. - 9:00 a.m.) and in the afternoon (16:00 p.m. - 19:00 p.m.).

Table 23.4-3 Alternative for Restriction of Vehicles with Plates in Final Number in Bogotá

Day	Year 2003	Year 2004
1. Monday	7-8-9-0	3-4-5-6
2. Tuesday	1-2-3-4	7-8-9-0
3. Wednesday	5-6-7-8	1-2-3-4
4. Thursday	9-0-1-2	5-6-7-8
5. Friday	3-4-5-6	9-0-1-2

b) Outline of Control Effects
The study was carried out by using the travel time survey and the plate registration survey, in order to understand the average travel speed and the passing time at the different control points. The effects of the demand control of the "Peak and Plate" are shown in Table 23.4-4.

Table 23.4-4 Effects of "Peak and Plate" Control in Bogotá

Type of Vehicle	Average Travel Speed (km/h)		
	In 2001 without Peak and Plate control	2002	In 2003, first 2 months
1. Collective Public Transport	21.5	27.0	20.4
2. Passenger Transport	26.9	35.7	32.2

4) Demand Control Impact

When the plate numbering control is done in the mass transit system, the public transport passengers will increase. The number of passengers, which diverts from the passenger car to the mass transit and taxi, depends on the strength of the control. In order to analyze those relationships, the Logit model in the disaggregated model, developed in Chapter 11, was used in the study. In this examination, it is important to evaluate the decrease of car trips and the increase of taxi and public mode trips. The Logit model can realistically estimate the travel demand to divert from passenger car to taxi and public modes.

In the sensitivity analysis on the restriction of car use, the travel demand by each mode is forecasted on the assumption that the restriction of car use by the numbering control is done. Figure 23.4-3 shows the modal shares of alternative cases in the peak hour in 2010, which are done in range between a control of 0% and 50% of car travel demand.

As can be seen, by the control of the passenger car, the car travel demand decreases in the whole study area. On the other hand, the demand of taxi and public transport slightly increase due to diversion to these modes.

Table 23.4-5 shows the total number of trips by type of vehicles according to the alternative control cases. In case of a control of 20% to the total car trips, the private vehicles, composed of car, taxi, and truck, in 2010 decrease in trips in comparison to that in the case in which plate-numbering control is not done. Its figure decreases by 10%, while the trips of public transport increase by 4%.

The control of 40% to the total car trips causes a decrease of 20% in the private vehicle trips and an increase of 8% in the public transport trips in comparison to the "without" case of the control. This shows that in 40%, the private vehicle trip is lower than that at the present (see Table 23.4-5).

Table 23.4-6 shows the average travel speed and volume-capacity ratio on roads in the whole study area. In cases of the control of 20% and 40% by TDM, the travel speeds

increase more than that at the present by the decrease of the private vehicle trips. At the same time, the traffic congestion is alleviated in comparison to that at the present in terms of volume-capacity ratio of 1.0 or more.

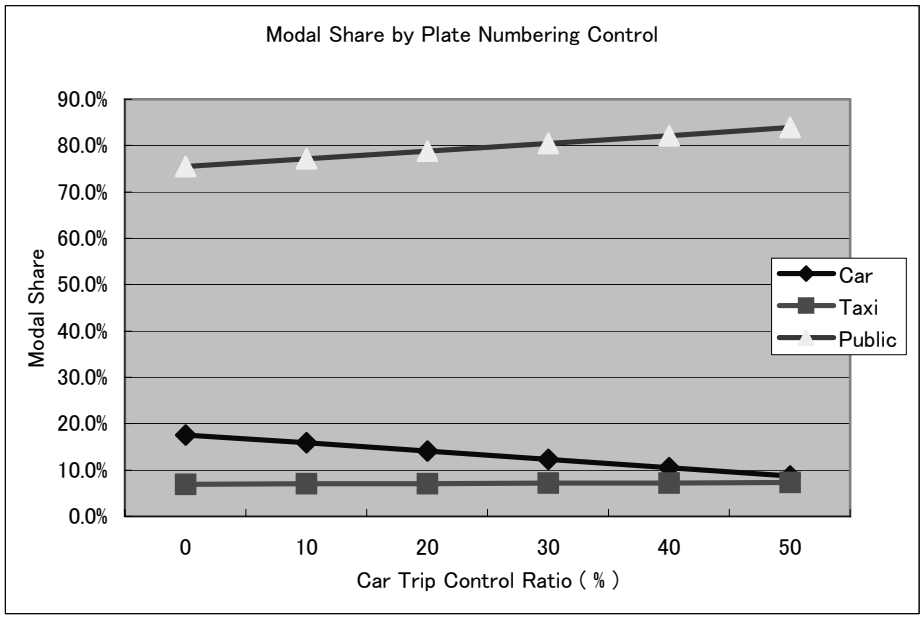


Figure 23.4-3 Modal Shares of Alternative Cases in 2010

Table 23.4-5 Total Number of Trips by Alternatives in the Peak Hour

Year	Alternatives		PCU/Peak Hour			Passenger/ Peak Hour	Alternative/2004	
	% of Control		Car	Taxi	Truck	Public	Private	Public
2004			80,405	113,862	17,427	820,377	1.00	1.00
2010	0%	With Case	105,555	116,645	23,291	885,598	1.31	1.02
2010	20%	With Case	83,496	117,762	23,291	921,239	1.04	1.03
2010	40%	With Case	61,471	118,721	23,291	957,236	0.76	1.04

Table 23.4-6 Average Travel Speed and Volume-Capacity Ratio on Road

Items	Unit	2004	2010			2010/2004		
			with	20%	40%	2010 with	2010 20%	2010 40%
Average Speed (km/h)	km/h	16.8	16.8	17.9	19.6	1.00	1.06	1.17
Volume-Capacity Ratio								
V/C < 1.0	km	3,978	3,946	3,980	4,023	0.99	1.00	1.01
1.0 =< V/C	km	340	334	300	257	0.98	0.88	0.76

Figure 23.4-4 and Figure 23.4-5 show peak hour traffic volumes on Av. Tupac Amaru and Av. Aviación, parallel to the mass transit lines in which total traffic volume, car and total passengers of public transport are shown by the alternative cases which are the case in 2004, the "without" case of the 2010 project, and the 0%, 20% and 40% control cases of the "with" case in 2010. The traffic volume on roads is forecasted by the traffic assignment method in which the OD trips, estimated by the Logit model, load onto the 2010 road and transport networks.

As can be seen on Av. Tupac Amaru, the total traffic and car volumes decrease according to the plate numbering control, while the passenger volumes increase by diversion from car trips.

On Av. Aviación, the passenger volume in the "with" case dramatically increases by the railway project and slightly increase by the control. On the other hand, the traffic and car volumes decrease.

As mentioned above, the plate-numbering control shows a high degree of effectiveness. Especially, the effectiveness to a control of 40% of car demand is higher. However, this condition of the control will be severe in actual enforcement. Therefore, even though the enforcement of the 20% control is executed, the car trips will be decreased by 10% of the "without" case of the control. Its travel condition is well improved in the travel speed and congestion level in comparison to that at the present.

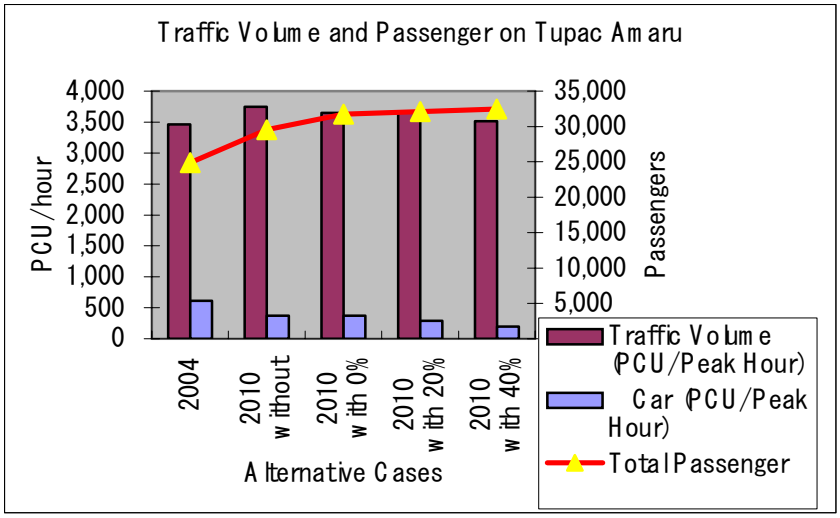


Figure 23.4-4 Peak Hour Traffic Volumes on Av. Tupac Amaru

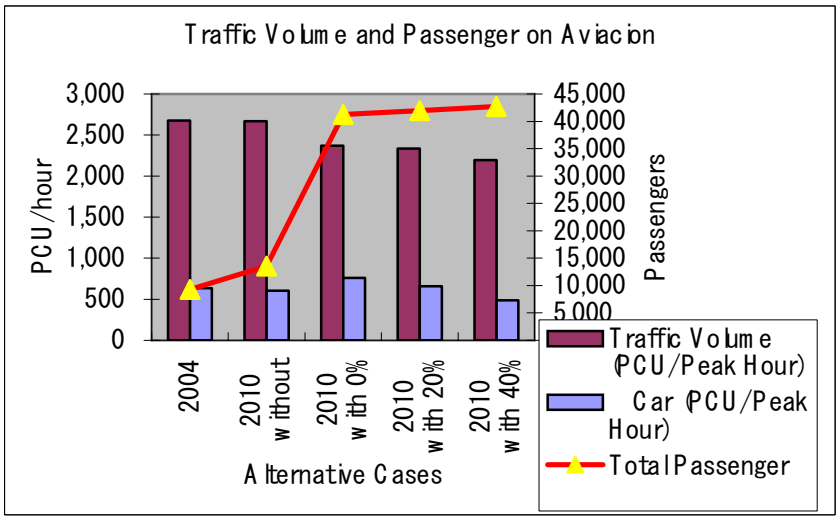


Figure 23.4-5 Peak Hour Traffic Volumes on Av. Aviación

23.4.3. URGENT ACTION PLAN FOR TRANSPORTATION DEMAND MANAGEMENT PLAN (TDM)

Based on the comparative merit of high cost performance, it is highly recommended that the license-plate numbering control should be urgently implemented for the Lima Metropolitan Area.

Based on the results of the impact study, it is recommended that Alternative 2 be adopted for the Urgent Action Plan. Vehicles with plates in final number 1, 2 3, and 4 are not permitted to enter the controlled area on one working day during peak periods, on the other hand, vehicles with plates in final number from 5 to 0 are permitted to enter controlled areas on the same day. Table 23.4-7 shows the restriction of vehicles with plates in final number. The restriction of time periods is as follows: 7:00 a.m. - 10:00 am. and 16:00 p.m. - 19:00 p.m.. All vehicles, except public transport, entering this area are presumed to be restricted.

Table 23.4-7 Restriction of Vehicles with Plates in Final Number

Day	Plates in Final Number
1. Monday	1-2-3-4
2. Tuesday	5-6-7-8
3. Wednesday	9-0-1-2
4. Thursday	3-4-5-6
5. Friday	7-8-9-0

23.4.4. COST ESTIMATES FOR TRANSPORTATION DEMAND MANAGEMENT PLAN (TDM)

The project cost will be estimated for the license-plate numbering control system. The project cost consists of equipment, maintenance, and engineering costs. The project cost by items is shown in Table 23.4-8.

Table 23.4-8 Project Cost for Transportation Demand Management Plan (TDM) by Introducing License-Plate Numbering Control

No.	Investment Items	Project Cost (x 1,000 US$)
1	Equipment and Propaganda (Mass media)	500
2	Personnel Expenses (Inspectors by police)*	3,600
Total		4,100
Engineering Cost (Total x 10%)		410
Administration Cost (Total x 10%)		410
Contingencies Cost (Total x 15%)		620
Total		5,540

Note *: Personnel expenses during one year.

23.5. IMPROVEMENT PLAN OF PARKING CONTROL SYSTEM

This section discusses an improvement plan of the parking control system by introducing the parking prohibition at parking lots along principal roads and the installation of charged on-street parking lots on minor roads.

23.5.1. NECESSITY AND OBJECTIVES

The necessity and objectives of the improvement plan of the parking control system are as follows:

a) There are many parked cars at off-street parking lots along the street in front of buildings. During peak periods, the conflict of merging and diverging, from/to parking lots along the street is observed in the study area. It leads to set the beginning of traffic congestion.
b) Two kinds of parking measures may be recommended; one is to take away the parking lots along the principal roads and the other is to install the charged on-street parking lot on the minor streets, by introducing a parking ticket system. These two ought to be applied at the same time within one system.
c) The charged on-street parking lot aims to raise the turnover rate in order to increase the parking capacity in the planned minor streets, to exclude long-stay vehicles, for instance vehicles that park throughout working time, in order to provide more opportunities to vehicles to park for shopping or business, to promote the conversion from private mode to public mode, and to increase funds to develop off-street parking facilities.
d) In order to start regulating the inflow of private vehicles by parking restriction and increasing the use of public transport facilities, it is necessary to improve the parking control system along heavy congested roads.

23.5.2. PLAN DESCRIPTION

The improvement plan of the parking control system focuses on the charged on-street parking lots on the minor streets, by introducing a parking ticket system. The plan should consider that the parking prohibition at parking lots along principal roads and the installation of charged on-street parking lots should be implemented simultaneously. The main contents are described below:

(1) Plan Location

Figure 23.5-1 shows the plan locations for the charged on-street parking lot on minor streets, which covers target routes including the key bottlenecks indicating heavy traffic congestions. In determining the locations for installation of charged on-street parking lots, the following criteria was used:

a) Location of many off-street parking lots in front of roadside buildings along the principal roads;
b) Traffic congested route indicating less than 10km/h of average travel speed.

They are minor streets behind Av. E. Benavides, Av. Aviación, Av. Canadá, Av. Javier Prado, Av. Angamos, Av. República de Panamá, Av. José Larco, and Av. La Marina.

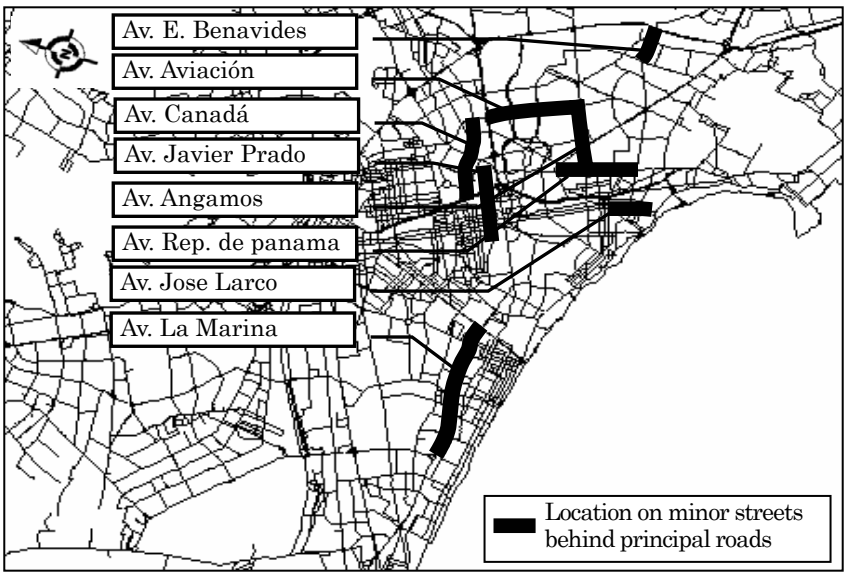


Figure 23.5-1 Plan Location for Charged On-Street Parking Lots on Minor Streets

(2) Operation System and Facility Plan

The operation system and facility plan for the on-street parking charge system is described below.

1) Operation System

The operation system discusses the parking ticketing system, the patrol and inspection system, and the organization for implementation.

a) Parking Ticketing
There are three kinds of tickets: one hour, two hour and three hour tickets. An example of a parking ticket is shown in Figure 23.5-2. A driver should buy a ticket directly from an inspector who is patrolling on the road. The inspector shall record the date and parking duration and sign the ticket.

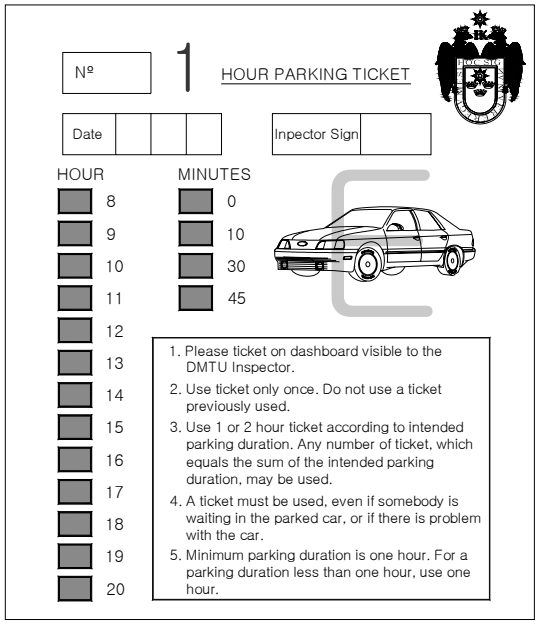


Figure 23.5-2 A Sample Design of a Parking Ticket

b) Parking Charge

If the parking charge is made too heavy a burden upon drivers, public opinion will be against the new system and a serious social problem may result. On the other hand, if the rate of parking charge is set at a very low level, the abovementioned purposes of the management system cannot be attained. For setting the rate of parking charge, an investigation by questionnaire will be needed to estimate the amount to be charged. The following items may provide a hint for setting the rate of parking charge.

- Car owners generally belong to the middle or higher classes;
- The rate must be suitable to avoid long-term parking;
- Consideration of the current rate of public parking charge; and
- What rate would help someone to decide whether to take a taxi to the city center area or to drive his car and then pay the parking charge?

Based on the foregoing considerations, the rate of parking charge may be assumed to be between S/.1.0 and S/.1.5 per hour.

c) Patrol and Inspection

An inspector, who is a person assigned by the traffic police or the Municipal Direction of Urban Transport (DMTU), shall patrol once every hour to check if there are violators. An inspector's sphere of activities will be a section between 100 m and 200 m in length, on a daily shift basis. The duties of an inspector are; ticket sales, patrol and inspection, enforcement of parking violation and regulations, giving a notice of penalty card, and the transfer of violating vehicles using a towtruck. Figure 23.5-3 shows the outline of the parking ticket system.

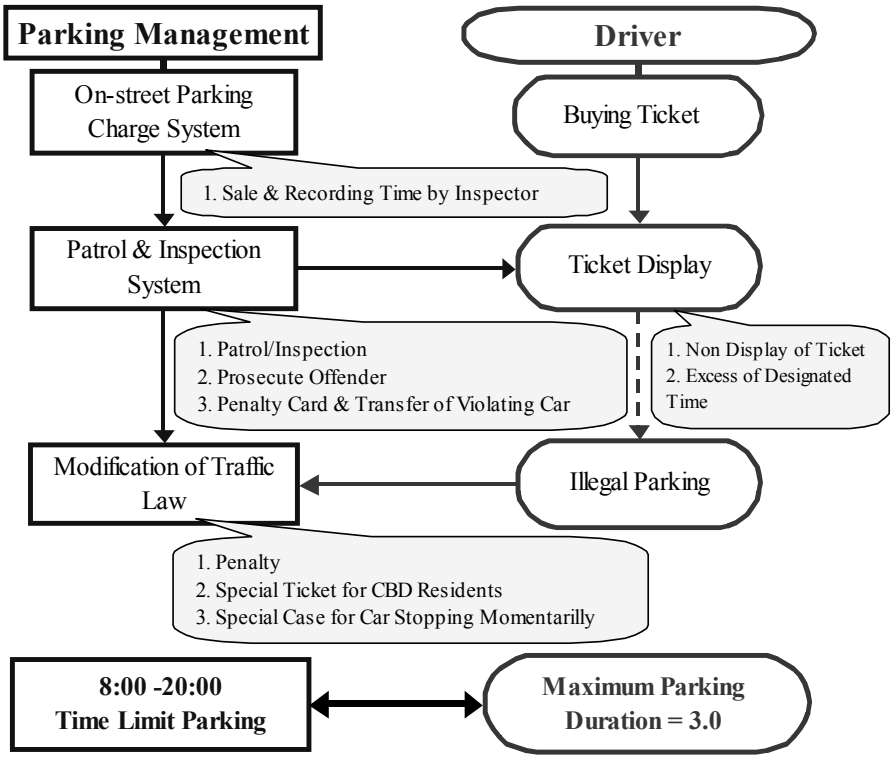


Figure 23.5-3 Outline of Parking Ticket System

d) Regulation of Parking Violation

A driver violating the parking system will be punished in accordance with the

traffic laws and regulations. After the inspector informs the driver of his/her offence, a series of procedures will be taken by the office of the traffic police. There are two kinds of parking violation penalties as follows; one is the payment of an excess charge in the case of the parking time violation being less than 1.0 hour, and the other is the transfer of a violating vehicle by towtruck when the time exceeds 1.0 hour. The procedure for regulation of parking violations is shown in Figure 23.5-4.

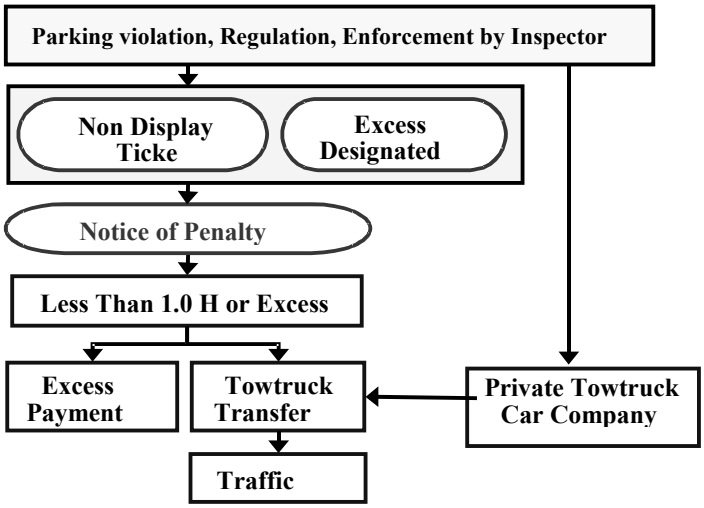


Figure 23.5-4 Procedure for Regulation of Parking Violation

e) Implementation and Organization

It is necessary to study the activities of planning and design of the parking ticket system in relation to the transport measures and their influence on business activities and drivers. It is desirable that the DMTU be in charge of such planning matters, because it is responsible for overall traffic management planning and policies. Regarding the operation of the parking ticket system, two ideas can be considered: a new organization responsible for operation will be formed, or the DMTU shall be responsible for operation. However, the staff of the DMTU should be recruited due to its small staff and its nature as a planning body. The share of management activities are described as below:

- Final Decision: DMTU;
- Planning, Design and Evaluation: DMTU;
- Operation: DMTU or new organization; and
- Enforcement: Traffic Police.

f) Preparation for Implementation

It is also recommended that, at the start, this new system be introduced in the most important areas as **"A Pilot Project"**, and its impact should be carefully monitored. As people become gradually accustomed to the new system, it should be expanded to other areas, and any modification necessary to make it more suitable for the Peruvian way of life should be implemented.

g) Facility Plan

The local facility for the on-street parking charge system is composed of parking spaces and guide signs. The layout of the parking spaces and guide signs shall be designed so that drivers can clearly identify them and easily follow the guiding information. These facilities are provided for parking vehicles on parking designated streets. The parking space will be designated by the use of road markings. The unit parking area is 11.25 square meters (5.0m x 2.25m). Parking

vehicles are led by the guide sign along the street. The guide sign should be installed at 50-100m intervals along the parking designated street. The standard designs of the parking space and the guide sign for the on-street parking charge system are shown in Figure 23.5-5.

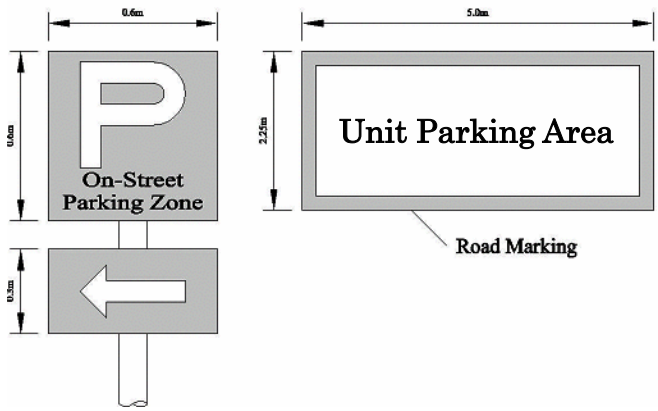


Figure 23.5-5 Standard Design of Unit Parking Area and Guide Sign

23.5.3. COST ESTIMATES FOR IMPROVEMENT PLAN OF PARKING CONTROL SYSTEM

The construction cost consists of equipment, construction, maintenance, and engineering costs. The construction cost by items is shown in Table 23.5-1.

Table 23.5-1 Project Cost for Improvement Plan of Parking Control System

No.	Investment Items	Project Cost (x 1,000 US$)
1	Equipment and Propaganda (Mass media)	500
2	Equipment and Devices (road marking/traffic signs)	550
3	Personnel Expenses for Inspectors*	720
	Total	1,770
Engineering Cost (Total x 10%)		180
Administration Cost (Total x 10%)		180
Contingencies Cost (Total x 15%)		270
Total		2,400

Note *: Personnel expenses during one year.

23.6. IMPROVEMENT PLAN OF MOTOR VEHICLE INSPECTION SYSTEM

Currently, the procedure of motor vehicle inspection in Lima has licensed the full responsibility of the government to private companies, based on the private participation. Therefore, this section introduces an example of the motor vehicle inspection system in Japan.

23.6.1. NECESSITY AND OBJECTIVES

The necessity and objectives of the improvement plan of the vehicle inspection system are as follows:

a) To ensure the safety of motor vehicles and to save energy, decrease pollution, and obtain harmonization with other social economies, it becomes indispensable to maintain motor vehicles under optimum conditions and to conduct periodical revisions and maintenance and to carry out inspections at regular intervals by

means of the motor vehicle inspection system, of which reliability has been scientifically and technically proven.

b) A lot of traffic accidents are attributed to simple carelessness on behalf of the drivers and pedestrians, this problem requires a greater awareness on behalf of every citizen in the developing process of motorization. Nevertheless, it is mandatory to maintain motor vehicles under optimum conditions by carrying out periodical maintenance so that improperly serviced motor vehicles may not constitute moving murder weapons.

c) Without the proper operation, management or maintenance or wrong methods being taken in these respects at the sacrifice of convenience, motor vehicles may have the potential of becoming "Socially Ill", it is, therefore, imperative to take some preventive measures to curb environmental pollution. The "Motor Vehicle Maintenance Service" plays a vital role in combating environmental pollution and helps prevent it.

d) Accordingly, the motor vehicle inspection system evaluates motor vehicles in an accurate and yet rationalized way and handles them efficiently to enable drivers to have a prompt and adequate inspection.

23.6.2. PLAN DESCRIPTION

(1) Inspection Procedure

In order to implement a more stringent vehicle inspection system, it is best that the inspection procedure be licensed to private companies. A proposed vehicle inspection system will consider two steps as shown in Figure 23.6-1.

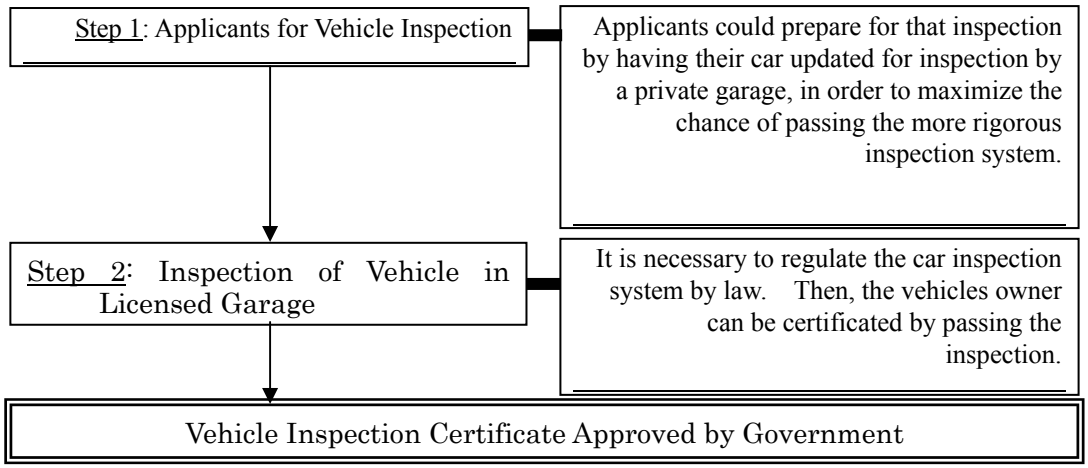


Figure 23.6-1 Procedure of Motor Vehicle Inspection

(2) Technical Inspection Items

A proposed standard inspection item will be comprised of 1) Part I: Chassis, 2) part II: Body, 3) Part III: Lamp. Each part is composed of detailed items. The detailed items for technical inspection are shown in Table 23.6-1. And, a sample of a format sheet for the technical inspection items is shown in Table 23.6-2.

Table 23.6-1 Proposed Inspection Items

Part		Items	No. of Sub-	Truck, Tractor	Bus	Motor Vehicle
I. Chassis	1	Frame	3	●	●	-
	2	Bumper	3	●	●	●
	3	Turning control system	4	●	●	-
	4	Disc wheel	1	●	●	-
	5	Tires	2	●	●	●
	6	Axle	1	●	●	-
	7	Spring	1	●	●	-
	8	Shock absorber	2	●	●	-
	9	Mud flap	6	●	●	-
	10	Hand brake	2	●	●	●
	11	Parking brake	6	●	●	●
	12	Engine	3	●	●	●
	13	Exhaust system	5	●	●	●
	14	Drive train system	3	●	●	-
	15	Ignition system	1	●	●	-
	16	Electric system	6	●	●	●
	17	Horn	6	●	●	●
	18	Fuel tank	4	●	●	-
	19	Speedometer	3	●	●	●
	20	Tachometer	3	●	●	-

Part		Items	No.	Truck, Tractor	Bus	Motor Vehicle
II. Body	1	Windshield and glass	4	●	●	-
	2	Rear view mirror	2	●	●	●
	3	Wiper	4	●	●	●
	4	Sun visor	1	-	-	●
	5	Rear body	4	●	-	-
	6	Letter, Picture or any mark	7	●	●	-
	7	Body color	1	●	●	-
	8	Roof	2	-	●	-
	9	Floor	2	-	●	-
	10	Side window	7	-	●	-
	11	Entrance door	8	-	●	-
	12	Emergency door	7	-	●	-
	13	Driver seat	3	-	●	-
	14	Passenger seat	2	-	●	-
	15	Driver cab	3	●	-	-
	16	Driver partition	2	-	●	-
	17	Passenger grip	4	-	●	-
	18	Bell for stop signal	2	-	●	-
	19	Fluorescent pad	13	●	●	●
	20	Safety belt	1	●	●	●

Part		Items	No.	Truck, Tractor	Bus	Motor Vehicle
III. Lamp	1	High beam lamp	7	●	●	●
	2	Low beam lamp	5	●	●	●
	3	Lamp for vehicle width	7	●	●	●
	4	Turning lamp	8	●	●	●
	5	Tail lamp	5	●	●	●
	6	Stop lamp	6	●	●	●
	7	Reversing lamp	6	●	●	●
	8	License plate lamp	6	●	●	●
	9	Lamp for vehicle's height and categories (for vehicles whose height exceeds 2.5m)	12	●	●	-
	10	Inside vehicle lamp	5	●	●	●
	11	Lamp for route plate	2	-	●	-
	12	Side lamp (option)	10	●	●	●
	13	Side turn lamp (option)	5	●	●	●
	14	Fog lamp (option)	7	●	●	●
	15	High mount stop lamp (option)	9	●	●	●
	16	Other lamps	1	●	●	●

Table 23.6-2 A Sample Format Sheet for Technical Inspection Items

Part	Items		How to check	Truck, Tractor	Bus	Motor Vehicle
III. Lamp	1	High beam lamp	1. White or light yellow	●	●	●
			2. 2 units	●	●	●
			3. Fixed at the front in the same level, both left & right	●	●	●
			4. Both of them must be the same color	●	●	●
			5. Fixed higher than the ground at least 40cm but not exceeding 1.35m	●	●	●
			6. They will be lightened whenever tail lamps are lightened except in case of temporary signal	●	●	●
			7. Additional 2 units are allowed (option)	●	●	●
	2	Low beam lamp	1. White or light yellow same as high beam lamp	●	●	●
			2. 2 units	●	●	●
			3. Fixed at the front in the same level, both left & right			
			4. Fixed higher than the ground 40cm but not exceeding 1.35m. And the length from the edge must not exceed 40 cm.	●	●	●
			5. They will be lightened whenever tail lamps are	●	●	●

(3) Facility Plan

a) Arrangement of System

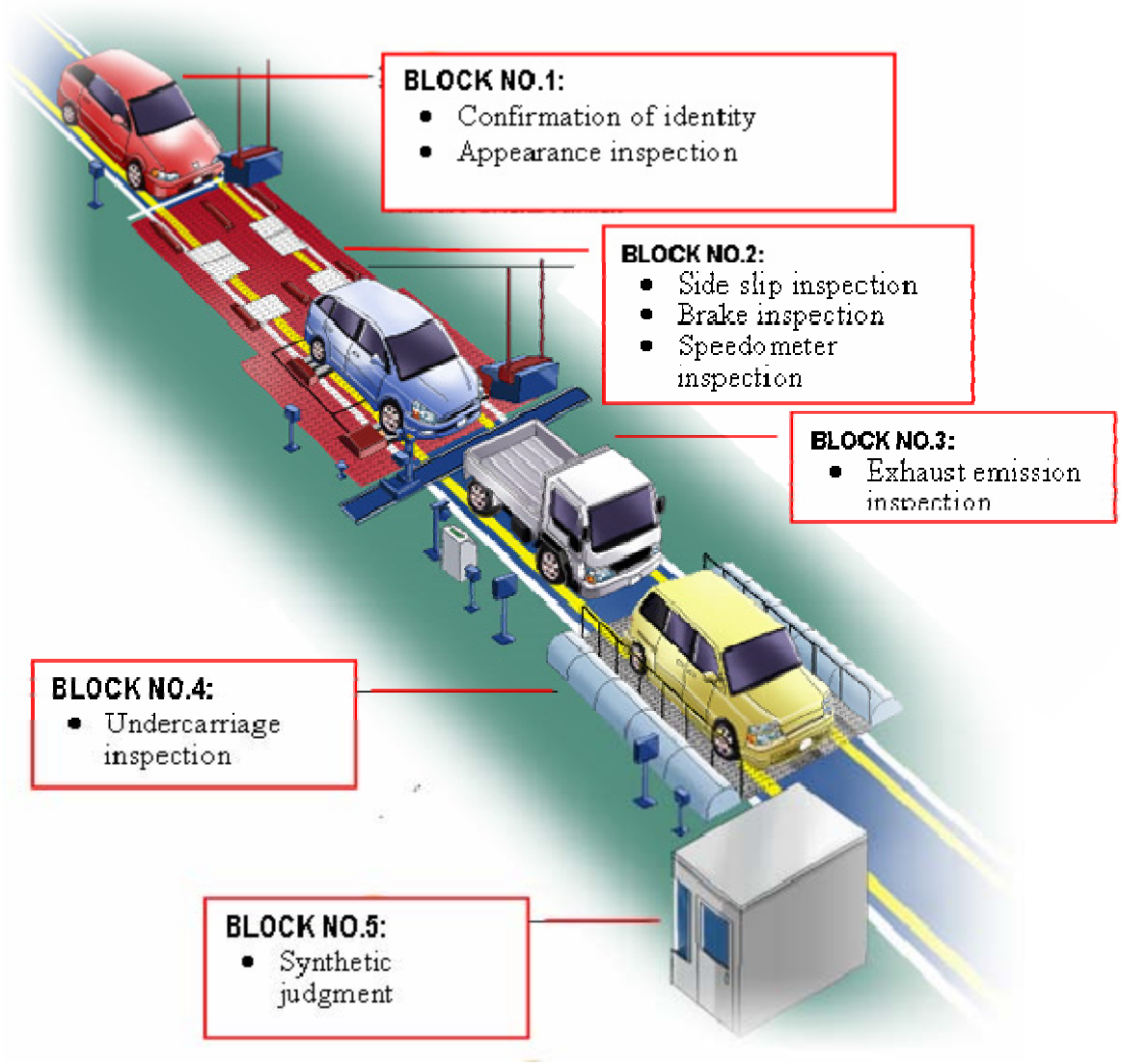
The arrangement of major inspection items for the system consists of the following components from Block No.1 to Block No.5. Figure 23.6-2 shows the arrangement of inspection items. A factory will consist of two components.

- Block No.1: Confirmation of identity, appearance inspection.
- Block No.2: Side slip inspection, brake inspection, speedometer inspection, and headlight inspection.
- Block No.3 Exhaust emission inspection.
- Block No.4: Undercarriage inspection.
- Block No.5: Synthetic judgment.

b) Equipment of System
This system consists of the following equipment.

- Vehicle data entry terminal;
- Safety related device inspection equipment;
- Side slip tester;
- Brake tester;
- Speedometer tester;
- Headlight tester;
- Equalizer;
- Exhaust emission tester;
- Undercarriage inspection equipment; and
- System controller.

c) Equipment by Block No.
The equipment by Block No. is shown in Table 23.6-3.



Source: Motor Vehicle Inspection and Registration Guide in Japan, 2004.

Figure 23.6-2 Arrangement of Major Inspection Items

Table 23.6-3 Equipment by Block No.

Block No.	Major Inspection Items	Equipment
No. 1	1) Confirmation of identity	• Vehicle data entry terminal
	2) Appearance inspection	• Safety related device inspection equipment
No. 2	1) Side slip inspection	• Side slip tester • Equalizer
	2) Brake inspection	• Brake tester
	3) Speedometer inspection	• Speedometer tester
	4) Headlight inspection	• Headlight tester
No. 3	1) Exhaust emission inspection	• Exhaust emission tester,
No. 4	1) Undercarriage inspection	• Undercarriage inspection equipment • System controller
No. 5	1) Synthetic judgment	• Documentary examination and synthetic judgment

d) Control of System
The system is fully computerized.

e) Evaluation and Recording
The pass and fail of inspection can be evaluated, and the test result can be printed out automatically. The evaluations of undercarriage inspection equipment and safety related device inspection equipment, however, should be manually transferred to the test lane computer, indicator, and printer respectively.

f) Instructions
The instruction to motor vehicle owners shall be provided by means of CRT process indicators, speakers, and so forth. CRT is colored type for easy understanding of instruction.

(4) Installation of Location for Inspection System

The proposed motor vehicle inspection system should be supplied at each of the central districts. Depending on the motor vehicle demands, in this moment, 4 locations are estimated in the study area.

23.6.3. COST ESTIMATES FOR IMPROVEMENT PLAN OF MOTOR VEHICLE INSPECTION SYSTEM

The construction cost consists of equipment, construction, maintenance, and engineering costs. The total cost excludes the land acquisition cost. The construction cost by items is shown in Table 23.6-4.

Table 23.6-4 Project Costs for the Improvement Plan of the Motor Vehicle Inspection System

No.	Investment Items	Project Cost (x 1,000 US$)
1	Equipments and Devices	14,400
2	Building	500
3	Supervision for operation	500
Total		15,400
4	Engineering Cost (Total x 10%)	1,540
5	Administration Cost (Total x 10%)	1,540
6	Contingencies Cost (Total x 15%)	2,320
Total		20,800

CHAPTER 24
Urgent Action Plan

24. URGENT ACTION PLAN

24.1. GENERAL

24.1.1. OBJECTIVES AND STUDY AREA

(1) Objectives

As mentioned previously, a total of 68 projects including the railway development projects, trunk bus development projects, road development projects and traffic management projects are recommended as the Long-Term Plan with target year 2025. Based on the implementation schedule of the Master Plan, a total of 33 projects among the Long-Term Projects are recommended as the Short-Term Plan with target year 2010 for the Urban Transport Master Plan in the Lima and Callao Metropolitan Area.

The objectives of the Urgent Action Plan are as follows, considering the characteristics and effectiveness of the Long and Short-Term Plans.

1) The Urgent Action Plan should mitigate traffic congestion without the implementation of the Long and Short-Term Plans.
2) The Urgent Action Plan should be carried out within one (1) or two (2) years.
3) The Urgent Action Plan is created as a supplemental traffic improvement project of the Short-Term Plan.

(2) Study Area for Urgent Action Planning

Based on the various traffic and transport surveys conducted in the Study, the heavy traffic congestion roads and areas are identified at the five (5) trunk radial transport axis, one (1) trunk ring transport axis, and urbanized area as shown in Table 24.1-1.

As shown in Table 24.1-1, the traffic congestion on the trunk radial and ring transport axis can fundamentally be mitigated by the Long and Short-Term Plans, however, the small areas or points within the urbanized area will not be mitigated. The Urgent Action Plan is required to mitigate the small areas or points of traffic congestions. Considering these traffic congestions and the characteristics or functions of the Long and Short-Term Plans, the study area of the Urgent Action Plan is selected covering the areas of Av. Javier Prado, Vía de Evitamiento, Av. Marina, Av. Faucett and Río Rímac. The study area of the Urgent Action Plan is shown in Figure 24.1-1.

Table 24.1-1 Relationship between the Traffic Congestion Axis and Solution Projects

Congested Transport Axis	Recommended Projects in Short-Term Plan of 2010 for the Solution of Traffic Congestion of Each Transport Axis	Recommended Projects in Long-Term Plan of 2025 for the Solution of Traffic Congestion of Each Transport Axis
1.Center to North Transport Axis	1)Trunk Bus System on Av. Tupac Amaru 2)Trunk Bus System on Panamericana Norte 3)Trunk Bus System on Av. Universitaria 4)Av. Faucett Road Improvement	1)Trunk Bus System on Av. Tupac Amaru 2)Trunk Bus System on Panamericana Norte 3)Trunk Bus System on Av. Universitaria 4)Av. Faucett Road Improvement 5)Railway on Av. Faucett (L-4)
2. Center to North-East Transport Axis	1)North-South Railway on Av. Independencia (L-1)	1)North-South Railway on Av. Independencia (L-1)
3. Center to East Transport Axis	1)Trunk Bus System on Carr. Central	1) East-West Railway on Existing Railway 2)Trunk Bus System on Carr. Central 3)Construction of Autopista
4. Center to South Transport Axis	1) North-South Railway on Av. Aviación (L-1) 2)Trunk Bus System on Panamericana Sur 3)Trunk Bus System on Paseo de la República 4) Extension Road of Paseo de la República	1) North-South Railway on Av. Aviación (L-1) 2)Trunk Bus System on Panamericana Sur 3)Trunk Bus System on Paseo de la República 4) Extension Road of Paseo de la República
5. Center to West Transport Axis	1)Trunk Bus System on Av. Venezuela 2)Trunk Bus System on Av. Brazil	1)Trunk Bus System on Av. Venezuela 2)Trunk Bus System on Av. Brazil 3)East-West Railway on Existing Railway
6. Ring Transport Axis	1)Trunk Bus System on Av. Javier Prado	1)Railway on Av. Javier Prado 2)Construction of Peripheral Road (Lima) 3)Construction of Peripheral Road (Callao) 4)Construction of Peripheral Road (1)-(5) 5)Improvement of Av. Javier Prado 6)Trunk Bus System on Av. Angamos
7. Transport Axis within the Urbanized Area	1) Av. Grau Improvement 2)Trunk Bus System on Av. Grau 3)Introduction of TDM 4)Signal Improvement	1)Av. Grau Improvement 2)Trunk Bus system on Av. Grau 3)Introduction of TDM 4)Signal Improvement

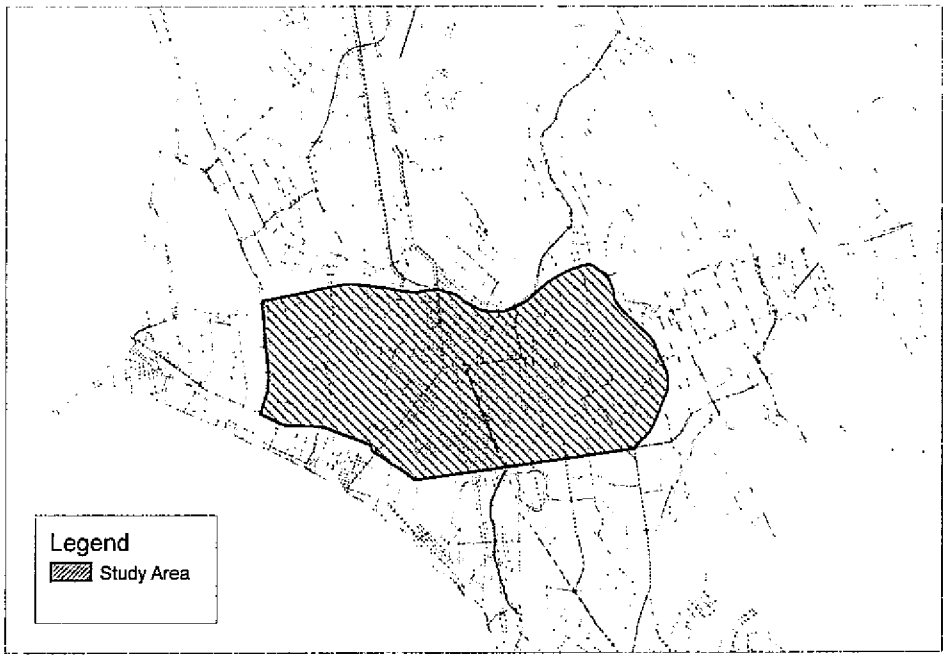


Figure 24.1-1 Study Area of Urgent Action Plan

24.1.2. PLANNING POLICY

To achieve the objectives of the Urgent Action Plan, the projects should be identified based on the following planning policies.

1) The construction completion period is within one (1) or two (2) years.
2) To improve the heavy traffic congestion on road segments or areas.
3) To avoid additional land acquisition as soon as possible.
4) To avoid re-settlement as soon as possible.
5) To ease construction.
6) Small-scale projects.

24.2. IDENTIFICATION OF URGENT ACTION PLAN

As mentioned previous, the projects of Urgent Action Plan are formulated based on the objectives of the Urgent Action Plan and the planning policy. The projects recommended by the Urgent Action Plan should be implemented by municipality's budget as soon as possible. The projects of Long and Short Term Plans are formulated based on the comparatively large scale project. On the other hand, the projects of Urgent Action Plan are formulated based on the small size projects and easy construction projects, considering the limited budget of the municipality.

24.2.1. IDENTIFICATION OF URGENT ACTION PROJECT

(1) Road Facility Improvement Projects

As a result of various traffic and transport surveys conducted in the Study, such as the traffic count survey, travel speed survey, full field reconnaissance survey, and discussion with Peruvian counterparts, a total of twenty-one (21) heavy traffic congested roads and intersections are observed in the urbanized area as shown in Table 24.2-1 This Table

presents a relationship between traffic conditions on the roads and mitigation projects recommended by the Long and Short-Term Plans.

The traffic congestion on fifteen (15) roads shown in Table 24.2-1, can be directly mitigated by the Long and Short-Term Plans. At present, the existing road infrastructure conditions for three traffic directions such as i) Lima Centro from/to North direction, ii) Lima Centro from/to West direction, and iii) Lima Centro from/to South direction are to ensure comparatively good conditions. However, Lima Centro from/to West direction is very weak. Therefore, the traffic congestion of Lima Centro from/to West traffic direction should be improved by the Urgent Action Plan. Considering these existing road infrastructures and traffic conditions, the following four (4) projects are identified as the Urgent Action Plan based on the full reconnaissance survey and its analysis.

a) UP-01 (Av. 28 de Julio Improvement Project)
b) UP-02 (Av. N. Ayllón Improvement Project)
c) UP-03 (Intersection between Av. N. Ayllón and Av. 28 de Julio Improvement Project)
d) UP-04 (Intersection Between Av. Ancash and Av. Riva Agüero Improvement Project)

Table 24.2-1 Traffic Congestion in Urbanized Areas

Traffic Congested Roads within Urbanized Area	Major Traffic Conditions	Projects Recommended to Solve Traffic Congestion in the Long and Short Term Master Plan
1) Av. Argentina	1) This road connects the Center of Lima and the Center of Callao. 2) Many bus routes are concentrated on this road. 3) Heavy traffic congestion occurs during peak hours.	1) East-West Railway project is recommended. 2) Traffic congestion is mitigated by the railway project. 3) Public transport passengers on Av. Argentina can be transferred to the railway system.
2) Av. Colonial	1) This road connects the Center of Lima and the Center of Callao. 2) Heavy traffic congestion occurs during peak hours.	1) East-West Railway project recommended. 2) Traffic congestion is mitigated by the railway project. 3) Public transport passengers on Av. Argentina can be transferred to the railway system.
3) Av. Venezuela	1) This road connects the Center of Lima and the Center of Callao. 2) Heavy traffic congestion occurs during peak hours.	1) The trunk bus system project is recommended. on this road. 2) The trunk bus project will mitigate traffic congestion on this road.
4) Av. Brazil	1) This road connects the Center of Lima and Magdalena. 2) Heavy traffic congestion occurs during peak hours.	1) The trunk bus system project is recommended. on this road. 2) The trunk bus project will mitigate traffic congestion on this road.
5) Paseo de la República	1) This road connects the Center of Lima and Miraflores.	1) The COSAC project is recommended on this road. 2) The COSAC project will mitigate traffic congestion.
6) Av. Aviación	1) This road connects the Center of Lima and Villa El Salvador. 2) Heavy traffic congestion occurs during peak hours.	1) The railway project is recommended on this road. 2) The railway project will mitigate traffic congestion on this road.

7) Vía de Evitamiento	1) This road belongs to the Panamericana. 2) Heavy traffic congestion occurs during peak hours.	1) The trunk bus system project is recommended. on this road. 2) The trunk bus project will mitigate traffic congestion on this road.
8) Carretera Central	1) This road connects the Center of Lima and the Eastern provinces. 2) Heavy traffic congestion occurs during peak hours.	1) The trunk bus system project is recommended. on this road. 2) The trunk bus project will mitigate traffic congestion on this road.
9) Av. Independencia	1) This road connects the Center of Lima and San Juan de Lurigancho. 2) Heavy traffic congestion occurs during peak hours.	1)The railway project is recommended on this road. 2) The road improvement project is recommended. 2) Railway and road improvement projects will mitigate traffic congestion on this road.
10) Av. Tupac Amaru	1) This road connects the Center of Lima and Comas. 2) Heavy traffic congestion occurs during peak hours.	1) The COSAC project is recommended on this road. 2) The COSAC project will mitigate traffic congestion.
11) Carretera Panamericana Norte	1) This road connects the Center of Lima and the Northern provinces. 2) Heavy traffic congestion occurs during peak hours.	1) The trunk bus system project is recommended. on this road. 2) The trunk bus project will mitigate traffic congestion on this road.
12) Av. Faucett	1) This road connects the Center of Callao and the Airport. 2) Heavy traffic congestion occurs during peak hours.	1) The railway project is recommended on this road. 2) The railway project will mitigate traffic congestion on this road.
13) Av. Universitaria Norte	1) This road connects Av. Javier Prado and Comas. 2) Heavy traffic congestion occurs during peak hours.	1) The trunk bus system project is recommended. on this road. 2) The trunk bus project will mitigate traffic congestion on this road.
14) Av. A. Ugarte	1) This road connects the Panamericana Norte and Av. Tupac Amaru. 2) Many bus routes and bus traffic are concentrated on this road. 3) Heavy traffic congestion occurs during peak hours.	1) The COSAC project is recommended on this road. 2) The COSAC project will mitigate traffic congestion on this road.
15) Av. Grau	1) This road is formed as the ring road of the Central Area of Lima. 2) Many bus routes and bus traffic are concentrated on this road. 3) Heavy traffic congestion occurs during peak hours.	1) The trunk bus system project is recommended. on this road. 2) The Road improvement project is recommended on this road. 3) The trunk bus and road improvement projects will mitigate traffic congestion on this road. 4) The Road improvement project is under-construction.
16) Av. 28 de Julio	1) This road connects Av. Aviación and Av. Paseo de la República. 2) Some parts of this road are occupied by vehicle parking and small shops. 3) There is a heavy traffic congestion of commercial vehicles.	----

17) Av. N Ayllón	1) This road connects the Center of Lima and the Carretera Central. 2) Some parts of this road are occupied by vehicle parking and small shops. 3) There is a heavy traffic congestion of commercial vehicles.	----
18)Av. Arequipa	1) This road connects the Center of Lima and San Isidro. 2) Heavy traffic congestion occurs during peak hours. 3) There are many traffic signals installed	----
19) IC（Av. N. Ayllón &Av. 28 de Julio）	1) At-grade intersection 2) Some parts of this road are occupied by vehicle parking and small shops. 3) There is a heavy traffic congestion by commercial vehicles.	----
20) IC（Av. Ancash & Av. Riva Agüero）	1) At-grade intersection 2) Heavy traffic congestion occurs during peak hours.	----

(2) Traffic Management Improvement Projects

In Chapter 23 of this report, a total of four (4) traffic management projects are examined as the Short-Term Action Plan. However, considering the objectives of the Urgent Action Plan, the following two (2) projects are recommended as the Urgent Action Plan.

a) UP-06 (Synchronized Signal System on Av. Arequipa Project)
b) UP-07 (License – Plate Numbering Control Project)

24.2.2. OUTLINE OF RECOMMENDED PROJECTS

The outline of each project included in the recommended Urgent Action Plan is presented in Table 24.2-2 to Table 24.2-7 respectively. The location of each project is shown in Figure 24.2-1.

Table 24.2-2 Outline of Av. 28 de Julio Improvement Project

Project Name UP-01 (Av. 28 de Julio Improvement Project)	
Project Location	See Figure 24.2-1
Existing Traffic and Road Facility Conditions	1) Total road length is about 3.0 km. 2) Some road segments are operated by one-way traffic flow. 3) The major intersections are located at Av. N Ayllón, Av. Aviación, Av. Manco Capac, and Paseo de la República. 4) The east segment of this road is occupied by many small shops. 5) The east segment of this road is congested by commercial vehicles and bus traffic.
Objectives	1) To ensure smooth traffic flows on this road and area. 2) To create a clean and safe area. 3) To create a functional road network within the urbanized area. 4) To mitigate traffic congestion within the urbanized area.
Outline of the Project	1) Improvement length = 1.0 km on the east segment of Av. 28 de Julio. 2) The 4-lane dual carriageway is paved by asphalt overlay. 3) The sidewalks will be covered by concrete blocks. 4) Lane marks and signal are improved. 5) Traffic information is improved. 6) 3-intersections are improved by at-grade type. 7) The project cost is estimated at about US$ 1.35 million.

Table 24.2-3 Outline of Av. N Ayllón Improvement Project

Project Name UP-02 (Av. N Ayllón Improvement Project)	
Project Location	See Figure 24.2-1
Existing Traffic and Road Facility Conditions	1) Total road length is about 5.0 km. 2) 4-lane carriageway 3) The major intersections are located at Vía de Evitamiento,, Av. Santa Rosa, Av. Las Torres, Av. Arriola, Av. Circunvalación, Av. México, Av. 28 de Julio, and Av. Grau. 4) A closed point of Av. 28 de Julio on this road is occupied by many small shops. 5) The Intersection of Av. 28 de Julio on this road is congested by commercial vehicles and bus traffic.
Objectives	1) To ensure smooth traffic flows on this road and area. 2) To create a clean and safe area. 3) To create a functional road network within the urbanized area. 4) To mitigate traffic congestion within the urbanized area.
Outline of the Project	1) Improvement length = 5.0 km on east segment of Av. 28 de Julio. 2) The 4-lane dual carriageway is paved by asphalt overlay. 3) The sidewalks will be covered by concrete blocks. 4) Lane marks and signal are improved. 5) Traffic information is improved. 6) 5-intersections are improved by at-grade type. 7) The project cost is estimated at about US$ 6.75 million.

Table 24.2-4 Outline of Intersection between Av. N. Ayllón and Av. 28 de Julio Improvement Project

Project Name UP-03 (Intersection between Av. N Ayllón and Av. 28 de Julio Improvement Project)	
Project Location	See Figure 24.2-1
Existing Traffic and Road Facility Conditions	1) At-grade intersection. 2) A closed point of Av. 28 de Julio on this road is occupied by many small shops. 3) The intersection is congested by commercial vehicles and bus traffic. 4) Traffic flows in the intersection are complicated. 5) The intersection is observed as a traffic bottleneck on Av. 28 de Julio.
Objectives	1) To ensure smooth traffic flows on this road and area. 2) To create a clean and safe area. 3) To mitigate traffic congestion within the urbanized area.
Outline of the Project	1) Improved from at-grade intersection to grade separated intersection. 2) Traffic signals are improved. 3) Traffic information systems are improved. 4) The project cost is estimated at US$ 4.4 million.

Table 24.2-5 Outline of Intersection between Av. Ancash and Av. Riva Agüero Improvement Project

Project Name UP-04 (Intersection Between Av. Ancash and Av. Riva Agüero Improvement Project)	
Project Location	See Figure 24.2-1
Existing Traffic and Road Facility Conditions	1) At-grade intersection. 2) Traffic congestion is caused by small truck vehicles. 3) The widths of the roads are comparatively narrow. 4) The intersection is observed as a traffic bottleneck on Av. Bolivar.
Objectives	1) To ensure smooth traffic flows on this road and area. 2) To create a clean and safe area. 3) To mitigate traffic congestion within the urbanized area
Outline of the Project	4) Improved from at-grade intersection to grade separated intersection. 5) Traffic signals are improved. 6) Traffic information systems are improved. 7) The project cost is estimated at US$ 4.4 million.

Table 24.2-6 Outline of Synchronized Signal System on Av. Arequipa Project

Project Name UP-05 (Synchronized Signal System on Av. Arequipa Project)	
Project Location	See Figure 24.2-1
Existing Traffic and Road Facility Conditions	1) Av. Arequipa is operated by a dual traffic system. 2) Av. Petit Thouars is operated by a one-way traffic system (inbound). 3) Av. Arenales is operated by a one-way traffic system (outbound). 4) The heavy traffic congestion on these roads is caused by buses and cars.
Objectives	1) To ensure smooth traffic flows. 2) To create a functional road network 3) To mitigate traffic congestion.
Outline of the Project	1) Improvement length on Av. Arequipa is 6.8 km. 2) Improvement length on Av. Petit Thouars is 6.1 km. 3) Improvement length on Av. Arenales is 4.8 km. 4) Improvement of traffic signal system, from individual system to synchronized system, on Av. Arequipa. 5) Improvement of traffic signal system, from individual system to synchronized system, on Av. Petit Thouars. 6) Improvement of traffic signal system, from individual system to synchronized system, on Av. Arenales. 7) The project cost is estimated at US$ 9.210 million.

Table 24.2-7 Outline of License - Plate Numbering Control Project

Project Name UP-06 (License – Plate Numbering Control Project)	
Project Location	The area that introduced the “Vehicle Plate Number Control System” is covered by Av. Javier Prado, Av. Evitamiento, and Río Rímac.
Existing Traffic and Road Facility Conditions	The heavy traffic congestion within the area is caused by cars and buses.
Objectives	1) To decrease the traffic demand in the study area of the Urgent Action Plan. 2) To mitigate traffic congestion in the study area of the Urgent Action Plan..
Outline of the Project	1) Private cars are controlled within the study area depending on the vehicle plate number. 2) Public transport is not controlled. 3) The detailed methodology of this project is described in Chapter 23 ”Traffic Management Plan”. 4) Project cost is estimated at US$5.54 million

24.2.3. ESTIMATED PROJECT COST

The construction of the projects is estimated to refer to the construction costs of the previous projects planned by the IMP cost and other related authorities, and the construction cost, including direct construction cost and indirect construction cost. The results of the project cost for each project of the Urgent Action Plan are shown in Table 24.2-8, as well as the project cost including the following.

1) Construction cost (A)
2) Contingency (A)*15%
3) Administration cost (A)*10%
4) Engineering cost (A)*10%

Table 24.2-8 Project Cost

Project Name	Size	Project Cost (million US$)
UP-01 Av. 28 de Julio Improvement Project	1.0 km	1.35
UP-02 Av. N. Ayllón Improvement Project	5.0 km	6.75
UP-03 Intersection Improvement Project (Av. N Ayllón and Av. 28 de Julio)	1 Vol.	4.40
UP-04 Intersection Improvement Project (Av. Ancash and Av. Riva Agüero)	1 Vol.	4.40
UP-05 Synchronized Signal System Project (Av. Arequipa)	17.7 km	9.21
UP-06 License Plate Numbering Control Project	1 Unit	5.54
Total		27.25

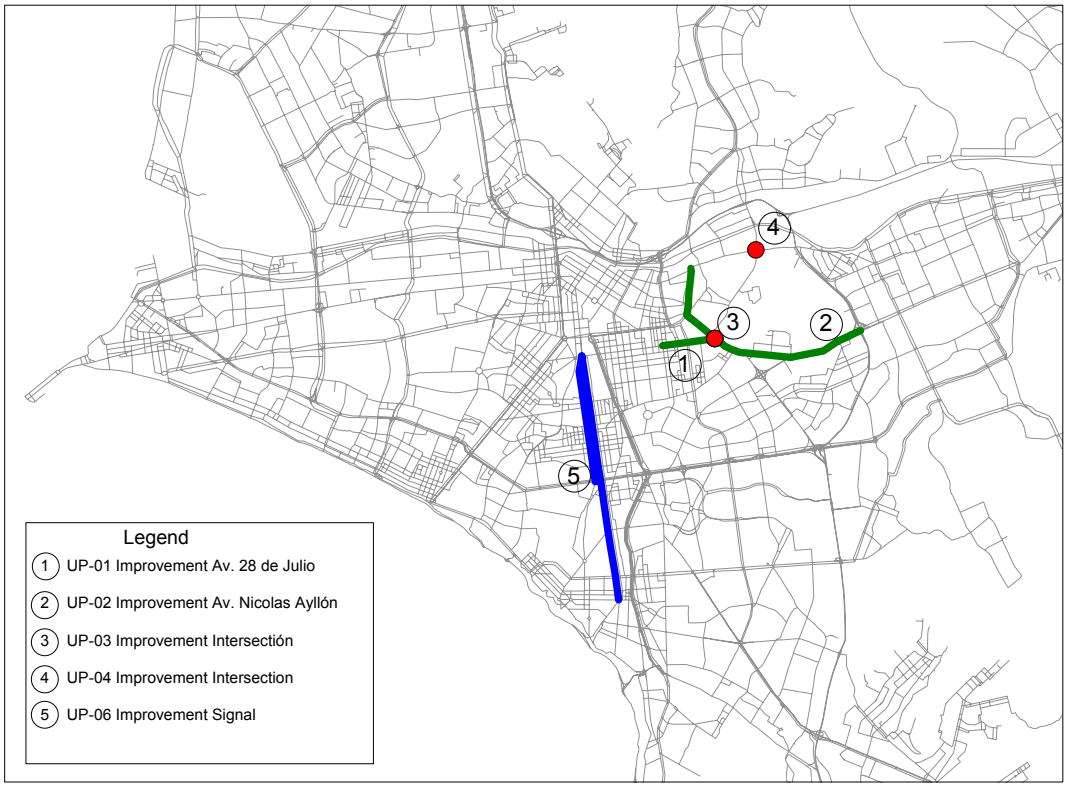


Figure 24.2-1 Location of Each Project

24.2.4. EVALUATION OF URGENT ACTION PLAN

The Urgent Action Plan consists of the following 6 small projects.

1) Av. 28 de Julio improvement project (L=1.0 km).
2) Av. N Ayllon improvement project (L=5.0km)
3) Intersection improvement project (Av. N Ayllo and Av. 28 de Julio)
4) Intersection improvement project (Av. Ancash and Av. Riva Aguero)
5) Synchronized signal improvement project on Av. Arequipa
6) License- Plate Numbering Control project

The tangible evaluation of each project mentioned above is very difficult, considering the characteristics and function of the project, and they are very small projects. Therefore, the mainly intangible benefit and social impacts evaluations are examined in this section based on the results of various traffic survey conducted. The results of examination are presented in Table 24.2-9.

Table 24.2-9 Intangible Benefit and Social Impacts of Each Project

Name of Project	Existing Conditions	Benefit and Social Impacts
1) Av. 28 de Julio improvement	1) Many vehicles parked on the road 2) It is very difficult to pass the road 3) Traffic volume is very few 4) Traffic capacity is very low.	1) The trunk road network in central area can be completed. 2) The traffic function of road can be recovered. 3) Smooth traffic flows can be ensured 4) The heavy traffic congestions can be mitigated from center to eastern direction. 5) The traffic capacity in central area can be increased 6) To decrease the traffic congestion on Av. Grau and Av. 28 de Julio. 7) Trunk ring road can be ensured 8) Travel time can be decreased 9) Travel speed can be increased 10) Re-development plan in central area can be promoted.
2) Av. N Ayllon improvement	1) Many vehicles parked on the road 2) It is very difficult to pass the road 3) Traffic volume is very few 4) Traffic capacity is very low.	1) The road can be formed at trunk road network in central area. 2) The traffic function of road can be improved. 3) Smooth traffic flows can be ensured 4) The heavy traffic congestions can be mitigated from center to eastern direction. 5) The traffic capacity can be increased 6) To decrease the traffic congestion on Av. Grau and Carr. Central. 7) Re-development plans in central area can be promoted. 8) Increased traffic volume on Carr. Central
3) Intersection improvement (Av. N Ayllo and Av. 28 de Julio)	1) Signalized intersection. 2) The heavy traffic congestion	1) Traffic capacity can be increased at intersection 2) Smooth traffic flows can be ensured 3) Heavy traffic congestion can be mitigated. 4) Travel speed can be increased 5) Travel time can be decreased

4) Intersection improvement (Av. Ancash and Av. Riva Aguero)	1) Signalized intersection. 2) The heavy traffic congestion	1) Traffic capacity can be increased at intersection 2) Smooth traffic flows can be ensured 3) Heavy traffic congestion can be mitigated. 4) Travel speed can be increased 5) Travel time can be decreased
5) Synchronized signal improvement on Av. Arequipa	1) There are many signal intersection 2) The heavy traffic congestion on all day long.	1) Smooth traffic flows can be ensured 2) Travel speed can be increased 3) Travel time can be decreased 4) The heavy traffic congestion can be mitigated.
6) License- Plate Numbering Control	1) The heavy traffic congestions are occurred on trunk roads. 2) The heavy traffic congestions concentrated on peak hours. 3) The growth ratio of passenger car is very rapidly. 4) Widening of existing road is very difficult.	1) The heavy traffic congestions can be mitigated 2) Travel speed can be increased 3) Travel time can be decreased 4) Refer to 23.4.2 in this report.

CHAPTER 25
Institutional and Operational Organization for the Trunk Bus Operation System

25. INSTITUTIONAL AND OPERATIONAL ORGANIZATION FOR THE TRUNK BUS OPERATION SYSTEM

25.1. OPERATIONAL ORGANIZATION FOR TRUNK BUS SYSTEM

25.1.1. EXISTING BUS OPERATION

(1) General Facts

The bus is the major public transport tool in the Lima and Callao Metropolitan Area. According to the person trip survey in 2004, the bus passenger's share in the mode accounts for 77% of the total motor vehicle use.

A summary of the existing bus operation in the Metropolitan Area of Lima and Callao is shown in Table 25.1-1. The characteristics of the bus operation in the study area are:

a) Too many bus fleets on the roads
b) Too many companies in operation
c) Too many routes
d) Long length of operation
e) Operation with superannuated vehicles

These characteristics show a weak control of the public authorities over the bus routes and bus operation. Basically, companies do not own buses and the average number of bus fleets owned varies between two and three. This situation makes the competition severe and there are hardly any profits as a result of the old age of the vehicles. The share of the population who is involved in the transport business in the Municipality of Lima accounts for approximately 20% of the total. This chaotic situation is created by the weak control of the public transport administration.

Table 25.1-1 Characteristics of the Existing Bus Operation

Items	Unit	Lima	Callao
Number of Bus Fleets	Vehicle	24,700	7,100
Number of Bus Companies	-	1,196	150
Number of Routes	No.	431	263
Route Length	km	64.3km	
Number of Roads with 100 or more bus routes	No.	6	
Age of Omnibus	years	20.2	
Age of Microbus	years	18.2	
Age of Combi	years	15.5	

Source: Study Team

(2) Bus Operating Companies

In order to grasp the significance of the bus companies in operation, the study team conducted interviews and questionnaire surveys to several companies. The points of the survey are as follows:

a) History of the entity
b) Structure of the capital

c) Figure in operation
d) Tariff problems
e) Maintenance of the bus fleet
f) Training of employees
g) Traffic safety
h) Environmental problems
i) Opinion regarding bus system improvement
j) Request for Municipality

According to the survey, most companies have been in operation for approximately 20 years and most of the companies do not own bus fleets. Although renting of registrations is commonly seen, they believe that this situation should be improved. Some operation routes are extremely long with more than 80km, which is a result of the poor administration of the municipalities. Because of the keen competition, they doubt that the companies, whose fleets operate with few passengers, could be profitable. Many of the companies have shown interest towards new projects such as the COSAC project and some of them are already in preparation for the necessary application to the COSAC projects. Most of the companies complain that the regulations tend to change too soon and that the annual route permits disturb their marketing and management strategy. They request that the duration of the route permits be at least five years.

Table 25.1-2 shows a summary of the operation of the companies surveyed.

Table 25.1-2 Summary of the Operation of Selected Bus Companies

Nombre de la Compañía	Ruta	Origen y Destino	Número de pasajeros por Dia	Longitud de ruta (km)	Frecuencia por dia (Minutos)	Distancia Promedio (km)	Flota de Bus (unidades)	Número de Empleados	Nº de vueltas	Horario	Tarifa
Aleluya Transportes S.A.C.	IO-76	Callao - Lima- Ventanilla- Lima - La Victoria	466	76	5	304	60	20	4	5 am-9pm	S/1.20 - 2.80
	IO-14	Ventanilla - Surco	183	75	6	300	40	20	4	5 am-9pm	S/ 1.20 - 2.80
E.T. San Martin 36 S.A.	NM 12	San Martin - S. de Surco	1,066	74	5	222	80	19	3	5:30am-11:30pm	S/ 1.20
E.T.Salamanca - Parral	EO 40	Ate - Carabayllo	9,000	72	5	216	70		3	5:30am-11:00pm	S/ 1.20
	NM 43A	Ate - Carabayllo		S/. 77.00							
ETUPSA 73	SO 24	Pachacamac - Los Olivos	970	98	6	294	87	51	3	5:15am-00hrs	S/ 1.20
	NO 07	San Matin de Porres-Villa Maria del Triunfo	1050	91	6	273	83	51	3	5:15am-00hrs	S/ 1.20
	IO 49	Pachacamac - Callao	950	88	6	264	63	51	3	5:15am-00hrs	S/ 1.20
Translima S.A.	NCR 01	Carabayllo - Lima	162	42	2	147	44	29	3 1/2	5:00am - 11:00 pm	S/ 1.20
	SCR 08	Chorrillos - Lima	240	46	2	184	80	29	4	5:00am - 11:00 pm	S/ 1.20
	SM 10	Chorrillos - Santa Anita	192	75	4	150	44	29	2	5:00am - 11:00 pm	S/ 1.20
	SM 18	Chorrillos - Carabayllo	236	117	4	234	131	29	2	5:00am - 11:00 pm	S/ 1.20
	IO 20	Callao - Villa Maria del Triunfo	297	82	5	246	71	29	3	5:00am - 11:00 pm	S/ 1.20
	NM 29	Carabayllo - San Juan de Miraflores	405	121	4	302	109	29	2 1/2	5:00am - 11:00 pm	S/ 1.20
	NM 47	Carabayllo - Pueblo Libre	320	63	3	252	89	29	4	5:00am - 11:00 pm	S/ 1.20
E.T. Santa Catalina S.A.	EO-18	S. J. de Lurigancho - V. M. del Triunfo	180	75		187.5	73		2 1/2	5:20am - 00hrs	S/ 1.20
	EO - 101	Villa Maria del Triunfo - S.J. de Lurigancho	400	78		195	76		2 1/2	5:20am - 00hrs	S/ 1.20
	EO-17	S.J.de Lurigancho - Villa el Salvador	450	84		210	81		2 1/2	5:20am - 00hrs	S/ 1.20
E.T.Unidos Chama S.A.	SO 04	V. M. del Triunfo - S. J. de Lurigancho	670	80	5	240	62	35	3	5:00am - 10:00 pm	S/ 1.20
	SO 26	Chorrillos - Chorrillos		123							
	IO 96	Callao - Villa el Salvador		63							
E.T. Especial Solidaridad S.A.	EM-02	San Juan de Lurigancho-S.de Surco	1000	83	2	249	83	10	3	5:00am - 00hrs	S/ 1.20
	NO-31	Carabayllo - S.J.de Lurigancho	650	78	2	234	80	10	3	5:00am - 00hrs	S/ 1.20
	EM-34	San Juan de Lurigancho - Los Olivos		67							
E.T. Urbano Linea 4 S.A.	SO-08	Chorrillos - San Juan de Lurigancho	833	68	5	272	53	12	4	5:00am - 00hrs	S/ 1.40
Cooperativa Sol y Mar Ltda	IM-31	Vellavista - Ate		59	1.5	210	400	22	3	5:00am - 00hrs	S/ 1.40
	IM-19	Ventanilla - Lima		60							
	IM-20	Lima - Ventanilla		60							
	IM-41	Callao - Ate		79							
E.T. Sol de Oro S.A.	EM-21	Ate - Los Olivos		92			112	10	3	5:00am-00hrs	S/ 1.20 - S/ 1.60
E.T. y Servicios 45 S.A.	IO-46	Los Olivos - San Juan de Lurigancho	227	113	5	339	109	13	3	5:15am - 00hrs	S/ 1.00
E.T.Luis Banchero Rossi S.A.	EO-24	Rimac - Villa el Salvador	400	64	4	128	40	12	4	4:00am - 10pm	S/ 1.20
	EO-64	Surco - S.J.de Lurigancho	733	51	4	204	61	12	4	4:00am - 10pm	S/ 1.00
	SO-11	V.El Salvador-S.J.de Lurigancho	700	26	4	78	81	12	3	4:00am - 10pm	S/ 0.5
E.T.y Servicios Nueva America S.A.	NM-33	Carabayllo - San Juan de Miraflores	400	111	5	147	80	280	3	5:00am - 00hrs	S/ 1.20
E.T.y Servicios San Pedro S.A.	SO-28	Chorrillos - S.J.de Lurigancho	550	71	5	96.5	72	5	2 1/2	5:00am - 11pm	S/1.20
E.T.José Leal Cocharcas	EO-48	Puente Piedra - El Agustino	145	92	6	276	65	4	3	5:40am - 10:40pm	S/ 1.20
E.T.Los Laureles S.A.	SO-13	V.M del Triunfo - San Juan de Lurigancho	700	88	5	106.25	86	8	2 1/2	5:30am - 9:30	S/ 1.20
	IO-57	La Punta - Pachacamac	850	85	5	340	72	8	4	5:00am - 10pm	S/ 1.40
E.T. El Triunfo S.A.	SM-11	Villa el Salvador - Lima		68							
E.T. Santísima Virgen del Carmen S.A.	IO-81	Callao - Santa Anita		55							

25.1.2. PROBLEMS ADDRESSED IN THE CURRENT BUS SYSTEM

The Counterpart Meetings, the Steering Committee and the Public Sector Consulting Seminars of the Master Plan Study have drawn the following problems in the current bus system. Most of the problems addressed have been discussed and mentioned repeatedly in the past study reports.

1) Bus Company
   a) Old aged bus fleets
   b) Low maintenance of bus fleets
   c) Too many companies
   d) Too many small buses
   e) Low profitability as a result of low fares and keen competition on major roads
2) Bus operation
   a) Too many operations on roads
   b) Too many bus routes and long travel times for public transport passengers
   c) Disorderly loading and unloading
   d) Unauthorized bus operation
   e) Long distance routes
   f) Too many destinations from origin
3) Poor bus facilities
   a) Busway
   b) Bus stops
   c) Bus terminals
4) Traffic congestion
5) Many public transport traffic accidents
6) Problems of air and noise pollution
7) Weak transport operation control on behalf of the public administration

In addition to addressing the abovementioned problems in the Counterpart Meetings, Steering Committee, Public Consultation Seminars, etc., the Study Team held three Stakeholders Meetings, with the help of Counterparts, in an attempt to obtain additional feedback from the existing public transport operators and citizens.

1) Stakeholder meeting with bus companies on January 12th,2005
2) Stakeholder meeting with citizens of Callao on January 18th, 2005
3) Stakeholder meeting with citizens of Villa El Salvador on January 24th, 2005

These workshops were held for the following three reasons; 1) to explain the study results of the existing transport situation, 2) to seek the opinions of what should be improved and 3) to discuss what they could do as a cluster of the transport system. The following problems were presented by the stakeholders.

1) Citizen as a passenger
   They recognize the bad customer service of drivers and collectors, dangerous driving, long commuting times, etc., as problems. On the other hand, while they are paying fees and taxes, they do not fully recognize themselves as the customer. They do not try to eliminate bad operators and useless public administration through their public opinion.

2) Problems of bus companies
Basically, bus companies are not satisfied with the public administration. They consider that there is no concrete regulation, guideline and instruction for the management of the organization. While complaining about the public administration, it is evident that bus operators do not consider passengers as their customers. There is no idea of customer service and safe driving.

3) Problems with public organizations

a) Weak and unclear control of public transport operation

- Keen competition is a result of the weak control and approval
- Weak instruction to improve the problem

b) No cooperation between the municipalities and provinces that compose the metropolitan area.

- Route permits for the route that operates in other municipalities or provinces
- No supervising authority of the transport administration for the whole metropolitan area

c) No cooperation between vertical organizations within the municipality.

25.1.3. IMPLEMENTATION OF TRUNK BUSWAY SYSTEM

(1) Trunk Busway

1) Characteristics of the Trunk Busway System

The Trunk Busway system is a city bus system that works in a similar way to the train system, where local services feed into a central network. Trunk Busway systems have been implemented all over the world, in countries including Brazil, Colombia, Ecuador, Mexico, United States, Canada, Australia, New Zealand and Indonesia, since they provide overall cost-effective and efficient public transport systems. The Trunk Busway was first developed in the 1970s in Latin America, where planners and officials were looking for a cost-effective solution for local transport problems. Latin American developers of the Trunk Busway devised a system that had the overall objective to move more people rather than to move vehicles, and to ensure that public transport began to cater for the wants and needs of the local community.

Characteristics of the Trunk Busway System

a) Flexible, permanently integrated high performance system with a quality image and a strong ID
b) Package of components appropriate for the present and the future

- Markets served
- Physical environment

Key Attributes

a) Speed
b) Reliability
c) Identity and image
d) Contextual design

BRT System Components

a) Vehicles
b) Running Ways
c) Stations & Terminals
d) Systems

e) Service Plan

Stops, Stations and Terminals

a) 400~1,600 meters station spacing
b) Permanent, substantial, weather protected
c) Amenities, passenger information
d) Good pedestrian, local bus, auto access
e) Safe, secure
f) Convey identity and image
g) Design integrated with surroundings

Fare Collection

a) Needs to facilitate multiple stream boarding
    - Off-board (preferred)
    - On-board multi-point payment
    - Significant pass utilization
b) Integrated with, but may not be the same as for, the local bus system.

In summary, the implementation of the Trunk Busway system is expected to reduce travel time, traffic congestion, and air pollution and to contribute to improve urban planning, especially commercial terminal development.

2) Examples of the Trunk Busway in Other Cities

Table 25.1-3 shows the summary of several trunk busway data in Latin American countries.

Table 25.1-3 Basic Busway Data in Latin America

SAO PAULO, BRAZIL											
Name of busway	Length	Segregated length	No. of lanes by direction	Volume	Pass. Peak hour Per direction	Commercial Speed	No. of stops	No. of Terminals	No. and Type of vehicles *		No. of Bus lines Operating
Unit	(Km.)	(Km.)	Number	Pass/day	pphpd	Km/h	number	number	number		number
Santo Amaro/9 de Julho	14. 6	10.8	1	196,202	17,658	16	23	2	-		25
Vila Nova Cachoeirinha	11.0	↑= 10.500 ↓= 7.400	1	38,247	3,442	16	↑= 23 ↓= 14	11	93		5
Paes de Barros	3.6	-	1	39,902	3,120	17	7	1	-		-
Sao Mateus/ Jabaquara	33	30. 0	1	206,778	21,600	22	110	9	189		10
CURITIBA, BRAZIL											
Boqueirão	10.63	10.63	1	90,663	7,552	18.75	16	3	33	Biart	2
Norte	9.3	9.3	1	86,412	7,198	18.32	14	3	40	Biart	1
Sul	10.08	10.08	1	156,231	13,014	18.61	18	3	85	Biart	3
Leste	12.04	12.04	1	89,476	7,453	18.82	24	4	45	Artic	4
Oeste	8.25	8,.5	1	46,023	3,834	18.72	16	2	24	Artic	2
Circular Sul	14.09	14.09	1	63,011	5,240	19.9	19	1	20	Biart	2
PORTO ALEGRE, BRAZIL											
1 Perimetral	6.4	-	4	147,288	11,783	6.77	14	0	100	C P	41
2 Perimetral	7.7	-	↑3 and ↓2	112,100	8,968	9.82	23	1	C P	19	
3 Perimetral	10.4	-	↑2 and ↓3	69,338	5,547	11.27	28	0	C P A	6	
Borges de Medeiros	7.7	-	3	101,100	8,088	17.43	13	1	ND	C P	36
João Pessoa/Bento Gonçalves	8.8	-	↑3 and ↓2	178,863	14,309	19.06	13	0		C P	29
Corr. Exclusivo João Pessoa/Bento Gonçalves	-	5.2	1	122,563	9,805	14.73	9	1	450	C P A	
Oswaldo Aranha/Protásio Alves	8.2	-	2	59,425	4,754	-	29	0		C P	19
Corr. Exclusivo Oswaldo Aranha/ Protásio Alves	-	8.2	1	131,788	10,543	14.67	29	1	131	C P A	
Independência/ 24 de Outubro/Plínio	5.4	1.1	3	193,663	15,493	10.22	18	1	ND	C P	10
Farrapos/Sertório	9.1	-	2	110,538	8,843	18.9	23	0	ND	C P	34
Corr.. Exclusivo Farrapos	-	3.8	1	134,700	10,776	14.18	8	3		C P A	
Assis Brasil	5.8	-	2	140,38	11,267	-	25	0	48	C P	36
Corr. Exclusivo Assis Brasil	-	5.8	1	151,863	12,149	10.29	25	1		C P A	
Cascatinha	2.8	-	2	17,800	1,424	-	3	0	ND	C P	10
Corr. Exclusivo Cascatinha	-	2.8	2	40,313	3,225	14.82	3	0		C P	
Oscar Pereira	2.9	-	2	30,638	2,451	17.4	5	0	ND	C P	9
QUITO, ECUADOR											
Trole	11	11	1	180	N.A.	20-25	39	2	54	A	3
BOGOTA, COLOMBIA											
Troncal Ave. Caracas	16	16	2	372.658	36.5	18	32	0	630	C	200
Calle 80	9.9	0	3	309.573	30,405	12	#	0	500	C B M	N.A.
Av. Amercias	9.8	0	3	332,454	32,647	15	#	0	N.A.	C B M	N.A.
Carrera 10	3.5	0	3	295,988	29,066	<10	#	0	N.A.	C B M	N.A.
Calle 68	12.9	0	2	191,008	18,757	<10	#	0	N.A.	C B M	N.A.
Carrera 7	3.2	0	3	108,523	10,657	10	#	0	N.A.	C B M	N.A.

*; C=Conventional, P=Padron, A=Articulated, B=Small buses, M=Minibus

3) Proposed Route Network

The Master Plan proposes 15 trunk busway routes in the Long-Term Transport Master Plan, which target year is 2025, with a mass transit bus system.

The 15 routes are the following:

a) Av. Grau
b) Carretera Central
c) Av. Venezuela
d) Paseo de la República
e) Av. Nestor Gambetta
f) Av. Brasil
g) Av. Angamos
h) Av. Universitaria Norte
i) Av. Panamericana Norte
j) Av. La Molina
k) Av. Panamericana Sur

l) Av. Universitaria Sur
m) Av. Javier Prado
n) Av. Tomas Valle
o) Av. Callao-Canta

Figure 25.1-1 shows the proposed trunk busway network.

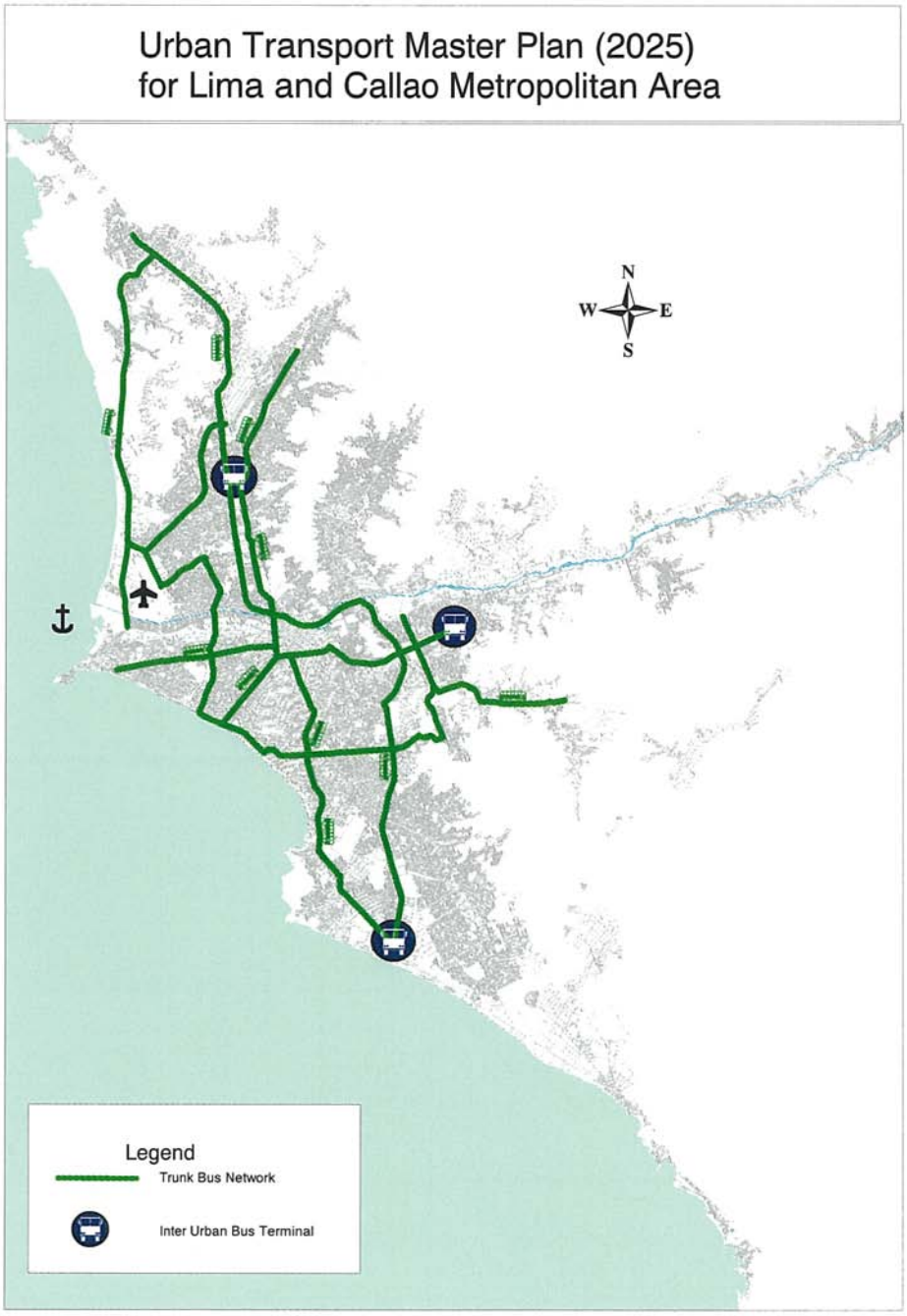


Figure 25.1-1 Location of Recommended Trunk Bus Routes

4) Future Demand and Business Opportunity for Buses

This section analyzes the size and opportunity of the public transport business based on the demand forecast.

The demand for public transport in 2004 was 9,365,000 trips per day. Assuming that the unit price of a trip is two soles, the daily expense for public transport is estimated at 18.7 million soles. This daily figure is converted into the annual figure of 6,826 million soles by simply multiplying it by 365 days. This figure amounts to 20% of the GRDP for tertiary industries, which is 35,050 million soles.

According to the demand forecast for 2025, although the modal share of trips for public transport decreases from 77.3% in 2004 to 70.1%, the total number of public transport trips increases by 3,080,000 from 9,365,000 in 2004 to 12,445,000. The forecast of the GRDP in 2025 for the tertiary industries is 83,397 million soles. If we simply calculate the annual expense for the public transport by using the same two soles as the unit price, the calculated figure of 9,089 million soles is 11% of the GRDP for tertiary industries. However, even though we are considering inflation, the public transport mode in 2025 includes the metro network and it is safe to say that the business environment for the bus service could be considered tough.

(2) Issues to be Considered for the Project

Transport projects require huge investment costs, debts that need to be repaid by the future tax revenue, which will be the financial burden for the next generation. Therefore, financial sustainability, fairness among generations and cost-effectiveness of the project need to be considered when making projects.

Also, introducing a mass transit system will cause the re-organization of the existing bus system and might cause employment issues. It is quite important to consider that the negative social impact that might be expected needs to be taken care of and minimized (this issue will be discussed later).

25.1.4. ORGANIZATION ISSUES

(1) Public and Private Partnerships in Transport

1) Clusters for the Project

There are many organizations that conform the public transport clusters in the Metropolitan Lima and Callao Area (Table 25.1-4). For the transport project there are many schemes in which each cluster plays each role. The scheme depends on the logic of the government towards public transport. It also reflects the relationship between the central government and the local government, as well as the public and private role in public transport. Roughly, there are three types of clusters in public transport.

a) Public organizations play a major role based on the public budget. This idea is based on the theory that public transport is one of the minimum basic infrastructures that the municipality needs to provide for the public, even if it is not a profitable project. Germany is a typical example of this idea.
b) Public organizations offer special incentives, such as the development right to the operating entity, instead of offering subsidies and the operation needs to be profitable. The railway project in Hong Kong is a typical example.
c) Governmental assistance is limited and basically private organizations manage it as an enterprise. This scheme is typically seen in the Japanese railway sector.

Some western countries, such as England and U.S.A., whose logic used to be a) above, have gradually started to shift to b) because of the fact that they have suffered budget limitations. Public Private Partnership (PPP) is one of the most common ways to implement public infrastructure projects based on theory b) above. The next section will verify the definition of the PPP and risk & responsibility of the participants of the scheme.

Table 25.1-4 Public Transport Clusters in Lima and Callao

Public		
Central Government		
	MTC	DGCT/OPP
	MEF	SUNAT/PROINVERSION
	FONAM	
	CONAM	
	SUNARP	
	PNP	
	SEDAPAL	
Local Government		
	MML	IMP/DMTU/EMAPE/CEPRI/AATE/PROTRANSPORTE/INVERMET/SAT
	MPC	DGTU/DGDU/FINVER
	Neighboring Provinces	
	Districts	
Consejo		
	CTLC	
	CNSV	
International Organizations		
	IBRD	
	IDB	
	IFC	
	MIGA	
	JICA	
	JBIC	
	Other foreign governments	
Private		
Residence		
Operators of public transport		
Operators of related business		
Investors		
Construction Company		
Consultants		

2) Role, Risk and Responsibility of Public and Private Partnerships

Figure 25.1-2 shows the interaction amongst these stakeholders. The Government allows the provision of the service to the users and receives taxes in exchange. The Government regulates the actions of the concessionaires and provides necessary circumstances such as regulations. The Government might also provide capital and guarantees depending on the condition of the concession. In exchange, the concessionaires comply with the contract and agreed performance and assume certain risks. Furthermore, the concessionaires provide the infrastructure and service to the users and the users pay tolls or fees for it. Finally, the concessionaires receive loans from investors and pay them interests and repayment.

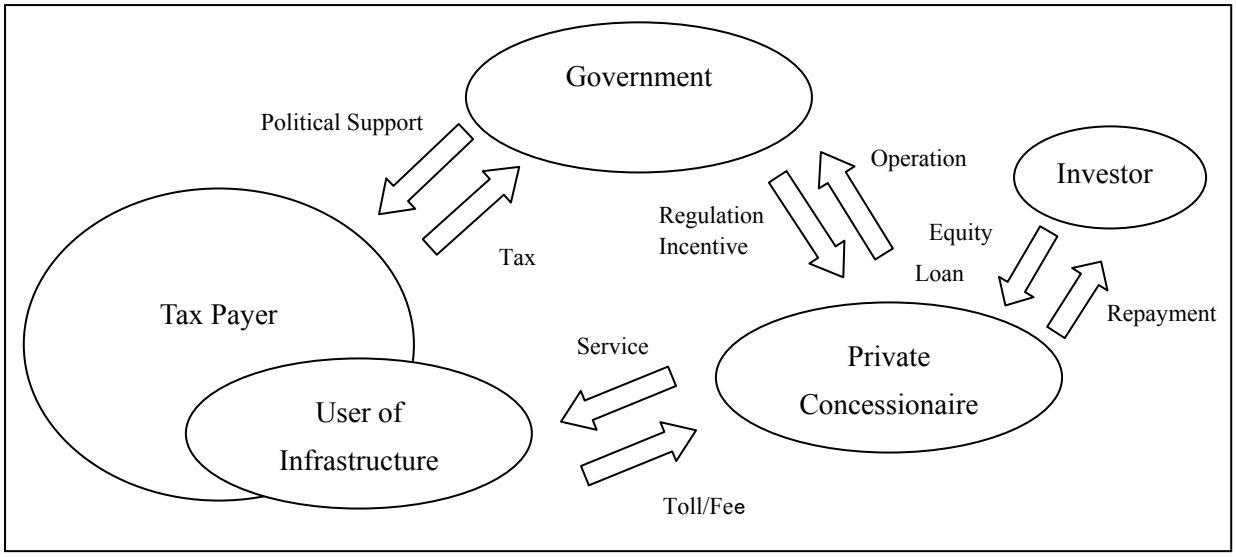


Figure 25.1-2 Stakeholders in PPP and its Interactions

During the process of structuring PPP projects, the analysis, assessment and definition of the following key factors should be considered.

a) Needs, level and form of government support
b) Fiscal impact of the project
c) Distribution of benefits among those affected by, or stakeholders of the project
d) Risks of the estimated economic and financial benefits
e) Performance indicators for the measurement of the future achievement of objectives and the application of the proper corrective actions.

The main idea of the PPP is not only to solve funding problems but also to provide competitive engineering skills and effective management skills of private organizations into the entire life cycle of the public infrastructure project.

Based on the partnership concession, risks will be distributed among the public and private organizations. To maximize its benefit from the project, the private organization will seek "value for money", an effective and high quality service. The public organization could provide this value for money service to citizens without a financial burden to the budget.

It is important to bear in mind that with the implementation of the PPP scheme public responsibility continues to exist, or becomes even higher in some ways. This is due to the fact that the PPP is based on the concession where the public organization needs to take responsibility to provide necessary institutional and regulation circumstances to the concessionaire. If the public organization fails to provide this circumstance, the concession scheme will collapse. The PPP is not a dreamland to release budget restrictions and establishing a concrete concession and execution of each role is inevitable.

Figure 25.1-3 shows the typical organization scheme and co-relations among the transport clusters in the scheme.

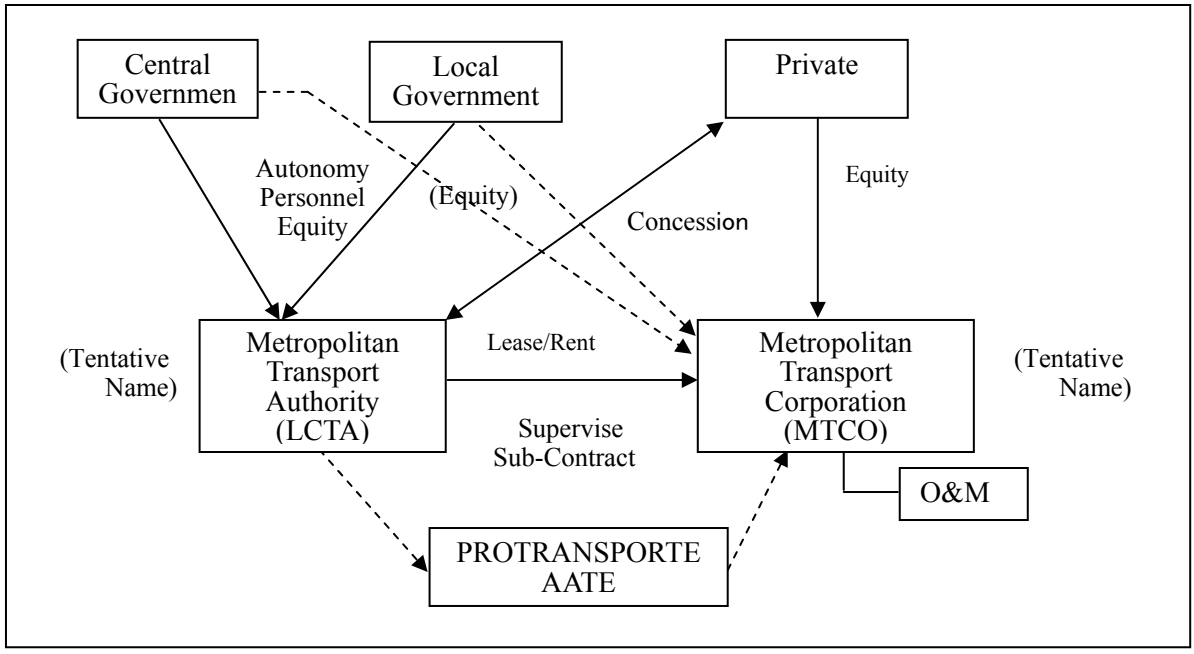


Figure 25.1-3 Organization Scheme and Co-Relations among the Transport Clusters

As mentioned, risk allocation is the base to establish a balanced partnership between public and private entities. Partnership aims to maximize benefits of each participant by risk allocation. Participants can also cooperate to minimize overall risks. Therefore, risk analysis is the core and primary object for the public private partnership. Figure 25.1-4 shows the classification and interrelation of the major risks in the PPP scheme.

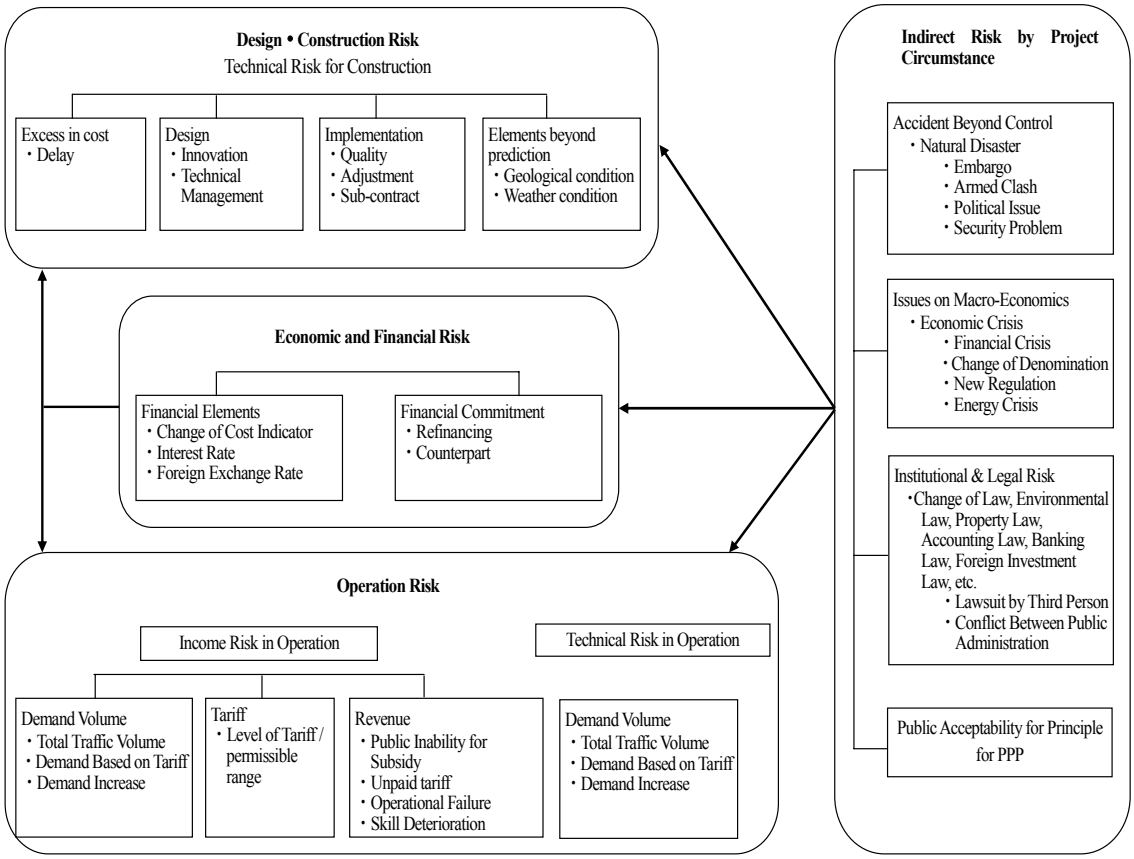


Figure 25.1-4 Classification and Interrelation of Major Risks in the PPP Scheme

3) Establishment of the Lima and Callao Metropolitan Transport Authority (tentative name)

As mentioned in 2) above, the execution of the public role is inevitable for the success of the PPP concession scheme. Therefore, the public role of Metropolitan Lima and Callao is important. If two municipalities and a central government cannot cooperate in this public responsibility, the concession scheme cannot survive. Therefore, a single corporate body is necessary in the region to manage traffic, to design an integrated infrastructure development and to provide a stable, reliable and safe public transport to all citizens in the region.

The major reasons perceived to consider the establishment of a new transport authority (Lima and Callao Metropolitan Transport Authority – hereinafter "LCTA") are to effectively and efficiently control transport issues extended to two jurisdictional municipalities (with neighboring provinces if required) and the central government, which makes matters more complicated.

Since extensive interest parties are involved in the transport sector, there should be a well-functioning institution that is effectively equipped with tangible transport policies and instruments. The CTLC, which is much expected to be in that position, does not show the expected performance mainly due to various constraints, such as weakness in regulatory structure, no transference of authority, insufficient financial and human resources, and no institutional capabilities for executing engineering issues.

Taking into account the objectives of the new transport authority to be established, there must be a sufficient argument indicating the use of existing institutions or strengthening the capacities of existing agencies at the central and local governments.

The foremost option will be incorporating anticipated duties into the functions of the CTLC. This can be achieved by granting the adequate legal authority, which is superior to provincial and local government authorities, to some extent, and to create a mechanism in order to obtain the sufficient revenue to carry out its duties, and to empower its personnel.

Since the LCTA needs an engineering body, some existing engineering and planning organizations that are currently working for Metropolitan Lima and Callao need to cooperate establishing a concrete authority.

(2) Construction of Infrastructure

The characteristics of the public transport projects are huge initial investment costs and low tariff rates that are set politically. This characteristic applies especially to the railway projects. Because of this characteristic, it is not always easy to make the project profitable. In this sense, in order to achieve a successful concession scheme, it is common that the government (public sector) constructs the infrastructure and the private sector (concessionaire) invests in the operation. Of course, there are many infrastructure projects in which the private sector constructs and operates successfully, however, most of those projects are toll roads, bridges, etc. and not mass public transport projects. Table 25.1-5 shows a summary of the recent metro railway projects under the PPP scheme. Among the 17 listed projects, private companies invested in the operation and construction of infrastructure in the BTS Sky Train, LRT STAR, LRT PUTRA and Hopewell projects. For a successful public transport concession in Metropolitan Lima and Callao it is advisable to analyze the risks, demand forecast, financial capability, etc., of these projects.

Table 25.1-5 Summary of Metro Projects under the PPP Scheme

Project	BTS Sky Train Bangkok	METRO Bangkok	Hopewll Project Bangkok	MRT Line3 Manila	LRT System1 (STAR) K.L.	LRT System2 (PUTRA) K.L.	KLIA Access Railway K.L.	H.K. Airport Access Rail H.K.
Commencement of service	Dec. 1999	Apr. 2004 (partial) Aug. 2004	Bankrupt	July. 2000	Dec.1996 (PhaseI) Jul.1998 (PhaseII) Transferred to public	Sep.1998 (SecI) Jun.1999 (SecII) Transferred to public	Apr.2002	Jul.1998
Line	23.1 km	20 km	60.1 km	16.9 km	27 km	29 km	57.6 km	35.3 km
Number of Station	23	18	42	13	25	24	5	4
Type	Elevated	Underground	Elevated/At grade	Elevated/At grade /Underground	Elevated/ At grade	Elevated/ At grade/ Underground	Elevated/At grade /Underground	At grade
Capacity								
SPC	ERTA	MRTA (facility) BMCL (R.Stock, E&M)	Hopewell Thailand	MRTC 18.6% Ayala Land 18.6% APOMC 18.6% Greenfield D.C. 16% Ramcar Inc. 18.6% ARDC 4.8% DB-H D.C. 4.8%	STAR (Sistem Transit Aliran Ringan Sdn. Bhd)	PUTRA LRT (Projek Usahasama Transit Ringan Automatik)	ERLSB	MTR Corp
Investor	Tanayong Group KfW Local Banks IBRD	Facility: JBIC Loan & MRTA Bond	Hopewell Thailand	MRTC JEXIM Cech EXIM Local Banks	STAR Tabung Haji (20%)	Renong Berhad	YTL Tabung Haji Trisilco	HK Government 100%
Capital	TBH 18 billion	TBH 2 billion (will increase to 6 billion)		US$ 190 million				HK$ 35.1 billion
Type of PPP	Facility: BTO R.Stock, E&M: BOT 30 years contract	BOT 25 year contract	BOT 30 year contract	BLT 25 year contract	BOO	BOO	BOT 30 year contract	BOO
Operating organization	BTSC	BMCL		DOTC	STAR	PUTRA LRT	ERLSB (Express Rail Link Sdn Bhd)	MTRC (Mass Transit Railway Corporation)
Maintenance	SIEMENS/BTSC			Sumitomo Corp Mitsubishi Heavy		PUTRA LRT	ERLSB	MTRC
Constructer	Italian Thai Development (ITD), Siemens	ITD, Chokanchang, Obayashi, Kajima, Kumagai, Tokyu, Nishimatsu, Hazama, Maeda, Siemens	Hopewell Thailand	CKD TATRA Ltd, Kaiser Engineering Int'l, Sumitomo, Mitsubishi	Kuala Lumpur Transit Group, Adtranz	PUTRA LRT		MTRC
Project cost	Baht 55 billion	Yen 396.5 billion	Baht 80 billion	US$ 486 million (R.Stock 117) (E&M 168) (Civil 201)	RM 1,646 million (Phase II)		MD 2,400 million	HK$ 35.1 billion
Construction period	5 years 1995 - 1999	7 years 1997 - 2004		4 years 09.1996-07.2000	2y3m: phaseI 3y : phaseII			3 years

Project	Croydon Tram Link Southern London	Northern Line (Underground) London	Docklands Light Rail London	Manchster Metrolink (LRT) Manchster	Nottingham Express Transit Nottingham	Arlanda Link Stockholm	Arganda Rail Madrid	Flumitrens Suburban Rail Rio de Janeiro
Commencement of service		1999		1992	n.a.	mid-1999	in operation	-
Line	28 km		23 km	30.9 km	14 km	20 km	20 km	200 km
Number of Station	36		27	26	-		-	-
Type	At grade	Underground		Underground	10 segregated 4 on road	airport link	n.a.	n.a.
Capacity								
SPC	Tramtrack Croydon Ltd (TCL)	GEC Arstom	London Docklands Development Corporation (LDDC)	Greater Manchester Passenger Transport Executive (GMPTE)	Nottingham City Councel	n.a.	n.a.	n.a.
Investor	Amey/Sir McAlpines/Centre West Buses/Bombaridier Eurorail/Royal Bank of Scotland/3i	LUL	DLR Serco	GEC-Alsthom Mowlem AMEC GM Buses	Adtranz Tarmac Transdev Nottingham City Tpt	Government grant $100mil Subordinate loan $120 mil Concessionaire equity $70mil	n.a.	Operations takeover, State responsible for investment plan
Capital								
Type of PPP	DBFO(BOO) 99 year contract	DBOL 20 years	BLT 7 years	DBOM 15 years	DBFO 27 years	BOT 45 years	30 years	25 years renewable
Operating organization	TCL	London Underground Ltd (LUL)	Docklands Light Railway Ltd (DLR)	Greater Manchester Metrolink (GMML)	Nottingham City Councel			
Maintenance	TCL	GEC Arstom (private rolling stock company)	Docklands Railway Management Ltd (DRML)					
Constructer			Private Company					
Project cost	US$ 320 million	STG 420 million	STG 833 million	STG 274 million	US$ 267 million	US$ 550 million	US$ 120 million	n.a.
Construction period	4 years	3 years	4 years	3 years		n.a.	n.a.	n.a.

1 $ =38 Bhats、1$ =3.8 MR、1$ =54 Peso、1$ =103 Yen
Source: OECF(JBIC) Recearch Papers No.25, Financing of major infrastructure and public service project by METL France, World Bank TWU Papers No.38

(3) Operating Organization

1) Infrastructure and Operating Organization

There are various forms for operating organizations. Each form has its own purpose and strength. A suitable form should be selected based on the purpose and characteristics of the organization. For the operating company of the Trunk Busway System, PROTRANSPORTE is responsible for the COSAC project and the coordination between the COSAC project and the Master Plan is required. The integrated public transport network in Metropolitan Lima and Callao in the Master Plan consists of a Trunk Busway network and a Railway network. For the benefit of the passengers and citizens, it would be ideal if a common system for the Trunk Bus and Railway were introduced. However, in addition to the coordination between AATE and PROTRANSPORTE, a detailed financial analysis is required for the realization of the common system.

In addition to the characteristics of the PPP scheme mentioned earlier, it should be noted that the conception systems of the Metro Rail proposed by AATE and the COSAC project proposed by PROTRANSPORTE differ. Under the current concept of AATE, for the extension of the existing North-South railway, the concessionaire will be responsible for the construction of the remaining infrastructure and operation. Part of the revenue from the tariff of the metro railway will be used for the repayment of the construction fee. On the other hand, under the concept of the COSAC project of PROTRANSPORTE, the concessionaire will be in charge of operation only. Infrastructure for the Trunk Busway will be constructed by the public sector and the concessionaire would use it without any charge. Therefore, the revenue of the Trunk Busway operation will not be used for the repayment of the construction costs of Trunk Busway infrastructure. These different concepts of the two public transport systems need to be well disputed among related authorities.

The feasibility studies of the COSAC Project and the Trunk Busway Project will surely give a suggestion on how the projects are feasible. Since the project is not the only public transport project, financial sustainability needs to be required for the projects on the waiting list and also for the assumed Metropolitan Transport Authority (LCTA).

2) Alternatives for the Operating Organization Scheme

As mentioned, there are various alternatives for the operating organization of the trunk bus system. However, in any case a regional transport authority, such as The Lima and Callao Metropolitan Transport Authority (LCTA) mentioned earlier, is necessary. Both the proposed Trunk Bus System and the Conventional Bus System, currently in each municipality (and province if required), will be operated under the license of the LCTA (refer to Figure 25.1-5).

The following five cases are proposed as the possible Trunk Bus operating organization system.

Case1; Public sector will construct and operate infrastructure. Therefore, LCTA and MTCO (Metropolitan Transport Corporation) are public organizations. In this case, concession is not considered.

Case2; Public sector will construct infrastructure and private sector will operate. LCTA is a public organization and the MTCO itself is the operating organization.

Case3; Public sector will construct infrastructure and private sector will operate. LCTA is a public organization and the MTCO is the concessionaire and will sub-contract operation and maintenance to several bus companies.

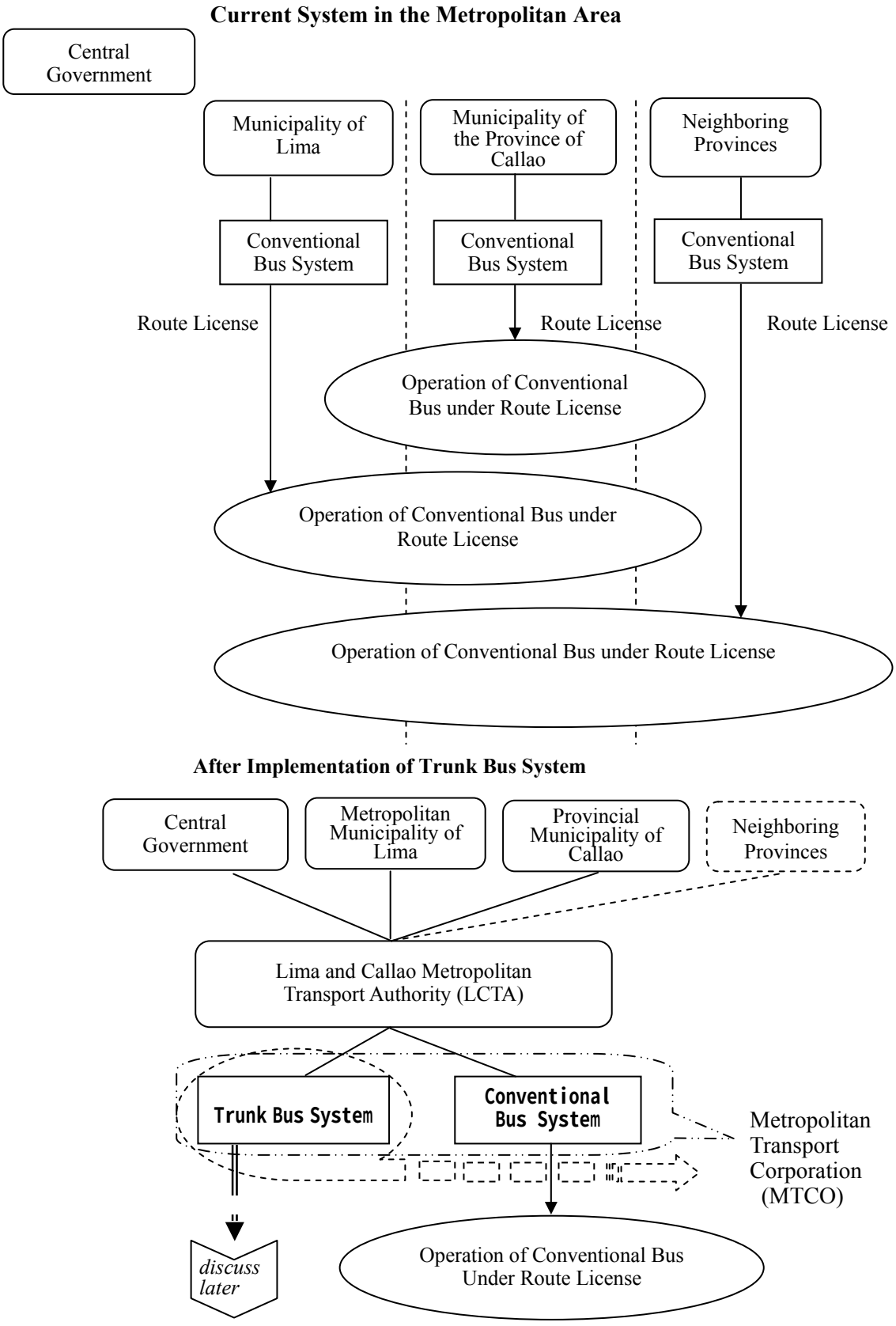


Figure 25.1-5 Bus Route System

Case4; Public sector will construct infrastructure and private sector will operate. LCTA is a public organization and the MTCO (Metropolitan Transport Corporation) is the concessionaire and has a regional division. The Regional MTCO will sub-contract operation and maintenance to several bus companies.

Case5; Private sector will construct infrastructure and operate. LCTA is a public organization mainly for supervision and the MTCO is the concessionaire, which could construct and operate by itself or could sub-contract to construction and bus companies.

A summary of the cases is shown in Table 25.1-6.

Table 25.1-6 Summary of Case

Items	Organization	Case 1	Case 2	Case 3	Case 4	Case 5
Supervising	LCTA	Public	Public	Public	Public	Public
Consruction of Infrastructure		Public	Public	Public	Public	Private
O&M	MTCO	Public	Private	Private	Private	Private
Sub-contract		X	X	○	○	△

The strengths and weaknesses of each case are summarized in below.

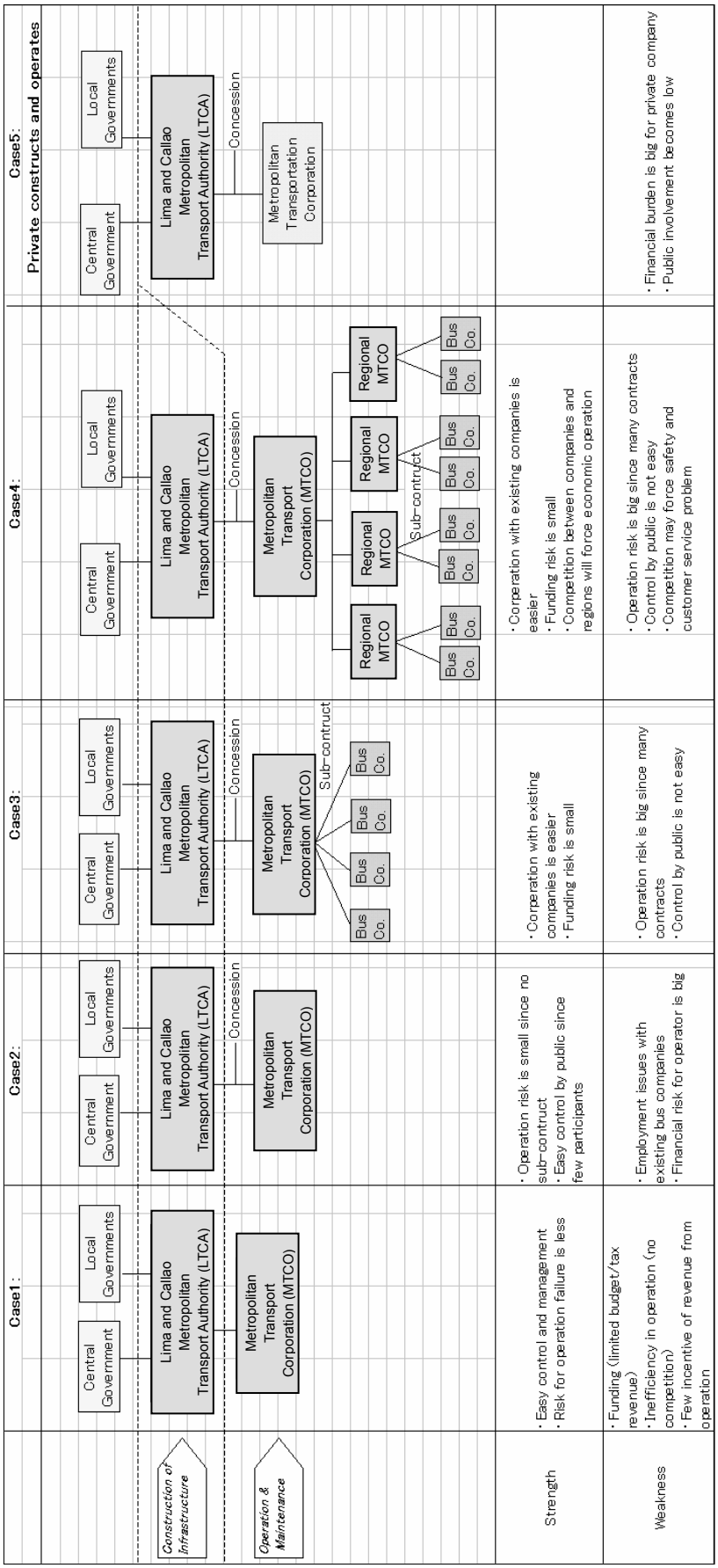


Figure 25.1-6 Operating Organization Alternatives

3) Alternatives for types of operating organizations

Based on the operating organization scheme mentioned above, several possible company types are considered.

a) Public Company
This type applies only to case 1 in section 2) of this section. There used to be many countries that had national organizations or public companies for public transport, however, mainly due to the budget limitations, privatization has progressed (refer to Chapter 25.1.4.). The background of the public company is that public transport is a basic urban function, which the local government is responsible of providing. There used to be a public bus company called ENATRU under the Municipality of Lima. Since ENATRU was abolished, public companies are hardly profitable and the local governments need to maintain their budgets for subsidy.

b) Third Sector Company
This is a joint venture company between the public and private sectors. The public sector provides the majority of equity and human resources and the private sector provides equity, human resources and marketing skills for efficient management. Past experience shows that, in many cases, the responsibilities and roles of the public and private sector become unclear and it is difficult to be profitable.

c) Newly Established Company
PROTRANSPORTE is considering a foreign company, which already has experience in trunk bus systems in other countries, as the concessionaire (new company) for the COSAC project. In this case, it is also possible for the municipality to propose a new company to invest as a shareholder if they wish. It is considered safe and easy for the success of the project as the company already has the experience. However, it is necessary for the public sector to consider the possibility that the new trunk bus system might drive existing conventional bus companies out of the market, resulting in unemployment and social problems. If it is a foreign company, there is the possibility that there may be similar public arguments as was the case with Peru Rail between Cuzco and Machu Picchu a few years ago.
In another case, it is possible for investors to establish a new company for the operation. In this case, human resources with good experience and skills will be hired from the existing or foreign company.

d) Joint Venture Company
A joint venture may be established between the existing bus companies, between the bus companies and other transport companies, between bus companies and investors, bus companies and the public, or between a mixes of those mentioned above. Some of the companies in Callao, whom the Study Team interviewed, have already established a joint venture company called the Consorcio Empresarial del Callao S.A. (CONECSA) and are preparing for the COSAC project. The benefits of establishing a joint venture are the cost reduction of fuel and the investment cost for repair shops, etc.

e) Union rather than a company
There may be a way to establish a union among the existing bus companies for the purpose of operating the trunk bus system. The conditions of establishing a union, regulations, responsibility of operation, revenue and dividend distribution, etc. should be discussed.

25.1.5. CONCESSION

A public-private partnership (PPP) constitutes a sustained collaborative effort between the public sector (government agencies) and private enterprises in which each partner shares in the design of a project, contributes a portion of the financial, managerial and technical

resources needed to design and execute that project, and partially shoulders the risks and obtains the benefits that the project creates. Managerial control normally rests with the private partner.

PPP initiatives are usually appropriate when:

a) Public sector wishes to maintain a degree of control over certain assets.
b) Public sector must contribute with resources or guarantees to make the project 'feasible'.
c) A publicly owned, commercially oriented entity wishes to participate in the project for commercial reasons.

In the case of transport infrastructure, due to its public nature, projects must often comply with regulations established by public authorities in order to address environmental, safety and, sometimes, social considerations. A tradeoff is then often present in the case of transport projects when the financial rate of return is below the market rate for private funds, and some form of public support is required to make the project feasible. The financial rate of return may be improved by way of additional user charges, but then the economic rate of return may be affected negatively and a compromise would have to be found.

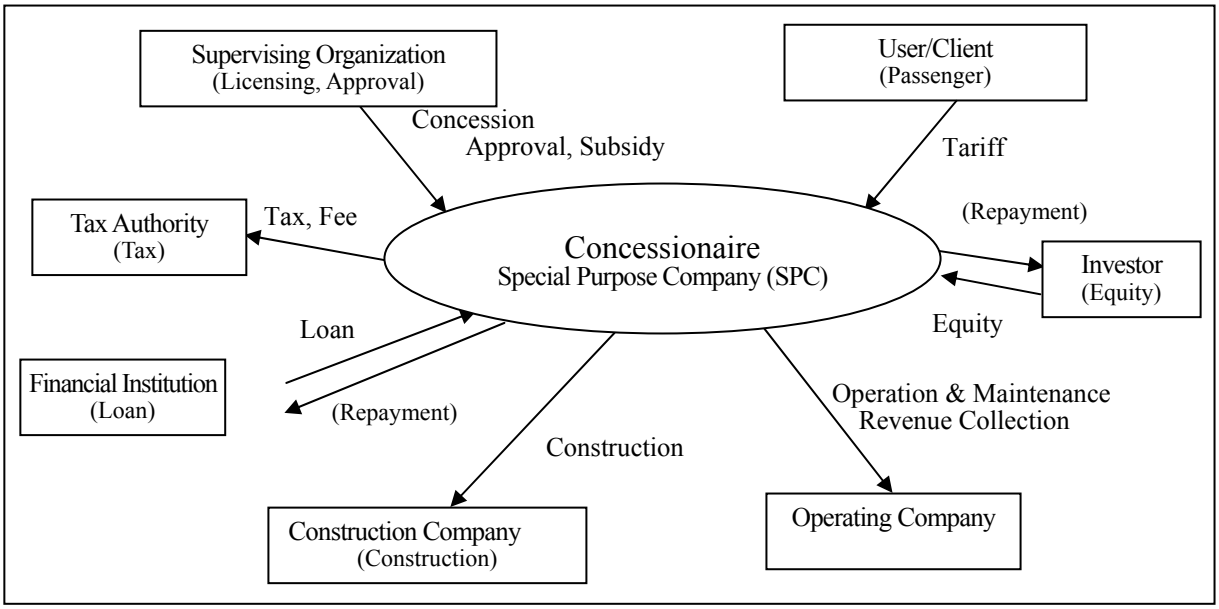


Figure 25.1-7 Major Clusters in Concession Scheme

(1) Key to a Successfull Concession

1) Concession and Public Contract in Use

Concession is the process in which the public sector encourages private partners, who have specific technical skills and funding capability, to participate in the construction and operation stages of public infrastructure projects. It is important to understand that a Concession contract is different from the typical contract for public projects, in which tenders compete to bid the lowest price based on the TOR (Terms of Reference) shown to the public beforehand. The PPP does not seek the lowest price bidder for the public made TOR, instead it seeks the best "value for money", technical skills and management skills for the operation of the public service. Table 25.1-7 shows the comparison of the definition and characteristics of the typical Public Contract and the Concession Contract.

Table 25.1-7 Comparison of Public Contract and Concession Contract

	Public Contract that has been used	Concession Contract
Definition	Provision of goods, construction or service based on the TOR set by the public sector	Based on the proposal of the private sector, the public sector will decide the best value for money service project for public service
Major Characrteristics	・Sole purpose ・Short term ・No participation in service management ・Public mission will not be entrusted to the private sector	・Multiple purpose ・Long-term ・Participation in service management ・Public mission will be entrusted to the private sector
Basic Feature	・Public sector supervises construction ・Contractor does not have funding responsibility ・Contractor does not invest in the project ・Contractor does not have a right to change service level or design ・Contract does not include additional services or changes in organization	・Concessionaire supervises service operation ・Concessionaire finances in some cases ・Concessionaire invests in some cases ・Based on proposal, the concessionaire can change service contents and design ・There exists a contract to institutionalize the service and change the organization

2) Obstacles for Concession

The steady growth of private sector participation in infrastructure since the eighties appears to show a process during which a novel approach needed some time to take roots and a substantial amount of learning experiences had to develop for new initiatives to unfold. Progress, however, has been limited due to the frequent political reluctance to give up control of infrastructure assets, which have been in public hands for a long period of time. This reluctance has been compounded by the existence of other institutional factors such as:

a) Absence of a matured regulatory framework, to prevent the appearance of monopoly situations and sharp increases in tariffs or reductions in the service levels.
b) Unstable sector policy environment coupled with an unclear path to recourse if problems ever arose.

These factors have often led to protracted tendering and negotiation processes, which have undermined the credibility of some PPP initiatives. Overall, they have raised the policy risks and widened the mismatch between the degrees of project risks as perceived by the public and private sectors.

Governments tend to perceive much lower risks than sponsors and lenders in the private sector, leading to terms-of-reference and a regulatory and policy framework not conducive to the expansion of PPP initiatives. The lack of clarity regarding government objectives and commitments often contributes to those factors.

In all, the conditions set for private participation are often too cumbersome to comply with, require a complex decision-making process, and imply a high level of risk. Nonetheless, even within a stable general macro-economic and political environment, two factors are effectively necessary for a project to have a chance of succeeding:

a) Strong government commitment that can counteract any possible institutional or vested-interest resistance.
b) Sound financial basis with, if required by the project, government support (subsidies or guarantees).

A PPP initiative cannot turn a weak project in terms of political commitment or financial/economic robustness into a strong project.

(2) Network and Feeder Service

Implementation of the new Trunk Bus System requires the rearrangement of the existing bus service. As mentioned earlier, the characteristic of the existing bus service is a long distance of operation. Long distance operation is based on the customers' demand and it is cheaper for the customer because of the lower transit times. Considering this demand, the Trunk Bus System should be integrated with the Feeder Buses. Therefore, the Trunk Busway System will take the place of some of the existing long operating routes and also of some of the feeder bus routes. For the customer service and concession, it is preferable to include feeder systems. However, it implies a severe competition with existing conventional bus companies and it is recommendable to carry out adequate discussions.

The idea of a future integrated public transport network includes the metro railway. It is ideal if the Bus and Metro tariffs are integrated. However, this means that the public transport project will be less profitable and it makes concession difficult. The elimination of existing bus operator costs and, as a whole, public needs for necessary funds might increase. It should be considered that the idea of a "good system" differs among users, bus operators and public organizations.

1) Good system for the user
    a) Simple and comprehensive network and system
    b) Alternative route is easy to recognize
    c) Easy transfer and low tariff
    d) Simple tariff system
    e) Minimum level of service
    f) User friendly tariff level especially for the low income class
2) Good system for the bus operator
    a) Route and vehicle supply are based on demand
    b) Better service will cause demand increase
3) Good system for the public
    a) User satisfaction
    b) Fair to all citizen classes (no social problem)
    c) Revenue from bus operators (financially sustainable system)

(3) Sustainability of the Scheme - Additional Revenue Sources

Budget is always the factor that restricts the implementation of projects in the world, and Peru is no exemption. There are lots of projects on the waiting list and, even though the funding source for this project is secured, the funding issues for the next project always remain. For the sustainability of the public transport projects, it is highly recommended to consider the additional funding source scheme. On the other hand, funding sources are also a remaining issue for the institutions. An organization without a sustainable funding source is not stable. The proposed Lima and Callao Metropolitan Transport Authority (LCTA) also requires a stable funding source, preferably its own, in addition to the budget allocation from related municipalities and the Central Government.

Considering the recent public transport projects in the world, subsidy is one of the key elements for success. In both OECD countries and non-OECD countries (Developing countries) without government's positive involvement, transport projects are hardly realized. The ways in which the government gets involved vary i.e.;

a) Public sector will construct infrastructure (civil works).

b) Offers subsidy for the construction cost.
c) Offer subsidy for the operation, guarantee for minimum ridership.
d) Public sector operates and repays construction cost, similar to BLT.
e) To avoid the actual cash flow of subsidies, the public sector will offer incentives such as development rights in the commercial area.

Each case has strengths and weaknesses and there is no best case in general. Table 25.1-8 shows examples of subsidies in the recent PPP Railway Projects.

Table 25.1-8 Examples of Subsidies in the Recent PPP Railway Projects

Type of Subsidy	Project	Country	Amount of Subsidy	Repayment	Remarks
Nil	Bangkok BTS Sky Train	Thailand	nil	n.a.	Concessionaire arranges all the project costs. At the end of the concession period, concessionaire needs to arrange spare parts for two years
Partially for Construction Cost	Bangkok MRTA Subway	Thailand	102 Billion Baht 85.4% of Project Cost	Private sector will pay rental fee to the infrastructure	Public sector construcst infrastructure (civil work, 80% of the necessary fund was by JBIC Loan)
Partially for Construction Cost	Channel Rail Link (Tunnel)	U.K.	3,100 Million Pound 59.6% of Project Cost	No direct payment for the subsidy	Pay dividends to the government after 2020
Partially for Construction Cost	Hong Kong Airport Access Railway	Hong Kong	Approximately 60% of Project Cost	No obligation to repay	Public hold 76% of the share in operation organization. Operating organization received the right to purchase land along the rail line for the development
Partially for Construction Cost	Croydon Tram Link	U.K.	128 Million Pound 53.3% of Project Cost	No obligation to repay	No subsidy for operation. Operating company also works for construction, operation and O&M.
Partially for Construction Cost	K. L..International Airport Access Rail	Malaysia (K. L.)	Airport User' Charge Int'l Airport: MR 5 Domestic Airport: MR 1	No obligation to repay	No subsidy for construction. Operating company also constructs.
Partially for Construction Cost and Operation Cost	Toulouse Metro (Subway)	France	225 Million Euro (36.6% of Initial Cost)	No direct payment for the subsidy	Subsidy for operation. If the profit surpasses a certain level, surplused amount will be shared by the operating company and the public sector
Partially for Construction Cost and Operation Cost	Strasbourg Tram Way	France	1.240 Million Euro (Investment Cost)	No obligation to repay	Subsidy for operation.
Partially for Construction Cost	Thessaloniki Metro (Subway)	Greece	160 Million Euro Approximately 30% of Project Cost	No obligation to repay	

Even from this point, a sustainable funding source is considered necessary, especially for the future projects.

Details of the possible funding sources will be discussed in Chapter 26 and this section mentions the summary and necessity of additional budget.

25.1.6. SOCIAL IMPACTS AND RELATED BUSINESSES

(1) Employment Issue

Unemployment is a serious social problem in Peru. The rationalization of the bus system will force a rearrangement in the bus sector and some small-scale bus owners may not be competitive enough. As mentioned previously, approximately 20% of the population in the Municipality of Lima has a relation with the transport business and social impact might be big. Therefore, it is important for the project to consider how the project or related project could offer employment opportunities for those who might face income problems. The following cases are considered in the project implementation.

a) Case introducing the latest cost-effective machine
   For the concessionaire as the entrepreneur, it is recommendable to take the most cost effective way. Most up-to-date auto machines will save personnel costs, however, considering the nature of the public transport system it should also consider the possible social effects.
b) Case utilizing human skill as much as possible
   As it is currently seen in European countries, in some way, the old-fashioned way of ticketing is still well functioning. Instead of introducing up-to-date smart-card systems, paper tickets and collectors will be in use. This case will maintain employment opportunities but may not solve the traditional problem of the free rider and efficiency in management.

(2) Possible Businesses Related to Bus Operation

The Trunk Bus System will introduce a terminal station where feeder buses gather and change to other bus or railway routes. For the convenience of users, it is possible that the current terminal for long distance (inter city) buses may intensively move to this new terminal station. Taking advantage of this new terminal station, business chances may develop for the transport businesses.

The Public Transport business itself, especially railway, is hardly profitable on its own due to the low tariff level that is politically set. Every operator in the world is trying to maximize its profits by raising transport-related businesses. Table 25.1-8 shows the financial statements of Japanese metro companies. The structure of the financial revenue varies in companies with their share of related businesses from 4% to even 54%. The type of related businesses differ in each company based on its size, constitution of shareholder, etc. One example of related businesses (case of KEIO Co. in Table 25.1-9) is:

a) Transport: Metro bus, Feeder bus, Long distance bus, Taxi, Transport of Goods
b) Distribution: Department Store, Super Market, Shopping Center, Kiosk, Bakery Shop, Flower Shop, Book Shop
c) Real Estate: Real Estate Agent, Rent as an Owner
d) Leisure / Service: Hotel, Restaurant, Travel Agent, Advertising Agent, Sports Center
e) Others: Construction, Building Maintenance, Rolling Stock Maintenance, Information, Accounting, Personnel, etc.

Table 25.1-9 Profits and Losses of Japanese Metro Railway Companies

(Unit: US$million)

	Eidan Metro	*	Tokyo Metro	*	Keio	*	Tokyu	*
Operating Revenue	2,656	*96%*	936	*88%*	687	*69%*	1,162	*44%*
Operating Cost	2,345		1,041		529		887	
Operating Profit	311		(105)		158		275	
Related Revenue	102	*4%*	n.a.		299	*30%*	1,428	*54%*
Related Cost	90		n.a.		225		1,270	
Related Profit	13		n.a.		74		158	
Gross Profit	324		(105)		232		433	
Other Revenue	21	*1%*	125	*12%*	7	*1%*	72	*3%*
Other Cost	263		336		68		239	
Interest payment	255		n.a.		53		190	
Net Profit	82		(316)		172		266	
Special Income	(53)		n.a.		(20)		(64)	
Profit before tax	29		n.a.		152		201	
Profit after tax	0.7		n.a.		86		60	

*shows the share revenue in total revenue

Considering the characteristics of the Lima and Callao Metropolitan Area, the following businesses are suggested as initial bus related businesses;

a) Other bus businesses such as Bus and Car Rentals, School Bus, Corporate Bus.
b) Considering the high level of mail service, the transport of goods, especially small goods as parcel, still has a chance to develop. The demand for the home delivery system of goods such as "Takkyubin", introduced in Japan, might increase.
c) Taking advantage of the largest international airport and port in the country, bus transport will have business opportunities that can be developed, especially for perishable goods.
d) Tourism has a big potential. According to the surveys, the number of foreign visitors increased 10% and revenue of tourism increased 26% in 2003. The Tourism Development Master Plan of Peru (JICA) of 1999 forecasts the number of foreign tourists at 1.3 million in 2005 and 2.7 million in 2015. Transport businesses should consider this potential and prepare the development of operator businesses and travel bus businesses.
e) Terminal Businesses, such as Kiosks and small shops (Convenience shop such as Seven Eleven), will be prepared. Because of easy access, a leisure facility such as a small-scale Disney Land might have potential.
f) Real Estate businesses. The residential area has steadily grown in accordance with the development of the Metropolitan area. In line with the bus route plan, a residential area could be planned.

The COSAC project is planning to utilize financing from the Global Environment Facility (GEF) to adopt sustainable low Green House Gas (GHG) emission transport measures and to facilitate modal shifts from personal transport to mass transport. The Municipality of Lima also has a plan to introduce CNG (Compressed Natural Gas) fueled vehicles to public transport. Since the Trunk Bus System will introduce new types of vehicles, it is also a good opportunity to introduce clean environmentally friendly vehicles. CNG vehicles require CNG fuel stations. This could also provide a new business chance and new employment opportunities to the public.

25.2. INSTITUTIONAL ORGANIZATION FOR REALIZATION OF MASTER PLAN

In this section, the major activity items and institutional organizations for realization of the Master plan are described based on the past experience of the similar transport plans.

25.2.1. ACTIVITY ITEMS FOR REALIZATION OF MASTER PLAN

The Master Plan was formulated as the comprehensive urban transport master plan in Lima and Callao Metropolitan Area. The Master Plan consists mainly, i) road development projects, ii) railway development projects, iii) bus development projects, and iv) traffic management development projects. The road development projects were formed by 33 projects mainly newly road construction, road widening, and road improvement projects. The railway development projects consists of 7 projects, and the bus development projects are formed by trunk bus, feeder bus, original bus system improvement projects and bus terminal construction projects. The traffic management development projects consists mainly traffic signal improvement, TDM introduction, and traffic safety improvement projects.

As mentioned the above, the Master Plan including various transport and traffic projects, therefore, there are many activities items for realization of these projects recommended by the Master Plan. The major activities items for realization for the Master Plan are described in accordance with working schedule.

1) Preparation of General Planning (A-1)
2) Implementation of Master Plan (A-2)
3) Implementation of Feasibility Study (A-3)
4) Implementation of Detailed Design (A-4)
5) Identification of Project Execution Administrative Organization (A-5)
6) Environmental Impact Assessment (EIA) (A-6)
7) Acquisition of Environmental Certification (A-7)
8) Approval of Plan or Project (A-8)
9) Financial Procurement (A-9)
10) Request of International Credit (if Necessary) (A-10)
11) Identification of Construction Execution Organization (A-11)
12) Preparation of Tender Document for Construction of Project (A-12)
13) Implementation of Land Acquisition (if necessary) (A-13)
14) Implementation of Re-settlement (if necessary) (A-14)
15) Review of Laws and Regulations (if necessary) (A-15)
16) Tender for Constructor (A-16)
17) Evaluation and Contract of Contractor (A-17)
18) Execution of Construction (A-18)
19) Supervision of Construction (A-19)
20) Maintenance of Project (A-20)

25.2.2. INSTITUTIONAL ORGANIZATION FOR REALIZATION OF MASTER PLAN

(1) Existing Major Organization Concerning Transport and Traffic Fields

The existing institutional organization for the transport and traffic projects in Lima and Callao Metropolitan area were presented in previous Chapter 7 of this Report. There are many organizations and related authorities within Central Government and Municipalities in the Study area as shown in Table 25.2-1. The major functions and responsibility of the each organizations or related authorities were described in Chapter 7 of this Report.

Table 25.2-1 The List of Major Organizations and Authorities for Transport and Traffic Fields.

Organization		Remarks
Central Government		
MTC	Ministry of Transport and Communications	DGCT,OPP
MEF	Ministry of Economy and Finance	SUNAT,PROINVERSION
SUNARP	National Superintendence of Public Registration	
PNP	National Police Peru	
CONAM	National Environmental Council	
FONAM	National Environmental Fund	
INEI	National Institute of Statistics and Computer Science	
Lima and Callao		
CTLC		CNSV
Lima Municipality		
MML	Metropolitan Municipality of Lima	
DMTU	Municipal Direction of Urban Transport	
IMP	Metropolitan Planning Institute	
EMAPE	Municipal Toll Administrates Company	
SEPRI	Special Committee of Private Investment	
PROTRANSPORTE	Special Preparation Project of the Investment Plan for the Metropolitan of Lima	
SETAM	Metropolitan Taxi Service	
AATE	Autonomous Authority of the Special Project Electric System of Mass Transport of Lima	
INVERMET	Metropolitan Investments	
SAT	Tributary Administration Service	
TRANSMET	Metropolitan Transport Committee of Lima	
Callao Municipality		
MPC	Provincial Municipality of Callao	
GGDU	General Management of Urban Development	
GGTU	General Management of Urban Transport	
FINVER	Callao Investment Fund	

(2) Relationship Between Activities for Realization of Master Plan and Existing Organization

Considering the function and responsibility of the existing organization, the relationship between responsible organization and activity items (in the previous mentioned A-1 to A-20) for the realization of projects recommended by the Master Plan is identified as shown in Table 25.2-2.

Table 25.2-2 Responsible Existing Organization and Activities (1)

Organization	Activities for Realization of Master Plan									
	A-1	A-2	A-3	A-4	A-5	A-6	A-7	A-8	A-9	A-10
MTC		X							X	X
MEF		X	X		X				X	X
SUNARP		X								
PNP		X								
CONAM		X	X	X		X	X			
FONAM		X	X	X		X	X			
INEI		X	X							
CTLC	X	X	X	X	X	X	X	X	X	X
MML	X	X	X	X	X	X	X	X	X	X
DMTU		X	X	X	X					
IMP		X	X	X	X					
EMAPE		X	X	X	X				X	X
SEPRI		X	X	X	X				X	X
PRPOTRANS PORTE		X	X	X	X					
SETAM		X	X	X	X					
AATE		X	X	X	X					
INVERMET								X	X	X
SAT									X	X
TRASMET	X	X	X	X	X	X	X	X	X	X
MPC	X	X	X	X	X	X	X	X	X	X
GGDU		X	X	X						
GGTU		X	X	X						
FINVER									X	X

Note: X: Responsible Organization

Table 25.2-3 Responsible Existing Organization and Activities (2)

Organization	Activities for Realization of Master Plan									
	A-11	A-12	A-13	A-14	A-15	A-16	A-17	A-18	A-19	A-20
MTC					X		X			
MEF					X		X			
SUNARP										
PNP										
CONAM					X					
FONAM					X					
INEI										
CTLC	X	X	X	X	X	X	X			
MML	X	X	X	X	X	X	X			
DMTU		X		X	X	X	X	X	X	X
IMP		X		X	X	X	X			
EMAPE		X	X	X		X	X	X	X	X
SEPRI		X			X	X	X	X	X	X
PRPOTRANS PORTE		X		X		X	X	X	X	X
SETAM										
AATE		X		X		X	X	X	X	X
INVERMET	X					X	X			
SAT					X	X	X			
TRASMET	X	X	X	X	X	X	X			
MPC	X		X		X		X			
GGDU		X					X	X	X	X
GGTU		X					X	X	X	X
FINVER	X						X			

Note: X: Responsible Organization

25.2.3. SUGGESTION FOR EXISTING ORGANIZATIONS

As the mentioned above, there are many organizations and related authorities concerned the realization on projects recommended by the Master Plan. The study area of the Master Plan is covered by Lima and Callao Metropolitan area, and the Study area is organized by the independently three (3) organizations such as Central Government, Lima Municipality, and Callao Municipality. In addition, as shown in Table 25.2-2, there are many organization and related authorities for the implementation of the activities concerned the realization of the projects recommended by the Master Plan.

Considering the functions and responsibility of existing organization and activities concerned the realization of the Master Plan, the following suggestions are pointed out.

(1) The function and responsibility of CTLC should be reinforced

As shown in Table 25.2-2, the most of all activities concerned realization of projects recommended by the Master Plan should be implemented by CTLC. However, considering the numbers of staff and technical capability in CTLC, it is very difficult to execute the activities concerned the realization of the Master Plan. Taking into account of the above conditions in CTLC, the following suggestions are pointed out.

1) The numbers of technical staff, and transport and traffic engineers should be reinforced.
2) The numbers of administrative staff should be reinforced.
3) The working activities of CTLC are covered among Central Government, Lima Municipality, and Callao Municipality. Therefore, the operation and administrative budgets should be financed by the three (3) organizations such as Central Government, Lima municipality, and Callao Municipality as a joint contribution.
4) In addition, numbers of staff and engineers should be employed by CTLC's own budget, due to keep the balance among Central Government, Lima Municipality, and Callao Municipality.

(2) The function and responsibility of TRANSMET should be reinforced

As mentioned previous, the projects recommended by the Master Plan are formulated by the various transport and traffic projects such as road, bus, railway, and traffic management development projects as the comprehensive or integrated urban transport Master Plan. And also, as shown in Table 25.2-2, the most of all activities concerned realization of projects recommended by the Master Plan should be implemented by TRANSMET. For realization of the Master Plan, the functions and responsibility of TRANSMET is very important, and the following suggestions are pointed out.

1) The numbers of technical staff, and transport and traffic engineers should be reinforced.
2) The numbers of administrative staff should be reinforced.
3) TRANSMET should be exhibited the more strong power for realization of the Master Plan, and to coordinate among the related organization and authorities concerned.

(3) The Coordination organization structures should be reinforced

The projects recommended by the Master Plan covered by integrated projects, and these Projects are located at Lima and Callao metropolitan area, as well as the project cost is estimated very large scale. However, the coordination organization structures among Central government, Lima Municipality, and Callao Municipality are very weak. Considering these coordination organization conditions, the coordination organization

among Central Government, Lima Municipality, and Callao Municipality should be reinforced for smooth implementation of the Master Plan.

CHAPTER 26
Financial Procurement for Master Plan Projects

26. FINANCIAL PROCUREMENT FOR MASTER PLAN PROJECTS

The major purpose of this chapter is to assess the probability of financial procurements for the proposed Master Plan projects from the broad viewpoints.

The financial procurement study in this section is to examine the possibility of the financial procurement for implementation of the Master Plan. Therefore, the results of financial procurement study in this section are not final recommendation. The detailed financial procurement study including implementation organizations and structures of each project should be conducted in further studies according to the recommended Implementation Program (IP) of the Master Plan.

The total necessary investment amount of US$5,535 million is divided into three phases: US$ 1,869 million for the short-term (2005-2010), US$ 2,630 million for the medium-term (2011-2020) and US$ 1,038 million for the long-term (2021-2025), respectively. On the other hand, they consist of the four different categories of projects/project packages such as road facility improvements (new construction, improvement and rehabilitation), urban railways, introduction of trunk bus systems and various traffic management schemes.

26.1. PROJECT COST OF MASTER PLAN

26.1.1. SUMMARY OF TOTAL PROJECT COST

The required cost for implementation of the projects proposed in the Master Plan is summarized, in accordance with the implementation schedule proposed in Chapter 19, as shown in Table 26.1-1.

Table 26.1-1 Summary of Proposed Project Costs

(US$ in million)

Phase / Project	Short-term		Medium-term		Long-term		Total	
	(2005-2010)	%	(2011-2020)	%	(2021-2025)	%		%
Road	**290**	16	**1,467**	56	**616**	59	**2,374**	43
Railway	**684**	37	**921**	35	**420**	41	**2,025**	37
Trunk Bus System	**739**	40	**242**	9	**0**	0	**981**	18
Traffic Management	**156**	8	**0**	0	**0**	0	**156**	3
Total	**1,869 (33.8%)**	100	**2,630 (47.5%)**	100	**1,036 (18.7%)**	100	**5,535 (100%)**	100
(Cost/year)	(312)		(239)		(207)		(252)	

Source: JICA Study Team

(1) Short-Term

Projects for the short-term mainly consist of the ones to be implemented rather urgently, such as the railway line No.1 (Section 1, 2 and 3), 10 trunk bus-way systems together with the construction of the three bus terminals and 10 kinds of various traffic management scheme packages, including ongoing and confirmed projects.

These projects will be able to cope with the existing and/or shortcoming traffic demands in the near future.

(2) Medium-Term

Medium-term projects are listed up following the completion of the short-term ones, which will be implemented during a 10-year period, from 2011 to 2020.

The components of the proposed projects in this phase will formulate the fundamental frame of the urban transport infrastructure system in the Study area. They are composed mainly of various road improvements such as expressways and arterial & collector roads, and may be referred to as the road improvement oriented projects. In addition, urban railway line No. 2 and section (1) of line No. 3 are included.

(3) Long-Term

In order to complete the urban transport system to satisfy the long-term traffic demand, expressways and new arterial road constructions together with new/extension of urban railway systems are proposed.

When this final stage of project implementation is executed, 275 km of expressways with huge amounts of rehabilitated existing roads, 96 km of urban railways and 201 km of trunk bus-ways in total length will be served for 10,993 million residents projected in 2025 within the Metropolitan Area of Lima and Callao, as a result of the total investment of US$ 5,535 million.

26.1.2. FINANCIAL AVAILABILITY IN GENERAL

On the other hand, average yearly investment costs show rather heavier allocation during the short-term in comparison to the medium and long terms. This is caused by the judgment of the Study Team, that the early investment allocations are indispensable for the effective executions of the other projects to avoid the rapidly increasing urban traffic problems, in addition to the big ongoing projects such as the 'COSAC' project of PROTRANSPORTE (US$ 222 million, including some extensions of the original plan) and 'urban railway line No. 1' by AATE (US$ 355 million, cost estimated by the Study Team). This is apt to give the impossible and hopeless impressions to the officers involved in financial arrangements for the implementation of the Master Plan projects, in comparison to the existing very limited budgets, when they judge their realizations within the existing legal and budgetary frameworks. Accordingly, it might be necessary to revise the actual implementation schedule in the future, especially regarding short-term projects in careful consideration with possibilities of new procurements of the budget.

However, maximum efforts should be made by the related agencies both in central and local governments to procure the necessary amount of budgets, as far as the increasing traffic demands are estimated in the future and the proposed Master Plan projects are evaluated with a significant economic rate of return, from the viewpoint of urban transport planning.

Moreover, there are not single measures to procure all the budgets only by the governments themselves, but there are various alternative solutions to reduce their burdens, such as examinations on cost-minimization of each project through an encouragement of private sector participation for some beneficial projects, review of implementation program, and selection of priority projects and so on.

26.2. BASIC POLICY FOR FINANCIAL PROCUREMENT

As there are some limitations to consider the revision of local government public revenues within the Urban Transport Master Plan Study, only some possible directions are indicated as preliminary suggestions.

26.2.1. GENERAL

All the possible measures should be examined in order to strengthen the fundamental financial situation of the local government and to enlarge the autonomous/self-reliant funds,

since the scale of the budget of the MML seems to be too small in comparison with other capital cities.

At first, the three principals of the taxation system should be applied, in general, in order to review the existing tax regulations.

1) Horizontal and vertical impartialities.
2) Neutrality in economic activities.
3) Simplicity in taxation system.

Next, the present performances of each tax collection system need to be examined carefully in order to achieve higher or complete rates of levy. An example of a preliminary investigation on the 'Vehicular property tax' (refer to the following column) results in an uncertain situation of the MML.

An Example of Tax Collection Performance

- *Vehicular property tax (1% of the value of vehicles for 3 years) regulation was revised from the end of 2001, from 'less than 3 years-old' to 'all of the vehicles' for 3 years from the initial registration. This is similar to the vehicle purchase tax in Japan (5% of purchase price is levied on purchase).*
- *The average vehicle value can be roughly examined in comparison with the tax revenue amount and number of newly registered vehicles.*
- *Total number of new registrations in the MML were 45,000 in 2000, 43,000 in 2001 and 40,000 in 2002, respectively.*
- *Actual tax revenues of this item counted for S/. 29.9 million in 2000, 22.7 million in 2001 and 26.7 million in 2002.*
- *Then, the average value of these vehicles can be estimated at S/. 20,860 ($ 6,100) per vehicle. (S/. 26,700X100/(45+43+40)). This is what a 'Honda Civic 1.6, 1997 model' or a 'Toyota Corolla 1.6, 1997 model' is worth in market price. Is this guess/estimation correct or not?*
- *It is not easy to judge from this fact, but it can be a clue to examine the performance of the tax collection.*

After the investigation of the accuracy of the performance of the existing tax collection, possibility of revision of tax rates and introduction of new taxation systems should be considered.

26.2.2. BASIC DIRECTIONS

The following are the basic principals for increment in financial resources to improve the existing severe and limited financial conditions in the local government.

In addition to the principals of the general taxation system mentioned above, the following points should be considered, when some initial ideas are proposed regarding urban transport fields.

1) Transparency and Impartiality
2) Sustainability
3) Self burden by beneficiaries
4) Burden by payable groups

5) Reality through public consensus

These ideas are summarized into some strategies below:

1) Increment in Autonomous/Self-reliant funds

   a) Original financial resources (special account for projects)
   b) Subsidies/transfer from central government
   c) Burdens by district governments for common/inter-district urban transport projects

2) Burdens by private vehicle owners/users (who are able to pay and be benefited by the projects)

   a) Increase/addition to existing tax rate
   b) Introduction of new taxation system
   c) Burdens from broad patrons (expansion of toll road sections)
   d) Collection of car parking charge on roadside

3) Burdens by patrons of the advanced public transit system

   a) Users of trunk-bus system (to some extent)
   b) Users of urban railway system (to some extent)

4) Reduction of investment costs

   a) Encouragement of 'Private Participant' in projects such as self-finance of toll roads, railway and trunk bus-way projects by concessionaires to decrease/exempt initial investment costs made by the government.
   b) Use of second-hand rolling stock and bus vehicle fleets
   c) Use of ODA loan for initial investment

5) Others

   a) Urban development tax
   b) Environment preservation tax
   c) Urban transport improvement fund
   d) Lottery by local government

26.3. EXAMPLES AND EXPERIENCES IN JAPAN AS A REFERENCE

This is an overview of the features that show how to procure the financial resources for road construction and maintenance and how huge burdens are imposed on vehicle users.

26.3.1. AUTOMOBILES AND TAX BURDEN

Table 26.3-1 Taxes Related to Automobiles in Japan (2001)

When Owned	**1. Vehicle purchase tax (5%)**	**$44.5 million**
	2. General sales tax (5%)	**$76.4 million**
During In Use	3. **Vehicle Ownership tax ($270-1,000/year for private car)**	**$162.7million**
	4. Light vehicle tax ($65/year)	**$11.8million**
	5. Vehicle tonnage tax ($115/ton-year)	**$102.7million**
During In Operation	6. **Gasoline tax ($0.44/liter)**	**$258.2million**
	7. Local road tax ($0.05/liter)	**$27.3million**
	8. Diesel tax ($0.29/liter)	**$113.6million**
	9. LPG tax ($0.16/kg)	**$2.7million**
	2. General sales tax (5% of fuel purchase)	**$32.7million**
National tax, Local tax, Both Mixed		**Grand Total: $ 832.7million**
Total number of registered vehicles: 74 million = $ 1,125/vehicle/year		

Source: Japan Automobile Manufacturing Association

Automobile users and/or owners in Japan are imposed nine (9) kinds of taxes in total, regardless of direct or indirect, through national and local government taxes, and the total

amount of the burden has reached $ 832.7 million, that is $ 1,125/vehicle/year in 2001. These are summarized in Table 26.3-1.

26.3.2. TAXES RELATED TO AUTOMOBILES AND RESOURCES FOR ROADS

As there are 9 kinds of taxes levied from vehicle owners and users in Japan, the types of taxes and accounts are summarized as follows:

Half of these taxes are transferred into a 'special account' for road related investments, not into a 'general account' in the cases of both national and local governments.

Table 26.3-2 Taxes related to Automobiles

	Item of Tax	Type of Tax1/	Accounts for	Rate5/
When Owned	Vehicle purchase tax	L1	**Specific for road** (L)	5%
	General sales tax	N & L	General revenue (N, L)2/	5%
During In Use	Vehicle ownership tax	L1	General revenue (L)	¥ 34,500/year
	Light vehicle tax	L2	General revenue (L)	¥ 7,200/year
	Vehicle tonnage tax	N	**Specific for road** (N, L)3/	¥ 12,600/ton/year
During In Operation	Gasoline tax	N	**Specific for road** (N)	¥ 48.6/liter
	Local road tax	N	General revenue (L)	¥ 5.2/liter
	Diesel tax	L1	General revenue (L)	¥ 32.1/liter
	LPG tax	N	**Specific for road** (N, L)4/	¥ 17.5/kg
	General sales tax	N & L	General revenue (N, L)2/	5%

Note 1/: N=national, L=local, L1=prefecture, L2=municipality
Note 2/: N:L=4:1, 3/: N=3/4, L=1/4, 4/: N:L=1:1
Note 5/: from 2003
Source: 2003 Yearly Research Paper of Automobile Transport Institute

26.3.3. HISTORICAL TREND OF VEHICLE RELATED TAXES

These taxes are summarized from the historical viewpoint.

1) Vehicle ownership tax started in 1950, 5 years after World War II, the total number of vehicles registered was 337.4 thousand in the whole country. That is, the ownership ratio was only 250 persons/vehicle.
2) Vehicle fuel taxes were introduced one by one, starting with the 'Gasoline tax' in 1954, 'Local road tax' in 1955, 'Diesel tax' in 1956 and 'LPG tax' in 1966.
3) 'Light vehicle tax', this is very exceptional in Japan, small vehicles with an engine capacity of less than 360cc (now 660cc) belong to different taxation streams from ordinary vehicles, introduced in 1958.
4) At last, two kinds of taxes for the special account, 'Vehicle purchase tax' and 'Vehicle tonnage tax' were introduced in 1968 and 1971, in order to secure the increasing financial requirements, respectively.
5) In addition to the above taxes, the 'General sales tax' has been imposed since 1989 in the same manner as for other general consumer goods.

Each tax has been revised several times towards the increasing directions since their introduction, in accordance with the increment in required road investments.

Table 26.3-3 Historical Trend of Vehicle Related Taxes in Japan

Item / Year	Vehicle Pur-chase (%)	Vehicle Owner-ship (000)	Light Vehicle (000)	Vehicle Ton-nage (000/ton)	Gaso-line (/liter)	Local Road (/liter)	Diesel (/liter)	LPG (/kg)	Gen-eral Sales (%)	Total No. of Vehicles (000)
1950		¥ 24.0								337.4
1954					¥ 24.3					
1955						¥ 4.4				900.8
1956							¥ 15.0			
1958			¥ 4.5							
1966								¥ 5.0		8,123.1
1967								¥ 10.0		9,639.4
1968	3.0%									11,690.8
1970								¥ 17.5		16,528.5
1971				¥ 5.0						18,919.0
1974	5.0%			¥ 10.0	¥ 29.2	¥ 5.3				25,962.9
1975				¥ 12.6						27,870.5
1976		¥ 31.5	¥ 5.9		¥ 36.5	¥ 6.6	¥ 19.5			29,143.4
1979		¥ 34.5	¥ 6.5		¥ 45.6	¥ 8.2	¥ 24.3			35,179.5
1984		¥ 39.5	¥ 7.2							44,558.8
1989									3%	55,136.6
1993					¥ 48.6	¥ 5.2	¥ 32.1			64,498.3
1997									5%	71,775.6

Source: Road Pocket Book 2004, MLIT

26.3.4. TOTAL BUDGET FOR ROAD INVESTMENT

As the result of the government efforts to increase the levy of these taxes, the total amount has reached ¥ 9,160 billion (US$ 832.7 million) in 2001.

On the other hand, financial resources of government budgets for roads are composed of three categories in addition to a certain amount from the above-mentioned tax revenues: national government revenue, local government revenue and national financial investment and loan (*zaitou*). The total budget amount for road sector investments counted for ¥ 11,190.8 billion (approximately US$ 102,000 million) at the beginning of the 2003 fiscal year. Each composition share in the total budget is 32%, 52% and 16% respectively. Details are tabulated in Table 26.3-4. The significant contribution by fuel taxes in the national budget and the budget from the general accounts in the local government can be found respectively among a variety of financial resources.

Table 26.3-4 Composition of Budgets for Roads, 2003

Budget for National Government			Budget for Local Government			Others
	¥ in billion	%		¥ in billion	%	National Investment and Loan (¥ in billion)
Gasoline tax	2,813.4	78.9	Local road tax	301.3	5.1	
LPG tax	14.0	0.4	LPG tax	14.0	0.2	
Vehicle tonnage tax	574.2	16.1	Vehicle tonnage tax	352.3	6.0	
General account	89.5	2.5	Diesel tax	1,128.3	19.2	
Others	74.6	2.1	Vehicle purchase tax	454.8	7.8	
			General account	3,615.3	61.6	
Total	**3,565.6**	100	Total	**5,866.0**	100	**1,759.2**
Burden by car users	3,476.2	**98%**	Burden by car users	2,250.7	**38%**	
Total composition: **32%**			Total composition: **52%**			**16%**

Source: 2003 Yearly Research Paper of Automobile Transport Institute

Historical trends of budgets for roads are tabulated with the composition of financial sources in Table 26.3-5.

Table 26.3-5 Historical Trends of Budgets for Roads

Year	National Budget	Local Budget	Investment Loan	Total		Composition		
	(1) ¥ in billion	(2) ¥ in billion	(3) ¥ in billion	¥ in billion	Growth to Previous year	(1) %	(2) %	(3) %
1980	1,937.9	2,624.9	1,266.1	5,829.0	3.2%	33	45	22
1985	2,101.4	3,407.2	1,678.8	7,187.4	8.7%	29	47	23
1990	2,722.2	5,590.0	2,420.6	10,732.8	6.6%	25	52	23
1995	4,347.2	7,830.0	3,097.3	15,274.5	12.3%	28	51	20
2000	4,285.2	6,530.5	1,952.9	12,768.6	-5.4%	34	51	15
2003	3,366.2	5,380.3	1,758.6	10,505.1	-7.4%	32	51	17

Source: Road Pocket Book 2004, MLIT

The previous Table shows the continuous increase of budgets until the 1990s, a growth of almost three times during 15 years from 1980 to 1995, but decreasing trends after 1995 because of the influence of the general recession.

The importance of road investment can be proved from the fact that it continues to certain shares to GDP (3%) and among general public investment (30%) since 1980, even though there are very wide fluctuations of those amounts as shown in Table 26.3-6.

Table 26.3-6 Road Investment and National Economy

Year	Total Investment For Roads (1)	Gross Domestic Products (2)	Comparison (1)/(2)	National Budget For Roads (3)	General Public Investment (4)	Comparison (3)/(4)
	¥ in billion	¥ in billion	%	¥ in billion	¥ in billion	%
1980	5,829.0	245,546.6	2.37	1,910.8	6,355.1	30.1
1985	7,187.4	330,968.9	2.17	1,826.0	6,207.6	29.4
1990	10,732.8	451,472.8	2.38	2,087.3	7,255.0	28.8
1995	15,274.5	504,037.5	3.03	2,586.5	9,171.5	28.2
2000	12,768.6	515,477.9	2.44	2,718.2	9,362.5	29.0
2003	10,505.1	497,900.0	2.11	2,574.3	8,024.5	32.1

Source: Road Pocket Book 2004, MLIT

26.4. INITIAL IDEAS TO INCREASE FINANCIAL SOURCES

In this section, some initial ideas are described as candidate measures to collect additional taxes and fees mainly from private car users/owners. This is based on the principal of self-burden by beneficiaries. Since this is at the Master Plan stage, and these are preliminary examinations without deep discussions with Peruvian counterparts, due considerations are necessary for its implementation to get a minimum consensus in a further stage.

26.4.1. SOME CANDIDATE IDEAS

Possible measures to procure the investment funds for urban transport infrastructure through the revision of tax rates can be suggested as follows:

(1) Revision of Taxation System Related To Vehicles

1) Additional Tax in Gasoline for Specific Purpose

Though the present gasoline price already includes a certain amount of various taxes such as IGV, ISC and others, one of the rational measures based on the policy of 'self burden by beneficiaries' is additional tax in gasoline for specific purpose. In the case of Japan, it counts for ¥ 48.6/liter (approximately 48% of the retail price) and contributes a significant share of the total national government budget source for roads. As the existing tax rate and unit price of gasoline in Peru already reaches a high level in comparison to other countries, careful consideration should be taken in the additional increase rate of the tax.

2) Vehicle Ownership/User Tax

Although there is a vehicular property tax in Lima for the newly registered vehicles (during the first three years), all the vehicles in use should burden some kind of tax because of the policy of 'self burden by beneficiaries'. A proposal of conversion of existing vehicular property tax to vehicle ownership/user tax is very rational, as far as they are in use. Additional advantage by the introduction of this tax is to secure the correct vehicle registration system in consideration of new registration and abandonment.

For instance, in Japan, the vehicle ownership tax started in 1950, 5 years after World War II, when the total number of vehicles registered was 337.4 thousand in the whole country. That is, the ownership ratio was only 250 persons/vehicle, but the tax rate was very expensive, ¥ 24,000, equivalent to US$ 67/vehicle/year.

(2) Expansion of Toll Road System

A total of 32.4million vehicles traveling the toll roads, Panamericana Norte and Sur in the MML, derived a total revenue of S/. 87.5 million ($ 25.7 million) in 2001. The amount of 46% of the total income was spent for various project executions in 1997 according to EMAPE's annual report, and efforts are necessary to increase the investment amount as much as possible, as well as to examine the possibility of introducing the same toll system in other sections. The following trunk road sections could be diverted into toll roads with the installation of adequate facilities, in accordance with the professional judgment of the Study Team.

a) Av. Javier Prado,
b) Costa Verde,
c) Autopista, (Extention of Ramiro Prialé)
d) Av. Paseo de la República, and
e) Av. Elmer Faucett (This project is under construction by concession system.

(3) Introduction of New Tax (motor vehicle tonnage tax)

This is an idea following the case in Japan. This tax is levied as a specific purpose national tax in accordance with the tonnage of vehicles, together with the authorized vehicle inspection system every 2 years after the initial 3 years of a new model, since the damages of roads basically depend on the squared-weight of the vehicle. The tax rate varies widely by vehicle characteristics; type of vehicle, size, type of use (private or commercial), etc.. The tax rate for a popular small passenger car (its weight = 1 ton) of private use is $ 250 per 2 years. This tax was introduced in Japan in 1971, when the vehicle ownership rate was 5.6 persons/vehicle.

It is not too early to introduce this tax in the MML, judging from the vehicle ownership ratio of 9.5 persons/vehicle in 2003, apart from the applying tax rate.

(4) Parking Charge on Roadsides

There are many arterial/collector roads installed with roadside car parking spaces even in the central business and commercial area in the MML as a result of rather wide road width and dense road networks. The users who occupy the public road-space as their own parking lots should pay a certain cost to the local government. Though some district governments collect parking fees at the roadsides, these revenues can be transferred as one of the resources for the investment of urban transport improvement and not for expenses of the district governments themselves.

(5) Justification of Financial Transfer from the Central Government to the Metropolitan Area

The economic roles of the metropolitan area are remarkably significant, as shown in the various shares of indicators to the whole country such as GRDP (48%), population (30%), number of vehicles (65%), gasoline consumption (80%), etc. The concentration of traffic demand into and within the metropolitan area causes various problems and results in an inefficient economic situation. In this Master Plan study, quantified economic benefits, travel time saving cost and vehicle operating cost, exceed the economic investment cost and the proposed Master Plan was proved economically feasible. On the other hand, it is evident that there is a shortage of financial abilities in the local governments of Lima and Callao to implement the projects proposed in the Master Plan.

Accordingly, it is necessary to reconsider the subsidy or financial transfer in order to succeed in the completion of all the projects, as much as possible apart from the decentralization policy.

(6) Burdens by District Governments

When the total current revenues of the MML and other districts in Lima are compared, there is a very big discrepancy between the two, districts have more than double the revenues of the MML: S/. 355.4 million of the MML vs. S/. 841.7 million of the other 42 districts in the province of Lima in 1999 (most updated available data). Therefore, a possibility of burdens by district governments should be discussed and examined, since all the residents can enjoy a certain amount of benefits even from the common and inter-district urban transport services.

26.4.2. INITIAL ESTIMATION OF SOME IDEAS

(1) Additional Gasoline Tax

The present composition of gasoline taxes, for example, *Gasolina '84*, is: S/. 4.62 (IGV=1.39, ISC=2.90, other tax=0.33) with a retail price of S/. 9.73 per gallon as of August 2004, that is 47% of the retail price is occupied by taxes. The retail price of S/. 9.73 per gallon ($ 0.76 per liter) seems to be at a sufficiently high level in comparison with that of $ 0.90 to $ 1.00 in Japan, and there may only be a limited allowance to add further taxes.

Meanwhile, approximately 80% of the total motor vehicles are being operated in the Metropolitan Area of Lima and Callao and the total consumption of gasoline in Peru was 266,175 thousand gallons in 2002, excluding diesel.

If only 10 to 20% of the existing ISC in gasoline is increased for the specific purpose, the local government can procure an amount of $ 8.2 million to $ 36.4 million per year. The retail price will increase in S/. 10.02 to S/. 10.31 per gallon from S/. 9.73 and this is equivalent only to 3 to 6% of increase in unit price.

Additional increase: 266,175 X 0.8 X 2.90 X (0.10~0.20)= S/. 61.8~123.6 million per year = $ 18.2~ 36.4 million/year

When the annual increase of vehicle ownership (2.73% in ownership ratio and 4.22% in number of vehicles) is applied for future estimation, there will be $ 21.7~43.5 million in 2010 and $ 34.8~69.5 million in 2025.

The retail price of gasoline in Peru has risen very widely and frequently these years because of the incredible hike of the crude oil price all over the world. The retail price of gasoline '97, for instance, is S/. 13.34 per gallon in February 2005 in comparison to S/. 12.22 in February 2004(13% per annum), and diesel had an increase of 22.8%. Although this is because of the direct imputation to the retail price, not due to the revision of taxation, an additional revision will be hardly acceptable by the public under this situation. As this is one of the most rational measures in developed countries, it might be almost impossible to execute in Lima under these circumstances.

(2) Vehicle Ownership Tax

As described before, it is necessary and rational to consider that all of the vehicles in use, not only for the initial 3 years, should burden some kind of tax because of their huge benefits from using public spaces and facilities.

When the new vehicle ownership/user tax system is applied to all of the registered vehicles in the Metropolitan Area of Lima and Callao (825thousand in 2002), $ 82.5million per year can be collected. (Assumption: $ 100/vehicle per year, in comparison with $ 400 in Japan. Amount of ¥ 24,000, equivalent to US$ 67, was levied in 1950 when vehicle ownership tax was introduced in Japan, and the vehicle ownership ratio was 250 persons per vehicle at that moment.)

Additional advantages of the introduction of this tax include securing a correct vehicle registration system in consideration of both new registrations and abandonment.

The tax revenue will count for $ 98.5 million in 2010 and $ 157.6 million in 2025 in accordance with the increase of vehicles.

(3) Vehicle Tonnage Tax

This is an idea following the case in Japan and the tax rate varies widely by vehicle characteristics; type of vehicle, size, type of use (private or commercial), etc. As the details of the tax rate will be decided in consideration with the status in Lima, it might be possible to apply the average rate of $ 50 per every 2 years for all the vehicles in the Metropolitan Area of Lima and Callao (825.1 thousand in 2002). The total amount is estimated at $ 20.6 million per year. This amount will also increase to $ 24.6 million in 2010 and to $ 39.5 million in 2025.

Moreover, this vehicle tonnage tax collection is executed at the time of the other authorized vehicle inspection systems in Japan, which is quite important from other viewpoints of traffic safety and urban environment, etc., and the introduction of the system was recommended in the traffic management planning of this Master Plan.

(4) New Toll Roads

The traffic demands at the major sections of 5 arterial expressways selected in the previous section are summarized in Table 26.4-1.

Table 26.4-1 Estimated Traffic Volumes on Major Expressways

(Unit: 1000 Vehicles/day)

Expressways	2004			2010			2025		
	Car	Taxi	Truck	Car	Taxi	Truck	Car	Taxi	Truck
Javier Prado	69.8	63.7	1.3	68.3	65.7	1.3	73.9	78.4	2.8
Costa Verde	13.4	14.0	1.7	16.8	21.6	3.1	26.2	55.2	7.4
Autopista	5.4	3.4	7.2	12.3	18.9	8.7	14.1	22.4	4.6
Paseo de la República	41.4	49.9	1.3	47.3	58.9	4.3	48.5	56.9	4.1
Elmer Faucett	16.1	24.1	4.6	21.1	35.9	7.8	30.0	61.0	7.8
Panamericana Norte	25.7	31.2	8.5	32.1	49.3	7.3	34.6	52.0	10.1
Panamericana Sur	39.6	31.9	9.7	34.2	42.9	11.1	44.5	64.8	11.1

Source: JICA Study Team

These traffic volumes are converted into yearly volumes when multiplied by 330, and two alternative cases are assumed: one is 'levy S/. 3.0 only from cars' and another is 'levy from all'.

In total, amounts of $ 47 million in 2010 & $ 55 million in 2025 (case 1) and $ 111 million in 2010 & $ 140 million in 2025 (case 2) will be derived from new toll road systems, respectively and at least 50% of the toll revenue will be provided for the investments.

(5) Trunk Bus Users

When the trunk bus system is introduced, the users can enjoy their benefits compared with the users of conventional buses, they even burden an additional fare for the new service, such as shorter travel time, comfort and so on. In case the unit fare of the trunk bus system is assumed at S/. 1.5 per ride, half a Sol higher than that of the present ordinary bus, almost half of this discrepancy (S/. 0.25 per passenger) can be invested for the improvement projects of trunk bus system facilities.

The forecasted numbers of passengers based on the daily demand are 1,563 million/year in 2010 and 2,170.6 million/year in 2025. Estimated amounts of $ 111.7 million in 2010 and $ 155.0 million in 2025 will be assigned as a source of investment funds.

(6) Urban Train Users

As well as the trunk bus users, some burdens by train passengers can also be examined. Based on the estimated demands of 645.0 million passengers in 2010 and 1,681.1 million passengers in 2025, available resources of the fund can be calculated in $ 46.1 million in 2010 and $ 120.1 million in 2025, respectively.

Table 26.4-2 Estimated Total of Public Passengers

(Unit: thousand passengers/day)

Items	2004	2010	2025
Conventional Bus	18,909	12,973	8,781
Trunk Bus	0	5,210	7,235
Urban Train	0	2,150	5,604
Total	18.909	20,333	21,620

Source: JICA Study Team

(7) Reduction of Investment Costs

As various examinations have been done in the previous sections to find the incremental possibilities of fund resources, there are other ways to reduce the investment costs in order to realize the proposed projects. Some of the following ideas are considered.

1) Review of the Investment Costs in Direction of Cost Reduction

As each cost estimation in this Master Plan has been done based on the existing conditions and experiences in Peru, there might be some room for revision from the viewpoint of cost reduction. Necessary costs will be reexamined in the following further stages for implementation, e.g. feasibility study and detail design stages, in detail and with more accuracy.

Since the investments for urban transport infrastructure are rather huge at the initial stage of development, the burdens by public sector seem to be impossible. They are, however, served to the public for long periods and should be sustained in accordance with the increasing future demands. Careful examinations, therefore, are necessary not only from the viewpoint of an initial cost reduction but from the total necessary costs during the whole life of the project considering the necessary maintenance and operation costs following the inauguration of the project.

The following points are observed:

2) Reduction of Costs in Coaches and Bus Fleet

In the case of the railway project, over half of the total cost depends on the purchase of new coaches/rolling stock. When the private concessionaire operates with its own burden of rolling stock, $ 1,223 million can be reduced from the total necessary investment amount of $ 2,025 million (60% of the total). The use of second-hand coaches instead of new coaches allows a 65% reduction ($ 1.223 million to $ 430 million).

Also, regarding the trunk bus system, when its private operating body burdens the amount of the fleet necessary for the trunk-bus system, $ 463 million will be neglected from the investment amount by the public sector. Though it is possible to introduce a used bus fleet from the viewpoint of cost savings, it is not recommendable from the environmental viewpoints as well as attractiveness of users.

3) Use of Official Development Assistant (ODA) Loan

ODA loans with various advantages to the borrowers, such as very comfortable conditions of low interest rates, grace period, etc., are exactly one of the key solutions in order to support the financial shortage for infrastructure developments in developing countries, both of multilateral or bilateral.

In fact, the COSAC project, at a total cost of US$ 134.4 million, by PROTRANSPORTE, is being implemented under IBRD and IDB loans (US$ 45 million each). However, the review of the borrower's condition by the WB pointed out some difficulties and problems in the appraisal documents such as:

a) Necessity of institutional strengthening,
b) Lack of timely counterpart funding,
c) Slow implementation,
d) Monitoring and evaluation mechanism in PROTRANSPORTE,
e) Planning for the long-term with flexibility, etc.

Therefore, it is necessary to improve the circumstances to cope with the creditors' conditions to secure smooth loan agreements.

Example conditions of JBIC loans, Japanese ODA loans for the group of countries with per Capita GNP of US$ 1,416~2,935 (Peru belongs to this category), are summarized in Table 26.4-3.

Table 26.4-3 Basic Condition of JBIC Loan

Conditions	Interest	Repayment (Grace)	Tied/Untied
Ordinary condition	1.50%	25 (7) years	Untied
Advantage condition	0.75%	40 (10) years	Untied
STEP	0.40%	40 (10) years	Tied

Source: JBIC web site

26.4.3. EXPECTED BALANCE

The results of the above examinations are summarized as follows:

(1) Examination of All Master Plan Projects as a Whole

At first, total necessary investment costs of $ 5,535 million are compared with the proposed additional financial resources.

As the existing ordinary local government revenues will continue in the future with its previous tendency of increase, these amounts will be spent for ordinary purposes that are not included in the proposed Master Plan. The judgment is tested whether newly proposed projects are possible or not from the viewpoint of financial satisfaction.

1) Total Necessary Project Costs

As the original estimated total cost in the Master Plan is $ 5,535 million, various ongoing or committed projects are included within that amount. They are the following:

a) (RP-15) Elmer Faucett: $ 59.4 million (ongoing under concession),
b) (TP-01) Line No. 1(1): Completed, and
c) (BP-01) Av. Grau: $ 32.4 million.

In addition to the above, the following two projects might be neglected from this assessment, but they are included because the examination will be on the safe side and there are some uncertainties in the implementation.

a) (TP-02) Line No. 1(2): $ 355.4 million (proposed under concession) and
b) (BP-02) COSAC Project: $ 134.4 million out of $ 222.2 million.

On the other hand, cost reduction can be possible through cost savings of coaches and bus fleets as explained before. That is:

a) Applying used coaches: $ 795 million, or
b) All coaches by private concessionaire: $ 1,223 million, and
c) All bus fleet by private concessionaire: $ 463 million.

The total necessary cost for the entire Master Plan projects accounts for $ 5,443 million to $ 3,757 million from 2005 to 2025, this is equivalent to $ 259 million per year to $ 179 million per year.

2) Available Total Funds and Balance

The estimations of all possible measures result in $ 121~140 million in 2004, $ 326~380 million in 2010 and $ 534~612 million in 2025. There are not too many discrepancies between case 1 (less case) and case 2, case 2/case 1 = 1.15, since the additional gasoline tax and the toll road fees share rather small portions to the total under the assumptions applied. In case 1, the major potions in the expected revenues are occupied by vehicle ownership tax (68%) in 2004, trunk bus fare (34%) and vehicle ownership tax (30%) in 2010 and by vehicle ownership tax (30%) and trunk bus fare (29%) in 2025, respectively.

When the less case is selected and a very simple linier interpolating method is applied for the calculation of the total cumulative amount from 2005 to 2025, the total possible revenue will amount to $ 7,245 million.

Table 26.4-4 Available Funds in Basic Years

(US$ million)

Case 1	Gasoline Tax	V. Ownership	V. Tonnage	Toll Roads	Trunk Bus	Urban Train	Total
2004	18.2	82.5	20.6	0	0	0	121.3
2010	21.7	98.5	24.6	23.5	111.7	46.1	326.1
2025	34.8	157.6	39.5	27.3	155.0	120.1	534.3

Case 2	Gasoline Tax	V. Ownership	V. Tonnage	Toll Roads	Trunk Bus	Urban Train	Total
2004	36.4	82.5	20.6	0	0	0	139.5
2010	43.5	98.5	24.6	55.5	111.7	46.1	379.9
2025	69.5	157.6	39.5	69.8	155.0	120.1	611.5

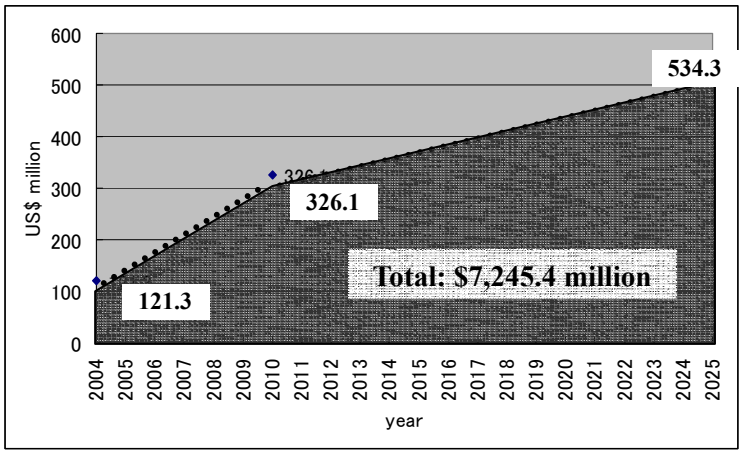


Figure 26.4-1 Total Available Revenues

This results, even in the less case, in a sufficient amount of total budget exceeding the total project cost and it reaches 1.3 times of the maximum project cost of $ 5,443. Therefore, it is possible to neglect the additional gasoline tax that seems to be very hard to execute and to reduce the rate of some additional taxation proposed hereinbefore.

(2) Examination by Stage

More detailed analysis were also carried out.

1) Available Revenue Estimation by Year/Stage

Regarding the financial revenue trends, the implementation schedule of related proposed projects is considered in the yearly estimation, such as urban train, trunk bus and expressway development projects, during the period of 2005 to 2010. The interpolating method with annual average growth rates is also applied for the estimation after 2010.

When the actual schedule of both taxation revisions and related project implementation is fixed, this estimation should be reexamined in accordance with the program.

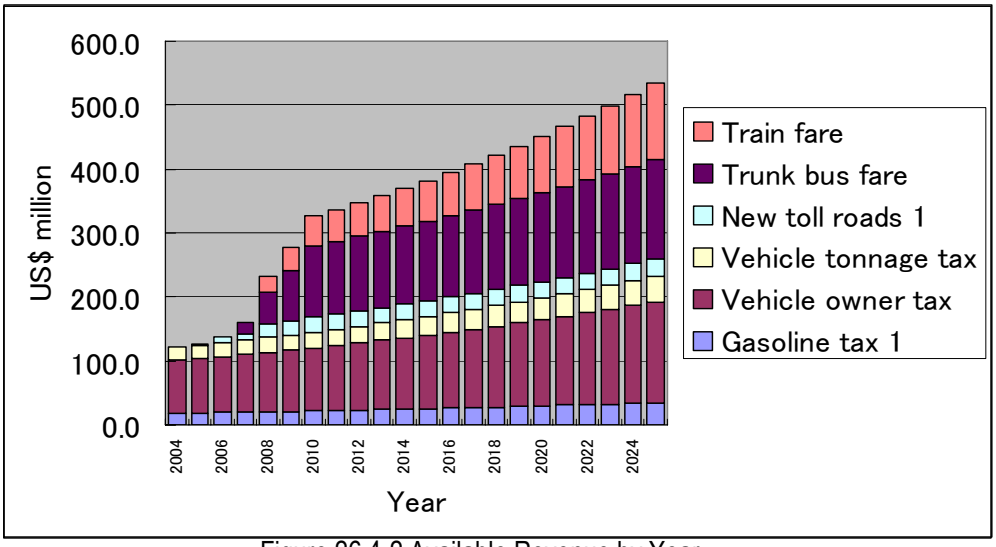


Figure 26.4-2 Available Revenue by Year

2) Allocation of cost by year/stage

The allocation of necessary project costs is proposed in Chapter 19 and this implementation schedule is applied for an examination of the balance between costs and revenues. The result is summarized in Figure 26.4-3.

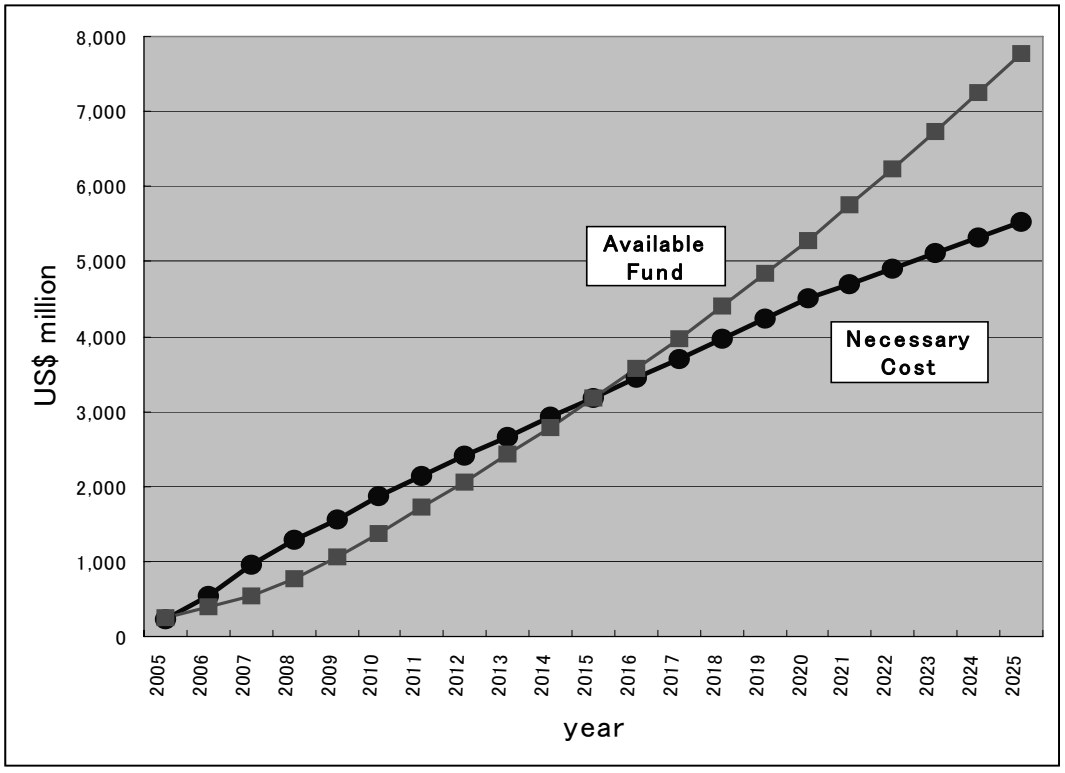


Figure 26.4-3 Balance of Revenue and Cost

In this case, the total amount of accumulated budgets will reach the necessary accumulated costs in the year 2015 and this means that the discrepancies until that year should be covered by some ODA loans or other cost reduction measures in order to satisfy all the proposed projects, even under such desirable finance conditions. Regarding the private participants and the implementation of urban transport infrastructure development, basic explanations are presented in other chapters of the study.

(3) Alternative test

An alternative case of financial analysis is also examined for the assessment of the Short-term plan (from 2005 to 2010).

Major assumptions are:

a) Additional gasoline tax is not introduced until 2010.
b) Other proposed measures are carried out from 2005.
c) Selected projects for short-term action plan are referred to in the list of Chapter 22.
d) The three projects currently under construction, Av. Grau ($ 27.1 million), COSAC Project ($ 189.1 million) and Av. Elmer Faucett ($ 59.4 million), are excluded in this examination.
e) Two alternative cases of cost, 'with costs of buses & coaches' and 'without costs of buses & coaches', are examined.

1) Necessary cost

In this section, necessary cost is calculated by eliminating the costs of on-going projects from the original list in Chapter 22, two trunk bus projects (Av. Grau: $ 42.9 million and COSAC Project: $ 189.1 million) and one road project (Av. Elmer Faucett: $ 59.4 million), which are summarized in Table 26.4-5.

Table 26.4-5 Summary of Costs for Short-term plan (excludes on-going)

(US$ million)

Items	Infrastructure	Bus & Coach	Total
Railway Project	238.4	138.2	376.6
Trunk Bus Project	216.2	107.0	323.2
Road Project	230.4	0	230.4
Traffic Management Project	73.0	0	73.0
Total	758.0	245.2	1,003.2

2) Available funds

Available funds, which consist of 5 kinds of new revenue for the urban transport projects, are also tabulated in Table 26.4-6.

Table 26.4-6 Summary of Available Funds, 2005-2010

(US$ million)

Items	2005	2006	2007	2008	2009	2010	Total
Vehicle ownership tax	85.0	87.5	90.1	92.8	95.6	98.5	549.5
Vehicle tonnage tax	21.2	21.9	22.5	23.2	23.9	24.6	137.3
New toll roads	2.4	8.6	8.9	21.1	21.4	23.5	85.9
Trunk bus fare	0	0	17.6	49.0	80.3	111.7	258.6
Urban railway fare	0	0	0	25.2	34.1	46.1	105.4
Total	108.6	118.0	139.1	211.3	255.3	304.4	1,136.7

1) Comparison

When both factors estimated in the previous tables are compared, the proposed new revenues can completely cover the total costs, not only the infrastructure but including both buses and coaches. The comparison ratio of revenue by fund is 1.13, this shows almost a very comfortable situation between the two.

In the case that all the buses and coaches are the responsibility of the operators themselves, the estimated new revenues can cover the necessary investment costs of infrastructure, that is, 1.5 times of necessary costs can be derived from the expected funds. This means, in the case of PFI applied, short-term plans can be executed with only 70% of the new additional revenue systems, in order to cope with this requirement.

In any event, the financial conditions of the implementation environment are very desirable as far as the proposed new strategies to increase the possible public revenue improvements are executed. Therefore, all the relevant agencies and government officers should make every effort to achieve the performance of the proposed measures to secure the self-financing of urban transport improvements.

26.5. PRIVATE SECTOR PARTICIPATION

As there are several measures to reduce financial burdens by the public sector, introducing the participation of the private sector in the field of transportation developments, the concession system is rather popular in Latin American countries.

Since some descriptions were already done in Chapter 25 (25.3.3), additional items are explained in this section.

26.5.1. GENERAL

As there are many examples of private participation in infrastructure developments since the1980s, the examples in developing countries during the 1990s are summarized in Table 26.5-1.

This is based on the database of the World Bank's Private Participation in Infrastructure (PPI) group and these projects include all divestitures, concessions (under which a private entity leases the assets and agrees to invest during the period of the contract), franchises, and operation and maintenance contracts (which award the right to operate and maintain the facility for a specified period) during the years.

Table 26.5-1 Number of PPI in the 1990s

(Value: in million US$)

Project	No. & Value	Africa	East Asia	Eastern Europe	Latin America	Middle East	South Asia	Total
Airport	Number	3	5	5	11	0	1	25
	Value	58.8	2,597.4	694.1	388.3	0	125.0	3,863.6
Port	Number	3	36	3	36	5	7	90
	Value	0	5,086.2	0	1,704.9	370.5	833.1	7,994.7
Railway	Number	3	7	1	26	0	0	37
	Value	0	7,483.3	0	6,208.1	0	0	13,691.4
Road	Number	5	102	2	93	0	6	208
	Value	426.0	18,567.0	1,086.0	18,794.8	0	63.5	38,937.3
Total	Number	14	150	11	166	5	14	360
	Value	484.8	33,733.9	1,780.1	27,096.1	370.5	1,021.6	64,487.0

There were many projects in every sector of transportation in Latin America under the preferable economic environments in that period.

The PPI, or privatization, is a broad concept that hides many forms of private participation. There are four categories:

1) Divestiture: The actual sale of public assets to the private sector can be accomplished through public offering of shares or private sale of assets.
2) Greenfield Projects: Under this approach the government commissions new investment projects to a private owner (built-operate-transfer (BOT) contracts are among the most common type). The development of new financing techniques that reduce or better allocate the risks of financing new infrastructure projects is one reason that Greenfield projects have been successful.
3) Operation and Maintenance Contracts: This option calls for a private operator to manage and maintain the service but does not include investment obligations. The operator assumes the risk of operating and maintaining the service, and the government retains the investment risk. These contracts are typically awarded for a given period (two to five years).
4) Concession Contracts (Franchises): This contract (10 to 30 years) assigns responsibility for operations and maintenance to a private operator that assumes both investment and service obligations. Many governments prefer this approach to divestiture because it does not imply a politically sensitive transfer of ownership of public assets to the private sector.

In developing countries, especially in Latin America, concessions are the most common form of PPI in every transport sector, in the meantime, BOT projects have been successful in East Asia during the past years.

Table 26.5-2 Types of PPI by Region

Project	Africa	East Asia	Eastern Europe	Latin America	Middle East	South Asia
Divestiture	0	8	5	6	0	0
Greenfield	1	49	1	8	2	6
O&M	10	10	1	12	2	0
Concession	3	83	4	140	1	8
Total	14	150	11	166	5	14

Table 26.5-3 Types of PPI by Sector

Project	Airport	Port	Railway	Roads	Total
Divestiture	2	6	4	7	19
Greenfield	5	32	6	24	67
O&M	3	21	4	7	35
Concession	15	31	23	170	239
Total	25	90	37	208	360

The recent financial crisis, however, essentially froze most project financing activities in developing countries, resulting in the reallocation of financial flows to industrial countries. And this situation makes it necessary for the government to provide more comfortable conditions for the private sector in order to attract their interests.

As explained above, the concession system is rather easily introduced in urban transport infrastructure improvement and several projects in the Metropolitan Area of Lima and Callao are actually under process or under study.

26.5.2. PPI EXAMPLES IN THE STUDY AREA

(1) Av. Elmer Faucett

The concession contract was signed between the conceder of the Provincial Municipality of Callao and the concessionaire of CONVIAL CALLAO S.A. on February 15th, 2001.

As the concession contract document consists of 22 articles (28 pages), together with various attachments/amendments,, major conditions of the contract are:

a) This is the toll road project by private concessionaire.
b) Concession includes design, construction, supervision, maintenance and exploitation of the expressway.
c) Concession period is 30 years.
d) Guarantee of US$ 1.5 million by concessionaire.
e) Average unit toll is US$ 0.71 (February 2000 base) including general sales tax (IGV) of 18%.

This project is now under construction and some conditions are being amended in accordance with the necessity, moreover, the operation of toll collection has not started yet. Accordingly, it is not possible to justify the condition of concession and the project will be evaluated in the future.

(2) COSAC Project by PROTRANSPORTE

This project, trunk bus-way project along Av. Paseo de la República, is now being prepared by PROTRANSPORTE under the MML. Financial resources consist of self-financing of the MML and ODA loans from IDB & WB. The outline of this project, regarding PPI, is the following:

a) The project will be completely presided by PROTRANSPORTE.
b) The assets of infrastructure will be transferred to the local government of the MML.
c) A consultant, under INVERMET, is now carrying out the Economic Financial and Institutional (EFI) Study.
d) PROTRANSPORTE has the idea of introducing concession systems for bus operations (bus operation, ticketing, advertisement, related business and so on, independently).

e) Public companies, with capital investment by the MML, for these operations are under consideration, and the establishment of new public entities is possible without the consent of Congress.
f) The fare of the COSAC Project will be decided at the lower level for the poor population and the repayment of the loans will be executed by general expenditure of the MML, not by fare revenue.

(3) Extension of Urban Railway Line No. 1 (Villa El Salvador to Av. Grau)

As the details are explained in Chapter 15, only summarized points are described in conjunction with PPI.

Though various processes have been examined and implemented by AATE for the extension of the existing 9.8 km of line No. 1, since its demonstrative operation at the beginning of 2003, the commercial operation has not been initiated yet.

Major activities since 2002 are:

a) AATE is responsible for the construction and operation of line No. 1: June, 2002.
b) All of the existing assets were transferred to AATE: May, 2003.
c) Concession system was selected for the implementation and CEPRI-Lima began the initial concession study.
d) The concessionaire will be selected by international tender.
e) The concession documents were published and 9 entities received the documents.
f) The Government of Spain declared an offer of finance (interest rate: 0.5% for half of the amount, and 4.7% for half = 30 years repayment with 3 years grace):
g) The Process of financial agreement is being discussed with the Ministry of Economy and Finance.

The conditions of the concession have been amended frequently and the latest ones are presented below:

a) Concessionaire can own and use every existing facility, such as infrastructure, E/M, depot and coaches, without any expense.
b) Concessionaire invests about US$ 150 million for additional investments.
c) Construction period is 3 years.
d) Concession period is 30 years.
e) Concessionaire can be exempted from duties.
f) Infrastructure will be owned by the MML, operation by concessionaire and AATE will supervise the concessionaire.

CHAPTER 27
Recommendations

27. RECOMMENDATIONS

(1) The Urban Transport Master Plan should be realized in Accordance with the Implementation Schedule.

As a result of the future socio-economic framework study, the population in the Study Area (Lima and Callao Metropolitan Area) in 2004 and 2025 is estimated at about 8 million and 11 million habitants, respectively. In comparison with the year 2004, in the year 2025 the population increased by about 3 million persons, the GRDP per capita increased about 1.78 times, the total trips (excluding walk) per day in the Study area increased about 1.46 times, and the number of private vehicles increased about 2.48 times. Taking into account the above socioeconomic framework and traffic demand in the year 2025, it is clear that the heavy traffic congestion will be expanded throughout the study area and the existing air pollution will also worsen

The projects recommended by the Urban Transport Master Plan will provide the following contributions detailed below. Considering the large-scale effectiveness of the projects, the Urban Transport Master Plan should be realized in accordance with the recommended implementation schedule.

a) To mitigate the heavy traffic congestion and to improve the transport service level.
b) To contribute reducing the Carbon Dioxide (CO_2) vehicle emission.
c) To increase economic and social activities.
d) To contribute to the improvement of poverty life conditions.
e) To contribute in setting up to maintain a modernized transport system.

(2) The Recommended Projects in the Urban Transport Master Plan

1) The Recommended Projects for the Long-Term Plan in 2025

A total of 67 package projects are recommended by the Long-Term Urban Transport Master Plan in the Lima and Callao Metropolitan Area (2025). The Urban Transport Master Plan is economically and technically feasible, and it also contributes in decreasing the air pollution, mitigation of traffic congestion, and improvement of transport services level. The total project cost is estimated at US$ 5,535 million (2004 prices). The investment allocation is about 54.3% of the total amount for public transport development projects, about 42.9 % for road development projects, and about 2.8 % for traffic management projects.

The Urban Transport Master Plan has recommended the following projects:

a) Railway development projects---------6 projects
b) Trunk Bus development projects-----18 projects
c) Road development projects----------33 projects
d) Traffic management projects----------10 projects

2) The Recommended Projects for the Short-Term Action Plan in 2010

Based on the Urban Transport Master Plan, the following 33 projects are recommended as Short-Term Action Plan projects for the Urban Transport Master Plan in 2010.

a) Railway development projects----------2 projects (Line-1)
b) Trunk Bus development projects------13 projects
c) Road development projects----------10 projects
d) Traffic management projects----------8 projects

All of the projects recommended by the Short-Term Action Plan in 2010 are economically and technically feasible, and will also contribute in decreasing the air pollution and in the mitigation of traffic congestion, as well as in the improvement of transport services. The total project cost is estimated at US$ 1,294 million (2004 prices). The investment allocation is about 72.0% of the total amount for public transport development projects, about 22.4 % for road development projects, and about 5.6 % for traffic management projects.

3) The Recommended Projects for the Urgent Action Plan

For mitigation of the heaviest traffic congested area, which is covered by Av. Javier Prado and Vía de Evitamiento, the following improvements of four (4) sections of road projects and two (2) traffic management projects should be implemented as soon as possible.

a) Improvement Project of Av. 28 de Julio
b) Improvement Project of Av. N. Ayllón
c) Intersection improvement Project on Av. 28 de Julio and Av. N Ayllón
d) Intersection improvement Project on Av. Ancash and Av. Riva Agüero
e) Traffic signal improvement Project on Av. Arequipa
f) TDM introduction projects

(3) Railway Development Projects (Mass Rapid Transit System) should be Realized.

At present time, in 2004, the mass number of bus passengers (25,000 to 35,000 persons /hour, direction, lane) are transported on each of the five (5) important transport axis. These figures obviously exceed the private car transport capacity (2,000 to 3,000 persons per hour, per direction, and per lane) and also the bus transport capacity (10,000 to 25,000 persons per hour, per direction, and per lane). The number of public transport passengers in 2025 on each of the five (5) important transport axis is estimated at about 50,000 to 60,000 (persons/hour/direction/lane). In addition, widening of the existing roads for increased transport capacity is extremely difficult, since many houses and commercial buildings have already been developed along the existing roads.

Considering the future public transport passenger demand, transport capacity on transport mode, existing road facility conditions, and natural-social environmental conditions, the construction of the Railway System is indispensable to succeed in having an effective transport system in the Study Area. In order to ensure the sound transport system and to decrease the CO_2 vehicle emission in the Lima and Callao Metropolitan Area, the railway development projects recommended by the Urban Transport Master Plan should be realized as soon as possible, including the feeder bus system to support the transport system of railway transport.

When the railway development projects are realized, the following effective measures are ensured.

a) To contribute in the mitigation of heavy traffic congestion.
b) To contribute reducing the CO_2 vehicle emission.
c) To contribute in the increase of socio-economic activities.
d) To contribute in the decrease of travel time.
e) To contribute in the decrease of gasoline consumption.
f) To contribute in the promotion of modern city structures.

In addition to the above, to introduce the railway development projects, the following advantages are pointed out considering the characteristics and conditions of transport facilities in the Study Area.

a) Use of the existing railway structures (about 9.2 km length).
b) The project cost can be decreased by using second-hand coaches.

c) The railway structure can be constructed without additional large-scale land acquisition and re-settlement since the railway can be constructed within the space of the existing roadway.
d) To re-develop, in the areas in front of railway stations and terminals, the economic activity conditions to be able to increase the number of railway passengers, as well as promote the modern city environmental conditions.

However, in order to realize the railway development projects, the following supporting systems should be reinforced.

a) The creation of a strong support system between the Local Government and the Central Government.
b) The creation of a strong support system between the Municipalities of Lima and Callao.
c) The creation of a strong support system between civilian and railway authorities.
d) The creation of a strong supporting system between railway authorities and private development companies.
e) The creation of a strong operation system between railway and feeder bus systems.

(4) Trunk Bus Development Projects should be realized

At present, bus exclusive roads have been constructed on the existing Av. Paseo de la República, Av. Brasil, Av. Grau, and short road segments of other roads, and the COSAC Project is also under construction on the existing Av. Tupac Amaru, Av. Ugarte, and extension of Paseo de la República. In order to mitigate the traffic congestion on the major existing congested bus routes, the trunk bus development projects, including the above-mentioned projects, should be constructed as soon as possible. When the trunk bus development projects are realized, the feeder bus system, with an integrated system at the bus terminals, should be developed as the same time

The trunk bus development projects have the following effective measures,

a) To contribute in the mitigation of heavy traffic congestion.
b) To contribute reducing the CO_2 vehicle emission.
c) To contribute in the increase of socio-economic activities.
d) To contribute in the decrease of travel time.
e) To contribute in the decrease of gasoline consumption.

In addition to the above, the trunk bus development projects have the following advantages,

a) Use of the existing bus exclusive road.
b) An effective trunk bus network can be created with the COSAC project.
c) The trunk bus exclusive road can be constructed without additional large-scale land acquisition and re-settlement since the bus road can be constructed within the space or area of the existing roadway.

(5) Traffic Demand Management (TDM) should be Realized

Even if all the projects recommended by the Urban Transport Master Plan are realized, the traffic conditions in the Study area in 2010 and 2025 would still be insufficient to ensure a good traffic service level. To improve traffic congestion and transport services without large-scale investments, the following two (2) traffic demand management (TDM) systems should be realized as soon as possible.

a) Traffic Signal Improvement Project.
b) TDM Introduction Project.

(6) Financial Resources

The total investment required to realize the Urban Transport Master Plan in 2025 is estimated at US$ 5,535 million. Comparatively, this required investment apparently exceeds the historical budget of the Municipalities of Lima and Callao. Taking into account the burden share of benefit, the following financial resources should be promoted.

a) Revenue from expansion of a toll road system.
b) Revenue from vehicle ownership taxes.
c) Revenue from vehicle tonnage taxes.
d) Revenue from railway and tram bus fare.
e) Use of ODA loan.
f) Reduction in the project cost by introducing used coaches.

In addition to the above, public facilities and infrastructure such as roads, buses and railways generate transport benefits to the users. Therefore, it is strongly recommended that the necessary funds be properly collected from the beneficiaries in proportion to the amount of the benefit account and the amount should be invested for facility/institution improvements.

(7) Institutional Reforms

To secure the realization of the comprehensive projects recommended by the Urban Transport Master Plan, it is necessary to create a new or reinforced existing organization system. The existing organization structures for the implementation of traffic and transport fields in the Lima and Callao Metropolitan Area are maintained by several individual authorities. Each authority has enough engineering technology for the transport aspects; however, it is very weak to promote and to realize the comprehensive transport projects. For a continuous execution and realization of the projects recommended by the Urban Transport Master Plan, a new organization structure, or strengthening of the existing organization structure, should be created to consider the following qualifications:

a) Organization should ensure a smooth and good coordination among related authorities,
b) Organization should maintain a strong and powerful capability, and
c) Organization should provide adequate technologies.

(8) Further Studies Needed

In order to advance the Urban Transport Master Plan, the following additional studies are required in the next stage.

1) Considering the importance of strengthening the public transport system in the Lima and Callao Metropolitan Area, a Feasibility Study should be conducted on the public transport network projects selected based on the Short-Term Action Plan in 2010 as soon as possible.
2) In accordance with the city grows the socioeconomic conditions in the Lima and Callao Metropolitan Area will change rapidly. Taking into account the change of socioeconomic conditions in the future, the Urban Transport Master Plan should be periodically reviewed and updated.
3) The large Scale Person Trip (PT) Survey and various traffic and transport surveys were conducted in the Study. Therefore, the data base of these surveys should be use actively for the further studies to be conducted.

(9) Obligations of the Lima and Callao Municipalities (Local Government)

In order to ensure sound traffic and transport conditions and good socio-economic and environmental conditions in the Lima and Callao Metropolitan area, the Municipalities of Lima and Callao (Local Government) should achieve the following actions as the coordinating authorities or bodies for the realization of the Urban Transport Master Plan.

1) The Local Government should carry out propaganda to the citizens regarding the importance of the realization of the Urban Transport Master Plan.
2) The Local Government should carry out measures to obtain the consensus of the citizens in the Lima and Callao Metropolitan area regarding the realization of the Urban Transport Master Plan.
3) The Local Government should create a strong and powerful executing authority for the realization of the Urban Transport Master Plan.
4) The Local Government should develop the public transport system, such as railway projects and trunk bus projects, as soon as possible.
5) The Local Government should be supported to develop the re-development projects in front of railway stations and terminals to increase the future railway passenger demand and the creation of a modern city.
6) The Local Government should discuss the total investment required for the realization of the Urban Transport Master Plan with the Central Government.