11.4. TRAFFIC DEMAND MANAGEMENT PLAN (TDM PLAN)

11.4.1. OBJECTIVES

The objective of traffic demand management plan is to mitigate the traffic congestion in specified area in the Lima Metropolitan area by introducing TDM technique, based on the assessment of TDM measures in major cities in the world.

11.4.2. SELECTION OF CRITICAL AREA FOR STUDY

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 TDM plan must consider how to create an attractive urban environment that is amenable to road users as well as pedestrians. In principle, the area for the TDM should be dealt with by the Lima Metropolitan area, or central city area.

11.4.3. IDENTIFIED TDM MEASURES

Many transportation demand management techniques have been considered, and implemented in major cities of the world. The target TDM scheme for the study will be selected by several impact assessments such as applicability and effectiveness, based on the practical sample of experience elsewhere in the world.

(1) Introduction of TDM Measures

This section summarizes the characteristics of major TDM techniques that may be considered for the study area as well. The measures of TDM are composed of twelve (12) typical schemes; alternative work schedule (flexitime, compressed workweeks, staggered shifts), car-sharing, traffic restricted residential area (traffic calming, traffic management), area-licensing system, auto-restricted zone in CBD, HOV (high occupant vehicle) priority, ridesharing, license-plate numbering system, parking pricing, busway (bus rapid transit, BRT, HOV lanes guideway), user taxes, and vehicle ownership restraints. The introduction of TDM measures, however, is not easy because the passenger car is restricted from freedom of use, though several countries in Europe, Asia and U.S. have introduced or discouraged ownership and use of private cars, are evaluated in the light of better public transport service. The outline of 12 typical TDM measures is described as below;

a) Alternative Work Schedule

The alternative work schedule can reduce peak period commute travel and help accommodate ridesharing and transit use. The alternative work schedule is also called variable work hours and includes flextime, compressed workweek, and staggered shifts.

- Flextime

This means that employees are allowed some flexibility in their daily work schedules, for example, rather than all employees working 9:00-18:00, some employees might work 8:00-17:00, or 10:00-19:00.

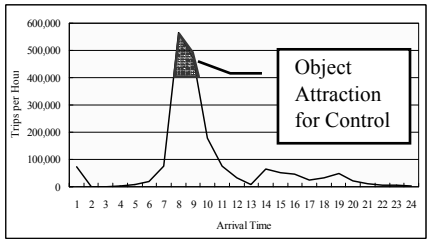

Figure 11.4-1Trips for Control

- Compressed workweek

This means that employees work fewer but longer days, for example, a 10-hour day with two days off each week, or 9-hour days with one day off every two weeks.

- Staggered shifts

This means that shifts are staggered to reduce the number of employees arriving and leaving a worksite at one time, for example, some shifts may be 8:00-16:30, others 8:30-17:00, and others 9:00-17:30. This has a similar effect on traffic to flexi time, it does not, however, give individual employees as much control over their schedules.

b) Car-Sharing

Car-sharing indicates vehicle rental services that substitute for private ownership. It makes occasional use of a vehicle affordable, even for low-income households, while providing an incentive to minimize driving and rely on alternative travel options as much as possible. It requires these features: a) service area is located in or near residential neighborhoods, b) fare for use of vehicles is reasonably priced, suitable for short trips, c) vehicles are easy to check in and out at any time, and d) vehicles are usually available and have minimal mechanical failures.

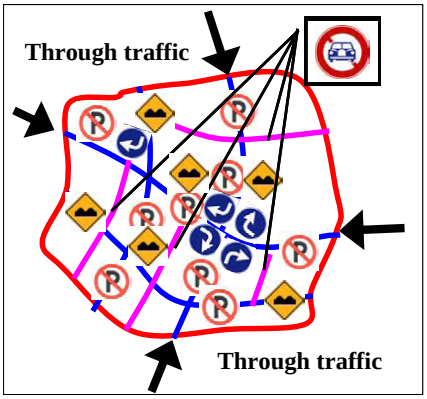

Figure 11.4-2 Traffic Calming

c) Traffic Restricted Residential Areas (Traffic Calming)

The traffic restricted residential areas (also called traffic calming, traffic management) indicate various roadway design features and strategies intended to reduce traffic speeds and volumes on particular roadways in residential areas. The traffic restricted residential areas can range from minor modifications of an individual street to comprehensive redesign of the road network. On-street parking, street closers, road humps, elimination of curbs, etc. are used to improve the residential environment.

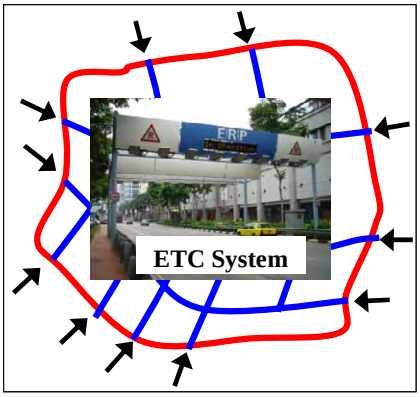

Figure 11.4-3 Area Licensing

d) Area-Licensing/Congestion Changing

The area-licensing/congestion changing means that users are charged a toll or fee for driving in a particular area, excluding public and emergency vehicles. The system consists of fees paid by motorists to drive in a particular area, usually a city center (Central Business District). Some area-licensing system only applies during peak periods, such as weekdays. The system is usually implemented by local authorities as a part of transportation demand management programs.

e) Auto-Restricted Zone in CBD (Traffic Cell System, Traffic Zone System)

The auto-restricted zone in CBD means zones where automobiles are totally eliminated by the introduction of a new circulation system for buses, pedestrians, taxies, and delivery trucks with priority given to buses. This system includes traffic cell systems and traffic zone systems. Traffic cell systems are divided into traffic cells that have direct walking, cycling and transit connections, but require a longer trip to travel between

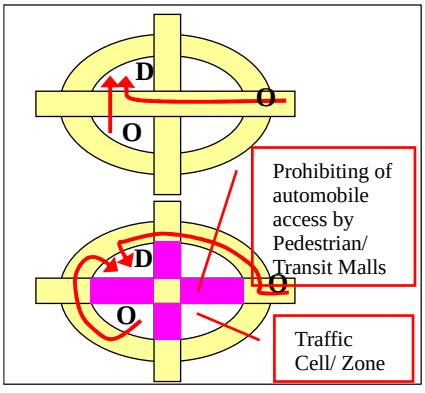

Figure 11.4-4 Auto-Restricted Zone

private automobiles. Traffic zone system has auto-restricted zones that limit automobile access, for example, to residents and commercial vehicles. These often have features of car-free planning, pedestrian improvements, traffic calming and location efficient development.

f) HOV (High Occupant Vehicle) Priority

HOV priority indicates that priority is given to high occupant vehicles (also called rideshare vehicles), including transit buses, vanpools and carpools. Priority bus services are sometimes called bus rapid transit. HOV priority is a major component of many regional TDM programs. Two, three or four occupants (indicated as 2+, 3+ or 4+) may be required to be considered an HOV, depending on circumstances. This is opposed to single occupant vehicles (SOVs). An HOV priority system includes bus rapid transit, 3-in-1 occupants system, HOV highway and arterial lanes, and high occupancy toll lanes.

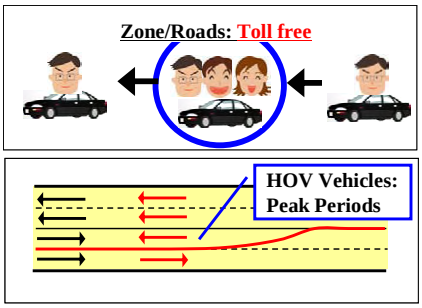

Figure 11.4-5 HOV Priority

- Bus rapid transit

Bus rapid transit, that is special lanes dedicated to transit buses, often incorporating other features to insure high quality transit service.

- 3-in-1 occupancy system

3-in-1 occupants system means that only vehicles with three or more passengers are allowed to enter the restricted area, during the restricted periods. Taxis and public buses are exempted from the restriction. Enforcement is done through surveillance by traffic police and offenders are apprehended on the spot.

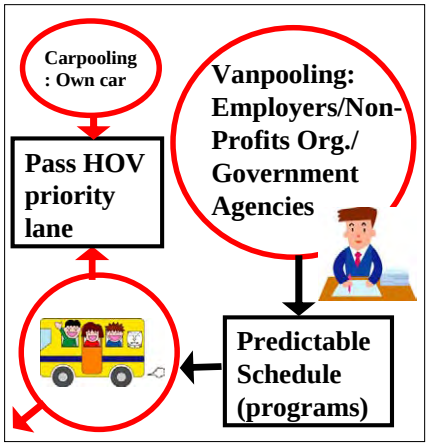

Figure 11.4-6 Ridesharing

- HOV highway and arterial LANES

These are sometimes reversible or counter flow lanes, which mean that they provide traffic capacity in the peak direction. Lanes open only to buses are called busway. These are a type of managed lanes.

- High occupancy toll lanes

These are HOV lanes that also allow low occupancy vehicles if they pay a toll, this is same as system of road pricing.

g) Ridesharing (Carpooling and Vanpooling)

Ridesharing indicates carpooling and vanpooling.

- Carpooling

Carpooling uses participant' own automobiles and is generally only suitable for trips with predictable schedules such as commuting or attending special events.

- Vanpooling

Vanpooling usually uses rented vans, often supplied by employers, non-profit organizations or government agencies. Most vanpools are self-supporting-operating costs are divided among members. Vanpooling is particularly suitable for longer commutes.

h) License-Plate numbering System

This system restricts the use of private cars in the congested area of the city every other day depending on the license plate number. This system is applied to a limited area and is effective in such a congested city. For instance, in the central area of the 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 license-plate number. In order to maintain this control system, it is necessary to have many policemen inspecting the traffic. It is to be expected that some people will attempt to acquire two different license plates for one car or modify plates, making it difficult to continue the system for along time.

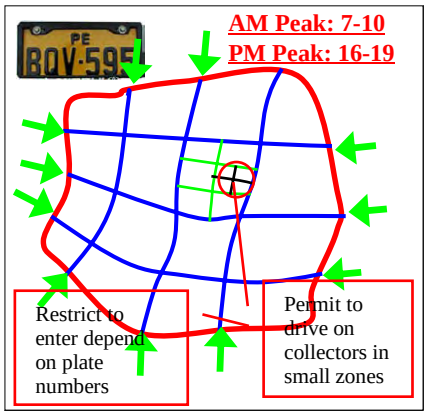

Figure 11.4-7 Auto-Restricted Zone

i) Parking Pricing

Parking pricing means that motorists pay directly for using parking facilities, and may be implemented as a TDM strategy to reduce vehicle traffic in an area, as a parking management strategy to reduce parking problems in a particular locations, to recover parking facility costs, to generate revenue for other purposes such as the local transportation program or downtown improvement district, or for a combination of these objectives. The specific parking pricing techniques are classified into three (3) strategies, parking management strategy, congestion pricing strategy, and regional TDM strategy.

- Parking Management Strategy

Prices for the most convenient parking spaces such as on-street spaces in commercial areas should encourage turnover, with lower price or un-priced parking at other locations.

- Congestion Pricing Strategy

This is to address local traffic and parking problems, rates should be higher during peak periods, and the rates structure should be applied consistently throughout the area, such as commercial area.

- Regional TDM Strategy

This is to reduce congestion problems and pollution emissions, pricing should be applied throughout a region to avoid simply shifting travel from one location to another, and coordinated with other TDM strategies that encourage use of alternative modes. If implemented for revenue generation, parking prices should be set as high as the market will bear, and competition such as nearby free parking should be minimized.

j) Busway (Bus Rapid Transit: BRT, HOV Lanes, Guideway)

The busway indicates a set of bus system design features that provide high quality and cost-effective transit services, in order to shift travel change of mode and increase public transport use. These include grade-separate right-of-way, including busway, HOV lanes,

and other transit priority measures by using automated guideway, high-capacity services, high-quality vehicles, pre-paid fare collection, integrated fare systems, convenient user information system, improved passenger information, high quality bus stations, modal integration, customer services, and improved security for transit users and pedestrians.

k) User Taxes (Taxes of fuel, tires, spare parts, etc.)

Vehicle use is restrained through user taxes imposed on fuel, tires, spare parts, etc., thus adding to the operating cost in relation to the distance traveled. Vehicle fuel tax is the major TDM method of user taxes. Fuel is the largest and the most visible motor vehicle operating expense (i.e. variable financial cost). There are several justifications for increasing taxes on petroleum products in general. Fuel taxes can be raised by: a) increasing motor vehicle fuel tax rates, b) imposing a carbon tax, a tax that reflects the amount of carbon released when a fuel is burned, as a climate change emission reduction strategy, c) applying general sales tax to fuel, d) index fuel taxes to inflation or roadway costs, and e) adding a special hazardous material tax to fund cleanup and environmental remediation programs.

l) Vehicle Ownership Restriction

Vehicle ownership is inhibited by high import taxes, purchase taxes, vehicle registration fees, and annual licensing fees. In general, two major vehicle ownership restraints are used to suppress the growth of vehicle to within tolerable levels: a) fiscal measures to increase the costs of owning, operating and maintaining of motor vehicles. These costs include import duties, vehicle registration fees, fuel and road taxes, and compulsory vehicle inspection fees. b) a vehicle quota system that requires anyone intending to purchase a car to first acquire a certificate of entitlement through an open bidding system. The vehicle quota system will be introduced with the government's decision to cap the growth rate of car population to within an acceptable level that will not create uncontrollable congestion in the road system, and yet strong enough to sustain economic development.

(2) Evaluation of TDM Measures

1) Characteristics of Typical TDM Measures

The above mentioned TDM measures should be evaluated, and how they can be used to evaluate the value of TDM programs, in order to introduce them for the study area. Table 11.4-1 shows the summary of characteristics for a typical TDM scheme in major cities of the world. The items of TDM characteristics consist of a) mechanism, b) travel change, c) applicable conditions, d) benefits, and e) major cost. TDM measures use a variety of mechanisms to change travel patterns, including facility design, improved transport choice, pricing, and land use changes, 12 TDM measures mainly indicate the improved transport choice. These affect travel behavior in various ways, including changes in trip scheduling, route, mode, destination, and frequency, plus traffic speed, mode choice and land use patterns. The applicable condition is important to identify the operable TDM measures, the items of applicable conditions are categorized by target audience, size of restricted area, execution body, facilities necessary and relevant strategies or programs. The benefits bring a variety of effects, which are generally positive. The major costs are classified into Administrative and management cost, program and enforcement expenses, management facilities cost, and various investments.

Table 11.4-1 Summary of Characteristics for Typical TDM Measures (1/3)

TDM Measures	Mechanism	Travel Changes	Applicable Condition	Benefits	Major Cost
1) Alternative Work Schedule (Flexitime, Compressed Workweeks, Staggered Shifts)	• Improved transport choice	• Shifts travel schedule (when trips occurs)	• Participating entities are allowed some flexibility in their daily work schedules. • Participating entities are allowed to work fewer but longer days. • Adapting to company unit.	• Reduction of commute trips • Flexitime: (-)25-50% • Compressed work week: (-)7-10%	• Administrative and management cost
2) Car-Sharing	• Improved transport choice	• Reduces vehicle ownership and trips	• Services are established at multi-family residential cooperatives (service area is located in or near residential neighborhoods). • Service may require subsidies (station cars are often implemented by public transit agencies).	• Reduction of vehicle use • A net reduction in per capita driving among participants : (-)40-60%	• Administrative costs of Car-sharing organizations
3) Traffic Restricted Residential Areas (Traffic Calming, Traffic Management)	• Improved transport choice • Facility improvements	• Shifts travel schedule • Increases walking • Reduces vehicular traffic from passing through an area • Reduces traffic speed	• Implemented by local engineering departments, initiated by neighborhood requests or as part of community redevelopment with community participation • Requires public relation activities and inspecting of speed limit	• Reduction of vehicle use and travel speed • Buxtehude Germany: vehicle speed on collectors at (-)40%, no change on semi-arterials and arterials	• Program and enforcement expenses • Improved traffic management facilities cost
4) Area-Licensing /Congestion Charging	• Pricing	• Shifts travel schedule • Reduces vehicle travel in a particular area	• Pricing all roads in the area, such as a central business area (CBD area). • Newer electric pricing system tends to have lower costs, greater users convenience, and more price adjustability. • Area-pricing should be implemented in conjunction with improved public transport serves.	• Reduction of passenger vehicle use • Revenue generation • London congestion pricing : total vehicle-kilometers at (-)12%, car traffic at (-)30%, crashes at (-)28%	• Reduces road and parking facility cost • Increases road safety, toll booth and electronic bill system facility • Toll agency or government cost
5) Auto-Restricted Zone in CBD (Traffic Cell System, Vehicle License Plate Number, etc.)	• Improved transport choice • Facility improvements	• Shifts mode • Increases public transport use • Reduces private automobile travels in CBD. • Reduces traffic speed	• Implemented by local government or regional governments. • Often as part of downtown revitalization program or neighborhood traffic management plan. • Be effective for historic center “car-restricted zone”	• Reduction of passenger vehicles use, reduction of automobile dependant communities • Bologna Italy: vehicle number at (-)62% • Gothenburg Sweden: number of vehicles at (-)48%	• Program and enforcement expenses • Improved public transport facility cost, fringe parking facility cost

Table 11.4-1 Summary of Characteristics for Typical TDM Measures (2/3)

TDM Measures	Mechanism	Travel Changes	Applicable Condition	Benefits	Major Cost
6) HOV (High Occupant Vehicle) Priority (Rideshare Vehicles, Bus Rapid Transit)	• Improved transport choice	• Increases vehicle occupancy • Reduces vehicle trip	• HOV facilities can be implanted by adding new road capacity designated HOVs (Busway, High occupancy toll lanes, etc.) • HOV programs are most successful as part of an integrated regional transportation strategy that includes other improvements and incentives for transit and rideshare use	• Increased travel speed for HOV passengers • Improves performance of transit and rideshare • Encourages shifts from SOV to HOV travel modes • Reduction of vehicle trips on particular roadway: (-)4-30%	• Project construction costs such as busway, exclusive bus lane, etc. • Management and enforcement costs
7) Ridesharing (Carpooling; uses participant's own automobiles, Vanpooling: uses rented vans)	• Improved transport choice	• Increases vehicle occupancy • Reduces vehicle trip	• Rideshare programs can be implemented by an individual employers as part of a Commute trip Reduction program • Implements by units of a transportation management association, a campus trip management programs, a transit agency and a regional transportation agency.	• Reduction of commute trips (peak-period vehicles trips) • Increase of commuters travel choice • Includes incentive HOV priority: reduction of affected commute trips by (-)10-30% • Without such incentive priority: (-)5-20%	• Reduces road and parking facilities costs • Ridesharing programs cost (administration expenses)
8) License-Plate Numbering System	• Improved transport choice	• Shifts travel schedule • Increases public transport use • Reduces private automobile travel in CBD.	• Implemented by local government or regional governments. • Implemented typically as a temporary measure to reduce traffic congestion during specified periods • System should be implemented in entire city or metropolitan area	• Increases public transport use, reduces passenger cars • Increases average speed • Bogota Colombia "Pico y Placa": occupation of buses/busetas by (+)19% and taxis by (+)50%, average speed by (+)25%	• Reduces road and parking facility cost • Program and enforcement expenses
9) Parking Pricing	• Pricing	• Shifts travel schedule • Reduces vehicle trip	• As a parking management strategy, rates for the most convenient parking spaces should encourage turnover with lower prices. • As a congestion pricing strategy, rates should be higher during peak periods, and the rate structure should be applied consistently throughout the area (commercial center) • As a regional TDM strategy, pricing should be applied throughout a region to avoid simply shifting travel from one location to another, and coordinated with other TDM strategies.	• Reduction of commuter trips (parking fees can affect vehicle travel pattern) • Increases of public transport use • More efficient use of parking facility • Creates revenues • Automobile commuting: (-)10-30%	• Equipment costs (signs, parking machine, ticket printers, access gates • Land cost (sidewalk space used by parking machines) • Administration and inspection cost

Table 11.4-1 Summary of Characteristics for Typical TDM Measures (3/3)

TDM Measures	Mechanism	Travel Changes	Applicable Condition	Benefits	Major Cost
10) Busway (Bus Rapid Transit: BRT, HOV Lanes, Guideway.)	• Improved transport choice	• Shifts mode • Increases public transport use	• Implemented through a cooperative effort involving local planning agencies and transits local providers • Requires that busway be given increased respect and priority in transportation planning decisions, including investments, roadway management and land use development	• Provides a variety of benefits, including reduced traffic congestion, road and parking facility cost savings, consumer cost savings, improved mobility options for non-drivers, increased safety, reduced pollution, and support for urban infill. • Bus Rapid Transit in Los Angeles: reduces travel time by (-)29%, passengers by (+)40% • "Transmilenio" Trunk Bus System in Bogota: reduces travel time by (-)32%, bus operating speed by 26km/h	• Requires various investments in vehicles, facilities and increased management responsibilities
11) User Taxes (Taxes of fuel, tires/spare parts, etc.)	• Improved transport choice	• Shifts travel schedule • Increases public transport use • Reduces vehicle ownership and trips	• Fuel tax can be raised by: increasing motor vehicles fuel tax rates, imposing carbon tax, applying general sales tax to fuel, index fuel taxes to inflation or roadway cost, etc.	• Effective energy conservation and emission reduction strategy • Modest vehicle travel reductions, and provides revenue • Vehicle travel impacts in 4 major regions in California: estimates that reduces total vehicle trips by (-)3.5-6.7%, reduces fuel consumption by (-)9.3%	• Implementation costs are minimal, administrative and management cost
12) Vehicle Ownership Restraints	• Improved transport choice	• Shifts travel schedule • Increases public transport use • Reduces vehicle ownership and trips	• Vehicle ownership can be inhibited by: high import taxes, purchase taxes, vehicle registration fees and annual licensing fees	• Increases public transport use, modest vehicle travel reductions, and provides revenue • Singapore: annual vehicle growth rate, 3% during 12 years	• Administrative and management cost

2) Selection of TDM Measure for the Study Area

a) Qualitative Benefit of Different Travel Impacts

This section discusses the selection of TDM measures for the study, based on the characteristics of 12 typical TDM measures. As previously pointed out in the analysis of characteristics of typical TDM measures, different types of travel changes provide different types of impacts. Table 11.4-2 shows how different travel behavior changes are rated according to the transportation improvement objectives (qualitative benefit of different travel impacts). The transportation improvement objectives consist of a) congestion reduction, b) road savings, c) parking savings, d) consumer savings, e) transport choice, f) road safety, g) environmental protection, h) efficient land use, and i) community liability, and the travel impacts are categorized by reduced traffic speeds, shift in travel schedule, shorter trips, shift mode, reduced vehicle trips, and reduced vehicle ownership.

The main study objectives of the TDM plan will be defined as the mitigation of traffic congestion, it should be, therefore, focused the advantage of travel impacts in terms of the congestion of transportation improvement objectives. Based on the qualitative analysis, the travel impacts such as shift travel schedule, reduced vehicle trips, and reduced vehicle ownership can be very effective in the mitigation of traffic congestion. Such travel impacts will be considered in the selection of TDM measures for the study area.

Table 11.4-2 Qualitative Benefit of Different Travel Impacts

Transportation Improvement Objectives	Travel impacts					
	Reduced Traffic speeds	Shift Travel Schedule	Shorter Trips	Shift Mode	Reduced Vehicle Trips	Reduced Vehicle Ownership
a) Congestion Reduction	-	A	B	B	A	A
b) Road Savings	-	C	B	B	A	A
c) Parking Savings	-	-	-	A	A	A
d) Consumer Savings	-	-	C	B	B	A
e) Transport Choice	-	C	-	A	B	A
f) Road Safety	A	-	B	B	A	A
g) Environmental Protection	C	-	C	B	B	A
h) Efficient Land Use	C	-	B	C	B	A
i) Community Liability	B	-	C	C	B	A

Rating from A (very beneficial) to –A(very harmful), Source: TDM Encyclopedia Victoria, Transport Policy Institute, Canada

Notes: Transportation improvement objectives definde as follows:

a) Congestion Reduction: Reduced urban-peak vehicle travel tends to reduce traffic congestion. Traffic congestion is a non-linear function, meaning that a small reduction in urban-peak traffic volume can cause a proportionally larger reduction in delay. Even relatively small traffic reductions can provide relatively large travel time savings benefits. Traffic congestion is usually defined and measured only in terms of the delays that motor vehicle traffic imposes on other motor vehicles.

b),c) Road and Parking Saving: Reduced vehicle travel can reduce the need to add roadway capacity, reduce some roadway operations and maintenance costs, and reduce some traffic service costs, such as policing and emergency response. Shifts from automobile to bus transport may increase some road maintenance costs. Reductions in automobile trips may provide little parking cost savings in the short-run if there is an abundant parking supply.

d) Consumer Savings: Many TDM strategies can provide consumer savings by improving transportation options, reducing vehicle costs, or providing direct financial benefits. Savings can be especially large if a TDM program allows a household to reduce the number of vehicles it owns or to defer the replacement of an older vehicle.

e) Transport Choice: Many TDM strategies improve transportation choices by improving alternative modes, providing new pricing options, or increasing land use accessibility. This provides various types of benefits to consumers and society, including improved access and opportunity, consumer cost savings, increased equity, improved community livability, and reductions in various external costs.

f) Road Safety: Many TDM strategies provide traffic safety, resilience, security and public health benefits (safety impacts of TDM). Strategies that reduce total vehicle mileage, reduce traffic speeds, or provide an incentive for safer driving tend to be particularly effective at reducing accidents. Strategies that reduce traffic congestion without reducing

mileage, by shifting travel times and routes, have mixed safety benefits: although accidents tend to decline, the collisions that do take place tend to be more severe because they occur at higher speeds.

g) Environmental Protection: TDM strategies that reduce vehicle mileage, optimize vehicle speeds and reduce traffic congestion, provide energy conservation and emission reduction. Strategies that encourage motorists to use more efficient, less polluting vehicles, or which reduce total vehicle ownership and trips, tend to be particularly effective at energy and emission reductions.

h) Efficient Land Use: Strategies that encourage more clustered, multi-modal, mixed land use patterns can improve accessibility and reduce per capita impervious surface coverage and land consumption. This can provide a number of economic, social and environmental benefits compared with more dispersed, automobile-dependent land use patterns.

i) Community Liability: Community livability refers to the environmental and social quality of an area as perceived by residents, employees, customers and visitors. This includes accident risk, noise, local pollutants (e.g., dust), preservation of unique cultural and environmental resources (e.g., historic structures, mature trees, traditional architectural styles), attractiveness of streets, opportunities for recreation and entertainment, and the quality of social interactions, particularly among neighbors. A livable community directly benefits the people who live in, work in or visit the neighborhood, increases property values and business activity, and can improve public health and safety.

b) Target TDM measure for the Study Area

The recommendable TDM measure for the study area will be selected on the basis of criteria, such as i) the analysis of the qualitative benefit of travel impacts relevant to congestion reduction and ii) applicable conditions in the study area. In the first criteria, the travel impacts such as shift travel schedule, reduced vehicle trips, and reduced vehicle ownership, can be very effective in the mitigation of traffic congestion, for this reason, therefore, these three (3) evaluation indicators will be included for the evaluation of 12 typical TDM measures. Next, the evaluation indicators for selection of the target TDM measure should take into account the target size of Lima and Callao cities and the affordability of implementation. The size of the study area will be adjusted to focus on the serious traffic congested area; the target area will be the central business district (CBD) area. The affordability of implementation should give consideration to indicators of low cost, short period of time for preparation, and minimal constraint of political judgment. These indicators reflect the key issue that is important to determine the overall quality and urgency of the recommendable TDM measure. Accordingly, in determining the recommendable TDM measure for the study area, the following indicators for evaluation are used (See Table 11.4-3).

Table 11.4-3 Indicators for Evaluation by Criteria

Criteria		Indicators for evaluation
1) Benefit of travel impacts relevant to congestion reduction		• Shift travel schedule • Reduced vehicle trips • Reduced vehicle ownership
2) Applicable conditions	a) Size of Lima/Callao study area	• Lima/Callao Metropolitan Area • Central business district (CBD) area • Old historical area
	b) Affordability of implementation	• Low cost • Short period of time for preparation • Minimal constraint of political judgment

Based on the above-mentioned indicators for evaluation, the selection of target TDM measure for the study area was done. The rating is a qualitative result where each TDM measure obtains a score between “A (very beneficial)” to “C (harmful)” per indicator. The results are shown in Table 11.4-4. The scoring defines as A (+3), B (+2), and C (+1). The total evaluation of scoring provided a ranking of recommendable TDM measures according to the weights attributed, and final ranking made based on which the measure with the highest total score is the best. In the list of typical TDM measures, it can be

concluded that the license-plate numbering system, the area-licensing/congestion charging system and the auto-restricted zone in CBD are the best three. The license-plate numbering system can be considered as the target TDM measure for the study area.

Table 11.4-4 Selection of Target TDM Measure for Study Area

Typical TDM measures	Benefit of travel impacts relevant to congestion reduction			Applicable conditions		Total Evaluation (Scoring)
	Shift Travel Schedule	Reduced Vehicle Trips	Reduced Vehicle Ownership	Size of Lima/Callao study area	Affordability	
1) Alternative Work Schedule	B	B	C	B	A	10
2) Car-Sharing	C	B	B	C	B	8
3) Traffic Restricted Residential Areas	B	B	C	C	A	9
4) Area-Licensing /Congestion Charging	A	A	B	A	B	13
5) Auto-Restricted Zone in CBD	C	A	B	A	C	12
6) HOV	C	B	C	A	B	9
7) Ridesharing	C	B	B	C	A	9
8) License-Plate Numbering System	A	A	B	A	A	14
9) Parking Pricing	B	B	C	C	C	7
10) Busway	C	B	C	A	B	9
11) User Taxes	C	C	A	C	C	7
12) Vehicle Ownership Restraints	C	C	A	C	C	7

Rating from A (very beneficial) to – C (very harmful), Source: TDM Encyclopedia Victoria, Transport Policy Institute, Canada

11.4.4. PLAN OF AREA LICENSING SYSTEM

As previously discussed in the analysis of target TDM measure for the study area, the best three TDM measures are selected, such as the license-plate numbering system. It is highly recommended that the license-plate numbering system should be introduced for the TDM measures in the study area. However, the area licensing system for the study area, at the request of Peru Technical Counterpart Committee.

(1) Identification of Effective TDM Area for the Area Licensing System

1) Criteria for Identifying Effective TDM Area

The area licensing system relies on market mechanism by imposing a certain amount of money to car use. If the area licensing system is applied, most of the users affected by the system are likely to be low- and middle-income class car users. High-income class car users are likely to continue to use their cars by paying the toll charge. The following criteria shall be applied to identify the effective TDM area of the area licensing system.

- Area for high vehicle density and chronic traffic congestion during peak periods;
- Area for traffic attraction of large trips middle- and high income users;
- Area that can be served by highly comfortable public transportation services, and
- Quality feeder services such as circulation system in CBD should be available at the same time to serve such highly comfortable trunk services.

2) Alternatives of TDM Area

The area licensing system will be designed for the alleviation of severe vehicular traffic congestion in Lima and Callao metropolitan area. Such congested road segments are observed in the major business and commercial activity cores in the city. Six (6) alternatives of TDM area are proposed as follows (See Figure 11.4-8):

- Alternative 1: Av. Javier Prado-Via de Evitamiento-Av. Morales Duarez- Av. Faucett
- Alternative 2: Av. Javier Prado-Via de Evitamiento –Av. Alfonso Ugarte
- Alternative 3: Av. Javier Prado-Av. Alfonso Ugarte-Av. Faucett
- Alternative 4: Av. Javier Prado-Av. Aviación- Av. Morales Duarez-Av. Universitaria
- Alternative 5: Av. Angamos-Av. Arequipa-Av. Javier Prado-Av. Brasil-Av. Grau- Av. Ayllon-Av. Circunvalación
- Alternative 6: Av. Angamos- Angamos-Av. Arequipa-Av. Javier Prado-Av. Brasil-Av. Alfonso Ugarte-Av. Aviación

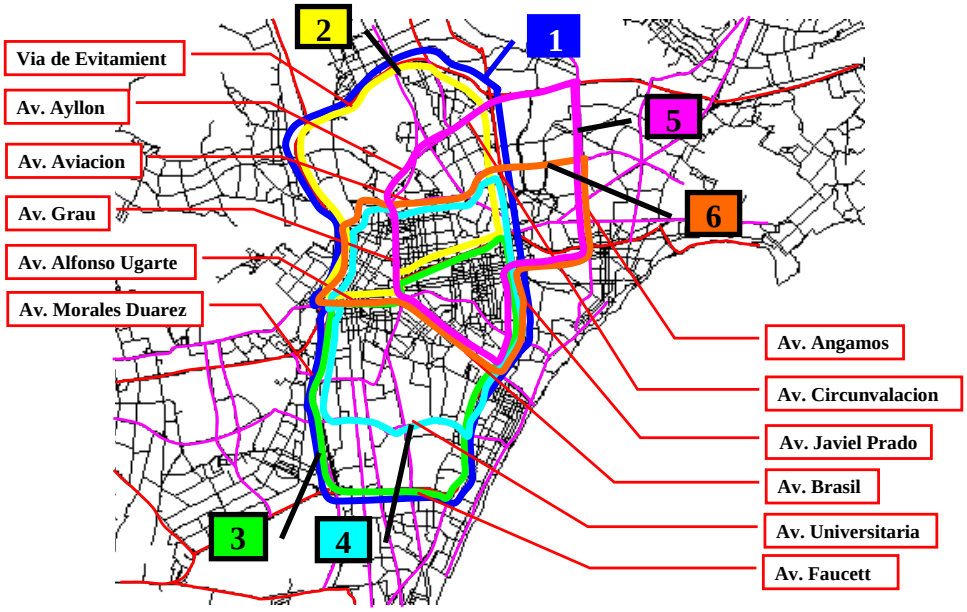

Figure 11.4-8 Alternatives TDM Area

3) Characteristics of Attraction Trips by Zone

In accordance with criteria for identifying effective TDM area, Figure 11.4-9, Figure 11.4-10, Figure 11.4-11 show the chronic traffic congestion, distribution of zonal car attraction trips, and distribution of attraction trip shares of middle- and high income users respectively. The characteristics of existing attraction trips by alternative are summarized in Table 11.4-5.

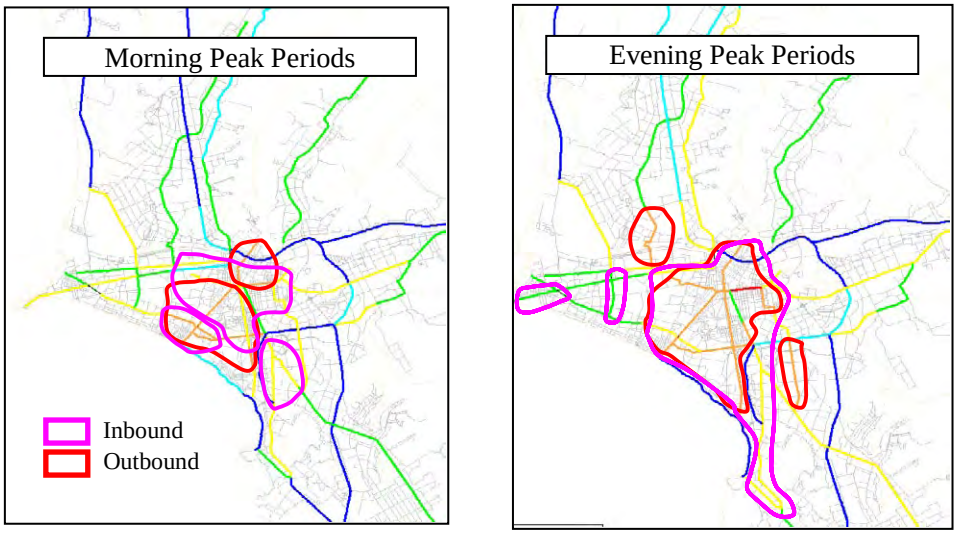

Figure 11.4-9 Area of Chronic Traffic Congestion

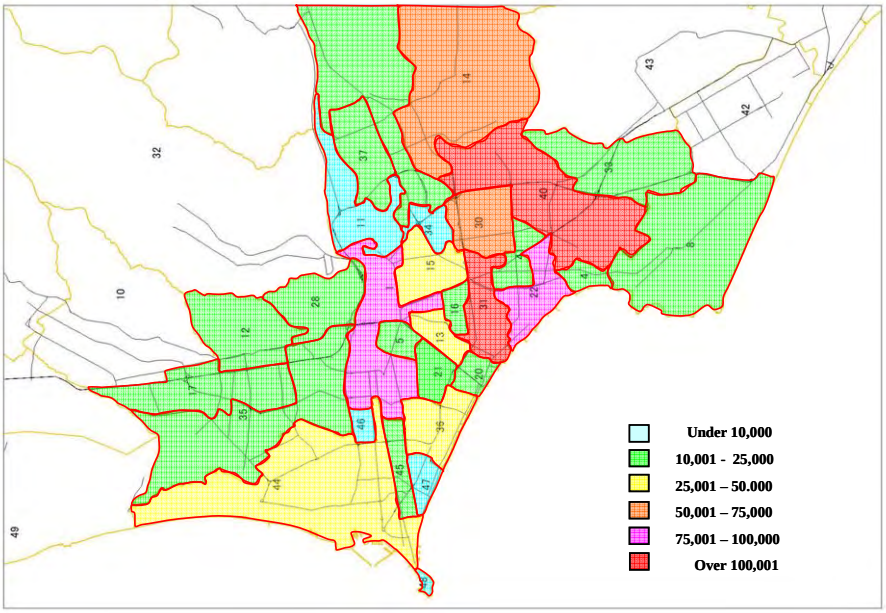

Figure 11.4-10 Distribution of Zonal Car Attraction Trips

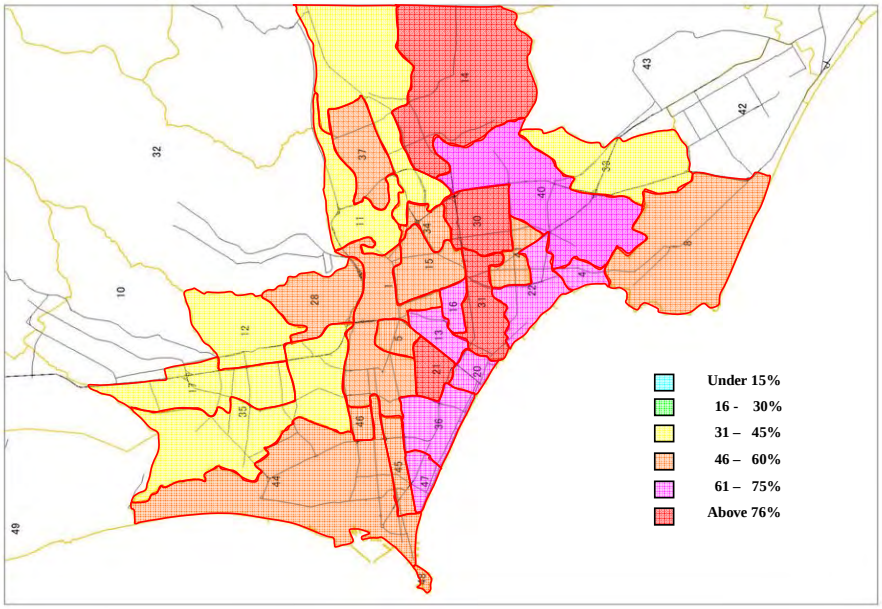

Figure 11.4-11 Distribution of Attraction Trip Shares of Middle- and High Income Users

Table 11.4-5 Characteristics of Existing Attraction Trips by Alternatives

Alternative	1) Traffic congestion during peak periods	2) Car attraction trips	3) Trip attraction of mid./ high income class	4) Saves by highly public transport	5) Quality feeder service (circulation. system)
Alternative 1	About 70% of total area; high density/ congestion	40% of total area: 75000-100000, other: under 10000-50000 trips	60% of total area: (46-60%), other: 20% (61- above 76%), 20% (31-45%)	Available: N-S (Paseo), E-W (Brasil), N-S/E-W busways	Circulation system: (J.P-E-D-F), but distributed by long distance
Alternative 2	About 50% of total area: high density/ congestion	25% of total area: 75000-100000, other: under 10000-50000 trips	50% of total area: 46-60%, other: 31-45%	Available: E-W busway, Limited: S-N direction	Circulation system : (J.P-E-U), but S-N: weak
Alternative 3	Almost entire area: high density/ congestion	50% of total area: 75000-100000, other: 10000-50000 trips	50% of total area: 61-above 76%, other: 46-60%	Available: E-W (Brasil), E-W busway Limited: S-N direction	Circulation system : (J.P-U-F), but S-N: weak
Alternative 4	Almost entire area: high density/ congestion	50% of total area: 75000-100000, other: under 10000-50000 trips	70% of total area: 46-61%, other: 61-above 76%	Available: N-S (Paseo R), E-W/S-N busways	Circulation system : (J.P-A-D-U), but S-N: weak
Alternative 5	About 80% of total area; high density/ congestion	50% of total area: 75000-above 100000, other: under 10000-50000 trips	60% of total area: 61-above 76%, other: 46-60%	Available: N-S (Paseo R, Marsano), S-N busway, Limited: E-W direction	Circulation system : (A-E-U), mostly effective feeder service
Alternative 6	About 90% of total area; high density/ congestion	50% of total area: 75000-above 100000, other: under 10000-50000 trips	50% of total area: 61-above 76%, other: 46-60%	Available: N-S (Paseo R), E-W/S-N busways	Circulation system : (A-A-B), but, part of S-N: weak

4) Assessment of Effective TDM Area for Area Licensing System

En effective TDM area for the area licensing system will be identified based on the advantages of attraction trips and quality feeder services. All alternatives are almost reasonable areas to be covered by the chronic traffic congestion CBD area. In terms of the car attraction trips, the areas of alternative 3, 4, 5, and 6 include a high share of car attraction trips. In addition, these alternatives have also trip attraction of mid- and high

income class users. Traffic restraint areas that can be served by highly comfortable public transportation services such as busway, alternatives 1, 4, and 6 will be best served by existing north-south or east-west busways, and planned east-west busway. The quality of feeder service, such as the circulation network in the alternatives 1 and 5 is mostly effective; other alternatives are weak in the south-north axis. In the context of such a situation, it can be concluded that it is preferable to introduce alternative 6 for the area licensing system based on the overall evaluation, rating form "A (strength)", "B (tolerable)", and "C (weakness).

Table 11.4-6 Assessment of Effective TDM Area for Area Licensing System

Alternative	1) Traffic congestion during peak periods	2) Car attraction trips	3) Trip attraction of mid./ high income class	4) Savings by public transport	5) Quality feeder service (circulation. system)
Alternative 1	A	B	B	A	A
Alternative 2	A	B	B	B	B
Alternative 3	A	A	A	B	B
Alternative 4	A	A	A	A	B
Alternative 5	A	A	A	B	A
Alternative 6	A	A	A	A	B

(2) Plan of Operation System

1) TDM Opinion Interview Survey

On the occasion of the introduction of the "Area Licensing System", it is important to grasp the user' perception regarding traffic congestion, and also social impact of the implementation of the system. The user' opinion will be utilized for the basic information of the area licensing system plan.

a) Outline of Survey

The TDM opinion survey was conducted through the interviewing private vehicle users directly at parking lots in mid- and high income class area. There were six locations as follows i) Alameda Chabuca Granda, ii) Las Malvinas, iii) C.C. MINKA, iv) RIPLEY/SAGA, v) Minicipaldad/RIPLEY, and iv) Jockey Plaza. The survey periods were in the daytime between 10:00-17:00. Approximately 330 drivers were sampled as drivers to be surveyed.

The interview items consisted of i) personal data such as sex, age, frequency of driving and others, ii) reasons to use a car, iii) do you encounter traffic congestion, iv) what do you think are the main traffic problems in Lima, v) what do you think of the TDM measures to improve traffic congestion and reduce air pollution, vi) rights and wrongs of the charging of a toll or fee for driving in a congested area,, vii) opinions concerning measures to restrict the use of private cars in the congested area, viii) opinions about how much to pay for driving in congested areas, and ix) what is your opinion about the environmental impact due to private cars.

b) Result of User' Opinion

The result of the interview survey is summarized in Table 11.4-7 and Figure 11.4-12 (1)-(4).

Table 11.4-7 Summary of Interview Result

Category	Brief summary
i) Personal data	• Of total sample, sex - male by 86% • The highest share 30% of age is 40-49 years, other high shares are 30-39 years by 28% • Type of occupation, expert/technician by 38%, businessman by 24% • Vehicle ownership, owner by 77%, borrow by 15%, and rent by 8% • Almost every day of driving frequency by 72%, next high share of some day by 25%
ii) Reasons to use a car	• Car driving faster than the bus by 29%, is comfortable by 26%, and is safer by 24%, indicating total share of about 80% • **Car user points about bus weakness of punctuality schedule and amenity**.
iii) Do you encounter traffic congestion	• Encounter traffic congestion frequently by 59%, sometimes by 35%
iv) What do you think are the main traffic problems in Lima	• Answer traffic congestion by 27%, lack of road driving education by 22%, bad road conditions by 19%, indicating total share of about 70% • **Drivers have the perception that road driving education is important**
v) What do you think of TDM measures to improve traffic congestion and reduce air pollution	• Disapprove, because users have their motives to use cars (highest share: 38%) • Approve, should be implement TDM measures (26%) • Approve, however, it is difficult for everybody to agree on effective TDM measures (17%) • Approve, it is better to promote measures to reduce the volume of vehicles voluntarily (12%) • **Shares of approving opinion shows by total 38%, quite negative opinion is high by 55%**
vi) Rights and wrongs about the charge a toll or fee for driving in a congested area	• Disapprove, because it restricts freedom of movement (highest share: 38%) • Approve, it should alleviates traffic congestion (26%) • Approve, it should improve public transportation (13%) • First it is necessary to improve road conditions much more; it is too soon to introduce restrictive measures (10%) • **Shares of negative opinion for charging toll or fee, by total 48%, approving opinion by 49%**
vii) Opinions concerning measures to restrict the use of private cars in the congested area	• Use bus or taxi of public transport (highest share: 24%) • Use the car even if I have to pay (highest share: 24%) • Reduce my trips to restricted areas during restricted periods (23%) • Depends on the amount charged (18%) • **Shares of shift mode or reduction of trips, by total 47%, use car to pay charge by about 42%**
viii) Opinions about how much to pay for driving in congested areas	• S./1.0 (highest share: 76%) • S./2.0 by 12% • S./3.0 by 3% • No pay by 9% • **Most drivers expect to pay S./1.0 for toll of charge**
ix) What is your opinion about the environmental impact of private cars	• It is necessary to measure a safe and comfortable public transport system (highest share: 50%) • It depends on individual action from within (16%) • Implementation of restricted measures (7%) • **50% of drivers expect measures for safe/comfortable public transport**

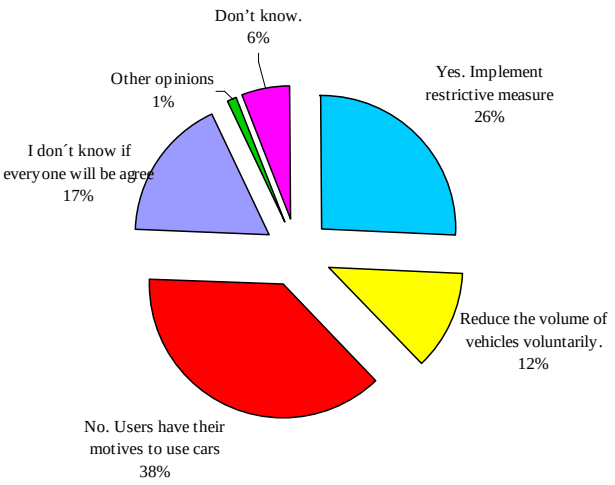

Figure 11.4-12 (1) Knowledge of TDM Measures

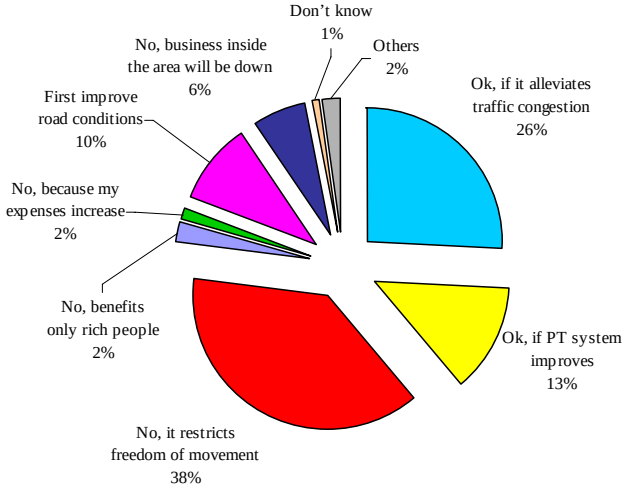

Figure 11.4-12 (2) Rights/Wrongs about Charge

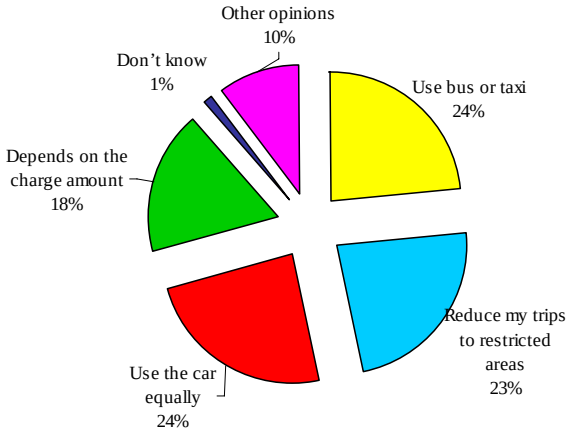

Figure 11.4-12 (3) Opinions Measures to Restriction

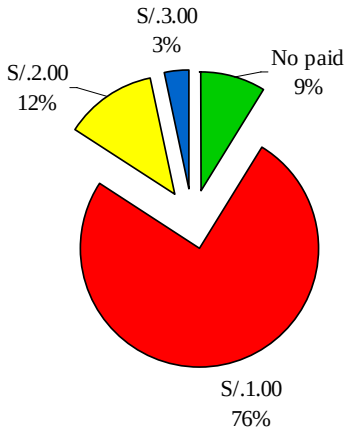

Figure 11.4-12 (4) Charge Cost

2) Control Function

a) Control Area for Area Licensing System

As discussed in section of (1) identification of effective TDM area for the area licensing system (hereinafter rederred to as ALS) , the control area is bordered by Av. Angamos- Av. Arequipa-Av. Javier Prado-Av. Brasil-Av. Alfonso Ugarte-Av. Aviación in Figure 11.4-13, the total area is estimated to be approximately 31km^2.

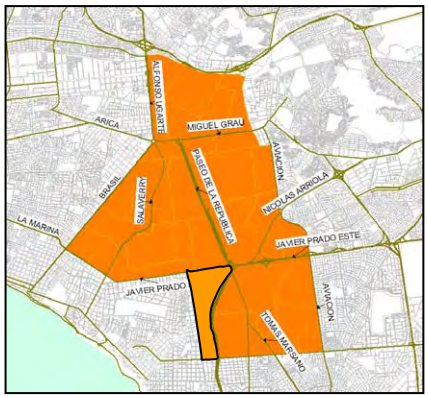

Figure 11.4-13 Control Area

b) Control Method

The ALS is controlled by toll collection; there are generally two methods for toll collection, namely: i) manual method and ii) mechanical method. Each method is described below:

i) Manual Method

The manual method consists of direct collection of the toll charge by a toll man, at a tollbooth at the tollgate. A tollbooth will be installed in each lane of the tollgate.

ii) Mechanical Method

The mechanical method is further divided into two systems, namely: i) camera-surveillance system as adopted in London (See Figure 11.4-14), and ii) ERP (Electronic Road Pricing) system as adopted in Singapore (See Figure 11.4-15). However, an electronic database of registered vehicles has not yet been established in Lima, and therefore a camera-surveillance system, such as the one in London cannot be adopted at present.

Figure 11.4-14 Camera-Surveillance System

Figure 11.4-15 Electronic Road Pricing System

Based on the foregoing, taking into consideration that the cost for establishment of the mechanical system is high, it is desirable to adopt the manual method in the short term and to change over to the mechanical method in the long term.

In this study, two (2) types of control methods are identified as follows:

- Vehicles entering the ALS area are charged at principal and local roads, by using tollgates.
- Vehicles entering the ALS area are controlled by collectors, by using one way regulation. It is necessary that the one way regulation be enforced by traffic police.

c) Operation Time Periods and Type of Vehicles to be Charged

The ALS will operate all day excluding night time on weekdays; it is effective to control traffic volume in order to mitigate traffic congestion in the CBD, following a similar system to Singapore. The operating time is defined as twelve hours 7:00-19:00.

In the short-term, target vehicle types for ALS will be passenger cars (including van and pickup) only. In addition, resident people inside the ALS should be given permission to circulate free of charge. In the long-term, targeting other vehicle types should be considered through further analyses and studies of the changing traffic situation. Charging levels can be changed based on the vehicle type. However, emergency vehicles and regular public buses are exempted from the ALS toll levy.

d) Toll Charge

If the toll charge places too heavy a burden upon drivers, public opinion will be against the ARP system and a serious social problem may result. On the other hand, if the rate of toll charge is set at a very low level, the aforementioned purpose of control system cannot be attained. The current public bus fare is about S./1.0. Considering that car owners generally belong to mid- and high income class, this rate would be low to avoid passenger car use. And the current rate of taxi is about S./3-5. According to the TDM opinion interview survey about how much to pay for driving in congested areas, drivers answer that they would be willing to pay a toll charge of between S./1.0 and S./3.0, however, 76% of drivers answered that they expect to pay S./1.0. In this study, a sensitivity analysis will be conducted based on the range of S./1.0 to S./3.0.

Under a manual control system, drivers need to purchase and display a paper area license or sticker, which is available at many sales outlets on the approach roads, to enter or drive in the ALS restricted zone. Such area licenses can be purchased on a daily or monthly basis.

3) Facility Plan

a) Control Facilities

As previously pointed out in the control method, the control facilities consist of tollbooths and one way regulation. The tollbooth will be installed by lane at the entrance of the principal roads and local roads along the ALS area. The one way regulation is to restrict vehicles entering the ALS area, by setting exit of one way road. It is necessary that the one way regulation be strongly enforced by traffic police. The control facilities are classified into three (3) types, namely: i) 2-3 tollbooths on two-way 4-6 lane road, ii) 1 tollbooth on two-way 2-lane road, and iii) one way regulation enforced by traffic police.

b) Location for Installation of Facilities

The proposed location and number for installation of control facilities are shown in Table 11.4-8 and Figure 11.4-16. Figure 11.4-17 shows the typical standard control facilities.

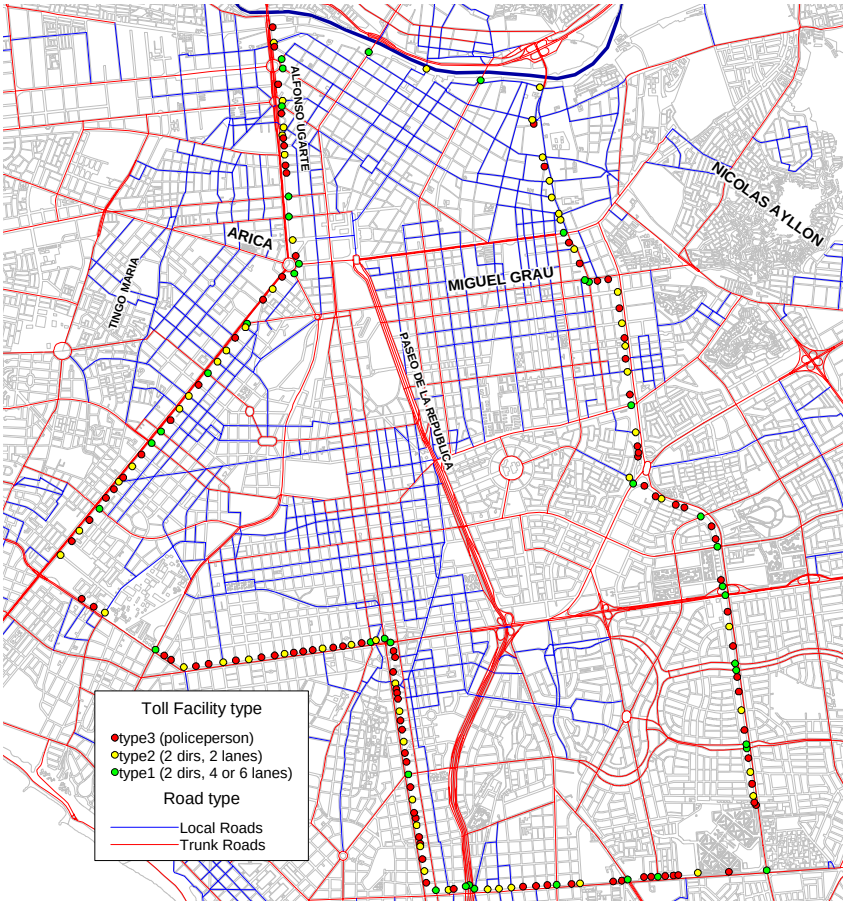

Figure 11.4-16 Proposed Locations for Installation of Control Facilities

Table 11.4-8 Number of Proposed Locations for Installation of Control Facilities

Major section by road	Type 1	Type 2	Type 3	Total
1. Av. Angamos	8	6	13	27
2. Av. Arequipa	2	7	17	26
3. Av. Aviación	9	6	16	31
4. Av. Brasil	1	5	7	13
5. Av. Huanuco	6	10	11	27
6. Av. Javier Prado	3	8	6	17
7. Rio Rimac	2	6	11	19
8. Av. Sanchez Carrion	2	1	0	3
9. Av. Ugarte	1	2	4	7
Total	40	59	94	191

Figure 11.4-17 Typical Standard Control Facilities

4) Administrative Organization

a) Operation and Management for ALS

The operation and management system is divided into two (2) activities, namely: i) ALS operation and management (toll fee collection and revenue distribution), and ii) ALS inspection (control and regulation of violators).

- ALS operation and management (toll fee collection and revenue distribution)
- ALS inspection (control and regulation of offenders)

Each of the above activities can be conducted both by public and private sectors. Thus, it will be possible to apply a "Public-Private Partnership" project in applying ALS.

b) Administrative Organization

It is preferable that this project be managed by Lima Municipality (Municipalidad de Lima), which covers not only part of the administrative regions (Municipalidades Distritales) but also the Lima metropolitan area. This is because the majority of vehicles regulated by ALS come from outside the ALS area beyond the administrative boundaries, though ALS area is located in the central CBD area.

Taking efficient implementation into consideration, ALS operation and management tasks will be contracted out to private companies through bidding. However, ALS technical inspection officers must be allocated all over the ALS area, and offenders should be controlled by the traffic police. Figure 11.4-18 shows the proposed administrative organization for the ALS.

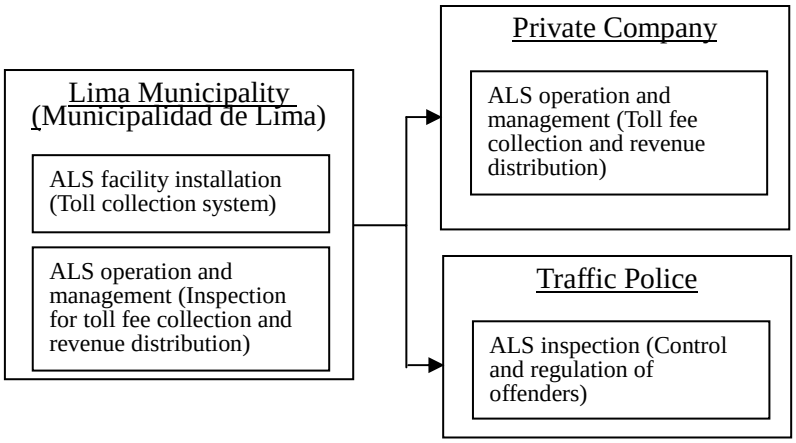

Figure 11.4-18 Proposed Administrative Organization for ALS

5) Impact Analysis

a) Sensitivity Analysis

Car mode will be reduced and other alternative modes such as taxis and public transportation will increase inside the area when the ALS is introduced. The diversion ratio of car trips to the other modes is forecast by using the modal split model developed in the Master Plan study on the assumption that the future mass transit system includes the east-west trunk bus, COSAC and Railway Line-1. Upon the application of the model, the car trip which only enters into the area is charged the toll fee, the return car trip is not charged. Taxis and public transportation are also free of charge.

Figure 11.4-19 shows the change of modal split in passengers inside the area with an increasing toll fee at S./1.0, 2.0 and 3.0. As can be seen, the car mode reduces as the charge increases, while taxi and public transportation modes increase. The ratio of passengers within the area to the total passengers in the whole study area is approximately 10% of all modes. With the licensing system, the influenced passengers are 10% in the study area.

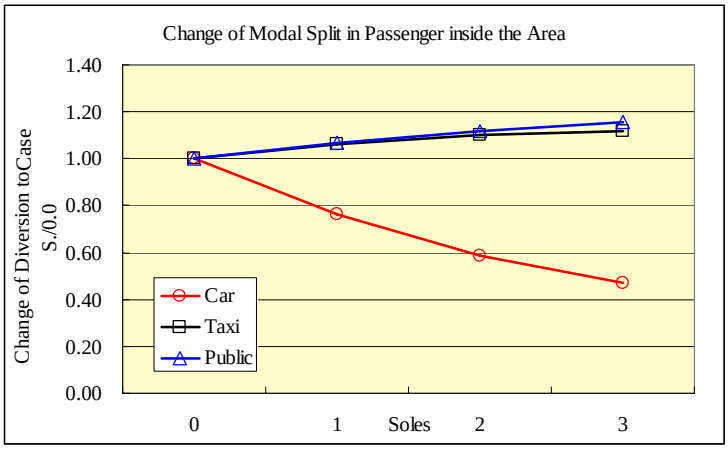

Figure 11.4-19 Change of Modal Split in Passenger inside the Area

Figure 11.4-20 shows the relationship between car volumes in PCU and revenue from the toll charge. The figure of the revenue is converted to a 12 hour value in which the licensing system is in effect. The 12 hour value applies the average ratio of 12 hour traffic volumes to daily traffic volume on Av. Javier Prado and Paseo de República in the traffic survey data in 2004. Its value is 0.75. The revenue also assumes that residential people inside the area are not charged for the toll fee. The travel ratio of the residential people to the total trips related to the area is estimated on the assumption that the travel demand related to residential people corresponds to trip production in the area and that trips generated and attracted inside the area is the trip generation and attraction. The travel ratio of the residential people is approximately 50%. In summary, the daily revenue considers the 12 hour traffic volume ratio (0.75) and travel ratio of the residential people (0.5)

The line graph of the car shows a reduction as the toll fee increases, while the revenue rises with it. These lines do not show the maximum or minimum point of inflection of a curve between S./1.0 and 3.0.

Table 11.4-9 shows the revenue by the toll fee. The revenues are S./42,000 for a toll fee of S./1.0 and S./78,000 for S./3.0, equivalent to 1.9 times the revenue from a toll fee of S./1.0.

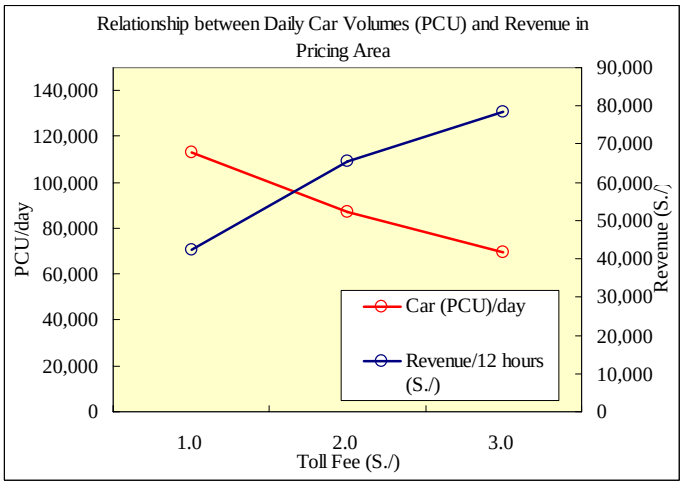

Figure 11.4-20 Relationship between Car Volumes and Revenue in Pricing Area

Table 11.4-9 Revenue from Toll Fee

Toll Fee (S./)	Cat (PCU)/day	Revenue/12 hours (S./)	Ratio of Revenue to a Toll fee of 1.0
1.0	112,889	42,000	1.0
2.0	87,294	65,000	1.5
3.0	69,736	78,000	1.9

b) Evaluation of Area Licensing System

In order to know an opinion of people for Travel Demand Management (TDM), the TDM opinion interview survey was carried out in October 2006. The number of samples is approximately 330. According to the survey data, approximately 76% of the total selected a toll fee of S./1.0, and S./2.0 and S./3.0 were 12% and 3%, respectively. It seems that most people will accept a toll fee of S./1.0.

The traffic volume of cars and taxis will reduce by 12% inside the area with a toll fee of S./1.0 in the area licensing system on the assumption that traffic passing through the area will divert to other routes of the road network to avoid a charge of the licensing area. The toll charge of S./42,000/day takes revenue in return for the alleviation of traffic congestion.

When the actual application is planned in the field, it is indispensable to further study the planned ALS. In the detailed study, traffic conditions such as traffic volumes on entrance roads into the area and alleviation of traffic congestion on roads should be estimated, together with the examination of modal share by toll fee and its revenue.

11.4.5. IMPLEMENTATION PLAN

(1) Outline of Task Items

The proposed ALS is to restrict the use of private vehicles by charging a toll or fee for driving in a congested area, it is, therefore, important that the implementation plan should be considered in detail through the various steps from further study of ALS to follow-up such as a) establishment of preparatory committee for feasibility study, b) legislative provision, c) establishment of project implementation body, d) construction and operation, and e) follow-up by monitoring.

1) Establishment of Preparatory Committee for Further Study

ALS has to be implemented not only from the technical viewpoint but also from the political and social evaluation viewpoint. In addition, there are some uncertain conditions even on technical aspects, such as modeling in demand forecast, actual repercussions from the public after the enforcement of the ALS regulation. In the first step, a preparatory committee should be established in order to do the feasibility study, which will be comprised of experts such as administrative officers, professors, sociologists, and consultants. The feasibility study will be discussed from the viewpoint of political, social, technical matters, and ALS will be actualized.

2) Legislative Provision

In terms of government legislation that allows for the introduction of ALS, it is necessary to stipulate restricted areas and hours, target vehicle types, toll fees, and so on. The implementation body and the implementation itself also have to be contained in the legislation

3) Establishment of Project Implementation Body

As mentioned before in the administrative organization, it is preferable that this project should be managed by Lima Municipality (Municipalidad de Lima). The activities can be conducted both by the public and private sectors. Thus, it will be possible to apply a "Public-Private Partnership" scheme in applying TDM.

4) Construction and Operation

Upon the establishment of the project implementation body, the facility installation and operation will be implemented.

5) Follow-up by Monitoring

Monitoring after the introduction of ALS such as traffic monitoring, public hearings, etc. is indispensable for smooth progress towards the ultimate success of the project. It is not necessary to avoid criticism. On the contrary, this becomes very effective advice for the improvement of ALS.

(2) Implementation Schedule

Based on the foregoing implementation steps, the implementation schedule for traffic demand management (ALS) project is proposed in Figure 11.4-21. The traffic demand management (ALS) project is scheduled to start in the second quarter of 2007 and be completed by the third quarter of 2009. After the establishment of preparatory committee, the feasibility study will be started in the fourth quarter, and be completed by the third quarter of 2007. The legislative provision is expected to be implemented between the fourth quarter of 2007 and the third quarter of 2008. After that, the establishment of the project implementation body will be started in the fourth quarter of 2008, and be completed by the second quarter of 2009, and the construction of facilities will be completed during the first three months of 2009. The operation may start in the fourth quarter of 2009, at which time, the follow-up action will also start.

Task Name	2007				2008				2009			
	1-3	4-6	7-9	10-12	1-3	4-6	7-9	10-12	1-3	4-6	7-9	10-12
1. Establishment of preparatory committee for feasibility study												
2. Legislative provision												
3. Establishment of project implementation body												
4. Final designed/ Building												
5. Construction												
6. Operation												
7. Follow-up by monitoring												

Figure 11.4-21 Implementation Schedule for Traffic Demand Management Project (ALS)

11.4.6. COST ESTIMATION

The project cost for the traffic demand management plan consists of 1) establishment of preparatory committee for feasibility study, 2) legislation provision, and 3) installation of control facilities, based on the contract package during 3 years. The project cost by items is shown in Table 11.4-10. The operation cost for traffic demand management during 1 year is shown in Table 11.4-11.

Table 11.4-10 Project Cost for Traffic Demand Management Project (ALS)

Investment Items	Project Cost (x 1,000 USD)
1. Establishment of preparatory committee for feasibility study	170
1-1 Establishment of preparatory committee	20
1-2 Feasibility study	150
2. Legislation provision	30
3. Installation of control facilities	1,580
3-1 Type 1: Toll facility on two-way, 4/6-lane road (94 locations)	920
3-2 Type 2: Toll facility on two-way, 2-lane road (59 locations)	649
3-3 Type 3: Onaway regulation on two-way, 2-lane road (40 locations)	11
Total	1,780
Engineering Cost (Totalx10%)	178
Administration Cost (Totalx10%)	178
Contingencies Cost (Totalx15%)	267
Grand total	2,403

Table 11.4-11 Operation Cost for Traffic Management Project

Operation Items	Cost (x 1,000 USD)
1. Enforcement by traffic police on road of Type 3	733
2. Annual personnel expenses for toll collector of Type 2	460
3. Annual personnel expenses for toll collector of Type 1	936
Total	2,129

Notes: The operation cost for traffic demand management during 1 year

11.5. ON-STREET PARKING IMPROVEMENT PLAN

11.5.1. OBJECTIVES

The objectives of the on-street parking improvement plan are to mitigate traffic congestion resulting from the conflict of merging and diverging of parked vehicles, by introducing a parking prohibition at parking lots along principal roads and the installation of charged on-street parking lots on minor roads.

11.5.2. SELECTION OF TARGET LOCATIONS FOR STUDY

Two target areas for the on-street parking improvement plan were selected at the request of Peru Technical Counterpart Committee, namely 1) Av. Angamos Este (blocks. 6-17) and the surrounding roads, and 2) Av. Saenz Peña (See Figure 11.5-1).

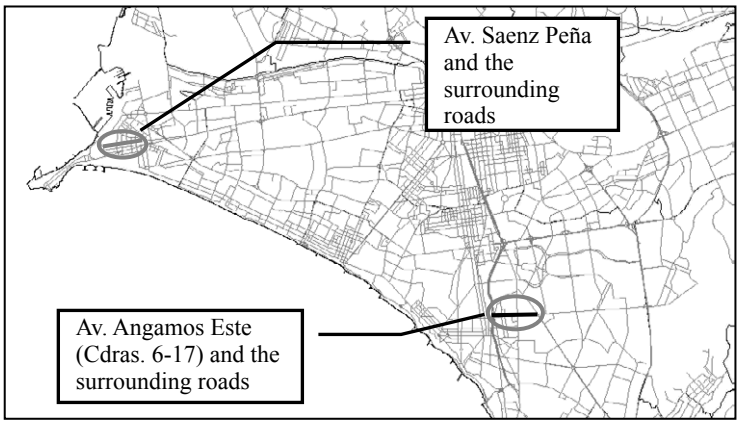

Figure 11.5-1 Target Locations for On-Street Parking Improvement Plan

11.5.3. CURRENT ON-STREET PARKING SITUATION

The present on-street parking characteristics in the target area were identified by the parking survey, in order to understand the detail parking situation and to find the parameters for the necessary parking control system.

(1) Parking Occupancy

1) Av. Angamos Este

Figure 11.5-2 shows the parking occupancy on Av. Angamos Este (block 1 to 9) and the surrounding roads. Parking occupancy during the midday peak time and evening peak time is comparatively higher than that of the morning peak time. The high occupancy road area expands more than in the morning peak periods. Especially, high occupancy was observed on Jr. Fco Moreno (block 7), and the surrounding roads, by 74% in the non peak period and 85% in the evening peak. The average parking occupancy of most sections of Av. Angamos Este was observed to be about 30-70% of parking occupancy in the non-peak time and evening in the peak time.

2) Av. Saenz Peña

Figure 11.5-3 shows the parking occupancy of Av. Saenz Pena and the surrounding area in each time period. The occupancy of each block of Av. Saenz Peña in the morning peak periods is comparatively low, in the range of 0-30 %. Meanwhile, the occupancy block in the midday peak periods and evening peak periods increases to 70-100 %. The occupancy of Av. Saenz Peña (block 1, 2, 5, and 6), the principal road, was especially high at 70 to 83%. It was seen, however, that the high occupancy area does not extend to the surrounding roads.

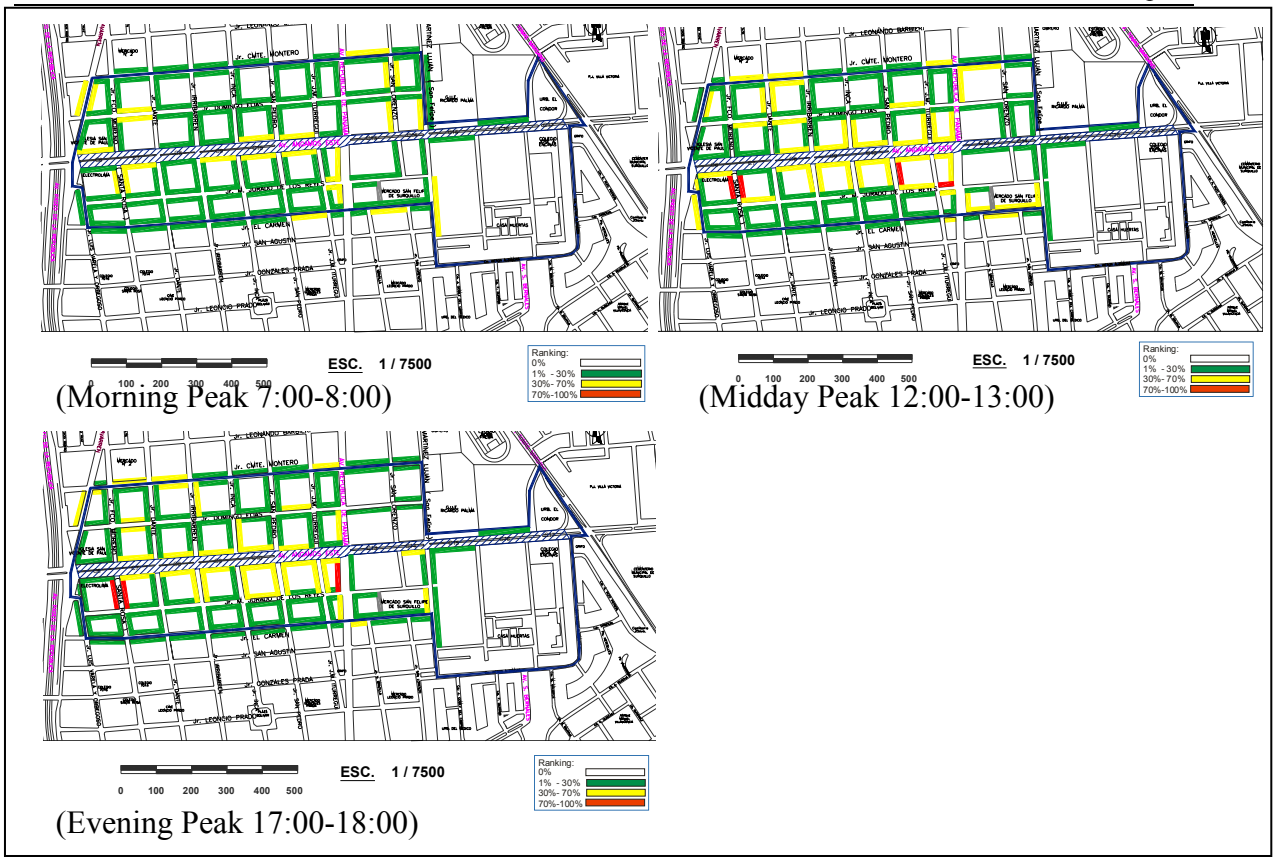

Figure 11.5-2 Parking Occupancy of Av. Angamos Este and Surrounding area

Figure 11.5-3 Parking Occupancy of Av. Saenz Peña and Surrounding area

(2) Parking Duration

1) Jr. Inca (minor road near Av. Angamos Este)

The average parking duration of Jr. Inca is in the range of 53 min (block 7) to 63 min (block 8) (See Table 11.5-1).

Figure 11.5-4 shows the accumulated curves of on-street parking duration on Av. Angamos Este and the surrounding area. 80.3 % of total parked vehicles on Jr. Inca 7 parked for less than 1 hour, 9.1 % for 1 to 2 hours and 2.9 % for 2 to 3 hours. The share of the vehicles with long parking durations of more than 3 hours of all parked vehicle are 7.7% on Jr. Inca block 7. 57.8% of total parked vehicle in Jr. Inca sq.8 parked for less than 1 hour, 13.1 % for 1 to 2 hours and 3.4% for 2 to 3 hours. The share of the vehicles with more than 3 hours is 9.7 % on the same avenue block 8.

2) Av. Marco Polo and Jr. Puno (minor roads near Av. Saenz Peña)

The parking duration of the surrounding road of Av. Saenz Peña is in the range of 48 min (Av. Marco Polo) to 102 min (Jr. Puno) (See Table 11.5-1)

Figure 11.5-5 shows the accumulated curves of on-street parking duration on Av. Saenz Pena and the surrounding area. 83.0 % of total parked vehicles in Av. Marco Polo parked for less than 1 hour, 8.9 % for 1 to 2 hours and 3.7 % for 2 to 3 hours. 51.1% of total parked vehicles in Jr. Puno parked for less than 1 hour, 11.1 % for 1 to 2 hours and 6.7% for 2 to 3 hours. The share of the parked vehicles for more than 3 hours on Jr. Puno is only 48.9% and this value is apparently more than the other area by 17.0% on Av. Marco Polo.

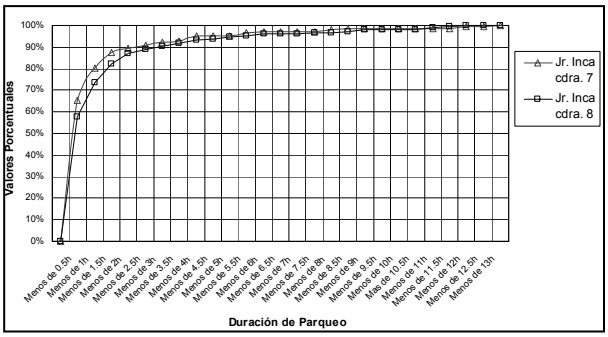

Figure 11.5-4 Accumulated Curves of Parking Duration on Av. Angamos Este

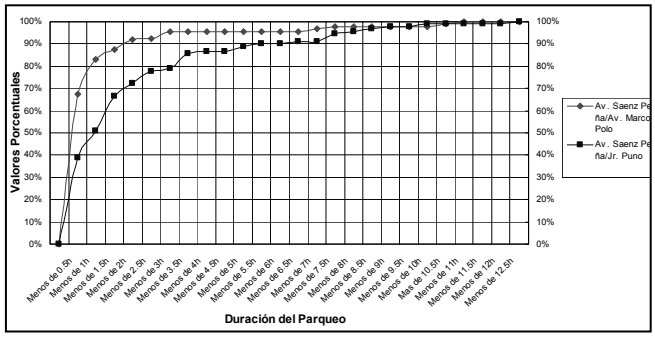

Figure 11.5-5 Accumulated Curves of Parking Duration on Jr. Inca/Av. Saenz Peña

(3) Parking Turnover Rate

Table 11.5-1 shows the parking turnover rate on the selected roads in the target areas. Jr. Inca has a rate of 3.73 times at block 7 and 5.26 times at block 8. On the other hand, the parking turnover rate in surrounding area of Av. Saenz Peña is low, the parking turnover on Av. Marco Polo block 1 is 2.29 times and on Jr. Puno block 1, 1.25 times, respectively.

Table 11.5-1 On-street Parking Duration by Sections on the Target Areas

Principal road	Street (section)	Parked vehicles	Parking capacity	Average parking duration (min)	Average parking turnover rate
Av. Angamos Este	1. Jr Inca cdra. 7	142	38	53 min	3.73
	2. Jr. Inca cdra. 8	206	38	63 min	5.26
Av. Saenz Peña	3. Av. Marco Polo	135	59	48 min	2.29
	4. Jr. Puno	90	72	102 min	1.25

(4) Hourly Fluctuation of Parked Vehicles

1) Jr. Inca (minor roads near Av. Angamos Este)

Figure 11.5-6 shows the hourly fluctuation of Jr. Inca. The peak periods were from 13:00 to 17:00. In block 7, the number of parked car increases gradually from the morning to noon and it sharply decrease from 18:00; however, it increases sharply in the morning and decreases also sharply at night from 18:00 in block 8.

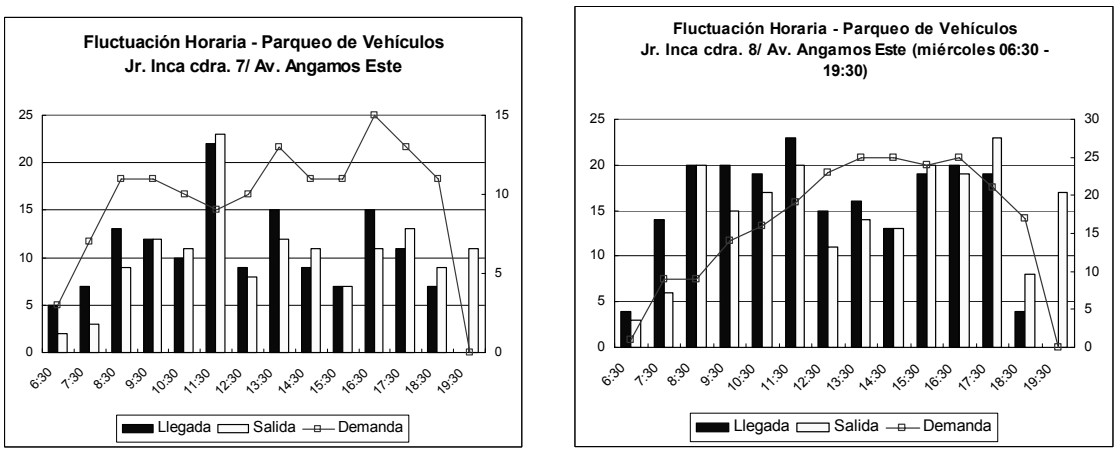

Figure 11.5-6 Hourly Fluctuation of Parked Vehicles on Jr. Inca

2) Av. Marco Polo and Jr. Puno (minor roads near Av. Saenz Peña)

Figure 11.5-7 shows the hourly fluctuation of Av. Marco Polo and Jr. Puno. On Av. Marco Polo, the peak period is during 11:00-14:00 at midday. The number of parked vehicles sharply increases in the morning, and gradually decreases after 14:00. While, for Jr. Puno, the peak period is during 12:00-17:00, and the number of parked vehicle gradually increases in the morning before 12:00, and rapidly decreases after 18:00.

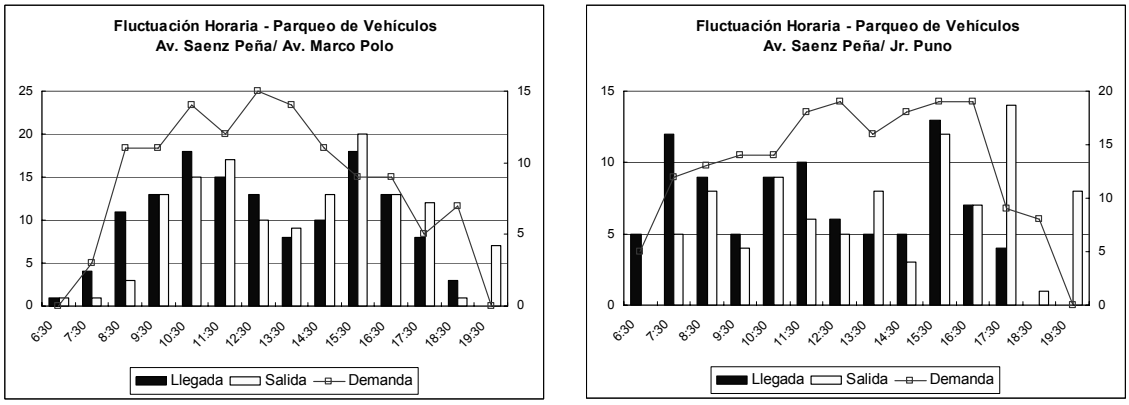

Figure 11.5-7 Hourly Fluctuation of Parked Vehicles on Av. Saenz Peña

(5) Problem and Issue of On-Street Parking in the Target Area

In Av, Angamos Este area, high parking demand was observed on the principal road and the minor roads in the midday and evening peak times, where commercial and business buildings are mixed. Average parking duration on minor roads is approximately 1.0 hour, the share of parked vehicles of less than 1.0 hour is very high, at approximately 80%.

In the Av. Saenz Peña area, high parking demand was observed in the midday peak period on the principal road. The average parking duration in the Av. Saenz Peña area, where mainly industrial facilities are located, is longer than in the Av. Angamos Este area, and