

4.2.2. TRAVEL SPEED

(1) Travel Speed by Route and Period

The objectives are to find where the bottle-necks of road network exist in the peak hour, and to set the quantity-velocity function for each road combined with the result from traffic volume count survey.

Travel speed survey is undertaken on 21 arterial roads by the floating-car method with GPS.

1) *Morning Peak Hour*

Figure 4.2-17 shows travel speed in the morning peak hour for inbound and outbound. Average travel speed is down below 20km/h on the following section for the inbound direction.

- a) Av. La Marina(Av. Javier Prado – Av. Universitaria)
- b) Av. Argentina (Av. Universitaria – Av. Ugarte)
- c) Av. Aviacion (Av. Grau – Av. Mexico)
- d) Av. Republica de Panama (Av. Javier Prado – Paseo de la Republica)
- e) Av. Tomas Marsano (Av. Republica de panama – Av. Aviacion)
- f) Av. Miguel Grau (Cementario – Braille: whole road)
- g) Av. Brasil (Plaza Bolonesi – Av. La Marina)
- h) Av. Arequipa (Av. Grau-AV. Javier Prado)

Average travel speed is down below 20km/h on the following section for the outbound direction.

- a) Av. Javier Prado(Av. Brasil-Paseo de la Republica)
- b) Av. La Marina (Av. Javier Prado-Av. Universitaria)
- c) Av. Miguel Grau(Av.Aviacion-Paseo de la Republica)
- d) Av. Brasil (Plaza Bolonesi-Circuito de Playas)
- e) Av. Tacna
- f) Av. Arequipa (Av. Javier Prado – Av. Angamos Este)

2) *Non-Peak Hour*

Figure 4.2-18 shows travel speed of the Midday non-peak hour for inbound and outbound. Average travel speed is down below 20km/h on the following section for the inbound direction.

- a) Av. Argentina (Av. Faucett-Av. Universitaria)
- b) Av. Aviacion(Av. Grau-Av. Republica de Panama:whole route)
- c) Av. Miguel Grau(Av. Aviacion-Braille)
- d) Av. Brasil (Plaza Bolonesi-Circuito de Playas)

Average travel speed is down below 20km/h on the following section for the outbound direction.

- a) Av. Argentina (Av. Universitaria-Av. Faucett)
- b) Av. Aviacion(Av. Javier Prado-Av. Republica de Panama)
- c) Av. Miguel Grau(Av. Aviacion-Paseo de la Republica)
- d) Av. Brasil (Plaza Bolonesi-Av. La Marina)
- e) Av. Tacna
- f) Av. Arequipa (Av. Angamos Este-Larco Mar)

3) Evening Peak Hour

Figure 4.2-19 shows travel speed results of the Evening peak hour for inbound and outbound. Average travel speed is down below 20km/h on the following section for the inbound direction.

- a) Av. Javier Prado (Paseo de la Republica-Av. Brasil)
- b) Av. Faucett (Av. Argentina – Av. La Marina)
- c) Av. Aviacion(Av. Grau-Av. Mexico)
- d) Av. Republica de panama – Av. Bolognesi
- e) Av. Colonial(Av. Ugarte – Av. Universitaria, Av. Guardia Civil – La Punta)]
- f) Av. Huaylas (Malecon – Av. Guardia Civil)
- g) Av. Brasil (Plaza Bolonesi-Av. La Marina)
- h) Av. Arequipa- Av. Tacna

Especially, on Av. Grau, average travel speed is down below 10km/h.

Average travel speed is down below 20km/h on the following section for the outbound direction. Av. Javier Prado (Paseo de la Republica-Av. Brasil)

- a) Paseo de la Republica(Av. Mexico –Av. Javier Prado)
- b) Av. Aviacion(Av. Grau-Av. Mexico, Av. Javier Prado-Av. Republica de la Panama)
- c) Av. Universitaria (Av. Argentina – Av. Tomas Valles)
- d) Av. Tacna
- e) Av. Arequipa

Especially, on Av. Grau, average travel speed is down below 10km/h.

4) Summary of the Result

On the following section, Travel speed is down below 20km/h in all time zones and tends to be below.

- a) Av. Brasil (Playa Bolonesi – Av. La marina)
- b) Av. Grau (Av. Aviacion- Paseo de la Republica- Braille)
- c) Av. Aviacion (Av. Grau – Av. Mexico) (Av. Javier Prado – Av. Republica de Panama)
- d) Av. Javier Prado (Paseo de la Republica – Av. Brasil)
- e) Av. Arequipa (Av. Grau- Av. Javier Prado)

On the following section, Travel speed is down below 20km/h in at least one time zone and tends to be below.

- a) Av. La marina (Av. Javier Prado – Av. Universitaria)
- b) Av. Grau (Av. Argentina - Av. La marina)
- c) Av. Argentina (Av. Faucett – Av. Universitaria – Av. Ugarte)
- d) Paseo de la Republica (Av. Mexico- Av. Javier Prado)
- e) Av. Aviacion (Av. Mexico – Av. Javier Prado)
- f) Av. Republica de Panama (Whole route)
- g) Av. Colonial (Av. Ugarte – Av. Universitaria)
- h) Av. Universitaria (Av. Tomas Valle – Av. Argentina)
- i) Av. Tomas Marsano (Av. Republica de Panama – Av. Aviacion)
- j) Av. Huaylas (Malecon – Av. Guardia Civil)
- k) Av. Grau (Cementario – Av. Aviacion)
- l) Av. Tacna – Av. Arequipa (Whole Route)

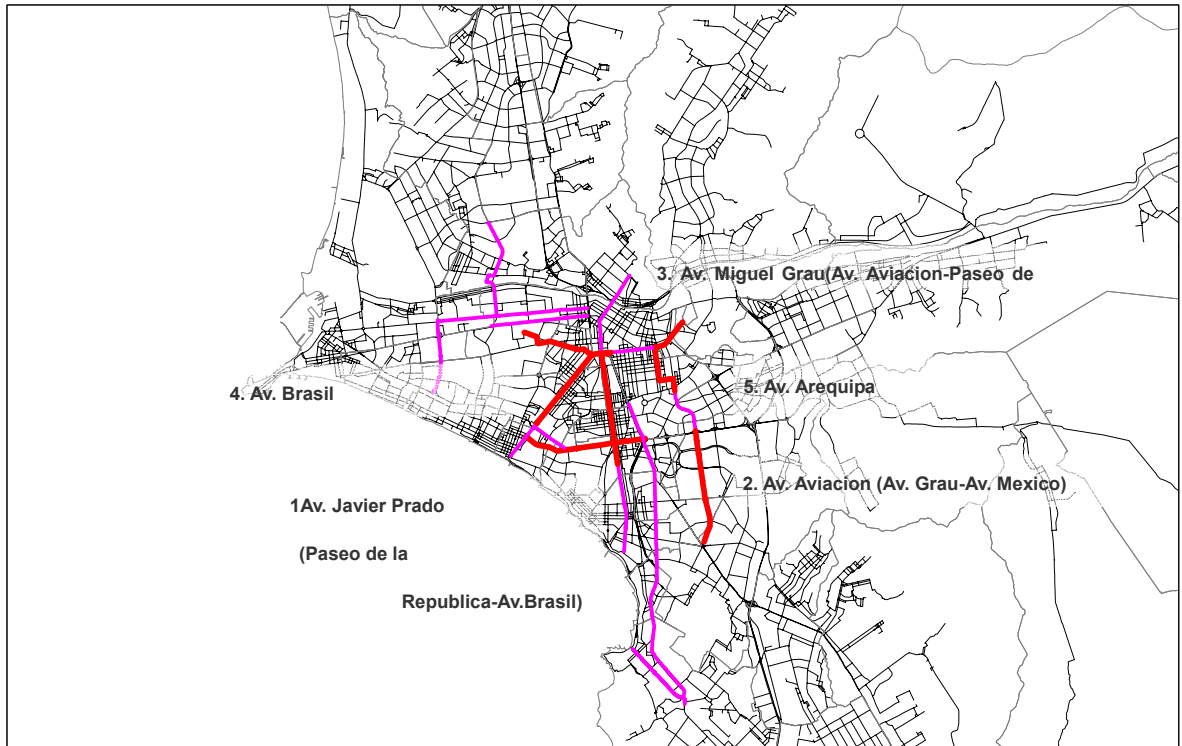


Figure 4.2-16 Main Road with Travel Speed Below 20km/h

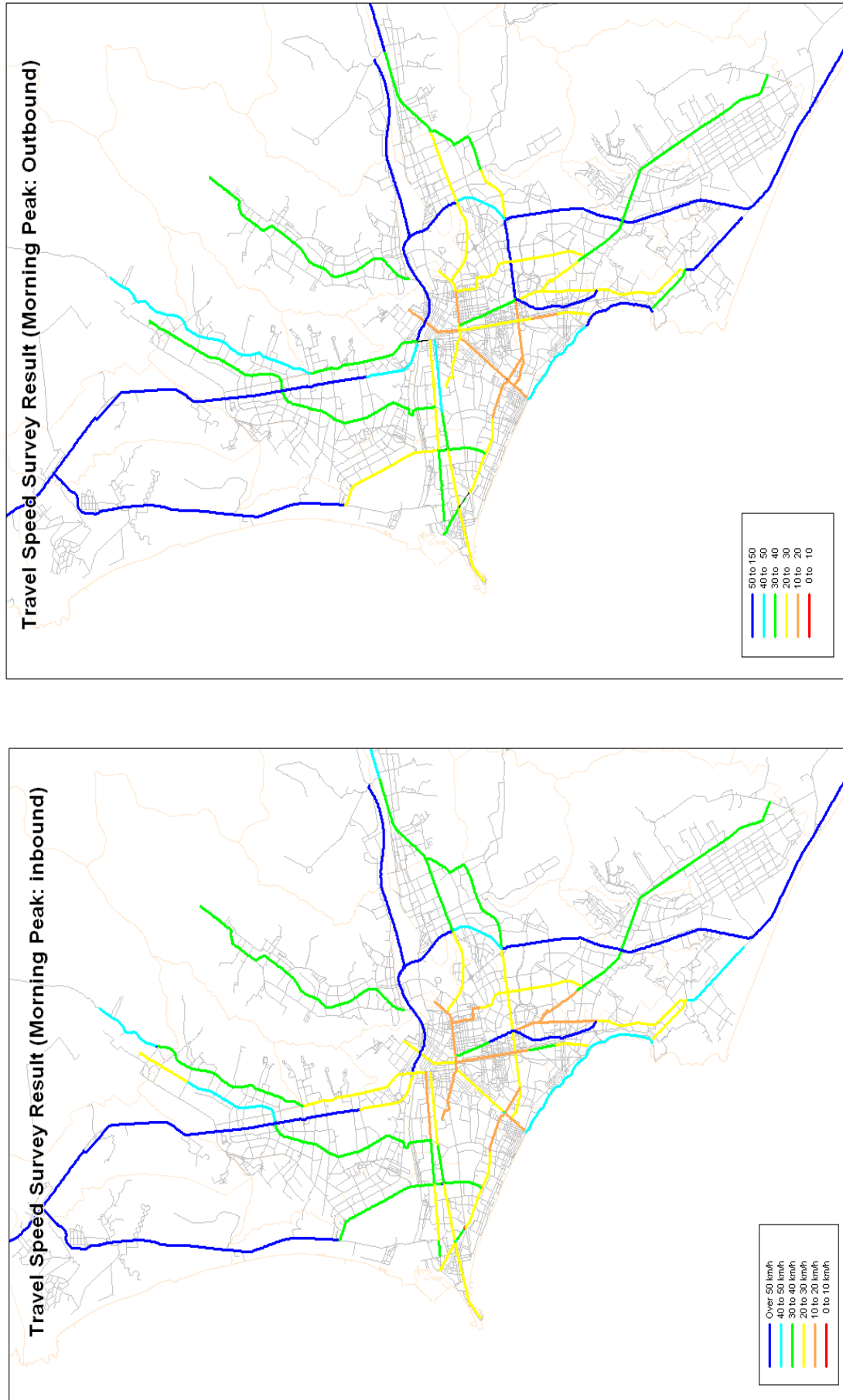


Figure 4.2-17 Travel Speed in the Morning Peak Time

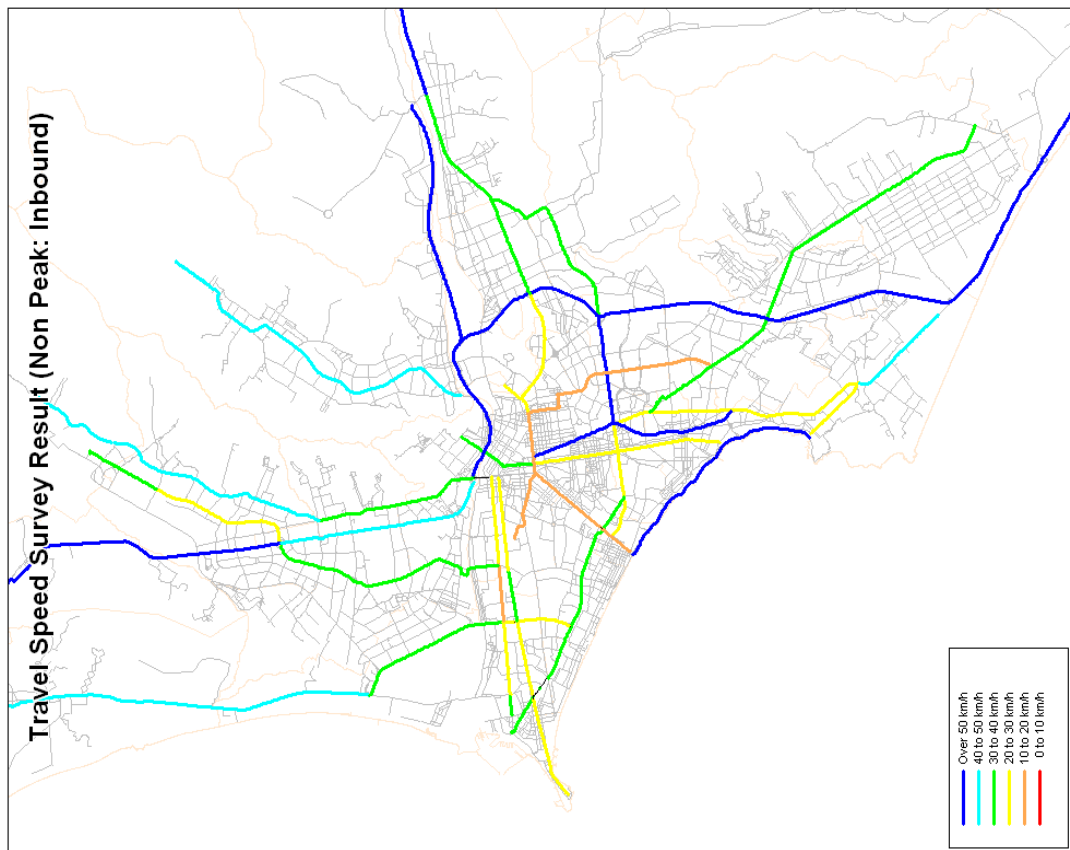
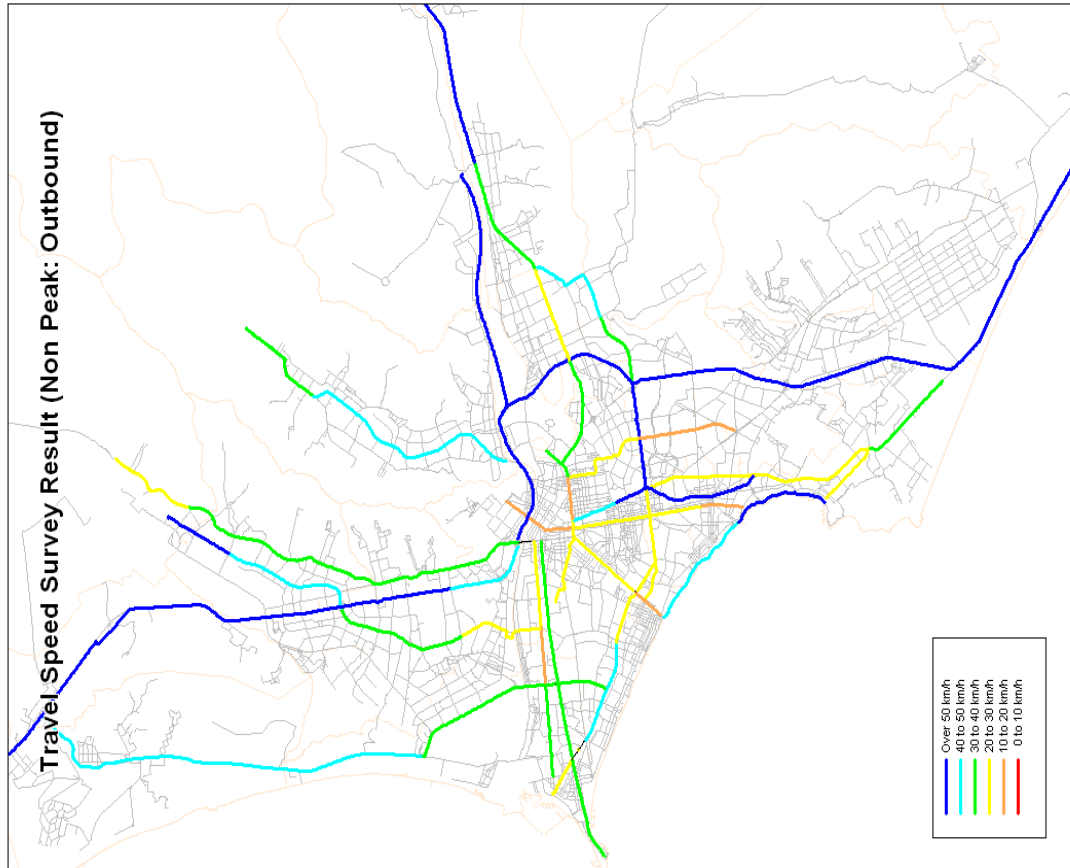


Figure 4.2-18 Travel Speed in Non Peak Time

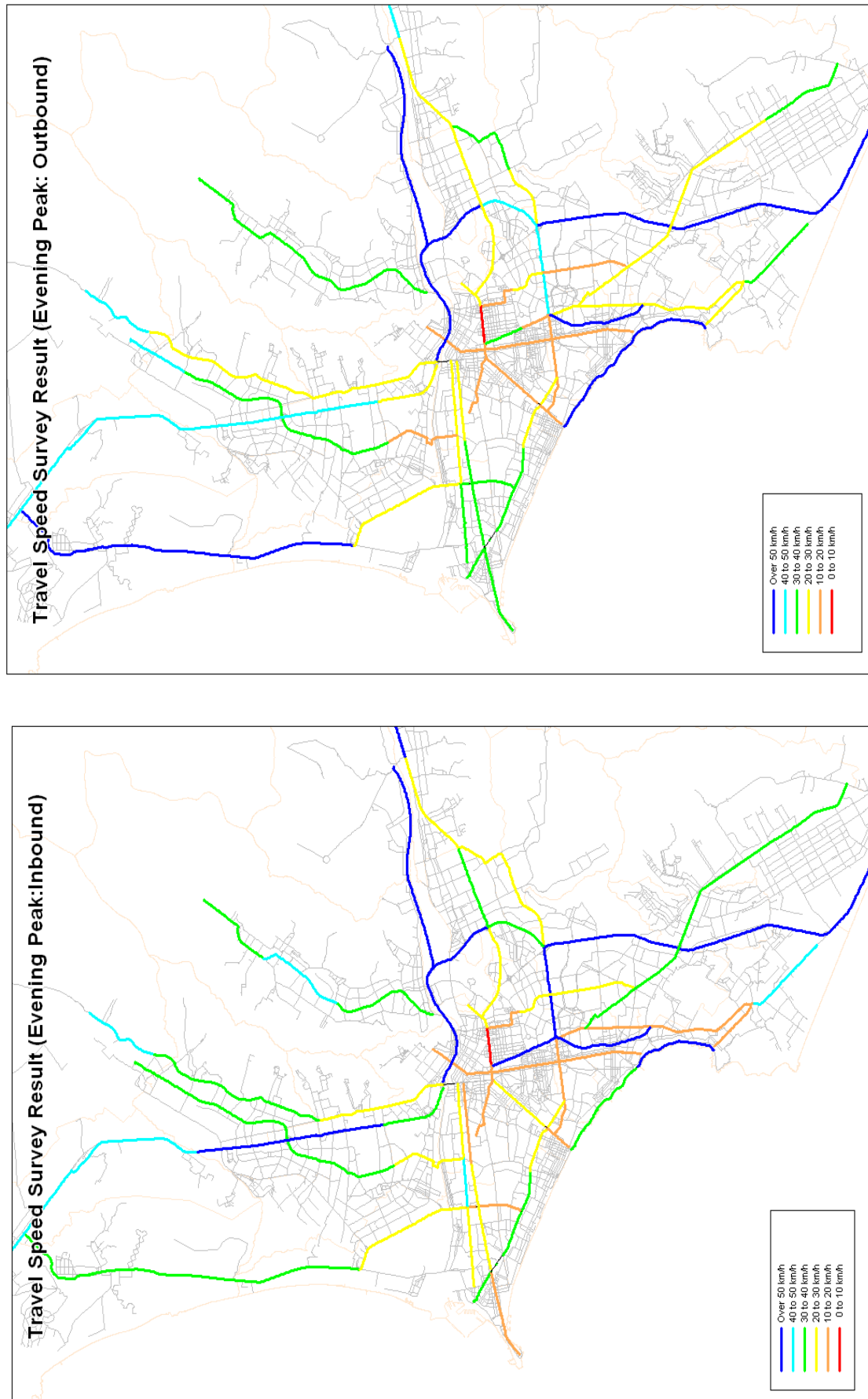


Figure 4.2-19 Travel Speed in the Night Peak Time

(2) Bottleneck

Figure 4.2-20 shows the location of the bottleneck in the Lima and Callao Metropolitan Area from the result of travel speed survey. The bottleneck point caused in the intersection is defined as below:

- a) Sections on major streets, indicating travel speed under 10 km/h by sections on the major roads during the morning peak period and the evening peak period, and
- b) Location of the intersection with traffic congestion by traffic spill back from upstream.

Bottlenecks are observed in the extensive area surrounded with Av. Pan Americana Norte, Sur and Av. Universitaria, including the central area of Callao and San Juan de Lurigancho.

The causes of bottlenecks characterized by travel speed of 10 km/h or less during peak periods are categorized into mainly 4 types as described below.

- a) Unsuitable traffic signal control system at intersections
- b) Conflict from buses, minibuses and combis near bus stops
- c) Blocking of signalized intersection due to heavy left-turn vehicles, and
- d) Conflict of merging and diverging, from/to side roads without signal light

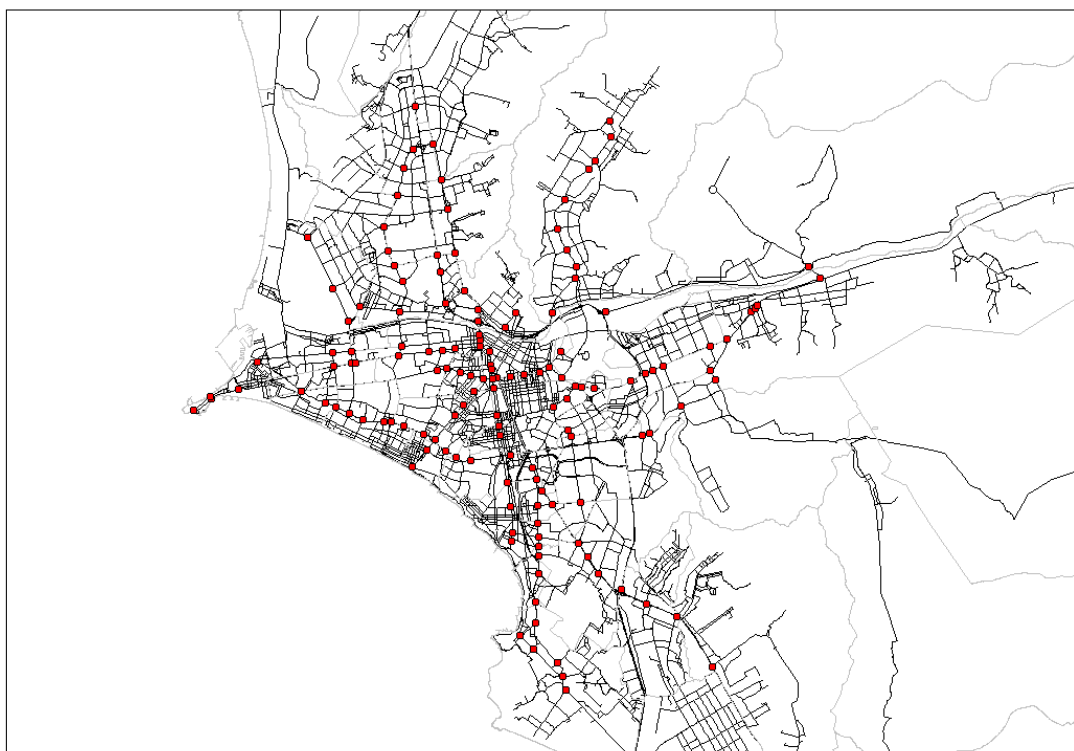


Figure 4.2-20 Locations of Bottleneck at the Intersection

4.3. CARGO TRANSPORT

The Person Trip survey explained in Chapter 3 focuses on the investigation of only individual trips traveled by the residents in the Study area. Therefore, a freight survey is needed to obtain the characteristics of goods movement in the study area.

This survey provide data basis, for instance, for development of origin and destination of truck movements to complement the OD matrices obtained from the person trip survey.

For this purpose, following surveys were conducted:

- a) Traffic count survey
- b) Roadside interview survey
- c) Interview survey at logistic and transport company

4.3.1. OUTLINE OF CARGO TRANSPORT DEMAND

The hourly vehicular traffic volume by vehicle type and by direction was conducted.

The type of vehicle was classified as following 7 types:

- a) Light cargo truck
- b) 2-axle Truck
- c) 3-axle Truck
- d) Dump Truck
- e) Trailer
- f) Tank Truck
- g) Mixer

Figure 4.3-1 shows freight traffic volume counted at each designated survey station and Figure 4.3-2 and Figure 4.3-3 shows the mode ratio of freight vehicle at cordon line point (total, inbound and outbound).

(1) Freight Vehicle Volume in Each Surveyed Point

1) Cordon Line

At survey station CL-1(Lima - Huaral), CL-4(Lima - Huarochiri) and CL-6(Lima – Cañate), freight vehicle volume of each point exceeds 2,500 vehicles totally inbound and outbound. Meanwhile at the point of CL-2(Lima – Huaral), CL-3(Lima - Canta) and CL-5(Lima - Huarochiri), freight vehicle volume of each point is approximately 700 vehicles.

At CL-1, a trailer occupies 44.3 % of the total number of vehicles and light cargo truck occupies 29.2%. At CL-2, small cargo truck is 98.5% of the total number of freight vehicles. At CL-2, freight vehicle except small truck is not tending to pass. Therefore most freight vehicle pass to Northern area beyond Lima go through pan Americana norte Antigua on CL-1.

At CL-4 and CL-6, small cargo truck and 2 axle truck occupies 25% to 30% of the total number of freight vehicle. Trailer occupies 28 to 33 %.

2) Airport Cargo

Table 4.3-1 shows freight vehicle count result of Jorge Chavez airport, Callao port, Mercado Mayorista Market and Pampilla Oil Refinery.

At the airport, totally 498 freight vehicles are counted. Trailer occupies 39% of the total volumes, however small trucks occupies 17%, trucks with two axles occupies 24% and tank truck occupies 16% as well.

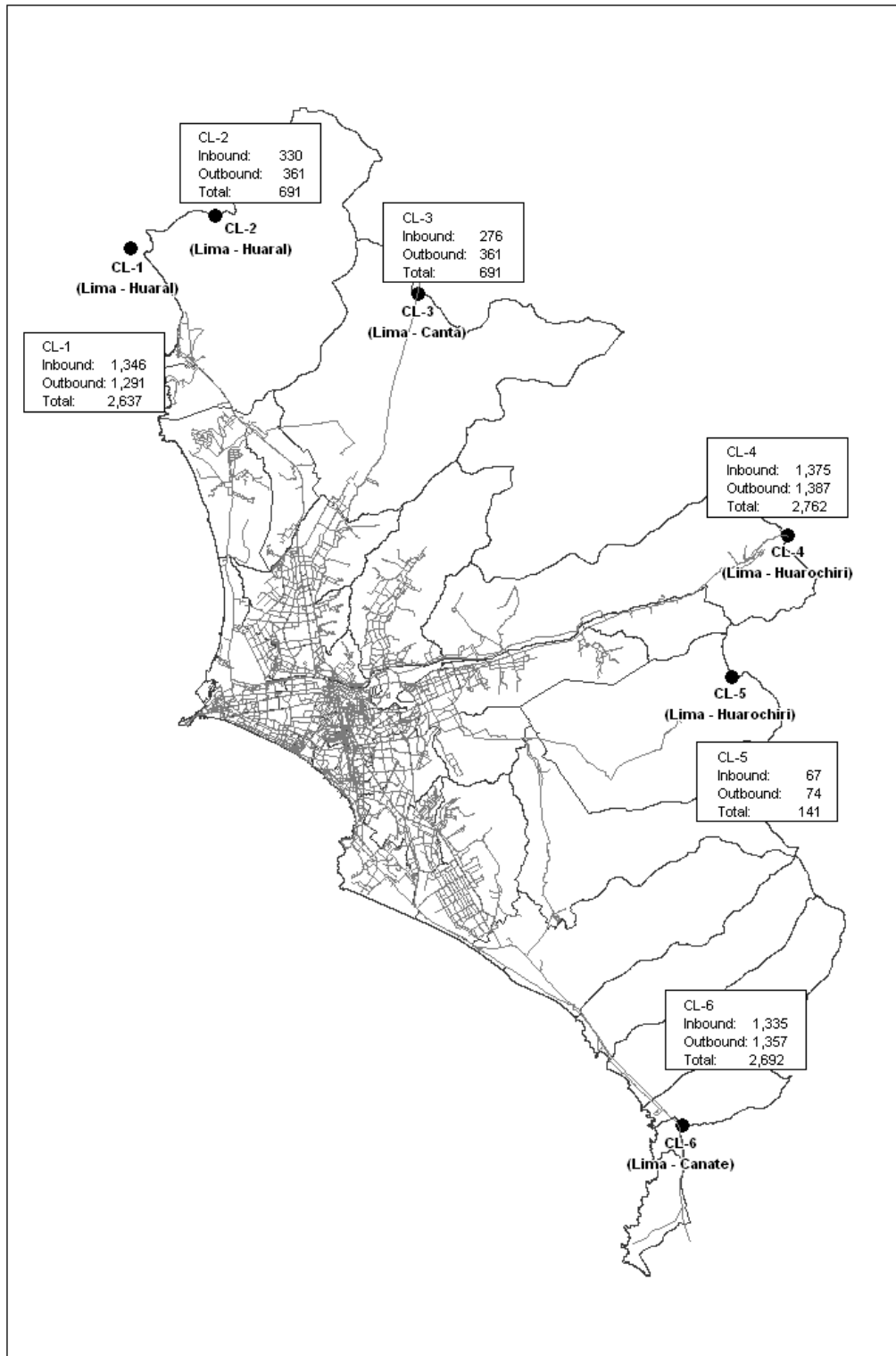


Figure 4.3-1 Freight Traffic Count Survey Result at the Cordon Point

3) Callao Port Cargo

Figure 4.3-1 shows that totally 1,647 freight vehicles were counted at the Callao port of totally three gates. Most freight vehicles counted in Callao port are trailers, which occupies 96.7 % of the total freight vehicles.

4) Result of the Terminal Survey

Freight count survey and interview were implemented at 2 points inside the Study area (Mercado Mayorista en Victoria and Pampilla oil refinery), as the representative freight vehicle terminal.

- a) Mercado Mayorista Market
At Mercado Mayorista (Retailing market), freight vehicle can enter the market from 14:00 to 7:00 of next day. Totally 447 freight vehicles are counted in one day. Trailer occupies 41.8%, three-axle truck does 33.1%, and two-axle truck does 22.8% of the total number of freight vehicle observed.
- b) Pampilla oil refinery
At Pampilla oil refinery, tank truck can enter the refinery from 5:00 to 1:00. Totally 692 tank trucks were counted.

Table 4.3-1 Number of Freight vehicle (J.C. Airport, Callao Port, Market and Oil refinery)

(Unit:vehicle/day)

<i>Inbound</i>										
Survey Point		Direction	small truck	2 axle truck	3 axle truck	Dump truck	Trailer	Tank Truck	Mixer	Total
CL7	Aeropuerto Jose Chavez	Inbound	33	58	3	7	100	38	1	240
CL8	Puerto de Callao	Inbound	2	5	23	5	1602	6	4	1647
CT1	Mercado Mayolista en Victoria	to the market	5	74	50	0	92	0	0	221
CT2	Panpilla oil refinery	to oil refinery	0	0	0	0	0	331	0	331
<i>Outbound</i>										
CL7	Aeropuerto Jose Chavez	Outbound	52	60	2	7	96	40	1	258
CL8	Puerto de Callao	Outbound	3	7	34	10	1623	5	5	1687
CT1	Mercado Mayolista en Victoria	to outside	5	74	52	0	95	0	0	226
CT2	Panpilla oil refinery	to outside	0	0	0	0	0	361	0	361
<i>Total</i>										
CL7	Aeropuerto Jose Chavez	Total	85	118	5	14	196	78	2	498
CL8	Puerto de Callao	Total	5	12	57	15	3225	11	9	3334
CT1	Mercado Mayolista en Victoria	Total	10	148	102	0	187	0	0	447
CT2	Panpilla oil refinery	Total	0	0	0	0	0	692	0	692

<i>Inbound</i>										
Survey Point		Direction	small truck	2 axle truck	3 axle truck	Dump truck	Trailer	Tank Truck	Mixer	Total
CL7	Aeropuerto Jose Chavez	Inbound	13.8%	24.2%	1.3%	2.9%	41.7%	15.8%	0.4%	100.0%
CL8	Puerto de Callao	Inbound	0.1%	0.3%	1.4%	0.3%	97.3%	0.4%	0.2%	100.0%
CT1	Mercado Mayolista en Victoria	to the market	2.3%	33.5%	22.6%	0.0%	41.6%	0.0%	0.0%	100.0%
CT2	Panpilla oil refinery	to oil refinery	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
<i>Outbound</i>										
CL7	Aeropuerto Jose Chavez	Outbound	20.2%	23.3%	0.8%	2.7%	37.2%	15.5%	0.4%	100.0%
CL8	Puerto de Callao	Outbound	0.2%	0.4%	2.0%	0.6%	96.2%	0.3%	0.3%	100.0%
CT1	Mercado Mayolista en Victoria	to outside	2.2%	32.7%	23.0%	0.0%	42.0%	0.0%	0.0%	100.0%
CT2	Panpilla oil refinery	to outside	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
<i>Total</i>										
CL7	Aeropuerto Jose Chavez	Total	17.1%	23.7%	1.0%	2.8%	39.4%	15.7%	0.4%	100.0%
CL8	Puerto de Callao	Total	0.1%	0.4%	1.7%	0.4%	96.7%	0.3%	0.3%	100.0%
CT1	Mercado Mayolista en Victoria	Total	2.2%	33.1%	22.8%	0.0%	41.8%	0.0%	0.0%	100.0%
CT2	Panpilla oil refinery	Total	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%

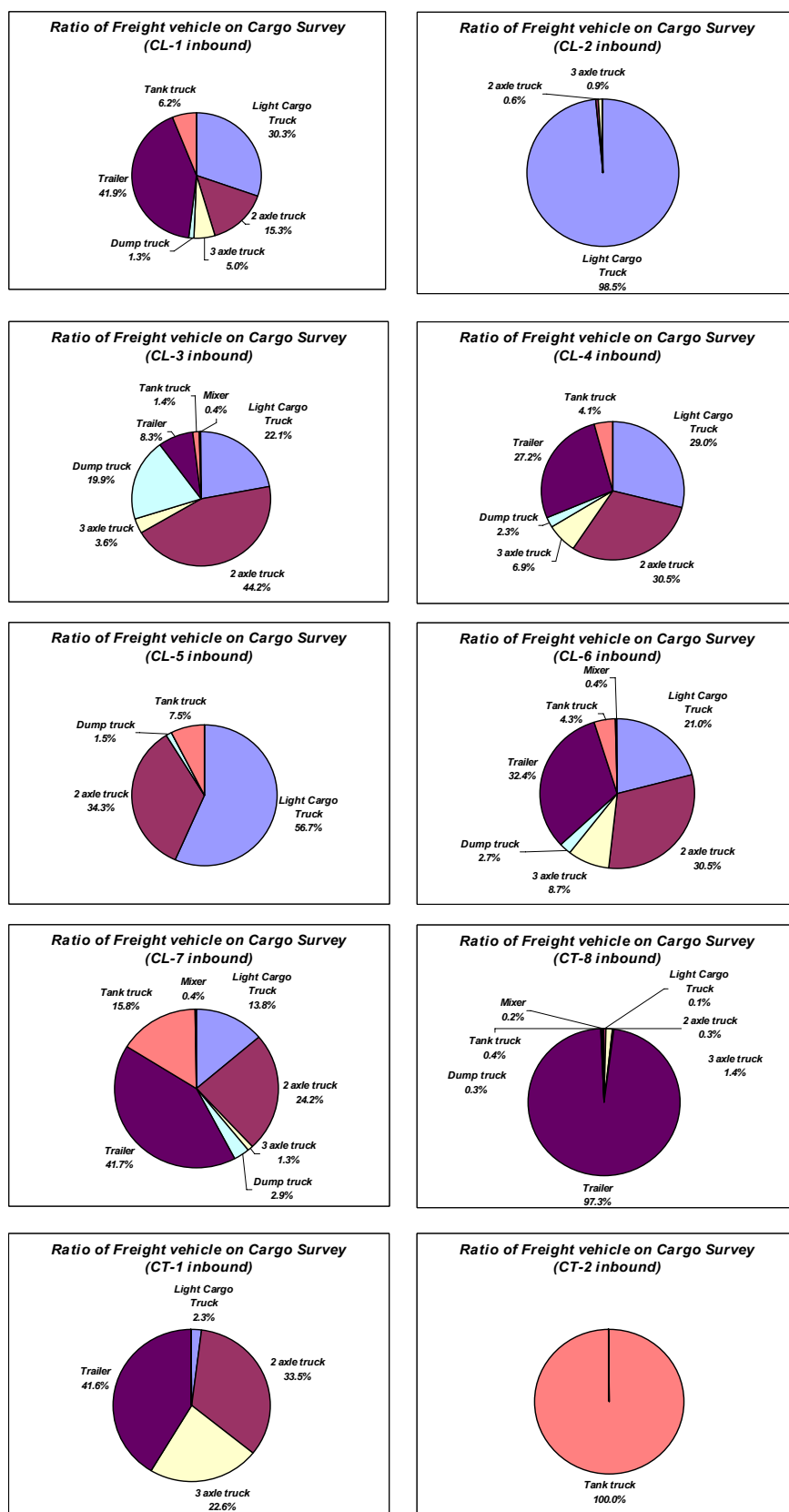


Figure 4.3-2 Ratio of Freight Vehicle at Point of CL-1 to CT-2 (Inbound)

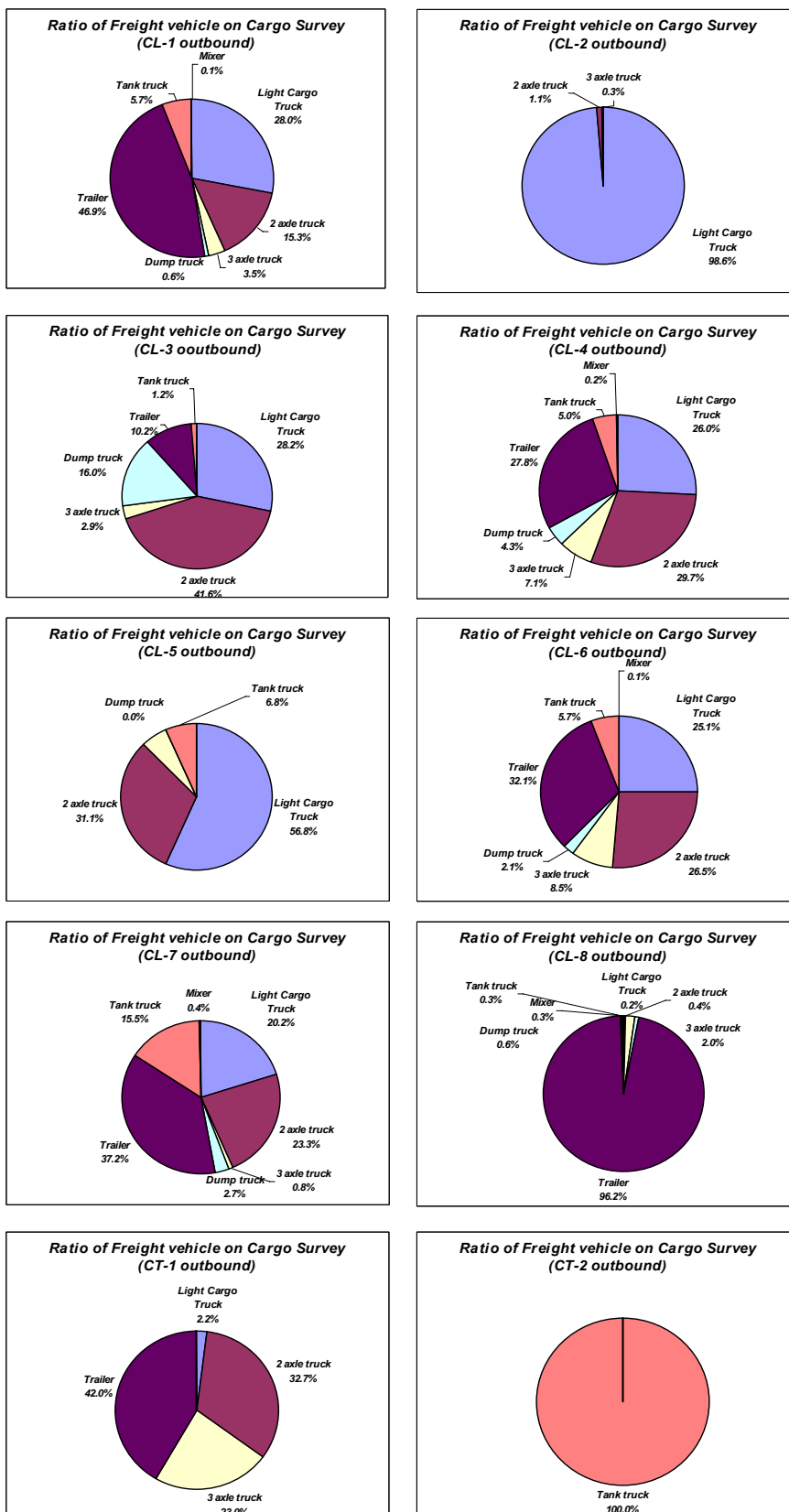


Figure 4.3-3 Ratio of Freight Vehicle at Point of CL-1 to CT-2 (Outbound)

(2) Type of Goods and Volumes Transported

Table 4.3-2 shows freight volume and ratio by sorts of article. Figure 4.3-4 and Figure 4.3-5 shows also ratio by sorts of article at survey point by total, inbound and out bound.

1) Freight Volume

CL-1, CL-4, CL-6 exceeds 20,000ton per day. At CL-2, mainly small cargo truck only passes. Therefore, most items are entering and go out of Lima at CL-1. At CL-2, only 165.7 ton per day. CL-3 1,800ton and CL-5 244.8 ton per day.

At Jorge Chavez International Airport, the freight volume in one day is approximately 3,600ton. The volume into the airport is 587.3 ton, and the one out of the airport is 3,063.7 ton.

At Callao port (CL-8), approximately 31,200ton per day into the port 17,311.7t, the volume out of the port is 13,890.1t.

At Mercado Mayorista market, approximately 3,870ton are conveyed into the market and 345.5 ton are carried out of the market in a day

At Pampilla oil refinery, 4,813ton of the fuel are carried out in a day.

2) Characteristic of the Freight Items in Each Surveyed Point

a) Inbound

At the cordon line from CL-1 to CL-6, Agriculture/Fishery occupies high ratio compared with the outbound. Especially, at CL-2 Agriculture/Fishery occupies 42.7 % and at CL-5 occupies 50.2 % of total volume.

In CL-3 and CL-4, Forestry and Mine occupies high ratio of 65.7% and 22.9 % of total volume.

At the airport and port, the others occupy 63.9 % and 71.3% of total volumes into the facility.

b) Outbound

Generally industrial products occupies high ratio of the whole conveyed items. Meanwhile, agriculture and fishery decrease the ratio. At CL-2, Light industrial products, at CL-3, heavy industrial products occupies high ratio as. At the airport, Fuel occupies high ratio 50.8 % of whole volume out of the airport. At Callao port, heavy industrial products occupy 66.6% of total volume out of the Callao port in a day.

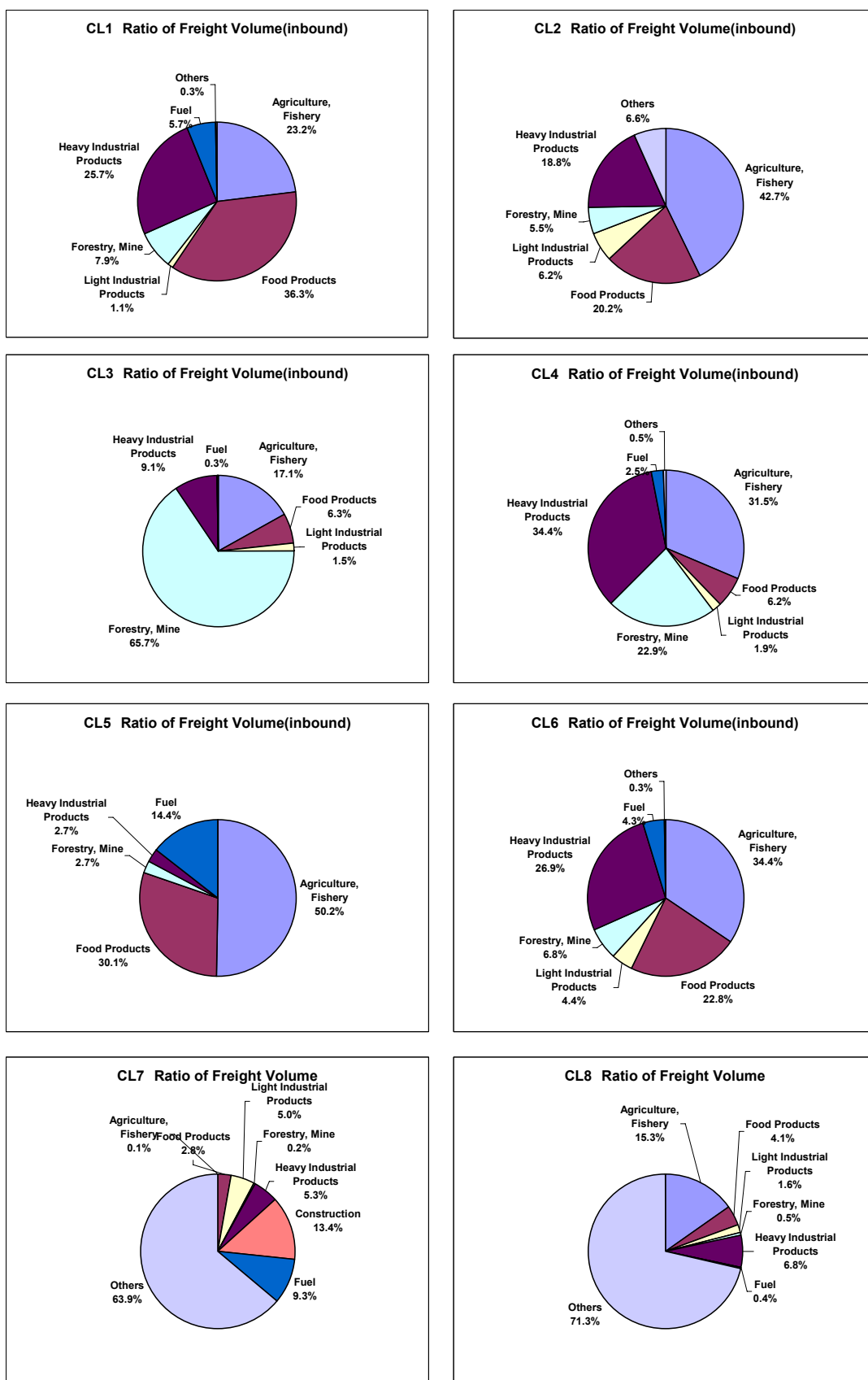


Figure 4.3-4 Ratio of Freight Volume of Survey Points (inbound)

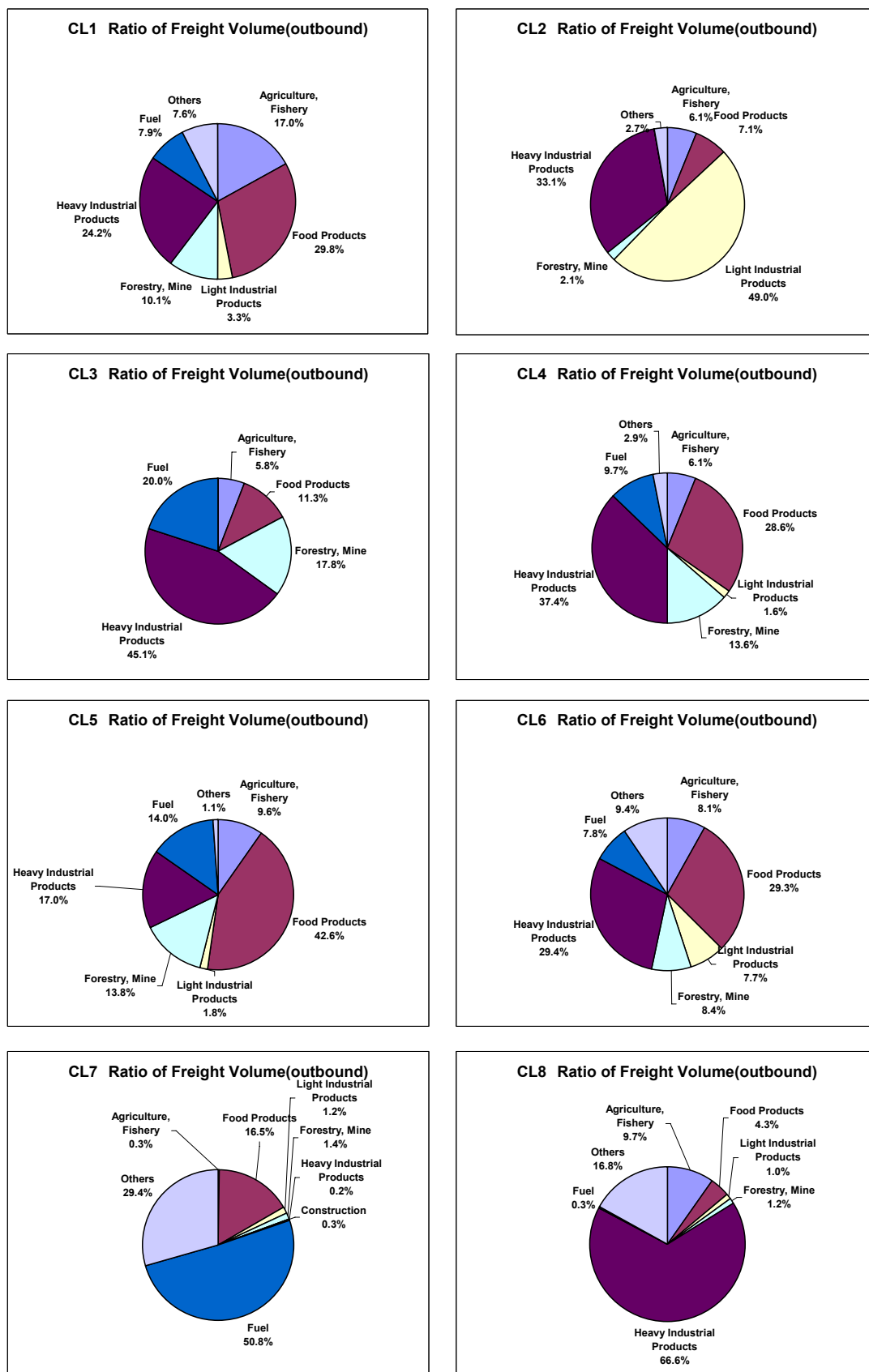


Figure 4.3-5 Ratio of Freight Volume of Survey Points (outbound)

Table 4.3-2 Freight Volume of Each Survey

Unit ton/day

Codigo de estacion	Direccion	Items	Agricultur e, Fishery	Food Products	Light Industrial Products	Forestry, Mine	Heavy Industrial Products	Constructi on	Fuel	Others	Total
CL1	Outbound	Freight Volume	1,976.5	3,450.6	377.5	1,176.0	2,809.4	2.8	920.9	879.5	11,593.3
		Ratio	17.0%	29.8%	3.3%	10.1%	24.2%	0.0%	7.9%	7.6%	100.0%
	Inbound	Freight Volume	3,534.6	5,532.5	160.5	1,200.6	3,914.8	0.0	869.7	46.6	15,259.2
		Ratio	23.2%	36.3%	1.1%	7.9%	25.7%	0.0%	5.7%	0.3%	100.0%
	Total	Freight Volume	5,511.1	8,983.1	538.0	2,376.6	6,724.2	2.8	1,790.6	926.0	26,852.6
		Ratio	20.5%	33.5%	2.0%	8.9%	25.0%	0.0%	6.7%	3.4%	100.0%
CL2	Outbound	Freight Volume	7.4	8.6	59.8	2.5	40.5	0.0	0.0	3.3	122.1
		Ratio	6.1%	7.1%	49.0%	2.1%	33.1%	0.0%	0.0%	2.7%	100.0%
	Inbound	Freight Volume	18.1	8.6	2.6	2.3	7.9	0.0	0.0	2.8	43.6
		Ratio	41.4%	19.6%	6.0%	5.3%	18.2%	0.0%	0.0%	6.4%	100.0%
	Total	Freight Volume	25.5	17.2	62.4	4.8	48.4	0.0	0.0	6.1	165.7
		Ratio	15.4%	10.4%	37.7%	2.9%	29.2%	0.0%	0.0%	3.7%	100.0%
CL3	Outbound	Freight Volume	15.8	30.8	0.0	48.3	122.4	0.0	54.4	0.0	271.7
		Ratio	5.8%	11.3%	0.0%	17.8%	45.1%	0.0%	20.0%	0.0%	100.0%
	Inbound	Freight Volume	277.0	102.0	24.9	1,064.9	148.4	0.0	5.0	0.0	1,622.1
		Ratio	17.1%	6.3%	1.5%	65.7%	9.1%	0.0%	0.3%	0.0%	100.0%
	Total	Freight Volume	292.8	132.8	24.9	1,113.2	270.8	0.0	59.4	0.0	1,893.8
		Ratio	15.5%	7.0%	1.3%	58.8%	14.3%	0.0%	3.1%	0.0%	100.0%
CL4	Outbound	Freight Volume	545.3	2,570.6	146.8	1,224.2	3,357.2	0.0	875.2	262.9	8,982.1
		Ratio	6.1%	28.6%	1.6%	13.6%	37.4%	0.0%	9.7%	2.9%	100.0%
	Inbound	Freight Volume	4,686.6	922.5	287.2	3,408.6	5,126.8	0.0	373.3	80.8	14,885.7
		Ratio	31.5%	6.2%	1.9%	22.9%	34.4%	0.0%	2.5%	0.5%	100.0%
	Total	Freight Volume	5,231.8	3,493.1	434.0	4,632.8	8,484.0	0.0	1,248.5	343.7	23,867.9
		Ratio	21.9%	14.6%	1.8%	19.4%	35.5%	0.0%	5.2%	1.4%	100.0%
CL5	Outbound	Freight Volume	11.5	51.0	2.2	16.5	20.4	0.0	16.8	1.4	119.7
		Ratio	9.6%	42.6%	1.8%	13.8%	17.0%	0.0%	14.0%	1.1%	100.0%
	Inbound	Freight Volume	62.7	37.6	0.0	3.3	3.4	0.0	18.0	0.0	125.1
		Ratio	50.2%	30.1%	0.0%	2.7%	2.7%	0.0%	14.4%	0.0%	100.0%
	Total	Freight Volume	74.2	88.6	2.2	19.9	23.7	0.0	34.8	1.4	244.8
		Ratio	30.3%	36.2%	0.9%	8.1%	9.7%	0.0%	14.2%	0.6%	100.0%
CL6	Outbound	Freight Volume	1,194.1	4,332.0	1,130.7	1,242.7	4,342.6	0.0	1,152.9	1,385.3	14,780.3
		Ratio	8.1%	29.3%	7.7%	8.4%	29.4%	0.0%	7.8%	9.4%	100.0%
	Inbound	Freight Volume	4,414.4	2,930.7	568.5	868.2	3,458.1	0.0	557.6	41.4	12,856.2
		Ratio	34.3%	22.8%	4.4%	6.8%	26.9%	0.0%	4.3%	0.3%	100.0%
	Total	Freight Volume	5,608.5	7,262.6	1,699.2	2,111.0	7,800.7	0.0	1,710.4	1,426.7	27,636.5
		Ratio	20.3%	26.3%	6.1%	7.6%	28.2%	0.0%	6.2%	5.2%	100.0%
CL7	Outbound	Freight Volume	9.7	505.0	36.4	43.1	5.8	7.9	1,555.0	900.9	3,063.7
		Ratio	0.3%	16.5%	1.2%	1.4%	0.2%	0.3%	50.8%	29.4%	100.0%
	Inbound	Freight Volume	0.6	16.2	29.6	1.0	31.0	78.8	54.6	375.5	587.3
		Ratio	0.1%	2.8%	5.0%	0.2%	5.3%	13.4%	9.3%	63.9%	100.0%
	Total	Freight Volume	10.2	521.2	66.0	44.1	36.8	86.7	1,609.6	1,276.4	3,650.9
		Ratio	0.3%	14.3%	1.8%	1.2%	1.0%	2.4%	44.1%	35.0%	100.0%
CL8	Outbound	Freight Volume	1,342.7	601.2	132.2	172.2	9,257.7	0.0	45.0	2,339.1	13,890.1
		Ratio	9.7%	4.3%	1.0%	1.2%	66.6%	0.0%	0.3%	16.8%	100.0%
	Inbound	Freight Volume	2,647.7	717.2	284.1	82.4	1,174.2	0.0	67.0	12,339.1	17,311.7
		Ratio	15.3%	4.1%	1.6%	0.5%	6.8%	0.0%	0.4%	71.3%	100.0%
	Total	Freight Volume	3,990.4	1,318.4	416.3	254.6	10,431.8	0.0	112.0	14,678.2	31,201.8
		Ratio	12.8%	4.2%	1.3%	0.8%	33.4%	0.0%	0.4%	47.0%	100.0%
CT1	Outbound	Freight Volume	345.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	345.5
		Ratio	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	Inbound	Freight Volume	3,869.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3,869.0
		Ratio	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	Total	Freight Volume	4,214.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4,214.5
		Ratio	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
CT2	Outbound	Freight Volume	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Ratio	-	-	-	-	-	-	-	-	-
	Inbound	Freight Volume	0.0	0.0	0.0	0.0	0.0	0.0	4,813.3	0.0	4,813.3
		Ratio	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
	Total	Freight Volume	0.0	0.0	0.0	0.0	0.0	0.0	4,813.3	0.0	4,813.3
		Ratio	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%

4.3.2. DEMAND OF BUSINESS ENTITY

The interview survey at transport companies is conducted. Five major transport companies are selected based on a list of transport companies. An interviewer conducts the survey with a person who is in charge at designated date. Main Interview items are as follows:

- a) Company profile and
- b) Transport commodity

Totally 5 freight companies are selected considering with the size of company and location. The locations of companies selected are shown in Figure 4.3-6, and the names of companies are shown in Table 4.3-3.



Figure 4.3-6 Transport Company Location to Be Surveyed

Table 4.3-3 Transport Company Surveyed (5 companies)

Code	Company Name	Company type	Area
TC-1	Transporte Girasoles S.A.C.	Transport Company	Est (Carretera Central)
TC-2	Transporte Cesaro Hermanos S.A.	Transport Company	Norte (P.A.N.)
TC-3	Transportes 77 S.A.	Transport Company	Est (Carretera Central)
TC-4	Deposito Isabel la Catolica	Deposit Company	Centro(Mcdo. Mayorista)
TC-5	Corporacion de Servicios Generales GyR S.A.	Deposit Company	Sur (P.A.S.)

CHAPTER 5

Public Transport Conditions

5. PUBLIC TRANSPORT CONDITIONS

5.1. GENERAL

Public transport in the Lima and Callao metropolitan area is composed of buses, taxis, colectivos, and moto-taxis. At railway facilities, there are a maintenance line of 10.2km length with 7 stations and a central operation center. This section is concluded but it is only used for maintenance during some days of the week. The main public transport is the bus, while taxis and colectivos are supplementary and rivalry means. The colectivo functions as a fixed-route taxi, and operates on a major bus route in competition with them.

Within the suburbs of Lima and Callao, the moto-taxi service operates as a paratransit. The moto-taxi is a motorcycle taxi with three wheels and a space for two passengers in the rear of the car. The moto-taxi operation is restricted within the suburbs because the tricycle car operates with low speed and instability in traffic flow and disturbs smooth traffic flow and safety.

The Municipal Direction of Urban Transport (DMTU) in Lima and the General Direction of Urban Transport (GGTU) in Callao control the public transport service. Private bus companies operate a bus under their jurisdiction.

Nowadays, there is a seemingly excessive supply of public transport. There are approximately 600 authorized routes that cover the city. The service is provided by many bus fleets, which are older than 15 years in average. 36% of the bus fleet in Lima is conformed by small vehicles called “Camionetas Rurales” with a capacity of 17 passengers. The old and low capacity fleets cause pollution and traffic congestion.

This chapter focuses on the present public transport conditions in the Lima and Callao metropolitan area, composed of bus, railway and taxi transport. The first section shows the demand of public bus transport. The second section shows the present conditions of the public transport. The last section evaluates the current problems and issues.

5.2. PRESENT PUBLIC TRANSPORT DEMAND

During the months of July and August in 2004, the Study team undertook a number of bus transport surveys, e.g., the Bus Passenger Survey, the Bus Traffic Volume Counting Survey, the Bus Operation Condition Survey and the Bus Passenger Interview Survey and so on. The present public transport demand in the Study area was grasped based on the surveyed data. The following sections show a detailed analysis.

5.2.1. BUS PASSENGERS

Bus passengers were counted at 104 survey locations on major roads together with vehicle volume counting and its findings are essential for planning a bus operation system. Figure 5.2-1 to Figure 5.2-2 show the passenger volumes by type of bus: Omnibus, Microbus and Camioneta.

As it can be seen in Figure 5.2-1, the highest bus passengers are recorded on Av. Tupac Amaru at 38,000/hour/ direction. Av. Panamericana Norte and Av. Zarumilla carry the highest bus passenger volumes. Its figures range from 24,000 to 26,000 passengers / hour/ direction. These roads are located in the northern part of the metropolitan area where bus passenger demands are relatively higher. Bus fleets mixed with Omnibus, Microbus and Camioneta transport those passengers. In 2004, bus passenger ratios by bus fleet are 31% for Camioneta, 42% for Microbus and 27% for Omnibus (see Table 5.2-1). However, the bus passengers in Bogotá in Colombia and Belem in Brazil recorded approximately 35,000

passengers / hour/ direction with only Omnibus (ordinary bus). Therefore, the passenger volumes on the major roads are close to transport capacity under the present public transport system on the mixed type of bus fleets.

On the other hand, the passengers in San Isidro, Miraflores, San Borja, Surquillo, etc., are somewhat low. Those areas are higher in ratio of passenger car volume in comparison to the rest of the modes.

Figure 5.2-3 illustrates major bus passenger corridors referred to the bus passenger volumes in Figure 5.2-1. The major corridors are the link between north and east-west areas and the Center, and also the south area and the Center Centro making a detour in San Isidro, Miraflores, San Borja, Surquillo, etc., where bus passengers are relatively lower.

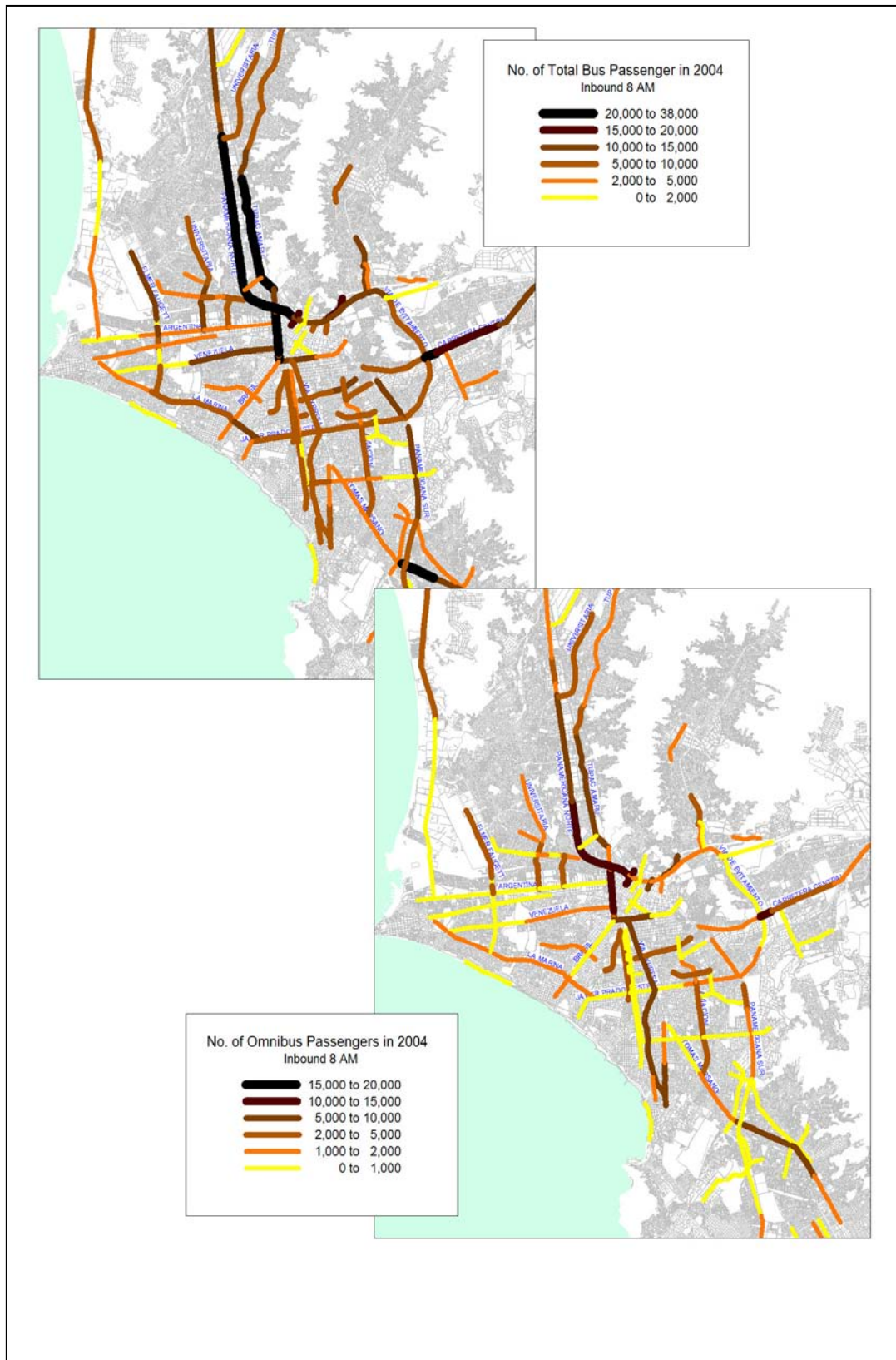


Figure 5.2-1 Numbers of Passengers by All Buses and Omnibus in 2004

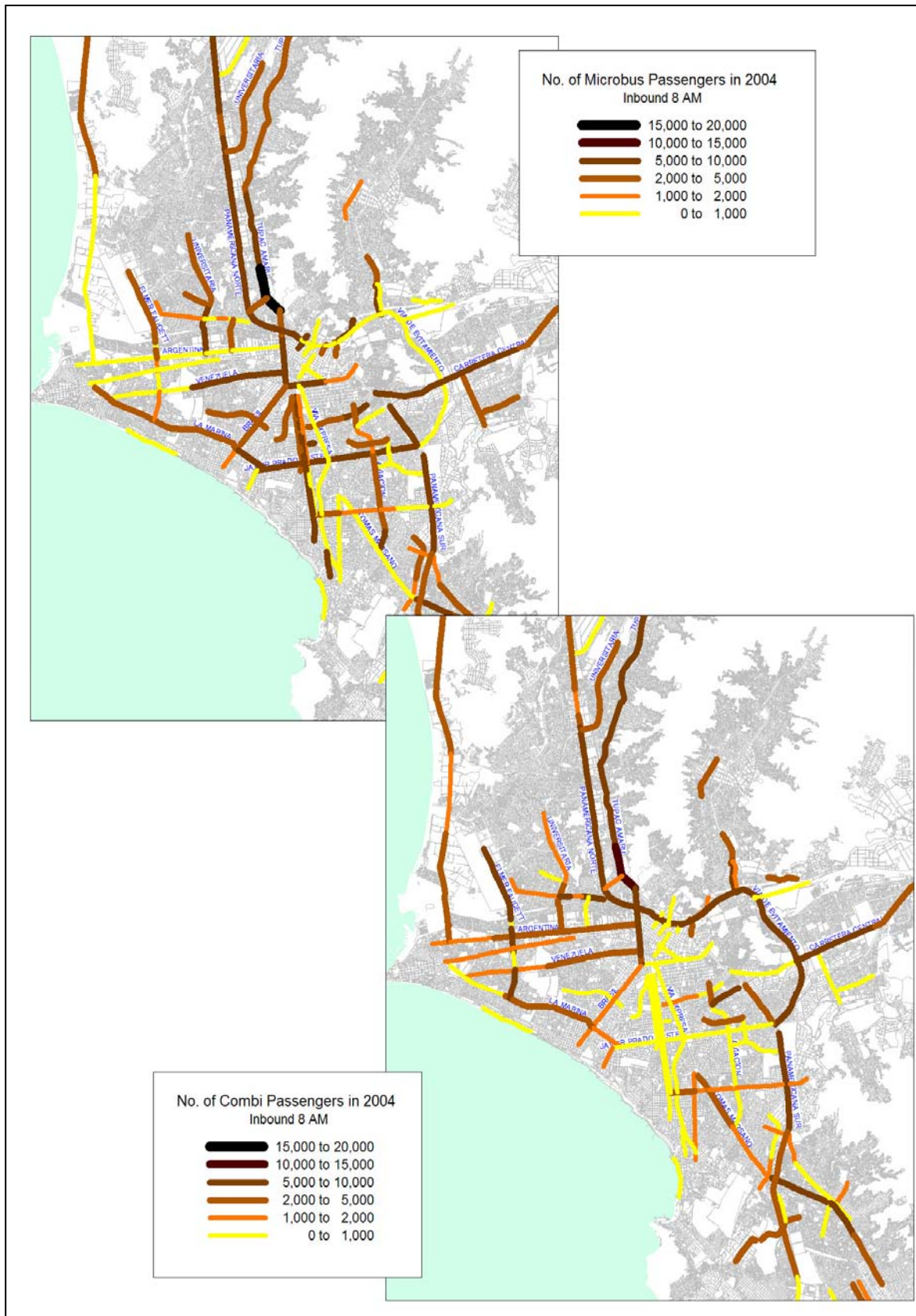


Figure 5.2-2 Numbers of Passengers by Microbus and Camioneta in 2004

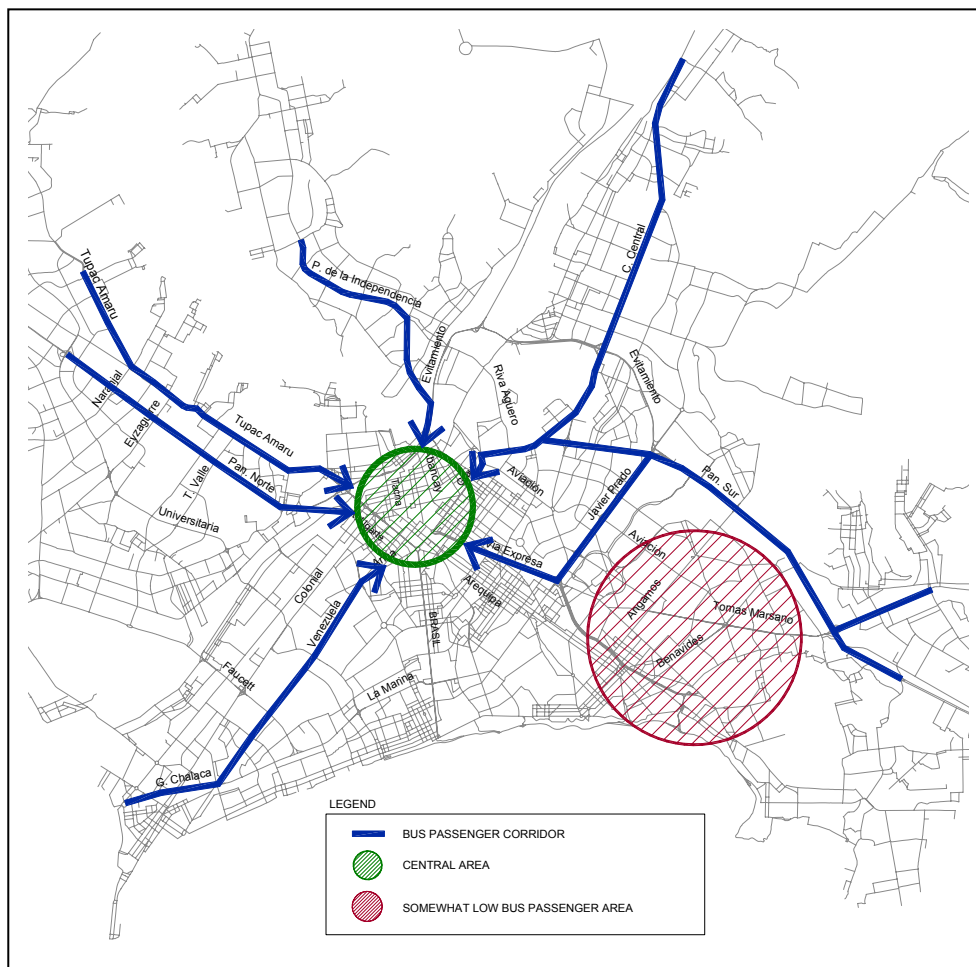


Figure 5.2-3 Major Bus Passenger Corridors in 2004

5.2.2. BOARDING AND ALIGHTING PASSENGERS AT BUS STOPS

A bus passenger survey was conducted on 31 major bus routes. Field workers rode the buses along these routes and counted boarding and alighting passengers at each bus stop or intersection during the morning peak hour. This is because buses currently stop anywhere, whether bus stop facilities exist or not, when bus passengers raise their hand as a signal at sidewalks on roads with the approach of buses since there are no bus stop facilities exclusive of particular roads.

Figure 5.2-4 and Figure 5.2-5 show the number of bus passengers on board and boarding and alighting passengers at each bus stop or intersection on bus route No. EO-29 and IO-81. The bus route No. EO-39 originates in San Miguel and passes through Av. Grau in the center, and reaches Chosica, with a route length of some 53km. The Microbus operates on the route with a total of 74 passengers. The passenger volume gradually increases and reaches a maximum before arriving at the Center, and then, passengers gradually alight from bus. After passing through La Molina, the passengers slightly increase and continuously decrease, and then, they reach Chosica. The passenger volume is close to seat capacity between Av. Venezuela and the Center and it increase again near the Carretera Central.

The bus route No. IO-81 originates in Ventanilla in the west area and passes through Av. Grau in the center, and reaches Ate Vitarte in the east area, with a route length of some 54km. The passengers gradually increase and reach a maximum before arriving at the

center, and then, gradually alight from the bus. Near the center area, there are few passengers on Microbus. There is a total of 86 passengers /direction. The congested section with heavy passengers in the inbound direction is from Ventanilla to the center. The other sections have approximately 10-15 passengers on board, in contrast to a seating capacity of 35 passengers.

As mentioned above, the bus routes that link the suburbs to the Center are effective in operation proceeds. On the other hand, with regards to the routes that link the suburbs, the operation proceeds are worse within the route segment, which passes through the Center and reaches the suburbs on the opposite side of the suburb of origin.

The bus route configuration makes it possible for bus passengers to arrive at many destinations without transfers from suburban areas. The bus must be operated on the route segments with lower passengers on board. This is ineffective in operation.

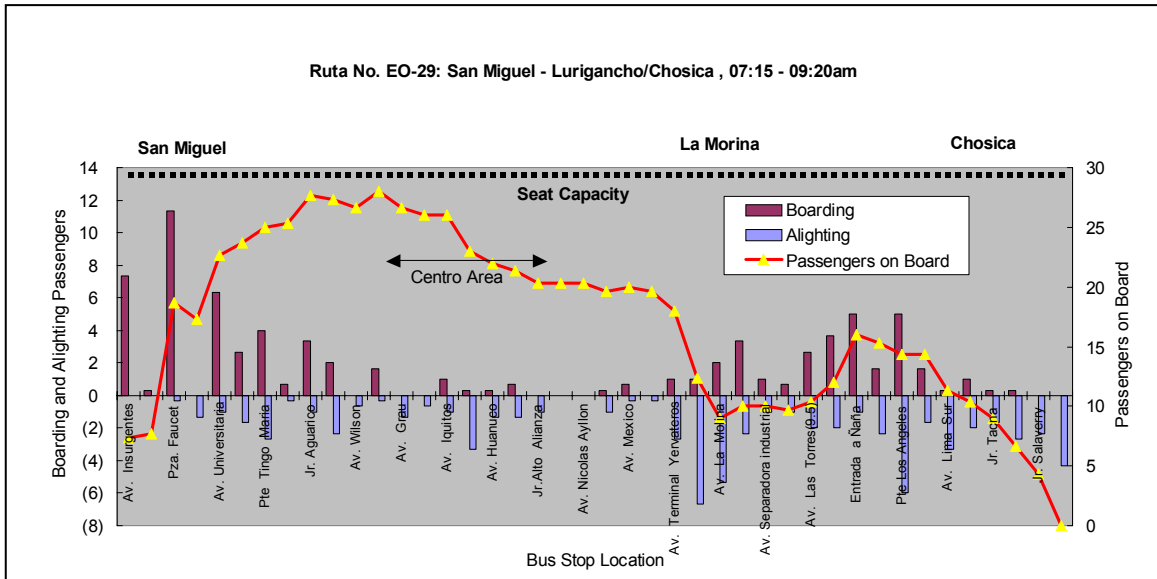


Figure 5.2-4 Boarding and Alighting Characteristics on Route No. EO-29

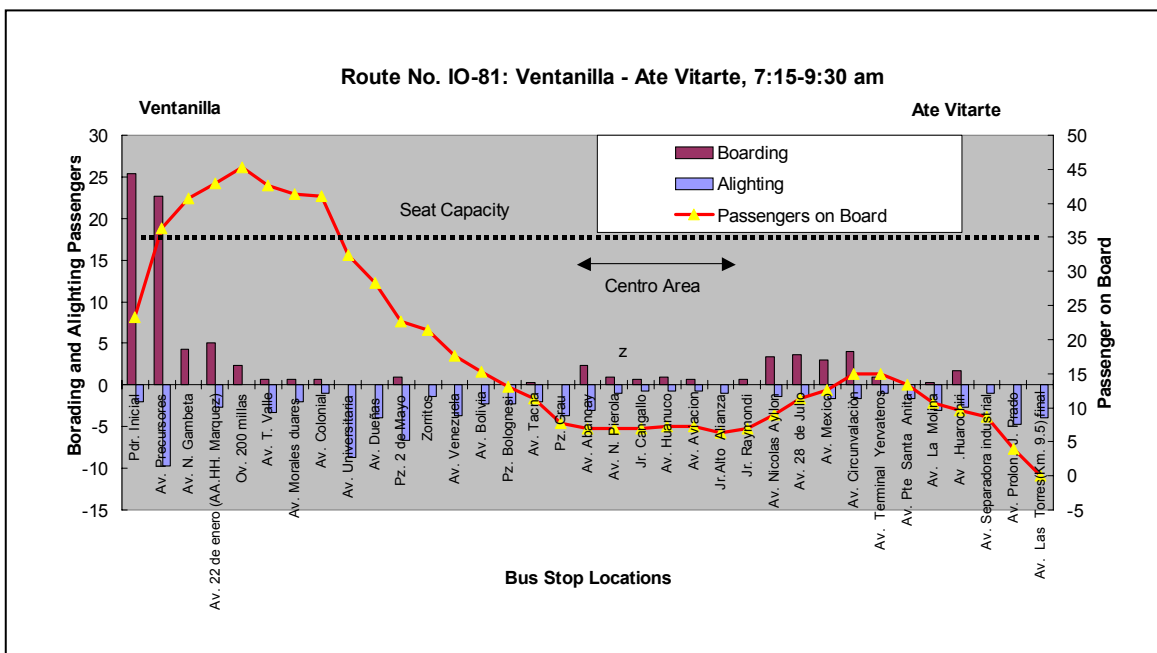


Figure 5.2-5 Boarding and Alighting Characteristics on Route No. IO-81

5.2.3. BUS TRAFFIC VOLUMES ON ARTERIAL ROADS

Bus volumes were counted at 104 survey locations on major roads together with bus passenger counting and its findings are essential for planning a bus operation system. Figure 5.2-6 shows the number of all bus volumes in the morning peak hour in the inbound direction. Figure 5.2-6 to Figure 5.2-7 show the bus volumes by type of bus: Omnibus, Microbus and Camioneta.

As it can be seen in Figure 5.2-6, the highest number of buses is recorded on Av. Tupac Amaru at 1,650 vehicles /hour/ direction. The Panamericana Norte, Carretera Central, Zarumilla, Pachacútec and Panamericana Sur carry the higher bus volumes. Its figures range from 800 to 1,000 passengers / hour/ direction. Those roads are located on the north, east and south areas of the study area where bus passenger demands are relatively higher. Those passenger volumes on the major roads are close to transport capacity under three bus composition including Omnibus, Microbus and Camioneta.

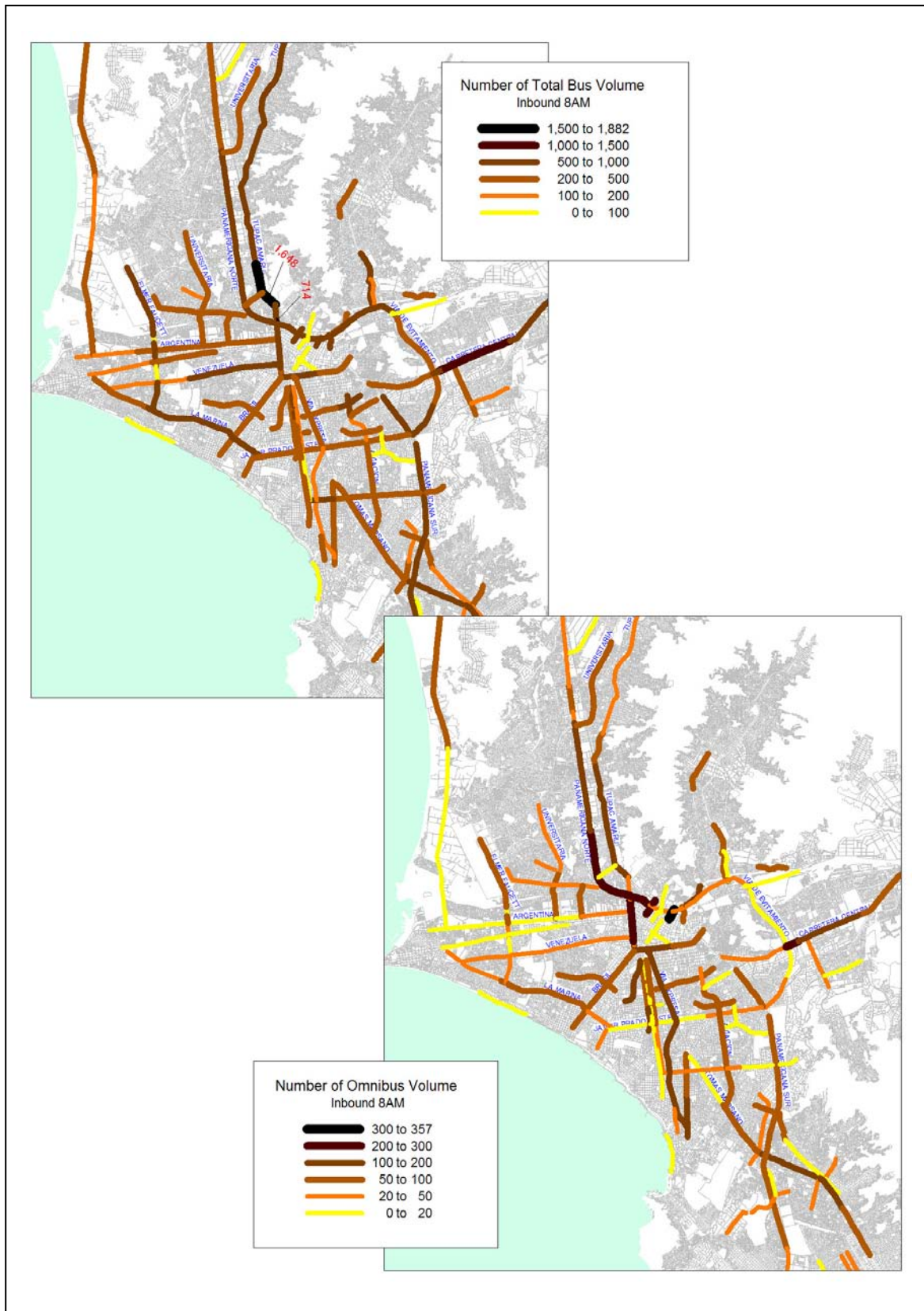


Figure 5.2-6 Numbers of Bus Volumes by Total Buses and Omnibus in 2004

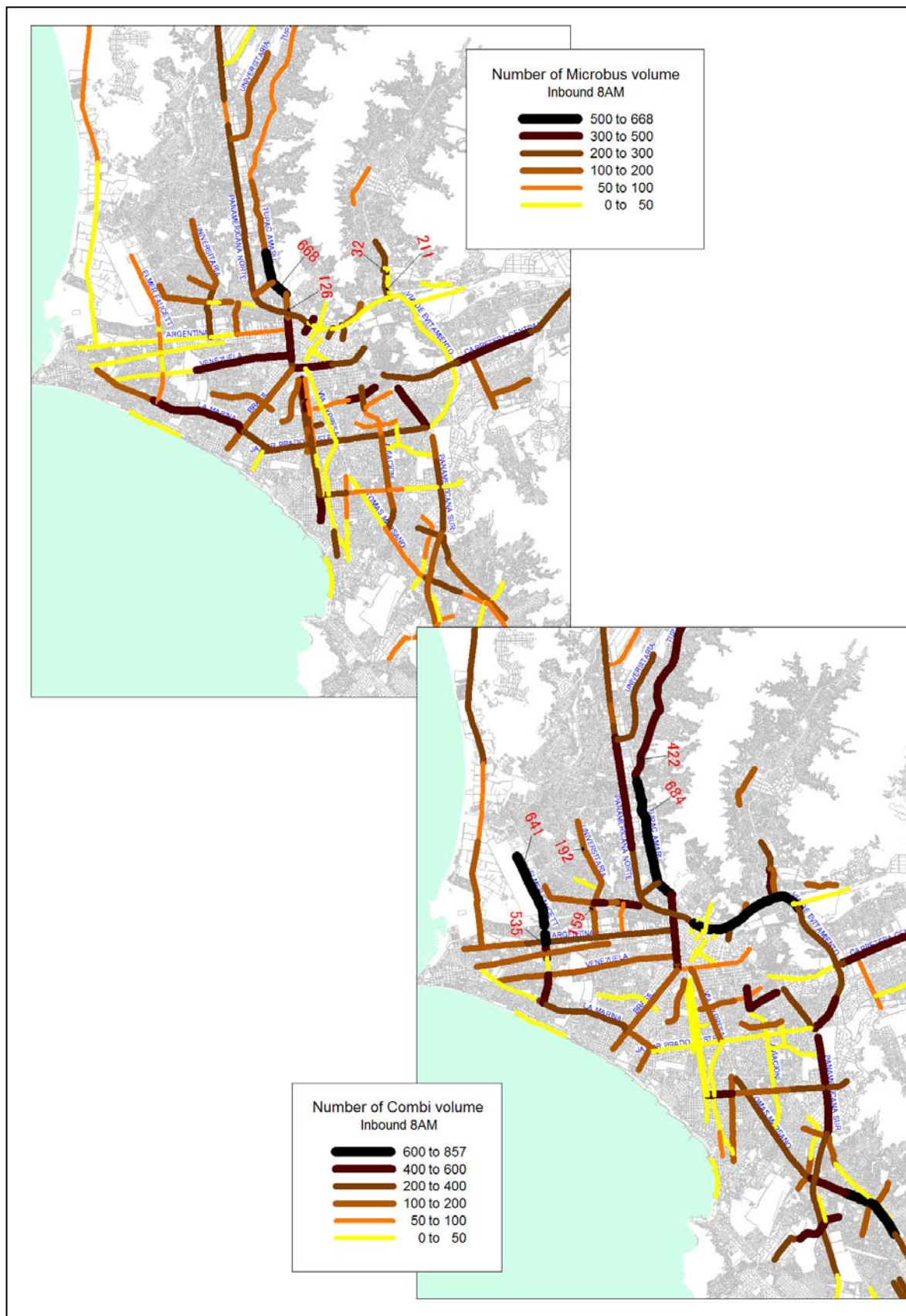


Figure 5.2-7 Numbers of Bus Volumes by Microbus and Camioneta in 2004

5.2.4. BUS, TAXI AND COLECTIVO IN 2004

1) Bus Composition Ratio on Roads

Table 5.2-1 shows the bus passengers and bus fleets in the morning peak hour by type of bus, whose figures accumulate the numbers of passengers and bus fleets on the counting locations. The Microbus is higher in ratio at 42% of the total passengers, followed by Camioneta (31%) and Omnibus (27%) as shown in Figure 5.2-8. These figures show a little difference between the counting and the interview of passengers. The interviewed shares of Camioneta, Microbus and Omnibus are 41%, 36% and 24%, respectively.

As for bus volumes, the ratio of Camioneta with regards to all of the buses is the highest at 51%. Omnibus is low in the ratio. The average number of passengers on board per bus is 38, 22 and 11 passengers, respectively. The capacities of the buses inclusive of seats and standing are 77, 37, and 15 spaces. The volume-capacity ratios of buses at major road counting locations are approximately 50%, 60% and 75%, respectively.

Table 5.2-2 shows roads with a higher Camioneta ratio, which is the ratio of Camioneta volume with regards to the total number of motor vehicles. Av. Tupac Amaru records a higher ratio of 40 –45%. The roads with the higher ratios are located in the north and south areas.

Table 5.2-1 Comparison of Bus Passengers and Bus Fleets in 2004

Item	unit	Camioneta	Microbus	Omnibus	Total
Passenger	Person/day	166,524	228,192	148,652	543,368
Composition Ratio in 2004	%	0.31	0.42	0.27	1.00
Bus Fleet	No.	14,822	10,382	3,922	29,126
Composition Ratio in 2004	%	0.51	0.36	0.13	1.00
Passenger/Bus	–	11.2	22.0	37.9	18.7

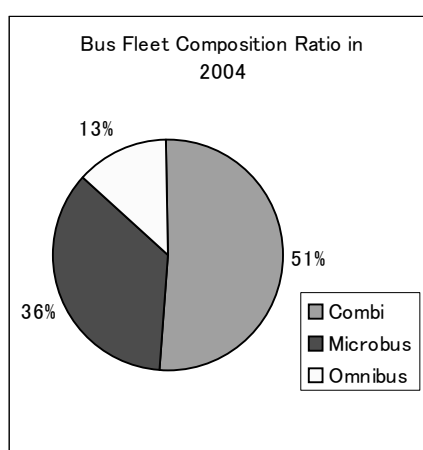


Figure 5.2-8 Bus Fleet Composition Ratio in 2004

Table 5.2-2 Roads with Higher Camioneta Ratio

Road Name	Combi/Total
AV.Losheroescdra-11Crucec	51.0%
Av.Tupac Amaru	44.3%
AV.Tupac Amaru4	41.2%
AV.Maria Tegui	39.8%
AV.Peru1	33.7%
AV.Pachacutec	33.4%
AV.Tupac Amaru	33.2%
Av.EduardoHabich	32.5%
AV.Aviacion	32.0%
AV. Canto Grande	31.9%
AV.Angamos2	31.2%
Av.Tupac Amaru	31.0%
AV.Faucett	30.6%
VIA Evitamiento	30.0%

Figure 5.2-9 shows the relationship between the volume and the ratio of the Camioneta in the morning peak hour on the counting roads. As it can be seen, roads with higher volumes of Camioneta are higher in the ratio of Camioneta. The higher volumes range from 600 to 900 vehicles/hour.

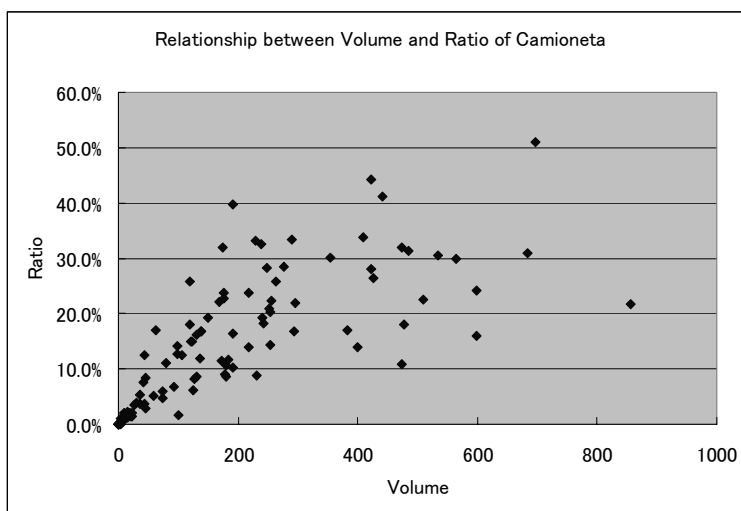


Figure 5.2-9 Relationship between Volume and Ratio of Camioneta

2) Authorized and Unauthorized Taxi Volumes on Roads

Table 5.2-3 shows traffic volumes by type of vehicle, whose figures accumulate the number of vehicles on the counting locations. In focus of the authorized and unauthorized taxis, the ratio of authorized taxi to all taxis is 54% in all counting locations. As it can be seen, the ratio of the authorized and unauthorized taxis operated on the roads is approximately 50% to 50%.

Figure 5.2-10 shows the relationship between the authorized taxi volumes in the morning peak and the unauthorized volumes, which shows the authorized taxi data on the X-axis against the unauthorized data on the Y-axis. The summarized data is already shown in Table 5.2-3. As it can be seen, the dotted data in number of taxis is scattered near the line at a ratio of 50% to 50%. This shows that the both volumes are close in number.

Table 5.2-3 Traffic Volumes on Major Roads by Type of Vehicle

Unit: vehicle/day

Item	Moto-taxi	Car	Taxi		Bus			Colectivo	Truck	Total
			Authorized	Unauthorized	Omnibus	Microbus	Camioneta			
Traffic Volume	2,484	59,276	22,113	19,360	5,027	14,278	19,614	3,399	5,341	150,892
Composition Ratio	1.6%	39.3%	14.7%	12.8%	3.3%	9.5%	13.0%	2.3%	3.5%	100.0%
Ratio of Subtotal	-	-	53.3%	46.7%	12.9%	36.7%	50.4%	-	-	-

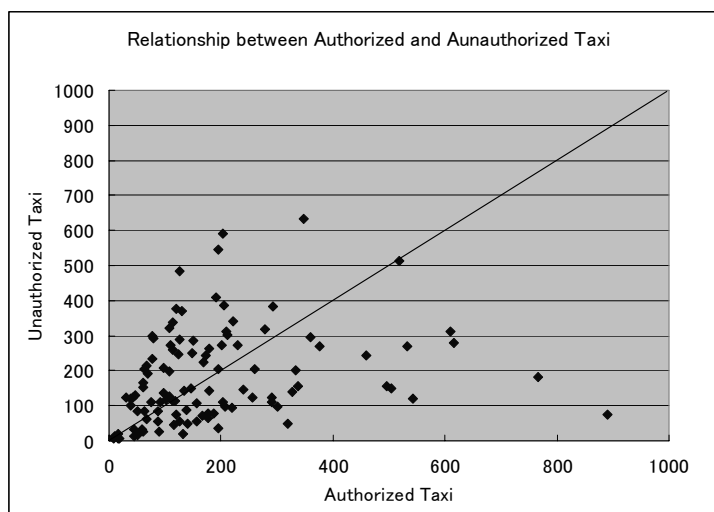


Figure 5.2-10 Relationship between Authorized and Unauthorized Taxi Volumes

3) Colectivo Volume on Roads

Table 5.2-4 shows roads with a higher colectivo ratio, which is the ratio of colectivo volume with regards to the total number of motor vehicles. Av. Ventanilla records a higher ratio of 40 –45%. The roads with the higher ratio are located in the north and Callao areas.

Figure 5.2-11 shows the relationship between the colectivo volume and the ratio of colectivos on the counted roads. As it can be seen, higher volumes of colectivos in the morning peak hour range from 100 to 250 vehicles/hours.

Table 5.2-4 Roads with Higher Colectivo Ratio

Road Name	Colectivo/Total
Av. Ventanilla	43.9%
Av. Republica de Panama	22.4%
AV. Santa Rosa	21.0%
JR.Lampa	18.8%
Av.Nicolas de Pierola	17.2%
Carr. Central	16.7%
Av. Panamericana Norte	15.8%
Av. Tupac Amaru	13.1%
AV. Colonial-German Amenazaga	11.4%
Av. Panamericana Sur	11.3%
Puente Lurin (Paradero)	11.0%

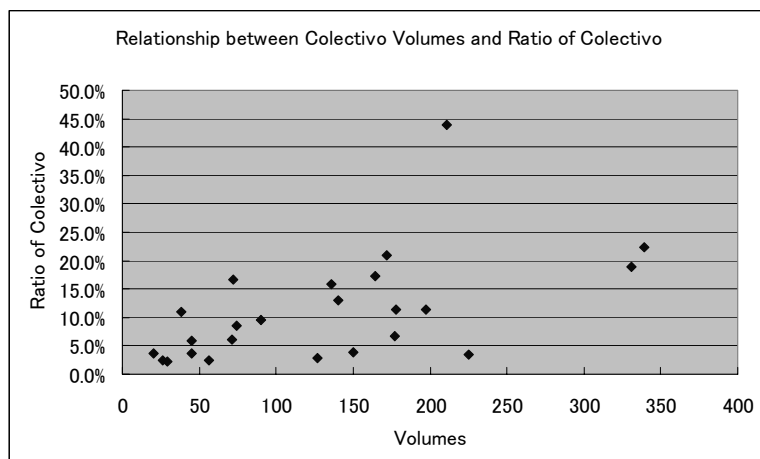


Figure 5.2-11 Relationship between Colectivo Volume and Ratio of Colectivo

5.3. BUS SERVICE

This section focuses on public bus transport service in the metropolitan area. The bus service is an important mode of public transport. Its passenger share of motor vehicle uses accounts for 77% of the total according to the person trip survey data in 2004. Some data regarding the present conditions of the bus service is available for a bus route, a bus fleet, a bus company, etc. However, bus users' conditions, bus operation conditions such as travel time, fare rate, waiting time, and transfer time are unavailable.

Therefore, the bus transport information was collected based on the bus passenger interview survey, as well as data from related administrative organizations. Figure 5.3-1 shows the relation between the survey data and others, in which the travel time, and bus fare characteristics, travel service and passenger conditions, and bus users' information were collected on the bus interview survey. On the other hand, the information regarding the number of bus routes, bus fleets, bus company and bus facility was collected from the concerned agencies of Lima and Callao. The following sections show the results of the detailed analyses

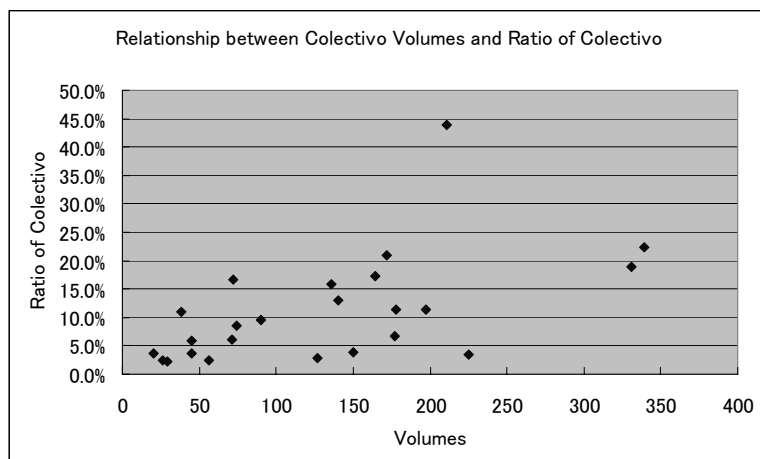


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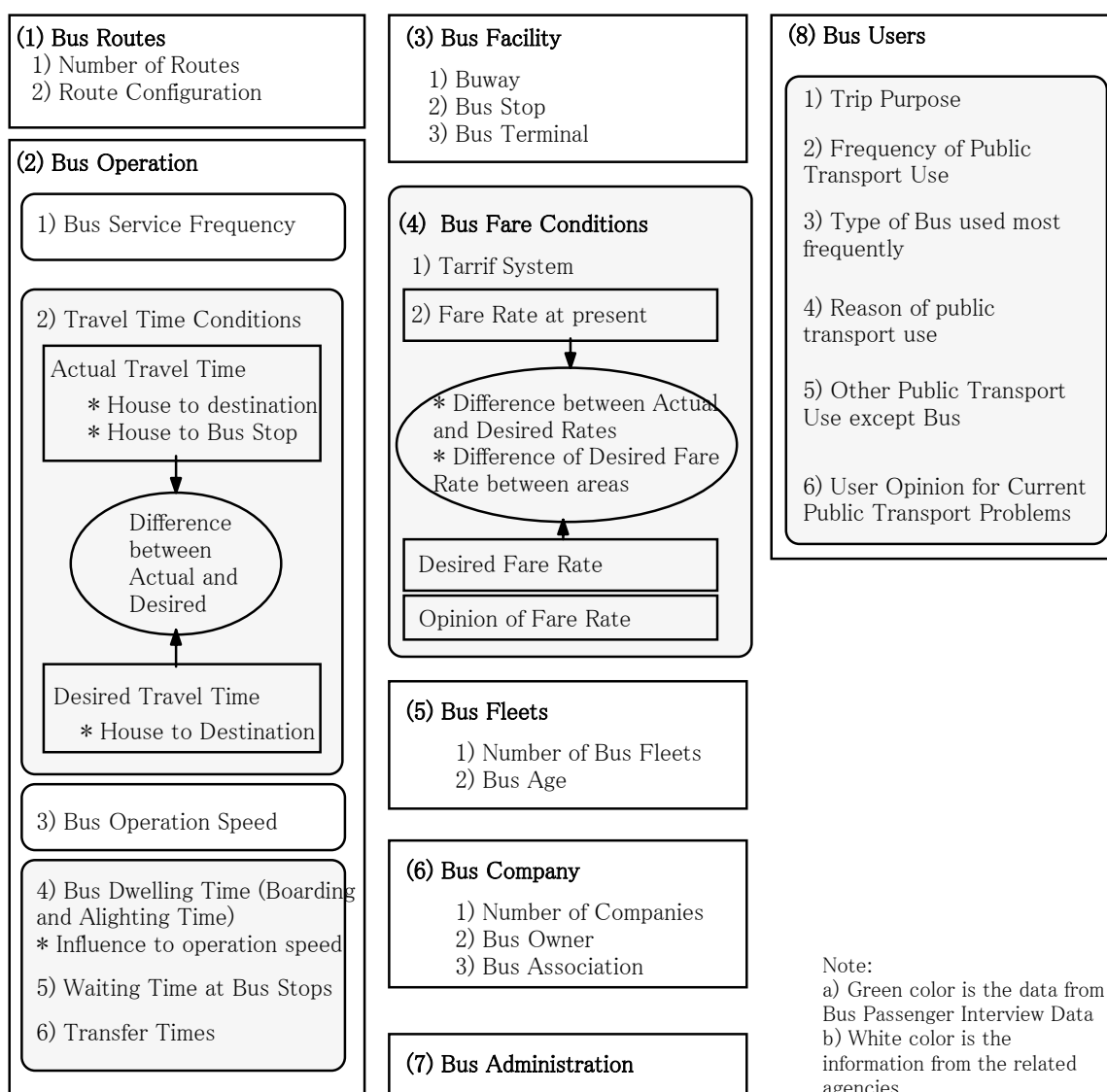


Figure 5.3-1 Study Contents of Bus Transport Service

5.3.1. BUS ROUTES

(1) Number of Bus Routes

A bus route is authorized under the jurisdiction of the DMTU and the GGTU. The total number of bus routes, removing 120 reciprocal overlapping routes between both cities, is 574 as of January 2004, of which 431 routes are in Lima and 263 are in Callao. The total number of bus routes, however, varies day by day.

1) Lima

Figure 5.3-2 shows the conditions of bus routes under the jurisdiction of the DMTU, which authorizes 403 bus routes (431 routes as of January 15, 2004) from among the 591 bus routes proposed by the DMTU. As for the remaining 188 bus routes, buses are not in operation, since no company bids for the contract. Among the authorized bus routes, about 10 bus routes are operated on Paseo de la República with a segregated Busway.

Out of 403 bus routes, the route licenses on 264 routes with busy traffic are given to only one company by bidding, while the licenses on the remaining 139 routes with easy traffic are given to two or more companies without bidding.

On the other hand, there are the unauthorized bus routes of which the DMTU does not identify the actual operation condition such as the number of routes and route configuration.

2) Callao

The number of bus routes authorized by the GGTU in Callao is 263, of which 209 routes connect between both cities, and the remaining 54 routes connect within Callao. Out of 209 routes between both cities, 120 bus routes are on the reciprocal bus operation system authorized by both cities, and 89 bus routes are authorized by the GGTU and the DMTU

The route license is given to a bus company without bidding under the condition that the application proposed by the company fulfills the criterion of the DMTU, such as bus service frequency, number of bus operations per hour and day, route configuration. The contract has a rule that states that the license gives one bus route to only one company.

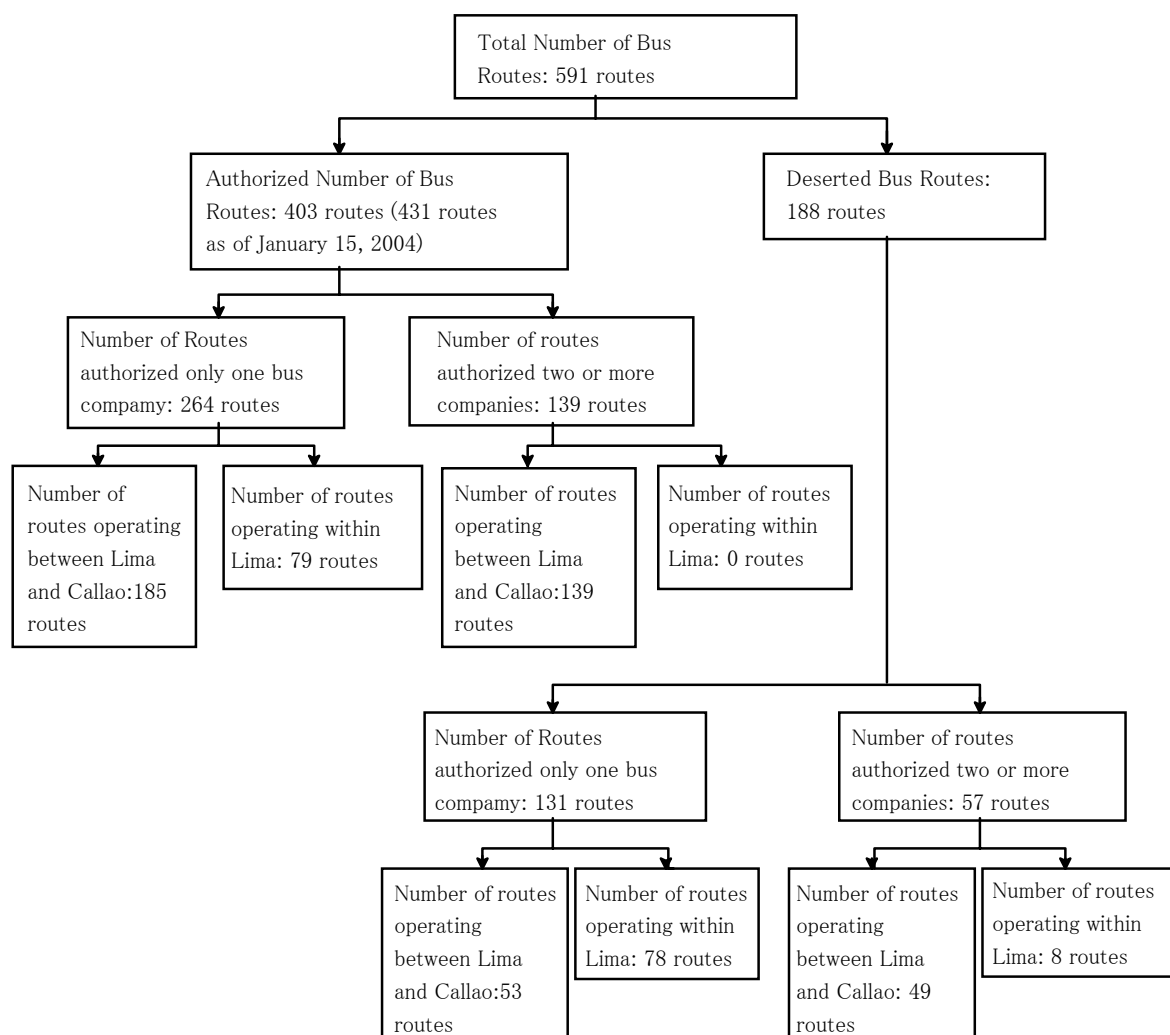


Figure 5.3-2 Conditions of Bus Routes by the DMTU in Lima (As of July 20, 2003)

(2) Bus Route Configuration

Figure 5.3-3 shows the number of bus routes superimposed on roads in which the value of bus routes takes 1 for a single route, while a roundtrip route counts as 2. As it can be seen, the route configuration forms to radiate in all directions from the Center area. The corridors with a heavy number of bus routes are from the north and east directions of Lima, and from Callao to the Center.

The roads with 100 or more bus routes are shown below.

- 1) North direction: Av. Tupac Amaru (Arterial road)
- 2) North-East direction: Av. Proceres de la Independencia (Arterial road)
- 3) North-West direction: Av. Nestor Gambetta (Expressway road in the future)
- 4) East-West direction: Av. Venezuela- Av. Grau – Av. N. Ayllon (Arterial road)
- 5) Av. De la Marina- Av. Javier Prado Este (Expressway road in the future)
- 6) South direction: Av. Aviación – Av. Santiago- de Surco (Arterial road)

The bus routes are concentrated on the arterial roads in Lima and Callao. Among them, about 150 routes, equivalent to 25% of the total routes, pass through Av. Ugarte in the Center.

Figure 5.3-4 shows a road segment with a heavy bus route of 100 or more, which shows a blue wide line according to Figure 5.3-3. Those blue roads function as arterial roads in Lima and Callao. As it can be seen, the major bus service roads are concentrated on the north area of Av. Javier Prado Este. In the south area, the roads with heavy bus service are few.

Figure 5.3-5 shows the number of bus routes that pass through a segment of Av. Tupac Amaru in order to identify the origin and destination of each bus route. In the Figure, a blue wide band shows the origin and the destination passing through the particular segment is shown in red. As it can be seen, the origin and destination on approximately 160 bus routes are identified.

Although the origin and destination areas of the bus routes that pass through Av. Tupac Amaru are mainly oriented towards the Center area, it seems that these areas cover all of the cities. The bus route configuration makes it possible for bus passengers to arrive at many destinations without transfers from the suburban areas. As a result, the number of bus routes increase. This means that the efficiency of the bus operation become worse.

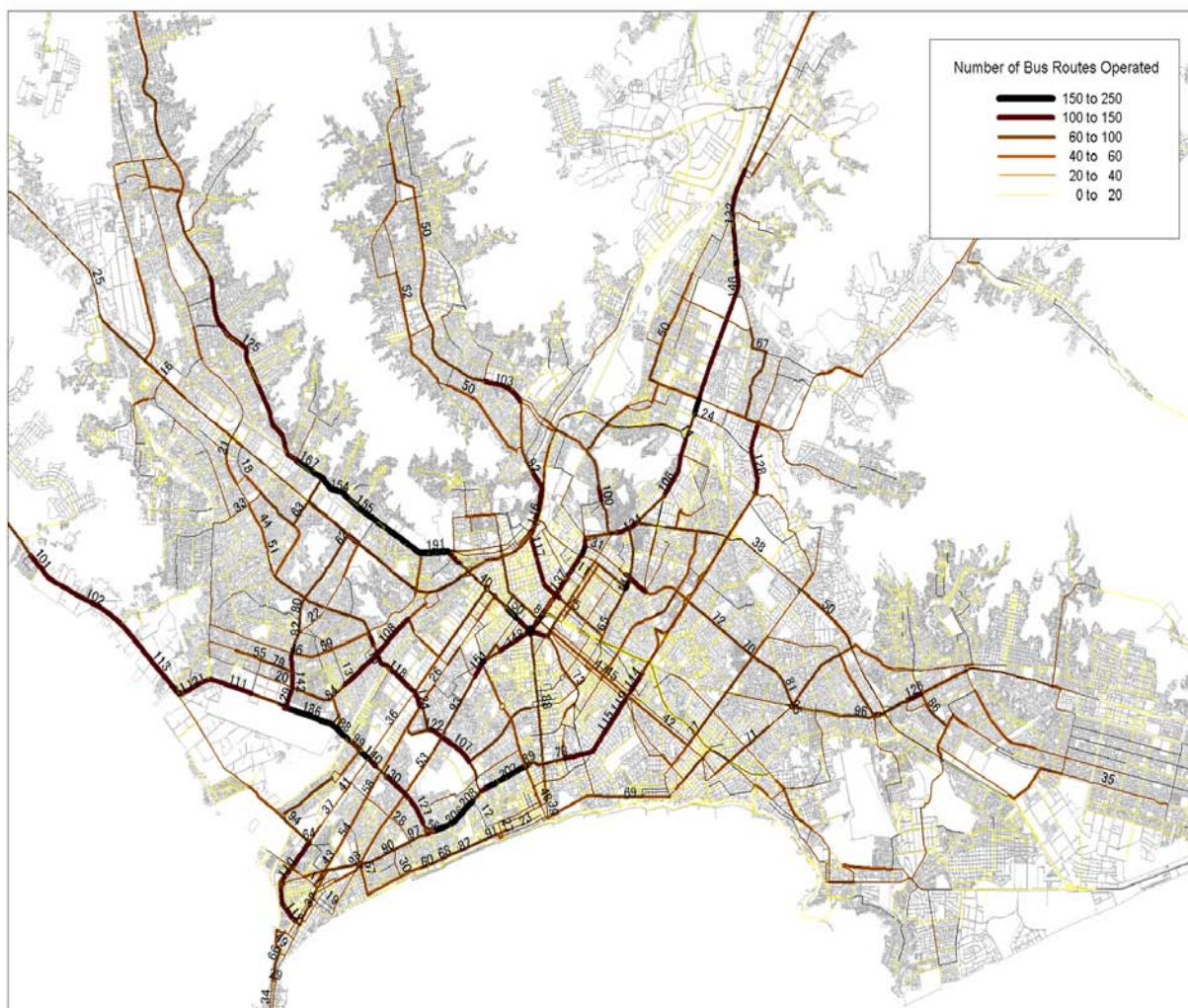


Figure 5.3-3 Number of Bus Routes Inscribed in the DMTU

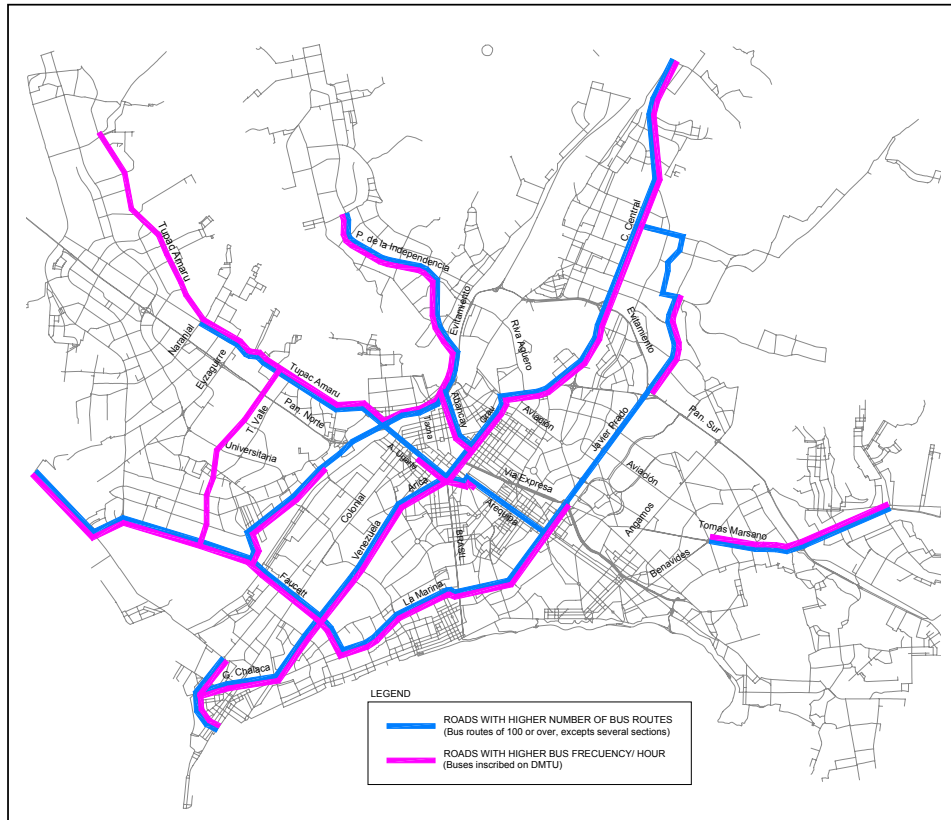


Figure 5.3-4 Road Segments with Heavy Bus Routes and Higher Service Frequencies

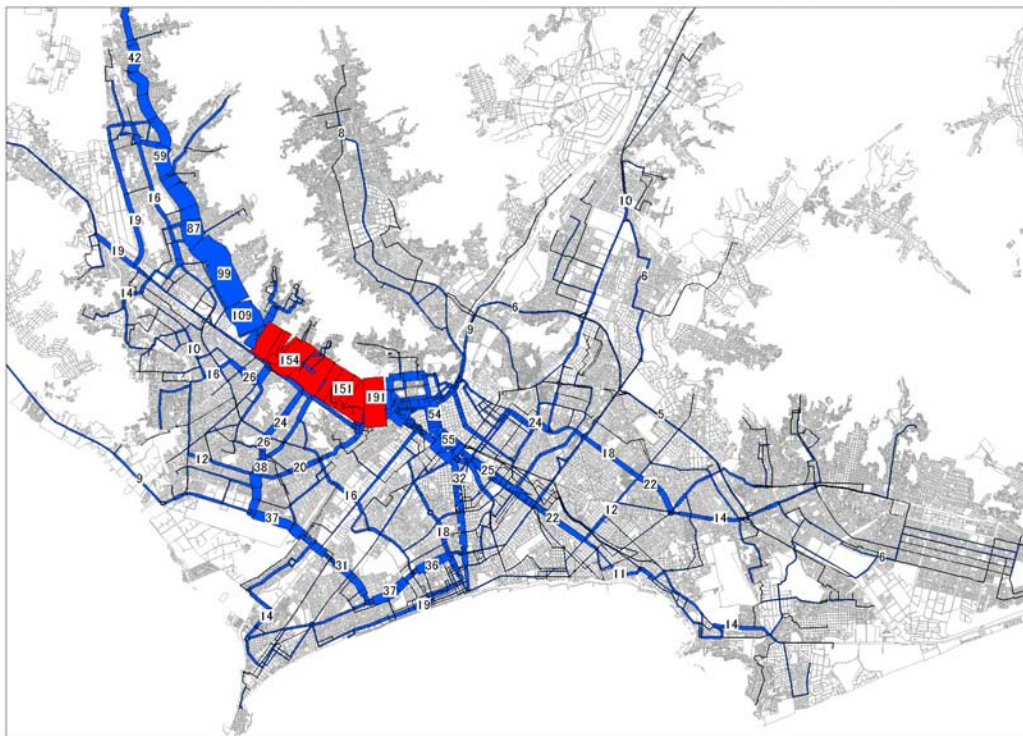


Figure 5.3-5 Number of Bus Routes that Pass through Av. Tupac Amaru

(3) Route Distance

Figure 5.3-6 shows the distribution of the route service distance authorized by the DMTU. This route distance shows the total distance and in the case of a roundtrip route it takes a roundtrip route distance. Since one bus route service is almost a roundtrip route configuration, half of the distance shown in Figure 5.3-6 indicates the distance of a single route.

As it can be seen, the average distance is approximately 64.3km in the roundtrip route. It means approximately 30-40km in the single route, whose distance is equivalent to the distance between the south and the north of Lima. The ratio of routes to exceed 100km in the roundtrip route to the total number is approximately 7% and the maximum route distance is 163km.

Since the route distance in Lima is very long, the operation efficiency between the origin of the route to the destination is not high in the ratio of passengers on board to the bus passenger capacity. In addition, since the bus operation hour is longer in proportion to the route distance, the operation is not steady in service frequency and headway.

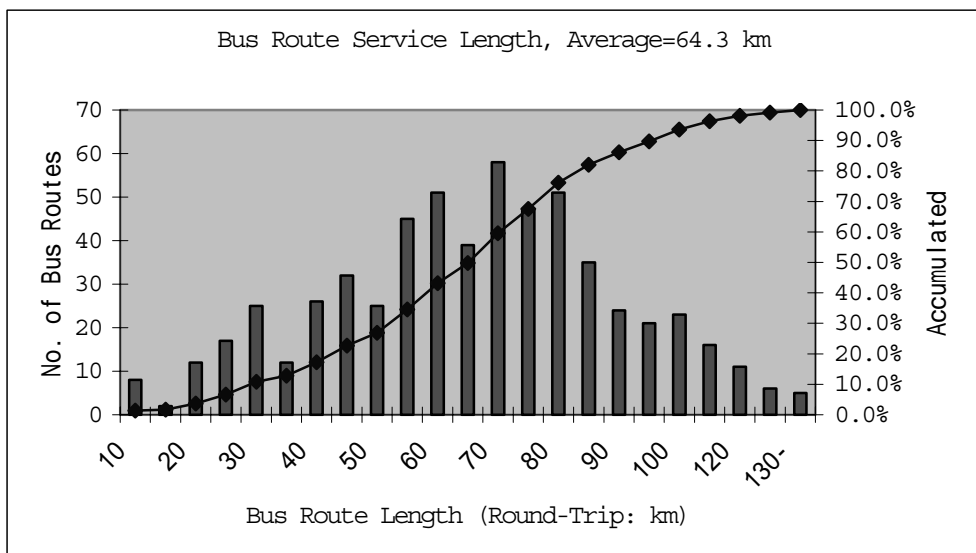


Figure 5.3-6 Distribution of Route Service Distance (km) authorized by the DMTU

5.3.2. BUS OPERATION

(1) Bus Service Frequency

Figure 5.3-7 shows a value converting the bus service frequencies per hour registered by a bus company into the number of bus volumes. The figures are not the actual number of bus volumes because a bus is not only operated in accordance with bus passenger demand, but it is also operated by unauthorized companies. The value totals the service frequency of each route by roads. The unit is vehicle/hour/roundtrip route. As it can be seen, the north area from the Center is higher than others in the service frequency, as well as in the bus volumes counted in 2004.

Figure 5.3-8 shows the ratio of bus volumes between volumes counted in 2004 and the authorized frequency. The figures serve to divide the counted volumes by the authorized frequencies. As it can be seen, since the counted volumes on Av. Panamericana Sur are higher than the frequencies, the residents in the south area arrive at a destination by way of the route on Av. Panamericana Sur, not by way of Av. Tomas Marsano. Since the travel time on the Av. Panamericana route is shorter than others, bus passengers select this route.

Therefore, the number of buses operated by a bus company becomes higher than the authorized figures in accordance with passenger demand.

As for the demand from the area of San Juan de Lurigancho in the north-east direction and of Comas and Los Olivos in the north direction, the supply of bus operation is insufficient, as well as in the area of Villa el Salvador in the south direction.

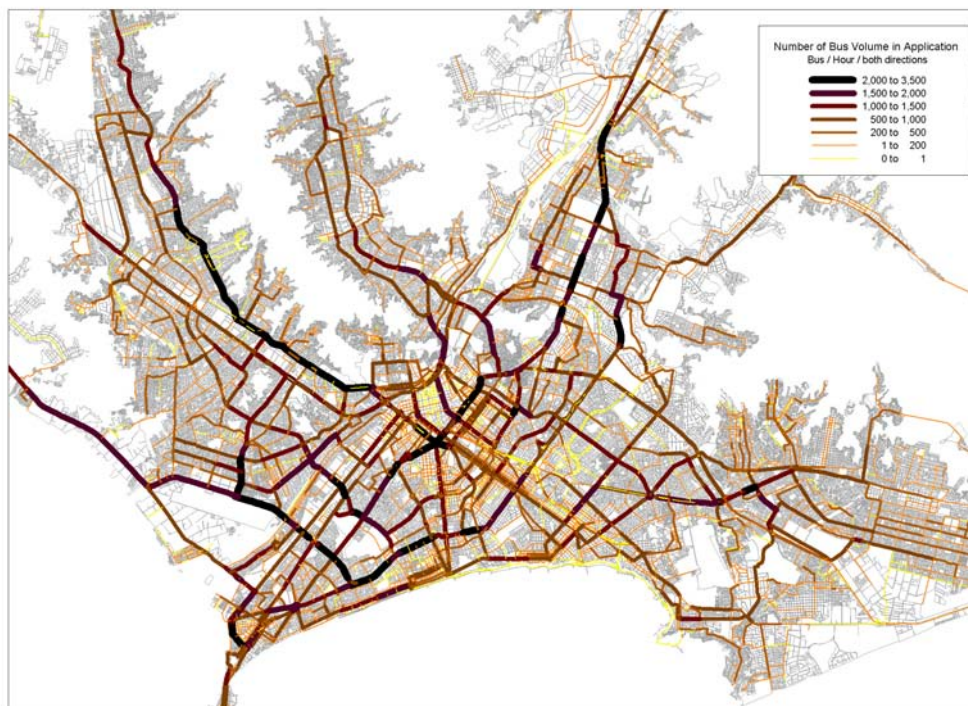


Figure 5.3-7 Number of Bus Service Frequencies/hour authorized by the DMTU

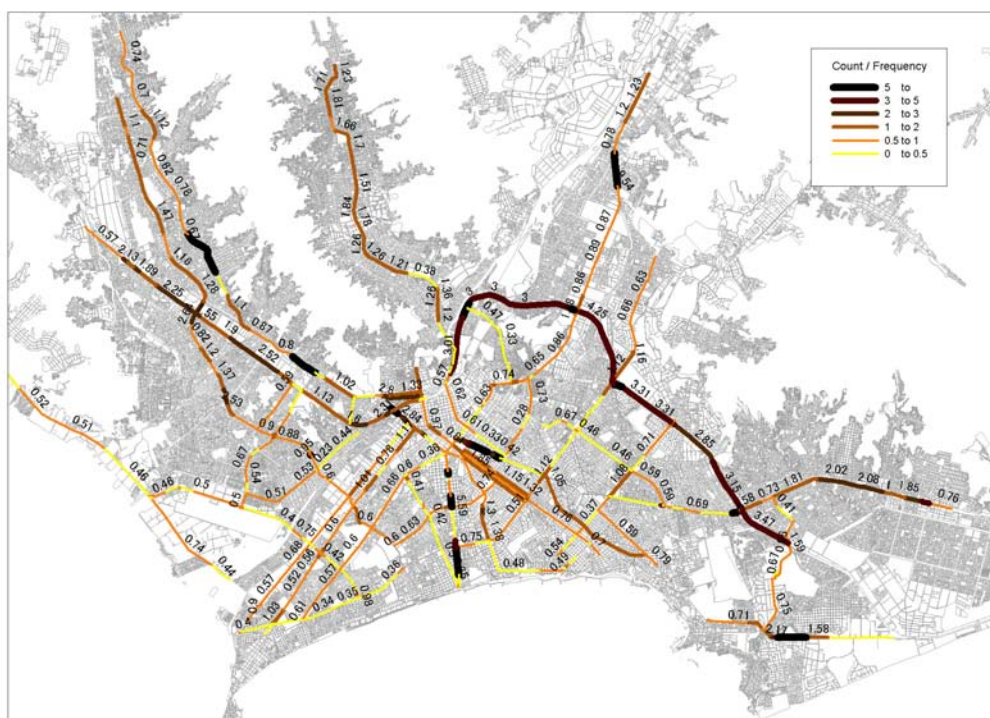


Figure 5.3-8 Ratio of Bus Volume between Counted Volume and Authorized Frequency

(2) Travel Time

Passenger travel time was surveyed in the bus passenger interview survey, in which travel times from house to destination and from house to near bus stop in the morning peak hour were interviewed in the whole study area.

Figure 5.3-9 shows the distribution of travel time from house to destination. As it can be seen, approximately 45% of the total have a travel time of more than 60 minutes and the ratio of travel time to exceed 90 minutes is approximately 20% of the total. As it can be seen, half of the bus passengers are forced to travel for an hour or more.

Figure 5.3-10 shows the distribution of travel time from house to bus stop. As it can be seen, approximately 75% of the total have a travel time of less than 10 minutes and the ratio of travel time to exceed 15 minutes is approximately 5% of the total. As it can be seen, almost all bus passengers can arrive at a bus stop within 10 minutes.

Figure 5.3-11 shows the composition ratio of travel times greater than 60 minutes by 17 zones. The zones with the greatest composition ratio of travel time with more than 60 minutes are zones No. 1, 10, 15, 17, which are located in the peripheral areas, while the lower zones are No. 5 and 6, which are within the central urban areas.

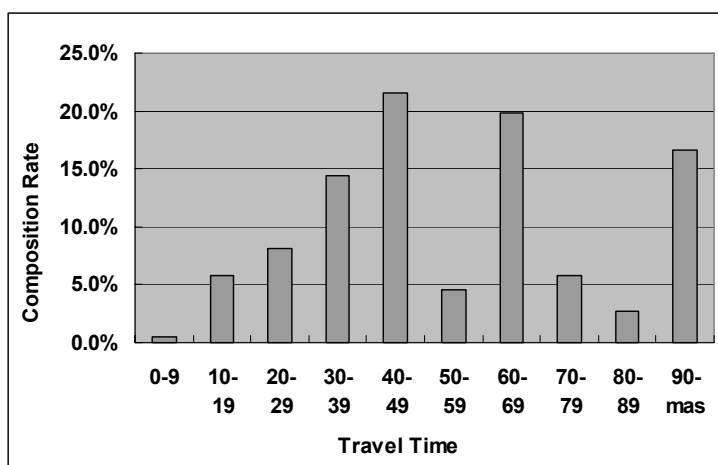


Figure 5.3-9 Distribution of Travel Time from House to Destination by Passengers Interviewed in the whole Area

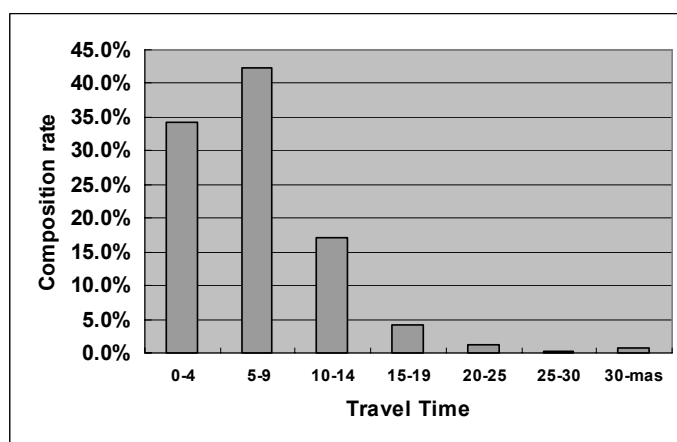


Figure 5.3-10 Distribution of Travel Time from House to Bus Stop

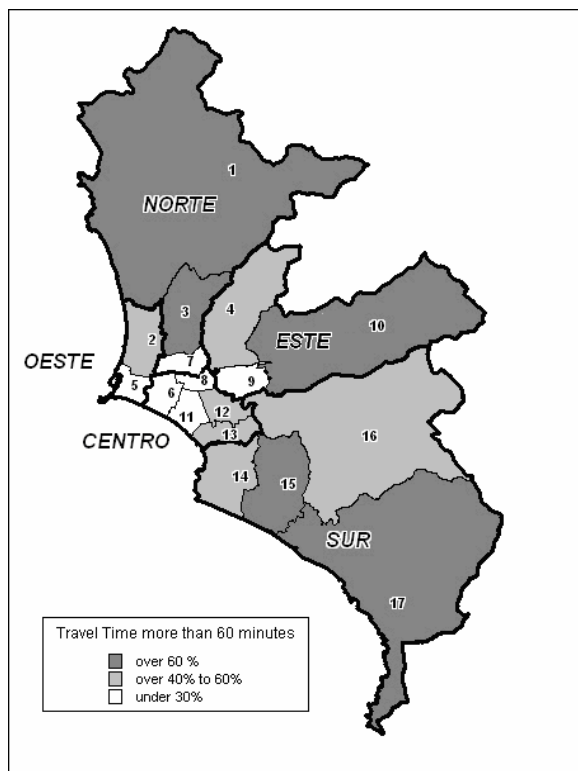


Figure 5.3-11 Composition Ratio of Travel Time greater than 60 Minutes

The interview survey also collected a desired travel time in order to identify a difference between the actual and desired travel times. Figure 5.3-12 shows the distribution of desired and actual travel times from house to destination. The distribution of the desired travel time reaches a peak at approximately 40 minutes or less, in contrast to the actual 40- 70 minutes. The passengers desire a 40% reduction of the actual travel time in average (see Figure 5.3-13). This gap between the actual and desired time becomes larger in the peripheral areas. It will be indispensable to improve the service level in those peripheral areas in a future public transport plan.

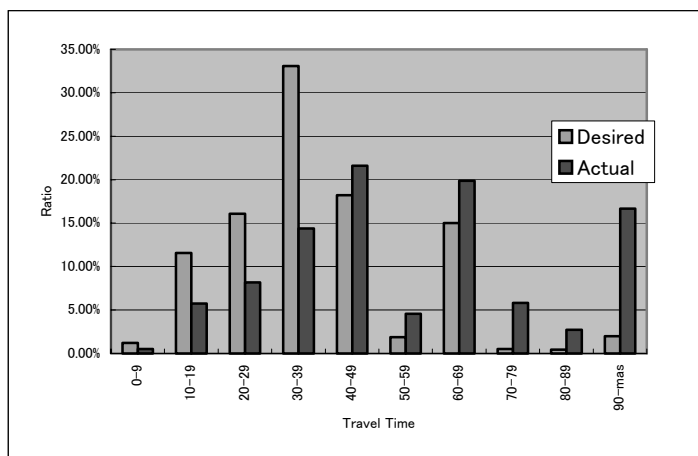


Figure 5.3-12 Desired and Actual Travel Times from House to Destination

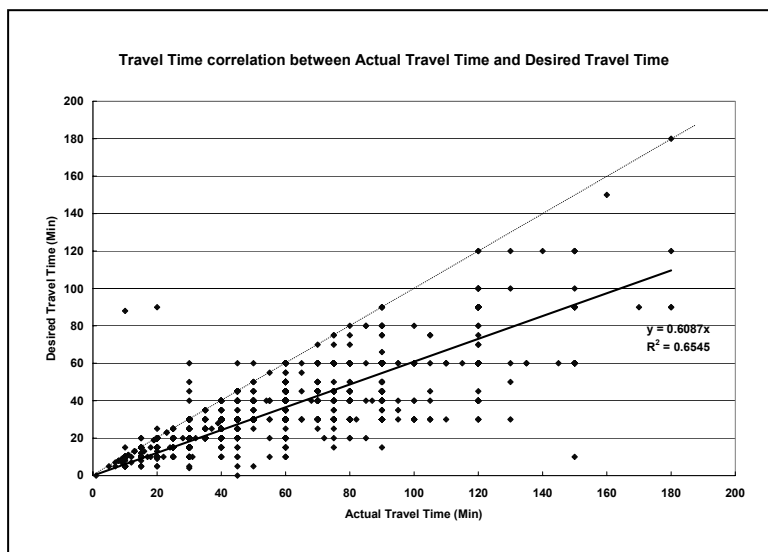


Figure 5.3-13 Relationship between the Actual and Desired Travel Times

(3) Bus Operation Speed at Peak Hour

Figure 5.3-14 shows an average bus operation speed in the morning peak hour. The operation speed was measured in the bus passenger survey, in which the bus passengers on board were counted on 31 major bus routes. In the survey, the bus operation speed was also measured. The operation speeds in Figure 5.3-14 are the average value of 3-5 measurements. On those 31 routes, three types of buses: Omnibus, Microbus and Camioneta are operated.

As it can be seen, in the Center area, buses are operated at 10 to 20km/h. On the other hand, in a suburban area, the operation speed ranges between 30 and 50km/h. A peripheral area is served at 50km/h or over.

However, Av. Panamericana Sur and Via de Evitamiento recorded a speed of 40 to 50km/h. The operation speeds on Javier Prado, Av. Venezuela and Av. Arequipa are low at a range between 10 and 20km/h.

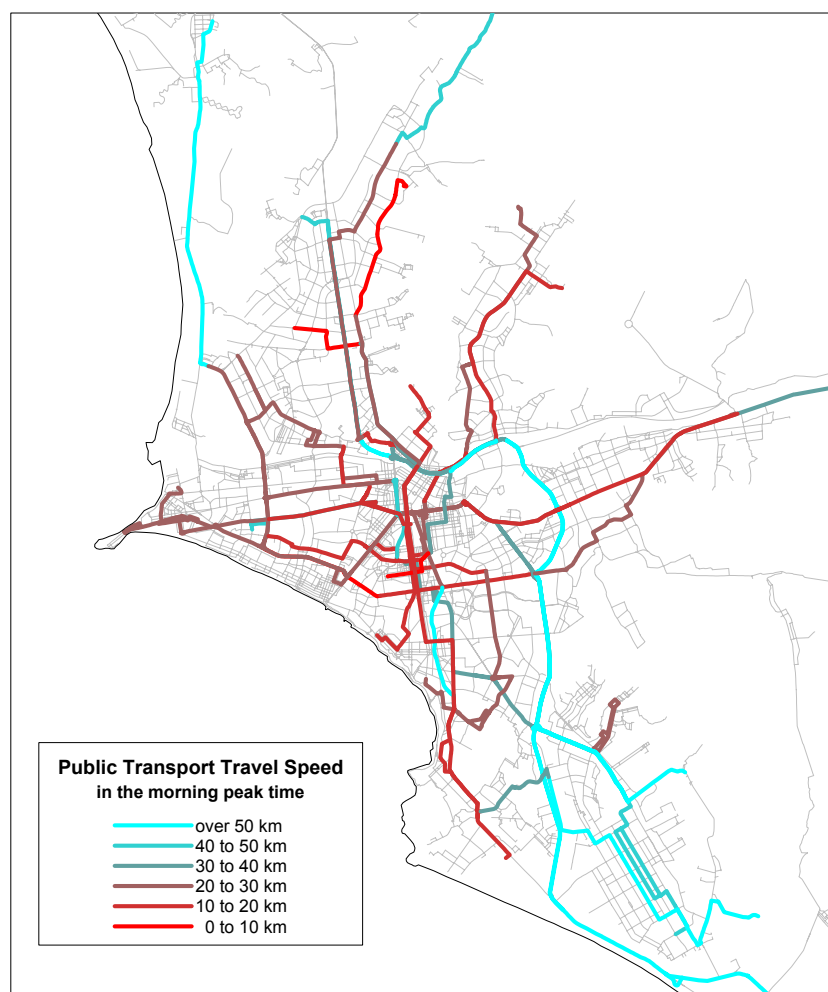


Figure 5.3-14 Bus Operation Speed in the Morning Peak in 2004

(4) Bus Dwelling Time at Bus Stops

Buses currently stop anywhere; whether bus stop facilities exist or not, when bus passengers raise their hand as a signal on the sidewalks of roads with the approach of buses due to the lack of bus stop facilities beyond particular roads. Paseo de la República, an urban expressway, has a busway exclusive of private vehicles with bus stops. The buses operate on the busway and stop at bus stops. The Av. Venezuela, in Callao, has bus stop facilities or bus bays on the roadside.

At most bus stops, travel times are measured for some buses passing through the stop area between an upstream “entry point” and a downstream “exit point”. The dwelling time is the duration from the moment when the bus wheels stop at a loading point to the moment when the wheels start to move at a bus stop including loading/unloading times.

In the planning stage of a trunk bus operation, since the bus dwelling time at a bus stop is related to the bus operation speed, it is important to measure the dwelling time at a bus stop. Therefore, in the study, the counting survey of the dwelling time was carried out at the major bus stops on the major bus routes.

The relation between dwelling time and the number of passengers at boarding and alighting was analyzed as shown in Figure 5.3-15. As it can be seen, the dwelling time increases in proportion to the number of passengers when passengers board and alight

on/from bus. The dwelling time at boarding is somewhat long with an average of 1.6 seconds, compared to 1.5 seconds at alighting.

Figure 5.3-16 and Figure 5.3-17 show the boarding and alighting times according to the type of bus. No difference between the type of bus is identified until 5 passengers. Over 5 passengers, the dwelling times of Omnibus and Microbus are shorter than that of the Camioneta due to the structure of the bus fleet in which Omnibus have two doors and others have one door, and the Camioneta is a small vehicle and difficult to board and alight.

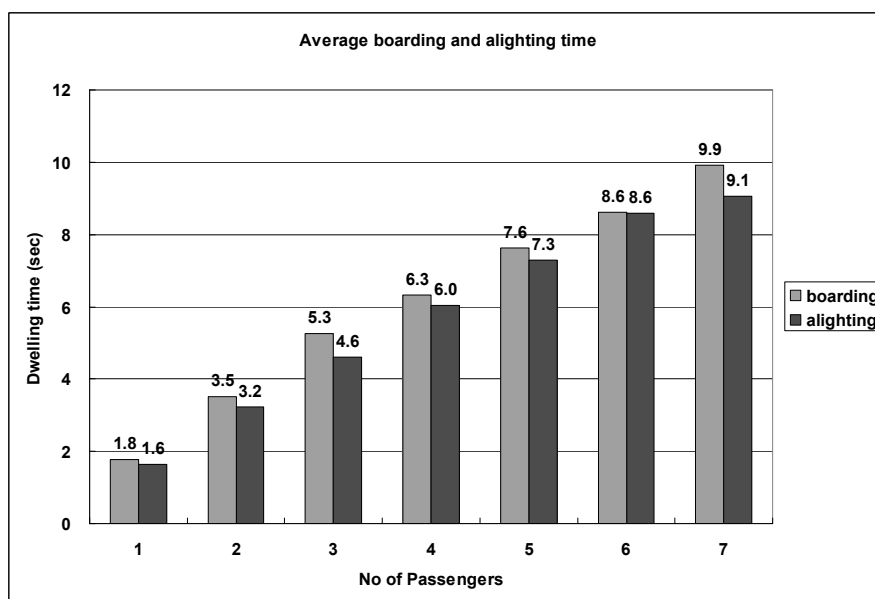


Figure 5.3-15 Dwelling Times according to Boarding and Alighting Passengers

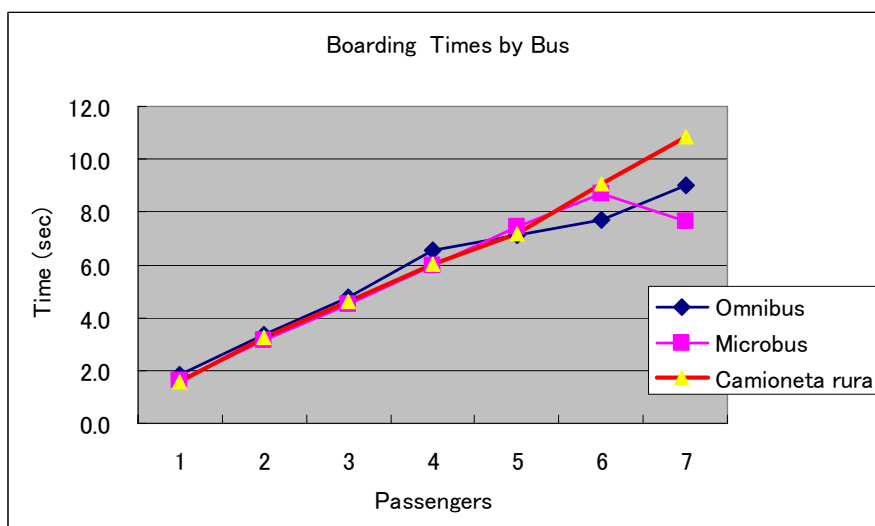


Figure 5.3-16 Boarding Time by Type of Bus

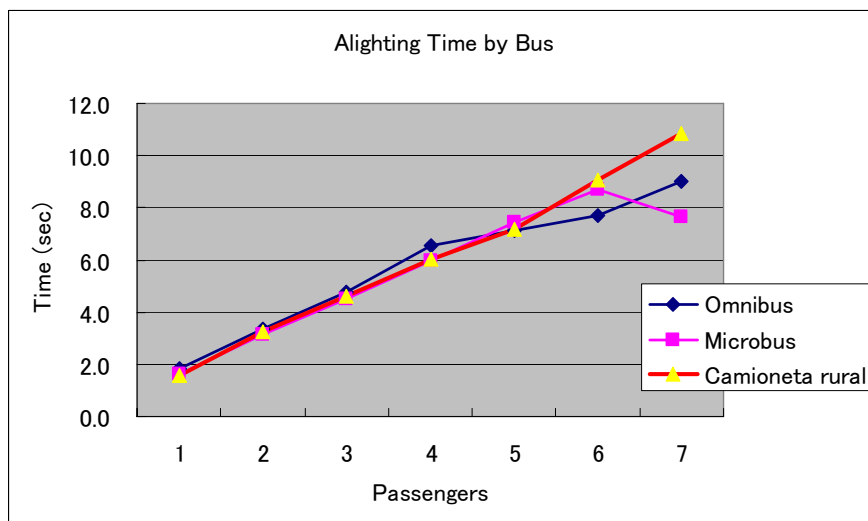


Figure 5.3-17 Alighting Time by Type of Bus

(5) Passenger Waiting Time

In order to see the passenger waiting time at the bus stops, the interview survey of the passenger waiting time was carried out at the major bus stops on the major bus routes.

Figure 5.3-18 shows the waiting time at bus stops analyzed from the interview survey. Approximately 15% of the samples have a waiting time of about 5 minutes at a bus stop. Its accumulative percentage reaches 85% with a waiting time of 15 minutes. Within 5 minutes, the west and Center areas are higher in the sample ratio. On the other hand, the ratio of bus passengers who wait over 15 minutes for a bus is higher in the north area.

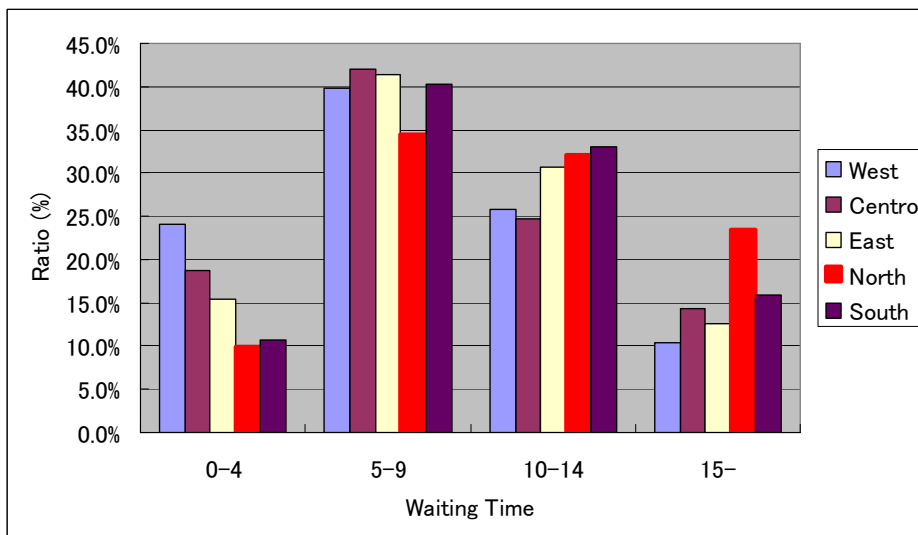


Figure 5.3-18 Waiting Time at Bus Stops

(6) Bus Transfer Times

Bus transfer times are closely related to the bus network service. The information regarding the current number of bus transfer times is important in the re-routing or integration of bus routes and its operation efficiency. Therefore, in order to see the number

of bus transfer times at the bus stops, the interview survey of the transfer times was carried out at the major bus stops on the major bus routes.

Figure 5.3-19 summarizes the number of bus transfer times. The ratio of non-transfer to the total is approximately 55%, and the one (1) time transfer is 40%. The ratio including one time transfer reaches approximately 95%. Locations with a higher ratio of transfer times (1 time or more) are No. 1, 15 and 16 where over 60% of the bus passengers are forced to carry out one or more transfers (see Figure 5.3-20).

According to the transfer times, almost all passengers are able to arrive at their destinations without transfers or with a one time transfer by assistance of the fine bus route service. However, approximately 570 bus routes are operated as a result of those route services and too many bus routes concentrate on some major roads with loading and unloading at non bus stops. On some roads, traffic volume is very heavy with a heavy bus volume.

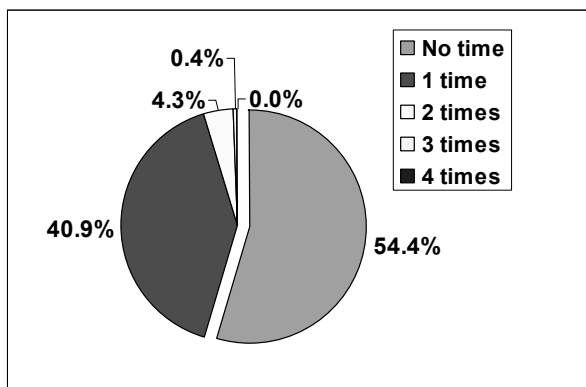


Figure 5.3-19 Number of Bus Transfers

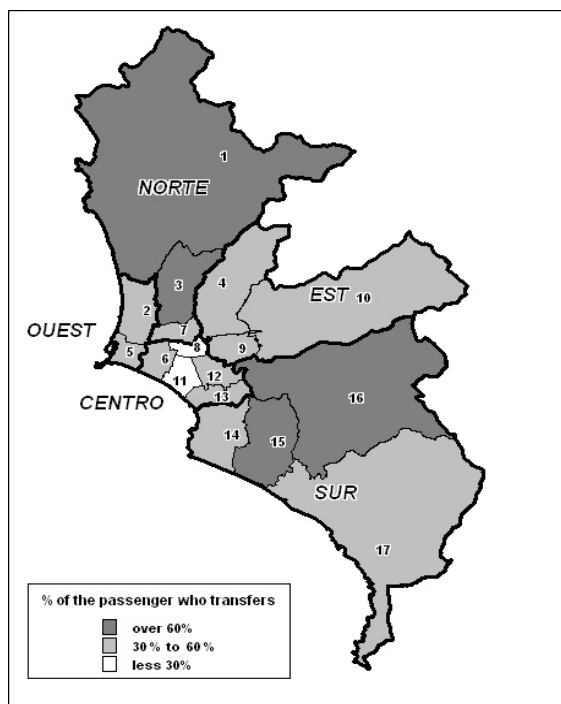


Figure 5.3-20 Higher Ratio Areas of Transfer Times (1 Time or More)

5.3.3. BUS FACILITIES

(1) Busway

The total busway length, exclusive of private vehicles with fence and cube, is currently approximately 30km. Figure 5.3-21 shows the present busway network in the Study area. This busway network was constructed from among the network plans proposed by “Transport Plan” conducted between 1988 and 1989. In 1988, busways were constructed on the following roads.

- a) Av. Tomas Marsano
- b) Av. Paseo de la República
- c) Av. Brasil

From those busways, a busway segment on Av. Paseo de la República will be succeeded to the COSAC-1 Project (Segregated High Capacity Corridor), in which the construction of the exclusive busway with a total length of 28.6km will be commenced in 2004 and completed in 2006 by the World Bank and Inter-American Development Bank.

Figure 5.3-22 shows a typical road cross-section on Paseo de la República, which is an urban expressway with full access control of motor vehicles at a grade-separated intersection. The width of the expressway is 72m with a 2 lane busway (7.0m) in dual way located in the center of the road (median). The exclusive busways have a green belt with 5.0m on both sides of the busway for urban landscapes (see Figure 5.3-23).

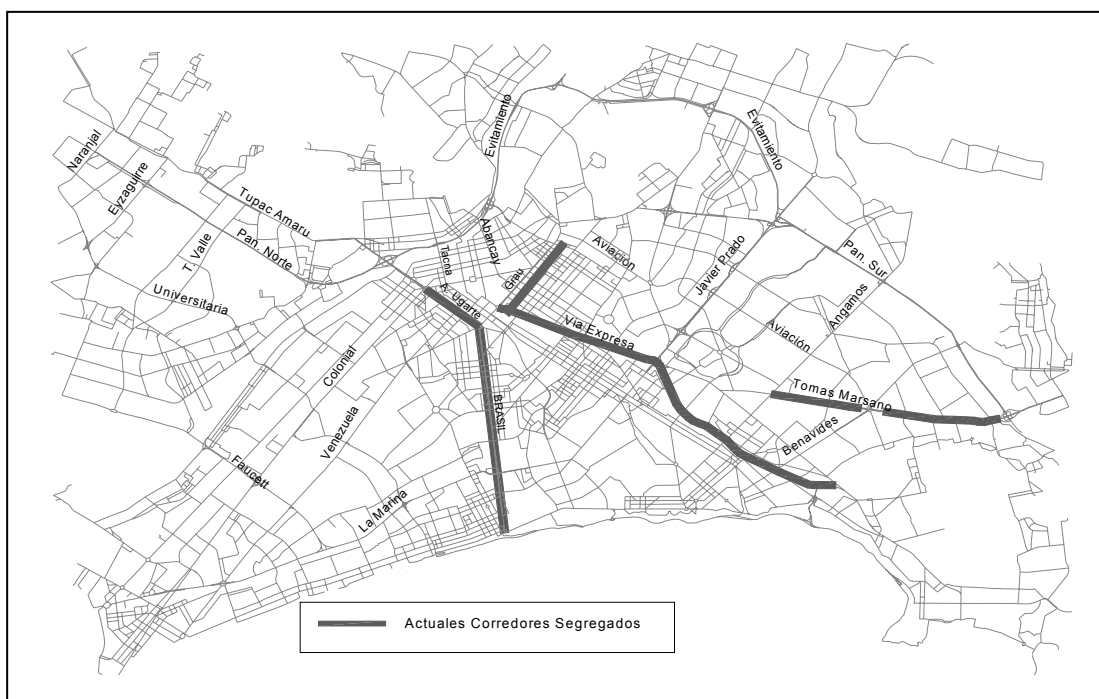
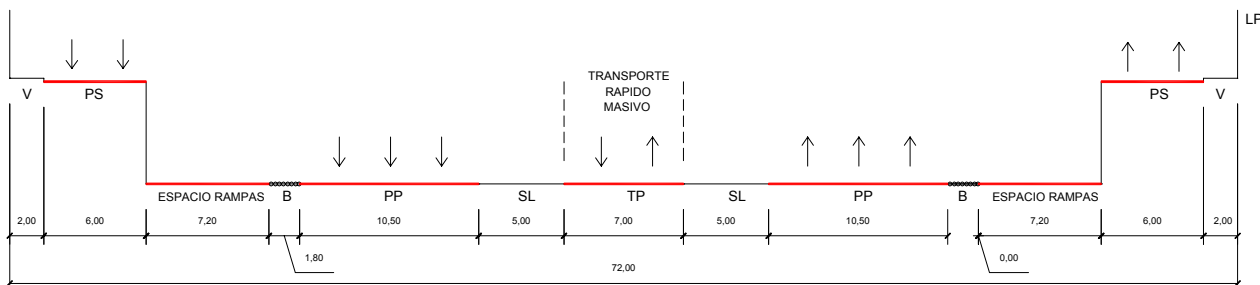


Figure 5.3-21 Present Busway Network in Lima

LEYENDA

B = BERMA	R = RAMPA
CV = CICLOVIA	SC = SEPARADOR CENTRAL
E = ESTACIONAMIENTO	T = TALUD
J = JARDIN	J = JARDIN
LP = LIMITE DE PROPIEDAD	TP = PISTA EXCLUSIVA DE TRANSPORTE PUBLICO
PP = PISTA PRINCIPAL	V = VEREDA
PS = PISTA SECUNDARIA	VAR = VARIABLE



SECCION E - 16: PASEO DE LA REPUBLICA
Tramo: Plaza Grau - República de Panamá = Secciones variables existentes conforme a los predios consolidados
Tramo: República de Panamá - Panamericana Sur = 72.00 metros

(Source: IMP/Lima)

Figure 5.3-22 Typical Cross Section of the Busway on Paseo de la República



Figure 5.3-23 Busway on Paseo de la República

(2) Bus Stop

Bus stops do not exist in Lima and Callao in exclusive of particular roads, which are Av. Venezuela, Av. Javier Prado, etc. The municipality does not control the bus stops. Therefore, bus passengers board and alight buses everywhere, whether bus stop facilities exists or not, when bus passengers raise their hand as a signal at sidewalks on roads with the approach of buses due to the lack of bus stop facilities beyond particular roads.

At present, the busway on Av. Paseo de la República expressway is preparing the bus stop facility under the pedestrian bridge or a grade separated intersection. The bus stop facility has no roof for the passengers. Spacing between the bus stops is approximately 600 to 800m. Figure 5.3-24 shows the bus stop facility installed on Av. Venezuela when improvement and widening were implemented.



Figure 5.3-24 Bus Stop Facility on Av. Venezuela in Callao

(3) Bus Terminal

1) Urban Bus Terminal

There are no urban bus terminals in Lima and Callao. Many buses use a road shoulder as a bus parking space at the origin and destination of the bus route under the control of a ward office of municipality. Figure 5.3-25 shows a bus deposit facility of a private bus company in a suburban area.



Figure 5.3-25 Bus Deposit of Bus Company

2) Inter-municipal Bus Terminal

In Lima, private bus companies that operate inter-municipal buses have inter-municipal bus terminals, which are managed by bus companies individually, not by directions. Figure 5.3-26 shows the location of the bus terminals, which are classified into two types: one is the off-street terminal and another is the on-street terminal. The off-street terminals are 79

locations, while 24 locations are on-street terminals. In the off-street terminal, the terminals are classified into three scales. One is a large-scale terminal that prepares 20-25 bus bays, the second is a medium class with 10 bus bays, and the last is a small scale with 2-3 bus bays. Figure 5.3-26 shows a large-scale private bus terminal near the intersection between Av. Javier Prado and Av. Paseo de la República, which has a facility with ticketing, waiting room, and kiosk.



Figure 5.3-26 Long Distance Bus Terminal of a Private Bus Company

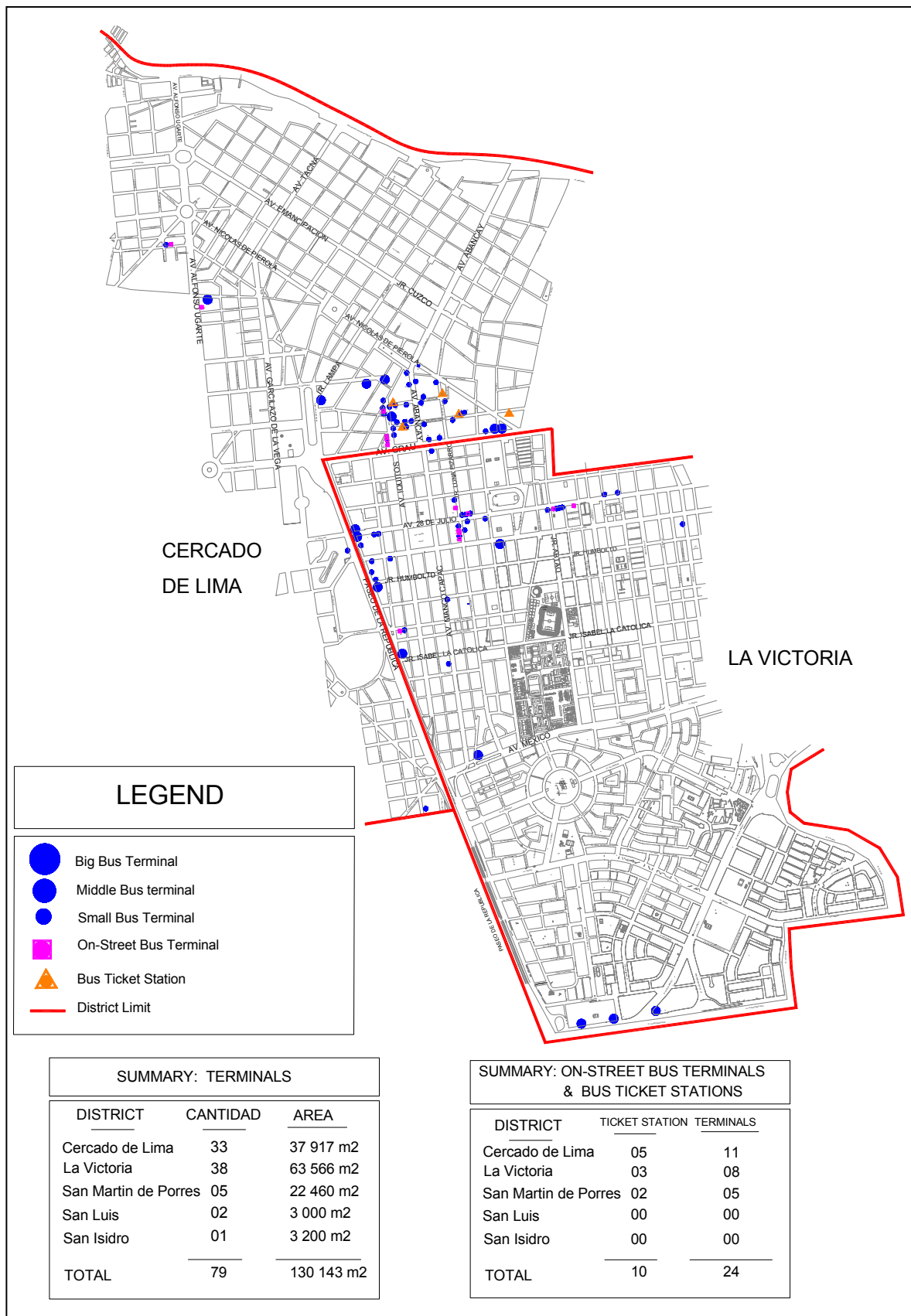


Figure 5.3-27 Location of Inter-municipal Bus Terminals

5.3.4. BUS TARIFF

(1) Tariff System

At present, bus companies in Peru can decide the bus fare rate under the law which enacted “Legislative Degree No. 651” on September 24, 1991. After that, this law was ratified under “Legislative Degree No. 25477” on April 28, 1992. The purpose of the law is to facilitate the investment of bus transportation companies under the conditions that the restriction to join a bus business of any company is removed and then, to provide a benefit to the bus passengers.

Passengers normally have to pay the tariff at each transfer from one bus route to another. The integrated system is not in operation at the bus terminals, where passengers can transfer without paying the tariff.

After boarding a bus, each passenger pays the tariff to the conductor in cash. Coupon tickets, monthly passes and ticketing cards of prepaid type are not in use.

Although bus companies freely set the fare rate, the rate is approximately S/.1.00 (approximately ¥31, US\$=¥110). However, the rate is somewhat dependant on the travel distance, i.e., the fare rate between the Center and a suburb of Lima ranges between S/.1.50 and S/.1.80, equivalent to a travel distance of 15km. The actual fare rate varies according to the travel conditions, such as morning peak hour and travel distance.

Certain categories of people are exempt from paying the tariff. Exemptions are separately granted by various public edicts and organizations. In the study area, exemptions are based on the decisions of the Municipality of Lima, the Municipal Ordinance of Lima (No. 104). At present, the following 6 categories of people are exempt from paying bus tariffs.

- 1) Children aged six or under
- 2) Military police
- 3) Police
- 4) Firemen
- 5) Primary and secondary school children: reduction by half of the rate
- 6) University and college Students: reduction by half of the rate

(2) Transport Fee Conditions

A bus passenger transport fee was surveyed in the bus passenger interview survey. Figure 5.3-28 shows the distribution of the paid transport fee from house to destination in the morning peak hour in the whole Study area. As it can be seen, approximately 70% of the total are less than a paid fare of S/. 2.0. Almost all passengers pay a range between S/.1.00 and –S/.1.90. Figure 5.3-29 shows the composition ratio of passengers who pay a transport fee of S/. 2.0 or more according to 17 zones. The higher zones of the composition ratio of the passengers are zone No. 1, 16 and 17 which are located in peripheral areas, while the lower zones are No. 5, 6 and 8, which are within central urban areas.

In the interview survey, the passenger opinion of transportation fees was collected and analyzed in a circular graph as shown in Figure 5.3-30. As it can be seen, approximately 70% of the passengers are satisfied with the present fare rate. The remaining has the opinion that the present rate is high.

The interview survey also collected a desired transportation fee in order to identify a difference between actual and desired fares. Figure 5.3-31 shows the distribution of desired and actual transportation fees in the morning peak hour. The composition ratio of passengers who desire a transportation fee of S/. 2.0 or more is approximately 80%, in contrast to 70% of the actual fare.

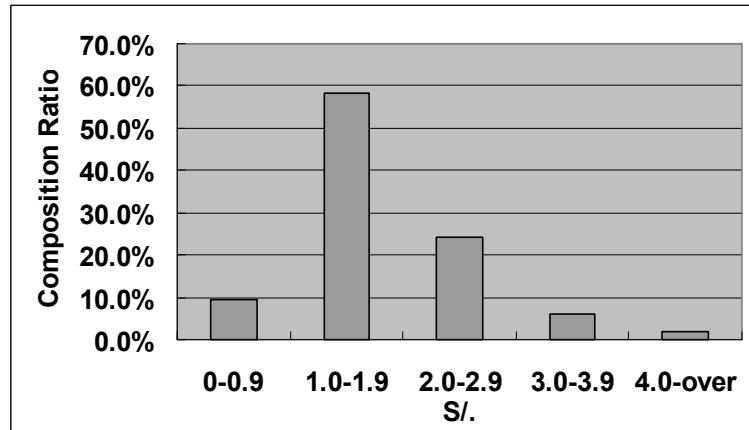


Figure 5.3-28 Paid Transportation Fee

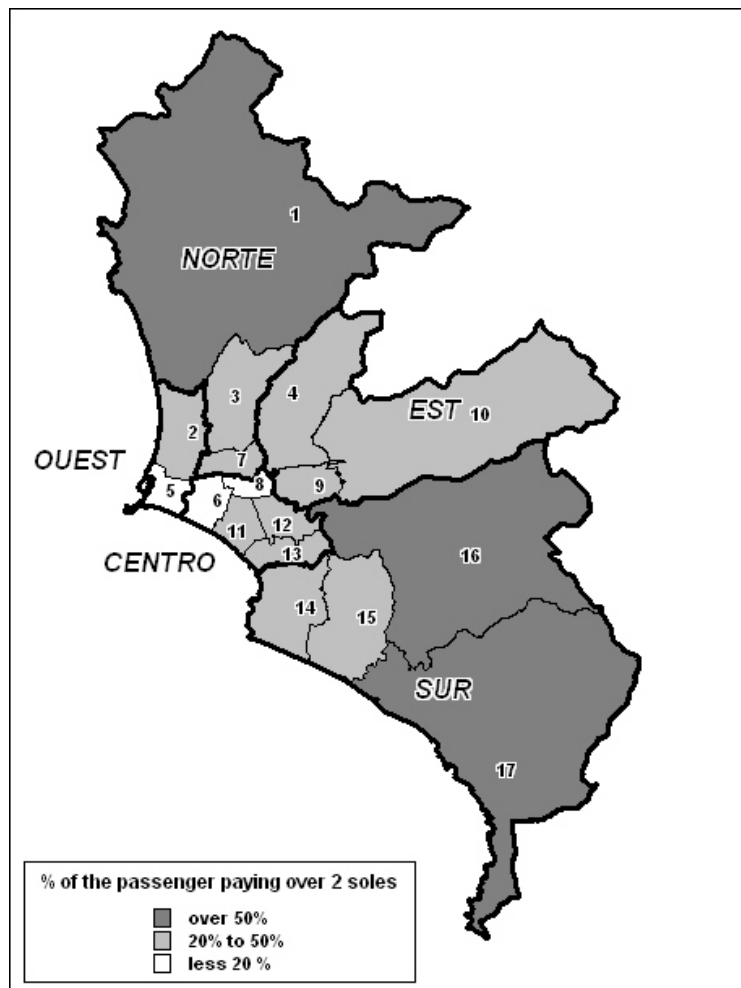


Figure 5.3-29 Ratio of Passengers Who Paid Transportation Fee (S/. 2.0 or more) to Total

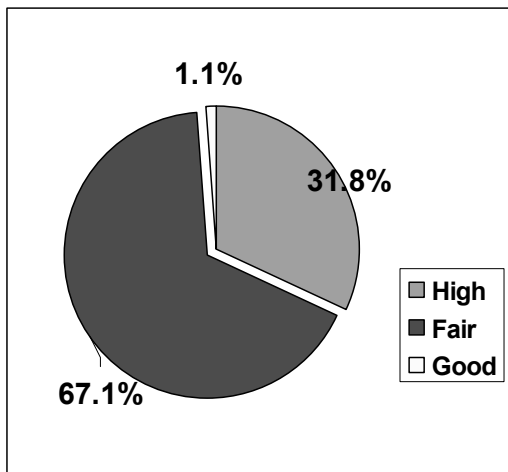


Figure 5.3-30 Bus Passenger Opinions Regarding Bus Fare Rates

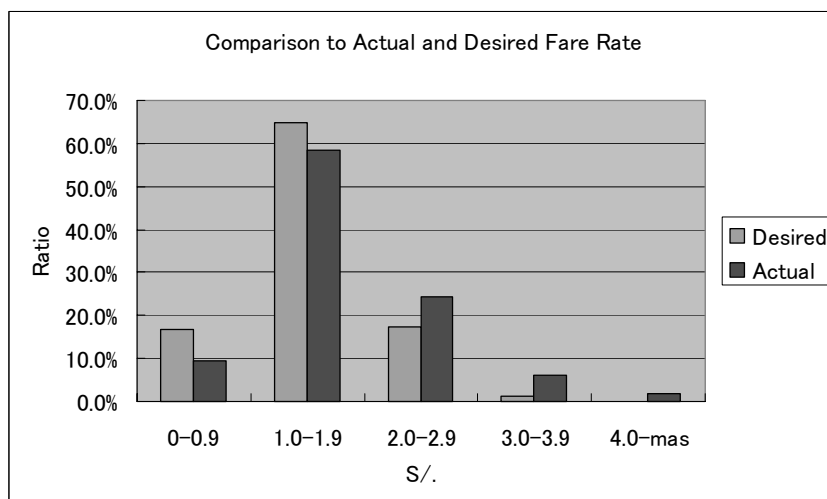


Figure 5.3-31 Comparison to Actual and Desired Fare Rates

5.3.5. BUS FLEETS

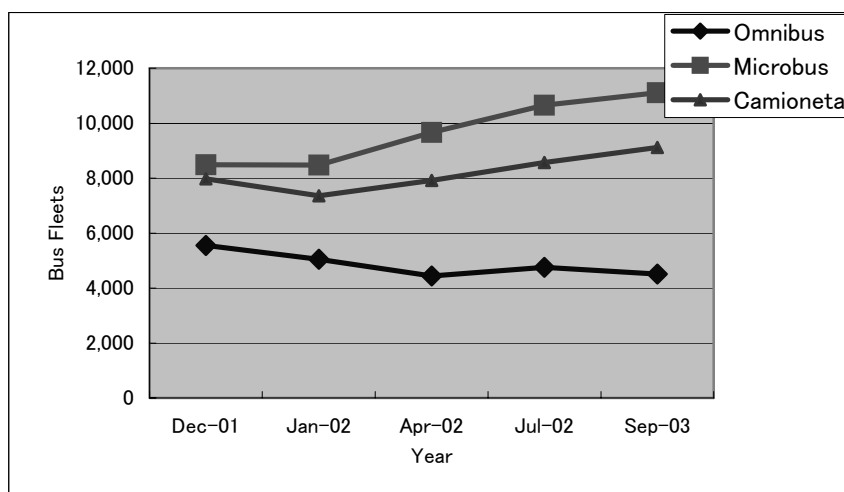
(1) Number of Bus Fleets

The type of bus fleets operated in Lima is mainly classified into three: Omnibus (a capacity of 80 passengers), Microbus (30 passengers) and Camioneta (17 passengers, called Combi-bus). Figure 5.3-32 shows the yearly fluctuation of the number of bus fleets owned by companies in Lima. The numbers of owned fleets, as of September 2003, are 4,500 for Omnibus, 11,000 for Microbus and 9,000 vehicles for Camioneta, respectively. The total number of bus fleets is approximately 24,700 vehicles.

As for the yearly fluctuation of the number of bus fleets, the Omnibus has decreased at approximately 10% per annum since 2001. This is because the Omnibus, which is old aged, is replaced by the Microbus.

Table 5.3-1 shows number of bus fleets registered in 2004 in the GGTU in Callao. The numbers of registered buses are 2,026 for Omnibus (a capacity of 80 passengers) and Microbus (22-25 passengers), and 5,068 fleets for Camioneta (15 passengers). Approximately 70% of the total fleets are Camioneta.

As it can be seen, though the required number of bus fleets in Callao is 9,757, the actual operated number of buses is 7,094. The difference is not in the operation of the bus routes since they do not possess bus fleets.



(Source: DMTU/Lima)

Figure 5.3-32 Yearly Fluctuation of the Number of Bus Fleets Owned by Companies in Lima

Table 5.3-1 Number of Buses Registered in the GGTU (Callao) in 2004

Type of Bus	Number of Buses	
	Authorized Buses	Buses Required by the GGTU
Camioneta (vehicles)	5,068	---
Omnibus+Microbus (vehicles)	2,026	---
Total (vehicles)	7,094	9757

Source: GGTU(Callao)

(2) Age Distribution of Existing Bus Fleet

Figure 5.3-33 shows the age distribution of the existing bus fleet by Omnibus, Microbus and Camioneta. As it can be seen, the average bus ages of Omnibus and Microbus are 20.0 and 18.2 years, while the Camioneta is considerably new-fashioned at an average of 15.5 years. The age distribution shows that the ratio of Omnibus, which is a bus age of 15 years or more, to the total reaches 78%, in contrast to 68% of Microbus and 53% of Camioneta.

Table 5.3-2 shows bus ages registered in Callao by Camioneta and Omnibus. As for bus fleets with a bus age of 15 years or more, Omnibus in Callao reaches 46% of the total, in contrast to 78% in Lima. On the other hand, the ratio of Camioneta is 15% in Callao, in contrast to 53% in Lima.

Table 5.3-2 Bus Ages Registered in Callao (As of July 2003)

Type of Bus	0-5 Years	5-10	10-15	15-20	20 Years or over	Total
Camioneta (vehicles)	253	2,496	2,816	967	29	6,561
(%)	3.9%	38.0%	42.9%	14.7%	0.4%	100.0%
Omnibus (vehicles)	42	517	1,278	1,324	257	3,418
(%)	1.2%	15.1%	37.4%	38.7%	7.5%	100.0%

Source: DMTU/Lima

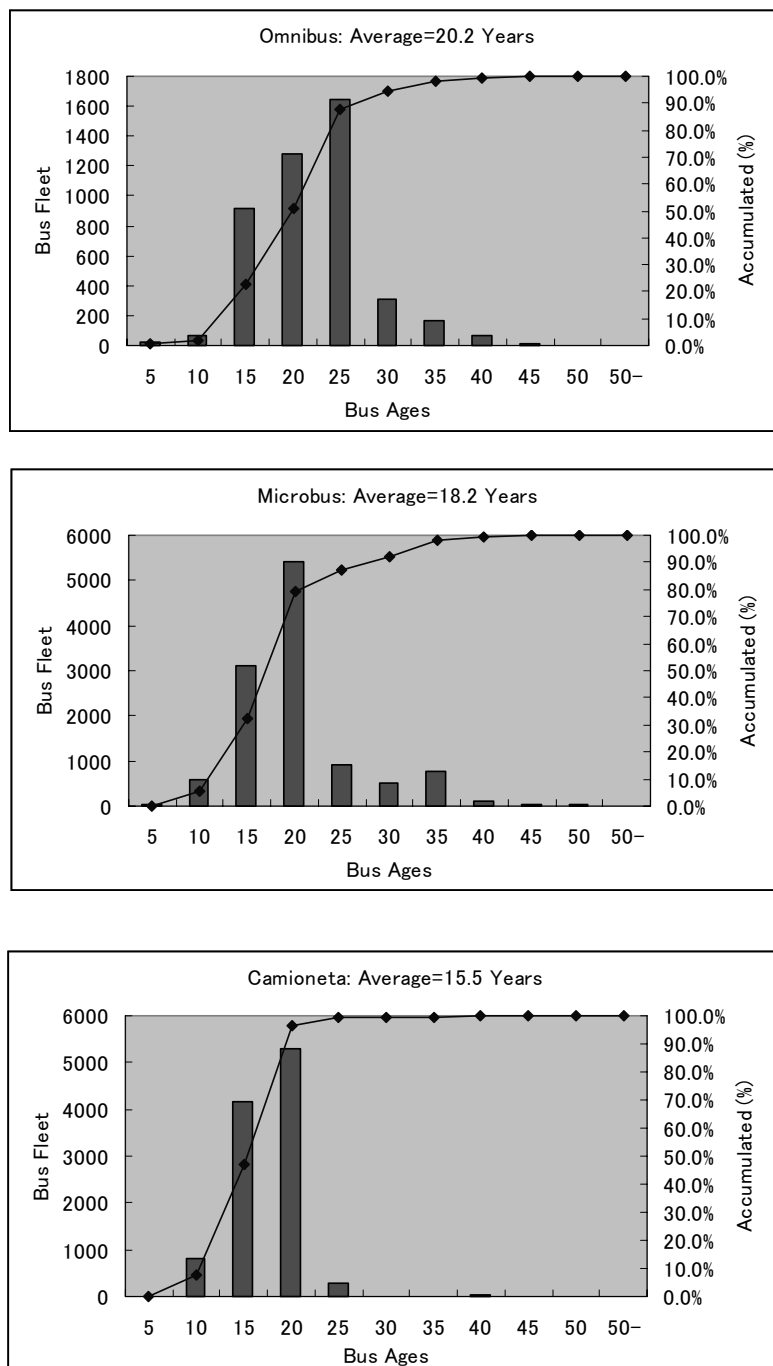


Figure 5.3-33 Age Distribution of Existing Bus Fleet in Lima