6.6. EXPECTED BENEFIT OF TRUNK BUS SYSTEM

The expected benefits of the trunk bus system to the transportation sector are analyzed in detail in this Section. The benefits of the system are shown by category of beneficiaries. The description below compares the "with project" situation with the "without project" situation respectively forecast in the years 2010. The results of economic and financial analysis on the proposed project are presented in Chapter 9.

6.6.1. BENEFIT TO BUS PASSENGERS

(1) Reduced Travel Time

The introduction of the trunk bus system expects the reduction of a commuting time. Figure 6.6-2 shows distribution of a travel time by the "with" and "without" cases, within the influence area which is assumed that the East-West trunk bus system directly effects. Figure 6.6-1 shows the influence area indicated with a yellow area which includes a southern part of Callao, Santa Clara and Huaycan. The northern part of Callao is excluded because passengers don't directly use the trunk-feeder bus system due to trip distribution characteristics.

As can be seen, a maximum point of inflection of distribution of travel time becomes shorter in the with case than that in the without case. The average travel time in the with case is approximately 28 minutes. The "without project" forecasts are 42 minutes. The "with project" forecast indicates significant improvement. The average travel time of 28 minutes is lower by 14 than the "without" forecasts. Commuters by bus will be able to save about 15 minutes one way by the introduction of the trunk bus system.

Figure 6.6-3 and Figure 6.6-4 also show the distribution of travel times and its accumulated percentage in travel distance of 20km or less, and more. Within the travel distance of 20km, the average travel time of 12 minutes is lower by 13 than the "without" forecasts (25 min). As for the distance of 20km or more, the average travel times in the with and without cases are approximately 52 minutes and 68 minutes, respectively. Commuters by bus will be able to save about 16 minutes one way. This means the introduction of the trunk bus system produces a good effect to a long travel passenger.

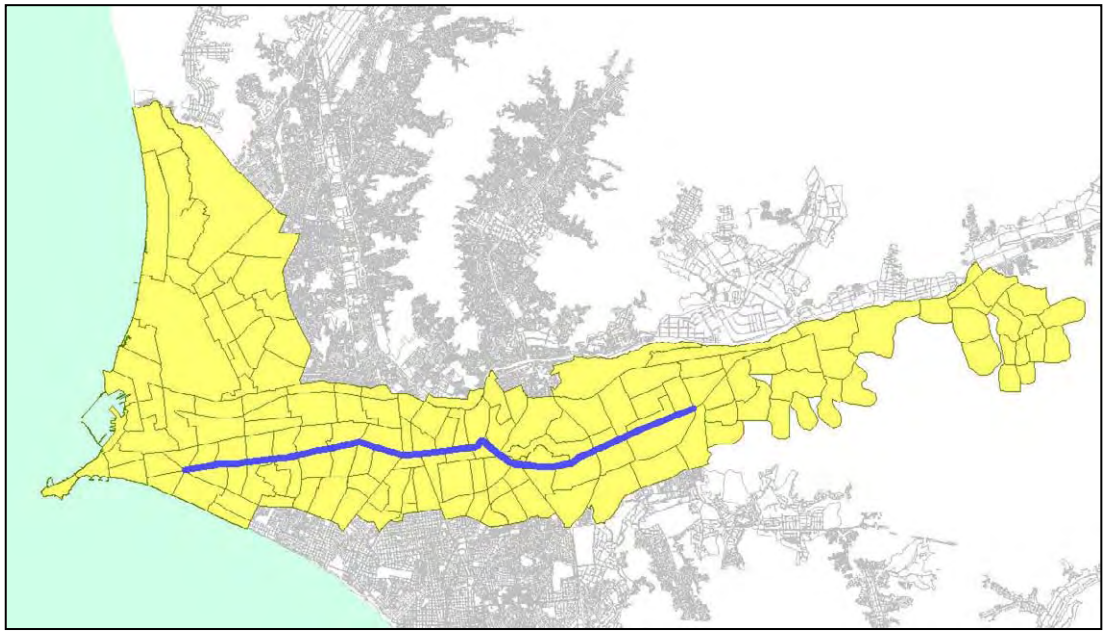


Figure 6.6-1 Area Assumed that the EW Trunk Bus System Directly Effects

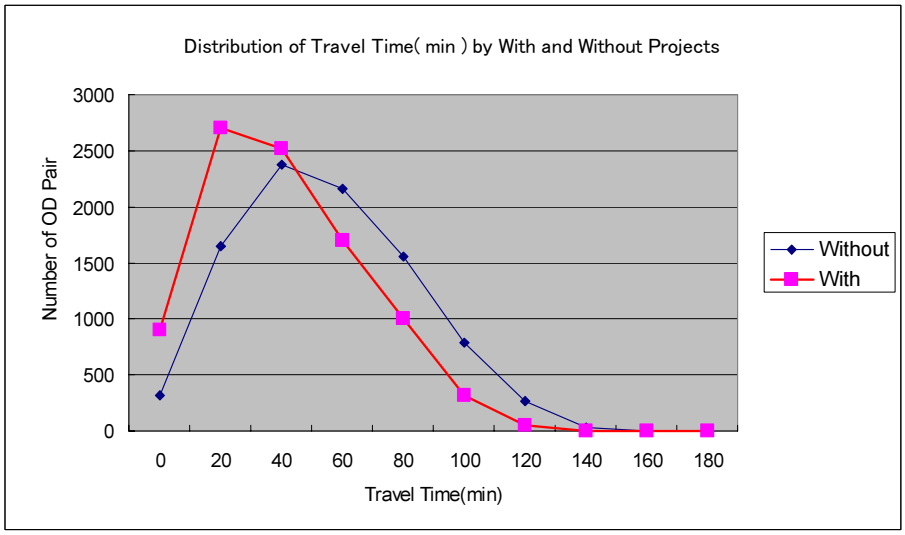


Figure 6.6-2 Distribution of Travel Time by With and Without Projects

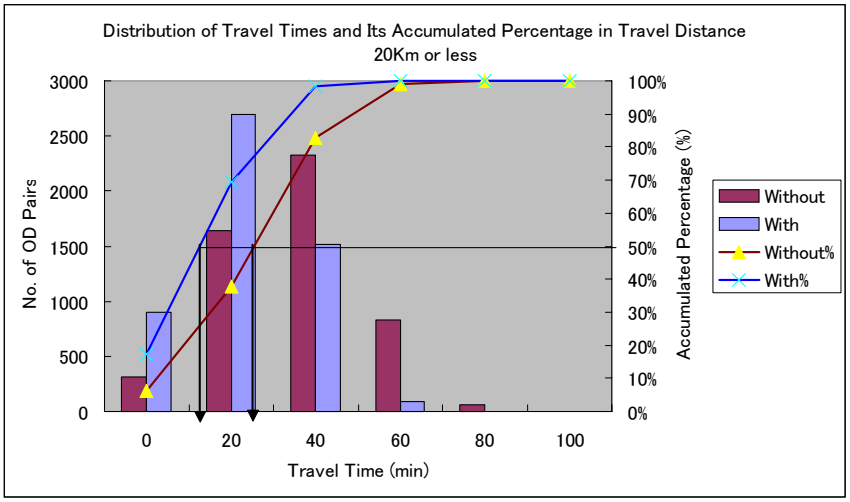


Figure 6.6-3 Distribution of Travel Times and Its Accumulated Percentage in Travel Distance 20km or Less

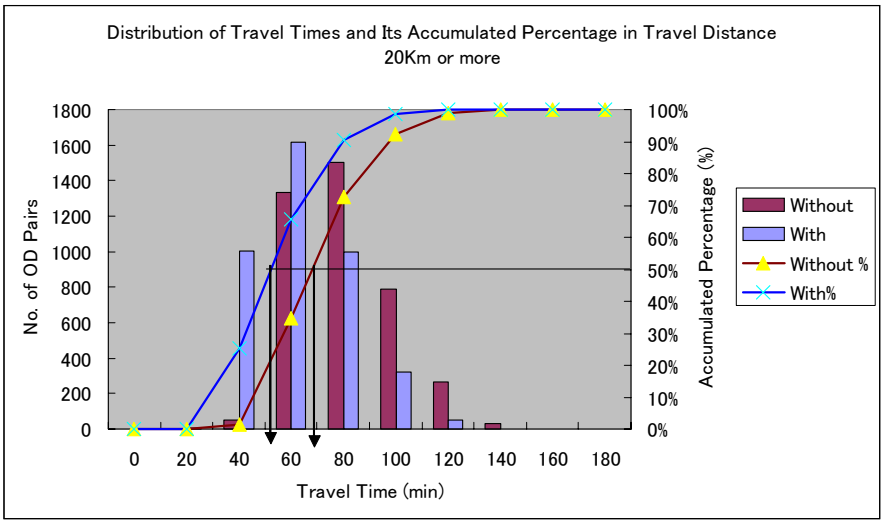


Figure 6.6-4 Distribution of Travel Times and Its Accumulated Percentage in Travel Distance 20km or More

(2) Reduced Waiting Time at Bus Stops

Figure 6.6-5 shows distribution of a waiting time at bus stop by the "with" and "without" cases, within the same influence area as that of travel time analysis. As can be seen, the maximum points of inflection of distribution of waiting time are same in the with and without cases. Its maximum point is around 1-2 minutes. Although the waiting time supposes to be shorter than that in the without case by the introduction of the trunk bus system, the forecast is the same. Since in 2010, the number of conventional bus lines reduces from 625 lines in 2004 to 202 lines in 2007, the bus frequency considerably rises together with the increase of demand. In the without case, the waiting time is also more decrease than that at present.

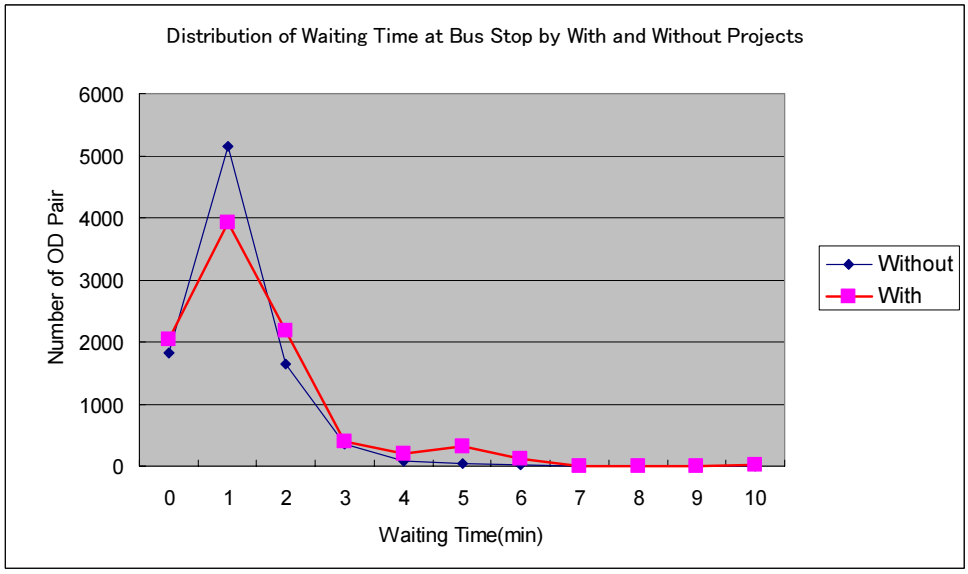


Figure 6.6-5 Distribution of Waiting Time at Bus Stop by With and Without Projects

6.6.2. BENEFIT TO THE PUBLIC AT LARGE

(1) Traffic Conditions on East-West Corridor

The trunk busway on the east-west trunk bus system is segregated by some concrete structure from the through traffic lane in order to ensure that the regular trunk bus service complies with schedule and traffic safety requirements. The busway is closed to private vehicles and the conventional bus. Since the overlapped conventional bus lines are eliminated and bus passengers diverts to the trunk buses on the trunk bus system, the total conventional bus volumes will be reduced.

Figure 6.6-6 shows traffic volumes by type of vehicles in the inbound and outbound directions in the morning peak hour on the east-west corridor in the with and without cases. The traffic volumes show on Av. Venezuela, Av. Grau and Carretera Central. As it can be seen, by the introduction of the trunk bus system, the conventional bus volumes dramatically reduce in the "with" case. However, instead of the conventional bus, the private vehicles considerably rise due to the diversion from other roads and increase of future private vehicle demand (ratio of demand 2010/2004: Public=1.08, Private=1.19). As a result, total traffic volumes on the corridor are the similar conditions as that in the without case in exclusive of Av. Venezuela where the volume rises.

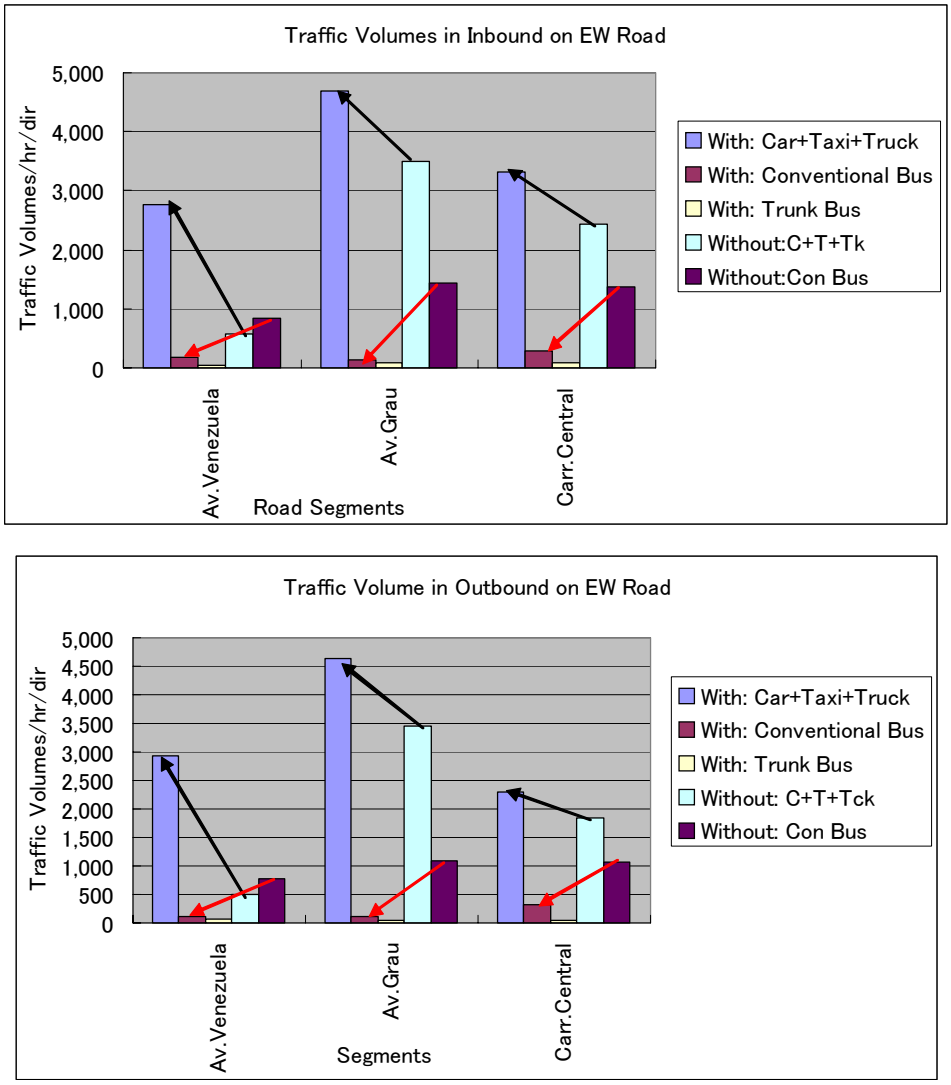


Figure 6.6-6 Traffic Volumes by Type of Vehicles on East-West Corridor in Without and With Cases

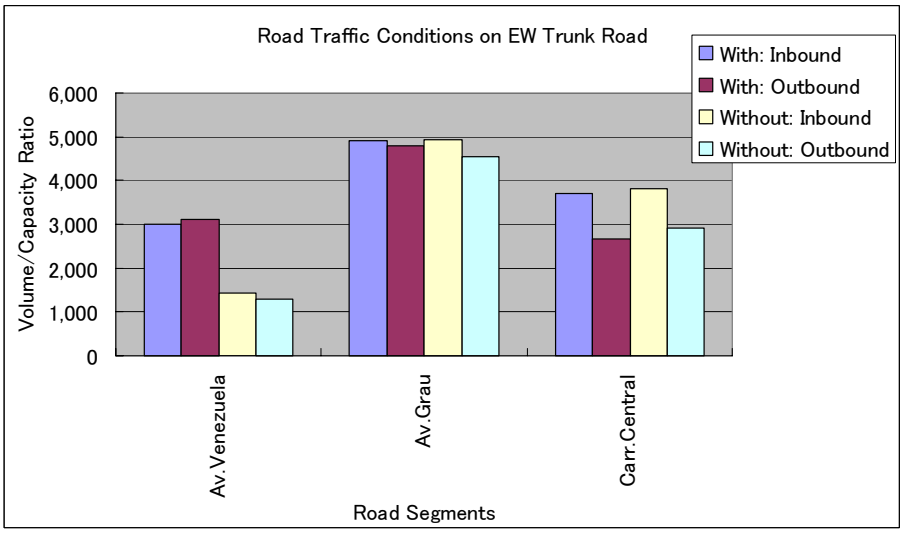


Figure 6.6-7 Total Traffic Volumes on East-West Corridor in Without and With Cases

(2) Traffic Conditions in the Whole Study Area

1) Volume-Capacity Ratio on Roads

Table 6.6-1 shows the traffic congestion length on roads in the whole study area, in which the congestion level is measured by a volume-capacity ratio classified into 3 levels: less than 1.0, less than 1.5 and 1.5 or over.

Both cases, "without project" and "with project", are different in congestion length. Especially, the congestion length with a volume-capacity ratio of over 1.5 decreases by 12% in the "with project" case. This indicates that the congestion level by the introduction of the trunk bus system is improved, in comparison to the figure in the "without project" case.

2) Average Travel Speed on Roads

The average travel speeds served on roads in the peak hour are shown in Table 6.6-1. The average travel speeds are a typical index to show service levels. In comparison to the "without project" case, the travel speed slightly increases in the "with project" case. It is also shown that the service level on roads in the whole study area is slightly improved by the trunk bus system.

Table 6.6-1 Average Travel Speed and Volume-Capacity Ratio on Roads in With and Without Cases

	Without (km)		With (km)		With/Without
Average Travel Speed (km/h)	13.5		13.8		1.02
Volume-Capacity Ratio					
<1.0	3839.5	88.8%	3857.0	89.2%	1.00
1.0<= <1.5	429.7	9.9%	418.6	9.7%	0.97
1.5<=	55.4	1.3%	49.0	1.1%	0.88
Total	4324.6	100.0%	4324.6	100.0%	1.00

(3) Improved Traffic Safety

The trunk bus system will reduce traffic accidents on the east-west corridor. In the Feasibility study, it is difficult to estimate quantitatively the reduction of the accidents. This is because the analysis of the relationship between the ratio of accidents generated and traffic conditions on the basis of past data is difficult.

However, the reduction of traffic accidents generally be found according to the contents of the projects as shown below.

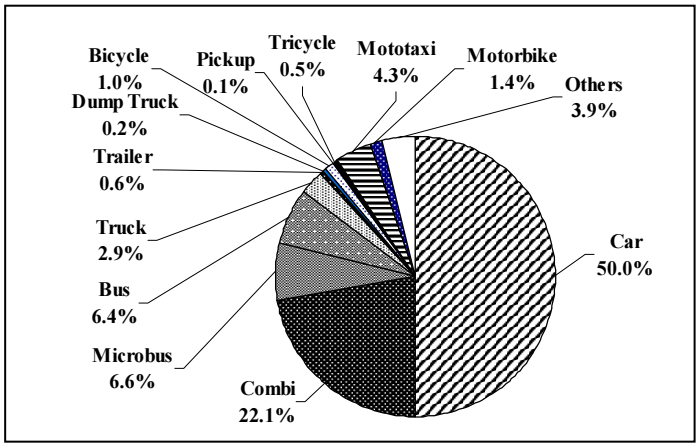
1) To reduce traffic accidents between conventional buses and private vehicles because the conventional bus passenger diverts to the trunk bus which is operated on the busway segregated the buses from private vehicles, and the conventional bus operation reduces.
2) To reduce traffic accidents between trunk buses because the trunk bus is operated on the segregated busway on which the bus cannot overtaken other buses.
3) To reduce traffic accidents for passengers and pedestrians because trunk bus stops at a bus stop facility. At the present, bus passengers boards and alights buses everywhere where bus stop facility exists or not, when bus passengers raise his/her hand as a signal at sidewalk on roads with the approach of bus due to no facility of bus stop in exclusive of particular roads. Therefore, under the trunk bus system, the potential of traffic accidents will be lower when boarding and alighting.

In this section, traffic accidents between conventional buses and private vehicles are analyzed based on the accident data and traffic assignment result on the EW corridor. Figure 6.6-8 shows the traffic accident data in 2003 in the metropolitan Lima and Callao. As can be seen, the accidents related to a car and bus are predominant in number. The ratio of the bus related accidents to total is approximately 35%.

On the other hand, traffic volumes on the east-west corridor are different between the "with" and "without" cases as shown in Table 6.6-2. The number of conventional bus volumes remarkably decrease in the "with" case. Its decrease ratio of bus volumes is approximately 10-25%.

It is difficult to estimate the reduction of traffic accidents on the east-west corridor from the both data. The estimation of number of accidents on the corridor needs the more detailed accident data such as accident ratio per vehicle-km by type of vehicle and accident type. However, it is difficult to obtain those data. It is obvious that the conflict caused the accidents between the conventional bus and private vehicle decreases.

According to the reduction of the conflict, the accidents will certainly reduce by introduction of the trunk bus system, though number of accidents can not estimate.



Source: Ministerio del Interio-PNP, DIVPIAT-PNP Statistics Section, ST-CNSV 2003.
Note: %=Shares of vehicles type involved traffic accidents.

Figure 6.6-8 Composition Ratio of Traffic Accidents by Type of Vehicles in 2003

Table 6.6-2 Traffic Volumes in 2010 on the EW Corridor

(Unit: volume/hir/dual directions)

Cases	Type of Vehicles	Av.Venezuela	Av.Grau	Carr.Central
With	Car+Taxi+Truck (PCU/Peak hour)	5,695	9,329	5,618
	Conventional Bus (PCU/Peak hour)	297	255	606
	Trunk Bus (Vehicle/Peak hour)	108	138	138
Without	Car+Taxi+Truck (PCU/Peak hour)	1,082	6,947	4,266
	Conventional Bus (PCU/Peak hour)	1,617	2,517	2,454
	Trunk Bus (Vehicle/Peak hour)	0	0	0
With /Without	Car+Taxi+Truck (PCU/Peak hour)	5.26	1.34	1.32
	Conventional Bus (PCU/Peak hour)	0.18	0.10	0.25
	Trunk Bus (Vehicle/Peak hour)	–	–	–

6.6.3. TRAFFIC FLOW CONDITIONS ON AV. VENEZUELA (RISK ANALYSIS)

(1) Procedure of Analysis

In the road segment of about 2.0km between Av. Elmar Faucett and Av. Universitaria on Av. Venezuela where the historical ruin exists, the cross section of the road is designed with segregated busway of 2 lanes/dual-way and 4 traffic lanes/dual-way. The present cross section, however, has 2 traffic lanes/dual-way. The execution of the road construction accompanies with land acquisition for widening of right of way. When the process of it will delay, the road segment is still left to the present cross section. In this situation, the trunk bus is forced to operate on the busway in the provisional right of way which consists of 2 exclusive trunk bus lane/dual and 2 traffic lanes/dual. This provisional cross section design is planned as an alternative case design in the preliminary engineering design.

The exclusive trunk bus lane is planned instead of a segregated busway. This road segment easily exerts an influence on traffic congestion by the reduction of traffic lanes between an adjacent road segment with a wider right of way. Especially, it seems that the conventional bus operation is key point for the congestion. Therefore, in order to see a traffic conflict at the difference point of the lane, the following one alternative case is prepared and the effect of the conventional bus operation is examined in comparison between the base case (elimination of 20% or more of conventional bus lines) and no conventional bus operation.

- Alternative case: elimination of 100% conventional bus lines.

Figure 6.6-9 shows the procedure of analysis as mentioned above.

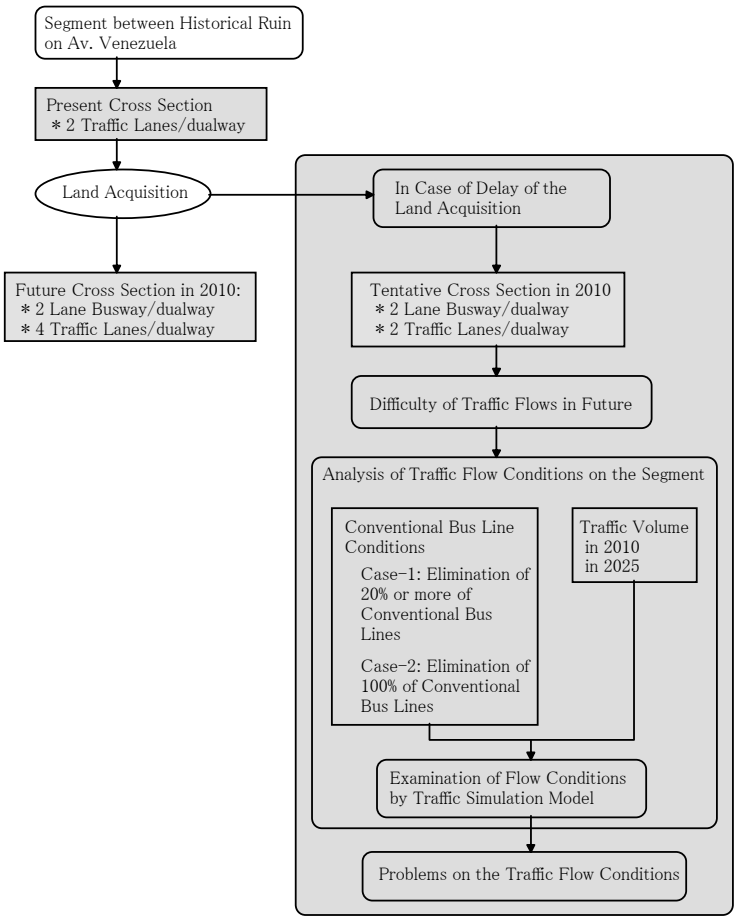


Figure 6.6-9 Procedure of Analysis

(2) Traffic Flow Conditions on Av. Venezuela

In order to analyze traffic flow conditions on Av. Venezuela by sudden reduction to one traffic lane in the trunk bus system, the traffic performance on this mixed traffic lane is simulated on a computer by means of a simulation model. By the model, it is possible to predict the effect of operation performance, as expressed in terms of measures of effectiveness, which include average vehicle speed, vehicle stops, delays, etc.

The TSIS models, which involve software supported by the Federal Highway Administration in U.S.A. (FHWA), is used in the Study. The TSIS is an integrated software system that consists of NETSIM and others. NETSIM is a microscopic stochastic simulation model of urban traffic.

1) Examination Cases

In order to simulate traffic characteristics, the one way traffic flow in the west to east direction of road segment on Av. Venezuela between Av. Elmar Faucett and Av. Universitaria, is selected as study road as shown in Figure 6.6-10. Table 6.6-3 shows the examination cases and Table 6.6-4 shows number of lanes by the examination cases.

Figure 6.6-10 Study Location

Table 6.6-3 Examination Cases

Examination Cases	Cross Section	Conventional Bus Operation	OD Table
2004 Present Case	Present	2007 bus system	2004
2010 Without Case	Present	2007 bus system	2010
2010 With Case (completed)	Completed	Elimination of 20% or more	2010
2025 With Case (completed)	Completed	Elimination of 20% or more	2025
2010 With Case (provisional)	Provisional	Elimination of 20% or more	2010
2010 With Case (provisional + no conventional)	Provisional	Elimination of 100% or more	2010
2025 With Case (provisional)	Provisional	Elimination of 20% or more	2025

Table 6.6-4 Number of Lanes by Examination Cases

Case	Segment A Inbound Direction			Segment B Inbound Direction			Segment C Inbound Direction		
	Total Numbre of Lane	Trunk Bus Lane	Ordinary Lane	Total Numbre of Lane	Trunk Bus Lane	Ordinary Lane	Total Numbre of Lane	Trunk Bus Lane	Ordinary Lane
2004	1	-	1	1	-	1	1	-	1
2010without									
2010with (Complete)	3	1	2	3	1	2	3	1	2
2025with (Complete)									
2010with (provisional)	3	1	2	2	1	1	2	1	1
2010with (provisional+Elimination of 100% of Conventional Bus on Av. Venezuela)									
2025with (provisional)									

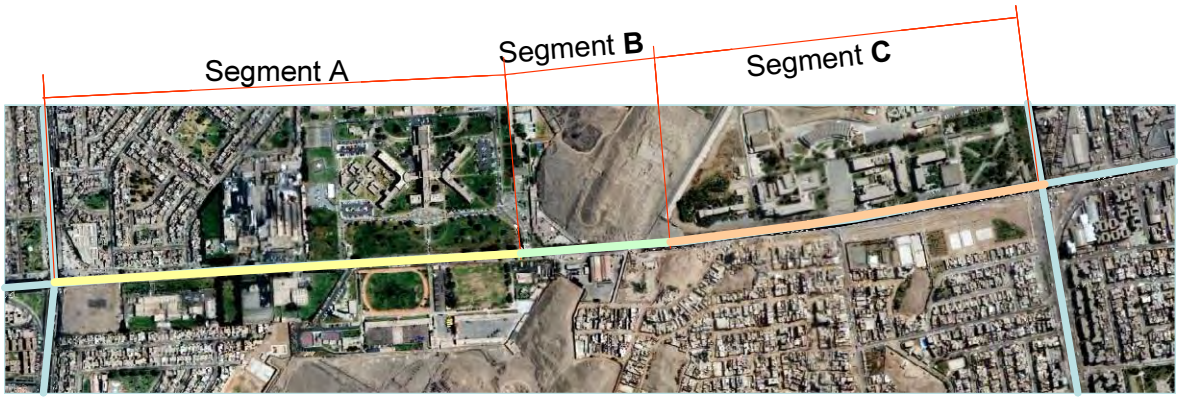


Figure 6.6-11 Location of Each Segment related to Table 6.6-3

2) *Traffic Flow Conditions on the Segment*

a) The procedure of analysis is as follows:

b) To collect present traffic data

c) To collect road inventory data

d) To set parameters for simulation model

e) To calibrate the present traffic conditions

f) To simulate traffic conditions for buses and private vehicles in the above cases.

Figure 6.6-12 shows the traffic flow conditions by simulation model in the 2010 with and without cases. In the figure, the traffic lane is shown with the inbound direction only. Therefore, in case of the with case the upper lane shows the trunk busway and bottom lane shows the mixed traffic lane. The conventional bus is shown with blue color and the white color is private vehicles. The upper figure is the present traffic flow condition calibrated by the simulation model. The middle figure is the 2010 without case and the bottom is the 2010 with case (completed).

As it can be seen, the traffic congestion in the 2010 Without case is severer and the With case (completed) is smooth in traffic flow. Since the trunk bus system is not introduced in the without case, the many conventional buses are operated on the mixed traffic lanes. Since in the 2010 With case, the conventional bus passengers divert to the trunk bus system, the conventional bus passengers reduce and its frequency also reduces. Therefore, the traffic flows in the mixed lane become smooth.

Figure 6.6-13 shows the traffic flow conditions in the 2010 completed and provisional cases. In the figures, the upper figure is the 2010 with case (completed). The middle figure is the 2010 with case (provisional) and the bottom is the 2010 with case (provisional+ no conventional bus) which is set to see the influence of no conventional bus operation in the provisional cross section.

As it can be seen, the traffic congestion in the 2010 with case (provisional) is severe and the with case (provisional+ no conventional bus) is somewhat improved in traffic flow. This is because the conventional bus fleets conflict a smooth traffic flow.

Figure 6.6-12 Simulation Results in Present, 2010 Without and 2010 With Cases

Figure 6.6-13 Simulation Results in 2010 Completed, Provisional and Provisional + No Conventional Bus Operation

3) Average Speed and Average Delay Time

Figure 6.6-14 and Table 6.6-5 show the average delay time and speed by the cases. These tendencies present the results of traffic flow conditions mentioned above. The average speed of the 2010 with case (completed) is the highest and the 2010 without case is the lowest. On the other hand, in the examination cases for the provisional cross section, the speed and delay time is worse in comparison to the cases of the completed cross section.

Since in the provisional cross section, the traffic condition becomes worse, it is necessary to eliminate the conventional bus line to improve the traffic flow condition.

Table 6.6-5 Average Delay Time and Average Speed by the Cases

Case	2004 Present	2010 Without Case	2010 With Case (completed)	2025 With Case (completed)	2010 With Case (provisional)	2025 With Case (provisional)	2010 With Case (provisional + no conventional)
Demand Year	2004	2010	2010	2025	2010	2025	2010
network	actual	actual	Complete	Complete	Provisional	Provisional	Provisional
Trunk Bus Lane			○	○	○	○	○
Remarks							Elimination of Conventional Bus on Av. Venezuela
Average Delay Time of All Vehicles (seconds/vehicle)	70.6	200.6	30.5	57.7	123.6	220.0	101.1
Average Speed of All Vehicles (km/hour)	15.3	9.6	24.9	20.7	14.7	10.4	16.4
Ratio of Average Speed to the 2004 Present Case	1.00	0.63	1.63				
Ratio of Average Speed to the 2010 With Case			1.00	0.83	0.59	0.42	0.66

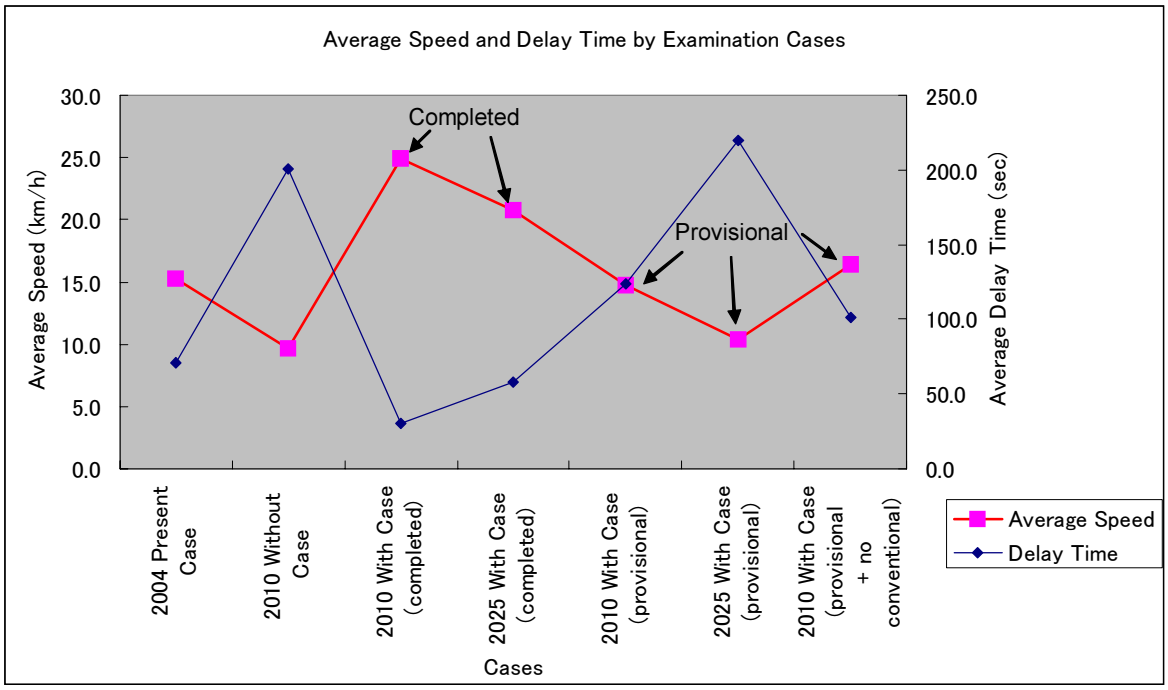


Figure 6.6-14 Average Speed and Delay Time by the Examination Cases

6.6.4. SOCIAL IMPACTS BY THE TRUNK BUS SYSTEM (RISK ANALYSIS)

The expected benefit of the trunk bus system is made based on the tangible items, which are composed of benefit to bus passengers and benefit to the public at large. They are the most objective items to indicate the effectiveness of project investment. However, there are many items to consider the evaluation of project investment in exclusive of these tangible items. Those items are difficult to measure from the socioeconomic viewpoint. One of those items is social impact derived from the implementation of the trunk bus system project. The social impacts in exclusive of the socioeconomic items are important in the evaluation of the trunk bus project.

However, it is difficult to carry out the detailed evaluation for those impacts in the feasibility study. Therefore, the general social impacts are intangibly evaluated due to difficulty of conversion to the value of money.

The proposed trunk bus system includes hardware and software as mainly shown below.

a) To introduce a large articulated bus with a higher capacity to alleviate a traffic congestion and problems for air and noise pollution caused by bus fleets
b) To integrate a bus route
c) To reorganize a private bus organization
d) To construct a busway segregated a private vehicle to actualize a higher bus operation speed
e) To prepare a bus facility such as bus terminal and bus stop
f) To propose a new tariff system
g) To prepare a feeder bus route

The social impacts are classified into two: direct and indirect effectiveness. Those impacts are shown below.

(1) Direct Effectiveness

1) Impact of introduction of the large articulated bus

The trunk bus system introduces a large articulated bus with a higher capacity. The east-west trunk bus system needs new 100 articulated and new 300 feeder buses by the introduction of the system in 2010. According to the introduction of the articulated bus, the total number of operated conventional buses is decrease and effectiveness of bus operation improves. The situations to shift toward the small bus are stopped in accordance with the direction of bus improvement plan in GTU-MML, which plans the introduction of large bus instead of small bus against future passenger growth. The small buses (Micro bus and Camioneta rural) with a bus age of 10 years or less will be operated on the feeder bus routes. The reduction of number of small buses operated on major roads alleviates traffic congestion. The heavy congested roads will decrease by 12% in the length with a volume-capacity ratio of 1.5 or more.

In Lima, the average bus ages of Omnibus, Microbus and Camioneta are approximately 15-20 years. Therefore, the old buses are close to a scrap due to not enough for maintenance of those buses. This is because bus company and owner can not afford the expenses of the bus maintenance and prefer to expense the survival of company. As the results of the situations, the environment conditions become worse. Especially, the air and noise pollution are severe. The introduction of the 100 articulated buses with compressed natural gas (CNG) engine will improve the conditions of air and noise pollution. Bus passengers desire the scrap of old bus according to the bus passenger opinion survey.

Since the new articulated bus is clean in board, the security in bus fleet is improved. The bus passenger opinion survey indicates that the security problem is higher rank in the current bus problem.

2) Impact of integration of a bus route

The bus route in the Lima and Callao municipalities is too many in numbers and too long in distance. And then, the bus service level such as service frequency is gradually lower due to the increase of operation cost. In general, it is said that short route distance is better in operation efficiency. From the viewpoint, the operation efficiency becomes worse in Lima.

When the trunk busway is constructed on Av. Venezuela and Carretera Central, conventional bus routes assigned on those roads must be rerouted by eliminating those which overlap with trunk bus lines. Twenty-two (22) lines/one-way, equivalent to 30% to the total bus lines, are eliminated from the conventional bus lines overlapped with the east-west trunk bus line. Instead of the elimination, 6 trunk bus lines/one-way and 20 feeder bus lines/one-way are prepared. The line length (14km/one-way) is shorter than the average conventional bus line. The integration of the route will improve the trunk bus operation efficiency. At the same time, the integration of the route influences to bus users at first, and then gradually satisfies sooner or later.

3) Impact of Reformulation of Bus Operating Company

The operation of trunk bus system, which can offer high performance and special operational measures are required. It is necessary to consider a metropolitan transport management organization to be created or reformulated for the operation of the trunk bus system. The trunk bus system operating companies will propose a candidate trunk bus routes or lines in the trunk bus system under public bidding. Under the situation, the reorganization or consortium of the trunk bus operating companies will be reformulated. The large-scale companies and consortiums will be prepared in future and strengthened for financial condition.

At the present, the bus companies are forced to operate bus under keen competition with other companies. This means that the efficiency of bus operation become worse. The bus company is hard in management such as income and expenditure balance. Under the trunk bus system, since the new bus fare system is introduced, the bus driver does not scramble the passengers at bus stop. Therefore, the keen competition with other companies in the operation will disappear and a traffic safety will improve.

4) Impact of employees of bus company

The introduction of the east-west trunk bus system influences the employees of transport company. The drivers and conductors of bus fleets will lose their jobs due to the reduction of operating buses. The number of employees influenced by the elimination of 22 bus lines/one-way is approximately 1,000 people. However, in order to accomplish high performance in the trunk and feeder bus system, an efficient ticketing system is needed. There is off-board ticketing system as an intelligent ticketing system. It offers the possibility to reduce passenger service time and thereby to reduce bus dwelling time and increase commercial speed.

The ticketing system proposes to sale the ticket at shops outside a bus fleet such as kiosks, newspaper stands, and bus stop. The system will need a ticket examiner at bus stop whose facility provides the ticket gates and ticket window to divide passengers and others. The new system needs a reshuffling of personnel according to the operation system. It is indispensable to shifts excess personnel of drivers and conductors to new working

positions. Since the new organization of the trunk bus system needs about a total of 1800 employees, the loss and hire of employees will be balanced.

5) Impact of preparation of a feeder bus route for poor people

In the proposed trunk and feeder bus system, the feeder bus service is indispensable. Especially, a feeder bus network and a fare rate system for a poor people are an important issue according to result of the poor people survey carried out in the study.

According to the survey, the travel of the poor people within walking distance is done by walking, not use other modes because of fare rate and poor bus route. The walking distance is longer than other people. The demand for the bus transport is mainly two: one is to improve bus route and the other is to be fare problem. Therefore, the proposal for the poor people is two: one is to prepare the feeder bus route network to answer their demand, and the other is to propose a lower fare rate of feeder bus.

In the feasibility study, the feeder bus lines are prepared in Callao, Santa Clara and Huaycan. The analysis of the feeder bus network system shows that a minimum bus network service needs to prepare the covered population ratio of 70% or more. Those areas serve the need for the network covered population ratio.

As for the fare rate system, the integrated fare system which allows transfer without payment of an additional fare when passengers transfer from/to feeder bus or trunk bus at terminal. The fare rate set at S./1.5. In the system, continuous use of trunk and feeder buses is precondition in the trunk bus system. The use of only the feeder bus is not assumed. The conventional bus service is prepared for this. When the feeder bus fare rate sets on S./0.5 or S./1.0, the conventional bus passengers are too many to operate a feeder bus. These conditions remarkably affect on the conventional bus operation and the conventional bus loses passengers to the feeder bus due to the lower fare rate. Therefore, it is obvious that the lower fare rate of the feeder bus is not acceptable in not only the conventional bus system but also trunk bus system.

(2) Indirect Effectiveness

1) Impact of employment by construction

The employment by construction for the projects will be promoted. Especially, the employment by construction and its material companies increase when the east-west trunk bus projects is implemented. Since the demand on the construction workers increases as an economic measure against poor people, the unemployment problem will be alleviated.

The employment by the project construction is estimated. The construction cost in exclusive of land acquisition is estimated at US$ 28,945 thousands as shown in the section 7 of which approximately 10% of the construction are accounted for an unskilled labor. To convert the total unskilled cost to total numbers of unskilled labors, divided by monthly salary US$300, approximately 10,000 unskilled labors are forecasted. The administrated, engineer and office workers in the construction field are also estimated from the construction cost in the same manner and its workers are approximately 10,000. The total workers related to the project construction correspond to 20,000.

2) Impact of development of bus terminal

The east-west trunk bus projects construct bus terminals at Callao and Santa Anita. The construction of those facilities accelerates the development of commercial facility near those areas, and the employment of service industry. The area surrounding those facilities will be developed to residential area and population will increase, as well as travel demand will increase. As a result, the value of the property will rise.

6.7. INFLUENCE OF OTHER MASS TRANSIT PROJECTS (RISK ANALYSIS)

The demand on the east-west trunk bus lines is influenced by other mass transit projects. In this section, the influence of the following projects on the east-west trunk bus demand is analyzed. The passenger demands on east-west trunk bus lines affected by these projects will be forecasted.

- COSAC
- Railway line-1 project between Villa el Salvador and Av. Grau.
- Railway line-2 project between Garibaldi in Callao and Via de Evitamiento

6.7.1. NETWORK CASES

Table 6.7-1 shows network project cases. The impact case-1 is the project case which includes the EW trunk bus, COSAC and Railway Line-1, each under the separated fare system. The impact case-2 consists of the same projects but with the integrated fare system between the EW trunk bus and COSAC.

As for both the impact cases-3, the Railway Line-2 is included under the same separated fare system.

Table 6.7-1 Network Project Cases

Case	Base Case	Impact Case-1	Impact Case-2	Impact Case-3
Fare System between Projects		Separated Fare System	Integrated Fare System	Separated Fare System
EW Trunk Bus Project	○	○	○	○
COSAC Project	-	○	○	○
Railway Line-1	-	○	○	○
Railway Line-2	-	-	-	○

6.7.2. PASSENGER DEMAND ON OTHER MASS TRANSIT PROJECT

Table 6.7-2 and Figure 6.7-1 show the total number of bus passengers in the morning peak hour by the projects. This figure indicates that when a passenger uses both the mass transits in one trip, the passenger is counted into both, i.e., “EW trunk bus line” and “COSAC line”.

The total number of passengers on the east-west line varies from approximately 40,000 to 65,000 passengers/hr. COSAC’ passengers range from 95,000 to 112,000 passengers/hr. Railway Line-1 takes approximately 68,000 passengers/hr.

Under the separated fare system, the number of passengers on the EW line in the impact case-1 is somewhat higher than that in the base case-1. On the integrated system, the passengers on the EW Line and COSAC rise considerably. The passenger increase ratios on the EW line and COSAC rise 1.4 and 1.2 times, respectively, in comparison with the separated case.

The Railway Line-2 is in competition with the EW trunk bus line. The construction of the Line-2 attracts passengers from the EW line. Its figure is 0.94 times in ratio of passengers compared to the impact case-1.

Table 6.7-2 Total Number of Hourly Bus/Railway Passengers by Project

Projects	Mode	Base Case-1	Impact-1	Impact-2	Impact-3
			Separated	Integrated	Separated
EW Line	Trunk Bus	41,064	46,449	65,492	43,713
COSAC	Trunk Bus	-	95,528	112,431	95,556
Railway Line-1	Railway	-	67,689	66,999	67,743
Railway Line-2	Railway	-	-	-	21,395
EW Line	Trunk Bus	1.00	1.13	1.59	1.06
COSAC	Trunk Bus		1.00	1.18	1.00
Railway Line-1	Railway		1.00	0.99	1.00

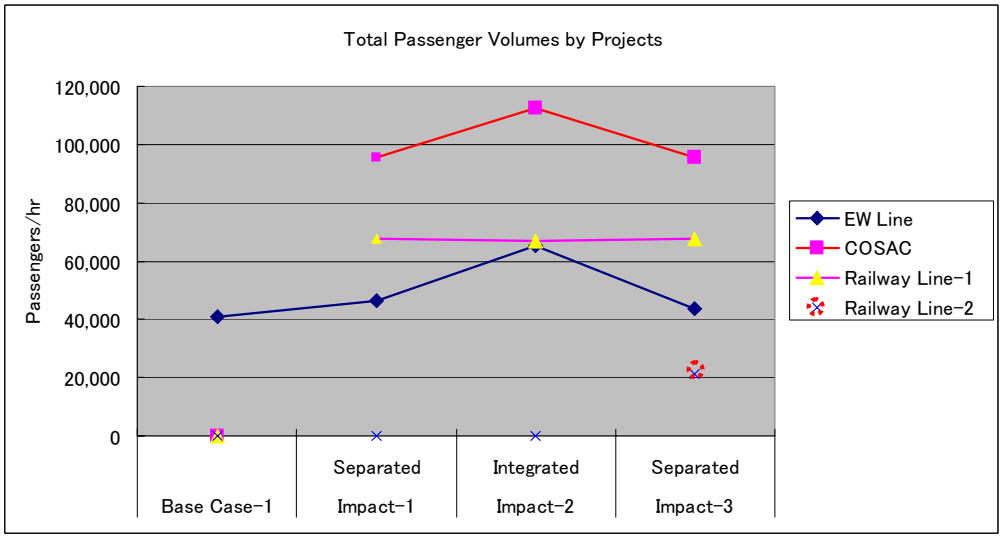


Figure 6.7-1 Total Passenger Volumes by Project

6.7.3. TOTAL PASSENGER VOLUMES TRANSFERRED TO/FROM COSAC

Table 6.7-3 shows total passenger volumes which are transferred to/from COSAC by the cases. Under the separated fare system, the transferred passenger volumes are approximately 1,700 to COSAC and 1,400 from COSAC. On the integrated system, the volumes rise considerably at 10,100 and 16,000 passengers/hr to/from COSAC. The transferred volume depends on the fare system.

Table 6.7-3 Total Passenger Volumes Transferred to/from COSAC

Transfer	Impact-1	Impact-2	Impact-3
	Separated	Integrated	Separated
EW->COSAC	1,744	10,164	1,742
COSAC->EW	1,357	15,947	1,357

6.7.4. MAXIMUM LINE PASSENGERS ON OTHER MASS TRANSIT PROJECTS

Figure 6.7-3 through Figure 6.7-5 show the forecast of the passenger volumes by project. The numbers in the figure indicate passengers on board in the dual directions per morning peak hour. Table 6.7-4 and Figure 6.7-2 shows maximum line passengers in the inbound or outbound direction on the EW-trunk busway, COSAC, Railway Line-1 and Line-2 by the examination cases. The maximum line passengers on the east-west line vary between approximately 14,000 -20,000 passengers/hr/dir. COSAC' passengers are in a range between 27,000 and 33,000 passengers/hr/dir. Railway Line-1 is forecasted at

approximately 30,000 passengers/hr/dir. The number of passengers of Railway Line-2 in the impact case-3 is as low as 9,000 passengers/hr/dir.

In comparison between the impact cases, the maximum line passengers by the project show the same tendency as that of the total passengers of the projects.

Table 6.7-4 Maximum Line Passenger Volumes by Project

Projects	Modes	Base Case-1	Impact-1	Impact-2	Impact-3
			Separated	Integrated	Separated
EW Line	Trunk Bus	13,685	15,232	20,136	14,563
COSAC	Trunk Bus	-	27,017	32,782	26,938
Railway Line-1	Railway	-	30,971	30,951	31,028
Railway Line-2	Railway	-	-	-	9,284
EW Line	Trunk Bus	1.00	1.11	1.47	1.06
COSAC	Trunk Bus		1.00	1.21	1.00
Railway Line-1	Railway		1.00	1.00	1.00

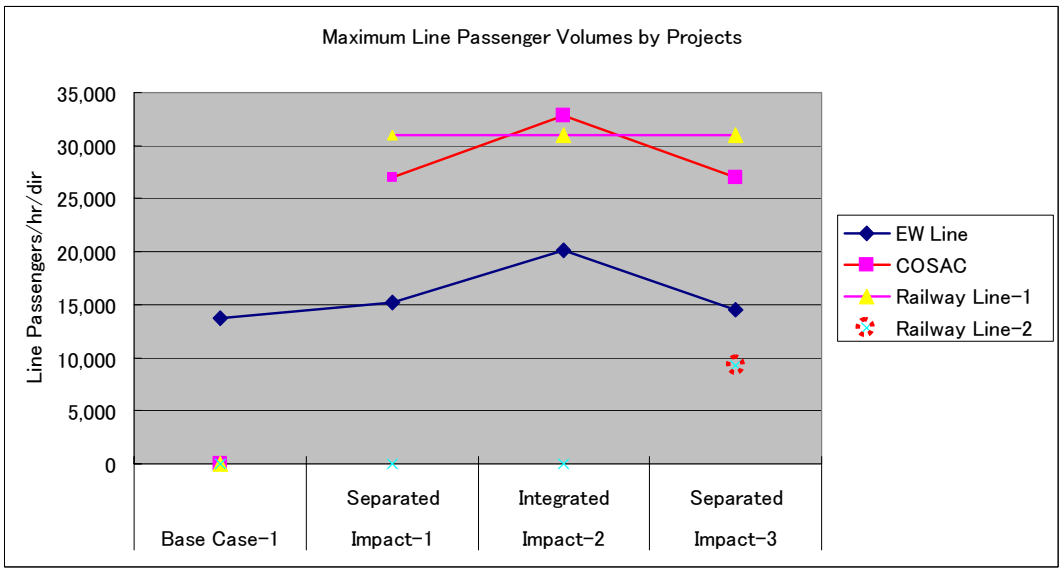


Figure 6.7-2 Maximum Line passenger Volumes by Project

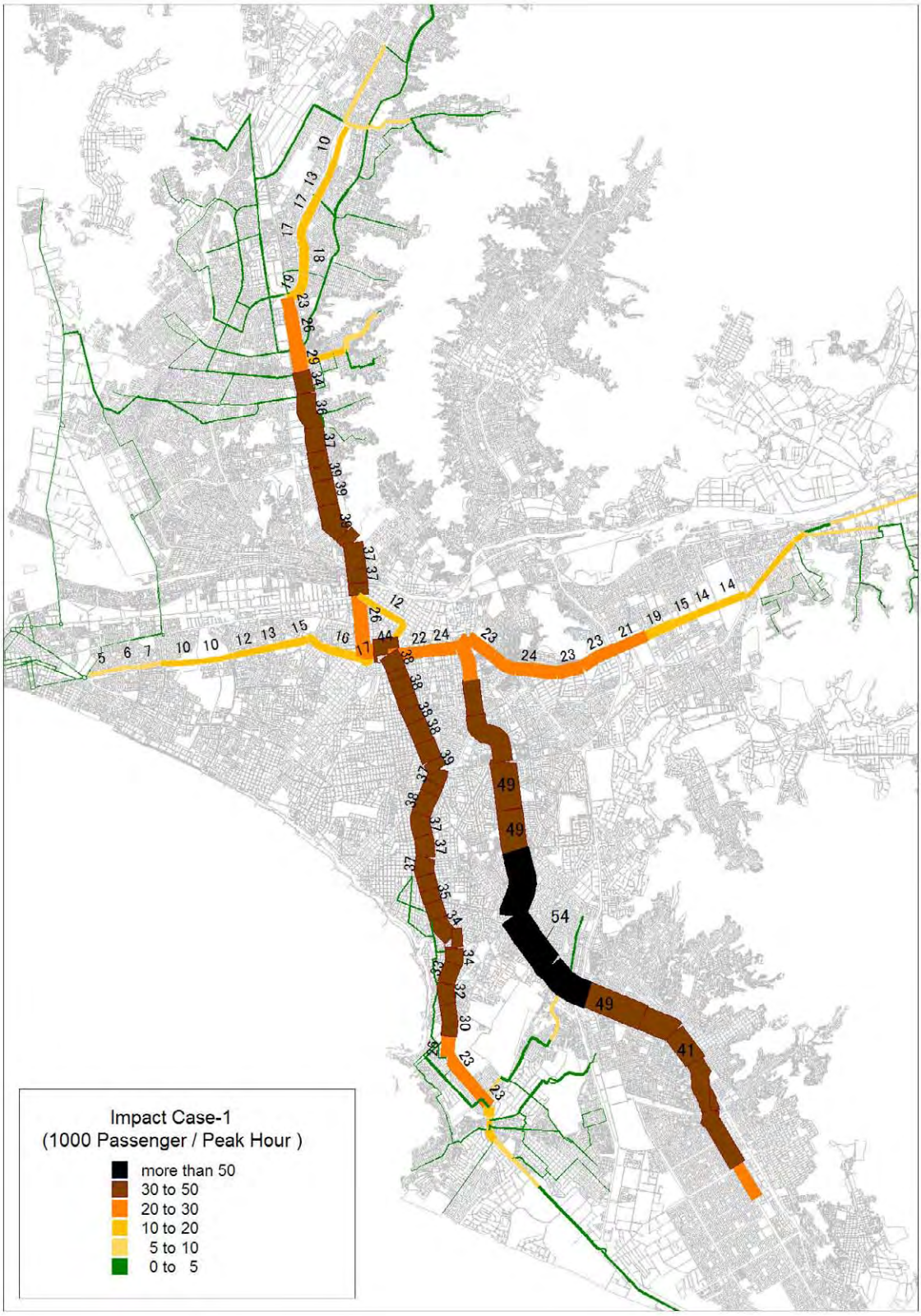


Figure 6.7-3 Trunk Bus and Railway Passenger Flows per Hour per Dual Directions in Impact Case-1

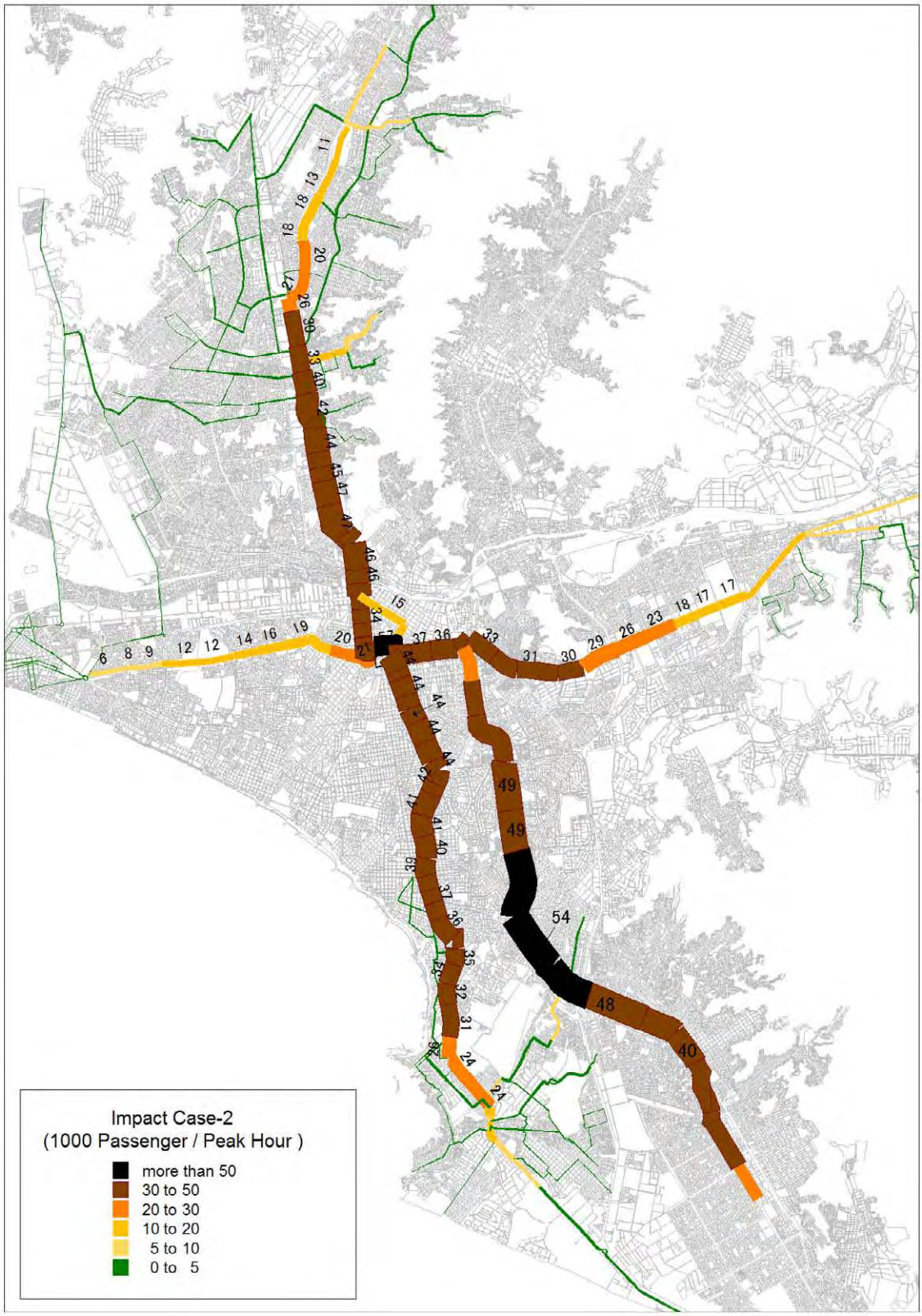


Figure 6.7-4 Trunk Bus and Railway Passenger Flows per Hour per Dual Directions in Impact Case-2

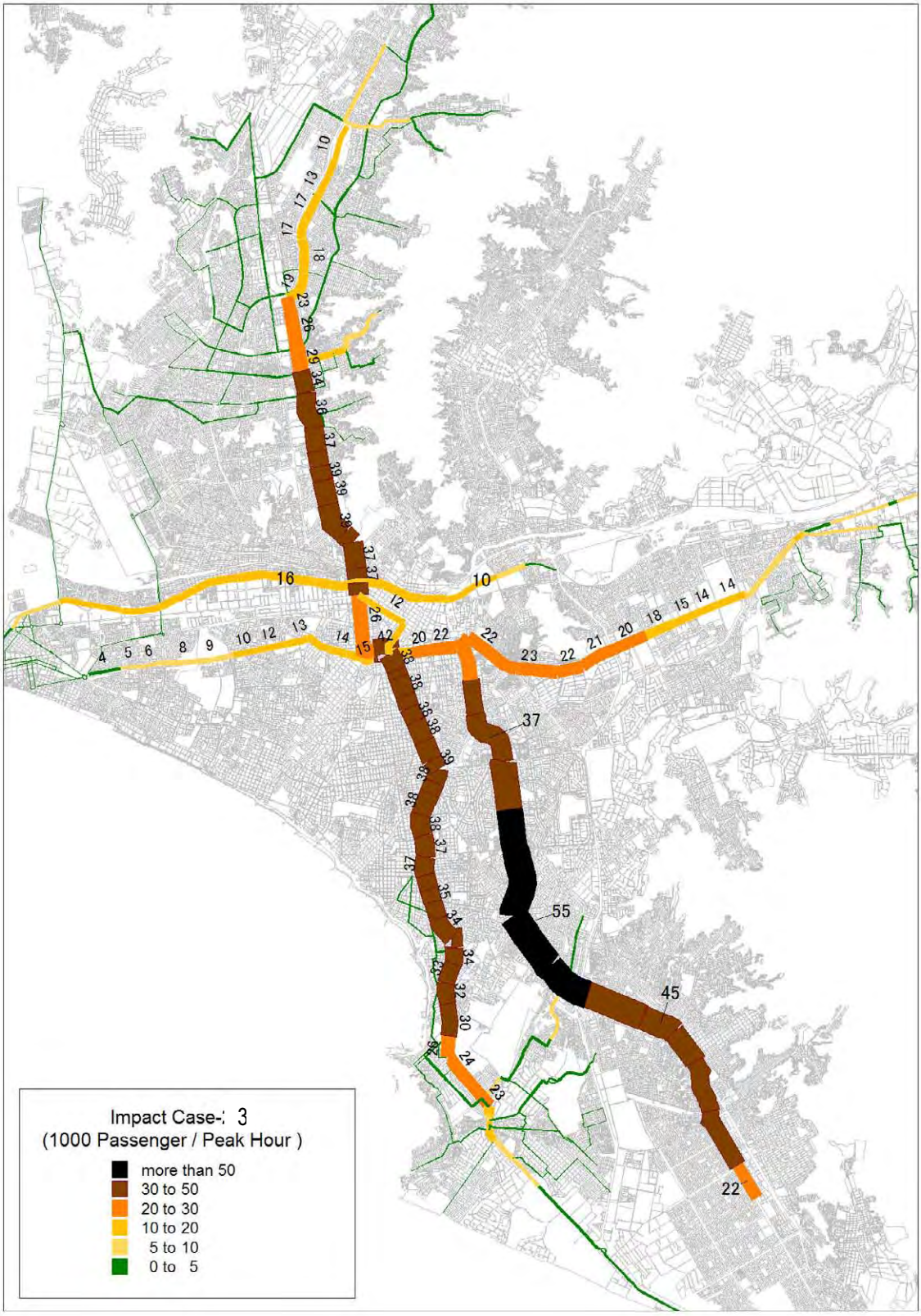


Figure 6.7-5 Trunk Bus and Railway Passenger Flows per Hour per Dual Directions in Impact Case-3

6.8. EAST-WEST TRUNK BUS OPERATION ORGANIZATION STRUCTURE

6.8.1. CURRENT (CONVENTIONAL) BUS OPERATION ORGANIZATION STRUCTURE

Based on the discussion with the Lima and Callao municipalities and the results of the bus company survey, the current bus operation organization system is as follows and organization structure is shown in Figure 6.8-1.

(1) Lima and Callao municipalities approve a bus operation route individually.

(2) Bus operation is controlled and instructed by each municipality.

(3) Conventional buses are operated by private bus companies.

(4) Private bus companies formed the following seven (7) organizations on a joint basis.

a) Vehicles only of the company

b) Vehicles only of the members

c) Vehicles only of a third party

d) Vehicles of the company and members

e) Vehicles of the company and third party

f) Vehicles of the members and third party

g) Vehicles of the company, members and third party

(5) Private bus companies can obtain bus operation route licenses through the concession system.

(6) Private companies are responsible for the bus operation

(7) Municipalities have responsibility for the maintenance and management of bus road infrastructures.

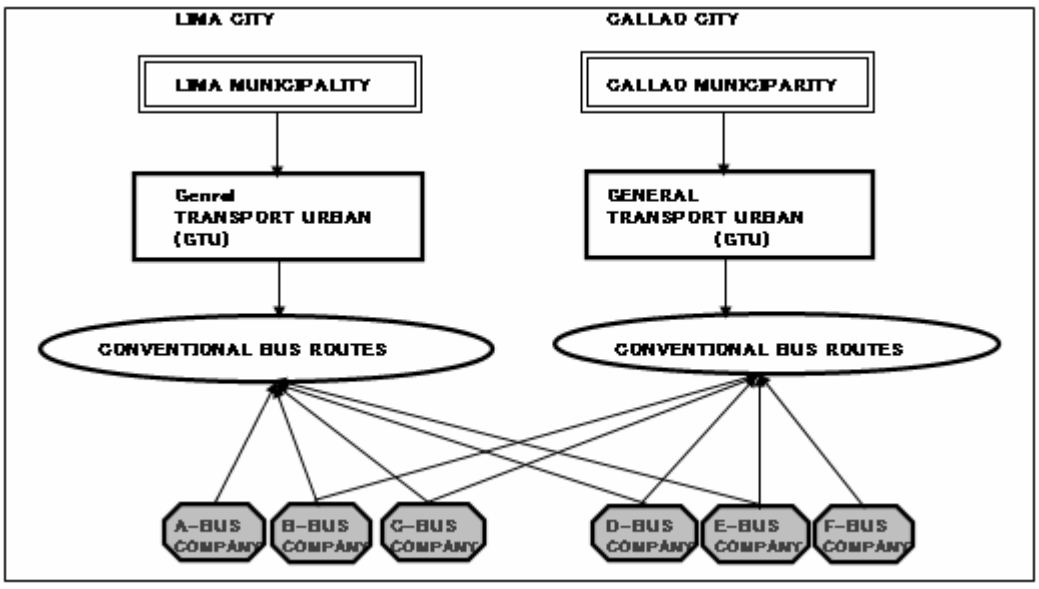


Figure 6.8-1 Conventional Bus Operation Organization Structure

6.8.2. OUTLINE OF PROPOSED TRUNK BUS OPERATION SYSTEM ON EAST WEST TRUNK BUSWAY

As mentioned in the previous section, the outline of East-West trunk bus operation systems is summarized as follows:

1) The bus system in the Lima and Callao metropolitan area is formed by the trunk bus, feeder bus, and conventional bus systems.
2) The East-West trunk bus system is formed by the trunk bus and feeder bus systems
3) However, the trunk bus and feeder bus are integrated at the bus terminal.
4) Trunk bus and feeder bus are not integrated at the bus stops.
5) Trunk bus and conventional bus are not integrated.
6) Trunk bus and feeder bus will be operated by private bus operating companies.
7) Licenses of trunk bus operation route will be obtained through the concession system prepared by Lima and Callao municipalities.
8) At present, the East-West trunk busway and COSAC trunk busway are not integrated. However, all trunk bus systems and conventional bus systems should be integrated in the future.
9) After construction of all of the trunk bus routes, the bus system in Lima and Callao metropolitan area will be formed by the trunk bus and feeder bus, and all conventional buses will be eliminated.

6.8.3. ALTERNATIVE OPERATION ORGANIZATION STRUCTURE

Considering the operation systems and the socio- economic characteristics of the Lima and Callao metropolitan area, the following two (2) alternative operation plans are identified.

(1) Alternative –A.

The functions and characteristics of these operating systems are as follows. The operation organization structure of Alternative-A is shown in Figure 6.8-2.

1) The Municipality is responsible for the operation and management of all bus systems including the trunk and feeder bus operation systems.
2) General operation and management of trunk buses and feeder buses are carried out by the cooperative private bus companies.
3) Cooperative bus companies are formed by groups of private bus operating companies.
4) The Cooperative bus company collects the bus fares of all of the trunk bus routes, and distributes the profits to the cooperative bus company members.
5) Trunk and feeder buses are operated by the same cooperative bus company.
6) Trunk and feeder buses of the same cooperative are integrated.
7) Conventional buses are operated by other private bus companies.
8) Conventional and the trunk buses are not integrated.
9) One cooperative company operates in the city.
10) The bus cooperative company is responsible for formulating the future bus development plans, implementation plan and budget procurement.

11) The bus cooperative company is responsible for the operation and management of the trunk bus system, as well as the collection of bus fare and distribution of profits to each bus company.

12) The Municipality should prepare and analyze the future development plans and implementation plans.

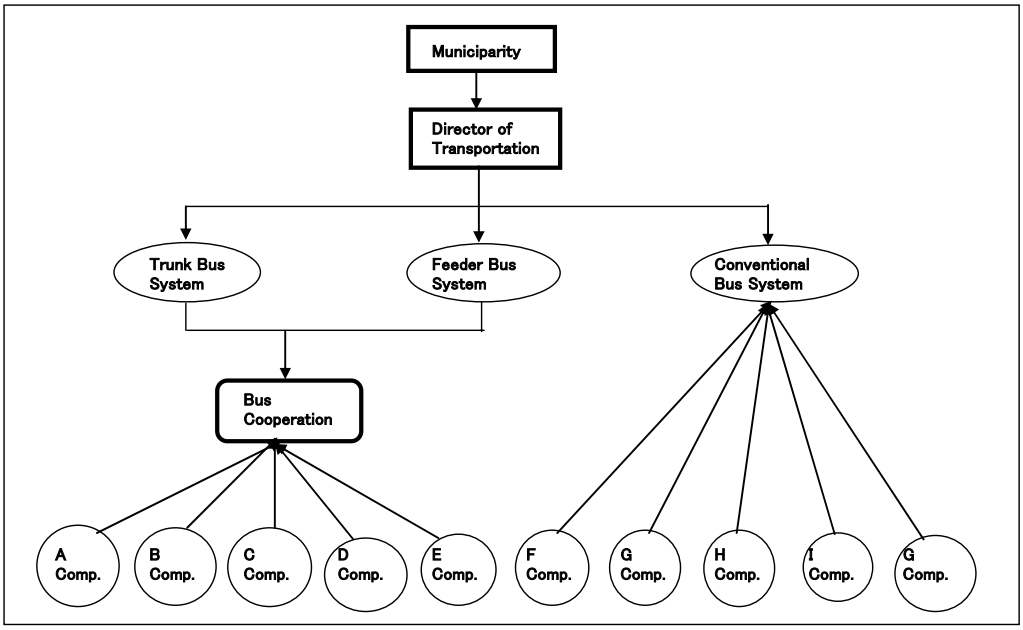


Figure 6.8-2 Operation Organization Structure of Alternative-A

(2) Alternative-B

The functions and characteristics of the operation systems are as follows. The operation organization structure is shown in Figure 6.8-3

1) The Municipality is responsible for the operation and management of all bus systems in the city.

2) The Municipality is responsible for approving the bus operation networks.

3) The bus system in the city is formed by the trunk bus and feeder bus systems.

4) A bus operation zone system is adopted.

5) Buses are operated by the private cooperative bus company in each bus operation zone.

6) Each bus operation zone will be divided into three (3) or four (4) zones, considering the characteristics of bus passenger trips and bus passenger demand.

7) The cooperative company in each bus operating zone is formed by several private companies.

8) The cooperative bus company is responsible for the operation and management of bus operations, as well as the collection of bus fares and distribution of profits to the each bus company.

9) Some cooperative companies operate in the city.

10) The cooperative bus company is responsible for formulating the future bus development plans, implementation plan and budget procurement.

11) The Municipality should be supported by the operation and management of the cooperative bus company.

12) Bus fare is adopted as a pool system among cooperative companies for each bus operation zone.

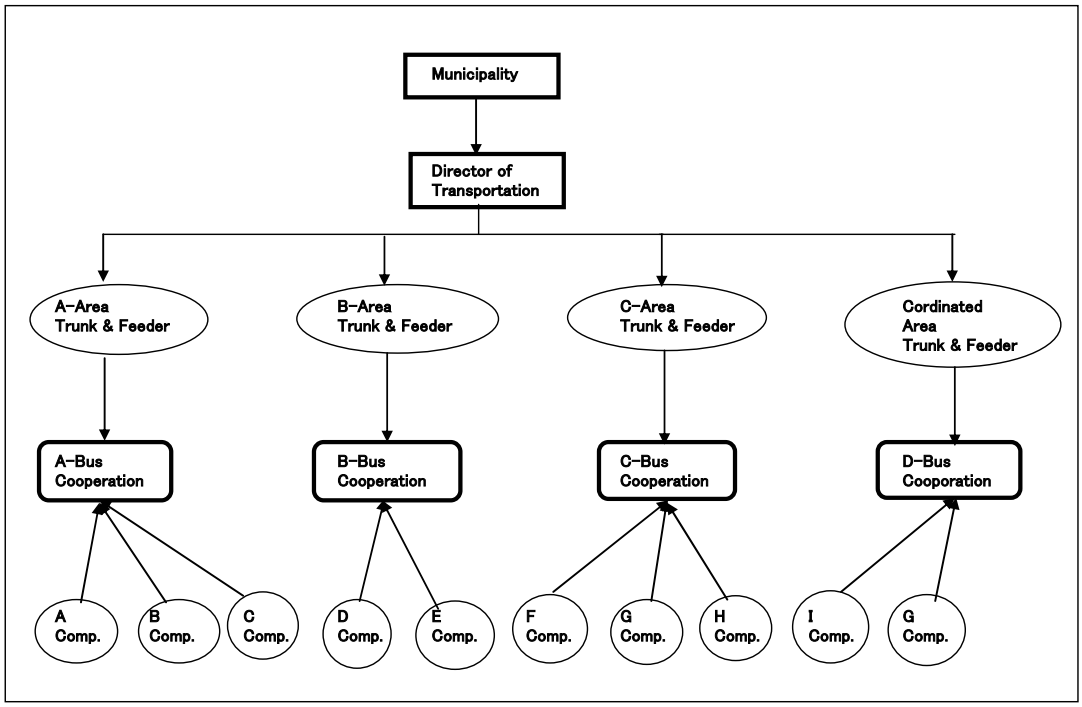


Figure 6.8-3 Operation Organization Structure of Alternative-B

(3) Advantages of Alternative-A

The following advantages of alternative-A are described.

1) All trunk and feeder buses in the city will be operated by one cooperative bus company, therefore, smooth and effective trunk and feeder bus operation systems can be expected.

2) All trunk and feeder buses in the city will be operated by the same cooperative company and, therefore, the implementation of the management and operation of the trunk and feeder buses will be easier.

(4) Disadvantages of Alternative-A

The following disadvantages of alternative-A are described.

1) Metropolitan Lima and Callao cover large areas, therefore, it is very difficult to establish one cooperative bus company.

2) In the future, many trunk bus routes will be constructed. In this case, the functioning and contracting of each bus company in the cooperative bus company should be reviewed and changed.

3) Depending on the type of cooperative structure, a number of people will lose their jobs. In addition, many companies will be incorporated into the cooperative company, therefore, it is very difficult to establish only one cooperative company.

(5) Advantages of Alternative-B

The following advantages of alternative-B are described.

1) The cooperative company will be established according to the increase in the trunk bus operation routes, therefore, it is comparatively easy to implement.
2) The cooperative company will be established according to the trunk bus construction, therefore, it is comparatively easy to implement.
3) Various cooperative bus companies will be established for each bus operation zone, therefore, management of the trunk bus system is comparatively easy.

(6) Disadvantages of Alternative-B

The following disadvantages of the alternative-B are described.

1) Depending on the type of conditions of the cooperative company, some people will lose their jobs.
2) Various cooperative companies will be established, therefore, various trunk bus systems will be expected in the Lima and Callao metropolitan area.

(7) Selection of Alternative

As mentioned above, there are many advantages and disadvantages to both Alternative-A and Alternative-B. In addition to the above mentioned alternative study, three (3) meetings of stakeholders were held during the F/S study, including the existing bus operating companies, however, no concrete decision was arrived at during said meetings, because this study is only at the feasibility stage. The detailed operation organization study should be conducted in the final design stage as soon as possible.

Considering the above mentioned conditions, and characteristics of the existing bus operating companies in Lima and Callao metropolitan area, alternative-B is suggested in this Study as the temporary stage. However, after completion of all the trunk bus routes recommended by the Master Plan of Urban Transportation in Lima and Callao metropolitan area, alternative–A is suggested to ensure the implementation of a smooth and effective trunk bus system. Therefore, a more detailed investigation should be carried out in future, with the existing bus operating companies and related bus operation authorities.

6.8.4. SUGGESTED TRUNK BUS OPERATION ORGANIZATION STRUCTURE

(1) Organization Structure

Based on the results of the alternative study, the trunk bus operation organization of the East-West trunk bus system is suggested as follows. The organization structure is shown in Figure 6.8-4 and the detailed organization structure is shown in Figure 6.8-5.

1) Lima and Callao municipalities are responsible for the general operation and management of all the bus systems, such as trunk bus, feeder bus, and conventional bus system.
2) Protransporte is responsible for the general operation and management of the trunk bus and feeder bus system in the Lima and Callao metropolitan area.
3) The actual operation and management of the trunk bus and feeder bus is performed by the cooperative bus company.
4) The cooperative bus company is formed by several private companies.

5) The actual operation and management of conventional buses is performed by the private bus companies.

6) At present, the East-West trunk bus and COSAC trunk bus are not integrated, however, in the future, these trunk bus systems should be integrated.

7) The trunk bus and the conventional bus are not integrated.

8) The East-West trunk bus system is operated by the cooperative bus company of the East-West bus.

9) COSAC trunk bus system is operated by the cooperative bus company of COSAC trunk bus.

10) In the future, these trunk bus systems will be operated by one cooperative bus company, and each trunk bus system should be integrated at the bus terminal and bus stop.

11) At present, the trunk bus, feeder bus, and conventional bus are operated in the Lima and Callao metropolitan area, however, after construction of all the trunk bus routes, only trunk and feeder buses will operate, and all conventional bus routes will be eliminated.

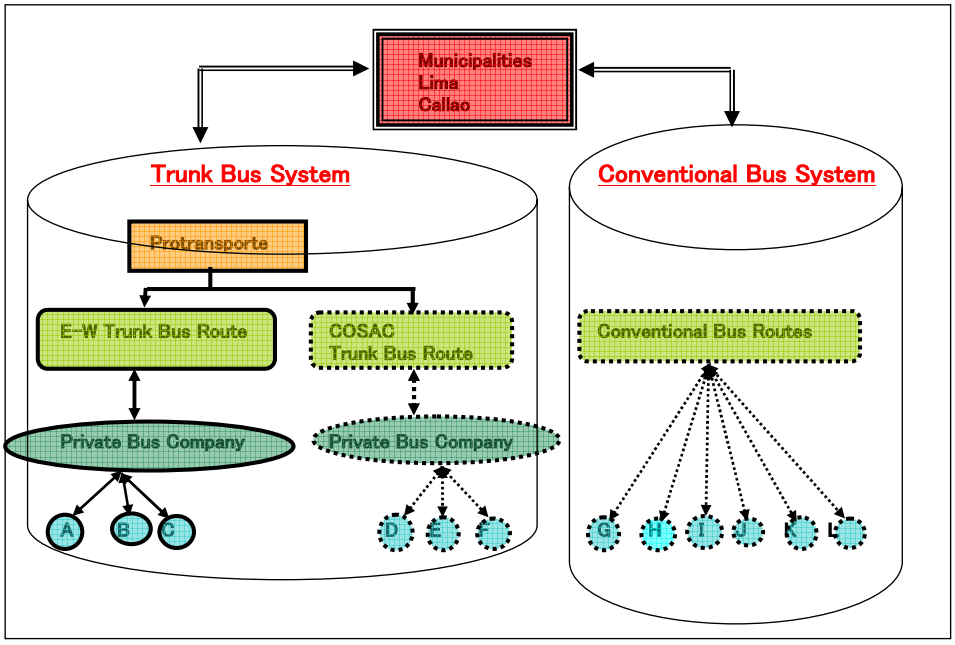


Figure 6.8-4 Organization of the Overall Bus Operation System

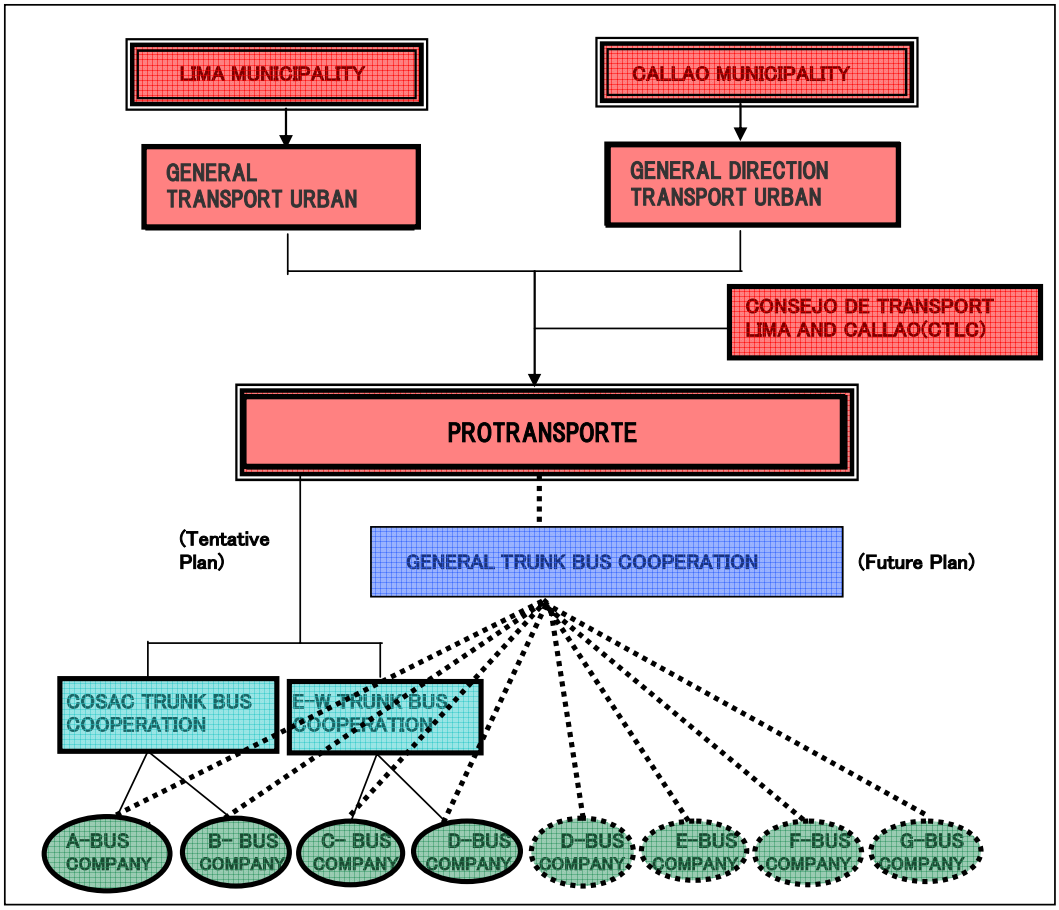


Figure 6.8-5 Organization of Trunk Bus System

(2) Conditions of Municipalities

1) Execution Organization within Municipalities

As mentioned previous, the existing bus in Lima city and Callao city are operating by private bus companies under controlled by General Transport Urban of Lima Municipality and General Direction Transport urban of Callao Municipality respectively.

Considering the existing organization of bus operation in Lima and Callao metropolitan area, the operation of East-West trunk bus should be controlled by General Transport Urban of Lima and General Direction of Callao.

2) Functions and Responsibility of Both Municipalities

Lima and Callao municipalities are required to take charge of the following functions and responsibility for the operation and management of the trunk bus system.

a) Prepare future trunk bus system development plans with Protransporte

b) To control the general operation and management of the trunk bus system.

c) Coordinate between Protransporte and cooperative bus companies.

d) Control and manage all of the bus system including trunk bus, feeder bus, and conventional bus systems.

3) Suggestions (Risks) of Municipalities

Both Municipalities have many experience of the control of the existing bus operation, however, they have not experience of the control of trunk bus operation. Therefore, the conditions should be reinforced to ensure the smooth operation of the trunk bus system.

a) Newly department for control the trunk bus system in General Transport Urban of Lima Municipality and General Direction Transport urban of Callao Municipality should be established.

b) Planner and engineer staffs for newly departments should be reinforced

c) Both Municipalities should be procured the budget for implementation of the new department.

(3) Conditions of Protransporte

1) Execution Organization in Protransporte

The organization of Protransporte was established by Lima Municipality for the implementation of trunk bus system. At present, Protransporte has responsibly for implementation of the COSAC trunk bus project. Considering the characteristics of Protransporte, the organization for the East-West trunk bus operation should be executed by Protransporte to ensure the smooth and rapid implementation of the East-West trunk bus project.

2) Functions and Responsibility of Protransport

Protransporte is required to take charge of the following functions and responsibility for the operation and management of the trunk bus system.

a) Prepare future trunk bus system development plans with municipalities and cooperative bus company.

b) Make decisions regarding trunk bus and feeder bus operation systems.

c) Control and manage all of the trunk bus systems including the feeder bus system.

d) Support a cooperative bus company.

e) Conduct the required technical engineering and field survey..

f) Maintain the trunk bus road and related facilities.

g) Promote the trunk bus system.

h) Construct the trunk bus and feeder bus-ways.

i) Examine laws and regulation for implementation of the trunk bus system.

3) Suggestions (Risks) of Protransporte

The COSAC trunk bus project has been developed by Protransporte, however, the construction of the COSAC trunk bus project is not commenced yet. In addition, Protransporte should be executed and responsible to implementation of the East-West trunk bus project as soon as possible. Considering these matters, the following conditions are suggested.

a) Newly department for promote and implementation of the trunk bus system in Protransporte should be established.

b) Planner and engineer staffs for newly departments should be reinforced

c) Protransporete should be procured the budget for the implementation of the newly department.

(4) Conditions of Cooperative Bus Company

1) Execution Organization of Cooperative Bus Company

In this study, a newly cooperative bus company is recommended for the execution and operation of the East-West trunk bus project. The newly cooperative bus company is recommended to ensure the organization as shown in Figure 6.9-1.

2) Functions and Responsibility of Cooperative Bus Company

The cooperative bus company is required to take charge of the following functions and responsibility for the operation and management of the trunk bus system.

a) Operate smooth, effective trunk bus and feeder bus systems.

b) Maintain a safe and comfortable trunk bus operation.

c) Prepare future trunk bus development plans with municipalities and Protransporte.

d) Manage and operate its own cooperative bus company..

e) Construct a management office, depot, and technical working office.

f) Employ the necessary administrative staff, bus operation staff and technical staff.

g) Coordinate with the cooperative bus company.

h) Collect bus fares and distribute profits to among member of cooperative bus companies.

3) Suggestions (Risks) of Cooperative Bus Company

When a newly cooperative company will be established, the following conditions should be ensured.

a) About 1,000 employees will be lost the jobs for the elimination of the conventional bus routes under recommendation of this East-West trunk bus project. Therefore, a newly cooperative bus company should employ about 1,000 jobless persons as firstly.

b) A newly cooperative bus company should conduct the traffic safety and traffic manner education to the employees before and during trunk bus operation.

c) A newly cooperative bus company should conduct the promotion about increase demand in the future.

d) A newly cooperative bus company should be maintained the good environmental aspects during operation of East-West trunk bus project.

(5) Responsibility of Local and Central Governments

In the financial analysis in Chapter 9 in this report, the various alternative cases based on the different execution organization are conducted. As a result of financial analysis, various execution cases or organizations can be established. Therefore, Local and Central Governments should decide the following conditions and strategies for execution of the East-West trunk bus project as soon as possible.

a) To make a decision about the project cost procurement.

b) To decide a execution organization, for instance, which organization has responsible for construction of trunk busway facilities, and operation of the East-West trunk bus system.
According to the COSA trunk bus project, Protransporte has responsible only for construction of busway and related facilities, and private bus company has responsible for operation and maintenance of trunk bus system.
Based on the condition of COSAC project and the results of financial analysis, the execution conditions of the East-West trunk bus project is desired to adopt the same conditions of COSAC project.

c) To decide a detailed condition of concession, for instance, environmental conditions of concession, tax exception, concession period, demand compensation, and so on.

d) To decide a supporting system to newly cooperative bus company, for instance, Government guarantee of credit loan of newly cooperative bus company for procurement of 400 new bus fleets. It is desired that Local and Central Government make a guarantee of credit loan of newly cooperative bus company for procurement of 400 bus fleets.

6.9. OPERATION AND MAINTENANCE (OM) COST ESTIMATE

6.9.1. CONDITIONS OF COST ESTIMATE

The operation and maintenance cost for the trunk bus and feeder bus system is estimated based on the following conditions and assumptions.

1) The operation and management of the East-West trunk bus system is carried out by only one cooperative bus company.
2) The trunk bus way facilities such as exclusive trunk bus way and related facilities such as bus terminals, bus stops, traffic signals, and traffic information signals are constructed by the municipalities.
3) Articulated bus and feeder bus fleets are prepared by the cooperative bus company.
4) Depots for bus maintenance, bus parking and administration offices are prepared by the cooperative bus company
5) The staff who inspect trunk bus and feeder bus operation and administration, depot, and drivers are employed by the cooperative bus company.
6) Articulated buses are operated by one driver without a conductor, however, the feeder buses are operated by one driver and one conductor.
7) About 150-170 persons (maximum capacity) of the articulated bus are required for the trunk bus system
8) About 35-40 persons (maximum capacity) of the single bus is required for the feeder bus system.
9) Operation and management of the 21 trunk bus stops and 2 bus terminals are performed by the cooperative bus company.

6.9.2. NUMBER OF EMPLOYEES REQUIRED AND PERSONNEL COSTS

(1) Organization of Cooperative Bus Company

Considering the functions and activities of the cooperative bus company, the following activities directors are required. The suggested organization structure is shown in Figure 6.9-1.

1) Chairman
2) Board of Directors (from each cooperative company)
3) Auditor
4) Advisor
5) Administration
6) Bus fare Accounting
7) Bus operation center
8) Maintenance
9) Depot
10) Bus Terminal

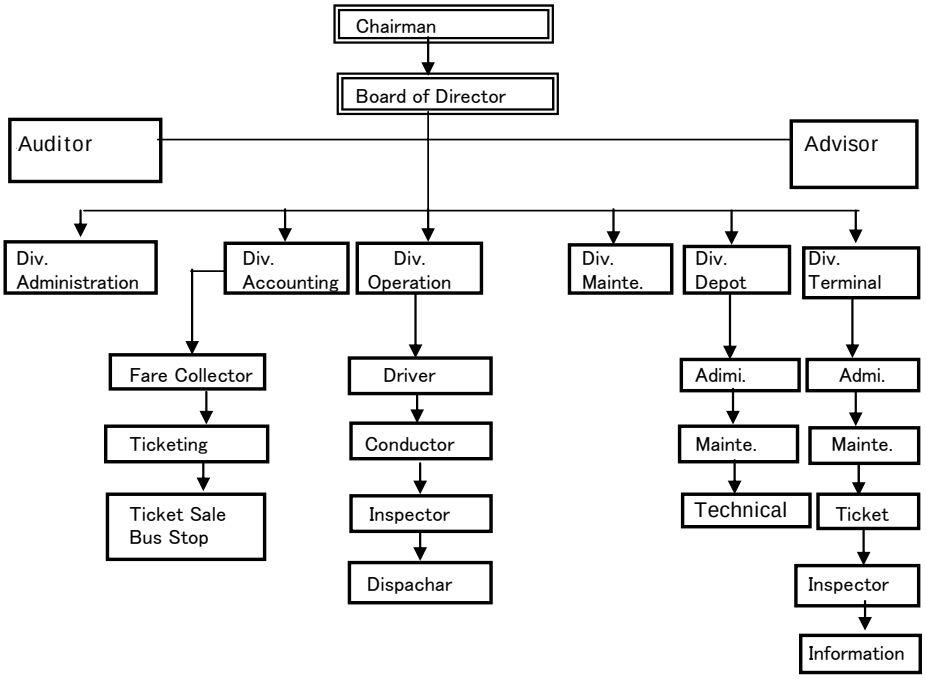


Figure 6.9-1 Suggested organization of Cooperative Bus Company

(2) Number of Employees Required in Cooperative Bus Company

The number of employees required for the cooperative bus company is estimated based on the organization structure and function and characteristics of each working division. A total of 1,803 employees is required, and the details are shown below in Table 6.9-1.

Table 6.9-1 Number of Employees Required

Main Division	Section	Functions or Classifications	No. of Staff (Persons)
Headquarters			
	Chairman	----------	1
	Board Meeting	Feeder bus = 2 persons, Trunk bus = 3 persons	5
	Accounting Audit	----------	2
	Legal Adviser	----------	2
	Administration	----------	5
	Accounting	----------	5
	Ticketing	Preparation of ticket	5
	Operation Control	Control bus operation 5 persons * 2 shifts	10
	Technical	Planning, design, and maintenance	5
	Ticket Sales	46 bus stops* 2 shifts * 1.1 (trunk bus routes)	101
	Bus Inspector	Trunk and Feeder bus routes	10
	Driver	400 buses * 2 shifts * 1.1	880
	Conductor	300 buses * 2 shifts * 1.1	660
	Collection of bus fare	Collection of bus fares from bus stop ticketing points	6
	Sub-total		1,697
Bus Terminal (for 2-terminals)			
	Manager	2 terminals	2
	Deputy manager	2 terminals	2
	Administrative	2 * 2 persons	4
	Accounting	2 * 2 persons	4
	Maintenance	2 * 4 person	8
	Bus inspector	2 * 4 persons * 2 shifts	16
	Ticket Sales	2 * 2 persons * 2 shifts	8
	Information	2 * 1 person	2
	Sub-total		46
Depot (for 1 depot)			
	Manager	----------	1
	Deputy Manager	----------	1
	Administrative	----------	2
	Accounting	----------	2
	Maintenance	Maintenance of depot facilities	2
	Spare Parts	Supervision of bus fleets spare parts	2
	Technical Staff	25 persons * 2 shifts, maintenance of bus fleets	50
	Sub-total		60
Total			1,803

(3) Personnel Costs of Cooperative Bus Company

The personnel costs for operation and administration of the cooperative bus company is estimated based on the number of employees required. The results of personnel costs are shown in Table 6.9-2.

Table 6.9-2 Personnel Costs for Cooperative Bus Company

Department/Section	Unit	Quantity	Monthly Salary(US$)	Annual Salary(US$)
A. Headquarters				
A.1 Manager	Person	1	3,000	48,000
A.2 Deputy Manager	Person	5	1,500	120,000
A.3 Auditor	Person	2	1,500	48,000
A.4 Advisor	Person	2	2,000	64,000
A.5 Administrative Dep.	Person	5	700	56,000
A.6 Accounting Dep.	Person	5	800	64,000
A.7 Ticketing Dep.	Person	5	400	32,000
A.8 Operation Dep.	Person	10	300	48,000
A.9 Maintenance Dep.	Person	5	300	24,000
A.10 Ticket Sales (Trunk)	Person	101	300	484,800
A.11 Ticket sales (Feeder)	Person	0	300	0
A.12 Inspector	Person	10	350	56,000
A.13 Driver	Person	880	300	4,224,000
A.14 Conductor	Person	660	300	3,168,000
A.15 Collector	Person	6	400	38,000
Sub Total	Person	1,697		8,475,200
B. Bus Terminal (2 Terminals)				
B.1 Manager	Person	2	1,000	32,000
B.2 Deputy Manager	Person	2	800	25,600
B.3 Administrative Dep.	Person	4	500	32,000
B.4 Accounting Dep.	Person	4	500	32,000
B.5 Maintenance Dep.	Person	8	400	52,200
B.6 Dispatcher	Person	16	300	76,800
B.7 Ticket Sales	Person	8	300	38,400
B.8 Guide	Person	2	300	9,600
Sub Total	Person	46		298,600
C. Bus Depot				
C.1 Manager	Person	1	1,000	16,000
C.2 Deputy Manager	Person	1	800	12,800
C.3 Administrative Dep.	Person	2	500	16,000
C.4 Accounting Dep.	Person	2	500	16,000
C.5 Maintenance Dep.	Person	2	300	9,600
C.6 Parts Dep.	Person	2	300	9,600
C.7 Engineer	Person	50	400	320,000
Sub Total	Person	60		400,000
Total	Person	1,803		9,173,800

6.9.3. FACILITIES AND EQUIPMENT COSTS

The cost of the operating facilities and equipment of the cooperative bus company is estimated based on the working items to be provided for the smooth and efficient functioning of the trunk bus system. The items and costs of the facilities and equipment needed are shown below in Table 6.9-3.

Table 6.9-3 Facilities and Equipment Costs

Cost Items	Class	Unit	Quality	Unit Cost (US$)/month	Cost/Year (US$)
A. Headquarters					
A.1 Office Rent	500m2	m2	500	5	30,000
A.2 Office Expense	0.5% of Personnel Cost	vol.	0.005	331,700	19,902
A.3 Miscellaneous	0.1% of Personnel Cost	vol.	0.001	331,700	3,980
A.4 Maintenance	0.2% of Personnel Cost	vol.	0.002	331,700	7,790
A.5 Others		vol.	1	10,000	120,000
Sub Total					181,672
B. Bus Terminal					
B.1 Office Rent	200m2*2	m2	400	3	14,400
B.2 Office Expense	0.5% of Personnel Cost	vol.	0.005	18,600	1,116
B.3 Miscellaneous	1% of Personnel Cost	vol.	0.01	18,600	2,232
B.4 Maintenance	5% of Personnel Cost	vol.	0.05	18,600	11,160
B.5 Others		vol.	1	10,000	120,000
Sub Total					148,908
C. Bus Depot					
C.1 Office Rent	2,000m2	m2	2,000	2	48,000
C.2 Land Rent	2Ha	ha	20,000	0.5	120,000
C.3 Machine Rent		vol.	1	2,000	24,000
C.4 Office Expense	0.5% of Personnel Cost	vol.	0.005	13,000	780
C.5 Miscellaneous	1% of Personnel Cost	vol.	0.01	13,000	1,560
C.6 Maintenance	5% of Personnel Cost	vol.	0.05	13,000	7,800
C.7 Spare Parts	2% of Vehicle Cost	vol.	0.02	2,466,666	592,000
C.8 Tires	US$59/1,000km	vol.	625,000	59/1,000	442,500
C.9 Others		vol.	1	10,000	120,000
Sub Total					1,356,640
Total					1,687,220

6.9.4. BUS FLEET OPERATION COSTS

The bus fleet operation costs of the articulated buses for the trunk bus system and the single buses for the feeder bus system are calculated based on the following conditions and assumptions. The bus fleet operation costs are summarized below in Table 6.9-4.

1) The daily operating distance of the trunk and feeder buses is adopted at 200km.
2) The annual number of operating days per year is adopted at 330 days.
3) The numbers of articulated and single buses per day are adopted at 80% and 50%, respectively, of the number of buses operated at peak hours.
4) The gasoline consumption of articulated and single buses are adopted at 1.6 km/ liter and 4.1 km/liter, respectively.

5) The oil consumption of articulated and mini buses is adopted at US$30/month / Bus and US$ 16/month / Bus.

Table 6.9-4 Bus Fleet Operation Costs

Cost Items	Classification	Unit	Quality	Unit Cost (US$)	Cost/Year (US$)
A. Articulated Bus Fleet	200km/day				
	100 *0.8 = 80 Fleets				
	330 days				
	1.6km/liter				
A.1)Fuel	200*330/2*100	liter	3,300,000	0.85	2,805,000
A.2) Oil	30*100*12	liter	36,000	10	360,000
A.3) Insurance	100	Vehicle	100	480	48,000
A.4) Tax & Others	100	Vehicle	100	902	90,200
Sub Total					3,303,200
B. Feeder Bus Fleet	200km/day				
	300*0.5=150 Fleets				
	330 days				
	4.1km/liter				
B.1) Fuel	200*330/4.1*150	liter	2,414,634	0.85	2,052,439
B.2) Oil	16*300*12	liter	57,600	10	576,000
B.3) Insurance	300	Vehicle	300	270	81,000
B.4) Tax & Others	300	Vehicle	300	410	123,000
Sub Total					2,832,439
Total					6,135,639

6.9.5. ANNUAL OPERATION AND MAINTENANCE (OM) COSTS

The annual operation and maintenance costs for operation of East-West trunk bus system are summarized in Table 6.9-5. On the other hand, the annual maintenance cost for the trunk bus-way facilities is adopted at 5.0 % of the total construction cost of the trunk bus-way.

Table 6.9-5 Annual Operation and Maintenance (OM) Costs

Items	Classification	Annual OM Costs (US$)
1. Personnel Cost	Manager, Driver, Inspector, etc.	9,173,800
2. Facility & Equipment Cost	Office, Depot, etc.	1,687,220
3. Operation Cost	Fuel, Oil, etc.	6,135,639
Total		16,996,659

6.9.6. BUS FLEET PROCUREMENT COSTS

The bus fleet procurement costs are estimated based on the number of bus fleets required and the following conditions and assumptions. The results of the procurement costs are summarized in Table 6.9-6.

1) In the previous section, the number of bus fleets was estimated based on the bus passenger demand.
2) The new articulated bus fleets are adopted for the trunk bus system with effect from the beginning of operation.
3) The new single bus fleets are adopted for the feeder bus system with effect from the beginning of operation.
4) The conventional bus fleets do not operate on the trunk and feeder bus systems.
5) The East-West trunk bus-way will be constructed by the end of 2010, and the trunk bus system will commence operation at the beginning of 2011.
6) The new bus fleets will be in operation for a period of 10 years. Upon completion of that period, the buses will be replaced by new bus fleets.
7) The cost of articulated and single buses are adopted at US$ 220,000 per articulated bus fleet and US$ 100,000 per single bus fleet, respectively.
8) The number of buses procured will be increased according to future projected demand.

Table 6.9-6 Bus Procurement Cost

(Unit: US$ 1,000)

Year	Trunk Bus System			Feeder Bus System			Total Cost
	No. of Buses	Unit Cost	Cost	No. of Buses	Unit Cost	Cost	
2010	100	220	22,000	300	100	30,000	52,000
2011	2	220	440	6	100	600	1,040
2012	2	220	440	6	100	600	1,040
2013	2	220	440	6	100	600	1,040
2014	2	220	440	6	100	600	1,040
2015	2	220	440	6	100	600	1,040
2016	2	220	440	6	100	600	1,040
2017	2	220	440	6	100	600	1,040
2018	2	220	440	6	100	600	1,040
2019	2	220	440	6	100	600	1,040
2020	100	220	22,000	300	100	30,000	52,000
2021	2	220	440	6	100	600	1,040
2022	2	220	440	6	100	600	1,040
2023	2	220	440	6	100	600	1,040
2024	2	220	440	6	100	600	1,040
2025	2	220	440	6	100	600	1,040
2026	2	220	440	6	100	600	1,040
2027	2	220	440	6	100	600	1,040
2028	2	220	440	6	100	600	1,040
2029	2	220	440	6	100	600	1,040
2030	100	220	22,000	300	100	30,000	52,000