社会開発協力部報告書

REPUBLIC OF THE PHILIPPINES

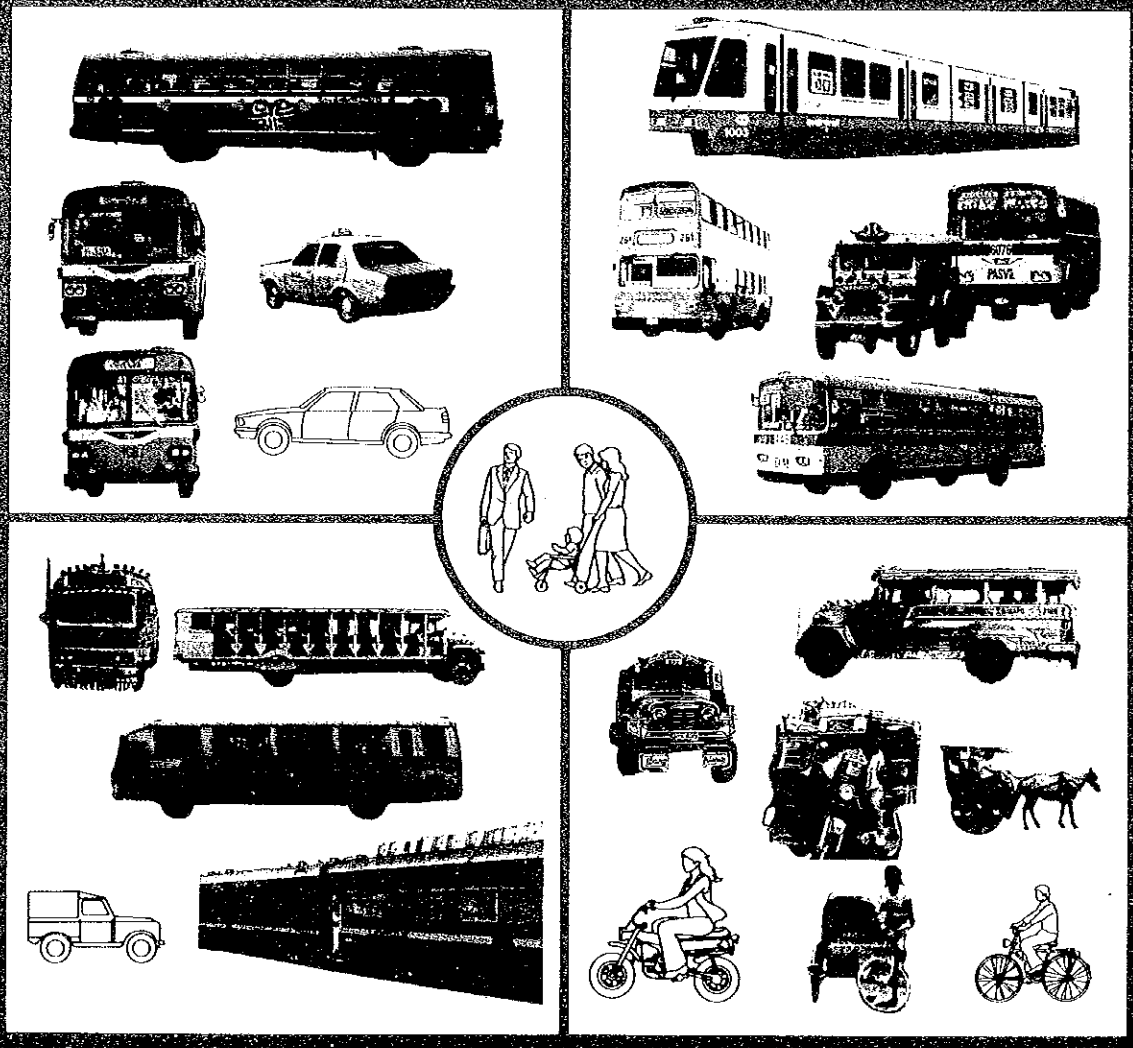
No. 18

THE METRO MANILA TRANSPORTATION PLANNING STUDY (JUMSUT)

FINAL REPORT

MAIN TEXT

PART I : Summary and Recommendations



March 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

SDF
-
84-026 (1/6)

JICA LIBRARY
1030488[9]

REPUBLIC OF THE PHILIPPINES

THE METRO MANILA TRANSPORTATION PLANNING STUDY (JUMSUT)

FINAL REPORT

MAIN TEXT

PART I : Summary and Recommendations

March 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

国際協力事業団
受入月日 '84. 5. 28
登録No. 10331
118
71
SDF

PREFACE

It is with great pleasure that I present this report entitled The Metro Manila Transportation Planning Study (JUMSUT) to the Government of the Republic of the Philippines.

This report embodies the result of the study which was carried out in Metro Manila Area, the National Capital Region, from November 1982 to March 1984 by the Japanese study team commissioned by the Japan International Cooperation Agency following the request of the Government of the Philippines.

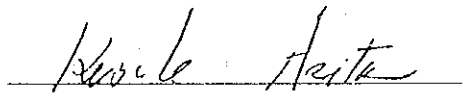
The study team, headed by Mr. Shizuo Iwata, conducted a series of surveys including various public transportation surveys, a formulation of transportation data base and a planning on the short-term public transportation rerouting program and associated facility improvement plans for the Light Rail Transit (LRT) corridor area.

Further, the study team and the supervisory committee, headed by Dr. Takeshi Kurokawa, Associate Professor of The University of Tsukuba, had a series of discussions in the course of the study with the officials concerned of the Government of the Philippines in order to orientate, smoothen and accelerate the study.

I sincerely hope that this report will be useful as a basic reference not only for the present transportation improvement of Metro Manila but also for the future development of its various transportation schemes.

I wish to express my appreciation to the officials concerned of the Government of the Republic of the Philippines for their close cooperation extended to the Japanese team.

March 1984



Keisuke Arita
President
Japan International Cooperation Agency

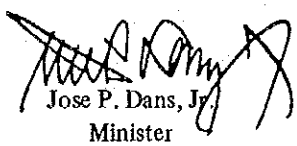
ACKNOWLEDGEMENT

The Ministry of Transportation and Communications is pleased to acknowledge receipt of The Metro Manila Transportation Planning Study (JUMSUT), undertaken by a Japanese study team through a technical cooperation grant from the Japan International Cooperation Agency (JICA). Said study, which commenced in November 1982, was aimed at providing the Ministry with the necessary transportation data base and planning scheme and associated facility improvement plans for the Light Rail Transit (LRT) corridor area.

The above study has been completed in a very satisfactory manner. It has, as well, effectively provided the transfer-of-technology to the Ministry local counterpart staff. As such, the study serves as another successful example of technical cooperation between the Governments of Japan and the Philippines. It is further worth noting that the JICA Supervisory Committee has provided the necessary guidance and impetus for the closer coordination of the JICA study team and the Ministry Steering Committee and Project Management Team.

This Ministry reiterates its appreciation and gratitude to the Government of Japan and looks forward to similar valuable undertakings in the future.

March 1984



Jose P. Dans, Jr.
Minister
Ministry of Transportation and Communications

MAIN TEXT PART I

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1. INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1. STUDY BACKGROUND AND OBJECTIVE

- The study was initiated at the request of the Philippine Government with the end-view of strengthening the data base and planning procedures required for various transportation planning programs and at the same time, to work out short-term public transportation plans/programs in relation with the completion of the currently on-going construction of the LRT.
- In accordance with the scope of work agreed upon between the governments of Japan and the Philippines, Japan International Cooperation Agency (JICA) dispatched a Study Team. The study started in October 1982 and the Draft Final Report was submitted in November 1983.
- The program of work submitted by JICA consists of the following four major tasks:

  1) **Transportation Data Base Management:**

     This task involves three sub-tasks:

     a) **Home Interview Survey (HIS) Analysis:** intends to complete the 1980 HIS done under MMUTIP where 25,000 household samples (2.5 percent of Metro Manila households) were collected, checked, and initially expanded but not fully analyzed.
     b) **Public Transport Surveys:** intend to provide the data for the jeepney/bus rerouting and associated physical improvement plans.
     c) **Formulation of MOTC Transportation Data Base:** intends to consolidate data collected and analyzed in the study in such a way that it will help MOTC to continuously update and effectively utilize the public transport data.

  2) **Transportation System Analysis:**

     This task aims to analyze the existing situation on urban transportation, particularly on public transport, and identify its characteristics, problems and causes on the basis of the analysis of the above data.

  3) **Transport Planning Procedures:**

     These intend to develop practical methods/procedures required for public transportation planning and to develop a pilot plan for training purposes. These involve the improvement of a public-transport assignment model called TRANSTEP.

  4) **Short-term Public Transportation Plans/Programs:**

     The objective is to formulate a jeepney /bus rerouting plan and come up with associated improvement plans for public transport facilities. It assumes that LRT Line No. 1 to be a part of the Metro Manila public transportation system.

- The overall study framework is shown in Figure 1.2

1.2 STUDY AREA

- Although the study area (Figure 1.1) is principally limited to Metro Manila (comprising 13 municipalities and 4 cities), adjacent areas of Metro Manila were also included in the public transport surveys for the following reasons:

  a) These areas are, in fact, already a part of Metro Manila in terms of daily activities and passenger movements.

b) Public transportation routes serving these areas are dense and extensive. They are being operated in such a way that they cannot be differentiated from the intra-city routes.

1.3 REPORT COMPOSITION

- This report consists of five (5) parts of Main Text and eight (8) Supporting Documents and Manuals. They are listed as follows:

A. MAIN TEXT

PART I : Summary and Recommendations

Chapter 1 Introduction
Chapter 2 Summary
Chapter 3 Recommendations

PART II : Metro Manila Public Transportation

Chapter 4 Metro Manila Socio-Economic Profile
Chapter 5 Metro Manila Overall Urban Transportation
Chapter 6 Metro Manila Public Transportation Characteristics

PART III : Planning

(III-A)

Chapter 7 Objectives and Framework of Short-Term Plan
Chapter 8 Public Transportation Route Planning
Chapter 9 Related Public Transportation Facility Planning
Chapter 10 Implementation Program
Appendix

(III-B)

Chapter 11 LRT Analysis
Chapter 12 Public Transportation Terminals
Appendix

PART IV : Transportation Data Base and Planning Procedures

Chapter 13 Urban Transportation Surveys
Chapter 14 Public Transportation Data Base Management
Chapter 15 Transportation Planning Procedures
Appendix

PART V : Home Interview Survey (HIS)

Chapter 16 HIS Survey and Analysis
Chapter 17 Travel Demand Characteristics (HIS Analysis Results)
Chapter 18 Model Analysis for Demand Forecasting
Appendix

B. SUPPORTING DOCUMENTS/MANUALS

No. 1: HIS Surveyor's Manual
No. 2: Public Transportation Survey Manual
No. 3: Micro Computer Transportation Planning Software Manual
No. 4: Transportation Planning Procedures Manual
-Public Transportation Traffic Assignment of TRANSTEP-
No. 5: Metro Manila Bus/Jeepney Route Inventory and Planning Data
No. 6: Metro Manila Bus/Jeepney Operation Characteristics Data
No. 7: Metro Manila Public Transportation Terminal Planning Data
No. 8: Metro Manila Socio-Economic Data

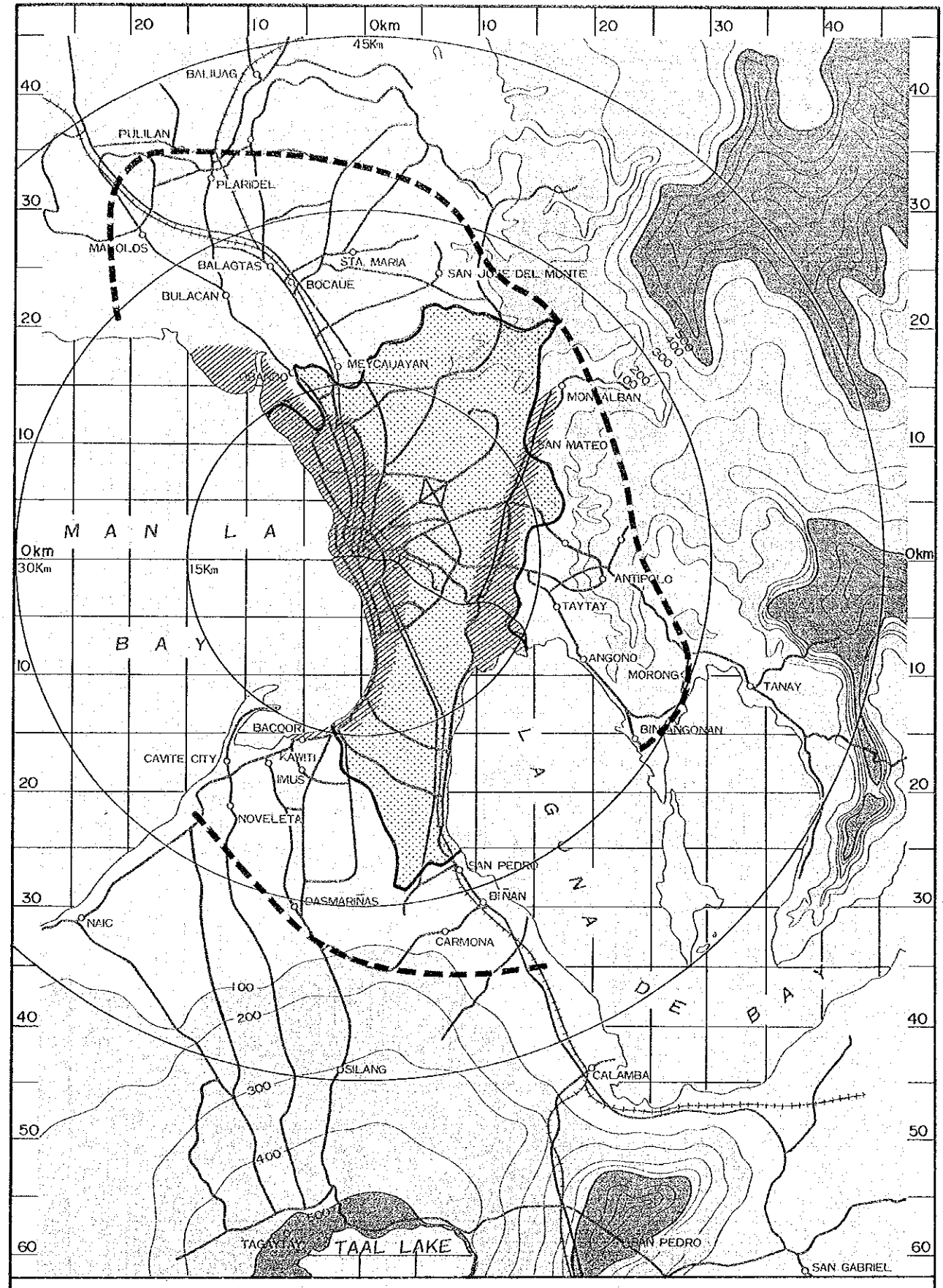
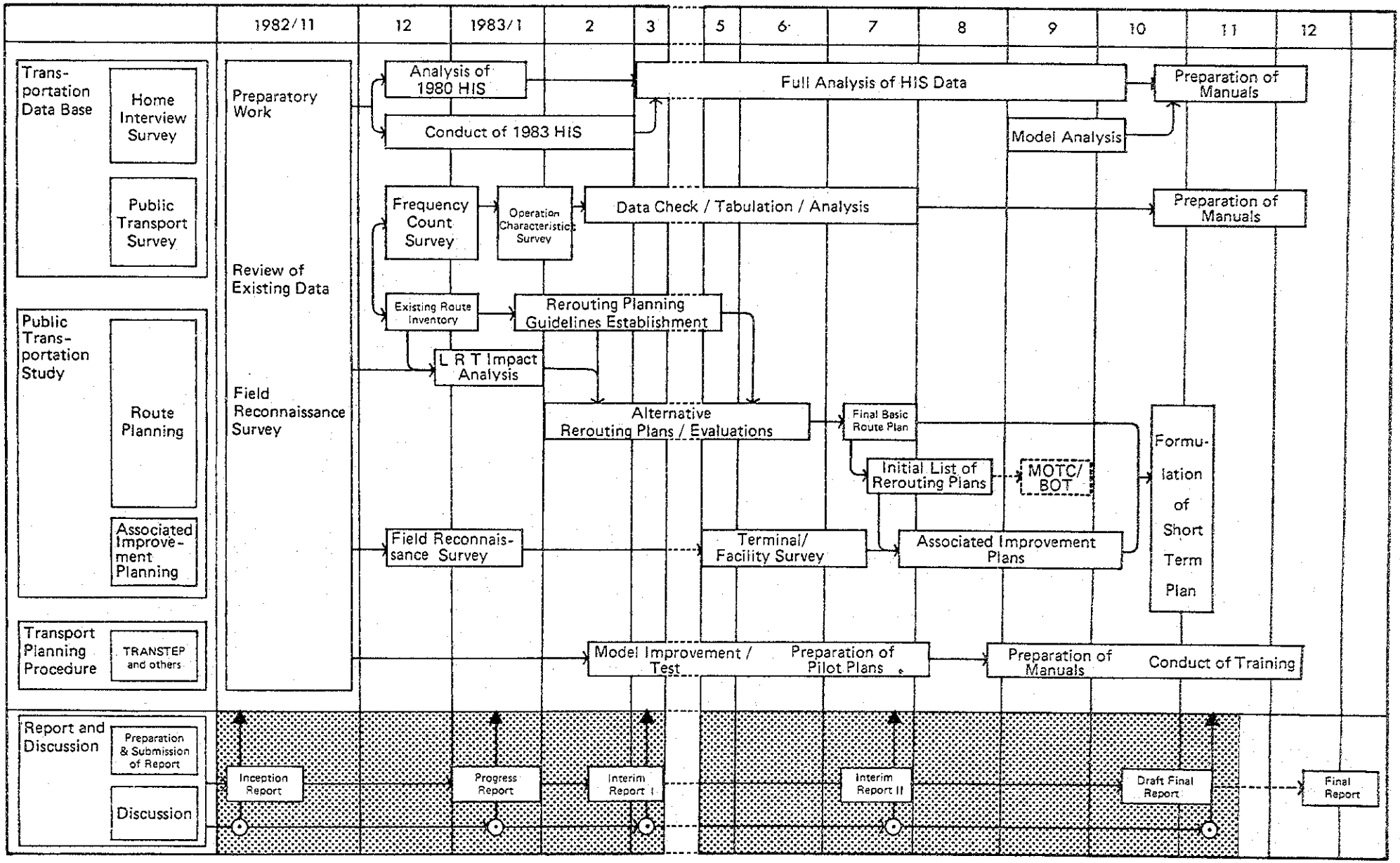


FIGURE 1.1 STUDY AREA

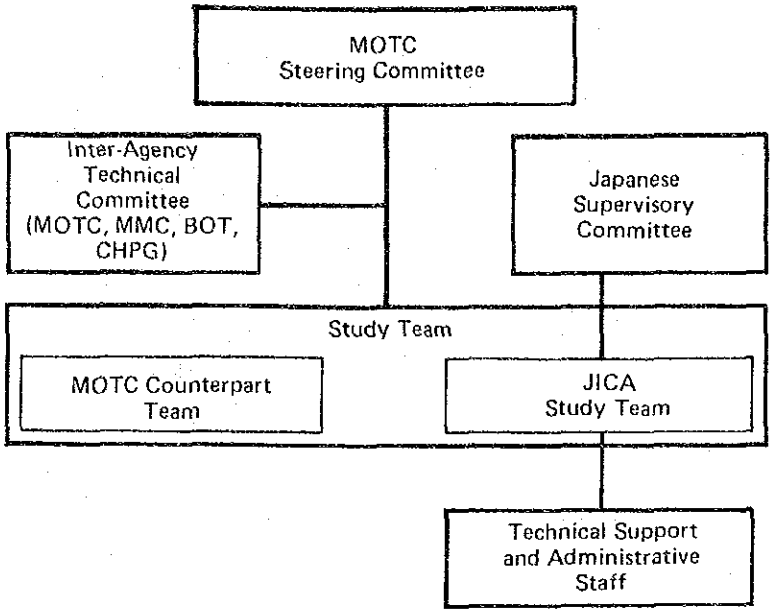
Figure 1.2
Overall Study Framework



1.4 PROJECT ORGANIZATION

- The study was conducted under the project organization shown below.

Figure 1.3
Project Organization Chart



- The members involved in this project are:

A. MOTC Steering Committee:

Minister Jose P. Dans, Jr.
Deputy Minister Jose P. Lavares, Jr.
Asst. Secretary Jose R. Valdecañas

B. Japanese Supervisory Committee:

Dr. T. Kurokawa	:	Associate Professor–TSUKUBA University
Dr. M. Asano	:	Ministry of Construction
Mr. S. Saso	:	Ministry of Transport
Mr. K. Satoi	:	Ministry of Construction
Mr. Y. Inagaki	:	Ministry of Transport
Mr. S. Mizuochi	:	JICA

C. Inter-Agency Technical Committee:

Mr. Conrado Dayrit, III	:	MOTC
Mr. Salvador Corteza	:	BOT
Ms. Evangeline Tablante	:	MMC
Mr. Robert Evaristo	:	BLT
Capt. Antonio Nañas	:	CHPG
Mr. Desmond Dent	:	MOTC
Mr. David Roberts	:	MOTC
Mr. Tohru Ida	:	MOTC

D. Study Team

JICA:

Mr. Shizuo Iwata	:	Project Manager
Mr. Takashi Shoyama	:	Public Transport Planner
Mr. Osamu Ohtsu	:	Transport Planner
Mr. Masahiko Nakayama	:	Systems Engineer
Mr. Susumu Furusawa	:	Transport Planner
Mr. Masato Kotoh	:	Transport Economist
Mr. Hiroshi Hotta	:	Traffic Engineer
Mr. Naoshi Okamura	:	Systems Engineer
Mr. Katsumi Imamura	:	Traffic Analyst
Mr. Shigeru Yagi	:	Traffic Analyst

MOTC:

Mr. Nicolas Acacio, Jr.	:	Project Manager
Mr. Honorio Vitasa	:	Deputy Project Manager
Mr. Ricardo Diaz	:	Chief, Land Transportation Planning Division
Mr. Nabor Gaviola	:	Chief, Land Transportation Planning Division (resigned)
Ms. Josephine Bondoc	:	Supervising Transportation Development Officer
Mr. Arnel Manresa	:	Senior Transportation Development Officer
Mr. Rafael Soro	:	Senior Transportation Development Officer
Mr. Bayani Tabajonda	:	Senior Transportation Development Officer
Ms. Cecilia Buhisan	:	Transport Development Officer II

SUPPORT STAFF (JAPAN):

Mr. Haruhiko Imai
Mr. Hiroshi Wakui
Mr. Jun Ishimoto

SUPPORT STAFF (MANILA):

Mr. Tetsuo Kidokoro
Ms. Merceditas Tuazon
Ms. Venetia Lynn Martinez

Chapter 2. SUMMARY

CHAPTER 2 SUMMARY

2.1 METRO MANILA PUBLIC TRANSPORTATION CHARACTERISTICS

2.1.1 Profile of Metro Manila

- Metro Manila covers an area of 636 square kilometers and comprises 4 cities and 13 municipalities. Its population of about 6 million people is increasing rapidly at a growth rate of 3.6 percent per annum. Constant pressure for development in Metro Manila has been spreading the actual Metropolitan area towards the adjoining areas in the north, east and south. The population in these areas is believed to have reached 1.3 million in 1980. (See Table 2.1)
- At present, the total length of roads in Metro Manila is approximately 2,800 kilometers. These roads are classified into national roads (790 kms.), provincial roads (164 kms.), city roads (1,118 kms.), municipal roads (533 kms.), and barangay roads (197 kms.). This administrative classification, however, does not necessarily match with the actual functional classification.
- The basic network of Metro Manila roads consists of radial and circumferential roads. A grand design of the ring and radial system was first adopted as early as 1945 in the Major Thoroughfares Plan, for the future development of the road network (which is composed of 10 radial and 6 circumferential roads of arterial standards). Many of the radial roads and a portion of the two innermost rings (C-1 and C-2) already existed then. EDSA (C-4) was considered to be the single, most influential development in the transportation system of Metro Manila. (See Figure 2.1)
- The distribution of household income and car ownership of Metro Manila residents indicates that 47 percent of the total households belong to the lowest group with an income of less than ₱1,000/month and who are totally dependent on public transportation or even walking. The second lowest group, with an average household income of ₱1,001 - ₱2,500/month, shares 38 percent; yet, 85 percent of them do not own cars. The middle income group receiving an average of ₱2,501 - ₱4,000/month shares only 8.4 percent of the total households; out of this, 37 percent own an average of 1.4 cars. Car-dependent households are those with an average household income of more than ₱4,000/month; 67 percent of them own an average of 2.1 cars (See Table 2.2).

Table 2.1
Socio-Economic Parameters of Metro Manila, 1980

Population (000 persons)	5,930
Population density (persons/ha)	93
Population growth rate (% year)	3.6
Ave. household size (persons/HH)	5.4
School Attendance (000 students)	
— Primary level	752
— Secondary level and above	795
Employment (000 persons)	2,007
Ave. household income (P/month)	1,152
No. of Vehicles registered[1] (000)	405

Source: Official Statistics and JUMSUT Surveys
[1]Includes 4-wheel driven vehicles only.

Table 2.2
Household Income Distribution and Car-Ownership, 1980

Household Income level (P/month)	% Distribution of Households[1]	Car-owing Households	
		Ownership Ratio (%)[2]	Ave. No. of Cars Owned
1,000 & less	47.0	3.1	1.0
1,001-2,500	38.0	15.2	1.1
2,501-4,000	8.4	37.2	1.4
4,000 & above	6.6	67.4	2.1
TOTAL	100.0	9.5	1.4

[1]estimated based on the 1980 HIS, 1983 HIS and NCSO data.
[2]% of car-owing households to total no. of households for each income group.

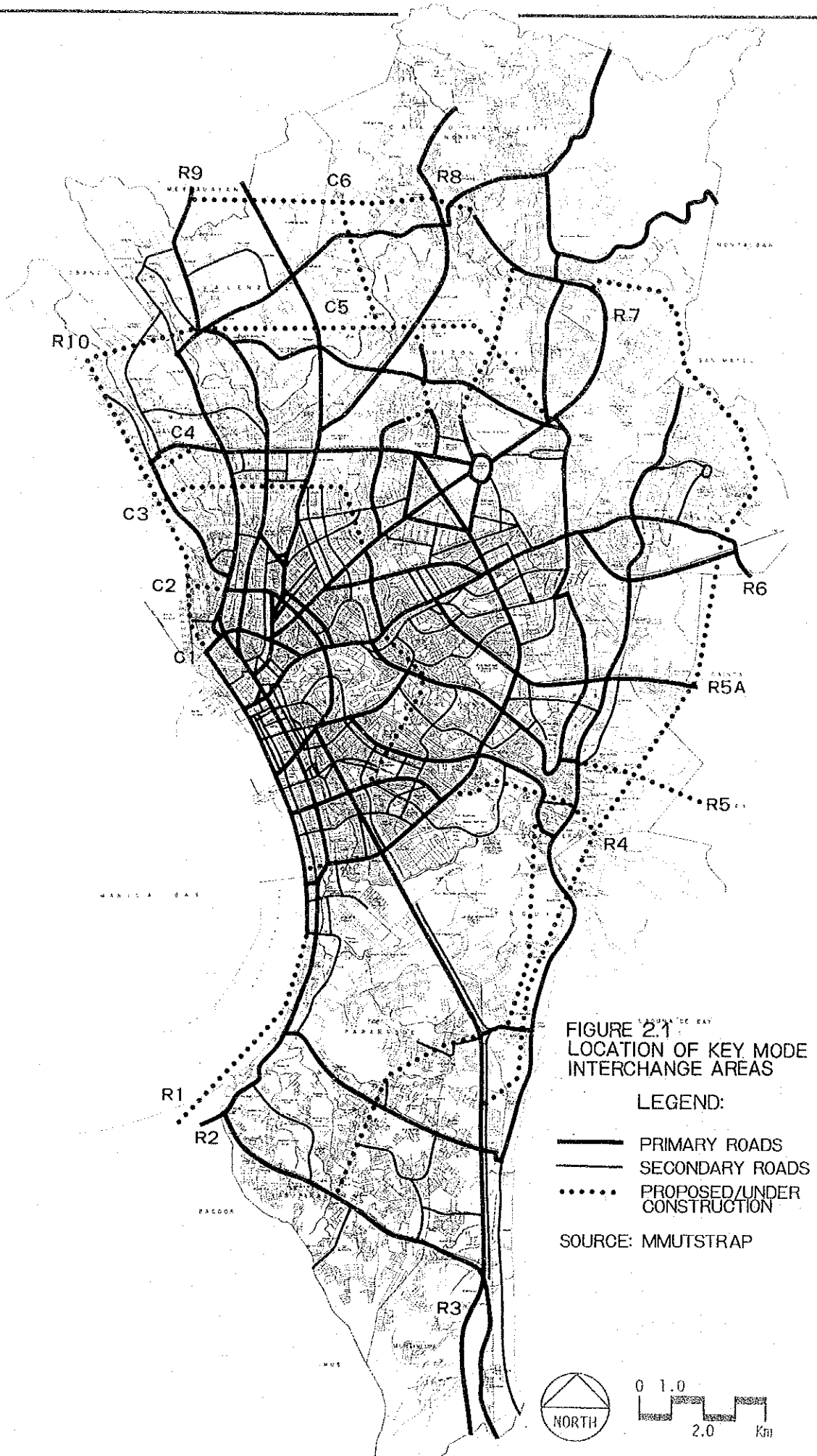


FIGURE 2.1
LOCATION OF KEY MODE INTERCHANGE AREAS

LEGEND:

- PRIMARY ROADS
- SECONDARY ROADS
- PROPOSED/UNDER CONSTRUCTION

SOURCE: MMUTSTRAP

2.1.2 Urban Transportation Demand and Traffic

- The total number of linked trips generated by Metro Manila residents (seven years old and above; 4,796,400 persons out of a total population of 5,926,000 in 1980) is estimated to be 10,633,000 per day excluding walk trips. The trip rate is, therefore, 2.2 trips per day per person.
- "To Home" trips share 47.9 percent of total trips followed by "to work" trips (18.1 percent), "to school" trips (16.3 percent) and "private" trips (13.5 percent); while the "business" or "at work" trips share only 4.2 percent.
- Total trips are classified into those using public transport modes (bus, jeepney, PNR, tricycle) and those by private modes (car/jeep, van/pick-up/truck, taxi). The former have a share of 74.4 percent or 7.9 million trips, while the latter, 25.6 percent or 2.7 million trips. Of the public transport modes, jeepneys share a significant portion of the total demand. This mode comprises 54.6 percent of the total demand or 73.4 percent of public transport demand. Forty percent of "business" trips are made by cars.
- Of the total trips, 77 percent are made by persons who belong to non-car-owning households and rely heavily on public transport, especially the jeepney. The remaining 23 percent are made by persons who belong to car-owning households and more than half of these trips are by private car. (See Table 2.3)

Table 2.3
Trip Composition by Mode and Car Ownership, 1980

Mode	Trips made by persons of car-owning households		Trips made by persons of non car-owning households		Total	
	000	%	000	%	000	%
Public	770	(32.0)	7,141	(86.8)	7,910	(74.4)
Train	0	0.0	10	0.1	10	0.1
Bus	150	6.2	1,524	18.5	1,674	15.7
Jeepney	571	23.7	5,226	63.5	5,796	54.5
Tricycle	49	2.0	381	4.6	430	4.0
Private	1,637	(68.0)	1,085	(13.2)	2,723	(25.6)
Car	1,267	52.6	427	5.2	1,694	15.9
Taxi	38	1.6	130	1.6	168	1.6
Truck/Others	332	13.8	528	6.4	861	8.1
Total 000	2,407	(100.0)	8,226	(100.0)	10,633	(100.0)
%	(22.8)	-	(77.2)	-	(100.0)	-

Source: 1980 HIS analysis results

- Modal split between public and private vehicles in Metro Manila is strongly related to household income. However, the modal split of "jeepney vs. bus" does not indicate a significant relationship as the former.
- In relation to the income distribution of trip makers, approximately 90 percent of total public mode users belong to the income bracket of less than ₱2,500/month. On the other hand, about 80 percent of private mode users constitute the income bracket of less than ₱4,000/month.

- The distribution of demand indicates that the public mode person traffic flow is centered in Manila, followed by Quezon City and Makati; while the private mode person traffic flow is concentrated in Manila, Makati and Parañaque.

- In terms of vehicle-kilometers, traffic demand on Metro Manila roads is estimated to be 16.2 million out of which 67.5 percent consists of private vehicles (car, taxi, truck), while 32.5 percent is composed of bus and jeepney. Considering the average size of the vehicles, it can be said that 40 percent of available road spaces is used by private car/taxi, 40 percent by bus/jeepney, and 20 percent by truck and others. (See Table 2.4)

Table 2.4
Vehicular Traffic Volume on Metro Manila Roads

Mode/Vehicle Type	No. of Trips /Day (000)	Vehicle-Kms./Day 000	Vehicle-Kms./Day %
Private	1,380	10,917	67.5
Car and Taxi	1,109	8,724	53.9
Truck and Others	271	2,193	13.6
Public	-	5,267	32.5
Bus	-	793	4.9
Jeepney	-	4,474	27.6
Total	-	16,184	100.0

Source: 1980 HIS analysis results and JUMSUT public transport surveys

- The traffic volume on major roads ranges from 10,000 to 100,000 vehicles per day. This depends upon the corridors and the number of lanes. The heavier vehicle volume was observed along EDSA, Quezon Boulevard, South Superhighway, Roxas Boulevard, and Taft Avenue. They exceed the volume of 65,000 vehicles per day and reach as much as 100,000 along some sections (J.P. Rizal and Ayala) of EDSA. EDSA, South Superhighway, Roxas Boulevard, P. Quirino (C-2), and Buendia are dominated by private transport vehicles. However, this is largely due to the policy-guided restrictions that jeepneys are banned along most of the sections of EDSA, Roxas Boulevard, and South Superhighway and almost no jeepney routes exist along Pres. Quirino, although there is a demand for these.

- Many of the road sections have reached their maximum capacities. Although traffic congestions may be attributed to various reasons (such as illegal parking, lack of traffic signals/ traffic management schemes, frequent road accidents), the fundamental point is an absolute lack of road space and capacity compared to its demand for the size of a city like Metro Manila.

2.1.3 Metro Manila Public Transportation System and Demand

- Public transport operation within and around Metro Manila is dominated by road transport. Intra-urban public transport comprises an assortment of jeepneys, buses (ordinary and premium buses), mini-buses, tricycles, taxis, and calesas; while inter-city services between Metro Manila and other neighboring areas are provided largely by buses, mini-buses, provincial buses and jeepneys. Buses form the trunk system, while jeepneys serve both as trunk and secondary systems. Tricycles provide feeder services to the trunk and secondary systems. Calesas, whose role in public transportation is negligible, are phasing out. The PNR commuter services play only a very limited role. Meanwhile, an elevated Light Rail Transit (LRT) system is currently under construction along Taft Avenue, Rizal Avenue and Rizal Avenue Extension between Monumento and Baclaran. The system (LRT Line No. 1) is approximately 15 kilometers long and interspersed with 18 stations. The line,

with an initial capacity of approximately 18,000 passengers (= 24 trains × 750 passengers/train) per hour per direction, will be completed by 1984.

- The Metro Manila public transport, as it is generally known, consists largely of jeepneys and buses. Buses are further classified into standard bus, double decker, limited bus, love bus, mini-bus, and provincial bus. They cover Metro Manila and its environs. Since the actual Metropolitan area extends to the neighboring sections of Metro Manila as well, short distance provincial operations also form an important part of the Metro Manila public transportation system, as intra-city operation does.

- Jeepney covers 610 kilometers of Metro Manila roads, while bus covers 330 kilometers. Out of the total, approximately 290 kilometers are served by both jeepney and bus. Of the total bus coverage, 88 percent is also served by jeepney. Tricycles extensively serve and cover almost one-third of the whole Metro Manila area.

- The current route configuration of jeepney and bus is complementary to each other except on some roads; jeepney routes are generally short and concentrated in the radial roads/streets, especially in Taft Avenue, Rizal Avenue, España and R. Magsaysay, while the bus routes in circumferential roads, like EDSA, are long.

  Of the total 640 intra-city jeepney routes, 24 percent (152 routes) are shorter than five kilometers, 48 percent (306 routes) are shorter than 10 kilometers, and 96 percent (612 routes) are shorter than 20 kilometers. The average route length is 10.4 kilometers. On the other hand, inter-city jeepney routes have an average length of 24.6 kilometers; 96 percent or 100 routes out of a total of 104 routes are longer than 10 kilometers.

  Bus routes are twice as long as jeepney routes, both intra-city and inter-city. The average route length of intra-city bus is 21.1 kilometers, while that of inter-city bus is 40.5 kilometers.

- The number of jeepney units actually operating for any given day is 35,600 units (29,300 units for intra-city routes and 6,300 for inter-city routes). Considering that the utilization ratio of jeepney units is approximately 85 percent, it is estimated that 41,000 units exist for Metro Manila public transport services. Out of these, 34,500 are for intra-city routes alone. (See Table 2.5)

Table 2.5
Public Transport Route and Fleet[1]

Mode	Metro Manila Intra-urban		Metro Manila Related Inter-City		TOTAL	
	No. of Routes	Estd. No. of Units	No. of Routes	Estd. No. of Units	No. of Routes	Estd. No. of Units
JEEPNEY	640	29,261	104	6,266	744	35,527
BUS TOTAL	150	4,368	47	1,543	197	5,911
– Standard Bus	106	3,750	13	346	119	4,096
– Double Decker	3	25	–	–	3	25
– Limited Bus	5	87	–	–	5	87
– Love Bus	27	299	1	15	28	314
– Mini-bus	9	207	20	933	29	1,140
– Provincial Bus	–	–	13	249	13	249

Source: JUMSUT Public Transportation Surveys
[1]estimated no. of units includes those actually operating in a given weekday.

The average daily load factors do not vary much between buses and jeepneys; 54 percent for jeepney and 56 percent for bus. The load factor of bus will become less when its capacity for standees is taken into account.

Average kilometrage run per day is approximately 108 kilometers and 116 kilometers for intra-city jeepney and bus, respectively, while those for inter-city jeepney and bus are 167 kilometers and 154 kilometers, respectively.

- The total Metro Manila bus and jeepney passenger traffic demand is estimated at 10.3 million passengers and 58.6 million passenger-kilometers for 16 hours of a weekday (6 a.m. - 10 p.m.). Jeepney carries 77 percent of total passengers and 60 percent of total passenger-kilometers, while bus services the remaining 23 percent of passengers and 40 percent of passenger-kilometers. Compared to 1980, the year when MMUTIP was conducted, the number of public transport passengers remains the same, while passenger-kilometers have increased by 9 percent. This is a result of the considerable increase in bus passenger traffic (53 percent increase in passengers and 58 percent increase in passenger-kilometers) and the decrease in jeepney passenger traffic of approximately 10 percent.

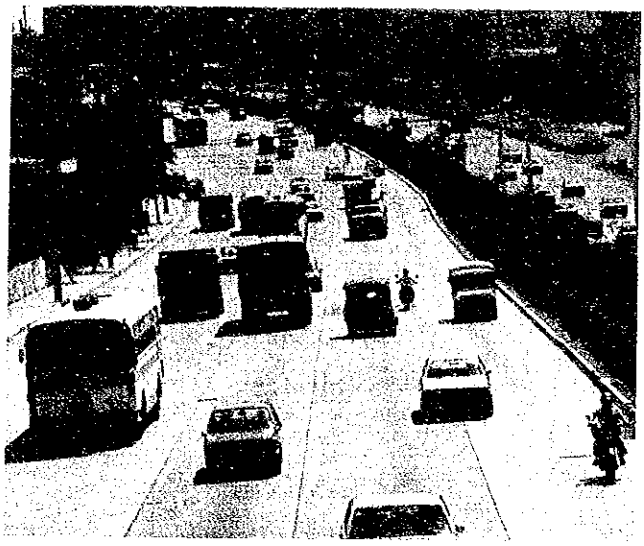
- For intra-city jeepney transport, 99.7 percent of passengers and 89.9 percent of passenger kilometers have a trip length of less than 10 kilometers. It is striking to note that 73 percent of the total number of passengers travel less than 5 kilometers, which is the minimum distance in existing bus and jeepney fare structures. On the other hand, intra-city bus passengers travel much longer, with an average trip length of 8.8 kilometers compared to 3.8 kilometers for intra-city jeepney. Eighty-seven percent of intra-city bus passengers travel between 5 and 15 kilometers.

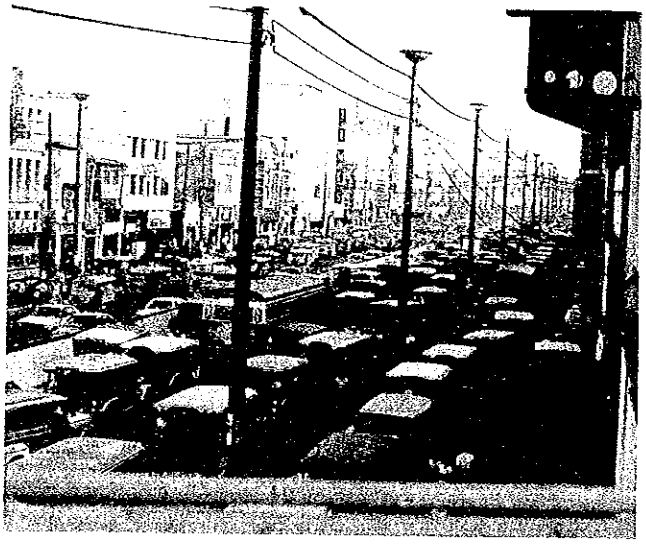
  Inter-city jeepney transport demand shows similar characteristics with intra-city bus transport. Eighty-three percent of the total inter-city jeepney passengers have a trip length between 5 and 15 kilometers, wherein 84 percent of the total inter-city jeepney passenger-kilometers also fall within this range. Inter-city bus passenger traffic is concentrated at a trip length range of 7.6 and 20 kilometers, wherein 88 percent of passengers and 83 percent of passenger-kilometers fall.

- In relation to the public transport passenger flow, corridors are dominated by jeepneys. Bus passenger volume is significant only along EDSA, South Super Highway, Taft, and Roxas Boulevard (where jeepneys are not allowed or are limited, except for Taft Avenue). In general, relatively dense distribution of bus passenger traffic is observed in the southern and eastern areas.

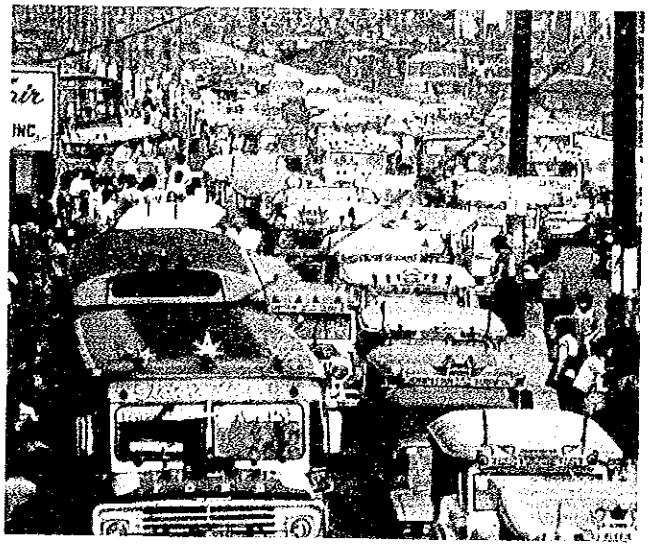
  Although jeepney passengers generate everywhere, heavier concentration is seen in the area within C-2 and other major terminal areas such as Blumentritt, Monumento, Cubao, Sta. Mesa, Guadalupe, Baclaran, Libertad, etc. On the other hand, major traffic generating areas for buses are rather limited in areas like Plaza Lawton, Quiapo, Divisoria, Cubao, and several areas along EDSA.

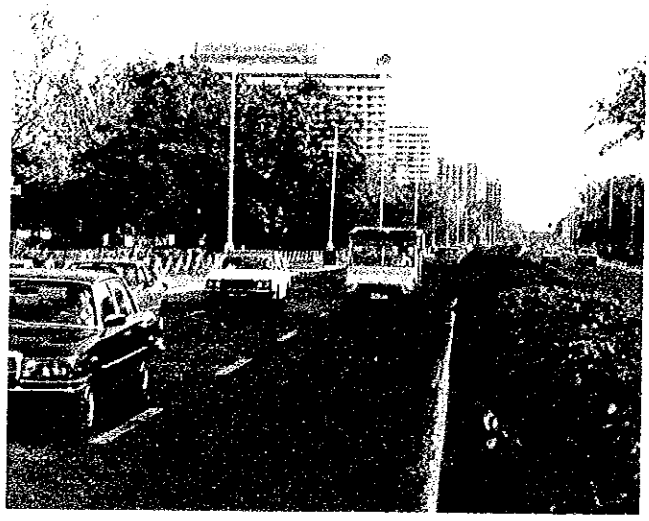
- Travel speed is generally lower in the inner areas of Metro Manila, especially within C-2 where jeepneys travel at a speed lower than 10 KPH throughout the day. Generally, buses travel faster than jeepneys. It was also observed that the travel speed of premium bus is determined not only by the overall road traffic situation but also by driving attitudes and operating practices of getting passengers.





EDSA	Taft Avenue
Quezon Blvd	URBAN TRAFFIC CONDITION
Quezon Blvd	Roxas Boulevard





2.1.4 Public Transportation along the LRT Corridor

- With regards to the LRT corridor, the existing jeepney and bus routes in Metro Manila are classified into seven types, shown as follows:

  Type I: Bus and jeepney routes within the LRT corridor.

  Type II: Bus and jeepney routes which pass the LRT corridor with one end outside the corridor.

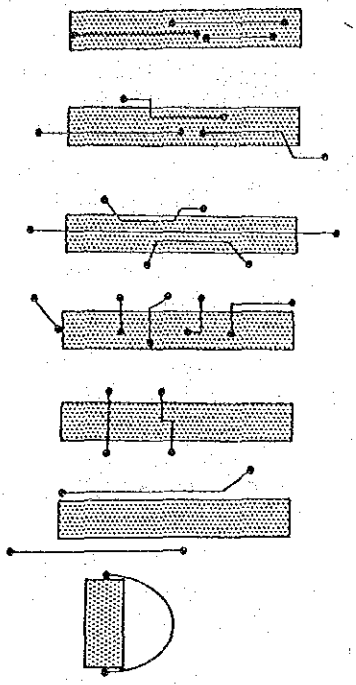
  Type III: Bus and jeepney routes passing the LRT corridor with both ends outside the corridor.

  Type IV: Bus and jeepney routes which terminate in the LRT corridor, but routes are not in the corridor.

  Type V: Bus and jeepney routes which cross the LRT corridor.

  Type VI: Bus and jeepney routes located outside the LRT corridor.

  Type VII: Bus routes located outside the LRT corridor, but pass EDSA with a connection to LRT.



In general, Types I, II, and III will compete with be directly affected by the LRT, while Types IV and V are those which will complement the LRT.

- The characteristics of jeepney and bus operations in relation to the LRT are shown in Table 2.6

- The heaviest traffic flow is observed in Plaza Lawton where the passenger volume reaches up to 800,000 passengers (16 hours, both directions). Quezon Boulevard, España, Taft Avenue, Rizal Avenue Extension, A. Bonifacio, Harrison, Buendia, EDSA, and C.M. Recto also show a heavy passenger flow.

- Major sources of jeepney/bus passengers are located in Quiapo, Divisoria, Monumento, Blumentritt, Pier, Plaza Lawton, T.M. Kalaw, Pedro Gil, Libertad, Pasay Rotonda, and Baclaran.

Table 2.6
LRT Related Public Transport
Characteristics by Route Type

Jeepney	Jeepney Route Type						Total
	I	II	III	IV	V	VI	
Number of Routes	24	157	39	146	89	289	744
Ave. Route Length (Kms.)	11.7	19.7	14.5	13.5	12.1	10.0	12.4
No. of Units Running	1,622	4,696	2,055	9,971	3,449	13,734	35,527
Total Vehicle-Kms. (000)	166	513	219	1,237	405	1,658	4,198
Ave. Load Factor (%)	61.4	60.9	59.3	52.2	55.5	50.2	53.5
Total No. of Pass/Day (000)	310	879	340	2,078	852	3,432	7,891
Total Pass.-Kms./Day (000)	1,590	4,854	2,043	9,696	3,555	12,845	34,868
Ave. Trip Length (Kms.)	5.2	5.5	6.0	4.8	4.2	3.8	4.4

Bus	Bus Route Type						Total
	II	III	IV	V	VI	VII	
Number of Routes	22	43	27	17	41	47	197
Ave. Route Length (Kms.)	26.9	22.8	29.7	24.1	26.4	26.1	25.8
No. of Units Running	371	880	856	385	871	2,548	5,911
Total Vehicle-Kms. (000)	42.8	75.1	127.3	41.1	91.6	365.7	743.6
Ave. Load Factor (%)	48.8	60.8	58.0	53.6	49.4	57.3	56.1
Total No. of Pass/Day (000)	109	401	276	145	269	1,226	2,426
Total Pass.-Kms./Day (000)	1,068	2,549	3,612	1,282	2,580	12,622	23,713
Ave. Trip Length (Kms.)	9.9	6.3	13.1	8.8	9.6	10.3	9.8

Source: JUMSUT Public Transportation Surveys

2.2 SHORT-TERM PUBLIC TRANSPORTATION IMPROVEMENT PLAN

2.2.1 Goals and Framework of the Short-Term Plan

- The primary objective of the proposed short-term plan is to prepare a jeepney/bus rerouting plan and the necessary public transport facility improvement plan in anticipation of the scheduled completion of the LRT in 1984.
- In view of the impact of the LRT construction, a strong socio-political need arose to restructure the existing bus/jeepney operation. Also, a plan which will render a short-term solution on the public transport operation (bus and jeepney) along the LRT has to be prepared. The principal considerations for the rerouting plan are as follows:
    a) The rerouting plan should be consistent with higher transport policies of the government.
    b) It should be financially acceptable to the LRT operation.
    c) The plan should be technically acceptable for BOT's implementation.
    d) It should be technically acceptable for police enforcement.
    e) The plan should be acceptable to existing transport operators (especially jeepney drivers/operators).

- However, in order for the plan to effectively function or properly meet its demand, it has to be prepared with regards to the necessary improvements in road links and intersections, as well as terminals/turning points. A balanced plan on the physical aspects of public transport improvement can only be worked out by monitoring the interactions among the factors relating to routes, terminals/turning points and road links/interactions.
- The short-term plan comprises a specific rerouting plan and an associated facility improvement plan for the LRT corridor. It also includes a preliminary plan on the overall development directions on rerouting and mode interchange areas (terminals/terminal areas).

2.2.2 Rerouting Plan

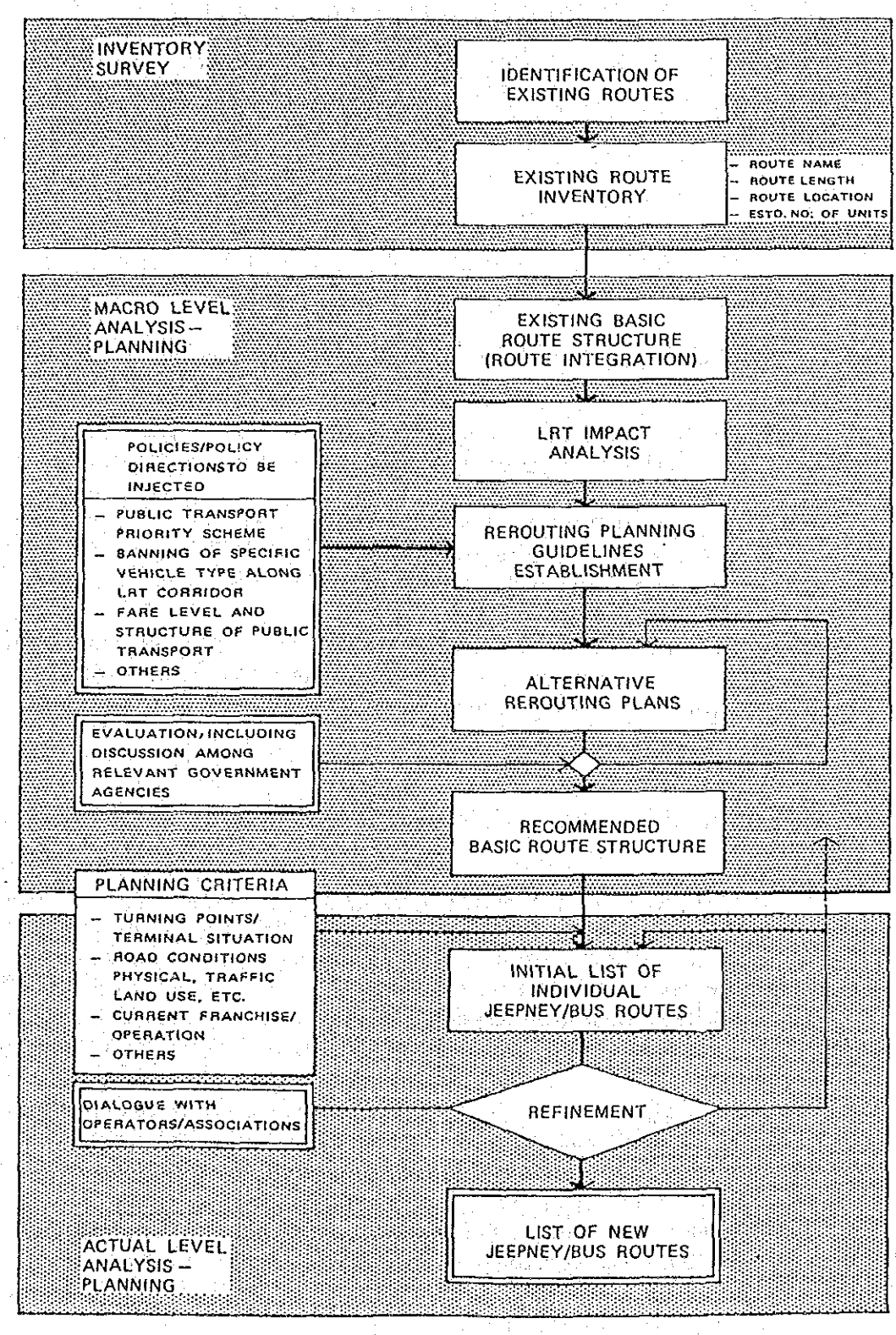
1) Planning Framework

- The overall process of this task can be divided into the following three tasks: (See Figure 2.2)
    a) **Inventory survey:** intends to identify the existence, location, and inventory of the routes currently being operated. This is achieved by conducting extensive field surveys.
    b) **Macro Level Analysis/Planning:** intends to analyze the characteristics of the existing public transport routes, impact of the LRT operation, preparation and evaluation of alternatives. Its aim is to establish a basic route structure plan for the LRT affected areas.
    c) **Actual Level Analysis/Planning:** intends to refine the basic route structure plans. This is in preparation of a plan for eventual implementation wherein a proposed individual route list with the required fleet capacity will be worked out.

2) Methodology

- Some characteristic aspects of the methodologies adopted for this particular task are as follows:
    1) **Inventory Survey:** Comprehensive public transport surveys were conducted for the existing public transport modes about their routes, operation and demand characteristics in order to prepare the data base required for the rerouting plan.
    2) **Integration of Routes:** The existing 744 jeepney and 197 bus routes were simplified by consolidating/integrating homogeneous or similar routes and their route information. Whole individual routes have to be dealt with during the actual implementation stage. However, in most cases, planning is primarily made based on the simplified input so that more alternative fundamental factors/policy directions can be tested and analyzed. As long as the process of simplication of actual/individual features is logical and realistic, it is always recommended that a simplified planning and data base be used for analysis.
    3) **Application of TRANSTEP Model:** In order to deal with sizeable data and to test different scenarios, a computer-aided methodology was extensively applied in data processing, traffic assignment and assessment. The TRANSTEP model was intensively used for public transport assignment.

Figure 2.2
Bus/Jeepney Rerouting Study Framework



3) LRT Operation and its Impact on Bus/Jeepney Operation

- An analysis was made on LRT operation. The implications among LRT fare level, number of passengers, expected revenue and generalized cost were simulated by changing the LRT fare level and other parameters, such as time value and accessibility. Through this process, it became evident that an increase in the LRT fare level directly leads to a decrease in the number of LRT passengers. However, the LRT revenue will not necessarily decrease accordingly with reduced patronage. It is, therefore, concluded that the LRT fare of ₱1.00 would give the maximum LRT revenue with a minimum increase in total generalized cost, assuming that the cost of LRT operation will not vary much depending on the LRT passenger traffic volume. This exercise is based on existing jeepney/bus fares.
- The impact of LRT was assessed on the assumption that it will be opened on the existing jeepney and bus transport system, that is, without any change in route configuration and fare structure. (LRT fare of ₱1.00 flat is also assured.)
- The number of LRT passengers was estimated at 49,000 for both directions for the morning peak hour. The average trip length calculated is 7.3 kilometers. Although it is estimated that the south-bound LRT traffic will exceed the LRT initial capacity of 18,000 passengers/hour between J.A. Santos and Carriedo, passenger loading is considered to be sufficient and reasonable for most sections of the LRT.
- The influence of the LRT on the existing jeepney and bus system is summarized as follows: (See Table 2.7)
  a) The demand for jeepney/bus in terms of passenger-kilometers will decrease by about 8 percent. Buses will be more affected (−14 percent) than jeepneys (−5 percent)
  b) The total number of passengers will increase by about 1 percent, reflecting the increase in number of transfers.
  c) Meanwhile, public transit users will benefit with the 4 percent reduction in travel time as a whole.

Table 2.7
Impact of LRT on Metro Manila's Public Transport System

Case		Jeepney	Bus	LRT	Total
Without LRT	No. of Passengers (000)	506	168	—	674
	Passenger-Kms (000)	2,941	1,371	—	4,312
	Passenger-Hrs. (000)	155	64	—	219
	Fare Paid (P000)	464	204	—	668
With LRT	No. of Passengers (000)	479 (−5%)	156 (− 7%)	49	684 (+ 1%)
	Passenger-Kms (000)	2,791 (−5%)	1,183 (−14%)	357	4,331 (+ 0%)
	Passenger-Hrs. (000)	144 (−7%)	55 (−14%)	12	211 (− 1%)
	Fare Paid (P000)	444 (−4%)	178 (−13%)	49	671 (+ 0%)

- The effect of the LRT on existing jeepney and bus operations will depend on the extent of their competitive relationship and route configuration. In general, Type I routes are affected more than Type II routes, which are affected more than Type III routes. However, feeder type routes (Types IV, V, and a part of VI) will benefit from the LRT.

- The number of jeepney and bus units running daily is estimated at 35,500 and 5,900 respectively. Assuming that the need for vehicle units is proportionate to passenger-kilometers required, approximately 1,800 jeepney units and 800 bus units need to be relocated if the current load factors are maintained.
- In relation to the LRT impact on bus/jeepney vehicular traffic on roads the following can be pointed out:
    a) The LRT corridor shows a decrease of jeepney/bus passenger traffic by about 20-25 percent. This is especially notable in the south corridor.
    b) Parallel corridors including Harrison, South Super Highway, J. Abad Santos, and Dimasalang/A. Bonifacio also show a considerable decrease of about 5-40 percent.
    c) The roads feeding into the LRT corridor generally show an increase of 5-30 percent.
    d) EDSA, which is used as a feeder road only between Balintawak and Monumento and between Pasay Rotonda and South Super Highway, shows a decrease of approximately 10 percent, reflecting the passengers' shift from EDSA to LRT.

4) **Rerouting Policies/Guidelines**

- It is clear that the entire public transport demand along the LRT corridor will not be accommodated by the LRT alone. An analysis of the public transport passenger demand related to the LRT corridor indicates that the type of demand along the LRT corridor is so complex that it requires a combination of different modes and route structures. This is largely due to the fact that the LRT corridor directly relates to almost all other important transport corridors.
- Jeepney operations in Metro Manila are so extensive and complicated that possible and realistic implementation and enforcement methods of rerouting plans have to take into account both institutional and traffic enforcement/control aspects. On the basis of discussions with relevant government agencies, it was agreed that this study consider the following points:
    a) Longer jeepney routes which run parallel to the LRT should be detoured at certain sections of the LRT corridor. This is to ensure that they will not compete with the LRT on long distances and that the required LRT patronage level is mantained. Bus routes can remain as they are, considering their relatively low share and the difficulties they will encounter in operating along narrow side streets.
    b) When jeepneys are deviated from the LRT corridor, it would be proper to ban all jeepneys from some common sections of the corridor to facilitate the implementation of rerouting plans. Consequently, there will be some routes running the corridor for a long distance that will be cut at certain points.
    c) New types of possible routes, including feeder services to LRT stations and in other potential demand areas, will be created to accommodate the expected surplus of jeepneys due to the LRT operation and subsequent rerouting.
    d) The new route list should correspond clearly to the existing route list in order to facilitate the relocation.

5) **Alternative Rerouting Structure Plans**

- Alternative rerouting plans were prepared in two steps. For the first step, five alternative plans were prepared mainly to identify the direction and drastic effect of the rerouting plan. The second step, on the other hand, tried to determine a more realistic and desirable rerouting plan.
- The concept of the five alternative plans prepared in the first step are:

  Plan A: minor modification of routes affected by the LRT

  Plan B: all jeepney routes not allowed to run the LRT corridor exceeding 1/3 of the corridor length

  Plan C: all jeepney routes cut at McArthur, Quezon and Jones Bridge

  Plan D: all jeepney routes passing McArthur, Quezon and Jones Bridge deviated to either Del Pan, Ayala or Nagtahan Bridge

  Plan E: combination of Plans C and D

  For all cases, bus routes were assumed to remain as they are.

- This exercise implies the following:

  a) Jeepney rerouting along the LRT corridor would not bring any significant adverse economic consequences as long as jeepney routes are allowed to exist along said corridor.

  b) The rerouting policy that would bring about an increase in patronage of the LRT is not to allow any jeepney routes run longer than ¼ to ⅓ of the LRT corridor distance at any section of the corridor. This is considered to be the most fundamental policy which will effectively meet planning requirements without bringing about any adverse effects on overall public transport. Since the basic route structure does not change much, no complicated measures are needed for implementation.

  c) A rerouting policy could also be effectively directed at diverting more routes from the LRT corridor to other corridors, particularly to C-2. Positive economic impacts can be expected.

- Based on the above results, the alternative plans in the second step have been prepared. In view of the fact that it is hardly possible to ban jeepneys along some sections mainly because of the non-availability of alternative roads, these plans were prepared taking into account actual realistic conditions. This exercise implies that the rerouting of jeepney routes from the existing LRT corridor to other corridors or to side streets is as similarly effective as cutting the jeepney routes which compete or run along the LRT corridor over a long distance.

6) **Proposed Rerouting Plan**

- The characteristics of this rerouting plan are as follows: (See Figure 3.1)

  a) The most important concept of this plan is the jeepney banned sections. They are:

i) Rizal Avenue Extension between 10th Avenue and 5th Avenue (South bound)
ii) Rizal Avenue between Aurora and Plaza Sta. Cruz (South bound), and between Lope de Vega and Antipolo (North bound)
iii) Taft Avenue between P. Quirino and EDSA (South bound), and between EDSA and Padre Faura (North bound)

b) Although the existing routes running along the LRT corridor are affected due to this banning, depending on the routes' origin, destination and via, their origin and destination remain basically the same.

c) The existing routes currently turning at Quiapo underpass will be transferred to the LRT Central Station at Arroceros. However, it has yet to be determined whether all jeepney routes should be transferred or not.

d) The existing routes which can function as feeder routes to the LRT will remain as they are inspite of the banning. However minor rerouting will be made to link them with an LRT station as much as possible.

e) New routes were proposed in connection with the operation of the LRT considering that a new flow of passenger demand will arise when the LRT is operated.

- The rerouting plan has no direct influence on other existing routes although the demand distribution changes to some extent depending on the route configuration.
- The proposed structure plan, which was finally assessed using TRANSTEP, can be summarized as follows:

a) LRT patronage will be guaranteed with the rerouting. The number of passengers during morning peak hour is estimated to be approximately 58,000, which is 20 percent more than that without rerouting. (See Table 2.8)

b) The LRT, together with the rerouting will bring about a 10 percent decrease in the number of passengers and passenger kilometers for the jeepney. The LRT will bring about a decrease of 7 percent in the number of passengers and 14 percent in passenger-kilometers for the bus without rerouting. However, with the combined effect of rerouting, the number of bus passengers will retain its existing level while a decrease of 6 percent in passenger-kilometers is foreseen. (See Table 2.8)

c) Adverse economic impact due to rerouting will be minimal.

d) Due to the LRT and associated rerouting, it is estimated that approximately 3,600 jeepneys and 300 buses will become surpluses on the demand level of 1980. However, considering the natural increase in transport demand of Metro Manila, this surplus will be easily absorbed within a year or two. Moreover, feeder routes newly created in connection with the LRT will be able to accommodate several hundreds of jeepneys.

e) Completion of the LRT will definitely lead to the decrease in jeepney and bus passenger traffic on various roads in and around the LRT corridor.

Table 2.8
Change in Intermodal Relations of the
Rerouting Plan

		Without LRT	With LRT	
		Without Rerouting	Without Rerouting	With Rerouting Plan
LRT	No. of Passengers/hr.[1/]	—	48,761 (100)	58,298 (120)
	Pass.-Kms (000)/hr.	—	357 (100)	405 (113)
	Ave. Trip Length (kms)	—	7.3	7.0
JEEPNEY	No. of Passengers/hr.[1/]	505,736 (100)	497,341 (95)	462,027 (91)
	Pass.-Kms (000)/hr.	2,941 (100)	2,791 (95)	2,640 (90)
	Ave. Trip Length (kms)	5.8	5.8	5.7
BUS	No. of Passengers/hr.[1/]	167,866 (100)	156,039 (93)	168,938 (101)
	Pass.-Kms (000)/hr.	1,371 (100)	1,183 (86)	1,289 (94)
	Ave. Trip Length (kms)	6.2	7.6	7.6
TOTAL	No. of Passengers/hr.[1/]	673,602 (100)	684,141 (102)	689,262 (102)
	Pass.-Kms (000)/hr.	4,312 (100)	4,331 (100)	4,335 (101)
	Ave. Trip Length (kms)	6.4	6.3	6.3

[1/]morning peak hour

2.2.3 Relevant Public Transportation Facility Planning

- The objective of this task is to identify the areas which have to be improved in connection with the rerouting plans and to prepare road facilities improvement plans in the affected areas. The steps taken are as follows:

  a) Identification of congested road sections; this intends to calculate volume/capacity ratio by section for both cases of "before" and "after" rerouting, and to determine problem sections where the volume/capacity ratio is expected to be high even after the rerouting.

  b) Assessment of road surface condition by section; this is done mainly by reconnaissance on road surface condition and other related road facilities.

  c) Identification of problem intersections; this is done by evaluating the capacity of each intersection based on the estimated traffic volume for the "after rerouting" situation.

- Problems were identified according to the above steps and then integrated by road section or intersection. The problems anticipated after the rerouting can be classified into the following four categories:

  Type I: due to absolute lack of road link capacity
  Type II: due to lack of intersection capacity
  Type III: due to poor road surface condition
  Type IV: due to the reduction of road capacity resulting from curbside parking, street vendors, etc.

- In order to relieve these problems, various countermeasures were considered depending upon the nature of each individual problem or combination thereof . They are as follows:

Type A: traffic control/management including one-way, parking control and more efficient use of available road spaces in road links

Type B: increase in traffic capacities at intersections by installing traffic signals

Type C: maintenance/rehabilitation of deteriorated road surface

Type D: restriction of private cars

- Problems and countermeasures are summarized in Table 9.3 and their locations are shown in Figure 9.5.

2.2.4 Implementation Program

1) General

- Various plans worked out with particular regard to the rerouting along the LRT corridor include the following:

  a) Rerouting of bus and jeepney routes
  b) Physical improvement of the road surface where jeepneys are to be rerouted
  c) Installation of signals at intersections as required by predicted traffic flow/volume
  d) Enforcement of traffic control measures, particularly on one-way and curbside parking.

- Although the implications among the activities are not complicated, the following points would have to be considered:

  a) Various work needed in relation with the rerouting would have to be modified when the rerouting plan changes.
  b) The recommended activities were worked out only from a short-term point of view. They would have to be carried out before or upon the implementation of the rerouting plan for the opening of the LRT.

- Since MOTC is not an implementing agency, enforcement of the plan needs close coordination with other government agencies on the following aspects:

  a) Rerouting: BOT
  b) Traffic Signal Installation: MMTEAM/MPWH
  c) Road Maintenance/Rehabilitation: MPWH and Local Governments
  d) Traffic Control/Management: TCC/MPWH
  e) Control on On-Road Market and Street Vendors: MMC
  f) Traffic Law Enforcement: INP

2) Implementation of Rerouting Plan

- To date, the progress of rerouting is at the stage of preliminary dialogue with jeepney operators. It is to be noted that the proposed plan might be modified to a minor extent depending upon further discussions with jeepney operators. However, the basic consensus has been reached already between MOTC and other relevant government agencies.

- In order to facilitate the various tasks at the different levels of implementation, the following tools have been prepared:

  a) **Individual route** list which includes:

     — Route name (before and after rerouting)
     — Route length (before and after rerouting)
     — No. of units running (before and after rerouting)
     — Hourly service frequency (before and after rerouting)
     — Load factor (before rerouting)
     — Relevant BOT Code (before rerouting)

     The list clearly indicates the relationship between the routes before and after the rerouting.

  b) **Route location map** which corresponds to the above individual route list.

  c) **List of possible (proposed) new jeepney routes** in relation with the LRT operation.

- It is anticipated that there will be a surplus of approximately 3,000 to 4,000 jeepney units when the LRT is opened for traffic. Since the jeepney operators are concerned more on profitability rather than on where they operate, the following points are to be taken into account:

  a) **Control of colorum vehicles/colorum operations:** A limited sample survey indicates that approximately 20 to 30% of the existing jeepneys are not properly registered. It is also identified that among 332 jeepney routes which relate more directly to the LRT (Types I, II, and III), 62 routes are not included in the BOT list. Approximately 1,200 units operate along these routes daily.

  b) **Diversion to new routes:** The proposed new 31 routes (13 LRT feeders and 18 others) would be able to absorb approximately 700 units.

  c) **A natural increase in public transport demand:** The demand which has been suppressed due to traffic congestions along the LRT corridor would absorb a considerable number of units.

3) **Implementation of Associated Improvement Work**

- The associated improvement work were grouped according to degree of urgency. Since these physical improvements require considerable time in financing and construction, necessary actions have to be started based on their level of priority. High priority projects were determined considering the magnitude of current problems and the relative importance of road sections/intersections in the public transport route configuration. (See Table 3.1)

- Fourteen (14) traffic signals need to be installed as soon as possible. Although 6 signals are already covered by the existing scheme of the MMTEAM for 1985, it is important for these signals to be installed by the time LRT starts its operation. The remaining 8 signals should be installed as well, after discussions with MMTEAM.

  Eight (8) traffic signals of the second priority also need to be installed. However, the implementation can be, though undesirable, deferred to a later stage considering their relatively small influence.

- In relation to road maintenance/rehabilitation, 6 road sections should be rehabilitated before the rerouting plan is implemented. Two (2) road sections will be taken cared of by MPWH and the remaining 4 will be done by the local government according to the instructions of MPWH.

  The second priority 9 road sections should be rehabilitated after the first priority road sections.
- The total amount of cost required for the improvement of road surfaces and installation of signals is roughly estimated to be ₱15 million. This can be brokendown into ₱6 million and ₱9 million for the first and second priority group projects, respectively.

  In addition to the above, an additional cost has to be allocated mainly for traffic signs and road markings. This is in relation to the traffic control measures which includes one-way curbside parking and restriction of on-road markets and street vendors. The cost is estimated to be ₱420,000.

2.3 PUBLIC TRANSPORTATION TERMINALS

2.3.1 Existing Public Transportation Terminals/Turning Points

- At present, there are 184 jeepney terminals, 121 bus terminals, 276 tricycle terminals and 17 PNR stations spread out all over Metro Manila.

  Normally, there are no fixed facilities used as terminals, only designated on-road spaces, off-road vacant lots or portions of gas stations. On the other hand, it has been observed that some provincial bus operators have off-road terminals in the real sense. They are equipped with shelters, berths, passenger waiting facilities, parking lots, information service and shopping facilities. Although railway stations are often important passenger transport terminals, only the Tutuban station of PNR provides proper functions and facilities. Due to its insignificant role, the rest of the PNR stations are merely platforms.

- Out of 184 jeepney terminals located in Metro Manila, 21 are within C-2, 80 are found between C-2 and C-4 and 83 are outside C-4 areas. Other characteristics observed are:

  a) Only 32 or 17 percent of the total number of terminals in Metro Manila are provided with off-road spaces. They are the 19 terminals within C-4 and the 26 outside of C-4. No terminal within C-2 is provided with off-road space.

  b) Of the total 16.1 million (per hour) jeepney boarding/alighting passengers, 40 percent or 6.4 million utilize the terminals. The remaining 60 percent use other road sections. The average number of boarding and alighting passengers per terminal is 68,500/16 hours within C-2, 38,400 between C-2 and C-4 and 23,400 outside of C-4.

  c) Many of the terminals interact with other public transport modes such as the tricycle, bus, PNR, and LRT.

     Major terminals which interact with several modes are Baclaran, Pasay Rotonda, Libertad, Lawton, Divisoria, Cubao, etc. Four other terminals interact with the PNR, while five, with the LRT.

- The characteristics of bus terminals are as follows:

  a) City buses normally use on-road spaces as passenger/terminals. On the other hand, provincial buses use off-road terminal spaces and a lot of them even have their own space and facilities. The largest bus terminals/terminal areas are Monumento and Baclaran, followed by Quiapo, Lawton, Alabang, MIA, and Divisoria. The most comprehensive provincial bus terminal is that owned by Victory Liner at Monumento. The terminal is provided with complete waiting sheds, berths, waiting facilities, shops as well as smooth interface functions with city jeepneys and taxis.

  b) Most off-road bus terminals (mostly for provincial buses) were acquired and developed by the operators themselves. Their locations are scattered and they are individually small. Although most of them are found along major thorough fares, the adverse traffic caused by these terminals is not so significant due to its relatively low frequency, as compared to that of city buses and jeepneys.

- The current role of the tricycle as a supplemental mode in the total public transport system is signficant. The tricycle service is characterized by a door-to-door or close-to-destination type of service, flexibility in the choice of way, availability of seats and personal atmosphere. Operating hours are long enough and the fare level is reasonable. The particular advantage of the tricycle, from the viewpoint of road development, is that the impact of tricycle operation to the road surface is very minimal due to its light axle load.

- PNR has stations located along the north, south and east lines of Metro Manila. These are Caloocan and Tutuban along the north line; San Lazaro, Laon-Laan, España, Sta. Mesa, Pandacan, Paco, Vito Cruz, Buendia, Pio Del Pilar, EDSA, FTI, Bicutan, Sucat, Alabang, and Muntinlupa along the south line. The south line carries most of the PNR commuter traffic while the role of the north line is limited only to those sections near Manila; the east line carries a negligible volume of traffic. A survey on boarding/alighting passengers was conducted in 1981 by the PNR Commuter Study.

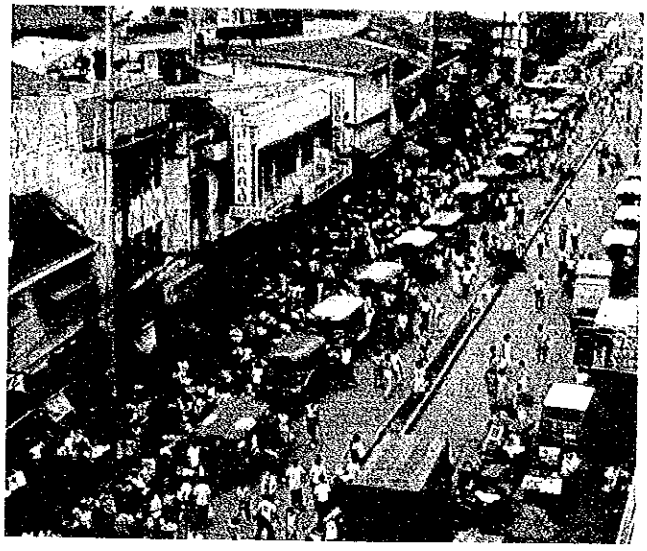
  Altough the major mode of access to these stations is the jeepney, the PNR stations are not directly served by jeepney routes. Passengers normally have to walk between stations and nearby jeepney routes. Several stations in such places as Vito Cruz, Bicutan, Sucat, Alabang, and Muntinlupa are served by tricycles at the same time.

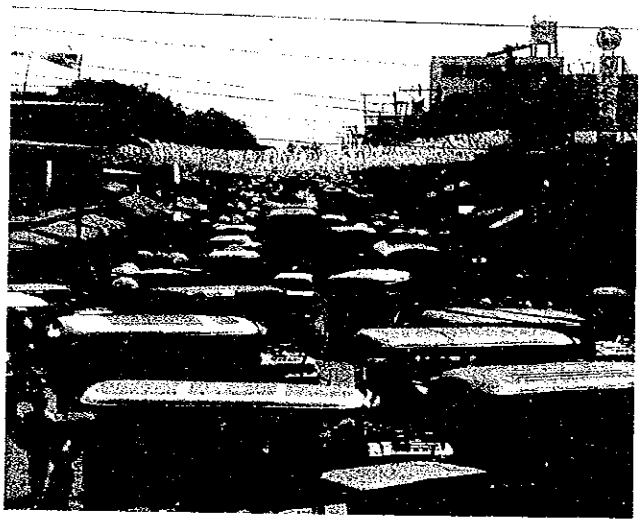
- There are 18 LRT stations currently being constructed. They are all elevated; therefore, people have to climb up the stairs which are approximately 20 feet above the existing road surface. Intensified development activities are already shown by private sectors around the North terminal; while studies are being undertaken on the development of various areas such as Blumentritt, D. Jose, Arroceros and Baclaran.

2.3.2 Improvement of Mode Interchange Facilities/Functions

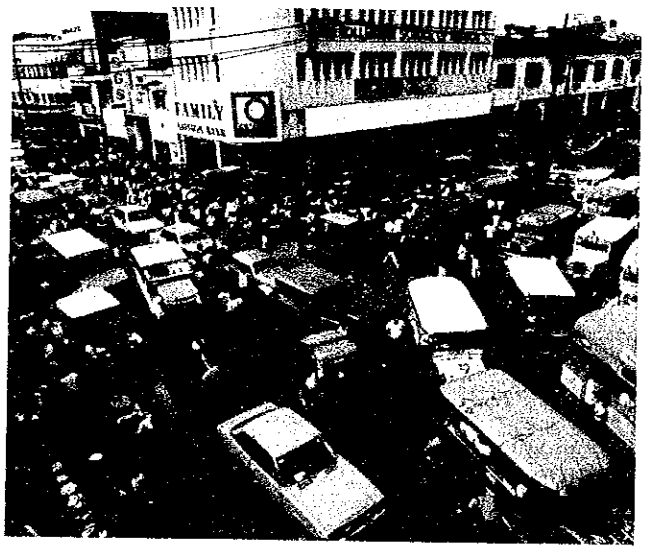
1) General

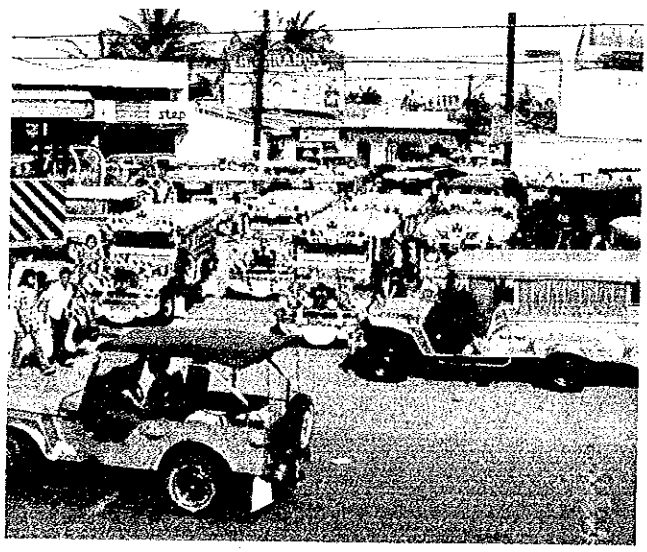
- The word "terminal" for public passenger transport is used and understood in various ways. It may mean a system with comprehensive facilities and functions or it may just be a designated on-road space without any facilities. Also, it may be an area or facility or any section of the road where passengers are loaded/unloaded; it may refer to a turning point where vehicles simply turn-around to get back to their respective origins.





Divisoria	Blumentritt
Baclaran	PUBLIC TRANSPORT TERMINAL AREAS
Quiapo	Zapote





- The current practice for boarding/alighting of public transport passengers in Metro Manila is done largely on road spaces, whether they are in terminal areas or elsewhere. This traditional method of boarding/alighting is considered as one of the most effective and inexpensive solutions. However, due to the ever increasing transport demand in the face of limited transport capacities, the method began to lose its advantages in many locations and instances. Serious congestions are observed throughout the day in many terminal areas caused by constant loading/unloading of passengers by vehicles. These congestions are reaching the level wherein not only the terminal area but also the road network will be affected, thus bringing about inconveniences to both public mode and private mode.

- Problems encountered in terminals and terminal areas vary depending upon their locations and the local factors which surround them. However, there are also problems commonly experienced by many of the terminals. These are those encountered in terminal/terminal areas in the developed urban area, while the other, in the less developed outer suburban area. (See Table 2.9)

Table 2.9
Summary of Current Problems Encountered

		Developed/Urbanized Area	Less Developed Area
Terminal User	Public transport Passengers	a) Increasing walking distance in access, transfer b) Increasing discomfort in waiting and access c) Increasing danger in waiting, loading/unloading d) Increasing difficulties in transfer	a) Accessibility to trunk PT routes b) Longer waiting time c) Less choice of destinations d) Safety of travel
	Operators/ Drivers	a) Lack of turn-around spaces b) Lack of waiting spaces c) Lack of loading/unloading places/facilities	a) Profitability
	Other Road Users	a) Traffic congestions in terminal areas b) Non availability of parking spaces	
From Government/ Overall National Economic Viewpoint		a) Increasing overall traffic cost due to increasing bottleneck in terminal area b) Decreasing accessibility to economic growth centers c) Decreasing development potentials at growth centers d) Increasing difficulties in route control and management	a) Providing reasonable level of public transport service to the isolated areas.

2) Development Directions

- In view of the fact that majority of Metro Manila residents heavily rely on public transport modes under limited road spaces, functional split between or among available public transport modes is to be highlighted. A better solution has to be arrived at with a combination of the LRT, ordinary bus, premium bus, jeepney, tricycle, walking and PNR. Since the expansion of LRT (and PNR) will not be realized in a short time, buses would have to expand their roles along the primary transport corridors. Jeepneys

would have to be more utilized in areas where it is difficult for buses to meet the demand.

- With the understanding that Metro Manila requires all existing public transport modes, not in a competitive manner, the strengthening of mode interchange functions are necessary by way of:

  a) developing/improving transport infrastructure, particularly the expansion and strengthening of the secondary/local road system which will be a strong incentive for the public transport operations to fill the demand.

  b) developing or improving the mode interchange facilities and traffic management at and around the mode interchange nodes.

- The goals and planning targets to be met can be summarized as follows, (although the relative weights differ depending upon the area):

  a) to revive transport functions of primary roads
  b) to strengthen off-road terminal functions at mode interchange areas by integrating/combining presently scattered facilities/functions
  c) to improve safety measures for pedestrians
  d) to secure smooth turning points and off-road waiting spaces
  e) to provide smooth interchange functions at LRT terminals/stations
  f) to expand/strengthen feeder services to/from mode interchange areas by low cost and high service sub-modes (tricycle, etc.)
  g) to simultaneously plan and develop commercial and transport functions/ facilities

  In suburban areas, there is still a need to develop integrated transport nodes to enable higher level of services to/from the urban centre, while at the same time, it has to be supported by a good and extensive lowcost/high service sub-modes.

- However, since problem areas are mostly located in already heavily developed areas, there are always difficulties in implementation. In addition, terminal development per se is not considered to be profitable and the following factors have to be duly taken into account:

  a) Development of new road projects such as R-10, C-3 and/or extension of EDSA: Since these projects themselves require the acquisition of land and implementation, the development/creation of new mode interchange nodes can be considered with much less difficulties.

  b) Simultaneous development with other potential development in the area: Transport terminals may be simultaneously developed with other types of development which can be considered the most profitable for that particular location.

  c) Institutional Support: To accelerate and promote the development of mode interchange facilities by the private sector. The government could prepare incentives, such as, acquisition of land, finance, approval of development and at the same time impose control measures to restrict developments which do not have proper transport plans.

3) **Selected Key Mode Interchange Areas**

- Towards the development of a total Metro Manila public transport mode interchange system, areas were selected on the basis of their importance in relation to the various impact factors considered. These are:

  a) completion of LRT
  b) construction of committed major road projects such as R-10, C-3 and extension of EDSA
  c) strengthening of PNR
  d) future urban development
  e) relief of some development constraints

- Completion of the LRT will highlight the importance of such areas as Monumento, Blumentritt, Arroceros, Baclaran and Pasay Rotonda, where the LRT will intersect with important trunk road network. Since these areas have already been fairly intensively developed (except Arroceros), the development/improvement of these areas requires the particular consideration of the following points:

  a) adjustment with existing rights and development from implementation viewpoint

  b) heavy concentration of public transport passenger flow around the LRT stations/terminals during a short period of time.

- The completion of some committed major roads such as R-10, C-3 and EDSA extension will affect the overall public transport route structure, particularly C-3. Areas to be highlighted are Divisoria in relation with R-10, 5th Avenue LRT station in relation with C-3, area where R-10 and C-4 intersect with C-3, Pasay Rotonda in relation with EDSA extension, Buendia/Washington in relation with C-3. Since the development in these areas are based on the completion of new roads, it is strategically important that the development of mode interchange functions/facilities be considered and planned together with the road projects.

- Strengthening of the PNR is also a factor which will increase the relative importance of the following areas: Divisoria, Paco, Blumentritt, Sta. Mesa/Stop & Shop, Buendia/Washington, Sangandaan, Alabang, and Sucat.

- As the urban development extends towards the outskirts and intensifies in already developed areas, needs increase on how to provide adequate public transport services or to cope with the demand. Although this factor should always be taken into account elsewhere in Manila when areas are looked into for future development, some typical cases are for the following areas: Crossing when Ortigas commercial complex is heavily developed; Ayala when the current development continues; Fairview and Novaliches when the current expansion of urban areas continues, and Marikina, Pasig and Alabang when the current development continues and they have to function more as sub-regional centers.

- There are some areas located in strategic points in the overall public transport network but entail social or political constraints to development. They are particularly, among others, Recto and Divisoria. Recto will provide a significant mode interchange function among the LRT, public transport along Rizal Avenue and Quezon Avenue corridors,

and other urban development opportunities, when Old Bilibid prison can be used for the development. The western portion of C.M. Recto in Divisoria area is extensively occupied by squatters causing serious bottleneck to the smooth link between C.M. Recto and Roxas Boulevard via Del Pan Bridge. Exercises made in a couple of studies indicate that a considerable volume of traffic will be diverted from already saturated McArthur and Quezon bridges to the Del Pan bridge, which is currently under-utilized due to the bottleneck in Divisoria.

- The above discussions are summarized in Table 3.2, wherein the areas encircled are those considered as important key mode interchange areas selected and that require further detailed studies. Their locations are shown in Figure 3.2.

2.4 TRANSPORTATION DATA BASE AND PLANNING PROCEDURES

2.4.1 Public Transportation Surveys

- Various public transport surveys were conducted in order to provide the data base required to meet the JUMSUT study objectives. Moreover, the data base was designed in such a way that it will be useful for other MOTC planning/data management purposes.
- Three major surveys were conducted to provide up-to-date route and operation information on jeepneys and buses, with emphasis on those along the LRT corridor, and to provide a basis to estimate the number of units currently operating along the routes. These surveys are:

  a) **Route Reconnaissance Survey:** The survey was made at 120 stations to initially identify existing routes and frequency levels and to determine the best survey method and work plan.

  b) **Frequency Count Survey:** Jeepney/bus frequency surveys based on roadside traffic counts were conducted covering 16 hours from 6 a.m. to 10 p.m. during normal weekdays. Using the results of the jeepney traffic count survey, the route list prepared in the route reconnaissance survey was amended and finalized.

     Buses were counted by corporation/company and by service type (ordinary, double decker, limited, love or pag-ibig bus, provincial and minibus). Collected data were processed using the TTC computer.

  c) **Operation Characteristics Survey:** The objective of the survey is to determine the travel time, turn-around time and occupancy of bus/jeepney and to estimate the number of operating units by route.

     A total of 468 jeepney and 72 bus routes were covered. Sample round trips for each route were taken for each of the morning peak (7-8 a.m.), afternoon off-peak (1-2 p.m.) and evening peak (5-6 p.m.) hours. The number of sampled round trips was determined through the hourly frequency of the particular route. However, the number of samples for jeepney routes along the LRT corridor was doubled. Total jeepney and bus samples taken were 3811 and 239, respectively. EDP framework and methodology were developed to process the data.

- Surveys were conducted on terminals and turning points for jeepneys, buses and tricycles in order to understand the basic characteristics and various problems currently encountered in those areas.

a) **Jeepney Terminal Survey:** This survey was conducted for all existing 270 jeepney terminals in Metro Manila. The items covered include location, on-road/off-road, general land use, inter-modal relationship, queueing conditions of jeepneys, etc. More detailed surveys on terminals were conducted since the need for further analysis and study arose. Interview surveys were made with jeepney drivers and dispatchers as well as passengers, at selected terminals.

b) **Bus Terminal Survey:** This survey covered all existing 113 bus terminals. The following items were surveyed: location, on-road/off-road, general land use, inter-modal relationship, queueing conditions, etc.

c) **Tricycle Terminal Survey:** This survey also covered all existing tricycle terminals. The items surveyed were: location of terminal, extension of service area, general land use, intermodal relationship, "year-started" of terminal, tricycle operation characteristics, etc.

The collected data were compiled, tabulated and mapped in a form required for planning and analysis.

- In addition to the above surveys, several ancillary surveys, on a limited scale, were carried out from time to time when the need arose from the planning side. They are:

  a) Jeepney/Bus Occupancy Survey
  b) Jeepney Fare Survey
  c) Jeepney Units Utilization Survey
  d) Jeepney Passenger Walking Distance Survey
  e) Jeepney Driver Interview Survey
  f) Jeepney Vehicle Operating Cost Survey

2.4.2 Public Transportation Data Base Management

- The objective of this task is to consolidate the data collected and analyzed in this study in such a way that it will help MOTC to continuously update and effectively utilize the public transport data. Several urban transport planning procedures were also developed for actual planning and training purposes.

  1) **Existing Data Base**

  - In the initial stage of JUMSUT, the following data for the year 1980 were readily available:

    a) Socio-economic data, which includes population, employment, school attendance, car ownership, family income, and land use collected from various government agencies.
    b) Road network and traffic data at major road sections collected and compiled mainly from MMTEAM.
    c) Public transport data on routes, operation, demand and other related social, economic and administrative aspects, most of which are available from MMUTIP.
    d) 1980 MMUTIP OD Tables

  - However, most of the existing data needed updating due to such limitations as difference in coverage date and recent changes in the public transport situation.

2) **JUMSUT Data Base**

- The JUMSUT Data Base include information of different types. The data cover areas like the socio-economic aspect, road network and traffic, and public transport and demand characteristics, which are processed at different levels:

  a) **Primary data base:** are those which are considered as fundamental data base and will become important sources for producing secondary processed data according to the needs of various planning and analysis work.
  b) **Planning data base:** are those processed based on the primary data base and are considered useful for the planning activities in the Ministry.
  c) **Programs:** are those which will link the data base and help in the various planning work in the Ministry.

- These data base are compiled in different forms depending upon the nature of the data. Some are stored in magnetic tapes and diskettes while others are in the form of documents, maps, or even in their original survey sheets. (See Table 3.3)

- In order to make use of the JUMSUT data base to its maximum extent, it is imperative that the data be always updated properly. However due to the fact that most of the JUMSUT data have been collected through large-scale field surveys consuming a sizeable amount of time, funds and manpower, it is crucial to look for an economical method of maintaining data within a tolerable level of accuracy. Considering the size, accuracy, coverage and possible usage of the various data, the method of data updating and file management can be summarized as follows:

  a) **Socio-Economic Data:** Since this is closely related to the NCSO Census and the HIS, the time for data updating should coincide with these surveys. It is recommended that an estimate be done on these data for the years between the last and next surveys through extrapolation using average annual growth rates. However, if these data become available from other comprehensive studies/surveys, it could be replaced with such data. Subsequently, the old data will be transferred to permanent files.

  b) **Road Data:** Since the responsible agency on this aspect is the MPWH, it is necessary to monitor the MPWH/TEAM regularly on the following points:

     — Location, length, number of lanes, carriageway width, pavement type and other physical characteristics of newly constructed roads during the year.
     — Location, length and other necessary information on road/intersection improvements during the year.

  c) **Traffic Data:** For traffic data, it is also necessary to coordinate with the MPWH/TCC/TEAM regularly on the latest available traffic data.

  d) **Public Transport Data:** This data base is most important to MOTC's daily planning and control/management needs of jeepney and bus. The following points should be duly taken into account:

     i) Organize a permanent survey team to regularly monitor the operation of buses and jeepneys. The team will cover the following activities.

— reconnaissance survey of jeepney/bus routes at selected terminals to identify the changes in routes and operation.
— frequency count survey for those routes where major changes are observed and for those which are relatively important (basic routes with high frequency).
— on-board operation characteristics survey for those routes where major changes are observed and those which are relatively important.
— jeepney/bus driver interview survey on financial aspects for selected routes.

ii) Subsequent updating of the route information stored in the micro computer. In order to facilitate this process, a set of control/ management programs on this data base has been prepared.

2.4.3 Transportation Planning Procedures

1) Development of Transportation Planning Procedures by JUMSUT

Improvement of TRANSTEP

- In relation to the public transport assignment modules of TRANSTEP, which have been extensively used for the route planning, the following improvements have been made in view of the objectives of JUMSUT:

  a) Capacity expansion and shortening of computation time: This was attained by re-adjusting memory allocation and by simplifying the input data. As a result, the capacity of TRANSTEP increased by about 50 percent in terms of PT lines without affecting the computation time.
  b) Improvement of output forms: Since the original TRANSTEP needed a sizeable amount of manual calculation to interpret the output, the output format of PTLOAD has been considerably changed by adding totals/subtotals and other useful information. In addition, considering the short headway of jeepney routes, the required input data of headway have been replaced with service frequency.
  c) In public transport route planning, a need sometimes arises to know the origin and destination of passengers passing specific corridors/road sections. This is useful for evaluating the appropriateness of existing routes on the corridor/road section. An option has been added to PTLOAD.

- The improved version of TRANSTEP is readily available on a disk at TTC computer center, although the original TRANSTEP is also stored on a magnetic tape.

Development of a Traffic Assignment Program for the Micro Computer

- A traffic assignment program has been developed. This program assumes predetermined traffic volume of public transport vehicles by link and assigns private traffic onto the network. Although the traffic assignment was carried out using the TTC computer, a program was also developed for the micro computer using the BASIC language, considering the following advantages:

a) Easy operation
b) Negligible cost
c) Facilitates training and technology transfer

Development of Preliminary Planning Package for Jeepney Route Information Management

- In the light of the important and urgent need for LTPD/MOTC to facilitate the control of various information on the existing 744 jeepney routes, a program package called "PTMANAGE" was developed for the micro computer. Although this system needs further improvements, it will provide an easy access to the use of updated jeepney information.This system comprises the following functions:

  Utility Functions

  a) File copy
  b) Hard copy
  c) Data Update
  d) Data Sort
  e) Data Retrieval
  f) Printout

  Planning Functions

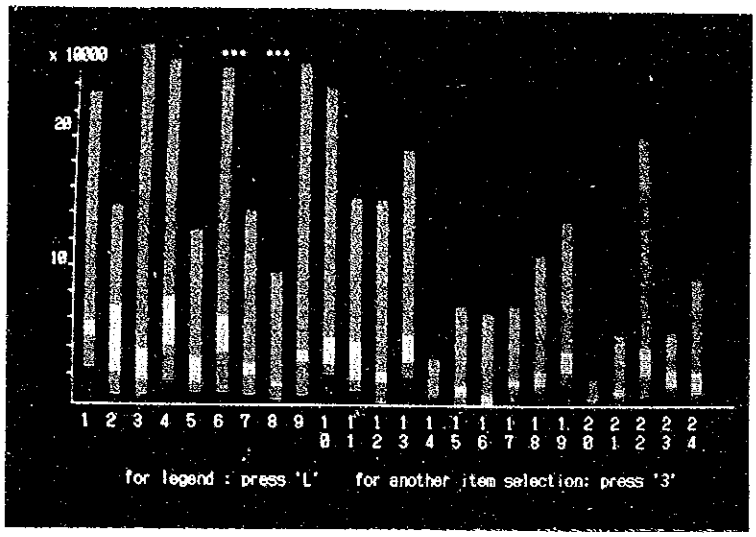
  a) Display Route Information
  b) Display Information on Corridors
  c) Display Information on Terminals
  d) Display Information on Competitive Routes
  e) Calculate Combined Service Frequency by Section

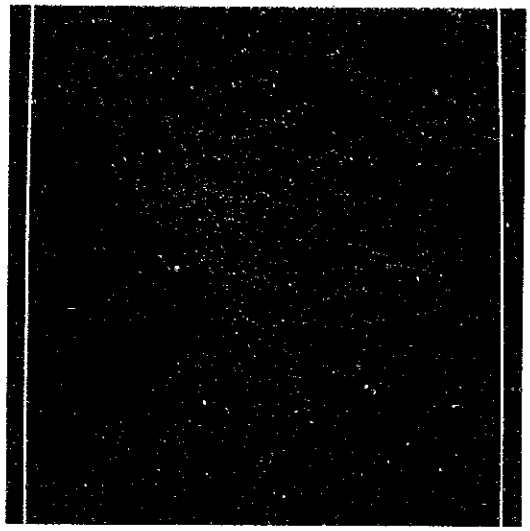
- The program has been designed basically as a manual-free system, although a user's manual is provided. Once "PTMANAGE" is loaded on the micro computer, the user only has to follow the instructions displayed on the CRT to get an output. If the output is not appropriate, the process can be repeated easily.

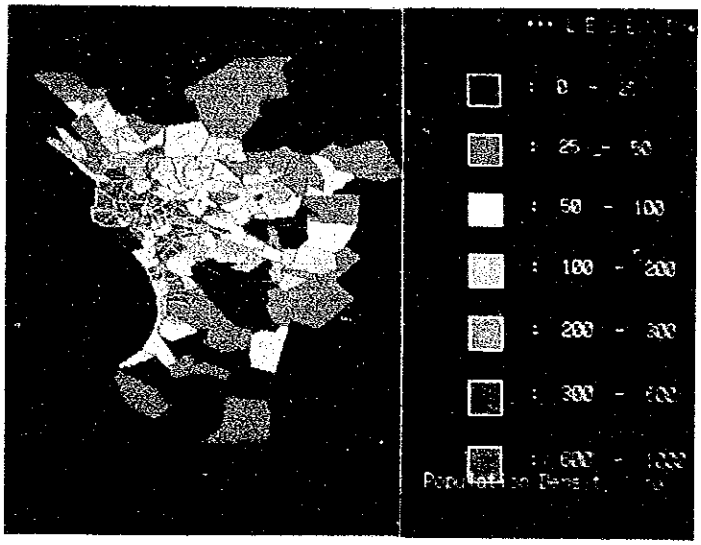
2) **Technology Transfer**

- The technology transfer of analysis and planning procedures/methodologies is also one of the objectives of this study. Although time has not been sufficiently allocated for this particular purpose, the study team tried to do its best through the following measures:

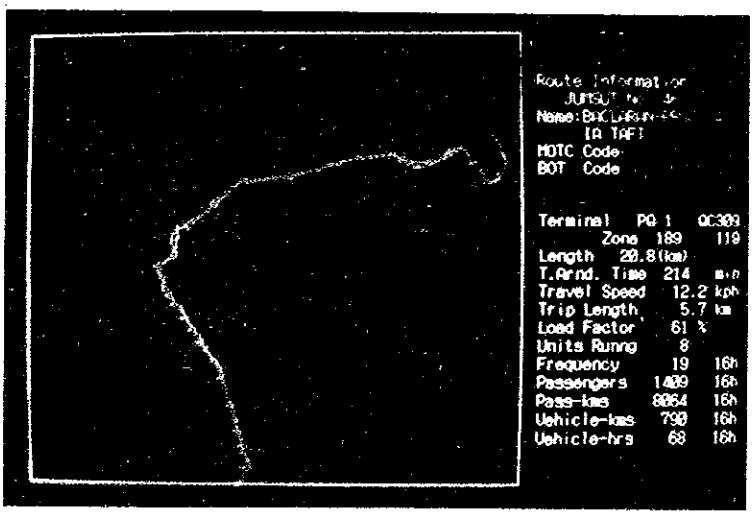
  a) Joint work and close coordination on a daily basis: In view of the fact that the rerouting planning process requires an extensive knowledge and detailed information on the bus/jeepney route and operation, the study team had to work closely and jointly with the LTPD team. Through the daily joint work, there was an exchange of planning and analysis procedures among the team members.
  b) Ad hoc lectures on transportation planning: Lectures were programmed and conducted by the Study team members as well as the JICA Supervisory committee members on various aspects of urban transport planning, particularly on traffic assignment procedures where actual exercises were made.
  c) Preparation of all necessary manuals by the time the Final Report is submitted. They include the following:

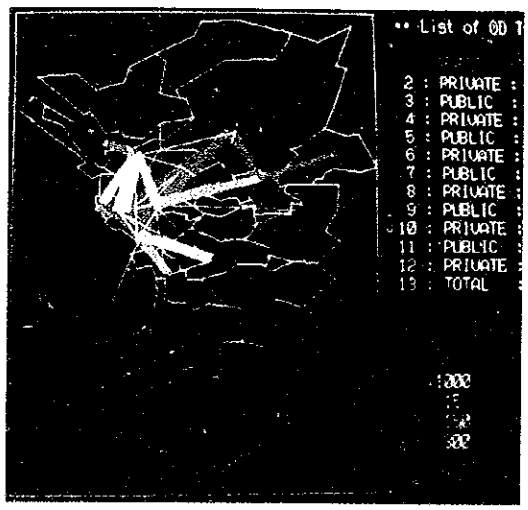






Socio-Economic Indicator	Metro Manila 202 Zone System
Socio-Economic Indicator by Area (202 Zone)	EXAMPLE OF MICRO COMPUTER BASED PROGRAM
Jeepney Route Management Information	Desired Line of Trip Table





— HIS survey
— Public transport survey
— Transportation planning procedures, covering traffic assignment, demand forecasting, etc.
— micro computer transportation planning software

2.5 HOME INTERVIEW SURVEY

2.5.1 Completion of 1980 HIS Data

1) **Analysis Framework**

- This task aims to complete the 1980 HIS data and to conduct further analysis on the travel characteristics of Metro Manila residents. This was undertaken on the basis of available data such as HIS, Cordonline Survey, and Screenline Survey conducted in 1980 under MOTC, 1983 supplemental HIS and associated ancillary surveys conducted by JUMSUT.

2) **Review and Further Analysis of the 1980 HIS**

- The 1980 HIS conducted August to December 1980, was designed and implemented by MOTC. It covered 2.5 percent of the total Metro Manila population — approximately 150,000 persons or 25,000 households. The collected interview sheets were checked and edited both manually and by computer. The data were then initially expanded on the basis of the provisional figures of 1980 population census. Further analyses were suspended and the data were stored a magnetic tape. Parallel to the HIS, a cordonline survey and screenline survey were conducted by MOTC. The data of these surveys were completely processed and stored in magnetic tape.

- The 1980 HIS was reviewed and it was identified that the following areas have to be looked into in detail and be supplemented.

  a) Need of updating socio-economic indicators: Since most of the socio-economic data were based on the preliminary figures of 1980 HIS, they had to be replaced with the final figures.
  b) Lack of "Private" and "Business" trips: The insufficient number of trips with "private" and "business" purposes (especially that of 'business') was evident as had been pointed out in the MMUTIP preliminary analysis report. This is mainly due to the lack of "business" and "private" trips which relatively constitute a large share of trips during off-peak hours.
  c) High peak-hour ratio: The result of the 1980 HIS analysis reveals a high morning peak-hour ratio of trip generation. It shows an 18.1 percent ratio to total motorized trips for 7:00 — 8:00 a.m. or 12.2 percent for two hours average (7:00 — 9:00 a.m.). This is mainly due to the lack of "Business" and "Private" trips which are observed more during off-peak hours.
  d) Low modal share of private mode: Although the modal split differs from one city to another, the percentage share of private mode in the 1980 HIS seems to be considerably low. This may be attributed to the missing portion of 'business' ('at work') and "private" trips which constitute a large share of private mode trips.

3) Conduct of 1983 Supplemental HIS

- After several surveys/analyses were proposed in order to cover these gaps, JUMSUT decided to undertake a new but limited HIS, adopting basically the same methods as the 1980 HIS, for the following reasons:

  a) Considerable "private" and "business" trips could be covered by a pilot survey conducted with a good control.
  b) Most of the existing EDP programs prepared for the 1980 HIS could be used with some minor changes.
  c) The results could be compared with those in the 1980 HIS due to the similarity of methodology used.

- The 1983 supplementary HIS was completed in a period of five weeks from January to February, 1983. The total number of interviewed households was approximately 3,300. Editing and coding of the collected data were done at the same time as the interviews. The coded data were then stored in magnetic tapes.

- After the expansion and tabulation of the Supplemental HIS data, the major characteristics of household and household members were compared with the original results from the 1980 HIS. This was done in order to integrate all similar results found in both HIS such as household size, number of employment by household, occupation composition and employment by sector.

4) HIS Data Compilation

- Analysis of both 1980 HIS and 1983 Supplemental HIS reveals that the data on the socio-economic characteristics of household/household members retain a reasonable level of accuracy. However, the data regarding trips require some adjustments on the following major areas:

  a) For 1980 HIS: the lack of trips with particular regard to "business (at work)", to "private" purpose trips and "to home" trips.
  b) For adjusted 1980 HIS: expansion of trips in comparison with the actual level of trips along screenlines.

  The first step of adjustment is to supplement the trip data to a reasonable level of accuracy within the limits of HIS. The second step is to quantitatively expand the collected and adjusted data to tally with the actual traffic level and flow across screenlines.

- After the adjustments mentioned above, the complete 1980 HIS OD tables were derived by adding the Cordonline OD volume to the expanded HIS OD tables. Expanded OD tables were tabulated in terms of person trips by mode (public and private) and by purpose ("to work", "to school", "private", "business", "to home", and "all purpose") for a 24-hour volume. Moreover, private mode OD tables by vehicle type (in terms of person trips) are simultaneously produced.

- The JUMSUT HIS data cover the following aspects:

  a) Household Information
  b) Household Member Information
  c) Trip Information
  d) OD Tables

The information on households, household members and trips cover only Metro Manila, while the OD tables cover not only trips within Metro Manila but also the external trips as estimated from the 1980 MMUTIP cordonline survey.

Although the information on households, household members and trips were prepared based on the MMUTIP 217 zoning system (202 Metro Manila zones plus 15 external zones), the OD tables were compiled based on various zoning systems.

2.5.2 Analysis of HIS Data

- Based on the completed HIS data, an analysis was made extensively on the socio-economic and travel demand characteristics of Metro Manila residents. Various facts were revealed and findings were made which were incorporated in the description and analysis explained in the preceeding chapters. The details are fully presented in the Main Text. Major areas analyzed, among others, are as follows:

  a) Socio-economic aspect of Metro Manila residents with regard to the following parameters and classifications thereof:

     — population by age and sex
     — number of households
     — employment by residence
     — employment by work place
     — school attendance
     — car ownership
     — household income

  b) Travel characteristics of Metro Manila residents with regard to the following parameters and classifications thereof:

     — trip purpose
     — travel mode
     — travel time
     — transfer
     — socio-economic parameters

- Based on the above analysis, a number of models which can be used for predicting future travel demand was preliminarily developed. They are related to the following aspects of travel demand:

  a) trip generation
  b) trip distribution
  c) intra zonal travel demand