Figure 2.18 shows in Kuala Lumpur, Jalan Kepong, Jalan Ipoh, Jalan Gombak, Jalan Sentul, Jalan Ampang, Jalan Datuk Keramat and Jalan Cheras are found to have congestion degrees above 2.0.

The northern corridor of Jalan Kuching and Jalan Ipoh, Jalan Semantan/Jalan Damansara, Jalan Segambut, Jalan Pahang and Jalan Genting Klang are having congestion degrees between 1.5 to 1.9. Low capacity intersections are identified at Kepong Roundabout, Pahang Roundabout, Edinburgh Roundabout, Ampang Intersection, Kg. Pandan Roundabout, Jalan Semantan Intersection, Jalan Gombak-Genting Klang Intersection, 5.5 km. and 8.0 km. Cheras Roundabouts, Jalan Batu Caves Intersection and Jalan Klang Lama-Syed Putra Intersection, a total of twelve (12) major points. Improvement works however have started at Jalan Batu Caves Intersection and Kepong Roundabout (Figure 2.18).

In the Other Klang Valley Area, severe traffic congestion is experienced in Jalan Vantooren, Jalan Langat and the Federal Highway from Klang to Subang. Intersection bottlenecks were identified at four (4) major points in Klang and Batu Tiga at Shah Alam. The Kota Bridge over Klang River in Klang is also a traffic bottleneck due to undercapacity. Rawang and Kajang are experiencing heavy through traffic on their narrow urban streets (Figure 2.19).

2.4.2 Public Transport

As far as the present situation is concerned, it can be said that considering the scale of the Klang Valley Region, the alarming inadequacy of the present public transport system to meet traffic demands has been quite well covered up by effective uses of the private vehicles. The Study Team's survey on public transport in Klang Valley identified the following existing problems.

(a) Inadequate Bus Route Network

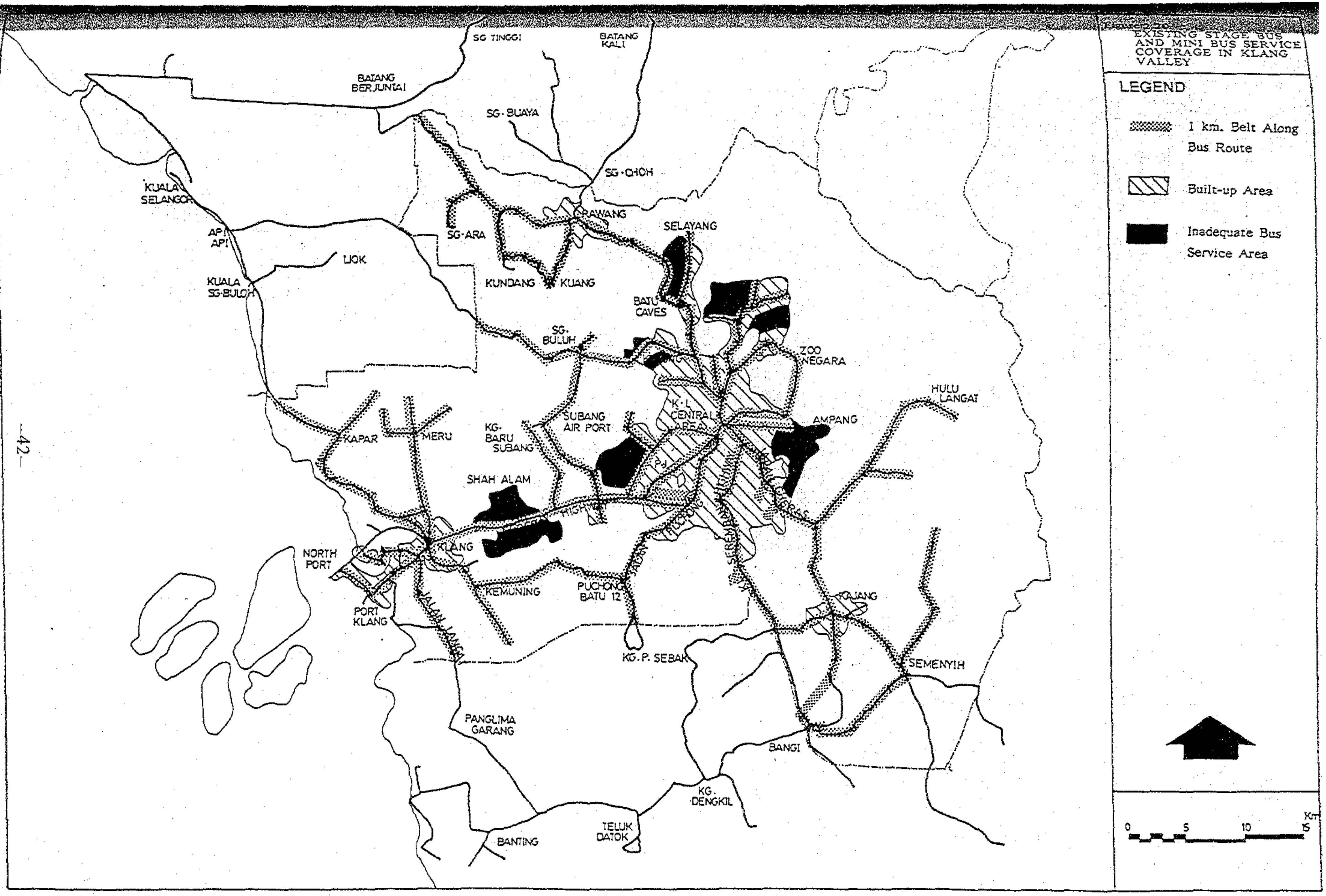
Figure 2.20 shows the area covered by a 1 km belt along the existing bus routes in Klang Valley. The built-up areas not covered by the 1 km belt (hatched area) represents the area inadequately served by buses currently. Inhabitants mobility is inhibited in areas especially the newly developed areas and low population density areas where bus route coverage is inadequate.

A major section of Petaling Jaya has no bus service. There is no town bus service within Shah Alam and the limited number of inter town bus services in Shah Alam has forced bus passengers to walk to the bus stops along the Federal Route II. The other areas lacking bus services are new residential estates in Petaling Jaya, Ampang-Hulu Langat, Selayang and Setapak-Wangsa Maju areas.

(b) Low Frequency of Bus Services

The public transport survey conducted by the Study Team found that bus schedules approved by JPJ are seldom followed strictly. Only about 72% of the total scheduled bus trips for Klang Valley were actually observed. Among the bus routes surveyed, 14% of the routes were found to be operating within the approved schedule, 13% were operating higher frequencies and 73% were operating below the approved scheduled frequencies.

Figure 2.20
EXISTING STAGE BUS AND MINI BUS SERVICE COVERAGE IN KLANG VALLEY



(c) Long Bus Travel Time

There exists little priority of road space for public transport especially buses. Buses have to compete with other road users and this has resulted in their inefficient service. The travelling time of three minutes per mile (1.6 km) used in planning the bus time-tables has increased due to traffic congestions on the roads. The observed average bus speed is 24 kph and this is further reduced to 18 kph at peak hours.

Figure 2.21 shows delay in travel time is particularly large along Cheras-Kuala Lumpur corridor, Jalan Sungei Besi and Jalan Pahang/Genting Klang.

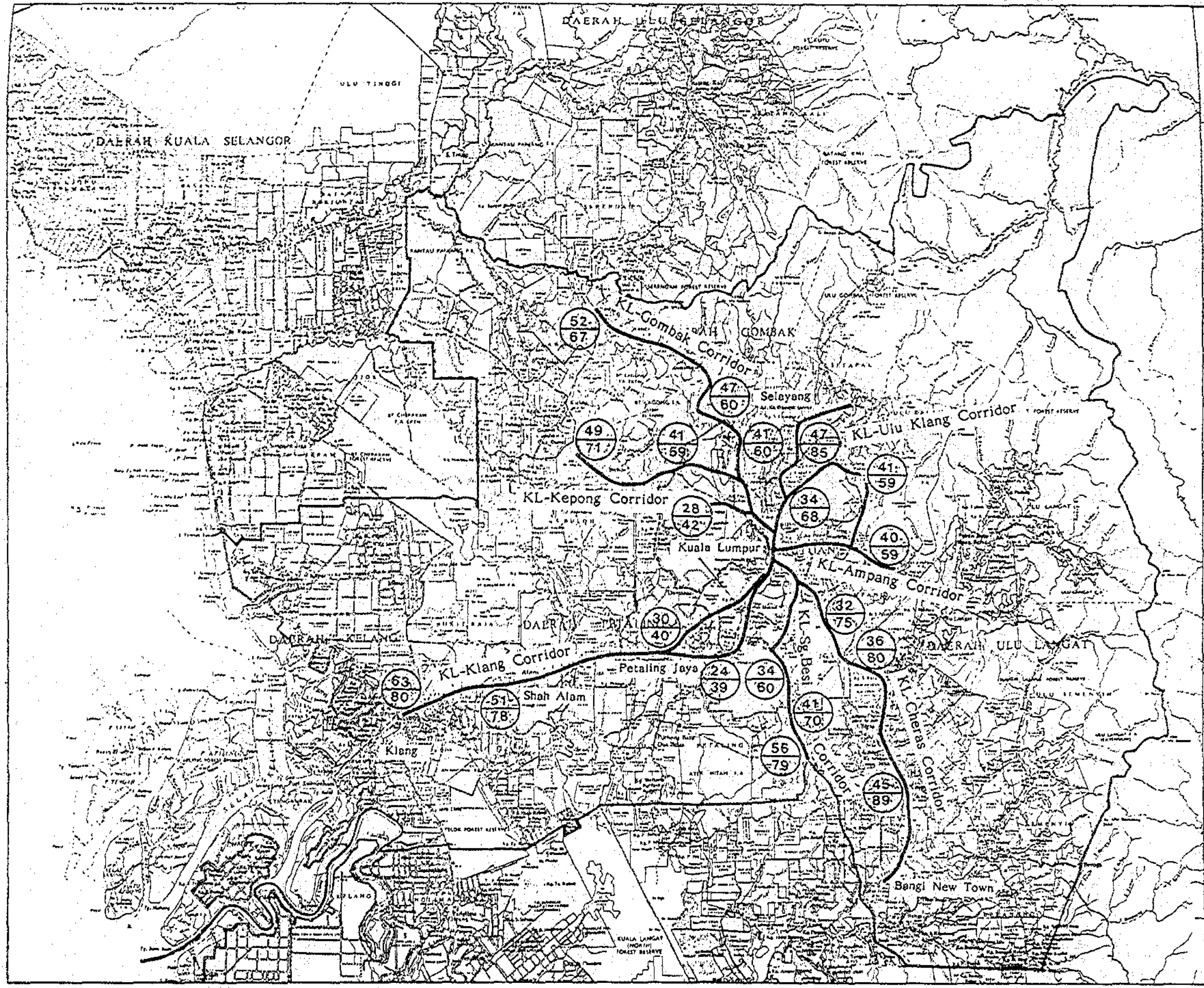
(d) Overloading of Passengers

Passenger traffic on public transport systems, especially bus transport always exceeds its capacity during peak periods. During the rush hours (6.00 – 8.00 hours and 16.00 – 18.00 hours) the average occupancy on stage bus is about 70 passengers while that of the minibus is about 40 passengers.

(e) Low Priority for Public Transport on Roads

Effective measures such as no-right turns and one-way streets to ensure free traffic flow on roads benefit the private vehicle users more than public transport users. No-right turns increase travelling time for the bus user while adding more 'dead mileage' to the operator. The bus routes are made more complicated because of one-way streets in that the routes from town are different from those coming into town.

Figure 2.21 : STAGE BUS SERVICE LEVEL IN KLANG VALLEY



LEGEND

— Major Bus Route Corridor

(55/90) Bus Trip Time Between Point and K.L. Central Area. Top Figure Indicates Mean Time in Minutes. Bottom Figure Indicates Slowest Time in Minutes.

Note: Difference in Bus Trip Time shows Delay to Bus Speed due to Traffic Congestion on Roads

SCALE: 0 5 10 15

KLANG VALLEY TRANSPORTATION STUDY

(f) Poor Terminal Facilities
Despite the fact that many work trips by means of bus involved a transfer of bus or mode, bus terminals or interchange facilities are not adequate for such purposes. Environment at the existing terminals which are not satisfactorily maintained, lack of benches and lack of bus transfer information do not help to encourage mode transfer or mode shift.

(g) Lack of Bus Monitoring System
There is a complete lack of bus monitoring system. Bus companies are unable to monitor and control the reliability of service, bus headways and stopping time at the bus-stops, much to the inconvenience of bus users.

(h) Lack of Bus Service Information
Bus route information and bus time-tables are often not available at bus stops and bus terminals. Infrequent bus users or out-of-town visitors often cannot use the public transport system effectively.

(i) No Railway Commuter Service
The existing railway facilities are not effectively utilized for providing commuter public transport in the Klang Valley Region.

2.4.3 Other Transport Facilities

(a) Operation of the Central Area Traffic Control System (ATC) in Kuala Lumpur is not always satisfactory.

In certain areas, the cycle lengths are excessive causing unnecessary long delays such as signals along Jalan Sultan Ismail, Jalan Klang Lama and Jalan Kepong.

(b) Traffic control devices are outdated, not properly installed or inadequate in the other urban centres like Klang or Shah Alam.

(c) Pedestrian facilities such as side-walks and pedestrian crossings are not sufficient or conducive to use, even in areas like shopping complexes, office buildings and school zones. There is no well defined pedestrian path network in the city centre.

(d) Disorderly parking in on-street parking facilities causes traffic congestion in the urban areas.

2.4.4 Implementation Authority

The responsibility and authority to plan, implement, license, monitor and manage the operation of transport facilities and systems in Klang Valley rest in the hands of too many agencies and up to now there is no effective coordination between them.

CHAPTER 3 : SOCIO-ECONOMIC FRAMEWORK AND LANDUSE PLAN

3. SOCIO ECONOMIC FRAMEWORK AND LANDUSE PLAN

3.1 Regional Development Plan

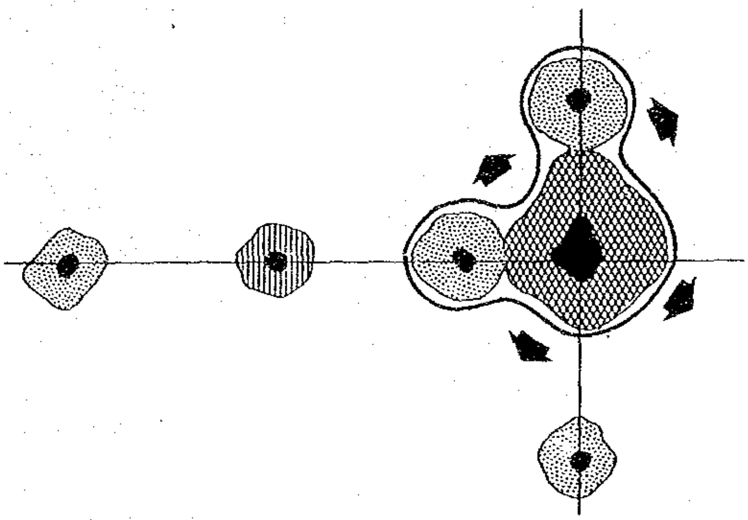
(1) Alternative Regional Development Options

Three possible regional development scenarios can be considered for the future development pattern in the Klang Valley (Figure 3.1).

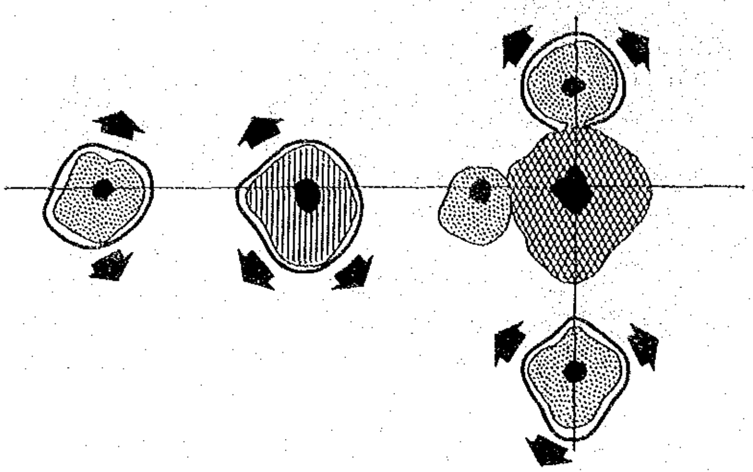
Scenario A : Concentrated Growth in Kuala Lumpur Conurbation Scenario
This scenario allows the future development to be concentrated at Kuala Lumpur and its Conurbation areas whereby it will grow without control to a much bigger urbanised area. The other centres hence are likely to remain behind the planned targets.

Scenario B : Dispersal to Selected Growth Centre Scenario
Future development in this scenario is to be directed as far as possible to the planned new growth centres whereby they can achieve their planned population and employment targets to function as self-contained cities.

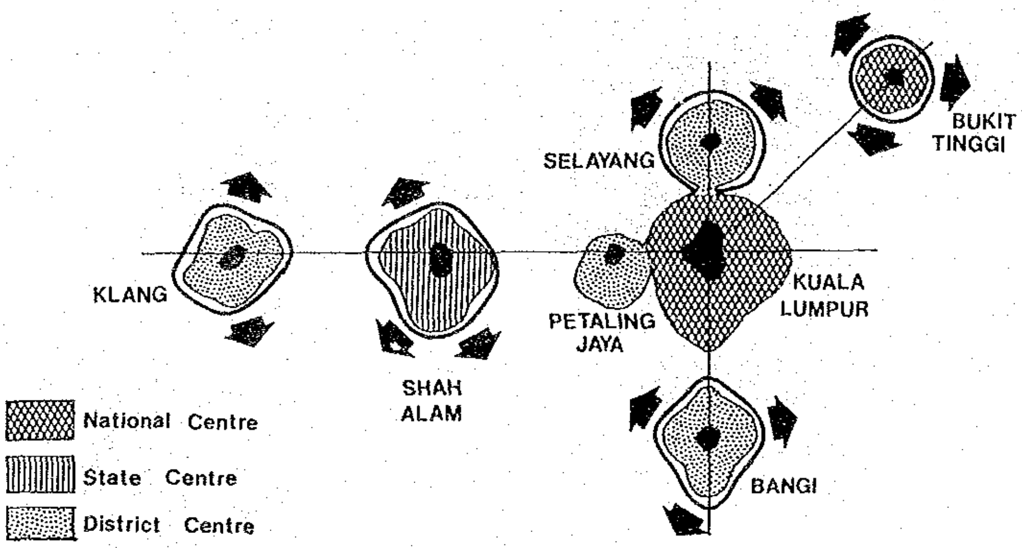
Scenario C : Dispersal and Twin City Scenario
This scenario has the main features of a dispersal growth strategy as in Scenario B. Added to this is a long-term planning strategy to divert some of the future development pressure on Kuala Lumpur to a new town, dubbed as Kuala Lumpur Twin City at Bukit Tinggi.



Scenerio A : Concentrated Growth in Kuala Lumpur Conurbation Strategy



Scenerio B : Dispersal to Selected Growth Centres Strategy



Scenerio C : Dispersal and Twin City Strategy

Figure 3.1 : The Three Alternative Regional Development Scenarios

Evaluating these three scenarios, Scenario A will produce a further primacy state where Kuala Lumpur Conurbation would become a very large metropolitan area commanding the region's economy and development. The surrounding centres lagging in their development are unable to attract investment and to provide employment. Housing, transportation and other service sectors will require large investment in Kuala Lumpur to meet the huge demand.

Scenario B will produce a balanced urban hierarchy structure with each centre having specific function and providing employment, i.e. having specific identity and being more or less self-sufficient. The strain on Kuala Lumpur will be lessened and the need to travel to the established centres are kept to the minimum.

Scenario C will have the advantages of Scenario B and the proposal for a new city of Bukit Tinggi viewed as a long term planning strategy will enhance the linkage of Klang Valley Region to Kuantan and hence the east coast region.

Considering the national level Regional Development and Klang Valley Development Policy, a dispersal strategy within the Klang Valley and a promotion for a linkage of this important growth region to the east is desirable. Scenario C is therefore viewed as the likely and desirable future development scenario for the Klang Valley.

(2) Selected Future Regional Development Pattern

The future regional development plan for Klang Valley's balanced growth is to have an urban structure consisting of six (6) major growth centres, namely Kuala Lumpur, Shah Alam, Petaling Jaya, Klang, Bangi and Selayang with Bukit Tinggi Twin City in Klang Valley each having its own specific hierarchy of functions. In the process of attaining this desirable balanced urban growth, specific development policies have to be properly implemented. They are : –

(a) Growth in congested areas in the Federal Territory of Kuala Lumpur be dispersed to the new centres of Shah Alam, Bangi and Selayang and Bukit Tinggi Twin City.

(b) The new centres on their part have to upgrade their commercial, industrial and service activities so that they can function as self-contained centres.

(c) While the inclusion of Selayang and Petaling Jaya in the Kuala Lumpur Conurbation physically cannot be changed, efforts to maintain self-contained entity of urban centres at Klang, Shah Alam, Bangi and Bukit Tinggi must be made.

(d) In order to 'contain' urban growth at the six (6) centres with Bukit Tinggi Twin City, landuse plans for all the centres have to be effectively enforced within the gazetted boundary.

(e) The six (6) urban centres with Bukit Tinggi Twin City are to have specific urban functions, Kuala Lumpur and Bukit Tinggi as National Centre, Shah Alam as the State Capital of Selangor; Klang, Petaling Jaya, Bangi and Selayang as District Centres (see Figure 3.2)

As a catalyst for achieving the targetted growth for each centre, transportation linkages by road and rail have to be provided timely. Delay in the implementation of transportation network to provide direct linkages among the growth centres would add favours to the established centres of Kuala Lumpur and Petaling Jaya in attracting urban growth while new centres would lag behind.

The recommended regional development conceptual plan that consists of the urban hierarchy structure and urban transportation linkages is shown in Figure 3.3.

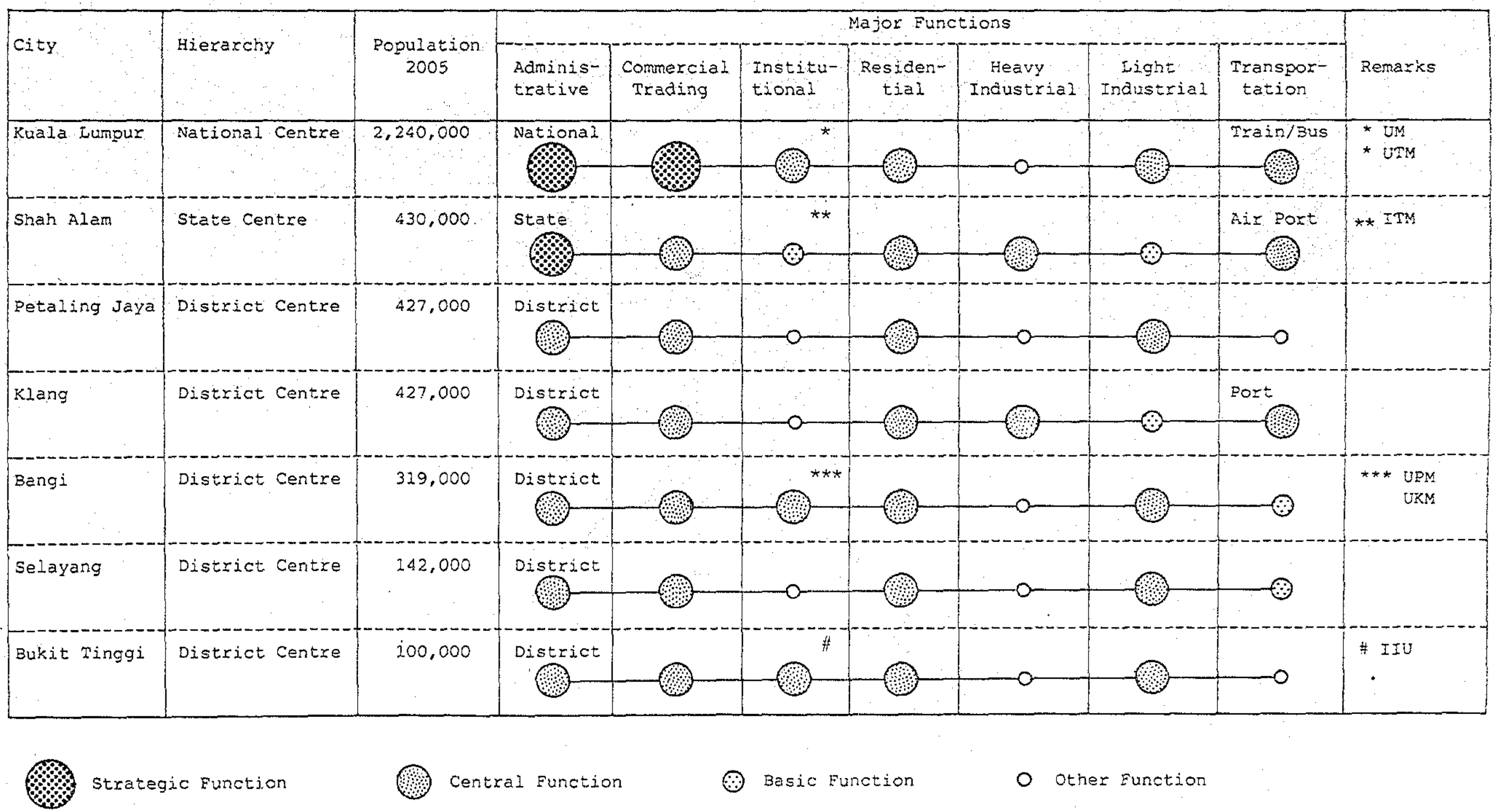


Figure 3.2 : Proposed Urban Functions Of Major Growth Centres

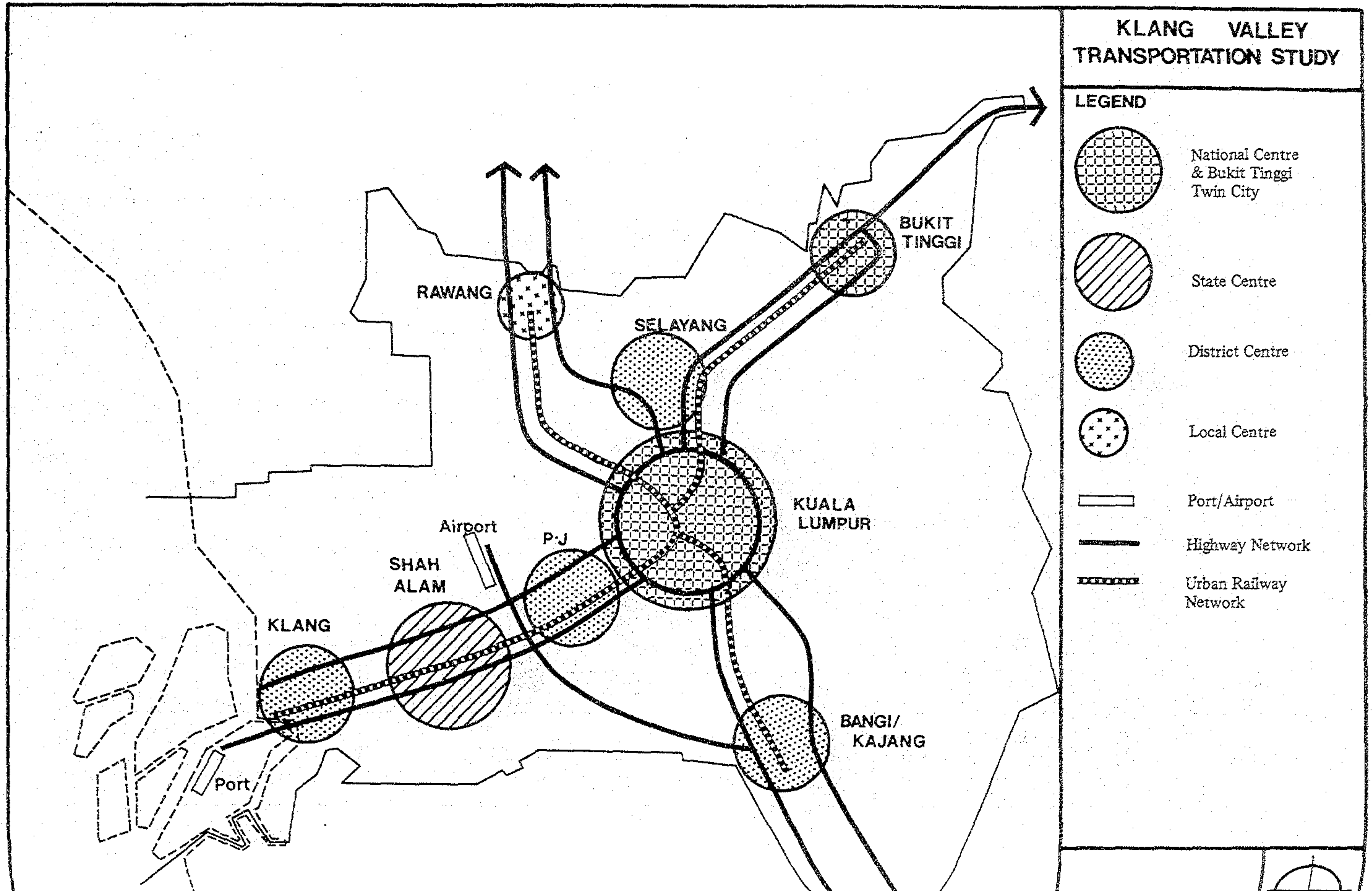


Figure 3.3 : Conceptual Regional Development Plan

3.2 Socio-Economic Framework

3.2.1 Economic Framework

(a) Projection of Gross Domestic Product

Malaysia was able to sustain a moderate economic growth between 1980 – 1984 at about 5.5% per annum. Due to the world economic recession, growth between 1984 and 1985 has dropped drasticaly to only 2.8%.

This current economic growth trend and target set in the Fifth Malaysia Plan together with the likely changes to the world economy have prompted the Study Team to project the Gross Domestic Product (GDP) based on the following three (3) scenarios, viz : –

High Estimates	:	The GDP is anticipated to grow by a higher average annual growth rate of 6% than that in the Fifth Malaysia Plan between 1986 and 2005
Medium Estimates	:	The average annual growth rate is expected to be at 5% between 1986 and 2005 following the target growth rate established in the Fifth Malaysia Plan
Low Estimates	:	The average annual growth rate is expected to be at a lower rate than that in the Fifth Malaysia Plan of about 3% between 1986 to 2005

Table 3.1 shows the projected Gross Domestic Product in 1995 and 2005.

Table 3.1 : Estimated Gross Domestic Product, Malaysia, 1985, 1995 and 2005

(In 1978 Constant Prices)

Year		Gross Domestic Product (M$ Million)	Average Annual Growth Rate (%)
1985 1) (Base Year)		59,544	–
1955 2)	Low	72,549	2.0
	Medium	96,665	5.0
	High	106,276	6.0
2005 2)	Low	97,500	3.0
	Medium	157,457	5.0
	High	190,324	6.0

Source : 1) Fifth Malaysia Plan
2) Klang Valley Transportation Study

(b) Projection of Gross Regional Product for Klang Valley

The GRP for Klang Valley was estimated for the period between 1985 and 2005 based on the assumption that percentage share of GRP in Selangor State is expected to improve from 15.2% in 1985 to 15.8% in 1995 and 16.4% in 2005. In the Federal Territory of Kuala Lumpur, percentage share of GRP is expected to increase from 15.1% in 1985 to 16.7% in 1995 and 17.5% in 2005. (Table 3.2)

In 1995, GRP of Selangor State and Federal Territory of Kuala Lumpur is estimated to attain M$31,416 million on medium estimates and in 2005, M$53,378 million. The GRP of Klang Valley is arrived at as shown in Table 3.3 by assuming a very gradual growth in the share of GRP for the region to the total Kuala Lumpur and Selangor State GRP.

Table 3.2 : Estimated Gross Regional Product, Federal Territory and Selangor State (In 1978 Constant Prices) And Their Share To GDP, 1985 – 2005

(In M$million)

	Federal Territory of Kuala Lumpur		Selangor State		Federal Territory of Kuala Lumpur and Selangor State		Malaysia	
	GRP	%	GRP	%	GRP	%	GDP	%
1) 1985	8971	15.1	9043	15.2	18014	30.4	59344	100.0
1) 1990	12068	15.9	11328	15.0	23396	30.9	75599	100.0
2) 1995	12116 16143 17748	16.7	11462 15273 16792	15.8	23578 31416 34540	32.5	72549 96665 106276	100.0
2) 2005	17062 27555 33307	17.5	15991 25823 31213	16.4	33053 53378 64520	33.9	97500 157457 190324	100.0

Source : 1) Fifth Malaysia Plan
2) Klang Valley Transportation Study

Table 3.3 : **Gross Regional Product – Share of Klang Valley To Kuala Lumpur And Selangor State**

(MS Million In 1978 Constant Prices)

Year	Federal Territory of Kuala Lumpur and Selangor State * A	Klang Valley Region B	Share of Klang Valley (%) B/A
1985 1)	18014	15511	86.1
1990 1)	23396	20564	87.9
1995 2)	31416	28275	90.0
2005 2)	53378	48842	91.5

Source : 1. Fifth Malaysia Plan, but GRP in Klang Valley Region is broken down in the Study
2. Klang Valley Transportation Study

Note : * Using the Medium Estimate from Table 3.2

(c) Household Income

Mean monthly household income in the Klang Valley Region is expected to grow in view of the anticipated economic growth, increasing productivity per employed person and increasing number of employed person per household. Previous years' figures for Peninsular Malaysia show a close correlation between mean monthly household income and per household GDP. Assuming that the correlation continues in Klang Valley, the average household income in the future are predicted as shown in Table 3.4.

Table 3.4 : Monthly Income Projection, Klang Valley, 1985 – 2005

(M$ in 1985 Constant Prices)

Income	1985 [1]	1995 [2]	2005 [2]	Average Annual Growth Rate (%) 1985 – 1995	1996 – 2005
Per Employee	763	873	1042	1.4	1.8
Per Capita	285	534	410	1.6	2.1
Per Household	1383	1578	1870	1.3	1.7

Source : 1) Results of H.I.S. 1985
2) Klang Valley Transportation Study

(d) Vehicle Ownership

The vehicle ownership is estimated by using the vehicle ownership models calibrated using the H.I.S. survey data (Figure 3.4). The projected future zonal population and average income are input into the models to obtain the future vehicle ownership level in 1995 and 2005.

Table 3.5 : Projection Of Persons By Vehicle Ownership Group, Klang Valley, 1985 – 2005

(1000 Persons)

		Non Vehicle	Motor Cycle	One Car	Multi Car	Total
1985	No.	599.2	712.2	934.3	288.3	2534.0
(Estimated)	%	23.6	28.1	36.9	11.4	100.0
1995	No.	878.2	1022.2	1483.0	556.5	3940.0
	%	22.3	26.0	37.6	14.1	100.0
2005	No.	1045.6	1313.3	2228.0	963.1	5550.0
	%	18.8	23.7	40.1	17.4	100.0

Source : Klang Valley Transportation Study

The total number of vehicles by type are projected to 2005 as shown in Table 3.6. Motorcycle is expected to increase to 662,000 and motorcar to 955,300 by the year 2005. Total vehicle growth rate is anticipated at 5.9% per annum from 1985 to 1995 and 5.5% from 1995 to 2005.

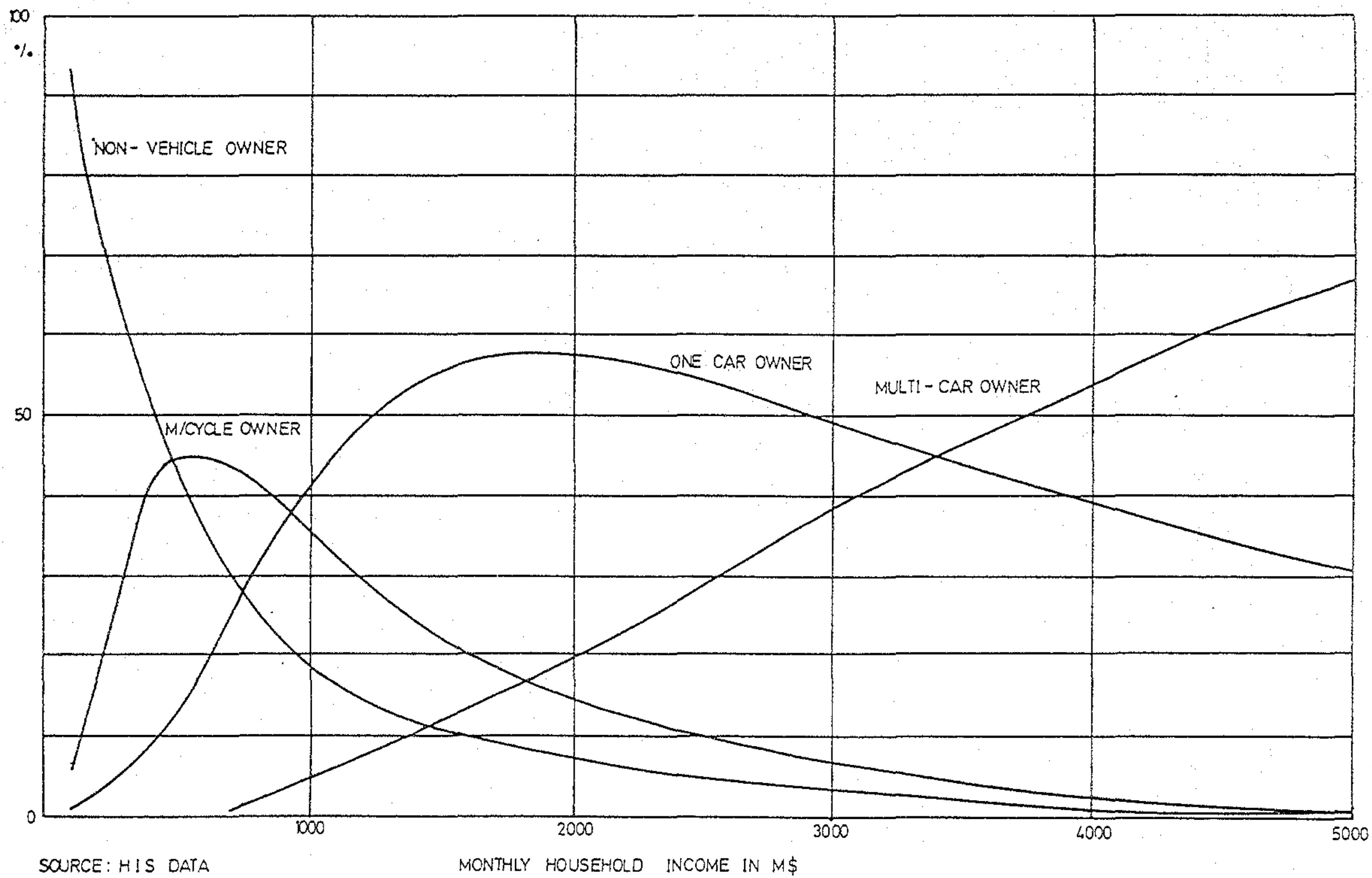


Figure 3.4 : Vehicle Ownership Curves, Klang Valley, 1985

Table 3.6 : Motor Vehicle Projection, Klang Valley, 1985, 1995 And 2005

	No. of Motor Vehicles ('000)			Average Annual Growth Rate In %	
	1) 1985	2) 1995	2) 2005	1985 – 1995	1996 – 2005
Motor Cycle	264.7	433.6	662.0	5.1	4.7
Motor Car	284.5	551.2	955.3	6.8	6.2
Taxi	6.8	13.2	20.0	6.8	5.5
Lorry	67.5	111.4	184.1	5.1	5.1
Total*	623.5 (358.8)	1109.4 (675.8)	1821.4 (1159.4)	5.9 (6.5)	5.5 (6.0)

Source : 1) Based on HIS and OIS Data
2) Projected by the Study Team

Note : * Figures in bracket exclude motorcycles

The vehicle ownership rate (per 1000 households) is shown in Table 3.7. Ownership rate for motorcycle is expected to increase to 543/1000 household and car 783/1000 household by 2005. That is to say in the year 2005, every four household will own 3 cars.

Table 3.7 : Motor Vehicle Per 1000 Households, Klang Valley, 1985, 1995 And 2005

	1985	1995	2005
Motorcycle	505	518	543
Motorcar	543	659	783
Taxi	13	15	16
Lorry	129	134	151
Total	1190 (685)	1326 (808)	1493 (950)

Note : Figures in bracket exclude motor cycles

3.2.2 Population Framework

(a) Population Targets

The procedure for establishing the future population framework for the Study Area is first to adopt the population targets set by the Klang Valley Perspective Plan to the year 2000. These population targets were then interpolated to 1995 and extrapolated to 2005.

For Klang Valley excluding Bukit Tinggi the population has increased from 2.0 million in 1980 to 2.5 million in 1985 and is estimated to increase to 3.9 million in 1995 and 5.5 million in 2005 (Table 3.8).

Table 3.8 : Future Population Framework, Klang Valley, 1985 – 2005

(In '000)

	1980	1985	1990	1995	2000	2005
Klang Valley as in the Perspective Plan 1)	2,020	–	3,283	–	4,760	–
Klang Valley's Population	2,020	2,534 2)	3,283	3,940 2)	4,760	5,550 2)
Bukit Tinggi Development	–	–	–	–	–	100
Klang Valley (without Bukit Tinggi)	2,020	2,534	3,283	3,940	4,760	5,450

Source : 1) Klang Valley Perspective Plan
2) The other figures are estimated by the Klang Valley Transportation Study

(b) Future Demographic Features

(i) Age Group

In estimating the age group composition of the estimated future population, a share and growth rate analysis is used with assumption on a declining fertility rate and smaller family. The increased 15 – 64 age group between 1970 – 1980 will advance into the 65+ age group by 2005. The future population by age group is estimated as in Table 3.9.

Table 3.9 : Estimated Future Population By Age Group, Klang Valley, 1985 – 2005

(In '000)

Age Group	1980 1)	1985 2)	1995 3)	2005 3)
0 – 5	290	363	573	810
6 – 14	373	468	721	1,019
15 – 64	1,300	1,632	2,534	3,574
65 +	57	71	109	107
Total	2,020	2,534	3,940	5,550

Source : 1) Statistics Department
2) Modified from HIS Data
3) Klang Valley Transportation Study

(ii) Ethnic Group Composition

The ethnic group composition of Klang Valley's Population is estimated as in Table 3.10.

The Perspective Plan has policised to allow the Malay migrants trend to continue though controlled in the future. The share of Malay population will increase while those of Chinese or Indian will declined slightly. In the target year of 2005, the Study Area's population will make up up of 43.5% Malays, 42.6% Chinese, 13.9% Indian and others.

Table 3.10 : Estimated Ethnic Composition, Klang Valley, 1985 – 2005

(In '000)

	1) 1985 ('000)	% Share	2) 1995 ('000)	% Share	2) 2005 ('000)	% Share
Malay	1005.7	39.7	1666.6	42.3	2414.3	43.5
Chinese	1147.7	45.3	1717.8	43.6	2364.3	42.6
Indian & Others	380.6	15.0	555.6	14.1	771.4	13.9
Total	2534.3	100.0	3940.0	100.0	5550.0	100.0

Source : 1) Modified from HIS Data
2) Klang Valley Transportation Study

(iii) Household Size

The existing trend of declining household size is assumed to continue into the future years. Klang Valley is estimated to have an average household size declining from 4.8 pphh in 1985 to 4.7 pphh in 1995 and 4.5 pphh in 2005.

Household size in the Federal Territory of Kuala Lumpur is expected to decline faster than the other areas of Klang Valley. The household size for Federal Territory is estimated to fall to 4.7 pphh in 1995 and and 4.4 pphh in 2005 (Table 3.11).

With these estimated household sizes, the future number of households are estimated as shown in Table 3.12.

Table 3.11 : Future Household Size, 1985 – 2005

(Person Per Household)

Area	1) 1970	2) 1980	3) 1985	3) 1995	3) 2005
Federal Territory of Kuala Lumpur	–	4.87	4.67	4.54	4.38
Rest of Klang Valley	–	5.22	5.00	4.86	4.68
Klang Valley	5.68	5.04	4.84	4.71	4.55

Source : 1) 1970 Population Census
2) 1980 Population Census
3) Klang Valley Transportation Study

Table 3.12 : Projection of Number of Households

('In 000)

	1985		1995		2005	
	Population	Household	Population	Household	Population	Household
Federal Territory of Kuala Lumpur	1215.0	260.2	1770.0	389.9	2240.0	511.4
Bukit Tinggi	–	–	–	–	100.0	22.8
Rest of Klang Valley	1319.0	263.8	2170.0	446.6	3210.0	685.6
Klang Valley	2534.0	524.0	3940.0	836.5	5550.0	1219.8

Source : Klang Valley Transportation Study

(c) Population Distribution by Districts and Major Urban Centre

The projected future population is distributed into districts and major towns taking into account the proposed distribution pattern in the Klang Valley Perspective Plan and targets in the Structure Plans for the major urban centres. The population distribution policy is basically that of encouraging faster growth in the District of Gombak and Hulu Langat while maintaining those of the other more developed districts (see Tables 3.13 and 3.14).

Table 3.13 : Population Distribution By District, Study Area, 1985 – 2005

District		1980[1]		1985[2]		1995[3]		2005[3]
Kuala Lumpur	Number ('000)	997		1215		1770		2240
	Annual Growth Rate (%)		4.0		3.8		2.4	
Gombak District	Number ('000)	176		243		444		746
	Annual Growth Rate (%)		4.7		6.2		5.3	
Hulu Langat District	Number ('000)	188		240		386		630
	Annual Growth Rate (%)		5.0		4.9		5.0	
Petaling District	Number ('000)	382		491		850		1157
	Annual Growth Rate (%)		5.0		5.6		3.1	
Klang District	Number ('000)	276		345		490		677
	Annual Growth Rate (%)		3.1		3.6		3.3	
Klang Valley	Number ('000)	2020		2534		3940		5450
	Annual Growth Rate (%)		4.6		4.5		3.3	
Bukit Tinggi	Number ('000)	–		–		–		100
	Annual Growth Rate (%)		–		–		–	
Study Area	Number ('000)	2020		2534		3940		5550
	Annual Growth Rate (%)		4.6		4.5		3.5	

Source: 1) 1980 National Census
2) Home Interview Survey in 1985
3) Projected by the Klang Valley Transportation Study based on the KVPP, Kuala Lumpur Structure Plan, Reports of Survey of Klang Structure Plan and Bangi Structure Plan and Interim Gombak Development Plan

Table 3.14 : Population Distribution By Major Centres, Klang Valley, 1985 – 2005

Major Centres		1980		1985		1995		2005
Kuala Lumpur	Number ('000)	997		1215		1770		2240
	Annual Growth Rate (%)		4.0		3.8		2.4	
Selayang[1]	Number ('000)	14		17		107		142
	Annual Growth Rate (%)		4.0		20.2		2.9	
Bangi[2]	Number ('000)	33		65		150		319
	Annual Growth Rate (%)		14.5		7.0		7.8	
Shah Alam[3]	Number ('000)	20		52		260		430
	Annual Growth Rate (%)		19.1		17.9		5.6	
Petaling Jaya[3]	Number ('000)	220		260		350		427
	Annual Growth Rate (%)		3.4		3.0		2.0	
Klang[3]	Number ('000)	203		247		365		427
	Annual Growth Rate (%)		4.0		4.0		1.2	

Source: 1) Includes Selayang Baru and Bandar Baru Selayang
2) Means Local Planning Authority Area of Bangi
3) Means Municipality Areas

3.2.3 Employment Framework

(a) Total Employment Projection

The number of employment in future is projected based on the GRP and population estimates. The procedure for the employment projection is shown in Figure 3.5. The projection is done based on the assumption that the participation rate will grow slowly while the unemployment rate will decrease in future.

The total employment in the Study Area is expected to grow from 950,000 in 1985 to 2,190,000 in 2005, including 40,000 in Bukit Tinggi (Table 3.15).

Table 3.15 : Estimated Future Total Employment, Klang Valley, 1985 – 2005

('000)

	1980 3)	1985 4)	1990 5)	1995	2000	2005
Population	2020	2534	3283	3940	4760	5550
Working Age Population (15 – 64)	1300	1632	2114	2537	3065	3574
Participation Rate (%) 1)	62.0	62.5	63.0	63.5	64.0	64.5
Labour Force	806	1020	1332	1610	1962	2305
Unemployment Rate (%)	5.7	7.0	6.5	6.0	5.5	5.0
Unemployment 2)	46	70	87	96	108	115
Employment	760	950	1245	1514	1854	2190

Notes : 1) Participation rate is defined as labour force per working age population
2) Unemployment is defined as the status of employment as not at work, actively unemployed and inactively unemployed and out of labour force

Source : 3) Department of Statistics
4) Modified from HIS Data by Klang Valley Transportation Study Team
5) Klang Valley Transportation Study

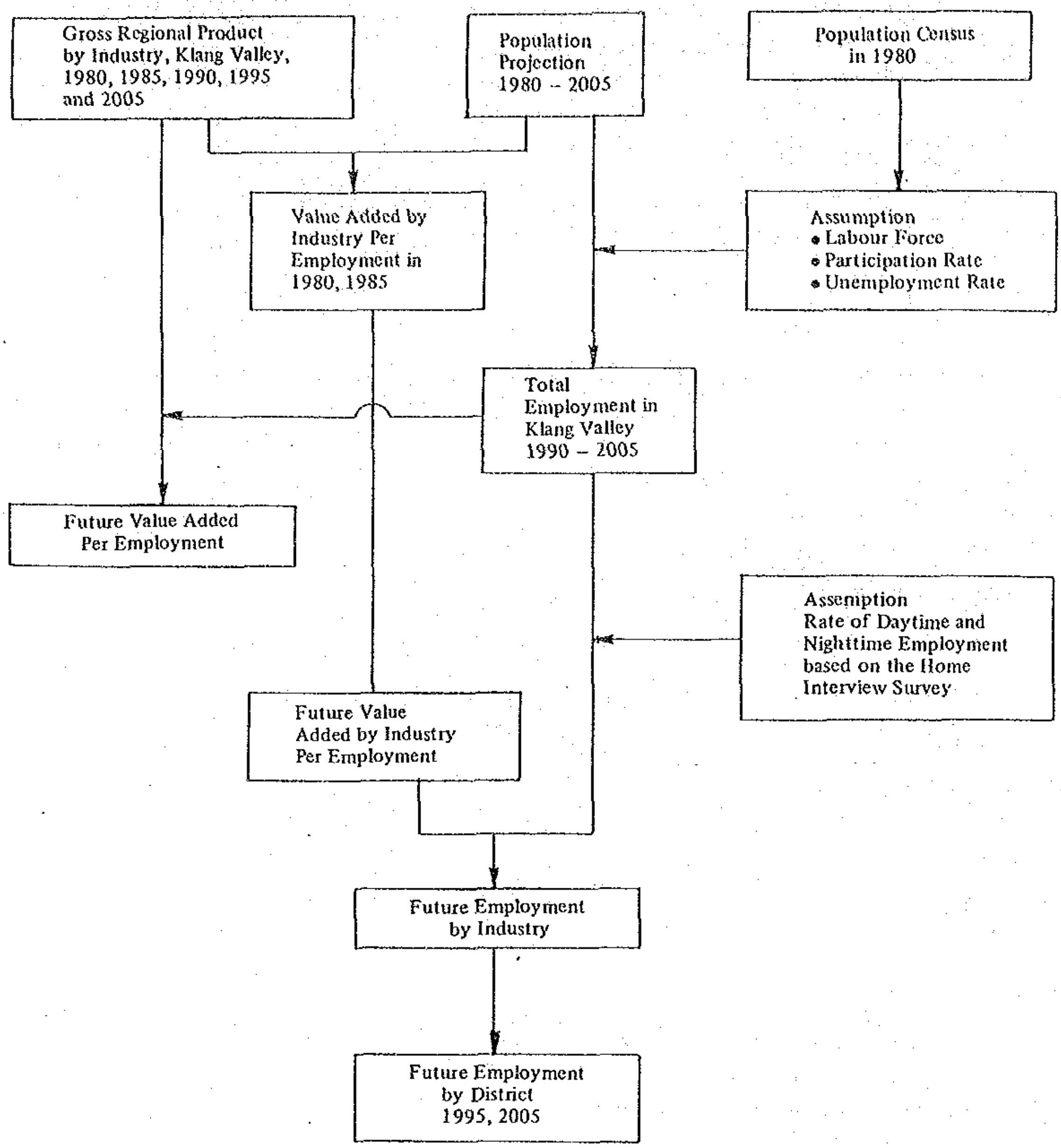


Figure 3.5 : Procedure For Employment Projection By District

(b) Total Employment by Industry

Employment by industry is projected based on the value added and the total employment.

The primary industry is expected to decline slowly whilst the secondary industry is expected to grow to 2.0 times from 1985 to 2005, and the tertiary industry is also expected to grow to 2.5 times for the same period.

Table 3.16 : Value Added By Industry, Klang Valley, 1985 – 2005

(M$/Employment)

	1980 [1]	1985 [1]	1995 [2]	2005 [2]
Primary	4399	6631	7333	8595
Secondary	18992	20301	22450	26315
Tertiary	13690	15348	16972	19895
Total	14604	16327	18055	21164

Source : 1) Calculated from GRP and Employment
2) Klang Valley Transportation Study

Table 3.17 : Employment By Industry, Klang Valley, 1985 – 2005

Industry	Employment ('000)				Average Annual Growth Rate (%)	
	1980 [1]	1985 [2]	1995 [3]	2005 [3]	1985 – 1995	1996 – 2005
Primary	56.6	46.3	45.2	38.7	-0.2	-1.5
Secondary	230.2	269.3	400.6	550.5	4.1	3.2
Tertiary	473.2	634.4	1068.2	1600.8	5.3	4.1
Total	760.0	950.0	1514.0	2190.0	4.8	3.8

Source : 1) Department of Statistics
2) Modified from HIS data
3) Klang Valley Transportation Study

(c) Distribution of Employment by District

Employment by industry by districts is derived based on the ratio of employment in the working and residential location and the census population figure in 1980.

Future values of this ratio for Kuala Lumpur and Petaling district are assumed to decrease judging from the effects of development to be promoted in the other districts.

Table 3.18 : Ratio Of Employment In Working And Residential Location, Klang Valley, 1985 – 2005

District	1985 1)	2005 2)
Kuala Lumpur	1.13	1.09
Gombak	0.70	0.80
Hulu Langat	0.49	0.80
Petaling	1.13	1.09
Klang	0.81	0.90

Source: 1) Results of HIS Data, 1985
2) Klang Valley Transportation Study

3.3 Future Landuse Plan

3.3.1 Major Landuse Planning Issues in Klang Valley

The results of the existing landuse study, examination of development trend and directions and the review of the structure planning of the urban centres have helped in identifying the major landuse planning issues in the Study Area.

(1) General Issues

(a) Residential development is spreading from the built-up areas with fairly low density which encourages the use of private vehicles. As these urban areas expand, public transport become less efficient to serve such a large conurbation. This indirectly inhibited the mobility of people who do not own any private vehicles especially the lower income groups, the aged and the young. From the transportation economics point of view, urban centres should be more compact.

The low density development does not encourage higher efficiency in infrastructure investment. Low density development requires higher investment on roads, utilities supply, waste collection, etc.

(b) Within the existing urban areas, there are substantial governmental or institutional land which have not been put to more efficient use. This is particularly true for Kuala Lumpur whose institutional land occupies some 19% of the total built up area. This also explains the persistence of some of the squatter settlements.

(2) Kuala Lumpur

(a) Based on the Kuala Lumpur Structure Plan, inside the Central Planning Area, people will have to live in high rise apartments and the low income group tends to remain. As witnessed in many other cities there is a probability that the centre can become a slum area.

(b) There is still no local plans prepared for Kuala Lumpur to effect better development control and ensure better living environment at the lower planning level.

(c) The planned Damansara sub-centre does not reflect any effort to take advantage of the planned LRT system. Possible diversion or a new line connecting Damansara-Kuala Lumpur City Centre has to be studied. Bukit Jalil is located too far out to the south. It is more desirable to shift Bukit Jalil sub-centre slightly towards the north (Bukit Indah area).

(3) Shah Alam

(a) The structure plan targetted a population of 131 thousand by 1985, however estimate by the State recently has placed the figures only at 48 thousand people in 1985 or 36.6% of the target.

One of the reasons for the under development of Shah Alam is the slow development in commercial and business functions in the urban centre coupled with the lack of a public transport system, all of which do not encourage new residents. The State Government's policy in achieving certain level of ethnic mix and the control of prices for houses by PKNS are the other reasons.

(b) Average population density of built up area will be 64.4 person/ha in the ultimate stage. Such low density development is disadvantageous for public transport development.

(4) Klang

(a) The promotion of a satelite town at Meru requires the strengthening of transport linkage between the existing centre and Meru.

(b) The Malay Reserve Land within the existing centre and especially along the newly completed North Straits Bypass is infact forcing the development to spread to the south and north. The authority should try to suggest proposals to develop the Malay Reserve Land as these areas are strategically located and with high accessibility. It is also a way to achieve a more compact city.

(5) Bangi

(a) Bangi New Town as proposed by the Structure Plan is a very low density development (57.5 pp/ha in residential area). Such low density again does not encourage the development of an efficient public transport.

(b) Development by PKNS for the town centre needs to be stepped up.

3.3.2 Future Landuse Requirements

Based on the future population and employment framework described in the previous section, the future landuse requirement in each district of Klang Valley is estimated according to the procedure illustrated in Figure 3.6.

The relationship between existing landuse with population and employment pattern is first analysed which forms the basis for estimating the tentative future landuse requirements by district. This is then evaluated from the viewpoint of the future development concepts and structure plans. Consequently, the land use requirements which are in line with the chosen fufure development concept and structure plans in Klang Valley is established.

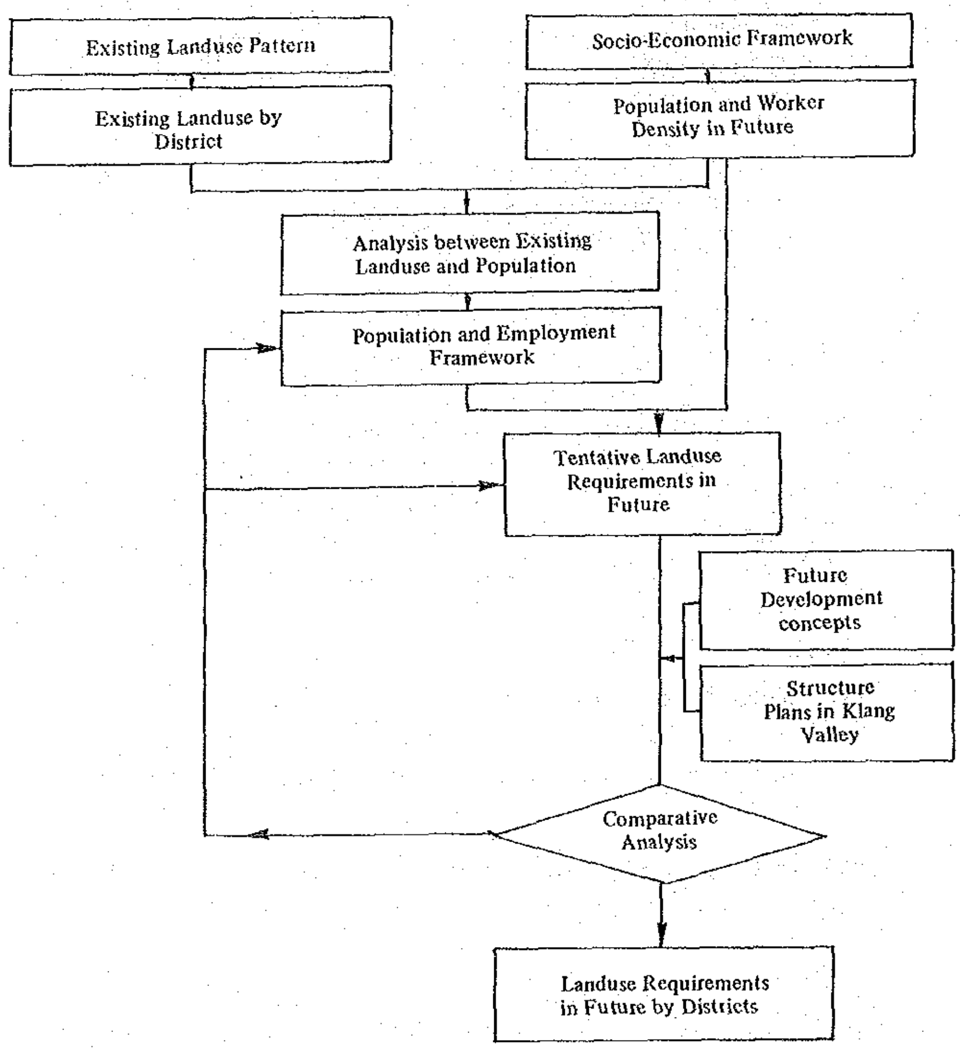


Figure 3.6 : Flowchart To Determine Future Landuse Requirements

The total urbanized area is expected to increase from 33,580 ha in 1985 to 48,280 ha in 1995 and 65,060 ha in 2005. The percentage share of urbanized area to the total area is therefore expected to grow from 12% in 1985 to 17% in 1995 and 23% in 2005.

The future urbanized area increment by district and landuse are shown in Table 3.19 and the future landuse distribution pattern by district is shown in Table 3.20.

Table 3.19 : Urban Area Requirements, Klang Valley, 1985 – 2005

District	Existing Urbanized Area (ha) 1985	Urbanized Area Increment (1985 – 2005)					Future Urbanized Area (ha) 2005
		Residential (ha)	Commercial (ha)	Industrial (ha)	Other Landuse (ha)	Total (ha)	
Kuala Lumpur	14,273	4,282	1,416	1,163	1,173	8,034	22,307
Gombak	3,744	3,513	338	698	1,297	5,846	9,590
Hulu Langat	3,980	2,617	397	449	1,978	5,441	9,421
Petaling	7,860	4,098	876	677	2,489	8,140	16,000
Klang	3,723	2,503	297	578	639	4,017	7,740
Total	33,580	17,013	3,324	3,565	7,576	31,478	65,058

Note : Exclusive of Bukit Tinggi

Source : Klang Valley Transportation Study

Table 3.20 : Future Landuse Requirements, Klang Valley, 2005

District	Urbanized Area (ha)					Undeveloped/ Agricultural Area (ha)	Total Area (ha)
	Urbanized Area	Commercial Area	Industrial Area	Other Landuse	Total		
Kuala Lumpur	11,276	2,346	1,710	6,975	22,307	1,933	24,240
Gombak	5,343	455	1,010	2,782	9,590	55,728	65,318
Hulu Langat	4,567	480	667	3,707	9,421	73,523	82,944
Petaling	8,020	1,350	2,070	4,560	16,000	40,798	56,798
Klang	4,520	470	990	1,760	7,740	47,178	54,918
Total	33,726	5,101	6,447	19,784	65,058	219,160	284,218

Note : Exclusive of Bukit Tinggi

Source : Klang Valley Transportation Study

3.3.3 Population and Employment Distribution

The procedure for determining the population and employment distribution is illustrated in Figure 3.7.

The tentative spatial distribution of landuse is first determined taking into account the landuse requirement by districts, the existing landuse pattern, the identified development pressure area and the chosen urban development concept.

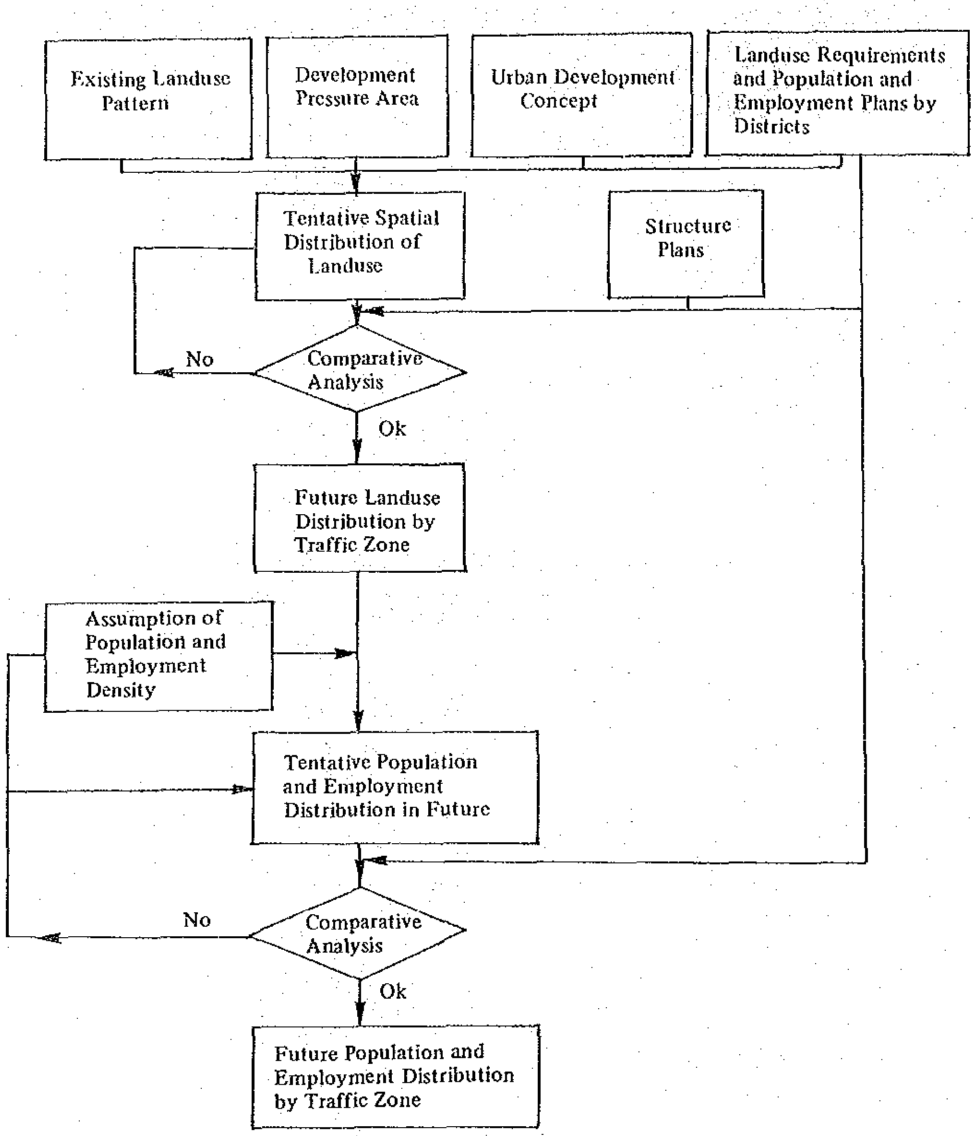


Figure 3.7 : Procedure For Population And Employment Distribution Planning

The future landuse distribution by traffic zone is then determined with a comparative analysis using inputs from population and employment plans by district and the structure plans in the Klang Valley. Following to this, the future population and employment distribution in each traffic zone is estimated using the landuse pattern in each of the traffic zones and the assumed population and employment densities respectively.

The results of the population distribution by district is shown in Figure 3.8 and that of employment in Figure 3.9.

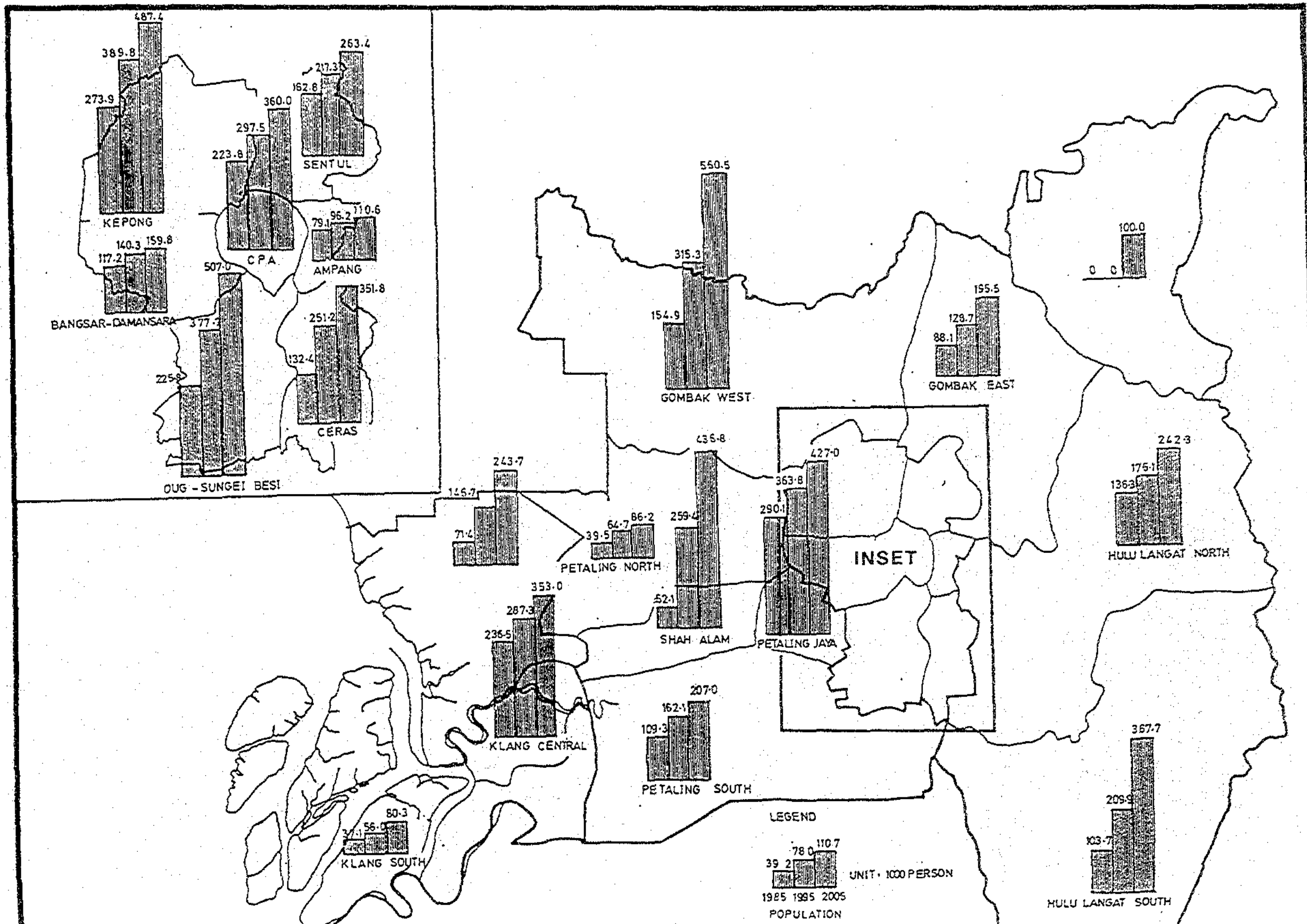


Figure 3.8 : Population Distribution Plan

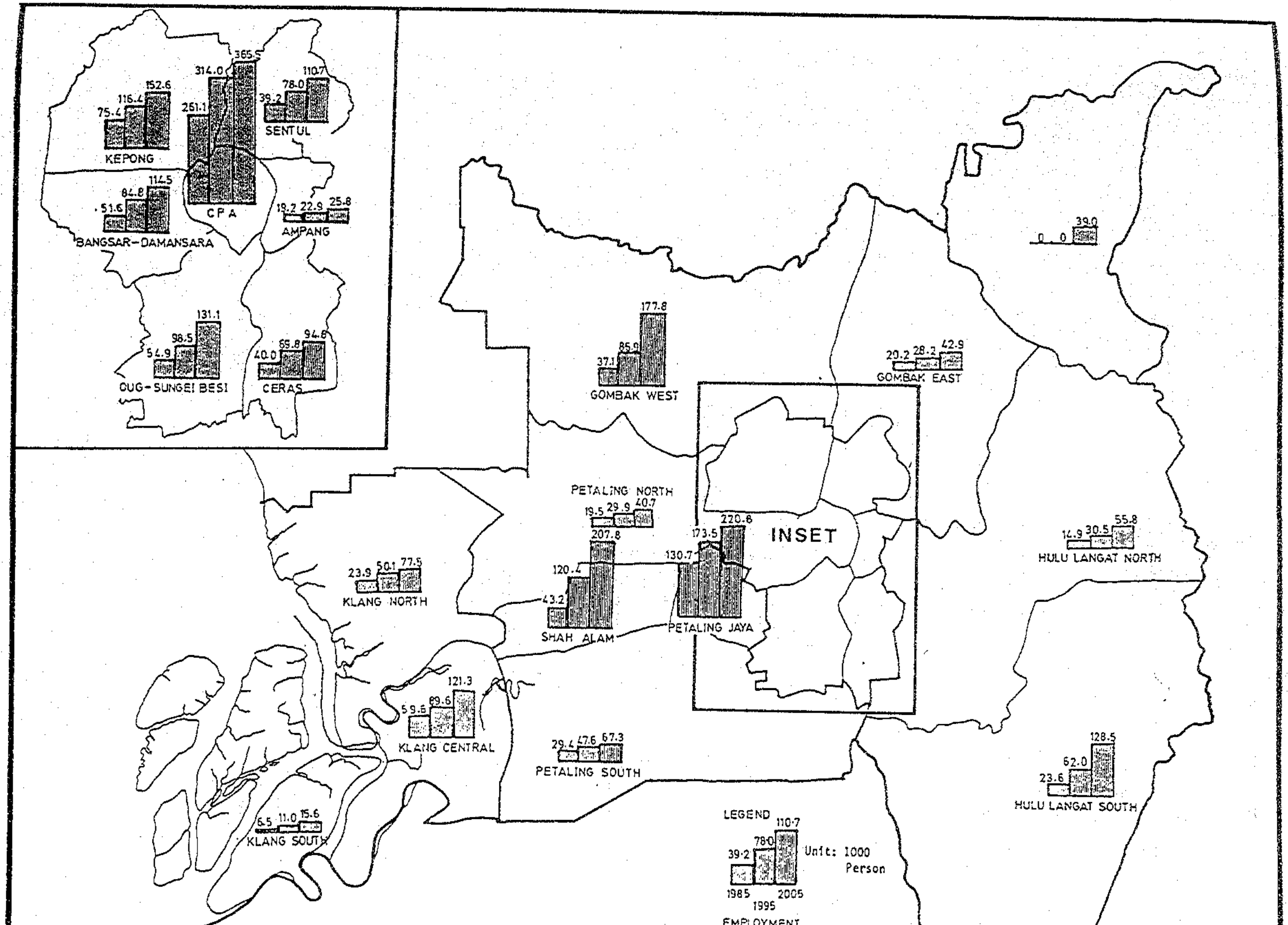


Figure 3.9 : Employment Distribution Plan

CHAPTER 4 : FUTURE TRAVEL DEMAND FORECASTING AND TRANSPORT SITUATION UNDER DO-NOTHING CASE

4. FUTURE TRAVEL DEMAND FORECASTING AND TRANSPORT SITUATION UNDER DO NOTHING CASE

4.1 General

The forecasting of future transport demand under the 'Do-Nothing Situation' is to simulate the future transport demand situation under an assumed circumstance that no improvement to the existing transportation system will be made. The results of such a simulation provide some form of bench mark or control for formulating future transportation plans.

The methodology for future travel demand is outlined first in this section followed by the forecasted transport conditions under the 'Do-Nothing' situation.

4.1.1 Procedure for Transport Demands Forecasting

Transport demands data consisting of person and freight movements are obtained from the HIS and OIS. The former provided data for the person trip movement while the latter for the freight traffic movement in the Study Area. The procedure for transport demands forecasting is divided into two(2) streams in this study, namely:-

a) Person Movement Traffic Demand
b) Freight Movement Traffic Demand

The conceptual procedure for each transport demand forecasting applied in this study is illustrated in Figure 4.1.

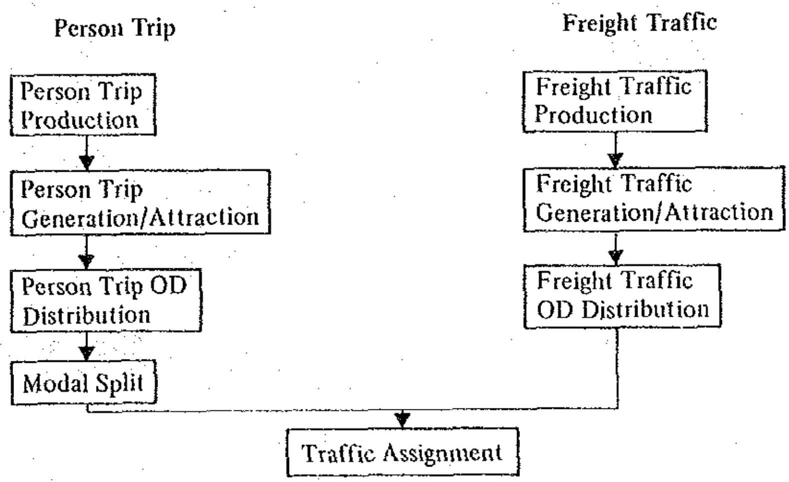


Figure 4.1: Conceptual Procedure for Transport Demands Forecasting

The procedure also allows for changes in the socio-economic factors in travel demand forecasting. Figure 4.2 shows the inter-relation between the changes of socio-economic, transportation system and the transport demands forecasting.

The detailed procedure adopted by the Study Team for transport demands forecasting is shown in Figure 4.3.

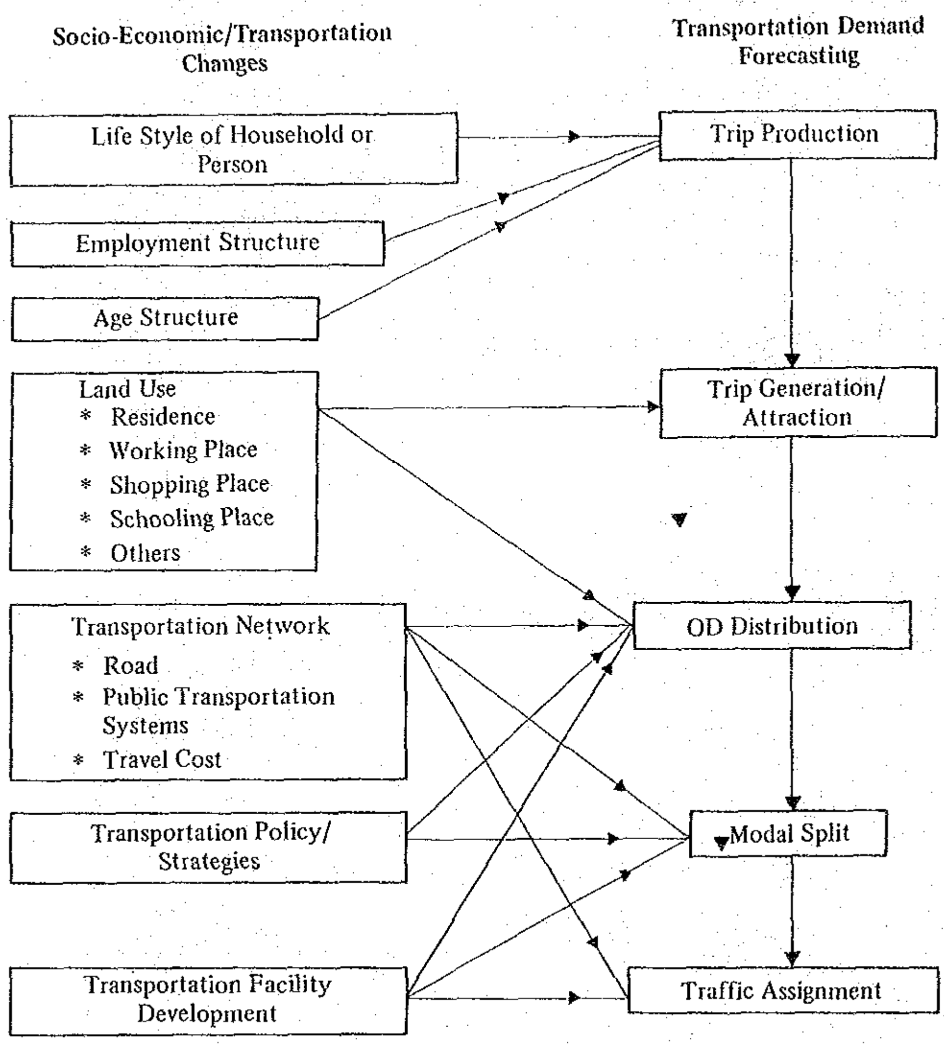


Fig. 4.2: Inter-relation between Changes of Socio-economic and Transportation System and Transport Demand Forecasting

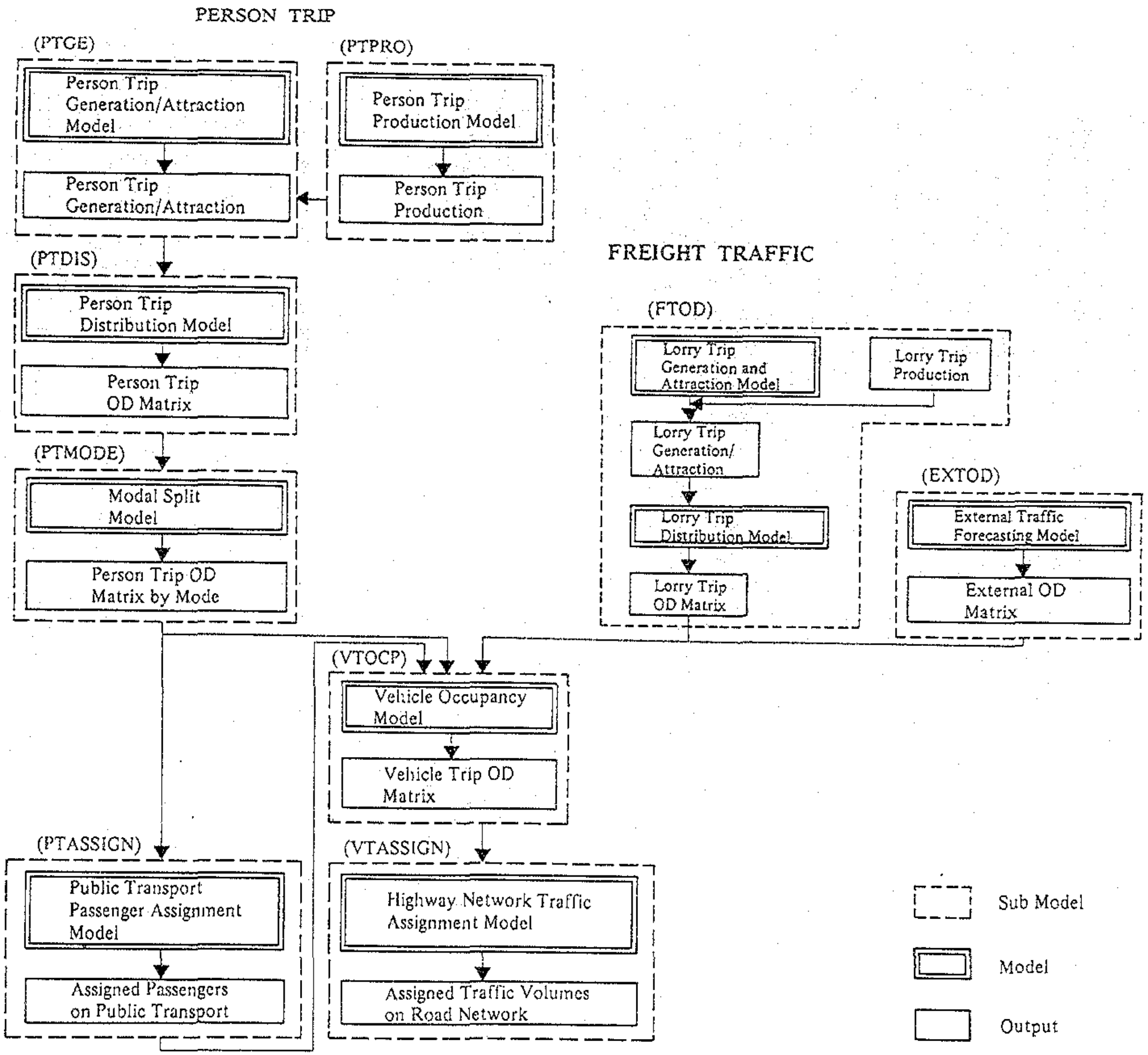


Fig. 4.3 : Procedure for Traffic Demand Forecasting

4.2 Forecasting of Person Trip Demands

4.2.1 Person Trip Procedure (Code: PTPRO in Figure 4.3)

(1) Trip Production Model Analysis

'Trip Production' is principally defined as the number of daily person trips produced in the entire study area by persons or households.

Based on past experiences, the number of trips made by a person is largely dependent on the socio-economic characteristics of that person or his household.

In the H.I.S., various household or person characteristics were surveyed.

As a result of the non-iterative two-way layout analysis of variance of the household and person characteristics or category, the following observations can be made.

(a) Among the categories, the most influential category on the trip production rate is the employment status.

(b) For "to school" and "business" trip purposes, the categories of "age" and "sex" are both influential on the trip production rates respectively. However, the difference in variance between "age" or "sex" and "employment status" for these trip purposes are comparatively small. Therefore, the "employment status" category must be taken into account as a second-ranking category.

(c) Vehicle ownership is also to be considered as one of the factors that influences trip production.

The analysis shows that the following factors are effective in explaining the person trip production structure:-

* Employment Status

* Vehicle Ownership

The formula of the trip production forecasting model is therefore taken to be:-

$$T^{\rho} = \sum_{\kappa}\sum_{\ell} A^{\rho}_{\kappa\ell} \times N_{\kappa\ell}$$

T^{ρ} : Trip production by trip purpose (ρ)

$A^{\rho}_{\kappa\ell}$: Trip production rate by trip purpose (ρ), vehicle ownership (κ) and employment status (ℓ)

$N_{\kappa\ell}$: Population by vehicle ownership (κ) and employment status (ℓ)

Table 4.1 shows the trip production rate ($A^{\rho}_{\kappa\ell}$) by trip purpose, vehicle ownership (κ) and employment status (ℓ).

Table 4.1 : Trip Production Rate By Vehicle Ownership By Employment Status and Trip Purpose in Klang Valley

Vehicle Ownership Category (κ)	Employment Status Category (ℓ)	$A_{\kappa\ell}^{\rho}$ = Trip production rate by trip purpose (ρ)					
		To Work	To School	HB Business	NHB Business	HB Private	NHB Private
Non Car	Employed	0.989	0.000	0.040	0.221	0.312	0.380
	Student	0.000	0.994	0.005	0.003	0.226	0.083
	Housewife	0.000	0.000	0.022	0.005	0.888	0.057
	Jobless	0.000	0.000	0.036	0.042	0.712	0.088
Motor Cycle	Employed	1.049	0.000	0.045	0.257	0.369	0.437
	Student	0.000	1.025	0.006	0.004	0.245	0.085
	Housewife	0.000	0.000	0.023	0.006	0.902	0.053
	Jobless	0.000	0.000	0.077	0.039	0.878	0.115
One Car	Employed	0.999	0.000	0.073	0.388	0.486	0.646
	Student	0.000	0.984	0.006	0.004	0.307	0.112
	Housewife	0.000	0.000	0.025	0.017	1.180	0.113
	Jobless	0.000	0.000	0.096	0.075	0.973	0.126
Multi Car	Employed	0.978	0.000	0.110	0.566	0.525	0.644
	Student	0.000	1.002	0.012	0.013	0.353	0.123
	Housewife	0.000	0.000	0.028	0.022	1.508	0.199
	Jobless	0.000	0.000	0.084	0.097	1.097	0.218

Unit: Trips/Person/Day
HB: Home-Based
NHB: Non Home-Based

(2) Forecasting of Person Trip Production

Table 4.2 shows the daily person trips produced in Klang Valley Region. The daily person trip production is expected to grow from 6.4 million in 1985 to 10.2 million in 1995 and 14.6 million in 2005 with an annual growth rate of 4.7% from 1985-1995 and 3.7% from 1995 to 2005.

Table 4.2: Daily Person Trip Production, Klang Valley, 1985-2005

TRIP PURPOSE	1985	1995	2005	Average Annual Growth Rate (%) 1985-1995	1995-2005
To Work	936,500 (14.6%)	1,493,300 (14.7%)	2,136,400 (14.7%)	4.8	3.6
To School	678,200 (10.6%)	1,098,600 (10.8%)	1,548,900 (10.6%)	4.9	3.5
Business	402,900 (6.3%)	676,100 (6.7%)	1,066,300 (7.3%)	5.3	4.7
Private	1,701,200 (26.5%)	2,690,000 (26.5%)	3,867,000 (26.5%)	4.7	3.7
To Home	2,706,700 (42.0%)	4,208,100 (4.3%)	6,013,100 (40.9%)	4.5	3.6
Total	6,425,500 (100%)	10,166,100 (100%)	14,571,700 (100%)	4.7	3.7

Note: (%) is percent composition of trip by purpose

Unit: Trips per day

4.2.2 Person Trip Generation and Attraction (Code: PTGA)

(1) Model Analysis

Trip generation is defined as the number of trips generated by each traffic zone per unit of time (daily), while the trip attraction is defined as those attracted by each traffic zone per unit of time (daily).

Trip generation or attraction is hence concerned with predicting the future level of person or vehicle travel due to changes in the activities in the traffic zones. Hence a traffic zone that will experience an increase in residential population would expect to generate more person travel demand. A newly developed Central Business District (CBD) area would on the other hand expect to attract more person work trips. The strong influencing factors in determining trip generation or attraction are:-

(a) The landuse pattern and developments in the area as reflected by increase or decrease in residential population and employment

(b) The socio-economic characteristics of the population such as age, income, vehicle ownership

(c) The nature, extent and capabilities of the transport system in the area.

Taking into account these factors, the model analysis for person trip generation and attraction is made.

i) Trip Generation

The trip generation model adopts the same model structure established in the trip production model.

$$G_i^{\rho} = \sum_{\kappa}\sum_{\ell} a_{\kappa\ell}^{\rho} \times N_{\kappa\ell i}$$

Where:

G_i^{ρ} : Trip Generation by trip purpose (ρ) and zone (i)

$a_{\kappa\ell}^{\rho}$: Trip Generation rate same as the trip production rate by trip purpose (ρ), vehicle ownership (κ) and occupation (ℓ)

$N_{\kappa\ell i}$: Population by vehicle ownership (κ), occupation (ℓ) and zone (i)

This model is used only for "Home-based purposes, namely "to work", "to school", "home-based private" and "home-based business".

For "Non home-based private and business" trips, the following multiple linear regression analysis model is adopted:-

$$G_i^{\rho} = a_0^{\rho} + a_1^{\rho} X_{1i} + \ldots\ldots + a_{\kappa}^{\rho} X_{\kappa i}$$

Where:

G_i^{ρ} : Trip Generation by Trip purpose (ρ) and zone (i)

a_0 : Constant

$a_1 \sim a_k$: Coefficients

$X_{1i} \sim X_{ki}$: Zonal Socio-Economic parameters

Table 4.3 shows the result of trip generation model analysis.

Table 4.3: Trip Generation Models

Trip Purpose	Category	Trip Generation, G	Correlation Coefficient	Standard Error	% Error
To Work	Non Vehicle Owner	G = 0.98228NEPN	0.996	244	9.2
	Motor Cycle Owner	G = 1.04118NEPM	0.988	435	13.4
	Car Owner	G = 0.96455NEPC	0.989	625	12.1
To School	Non Vehicle Owner	G = 0.9958NSTN	0.995	104	11.0
	Motor Cycle Owner	G = 1.02152NSTM	0.993	243	10.8
	Car Owner	G = 0.97862NSTC	0.994	378	9.5
Home Based Business	Non Vehicle Owner	G = 0.2927POPN - 22	0.774	140	91.6
	Motor Cycle Owner	G = 0.02870POPM + 23	0.772	150	66.1
	Car Owner	G = 0.05442POPC - 53	0.857	337	55.8
Non Home Based Business	Non Vehicle Owner	G = 0.05141DEP3 + 0.01348DEP + 10	0.907	288	49.1
	Motor Cycle Owner	G = 0.05045DEP3 + 0.02568DEP + 117	0.906	343	41.9
	Car Owner	G = 0.21477DEP3 + 0.04408DEP + 70	0.941	889	37.8
Home Based Private	Non Vehicle Owner	G = 0.35487POPN + 394	0.852	1279	50.9
	Motor Cycle Owner	G = 0.45009POPM + 79	0.883	1518	46.3
	Car Owner	G = 0.59239POPC - 47	0.910	2755	38.7
Non Home Based Private	Non Vehicle Owner	G = 0.10214DEP3 + 0.04694DEP - 117	0.900	698	55.9
	Motor Cycle Owner	G = 0.00447DEP3 + 0.13537DEP + 153	0.831	972	58.2
	Car Owner	G = 0.36239DEP3 + 0.14003DEP - 382	0.958	1454	34.8

Where.
NEPN, NEPM, NEPC = Total Night Time Working Population by vehicle ownership type (N: Non Vehicle Owner, M. Motor Cycle Owner, C Car Owner)
NSTN, NSTM, NSTC = Total Night Time Student Population by vehicle ownership type
POPN, POPM, POPC = Night Time Population Aged 6 Yeard and above by vehicle ownership type
DEP3 = Daytime Employment of Tertiary Industry
DEP = Total Daytime Employment

ii) Trip Attraction

For the trip attraction, multiple linear regression method will determine the relationship between a dependant variable (trip attraction) and an array of independent variables (socio-economic parameters) as in the following;-

$$A_i^\rho = b_o^\rho + b_1^\rho X_{1i} + \ldots\ldots + b_j^\rho X_{ji}$$

Where:

A_i^ρ : Trip Attraction by trip purpose (ρ) and zone (i)

b_o : Constant

$b_1 \sim b_j$: Coefficients

$X_{1i} \sim X_{ji}$: Zonal Socio-economic parameters

Table 4.4 shows the trip attraction models.

Table 4.4: Trip Attraction Models

Trip Purpose	Trip Attraction, A	Correlation Coefficient	Standard Error	% Error
To Work	A = 1.05181DEP2 + 0.99865DEP3 + 141	0.995	1067	9.7
To School	A = 0.97987DST	0.997	563	7.1
Home based Business	A = 0.02445DEP3 + 0.06659DEP + 52	0.830	617	62.7
Non Home Based Business	A = 0.26926DEP3 + 0.11135DEP + 283	0.947	1245	33.1
Home Based Private	A = 0.25884POP + 0.69345DEP3 + 0.25212DST - 1422	0.857	6435	49.8
Non Home Based Private	A = 0.03071POP + 0.79656DEP3 + 0.05215DST - 759	0.913	3546	50.0

Where:

DEP 2 = Daytime Employment of Secondary Industry
DEP3 = Daytime Employment of Tertiary Industry
DEP = Total Daytime Employment
DST = Total Daytime Student Population
POP = Night Time Population aged 6 years and above

iii) Treatment of To Home Trip

To Home Trip can be divided into 4 categories depending on the trip purpose of the other trip end.

a) To Home from Work
b) To Home from School
c) To Home from Business
d) To Home from Private

The generation of "to home" trip by these trip purposes bear great relationship with the trip attraction of these trip purposes. The trip attraction is much dependant on the night time population, employment, student numbers, etc. Therefore, analysis for the "To Home" trips will follow these similar pattern. For example, the following models can be calibrated for "To Home from Work" trips.

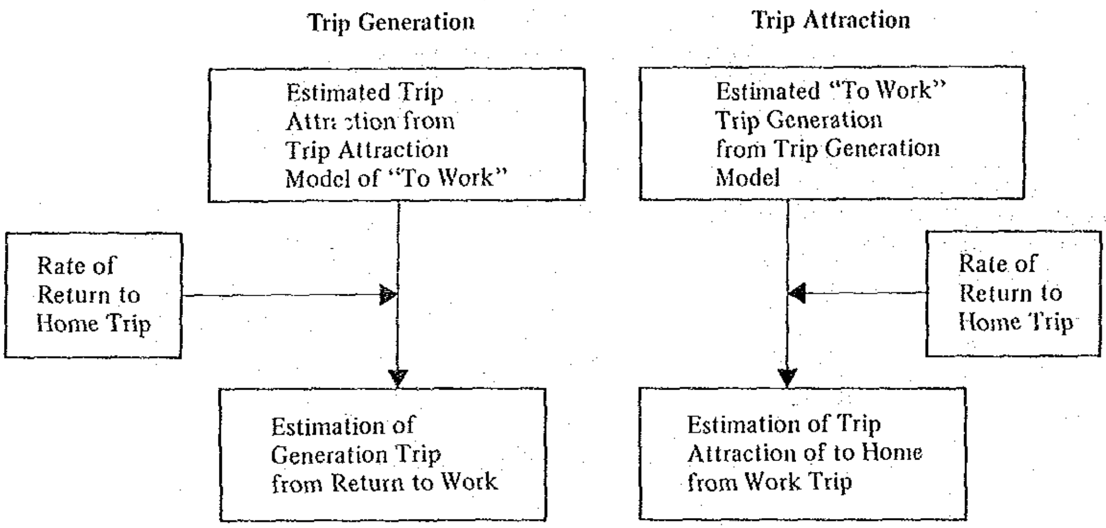


Table 4.5 shows the results of to home trip models using return to home rate. The results show a very high degree of fitness in the values obtained by these models.

Table 4.5: Models for Forecasting the Number of Return to Home Trips

Trip Purpose To Home	Category	Average Rate of Return to Home	Correlation Coefficient	Standard Error	% Error
From Work	Non Vehicle Owner	0.837	0.997	160	7.3
	Motor Cycle Owner	0.814	0.995	219	8.2
	Car Owner	0.778	0.997	312	7.9
	Total	0.805	0.998	524	5.6
From School	Non Vehicle Owner	0.868	0.999	60	3.5
	Motor Cycle Owner	0.874	0.999	75	3.5
	Car Owner	0.879	0.999	91	2.4
	Total	0.895	0.999	161	2.1
From Business	Non Vehicle Owner	0.383	0.933	105	39.6
	Motor Cycle Owner	0.366	0.905	159	41.6
	Car Owner	0.348	0.971	249	24.3
	Total	0.383	0.972	376	22.5
From Private	Non Vehicle Owner	0.689	0.990	433	16.3
	Motor Cycle Owner	0.685	0.989	535	15.4
	Car Owner	0.664	0.990	1084	14.3
	Total	0.682	0.991	1790	13.1

Model:

No. of Return to Home Trips, Y = Average Rate of Return to Home x Number of Attraction Trips for the purpose and category indicated

(2) Forecasting of Trip Generation and Attraction

Future trip generation and attraction are forecasted using these models developed in the study and zonal socio-economic indicators following the procedure shown in Figure 5.4 below.

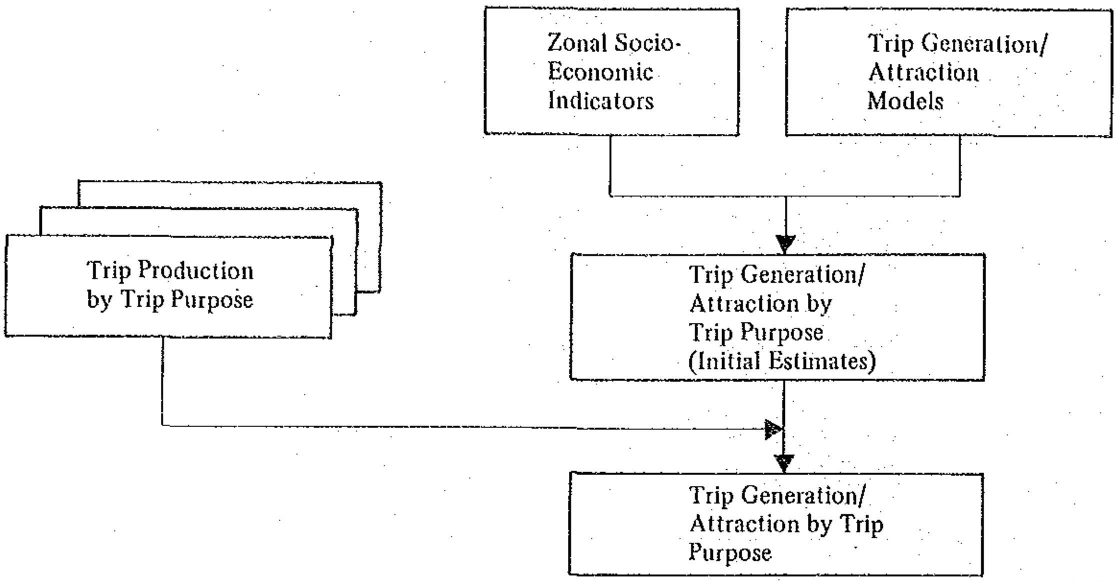


Figure 4.4: Trip Generation/Attraction Forecasting Procedure

Figures 4.5 and 4.6 show the person trip generation and attraction in 'B' zones for 1985 and 2005.

Figure 4.5 : Trip Attraction for Person Trips in 'B' Zones

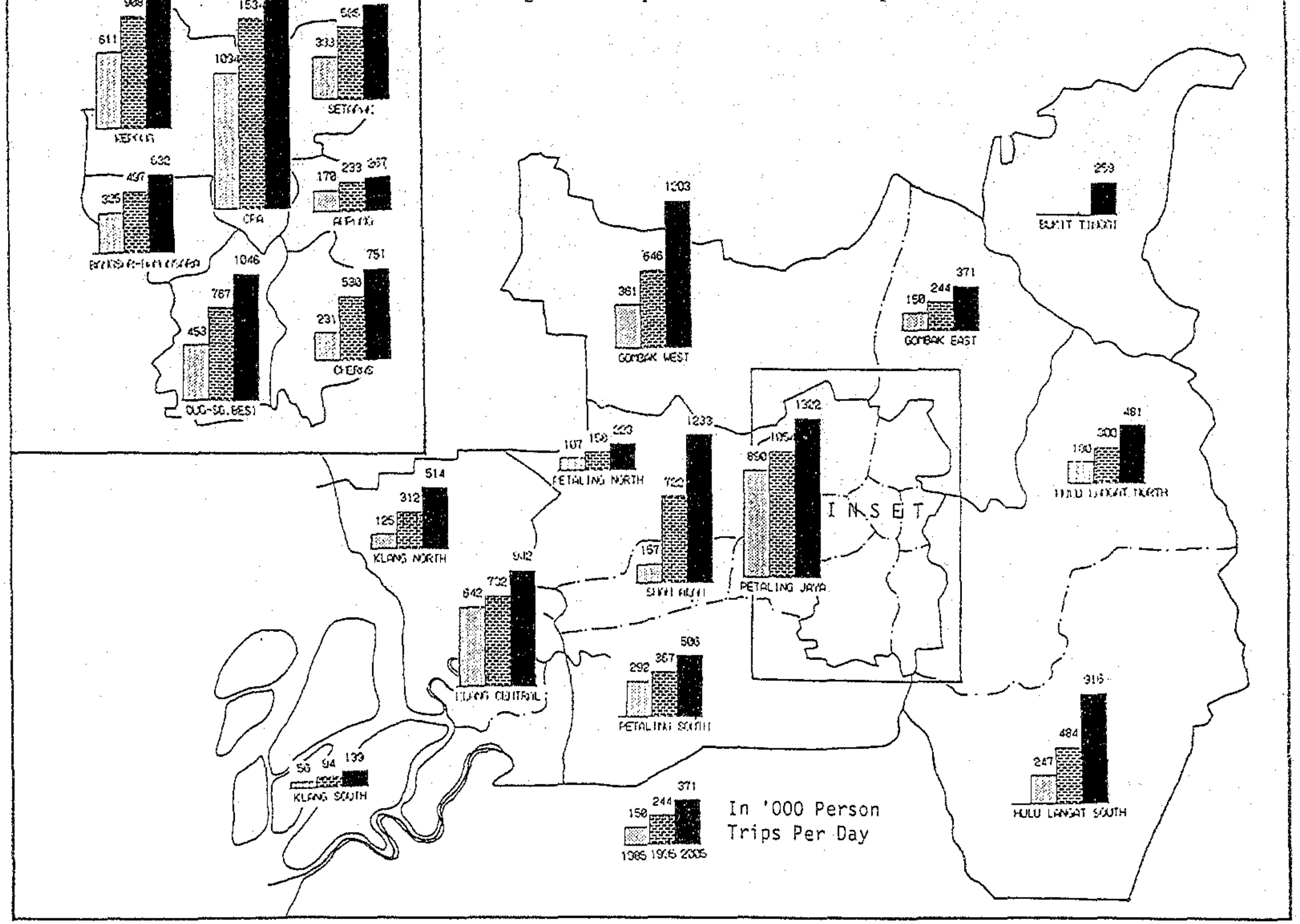
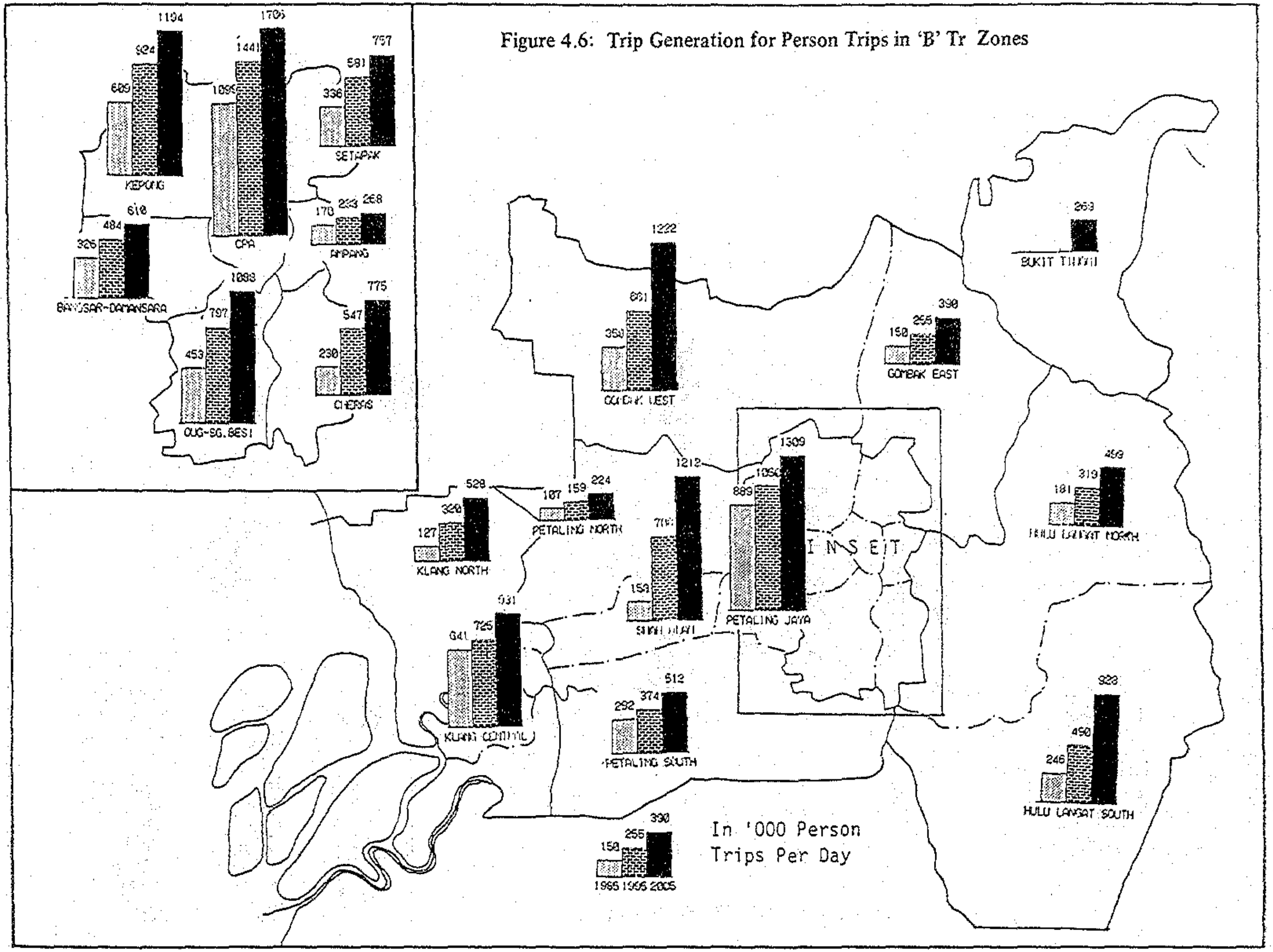


Figure 4.6: Trip Generation for Person Trips in 'B' Tr Zones



4.2.3 Trip Distribution (Code: PTDIS in Figure 4.3)

(1) Model Analysis

The trip distribution model is basically used to distribute the trip generation and attraction forecasted above into the person trip OD matrix.

In general, there are three(3) kinds of trip distribution models.

(a) Present pattern model
(b) Gravity model
(c) Probability model

The present pattern model which is comparatively easy to compute and to arrive at the OD matrix does not consider the impacts of any improvement of the transportation systems to trip distribution. Such impacts however can be incorporated into the other models. Therefore, the gravity model is preferred as a trip distribution model for this study.

In order to establish the OD distribution model, the following items are clarified:-

i) Treatment of Vehicle Owning Groups

In this study, the trip distribution is computed by vehicle owning group to facilitate model split in the next section.

ii) Intrazonal Trip Distribution Model

It is principally preferable to establish the intrazonal trip distribution model separately. The concept of this model is as follows:-

a) utilize existing intrazonal trip distribution rate
b) establish intrazonal trip distribution model

iii) Travel distance or Travel Time between Zones

The trip OD distribution using the gravity model is directly proportional to the magnitudes of trip generation and attraction and inversely proportional to the spatial impedance. As a measure of spatial impedance, either one of the following is normally used.-

(a) travel distance between zones
(b) travel time of representative mode between zones
(c) simple average travel time by mode between zones
(d) weighted average travel time by mode between zones.

Since the trip distribution is computed by vehicle owning groups, the travel time of representative modes for vehicle owning groups between zones are used in this study.

iv) Interzonal OD Distribution Model

The formula of the type of Gravity Model to be used here is as follows:-

$$X_{ij} = \kappa G_i^{\alpha} A_j^{\beta} t_{ij}^{-\gamma}$$

Where

X_{ij} : Trips between zones i and j

G_i : Trip generation in Zone i

A_j : Trip attraction in Zone j

t_{ij} : Travel time of representative mode between zones i and j

κ : Constant

α, β, γ : Coefficient

v) Intrazonal Trip Distribution Model

Several intrazonal trip distribution models have been applied in various transportation studies. The following model is applied in this study.

$$X_{ii} / G_i = 1/[1 + \kappa (A\backslash_i / A_i)^{\beta}]$$

$$A\backslash_i = \sum_{j=1}^{\eta} A_j t_{ij}^{-\gamma} \ (i \neq j)$$

Where:

X_{ii} : Intrazonal trips in zone (i)

G_i/A_j : Trip generation/attraction

κ : Constant

β, γ : Parameters

$A\backslash_i$: Accessibility of zone i

t_{ij} : Travel time between zones

iv) Results of Analysis

Several trip distribution models were formulated and the best model was finally chosen based on a comparison of model results against the observed values. Table 4.6 shows comparison of the number of intrazonal and interzonal trips obtained by the modelling against the observed values. The intrazonal trip rate and average trip length by trip purpose for each category of vehicle ownership type are also compared in Table 4.6. The modelling results do not differ from the observed values by a significant amount of 10%. Next the trip length distribution by trip purpose and vehicle ownership type were also compared. Figures 4.7(a), (b), (c), (d), (e) and (f) show the trip length distribution by trip purpose for both model and observed cases. The estimated trip distribution using models fit rather well with the observed distribution pattern. As such, the models whose parameters are shown in Table 4.7 will be used to forecast future trip distribution pattern.

Table 4.6: Comparison of Intrazonal Trips, Interzonal Trips, Interzonal Trip Rate and Average Trip Length

Vehicle Owner-ship	Purpose	Observed					Model				
		No. of Trips	Intrazonal Trips	Interzonal Trips	Intrazonal Trip Rate	Ave. Trip Length (km)	No. of Trips	Intrazonal Trips	Interzonal Trips	Intrazonal Trip Rate	Ave. Trip Length (km)
Non-Car Owner	To Work	221609	72755	148854	0.328	8.6	221609	76354	145255	0.345	8.8
	To School	150555	80704	69851	0.536	5.6	150555	85766	64789	0.570	5.7
	Business	62898	16368	46530	0.260	10.8	62898	15953	46945	0.254	10.9
	Private	319929	174518	145411	0.545	7.0	319929	179666	140263	0.562	7.1
	To Home	579052	268572	310480	0.464	7.5	574754	279253	295501	0.486	7.7
	Total	1334043	612917	721126	0.459	7.7	1329745	636992	692753	0.479	7.9
Motor-Cycle Owner	To Work	276799	90195	186604	0.326	10.1	276799	94779	182020	0.342	10.6
	To School	191084	105347	85737	0.551	6.7	191084	112149	78935	0.587	7.9
	Business	88975	27688	51287	0.311	10.0	88975	27254	61721	0.306	10.7
	Private	420878	236248	184630	0.561	8.0	420881	236612	184269	0.562	8.4
	To Home	738838	354703	384135	0.480	8.8	740153	366533	373620	0.495	9.3
	Total	1716574	814181	902393	0.474	8.8	1717892	837327	880565	0.487	9.4
Car Owner	To Work	438066	106384	331682	0.243	10.2	438066	107512	330554	0.245	10.7
	To School	336527	145260	191267	0.432	6.1	336527	151346	185181	0.450	6.1
	Business	251034	53639	197395	0.214	10.4	251034	53235	197799	0.212	10.8
	Private	960372	402574	557798	0.419	7.4	960372	404985	555387	0.422	7.2
	To Home	1390170	501481	888689	0.361	8.3	1385978	522472	863506	0.377	8.4
	Total	3376169	1209338	2166831	0.358	8.4	3371977	1239550	2132427	0.368	8.5
Total	To Work	936474	269334	667140	0.288	9.8	936474	278645	657829	0.298	10.2
	To School	678166	334311	346855	0.489	6.2	678166	349261	328905	0.515	6.5
	Business	402907	97695	305212	0.242	10.4	402907	96442	306465	0.239	10.8
	Private	1701179	813340	887839	0.478	7.4	1701182	821263	879919	0.483	7.5
	To Home	2708060	1124756	1583304	0.415	8.3	2700885	1168258	1532627	0.433	8.5
	Total	6426786	2636436	3790350	0.410	8.3	6419614	2713869	3705745	0.423	8.6

Note: Average Trip Length is for interzonal trips only.

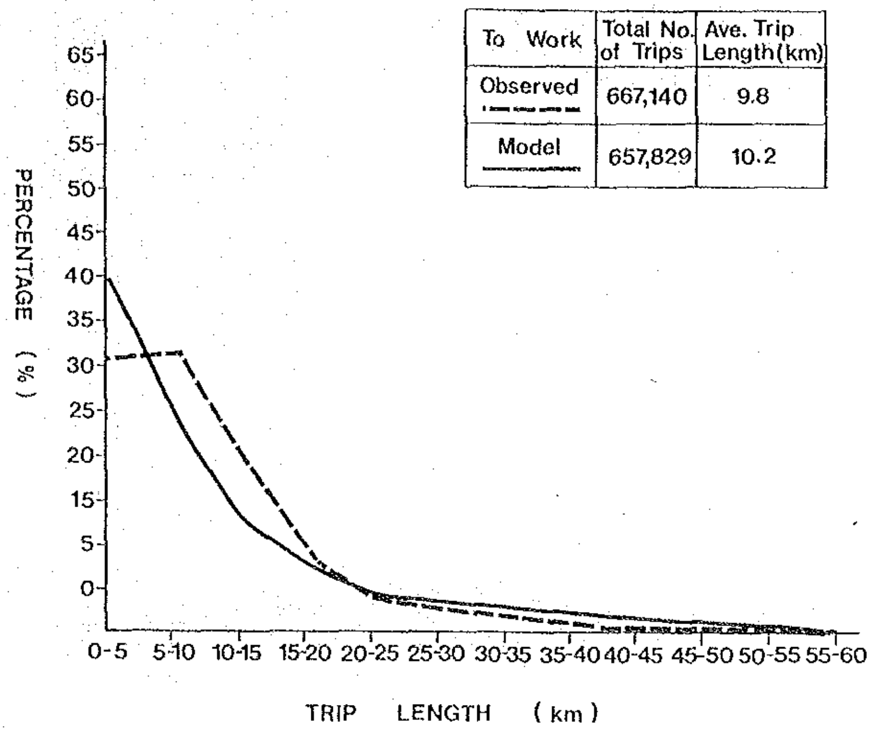


Figure 4.7 (a) : Distribution of Trip Length for Trips To work

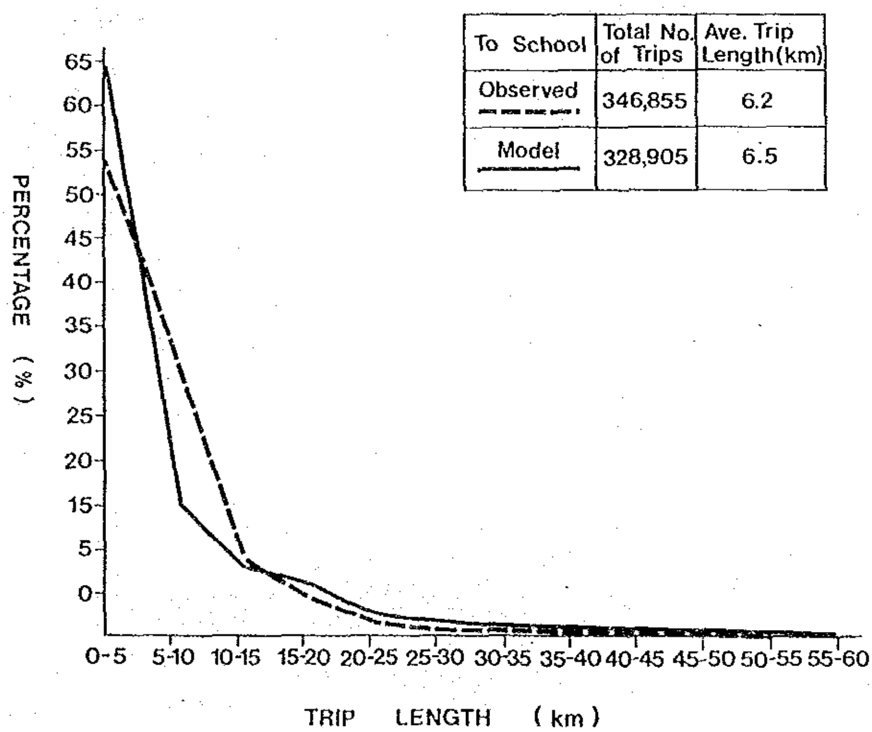
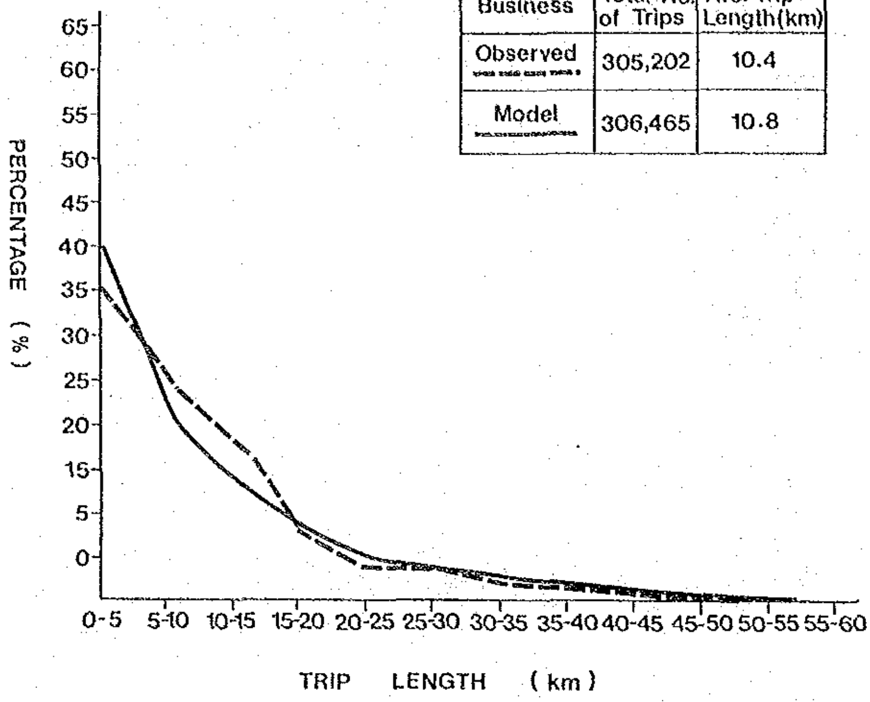
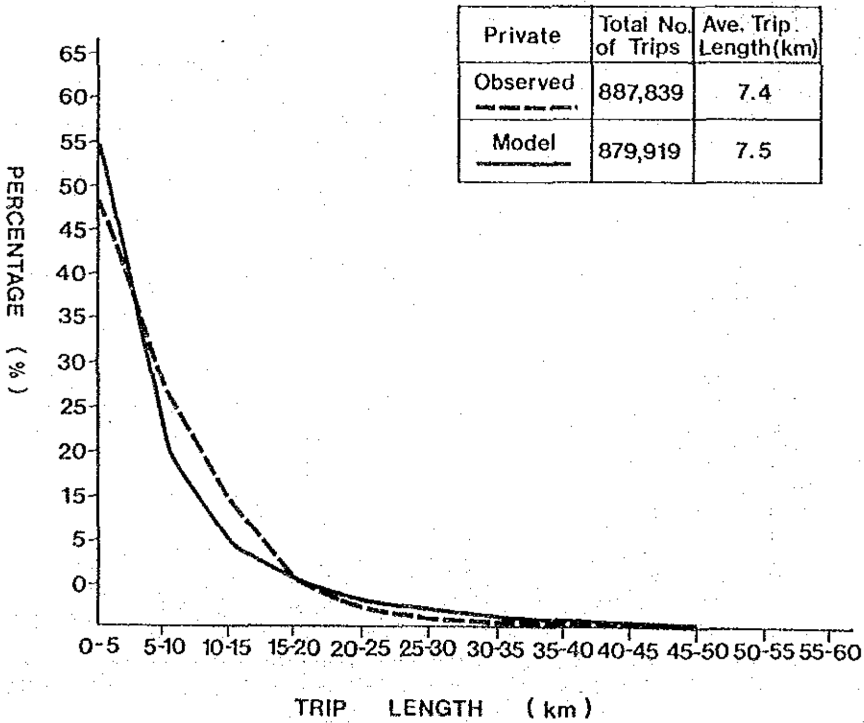


Figure 4.7 (b) : Distribution of Trip Length for To School Trips



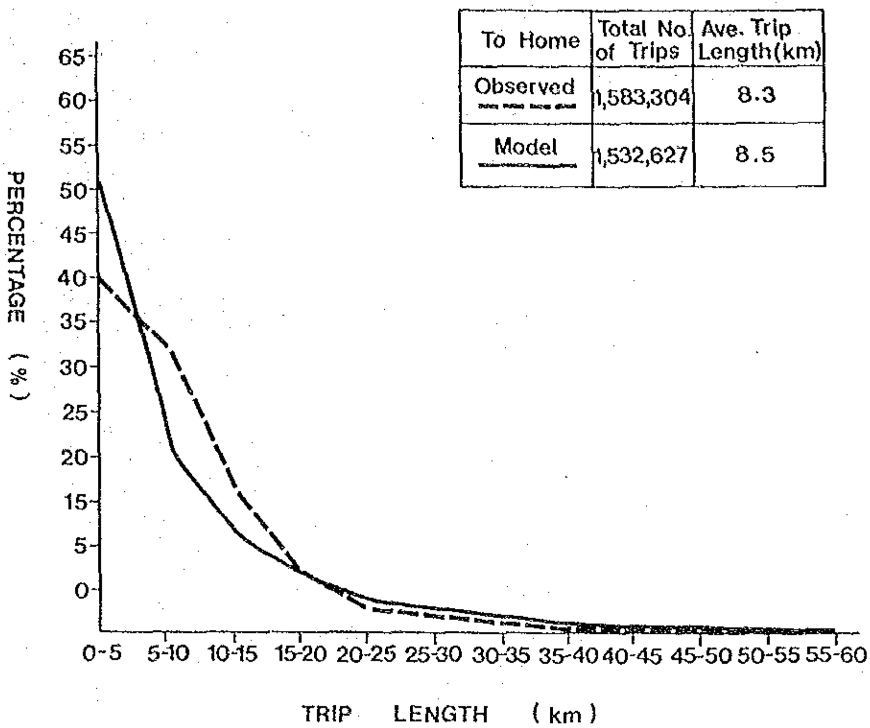
Business	Total No. of Trips	Ave. Trip Length(km)
Observed	305,202	10.4
Model	306,465	10.8

Figure 4.7 (c) : Distribution of Trip Length for Business Trips



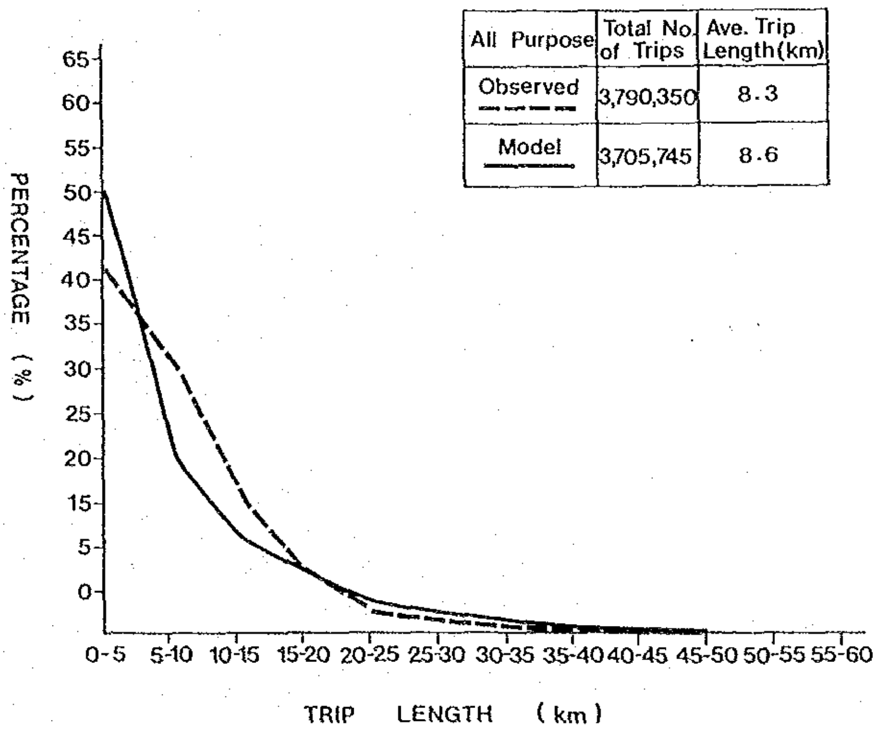
Private	Total No. of Trips	Ave. Trip Length(km)
Observed	887,839	7.4
Model	879,919	7.5

Figure 4.7 (d) : Distribution of Trip Length for Private Purposes



To Home	Total No. of Trips	Ave. Trip Length(km)
Observed	1,583,304	8.3
Model	1,532,627	8.5

Figure 4.7 (e) : Distribution of Trip Length for To Home Trips



All Purpose	Total No. of Trips	Ave. Trip Length(km)
Observed	3,790,350	8.3
Model	3,705,745	8.6

Figure 4.7 (f) : Distribution of Trip Length for All Trip Purposes

Table 4.7: **Trip Distribution Model**

Trip Purpose	Category	Parameters for Intrazonal Trip Model			Parameters for Interzonal Trip Model			
		k	β	γ	k	α	β	γ
To Work	Non Vehicle Owner	0.741	0.337	0.512	2.719	0.348	0.225	2.112
	Motor Cycle Owner	0.447	0.515	0.536	0.887	0.456	0.300	2.736
	Car Owner	1.177	0.343	0.493	0.216	0.479	0.406	1.760
To School	Non Vehicle Owner	0.201	0.414	0.466	21.444	0.296	0.060	9.932
	Motor Cycle Owner	0.058	0.674	0.448	6.980	0.363	0.143	11.000
	Car Owner	0.614	0.293	0.671	11.454	0.338	0.164	7.842
Home Based Business	Non Vehicle Owner	0.184	0.280	0.066	1.494	0.360	0.264	0.866
	Motor Cycle Owner	0.041	0.699	0.134	3.728	0.381	0.147	1.134
	Car Owner	0.288	0.393	0.206	2.192	0.416	0.180	1.206
Non Home Based Business	Non Vehicle Owner	3.021	0.118	0.090	8.740	0.136	0.190	0.890
	Motor Cycle Owner	2.429	0.058	0.159	8.653	0.172	0.170	1.159
	Car Owner	4.309	0.065	0.306	6.094	0.226	0.224	1.306
Home Based Private	Non Vehicle Owner	0.279	0.300	0.408	6.923	0.263	0.227	3.516
	Motor Cycle Owner	0.104	0.506	0.447	3.558	0.340	0.252	12.000
	Car Owner	0.910	0.143	0.594	1.458	0.431	0.300	3.788
Non Home Based Private	Non Vehicle Owner	0.410	0.319	0.386	11.857	0.170	0.216	1.772
	Motor Cycle Owner	0.164	0.598	0.302	12.397	0.158	0.182	2.104
	Car Owner	1.510	0.010	0.535	14.081	0.211	0.205	2.070

Note: 1. Intrazonal Trip Model, $X_{ii}/G_i = 1/(1 + k(A\backslash_i/A_i)^{\beta})$;

$$A\backslash_i = \sum_{j=1}^{n} A_j t_{ij}^{-\gamma} \quad \text{for } (i \neq j)$$

2. Interzonal Trip Model, $X_{ij} = kG_i^{\alpha} A_j^{\beta} t_{ij}^{-\gamma}$ for $(i \neq j)$

(2) Forecasting of OD Distribution

Following the trip OD distribution forecasting procedure shown in Figure 4.8 the person trip OD matrix by trip purpose is obtained.

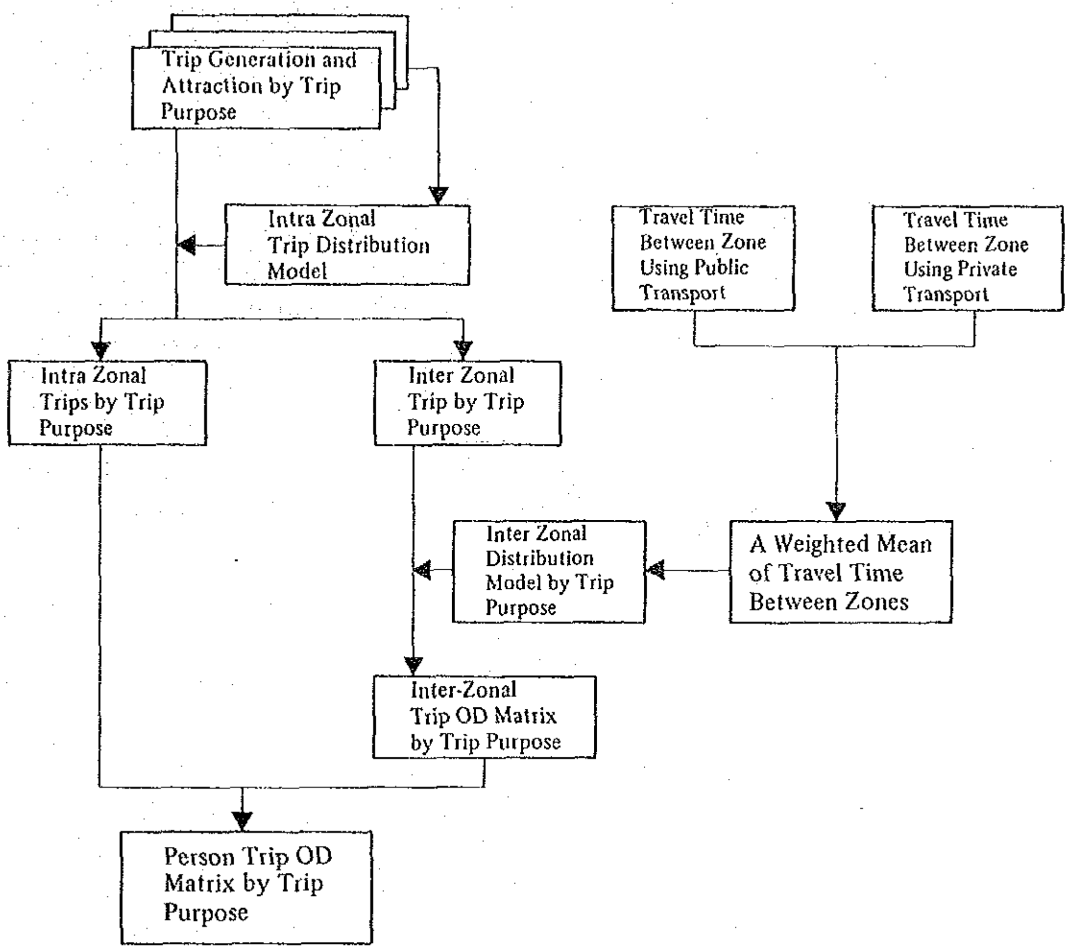


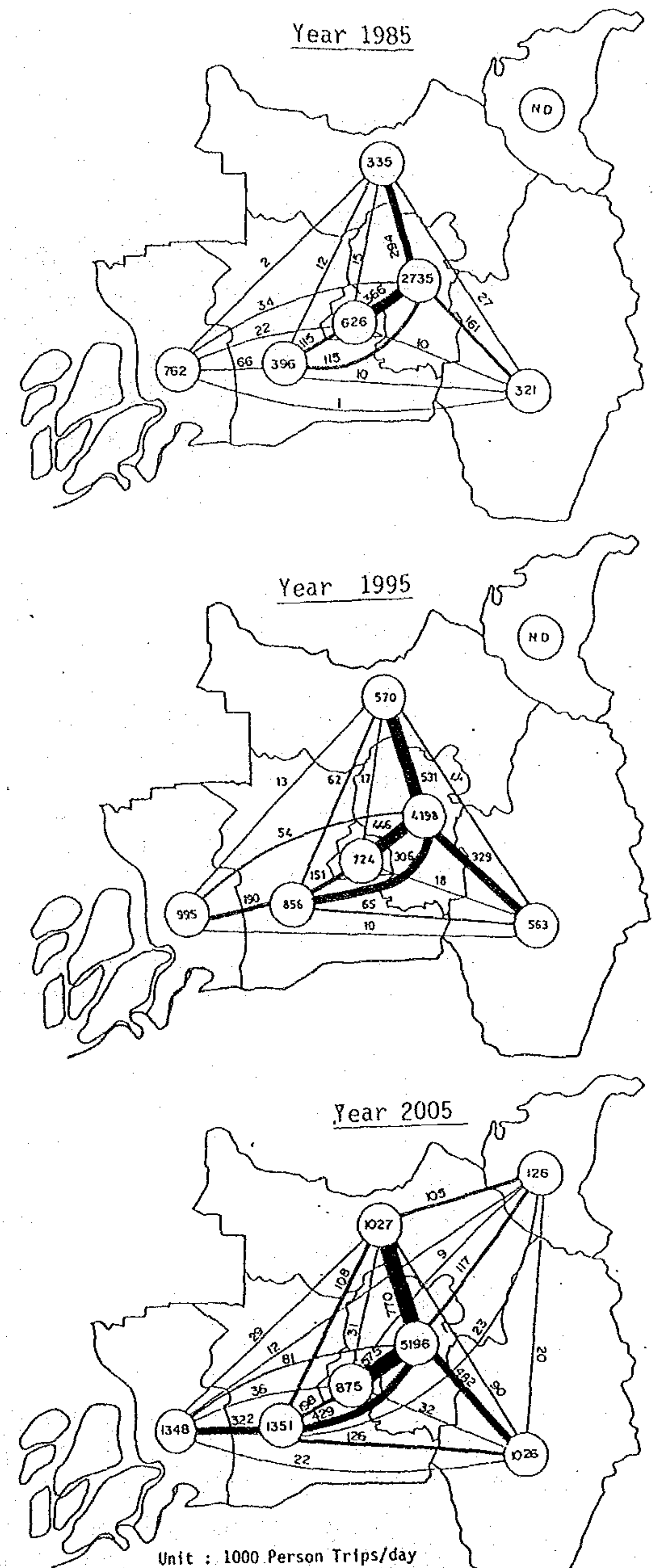
Figure 4.8: Trip OD Distribution Forecasting Procedure

(3) OD Distribution

Figure 4.9 shows the 'A' Zone desire line of person trips for all purpose in the years 1985, 1995 and 2005. The main corridors of travel demand in 1985 are those linking Kuala Lumpur to its immediate neighbouring districts of Petaling, Gombak and Hulu Langat. By 1995 and 2005, these corridors are still the main corridors of person trips movement. However, the passenger travel demand between Kuala Lumpur and Hulu Langat District will double from 161,200 person trips per day in 1985 to 328,800 person trips by 1995 and increase by three times to 481,800 person trips by 2005.

The person trip demand between Kuala Lumpur with Gombak District and Kuala Lumpur with Petaling District will increase by 2.6 times and 2 times respectively and that of Klang with Petaling District will increase by 4 times from 1985 to 2005.

The establishment of a new institutional and high-tech centre at Bukit Tinggi is expected to generate a person travel demand volume of 116,500 trips with Kuala Lumpur and 104,800 trips with Gombak District by 2005.



Note : (I) Numbers beside lines indicate No. of Inter Zonal person trip movements in thousands

(II) Numbers inside circles indicate No. of Intra Zonal person trip movements in thousands

Figure 4.9: Desire Line of Person Trips by All Purpose, Klang Valley, 1985, 1995 and 2005

4.2.4 Modal Split (Code: PTMODE in Figure 4.3)

(1) General

Modal split is the determination of the share of the future OD trips by the various transport modes. Normally intra-zonal trips are excluded from this analysis. The output of the modal split is a set of OD matrix by the various travel modes.

Modal split is the most important step among the various steps in the procedure for forecasting future travel demand. There are generally two approaches to forecast the future modal split, viz.-

a) Analytical Phenomenon Approach
b) Policy Oriented Approach

The analytical approach is used in this study. As far as the modal split model calibration is concerned, the following concepts are adopted in this study:-

a) Trip Interchange Model

Modal split models are generally classified into four(4) types i.e. trip production model, trip-end model, trip interchange model and path model. Among these models, the trip interchange model, which is to determine the mode share after forecasting OD distribution, is the most appropriate model for this study. This is because effects on the transportation network improvement could be incorporated with this model.

b) The Aggregate Model and Disaggregate Model

The aggregate model is based on analysis of the modal choice of trip-makers aggregated by traffic zones while the disaggregate model is based on the analysis of the model choice of each individual traveller.

In this study, the models for trip production, trip generation and attraction and OD distribution are calibrated as a series of aggregate models. In this connection the aggregate model is used for the modal split model.

The disaggregate model however has an advantage that enables the analysis of transport policy issues. The disaggregate model choice model is simultaneously used for analysis in this study.

c) The Binary Mode Choice or Multiple Mode Choice

There are two(2) mode choice models; one is the binary choice model and the other multiple choice model.

In this study, the binary mode choice is principally adopted for the aggregate model type being employed while the multiple mode choice is adopted in case of the disaggregate model type being employed.

Figure 4.10 shows the algorithm for the modal split based on binary mode choice while Figure 4.11 shows the algorithm for the modal split based on multiple mode choice.

d) Treatment of Vehicle Owning Groups

As mentioned in the previous section, the models which include trip production, trip generation and attraction and OD distribution was formulated by vehicle owning groups. This is based on the following reasons:-

i) For non-vehicle owning group, there is no choice of transport mode (so-called the captive mode choice group)

ii) For motor cycle owning group, there are limited mode choices (so-called the limited mode choice group)

iii) For motor car owning group, there are mode choices (so-called the mode choice group)

However, even in the captive mode choice group, the statistics show that there are a few motor car users or a few motor cycle users. It is supposed that these users are mainly shared-riders. Based on the above considerations, the modal split model analysis will be made by vehicle owning groups.

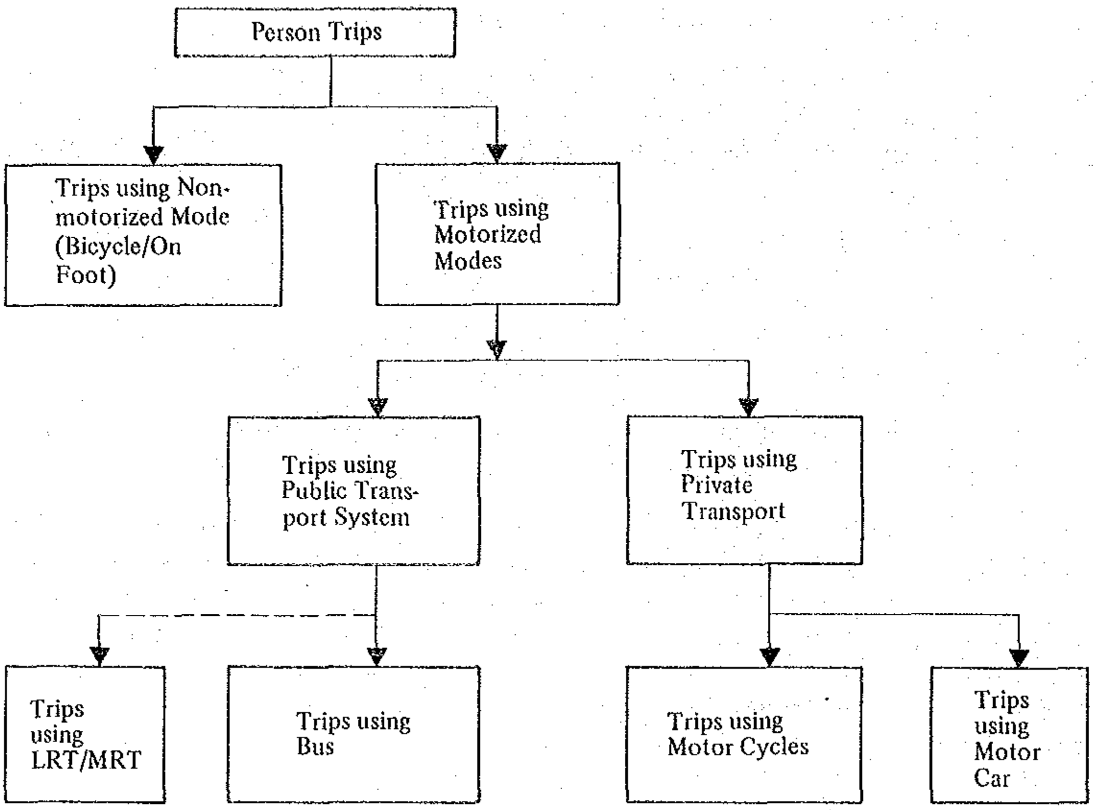


Figure 4.10: Modal Split Procedure by Binary Mode Choice

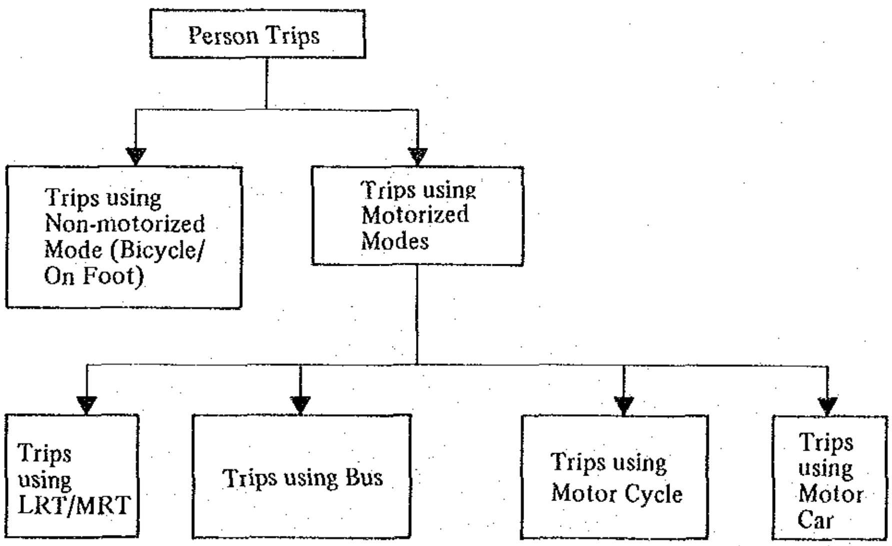


Figure 4.11: Modal Split Procedure by Multiple Mode Choice

(2) Binary Mode Choice for Aggregate Model

In this section, the modal split using the binary mode choice models described earlier in Figure 4.10 were obtained for each trip purpose by vehicle ownership type. The appropriateness of each model was tested by comparing the number of trips made by each mode and its percentage share to the total number of trips. Figure 4.12 and Figure 4.13 and Table 4.8 show the results of the modal split obtained from models compared to the mode share distribution observed from the HIS. The models were adopted on the strength that all deviations are within 10% from the observed values. The following subsections describe the modal split adopted by the Study Team.

a) Modal Split of Person Trips using Non-motorized Mode i.e. Bicycle/On Foot

At the first step of the modal split, all person trips are to be divided into two(2) types; one is the person trips using bicycle/on foot and the other is those using the transport modes. The mode share of bicycles/on foot is largely depended upon the travel length of the trips. The diversion curves of the percentage mode share is plotted with the distance travelled by trip purpose for the car owner group and the result is shown in Figure 4.14(a). These are simple decreasing curves. These curves are also plotted for the other vehicle owning groups and together they are used for the forecasting of future modal split of inter-zonal person trips using non-motorized mode. As for the intra-zonal person trips, the existing mode share between non-motorized mode and motorized mode in each zone is assumed to remain unchanged in the future.

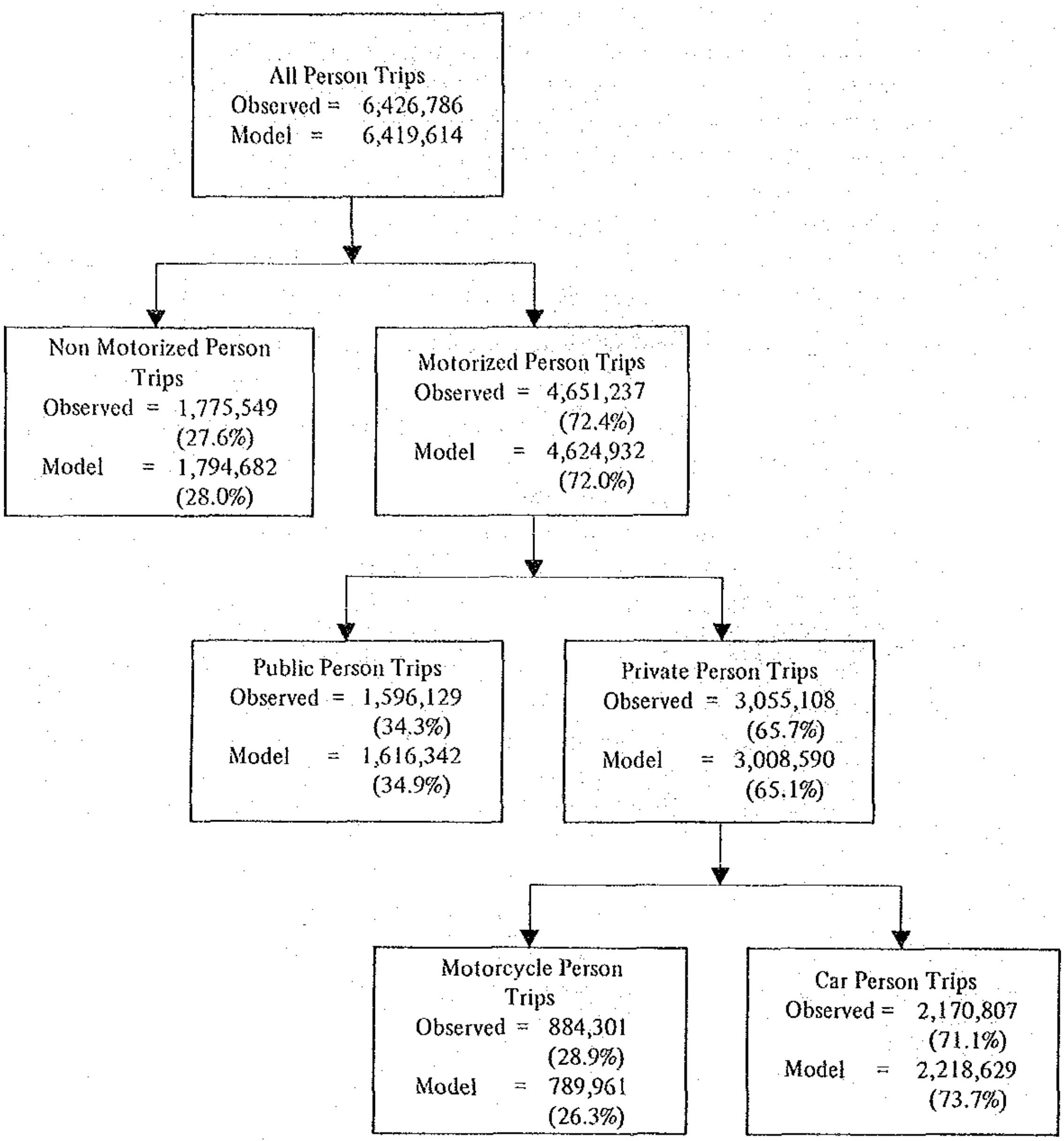


Figure 4.12: Results of Comparing the Compatibility of Models

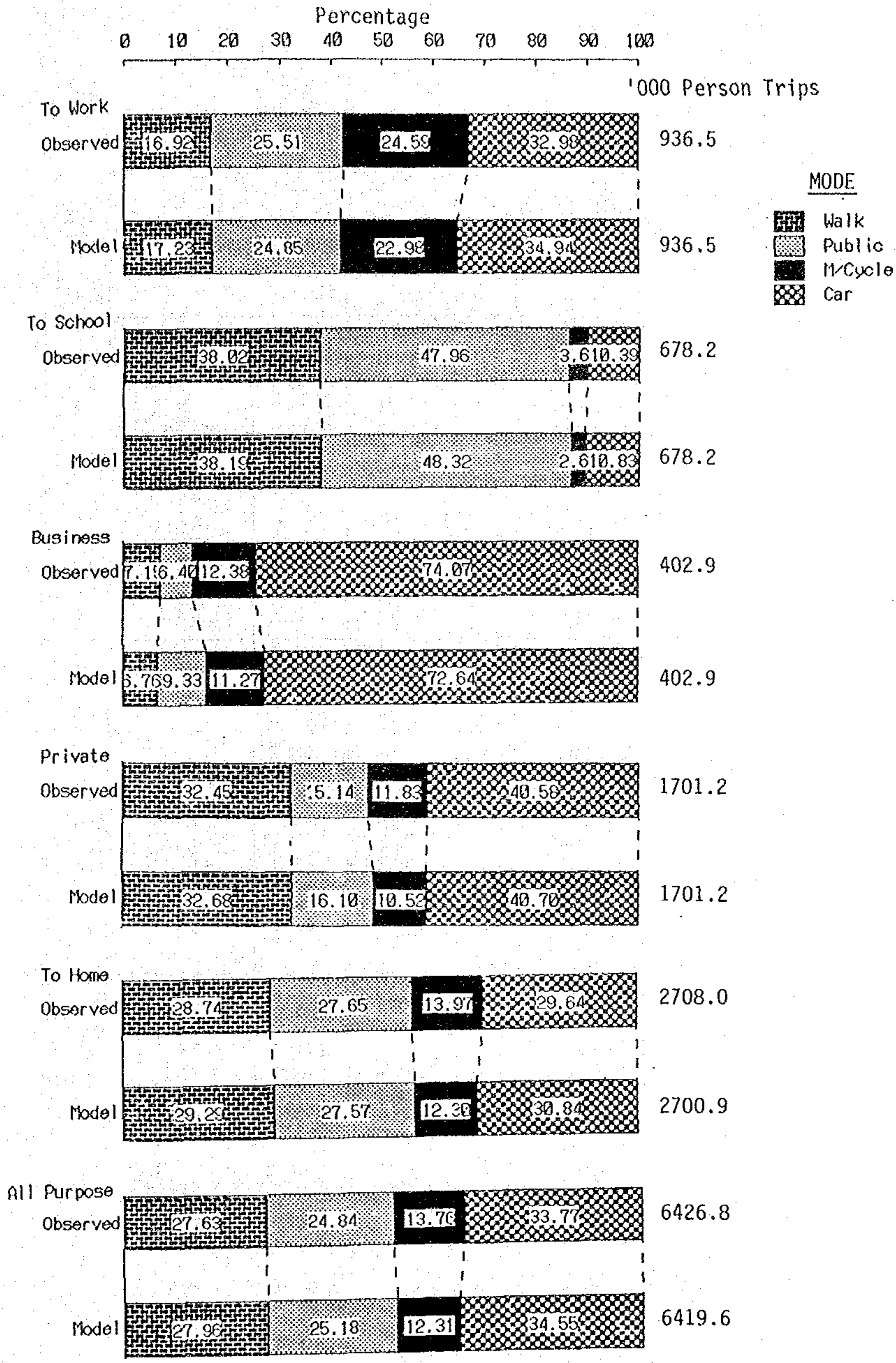


Figure 4.13 : Mode Share by Trip Purpose by Model and Observation

Table 4.8: Test of Compatibility of models

	Trip Purpose	No. of person trips ('000 Trips/Day)		Average Trip Length (km)	
		Observed	Model	Observed	Model
Non-Motorized	To Work	158.5	161.3	3.8	1.8
	To School	257.9	259.0	3.9	2.0
	Business	28.8	27.2	3.5	0.9
	Private	552.1	556.0	3.0	1.3
	To Home	778.3	791.1	3.7	1.7
	All Purpose	1775.5	1794.7	3.6	1.7
Public	To Work	238.9	232.7	9.8	10.2
	To School	325.2	327.6	6.6	7.3
	Business	25.8	37.6	9.6	11.1
	Private	257.5	273.9	8.6	8.3
	To Home	748.6	744.6	8.3	8.6
	All Purpose	1596.1	1616.3	8.3	8.6
Motor Cycle	To Work	230.3	215.2	9.7	10.3
	To School	24.6	18.1	7.6	5.5
	Business	49.9	45.4	7.5	6.7
	Private	201.3	179.0	7.4	7.8
	To Home	378.2	332.3	9.1	9.3
	All Purpose	884.3	790.0	8.8	9.1
Car	To Work	308.8	327.3	10.8	11.4
	To School	70.5	73.5	6.2	7.6
	Business	298.4	292.7	11.1	11.6
	Private	690.2	692.3	7.9	8.1
	To Home	802.9	832.9	9.2	9.7
	All Purpose	2170.8	2218.6	9.3	9.7
All Person Trips	To Work	936.5	936.5	9.8	10.2
	To School	678.2	678.2	6.2	6.5
	Business	402.9	402.9	10.4	10.8
	Private	1701.2	1701.2	7.4	7.5
	To Home	2708.0	2700.9	8.3	8.5
	All Purpose	6426.8	6419.6	8.3	8.6

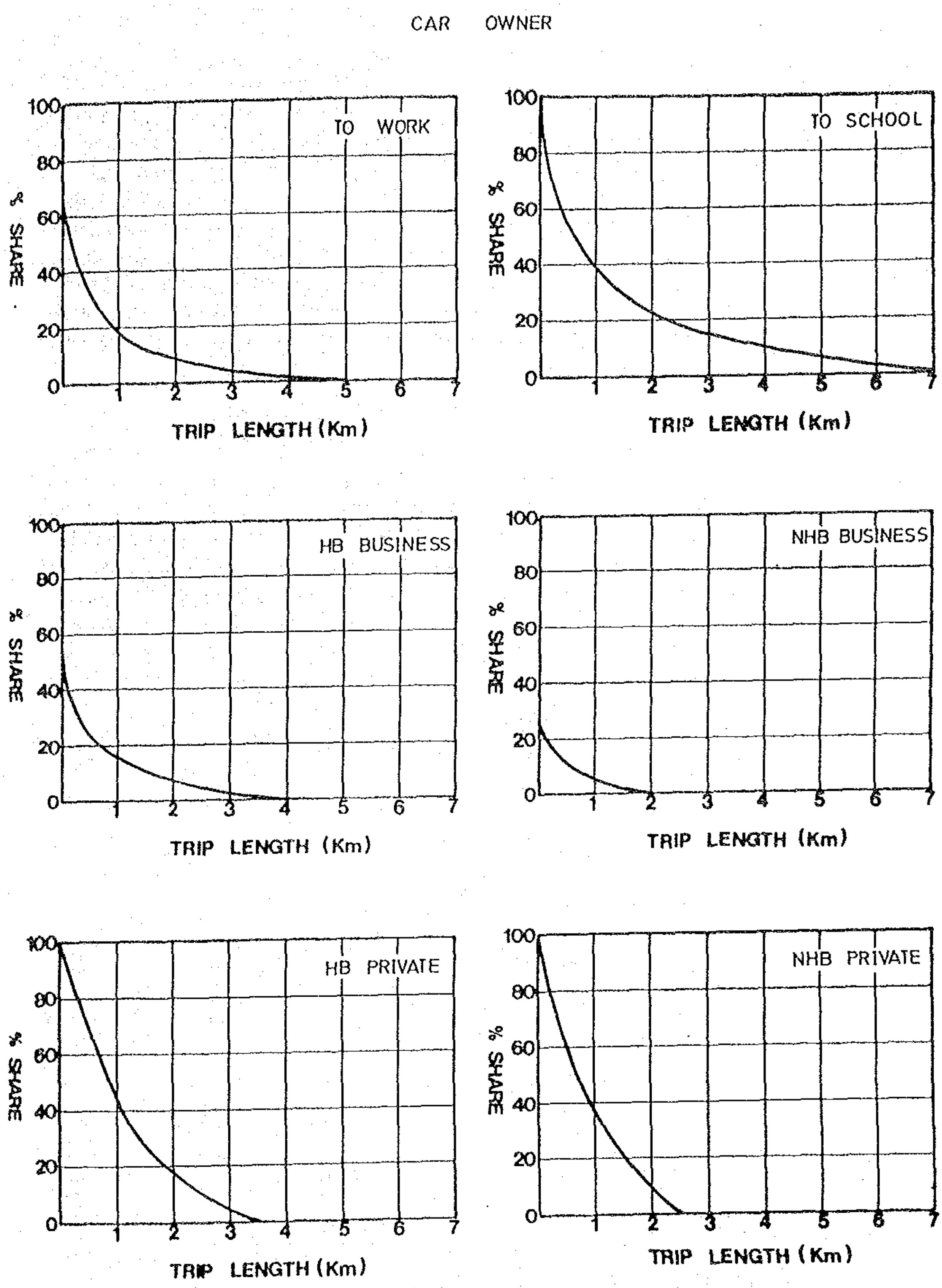


Figure 4.14 (a) : Diversion Curves of Non-Motorized Modes for Car Owner Group

b) Modal Split of Person Trips using Private and Public Transport Mode

At the second step of the modal split, the person trips using the transport modes are to be divided into two(2) types. One is the person trip using private transport mode and the other is using public transport mode. It is assumed that the mode share between the two(2) modes is determined by travel time ratio. The % share by private mode by trip purpose for the car owner group for example are plotted against this travel time ratio (private/public) and the result is shown in Figure 4.14(b). These models are used to forecast future modal split of interzonal person trips using private transport and public transport. As for intra-zonal person trips, the existing mode share between private transport and public transport in each zone is assumed to remain unchanged in the future.

c) Modal Split of Private Transport Modes

At the third level, the mode share for private transport mode is further split into car and motorcycle. The diversion curves are plotted using the mode share percentage of motorcycle trips and trip length in km. The diversion curves by trip purpose for the car owner group for example are plotted and shown in Figure 4.14(c). These models are used to forecast future modal split of interzonal trips using motorcycle and car. As for intra-zonal person trips, the existing mode share between motorcycle mode and car mode in each zone is assumed to remain unchanged in the future.

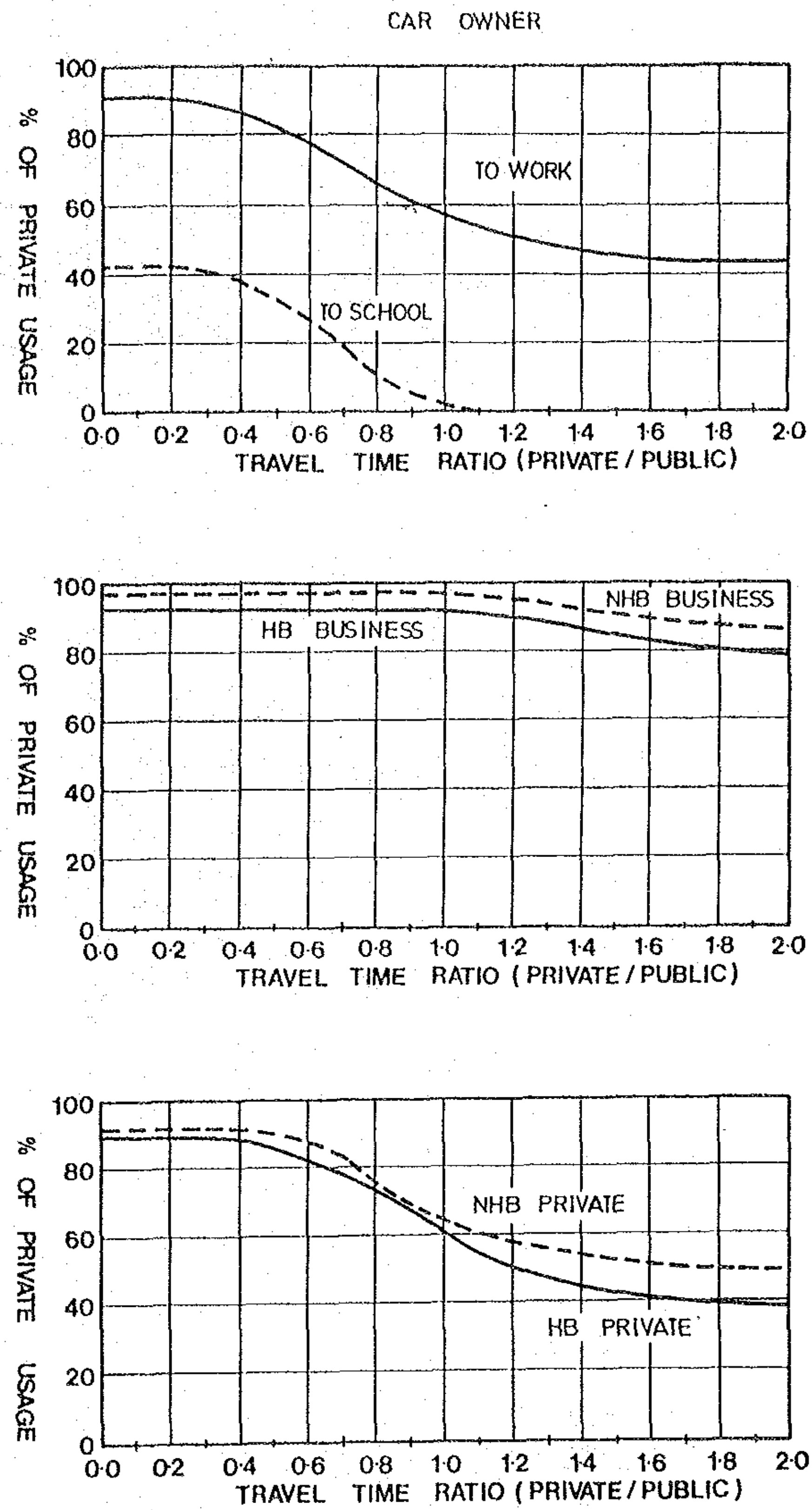


Figure 4.14 (b) : Diversion Curves of Private Modes for Car Owner Group

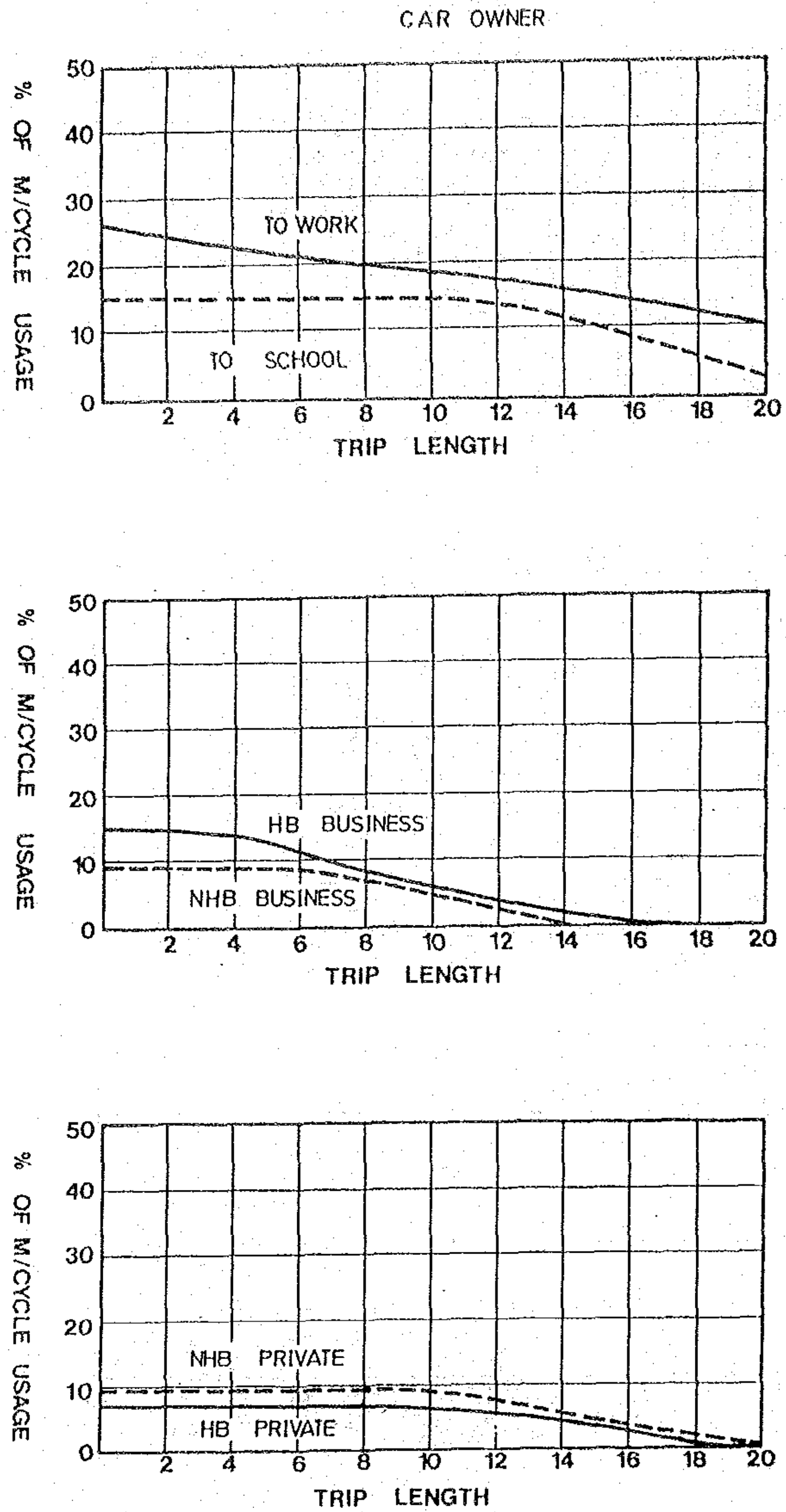


Figure 4.14 (c) : Share of Motor Cycle Usage for the Car Owner Group

d) Modal Split of Public Transport Modes

In the forecasting of the share of rail users for the future alternative plans trips using the public modes in future obtained from the above modal split computations are further split into rail and bus using the theoretical case of percentage share by rail based on the travel time ratio of rail to bus with the non-bias to either mode (Figure 4.13(d)). The travel time of rail here is taken to be the total travel time for either the walk-rail-walk or bus-rail-walk combinations.

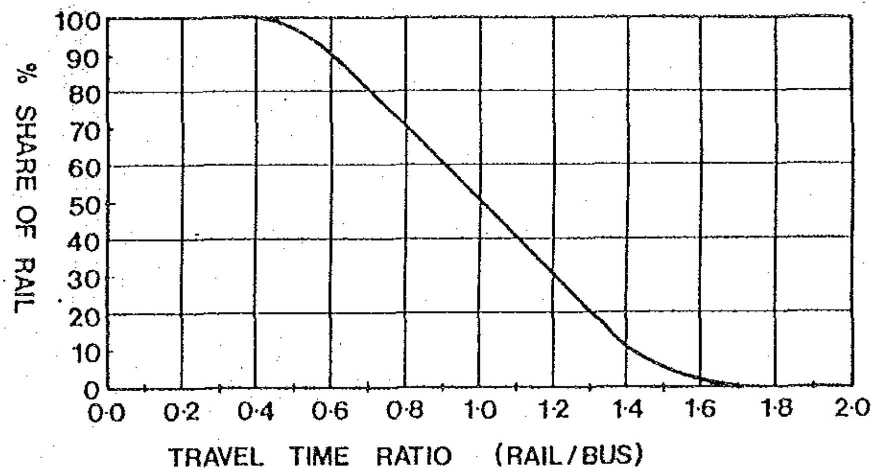


Figure 4.14(d): The Theoretical Non-bias Diversion Curve for Rail and Bus Riders

(3) Forecast of Modal Split

Table 4.9 shows the final outcome of the modal split forecasts for 1995 and 2005 compared to the 1985 situation. If the present mode trend continues, the private mode share will increase from 47.6% in 1985 to 51.6% in 1995 and 56.8% in 2005. Public transport mode share among the motorized modes will drop from 34.3% in 1985 to 29.6% in 2005.

Table 4.9: Interzonal Person Trips by Mode, Klang Valley, 1985 - 2005

Mode	1985 ('000)	1995 ('000)	2005 ('000)	Average Annual Growth Rate (%) 1985-2005	1985-1995	1995-2005
Walk/Bicycle	1,775.5 (27.6%)	2,055.2 (20.2%)	2,793.7 (19.2%)	2.3	1.5	3.1
Motor Cycle	884.3 (13.8%) (19.0%)	1,376.0 (13.5%) (17.0%)	1.956.1 (13.4%) (16.6%)	4.0	4.5	3.6
Car	2,170.8 (33.8%) (46.7%)	3,871.3 (38.1%) (47.8%)	6,331.1 (43.4%) (53.8%)	5.5	6.0	5.0
Public	1,596.1 (24.8%) (34.3%)	2,858.7 (28.1%) (35.3%)	3,490.8 (24.0%) (29.6%)	4.0	6.0	2.0
Total	6,426.7 (100%)	10,161.2 (100%)	14,571.7 (100%)	4.2	4.7	3.7

Note: Upper (%) indicates percentage share to all modes
Lower (%) indicates percentage share to motorized modes only

(4) Mode Choice Analysis using Disaggregate Model

Disaggregate modelling, a new transport modelling method has been increasing used in mode choice analysis in transportation studies.

In replacement for the zonal data based on the traffic zoning scheme, disaggregate model utilizes each traveller as units of analysis.

This modelling method is based on the theory that "The probability which a traveller will choose a particular alternative travel mode is a function of the characteristic of the individual himself and of the overall utility of the chosen travel mode relative to all other modes".

The probabilitic multinomial logit function is the most common function used in the disaggregate modelling analysis which has the form;

$$P(i : A_t) = \frac{e^{U_{it}}}{\sum_{j \epsilon A_t} e^{u_{jt}}}$$

Where:

$P(i : A_t)$ = Probability of traveller t in choosing alternative i from the set of alternatives A_t

U_{it} = Utility of alternative i to traveller t

The Utility has a linear function as,

$$U_{it} : U_i (X_i : S_t) + E_{it}$$

Where:

X_i = Attributes of the alternative i

S_t = Socio-economic characteristics of t

E_i = Constant to the alternative i

This disaggregate modelling method although requires a much smaller volume of data, it demands on the contrary a high precision of these data. For instance, the travel time for each sampled traveller has to be vevy accurate, ideally, right from the time he leaves his house, walks to the nearest bus stop, to the bus stop in town and to the doorstep of his office.

An attempt has been made here by using 591 samples from the Home Interview Person Trip Survey data in analysing the mode choice behaviour of commuters in the Kuala Lumpur Conurbation. The results (in Table 4.10) indicate that at least for work trip in the Kuala Lumpur Conurbation, mode choice between car, motorcycle and bus is dependant on the In-vehicle travel time, the ratio of travel cost to the monthly household income, as well as the socio-economic characteristics of the traveller such as his sex, age, occupation and vehicle availability.

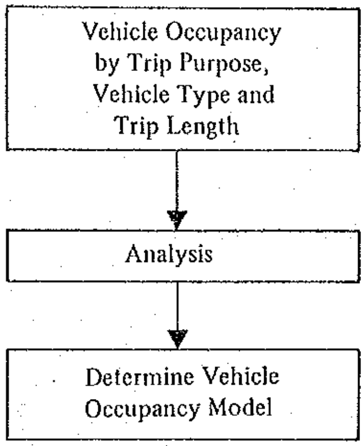
Table 4.10: The Estimated Mode Choice Work Trip Model for Kuala Lumper Conurbation

Independant Variable		Estimated Coefficient	T-Statistics
All Mode-	In-Vehicle Travel Time	-0.0551	-2.836
All Mode-	Ratio of Out of Pocket Travel Cost to Income	-0.0231	-3.043
M/C	Sex	4.0941	5.423
M/C	Vehicle Availability	0.0434	10.797
Car	Occupation	0.9212	2.739
Car	Vehicle Availability	0.0326	6.398
Bus	Age	1.3006	4.744
Bus	Out of vehicle travel time	-0.0498	-2.765
M/C	Constant	-7.5659	-7.721
Car	Constant	-2.4224	-3.454
Likelihood Ratio Index		= 0.604	
Percent Correct in Prediction	M/C	= 75.0%	
	Car	= 90.2%	
	Bus	= 84.3%	
	Total	= 83.9%	

4.2.5 Vehicle Occupancy (Code : VTOCP in Figure 4.3)

Vehicle occupancy is expressed as the ratio of driver trips (vehicle trips) to all person trips made by private vehicles. Very often, trip purpose is the main factor describing variations in vehicle occupancy. The other factor affecting vehicle occupancy is trip length. These two factors will be analysed using the HIS data.

The general procedure for vehicle occupancy model analysis is presented below:-



The result of HIS data analysis shows that there is not much difference between vehicle occupancy by trip length so that in this study the vehicle occupancy by trip purpose, as shown in Table 4.11 will be adopted.

Using vehicle occupancy model, person trips using private vehicles are converted into private vehicle trips (motor car and motor cycle trips).

Table 4.11: Number of Passengers per Vehicle in the Study Area

Purpose	Motorcycle	Car
To Work	1.3	1.8
To School	1.6	2.4
Business	1.4	1.6
Private	1.5	2.2
From Work	1.3	1.8
From School	1.6	2.4
From Business	1.4	1.6
From Private	1.5	2.2

4.3 Forecast of Lorry Traffic Demand (Code: FTOD in Figure 4.3)

4.3.1 General

In this Study, person movement has been surveyed by HIS, while freight movement using lorry has been obtained through OIS. Here the lorry traffic is forecasted in this section together with an analysis of lorry traffic demand forecasting models.

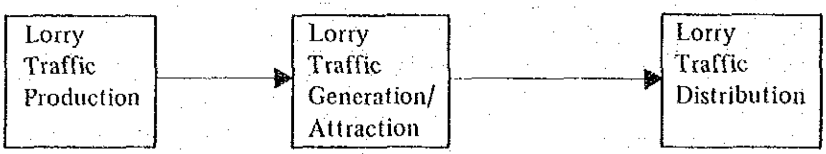
The lorry traffic is classified into three(3) categories based on the type of permit issued by the Government, i.e.:-

a) Lorry Type 'A'. Lorry with 'A' permit which is lorry for fire and having ladden weight over 2500 kg.

b) Lorry Type 'C': Lorry with 'C' permit which is lorry for own use only

c) Lorry Type 'Decontrolled' Decontrolled lorry ('D' permit) which is lorry with ladden weight below 2000 kg, and for own use only

The lorry traffic forecasting procedure is as follows:-



4.3.2 Lorry Traffic Production

Lorry traffic production is defined as the number of lorry trips produced in the entire Study Area by all lorries per day. The number of trips made by a lorry is dependent on the type of permit under which it is operated. Therefore the lorry traffic production forecasting model is formulated as follows:-

$$T_k = A_k \times N_k$$

Where:

T_k: Trip production for lorry type (k)

A_k: Trip production rate for lorry type (k)

N_k: Number of type (k) lorries

The OIS result shows in 1985 the average lorry trip production rate for Klang Valley is 4.65 trips per lorry per day (see Table 4.12).

Table 4.12: Lorry Trip Production by Permit Types, OIS 1985

Lorry Type	Lorry Trip Production Rate (trips/lorry/day)	% of Lorry Making Trip to Total No. of Lorry Registered
'A'	3.94	74.6
'C'	4.68	75.4
'Decontrolled'	4.73	75.3
Total	4.65	75.0

Based on the lorry trip production rate obtained from OIS and number of lorries projected by the Study Team, the lorry traffic demands are estimated and shown in Table 4.13.

Table 4.13: Lorry Trip Production, Klang Valley, 1985 - 2005

Lorry Type	1985 1)		1995 2)		2005 2)	
	Number of Lorries	Number of Trips	Number of Lorries	Number of Trips	Number of Lorries	Number of Trips
'A'	5,557	21,895	8,760	34,514	13,810	54,300
'C'	19,450	91,026	30,670	143,536	48,360	226,300
'Decontrolled'	42,486	200,959	71,970	340,418	121,920	576,600
Total	67,493	313,880	111,400	518,468	184,090	857,200

Notes; 1) OIS Data
2) Other Figures are estimated by the Study Team

4.3.3 Lorry Traffic Generation and Attraction

For the lorry trips, the following multiple linear regression analysis models are adopted :-

$$G_i = a_o + a_1 X_{1i} + \ldots\ldots + a_k X_{ki}$$

$$A_j = b_o + b_1 X_{1j} + \ldots\ldots + b_k X_{kj}$$

Where:

G_i, A_j: Trip Generation and Attraction by Zone i and j respectively

a_o, b_o: Constants

$a_1 \ldots a_k$: Coefficients

$b_1 \ldots b_k$: Coefficients

X_{ki}, X_{kj}. Socio-economic parameters for zones i and j

Table 4.14 shows the results of the trip generation and attraction models for lorry traffic.

Future trip generation and attraction of lorry traffic are forecasted by using these models and zonal socio-economic indicators. Figure 4.15 shows the total trip ends of lorry traffic in Klang Valley from 1985 to 2005.

Table 4.14: **Trip Generation/Attraction Models for Lorry Traffic in Klang Valley**

	Trip Generation, G Trip Attraction, A	Correlation Coefficient
Lorry Type A & C	G = 0.16388DEP2 + 0.09926DEP3 - 1071.4DUM1 + 818.0DUM2 + 345.9	0.641
	A = 0.17211DEP2 + 0.07739DEP3 - 1088.7DUM1 + 951.3DUM2 + 342.3	0.642
Decontrolled Lorry	G = 0.31635DEP2 + 0.16553DEP3 - 22397.1DUM1 - 160.1DUM2 + 454.4	0.709
	A = 0.33937DEP2 + 0.16200DEP3 - 2448.3DUM1 - 154.5DUM2 + 433.6	0.708

Where:

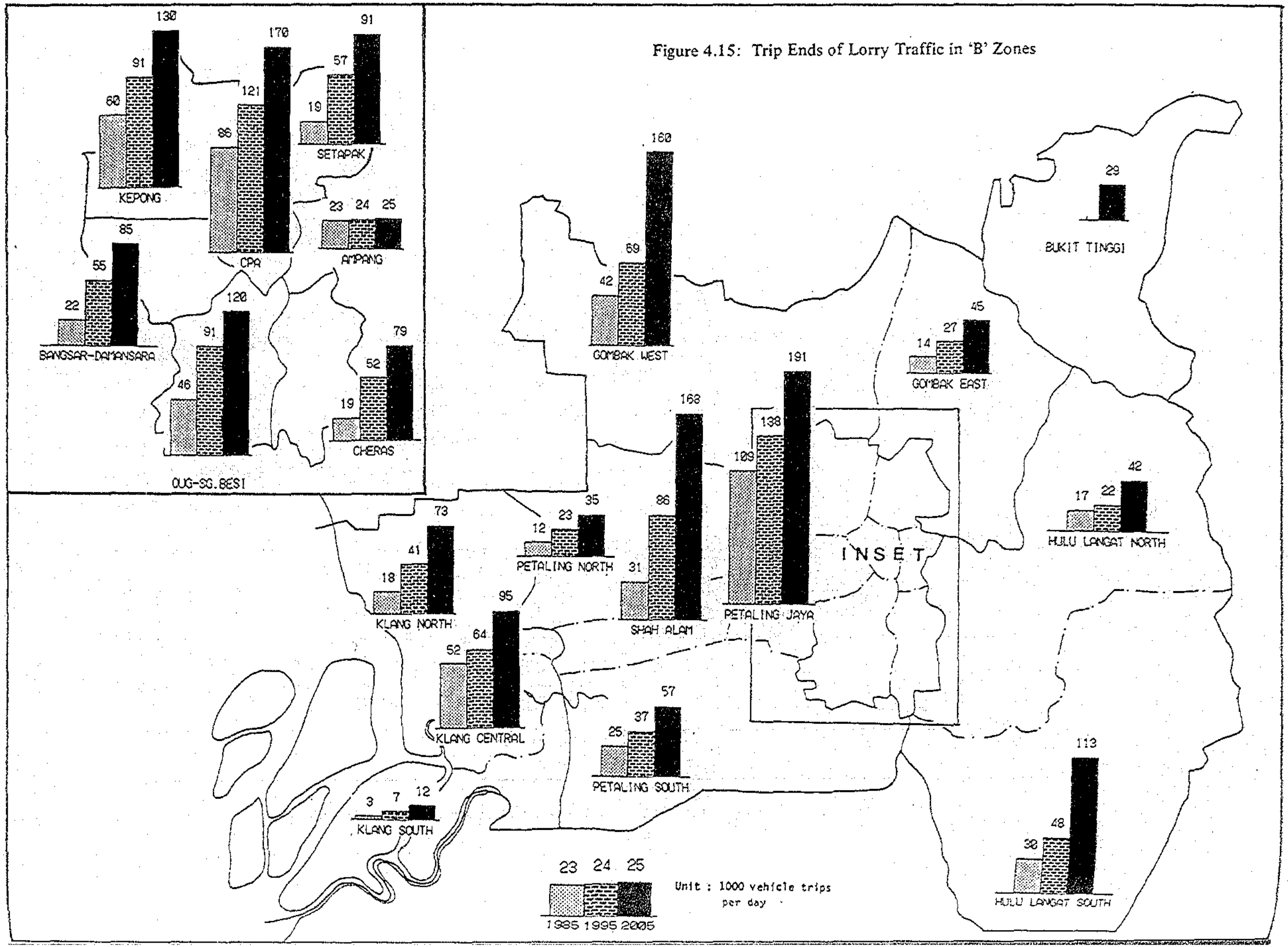
DEP2 - Daytime Employment of Secondary Industry

DEP3 - Daytime Employement of Tertiary Industry

DUM1 - (0 or 1) Dummy variable indicating locations of special commercial areas affecting lorry traffic. Traffic zones inside the Central Planning Area of Kuala Lumpur are assigned a numeric value of 1, all other zones are assigned a numeric value of 0.

DUM2 - (0 or 1) Dummy variable indicating locations of special freight handling terminals. Locations of Subang Airport, Klang South Port and Klang North Port are assigned a numeric value of 1; all other zones are assigned a numeric value of 0.

Figure 4.15: Trip Ends of Lorry Traffic in 'B' Zones



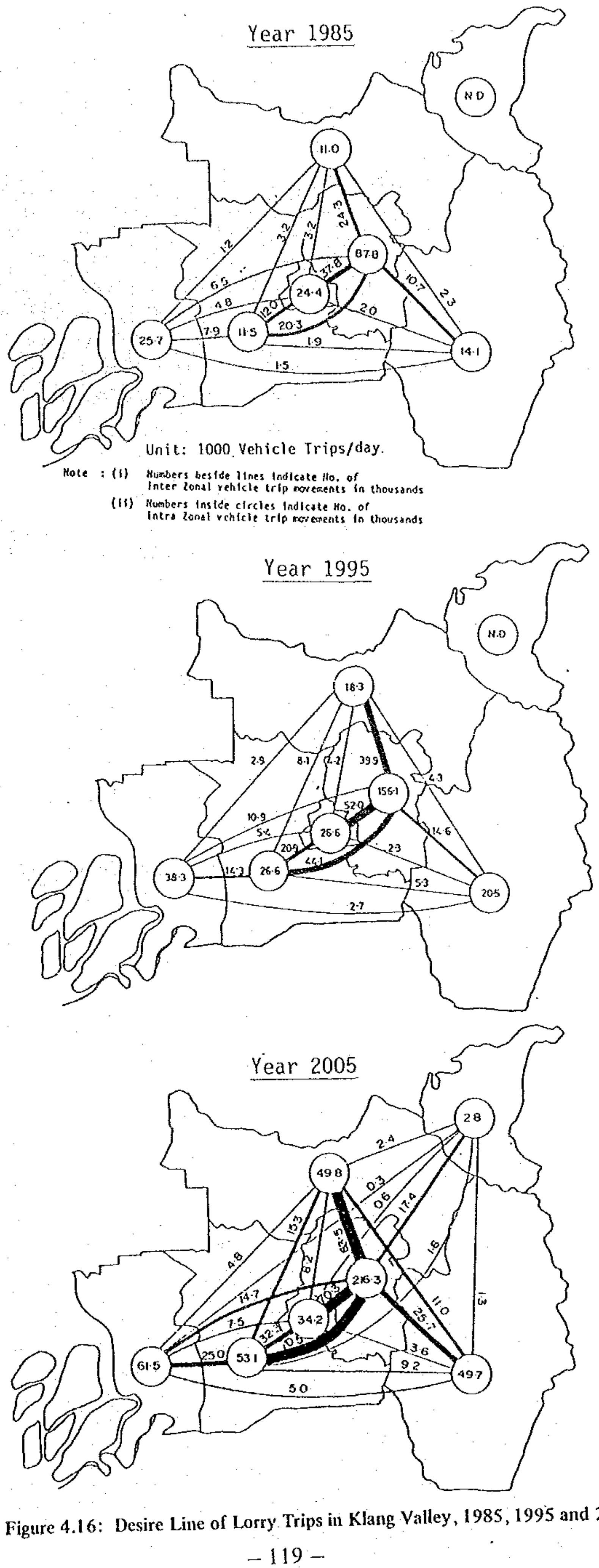


Figure 4.16: Desire Line of Lorry Trips in Klang Valley, 1985, 1995 and 2005

4.3.4 Lorry Traffic OD Distribution

Among the trip distribution models mentioned in 4.2.3, the present pattern model is adopted for estimating future lorry OD distribution after several trials of model calibration.

Figure 4.16 shows the results of the lorry traffic OD distribution in 1985, 1995 and 2005. The desire line of lorry trips in 1985, 1995 and 2005 all show strong desire lines between Kuala Lumpur with Gombak and Petaling District. By 2005, lorry trips between Kuala Lumpur and Petaling District will increase by 2.4 times from 1985 while it is 2.6 times for Kuala Lumpur-Gombak District.

4.4 Forecasting Vehicular Traffic

(1) Total Vehicular Traffic in Study Area

The vehicular traffic volume converted from the forecasted person trip volume using the vehicular occupancy rates is combined with the forecasted lorry traffic. The resultant total vehicular traffic volume expressed in desire lines between traffic zones is shown in Figure 4.17.

(2) External Traffic

External traffic, coming into and going out of or through the Study Area, contributes a relatively minor proportion to the total traffic in the Study Area.

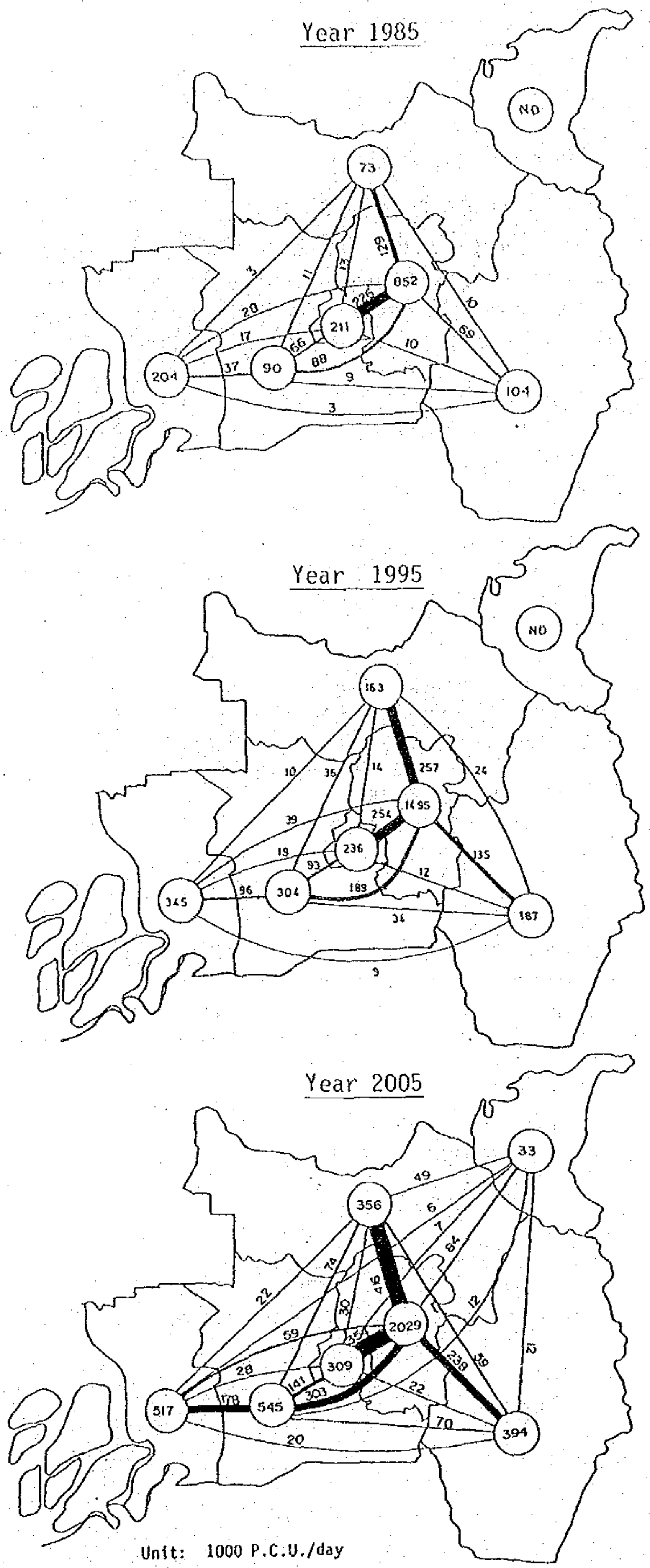
It is assumed that the external traffic increases in proportion to the growth of Gross National Product. Consequently, the external traffic is forecasted and shown in Table 4.15.

Table 4.15. Forecast of External Vehicle Traffic, Klang Valley, 1985-2005

Type of External Traffic	1985[1]	1995	2005
External Traffic Going Out of Study Area	33,120	70,900	99,100
External Traffic Coming into Study Area	31,470	67,400	94,200
Through Traffic	3,610	7,800	10,900
Total	68,200	146,100	204,300

Notes:

1) Cordon Line Interview Survey Data
2) All other figures are estimated by the Study Team



Unit: 1000 P.C.U./day

Note : (I) Numbers beside lines indicate No. of Inter Zonal vehicle trip movements in thousands

(II) Numbers inside circles indicate No. of Intra Zonal vehicle trip movements in thousands

Figure 4.17: Desire Line of Vehicular Trips by All Purpose, Klang Valley, 1985, 1995 and 2005

4.5 Highway Network Traffic Assignment (Code: VTASSIGN in Figure 4.3)

Based on the existing transport network system in 1985 and the vehicle OD matrix for 1985 and 2005, travel demands in each time frame is assigned to the road network system using the Urban Transport Forecasting System (UTFS) programme package.

"Route searching" in the road network is performed by minimization of generalized cost which combines the travel time and the travel cost. The generalized cost is expressed in the following formula:-

$$GC_i = (C_t + C_f)\, t_i + C_o d_i$$

Where:

GC_i = Generalized cost of link i

C_t = Time value

C_f = Fixed cost

C_o = Vehicle operating cost

t_i = Travel time of link i

d_i = Length of link i

Table 4.16 shows the time value and vehicle operating cost estimated by the study team.

Table 4.16: Time Value and Vehicle Operating Cost by Vehicle Type

Vehicle Type	Time Value (Ct) (M$/Hour/ Vehicle)	Distance Related Running Cost (Co) (cts/km)	Time Related Running Cost (Cf) (M$/Hour)
1. Motor Cycle	1.28	4.5	N.A.
2. Passenger Car	4.57	15.0	N.A.
3. Taxi	N.A.	11.8	4.60
4. Lorry	N.A.	36.8	7.5
5. Bus	32.10	40.2	10.68

Note: 1) All figures are estimated by Study Team
2) N.A. - Not Applicable

4.6 Forecasting Transport Conditions Under 'Do-Nothing' Situation in 1995 and 2005

With all the future travel demand between each origin and destination zone pair forecasted, the result is then assigned to the existing transport facility in forecasting the future traffic conditions under a 'Do-nothing' situation.

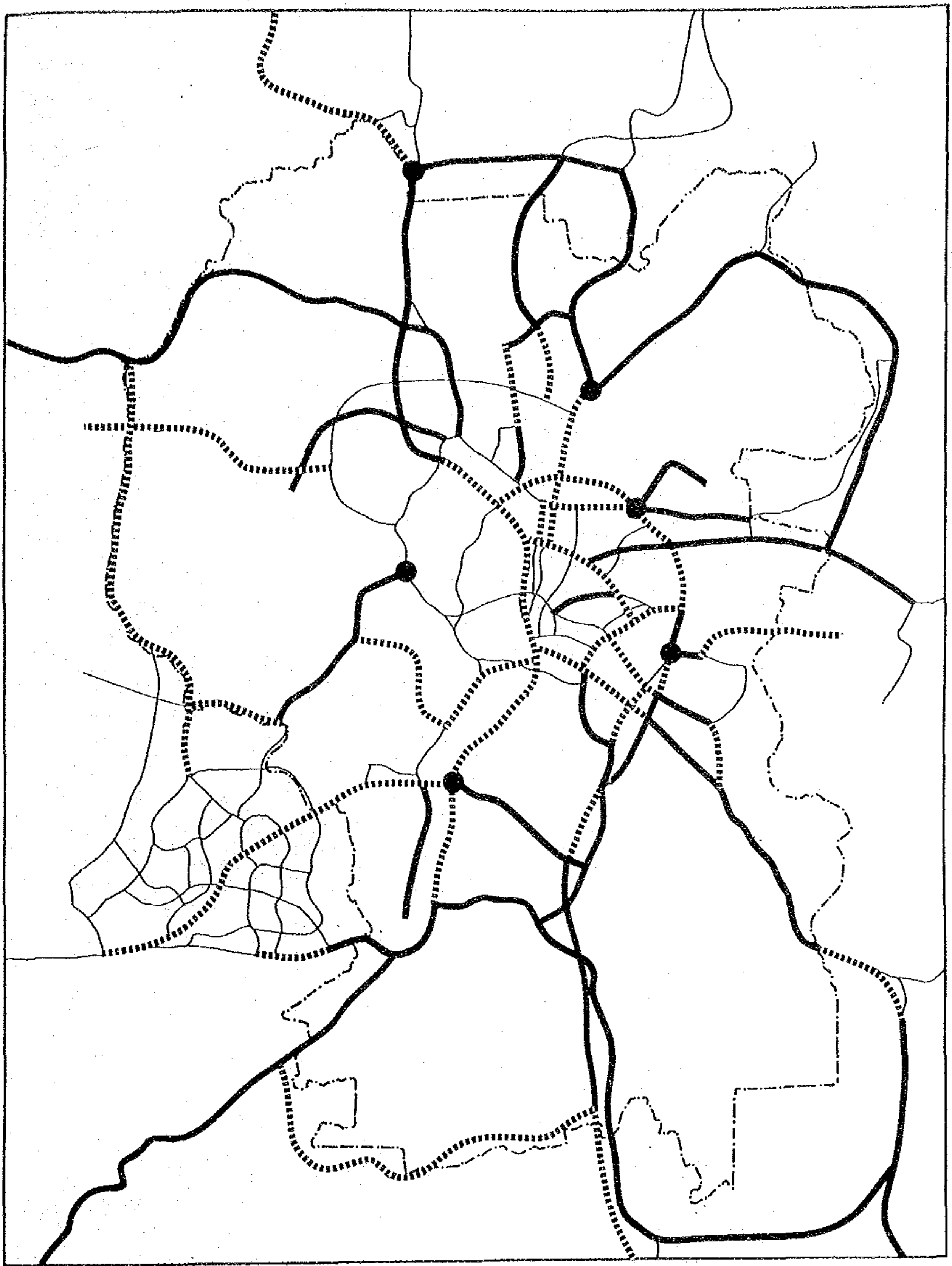
This exercise is to highlight the future transport problems assuming that future travel demand increases while no effort is made to expand the transport facility. Though such a situation will not likely to happen in future, the results will give clues to where the problematic areas are and act as the conditions of a plausible 'worst case' with which the performances of alternative transport improvement plans can be compared and hence assessed.

The results of traffic assignment of the future travel demand or the existing transport facility in terms of overall vehicle-kilometer, average trip length and congestion degree are shown in Table 4.17.

The traffic congestion degree on specific road links or the network in 1995 is shown in Figures 4.18 and 4.19 while those of 2005 is shown in Figures 4.20 and 4.21.

Table 4.17: Traffic Assignment for Klang Valley, 1985 - 2005

	(Existing) 1985	(Do-Nothing Case) 1995	2005
No. of Trips (1000 PCU)	2,051	3,600	5,723
Vehicle Kilometer (1000 PCU km)	24,988	48,871	86,962
Capacity Kilometer (1000 PCU km)	25,619	26,698	26,698
Average Trip Length (km)	12.2	13.6	15.2
Congestion Degree	0.98	1.83	3.26



LEGEND

ROAD WITH CONGESTION DEGREE 2.0 & ABOVE

ROAD WITH CONGESTION DEGREE 1.5 - 1.9

CONGESTION CAUSED BY LOW CAPACITY INTERSECTION

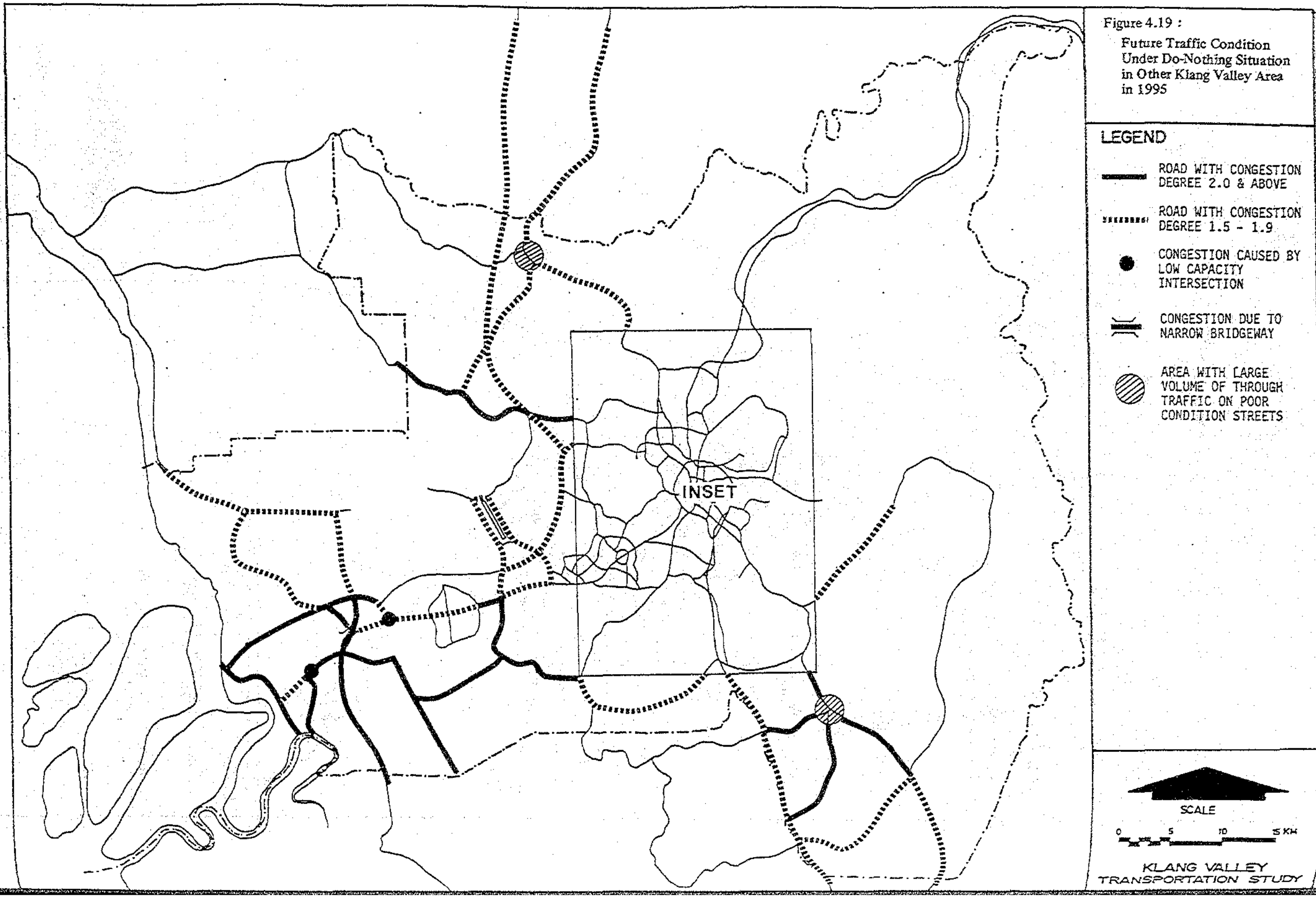
Figure 4.18 : Future Traffic Condition Under Do-Nothing Situation in Kuala Lumpur Conurbation in 1995

SCALE

0 1 2 3 4 5 KM

KLANG VALLEY TRANSPORTATION STUDY

Figure 4.19 : Future Traffic Condition Under Do-Nothing Situation in Other Klang Valley Area in 1995



LEGEND

ROAD WITH CONGESTION DEGREE 2.0 & ABOVE

ROAD WITH CONGESTION DEGREE 1.5 - 1.9

CONGESTION CAUSED BY LOW CAPACITY INTERSECTION

Figure 4.20 :
Future Traffic Condition Under Do-Nothing Situation in Kuala Lumpur Conurbation in 2005

SCALE

0 1 2 3 4 5 KM

KLANG VALLEY TRANSPORTATION STUDY

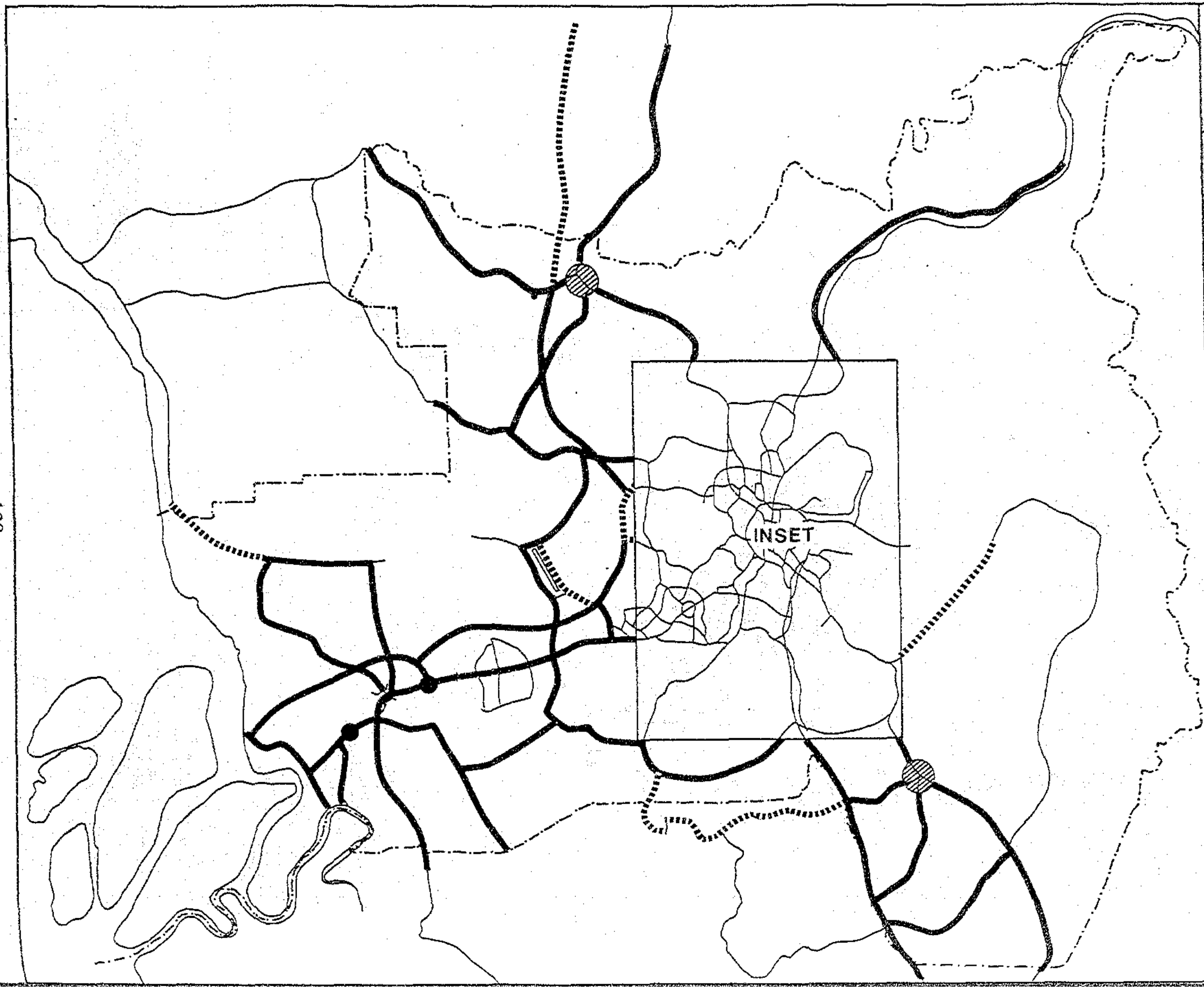


Figure 4.21 :
Future Traffic Condition
Under Do-Nothing Situation
in Other Klang Valley Area
In 2005

LEGEND

- ROAD WITH CONGESTION DEGREE 2.0 & ABOVE
- ROAD WITH CONGESTION DEGREE 1.5 - 1.9
- CONGESTION CAUSED BY LOW CAPACITY INTERSECTION
- CONGESTION DUE TO NARROW BRIDGEWAY
- AREA WITH LARGE VOLUME OF THROUGH TRAFFIC ON POOR CONDITION STREETS

SCALE

0 5 10 15 KM

KLANG VALLEY
TRANSPORTATION STUDY