4.4   Discrete Choice Model

(1)   Model Form

The discrete model is based on theories of individual behavior, and it is probabilistic. It yields the probability of choosing each alternative.   The model is based on the theoretical framework termed the random utility theory.   Following this theory, the probability for a person to choose mode i instead of mode j is expressed by the formula below.

$$P_{in} = \text{Prob } (U_{in} > U_{jn}; i \neq j \text{ for all j})$$

where, P_{in} : probability that person n will select mode i

U_{in} : utility of mode i for person n.

Utilities can be decomposed into constant V_{in} and random part ε_{in}

$$U_{in} = V_{in} + \varepsilon_{in}$$

Assuming random ε_{in} follows the "Gumbel distribution", a simple formula is derived as follows.

$$P_{in} = e^{V1n} / (e^{V1n} + e^{V2n}) \qquad \text{(Binary logit model)}$$

where Vi are utilities associated with choice alternatives.

Utilities of the mode alternative can be decomposed into two:

- Attributes of modes such as

Time: Total travel time, Access time, Egress Time, Waiting Time etc.

Cost: Total travel cost, Fuel cost, Toll fee, Fare of Public Transport

Parking, Road Pricing, etc.

LOS: Frequency of services, comfort of transfer etc.

- Attributes of individuals

Income level, vehicle ownership etc.

The Opinion Survey was designed to obtain the above-mentioned information through the field survey, especially focusing on the office workers' commuting trip characteristics.

(2)   Opinion Survey

1) Survey Area and Sampling Method

As the site for the office worker interview survey, 58 buildings along the major roads within the middle ring road I (Jln. Tun Razak) were selected in accordance with their distance from the nearest LRT/KTM.

As for the student survey, University of Malaysia (UM), University Technology Malaysia (UTM), Inti College (INTI), and Sek. Men. Methodist (high school) were selected.

2) Survey items

The survey is divided into five categories; namely; a) household information, b) individual attributes, c) revealed preference information, d) stated preference information, and e) opinions on transport policies.

a) Household Information

- Location of the residence
- The number of household members
- Ownership of the living quarters
- Type of living quarters
- Vehicle ownership of the household members
- The total gross income of the household

b) Individual Attribute

- Location of work place
- Employment sector
- Occupation
- The number of employees of the organisation which is his/her work place
- Type of driving license
- Availability of car for commuting
- Monthly gross income

c) Revealed preference and attributes of alternative transport modes in commuting

- Alternatives of major transport modes
- Usual mode of use
- Transport costs of usual commuting method
- Departure and arrival time by usual commuting method
- Travel pattern and attributes (cost and time) by alternative

d) Stated preference

- Responses to time saving
- Responses to cost saving
- Responses to LOS : headway
- Responses to accessibility improvement

e) Opinions on transport policies and the existing system

- Parking charge
- Low occupancy vehicle restraint scheme

- Road pricing
- Bus & Taxi priority lane
- Complaints about the existing public transport system

(3) Sample's stated preference in association with changes in level of service

Prior to developing discrete choice models, basic analyses was made as follows.

1) Private Mode Users' Responses

a. Travel Time Saving

The sample workers of the opinion survey stated their expected time savings when they were asked to use buses or railways for commuting.   The result shows that there is a huge gap between their current commuting time and their expected commuting time when using public transport modes.   The diagram shows the car users' stated preference for using public transport modes in accordance with the degree of time saving to be realised by using public modes.   It shows that even time savings of 20% may not be effective in diverting them to become a public transport user.
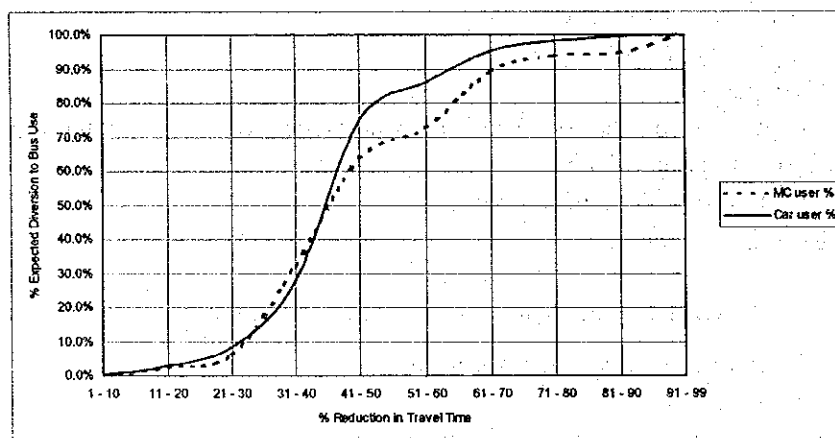

Figure 4.4.1   Stated preference to using public modes in accordance with time saving

b. Increase of Travel Cost

The sample private mode users stated the minimum degrees of cost increase in using private modes for commuting that would make them switch to public transport.   An increase of RM150 per month, which is close to the current monthly parking fee in the CPA, has a significant impact, resulting in 60% diversion to public transport modes. The average difference between the current cost and the stated minimum cost is RM170 for car users and RM75 for motorcycle users respectively (the average monthly cost is RM75 for motorcycle users and RM150 for car users).   Figure 4.4.2 shows that motorcycle users are much more sensitive to increases in transport cost.
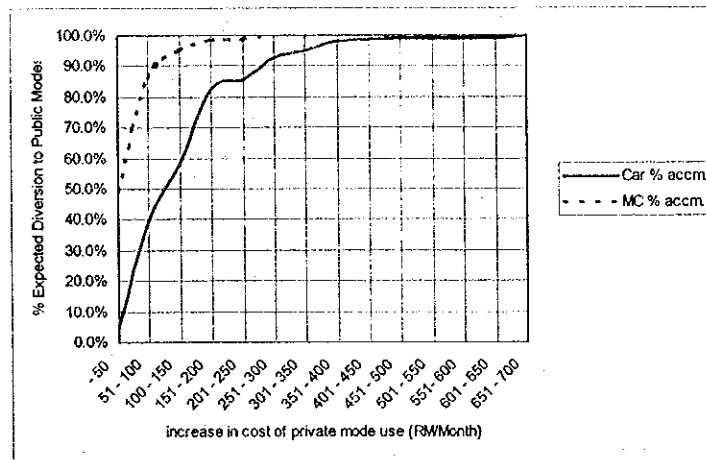
**Figure 4.4.2   Stated preference to use public modes in accordance with cost increase
of private modes of transport**

c. Preference for "Park and Ride" System

The sample car users stated their preference for using the "Park & Ride" system when
they use the KTM/LRT for commuting.   Ten cases were assumed in terms of time
saving and increase of cost.

In the previous similar questionnaire regarding time saving, 70% of the respondents
answered that they will a become public transport user if 50% time saving is
achieved, but only 10 % of them will use the public modes of transport in the case of
25% time saving.

Unlike the above response, in this question regarding "Park & Ride", nearly 90% of
the sample car users stated that they will use public transport modes if the parking is
free, in both cases of 50% time saving and 25% time saving.   However, this figure
falls in proportion to the increase in cost for the "Park & Ride".   For example, the
percentage of expected public transport user falls from 90% to 50% at a cost of RM55
a month in the case of the car users.   This is clearly implies that the respondents are
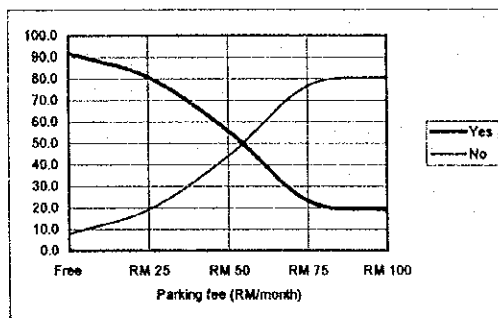more sensitive to cost other than time saving.

Case 1: 50% reduction in travel time
Motorcycle user (worker)
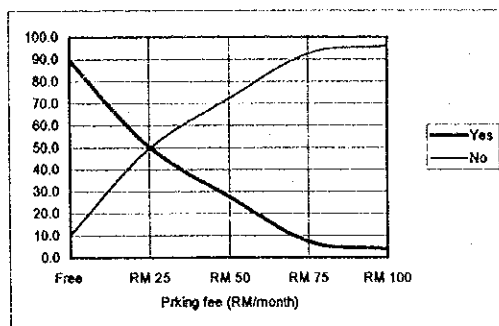
Case 2: 25% reduction in travel time
Motorcycle user (worker)
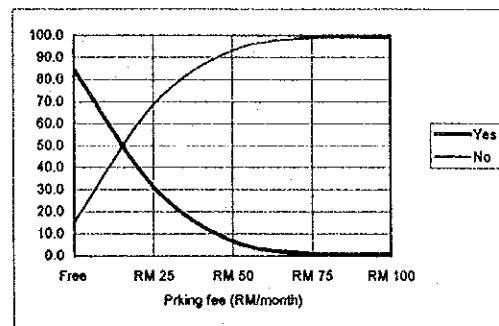
Car user (worker)

Car user (worker)
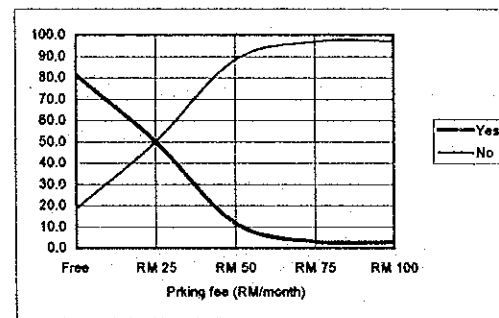
Figure 4.4.3   Stated preference for using "Park & Ride"

d. Parking Charge

The sample car users stated the maximum amount of monthly parking fee that they can pay by themselves.   If it exceeded the stated amount they would use public transport modes.

The pattern obtained for responses to the "Parking Charge" depicted in Figure 4.4.4 is quite similar to that of Figure 4.4.2.   This indicates that the sample car users' responses to the cost issue is rather reliable.

The expected rate of diversion to public transport mode increases rapidly from 30% at a cost of RM125/month to 90% at a cost of RM175/month.   There may exist a critical point between RM 125 and RM175 for car users, which has great influence on their modal choice in terms of cost.   Motorcycle users are very sensitive to cost increases as shown in the figure.   This seems to simply reflect the differences in the level of personal income, i.e., the lower the income level, the more sensitive the cost issue.
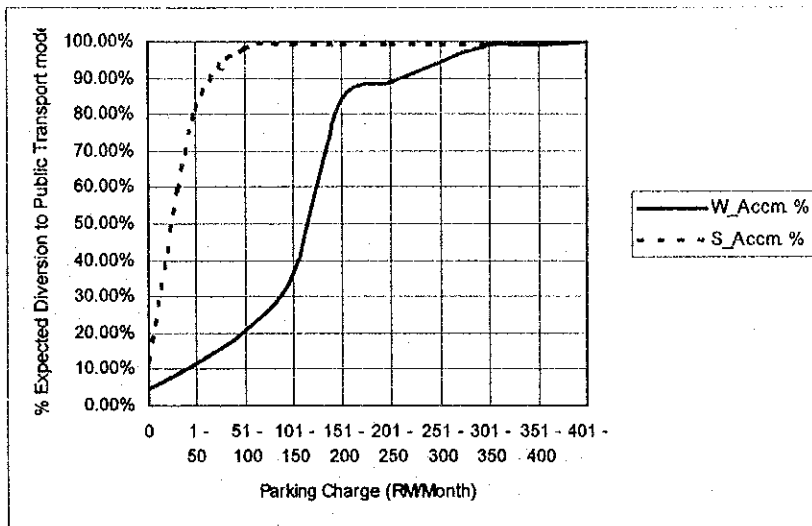
Figure 4.4.4   Response to "Parking Charge"

e. Road Pricing

The sample car users stated their preference for a rather strict traffic demand control measure termed "Road Pricing", a type of which has been introduced in Singapore since 1975. The pattern of responses to this policy was quite similar to that of the "Parking Charge", which, however, had slightly strong impact on their modal choice.
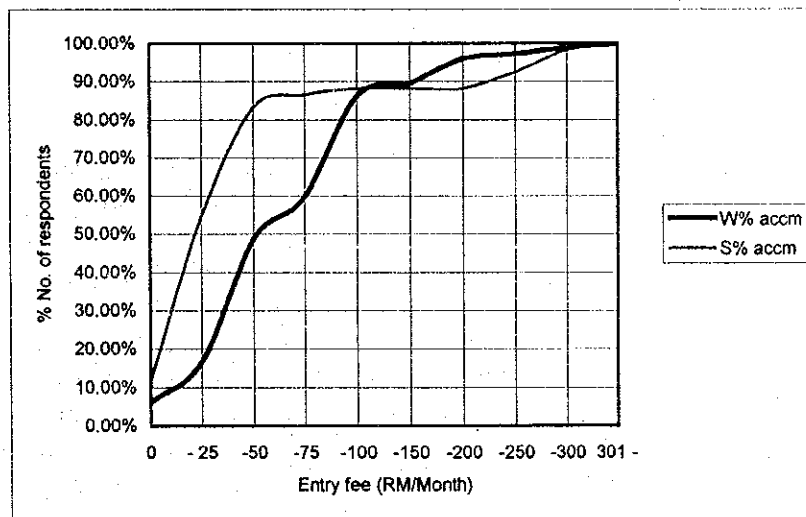

Figure 4.4.5   Response to "Road Pricing"

f. "Low Occupancy Vehicle Restriction" Scheme

The sample car users stated their preference for a transport demand control scheme termed "Low Vehicle Occupancy Restriction" like the transport policy in Jakarta, Indonesia, known as "Three in One".

No significant differences exist in the responses to this policy between people in different levels of income. About 60% of the sample car users answered that they would call two more persons to share the car and 20% of them stated that they would become public transport mode users.

Figure 4.4.6   Response to "Low Occupancy Vehicle Restriction"

2) Public Mode Users' Responses

a. Car Availability and Time

The sample public transport user stated their preference for using a car for commuting purposes if a car was available for their own use. The horizontal axis is time saving achieved by using a car and the vertical axis represents the expected diversion to modal share in the aggregated term.

90% of the respondents stated that they still use public transport modes if no time saving is realised. However, 20% of them are very sure of using car for commuting if a 10 minutes time saving was expected. And nearly half of them would shift to being a car user if a 20 minutes time saving was expected. We can easily imagine that such the situation is likely to happen through reminding the current level of services of the bus operation.

Thus, contrary to the responses to time saving by the car users, once one possesses a car one is likely to become a private mode user.

f. "Low Occupancy Vehicle Restriction" Scheme

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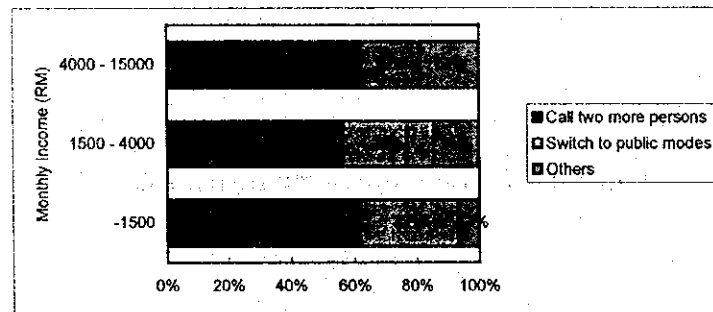

Figure 4.4.6   Response to "Low Occupancy Vehicle Restriction"

2) Public Mode Users' Responses

a. Car Availability and Time

The sample public transport user stated their preference for using a car for commuting purposes if a car was available for their own use. The horizontal axis is time saving achieved by using a car and the vertical axis represents the expected diversion to modal share in the aggregated term.

90% of the respondents stated that they still use public transport modes if no time saving is realised. However, 20% of them are very sure of using car for commuting if a 10 minutes time saving was expected. And nearly half of them would shift to being a car user if a 20 minutes time saving was expected. We can easily imagine that such the situation is likely to happen through reminding the current level of services of the bus operation.

Thus, contrary to the responses to time saving by the car users, once one possesses a car one is likely to become a private mode user.

Figure 4.4.7   Expected Diversion to Private Mode from Bus User

3) Preference for Using LRT/KTM by Bus User

As depicted in the figure below, the sample bus users were more sensitive to cost than time saving when they chose buses or the railway for commuting.   50 to 70 % of the respondents were expected to use the LRT/KTM if a 50 % time saving is expected at a 25% cost increase.   However, if the cost of using the railway increases by 50%, only 20 to 30% of the respondents will use the railway even though a 50% time saving is expected.
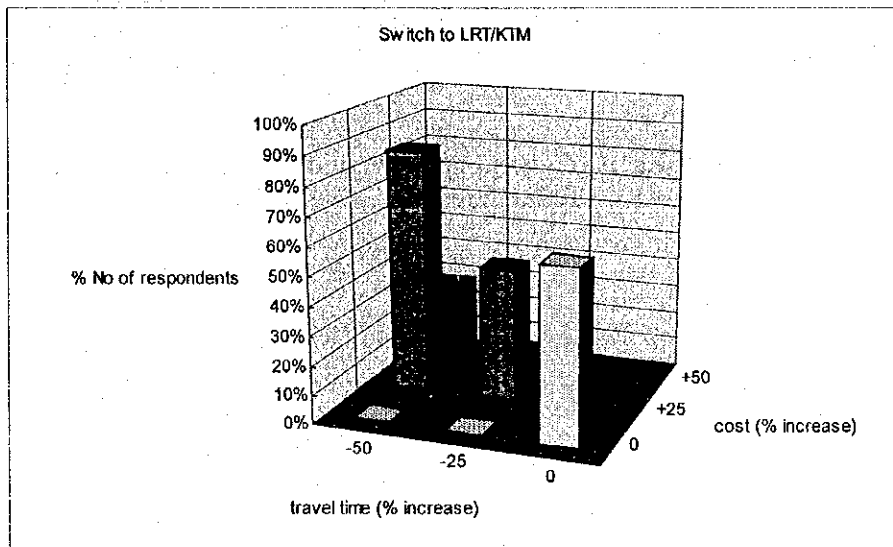
Figure 4.4.8   Expected Diversion to Railway from Bus User

Figure 4.4.7   Expected Diversion to Private Mode from Bus User

3) Preference for Using LRT/KTM by Bus User

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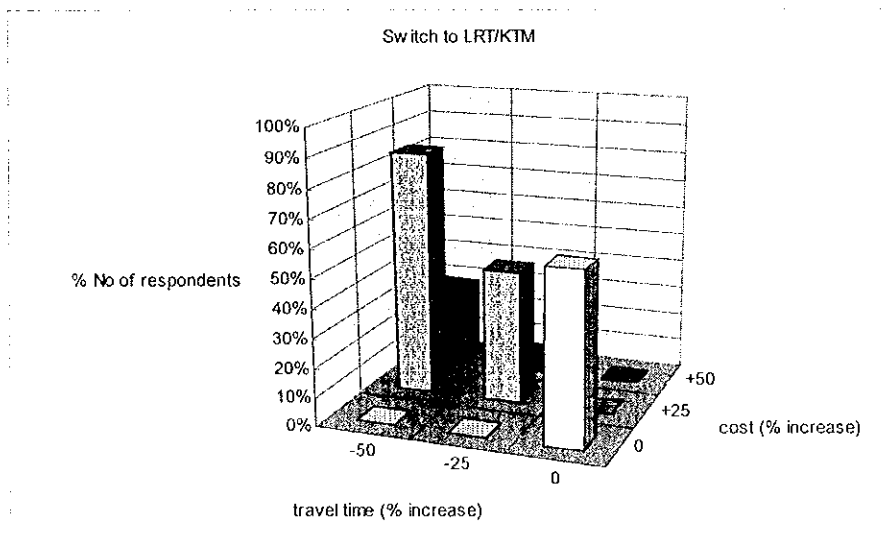
Figure 4.4.8   Expected Diversion to Railway from Bus User

(4) Development of Discrete Choice Models

1) Limitation of Model Application

As the respondents were collected from among the workers in the CPA, application of the models should be limited to part of the HBW OD matrices, that is, the models can only manage trips with destination located within the CPA. There is another reason for the limitation of the application. The socio-economic characteristics of the sample is quite different from the average for the Klang Valley region. For example, the average household income of the respondents was RM 4,750 per month, whereas that of the Klang Valley is RM 3,057.

The models are limited to choosing from alternative motorised modes of private car, motorcycle, bus, and rail. Non motorised modes such as walking and bicycle were ignored because the size of the sample was too small.

Unlike the conventional diversion curve models, the discrete choice model for this study does not provide sequential modal split from the total person trips. The models depicts only the degree of diversion between two different motorised modes in accordance with the applied transport policy.

2) Data Sets and Independent Variables

As shown in Table 4.4.1 twelve effective data sets were obtained from the Opinion Survey. Among them, the data sets important for the planning purposes are Data Set02 (Private vs. Public) for Model A, Data Set08 (Car vs. Buses) for Model B, Data Set06 (Motorcycle vs. Buses) for Model C, and Data Set04 (Bus vs. Rail) for Model D.

Explanatory variables used to explain the utility of the modes are summarised in Table 4.4.2. Almost every combination of variables was tested to get the best fit utility function.

Table 4.4.1 Data Sets for Discrete Choice Analysis, obtained from the "OPINION SURVEY"

Data Set Name	Sample	Available Choice	Mode No	No of responses	Model Type	No of observation
SET00	Samples that have information both of a representative mode and alternative modes					1467
SET01BASE	Samples that have resposes both in non-motorised mode and motorised modes	Non-motorised modes / Motorised Modes	1 / 2	72 / 204	Binary Logit Model	276
SET01SMALL	Samples that have one responses in non-motorised mode and in a motorised mode respectively.	Non-motorised modes / Motorised Modes	1 / 2	43 / 77	Binary Logit Model	120
SET02BASE	Motorised mode user samples that have responses both in private and public modes.	MC or CAR / BUS or RAIL	1 / 2			1008
SET02SMALL	Motorised mode user samples that have one private and one public mode response in their choice alternatives.	MC or CAR / BUS or RAIL	1 / 2	566 / 197	Binary Logit Model	763
SET02SMLW	Motorised mode user samples that have one private and one public mode response in their choice alternatives. (Worker only)	MC or CAR / BUS or RAIL	1 / 2	435 / 160	Binary Logit Model	595
SET03ALL	Private mode user (public modes are not available)	MC / CAR	1 / 2	22 / 8	Not available (Sample is too small)	30
SET04ALL	Public mode user (private modes are not available)	BUS / RAIL	1 / 2	52 / 127	Binary Logit Model	179
SET05ALL	All motorised mode user who have the four alternatives (MC, CAR, BUS, RAIL).	Motocycle / Car / Bus / Rail	1 / 2 / 3 / 4	8 / 18 / 2 / 7	Not available (Sample is too small)	33
SET06ALL	Motorised mode user (CAR and RAIL are not available)	MC / BUS	1 / 2	183 / 43	Binary Logit Model	226
SET06W	Motorised mode user (CAR and RAIL are not available) (Worker only)	MC / BUS	1 / 2	109 / 29	Binary Logit Model	138
SET07ALL	Motorised mode user (CAR is not available)	MC / BUS / RAIL	1 / 2 / 3	21 / 6 / 9	Not available (Sample is too small)	36
SET08ALL	Motorised mode user (MC and RAIL are not available)	CAR / BUS	1 / 2	427 / 149	Binary Logit Model	576
SET08W	Motorised mode user (MC and RAIL are not available) (Worker only)	CAR / BUS	1 / 2	360 / 125	Binary Logit Model	485
SET09ALL	Motorised mode user (MC is not available)	CAR / BUS / RAIL	1 / 2 / 3	67 / 15 / 27	Multinomial Logit model	109
SET10ALL	Motorised mode user (RAIL is not available)	MC or CAR / BUS	1 / 2	566 / 192	Binary Logit Model	758
SET10W	Motorised mode user (RAIL is not available) (Worker only)	MC or CAR / BUS	1 / 2	465 / 154	Binary Logit Model	619
SET11ALL	Motorised mode user (BUS is not available)	MC or CAR / RAIL	1 / 2	2 / 9	Not available (Sample is too small)	11

Table 4.4.2   Explanatory Variables for Utility Function

Variables	Description	Unit
V01	Total travel time	Minutes
V02	Total riding time	Minutes
V03	Total access time	Minutes
V04	Total egress time	Minutes
V05	Total waiting time	Minutes
V06	The number of transfer (public transport)	Minutes
V07	Total cost for a travel	RM/travel
V08	Fuel cost	RM/travel
V09	Toll fee	RM/travel
V10	Parking fee	RM/travel
V11	Bus fee	RM/travel
V12	Rail fee	RM/travel
V13	Total cost for public transport use	RM/travel
V14	Total cost for private mode use	RM/travel
V15	Total access and egress time	Minutes
V16	V01-V02/V03	Ratio

3) Obtained Models

MODEL A

Mode 1: Private (MC or CAR) vs. Mode 2: Public (BUS or RAIL)

Logit (p) = -0.0989 - 0.0033 × ΔV01 - 0.0853 × ΔV07 + 0.2298 × INCOME

MODEL B

Mode 1: CAR vs. Mode 2: BUS

Logit (p) = 0.53330 - 0.0278 × ΔV01 - 0.1235 × ΔV07 + 0.0288 × INCOME

MODEL C

Mode 1: MC vs. Mode 2: BUS

Logit (p) = -0.723 - 0.0251 × ΔV01 - 0.7661 × ΔV07 + 0.0417 × INCOME

MODEL D

Mode 1: BUS vs. Mode 2: RAIL

Logit (p) = -2.4001 - 0.0259 × ΔV01 - 1.7094 × ΔV07 - 0.0687 × INCOME

where,

ΔV01   =   Travel time of MODE 1 – Travel time of MODE2 (minutes)

ΔV07   =   Travel cost of MODE 1 – Travel cost of MODE 2 (RM / travel)

INCOME   =   1 : Person of low income household

2: Person of low middle income household

3: Person of upper middle income household

4: Person of high income household

And probability of selecting each mode is given as follows;

P(Mode 1) = exp(logit(p))/{1+exp(logit(p))}

P(Mode 2) = 1- P(Mode 1)

Table 4.4.3   Summary of Estimated Parameters

MODEL	MODEL A	MODEL B	MODEL C	MODEL D
DATA SET	SET02SMLW+SP	SET08W+SP	SET06W+SP	SET04ALL
INTERCEPT (t-value)	-0.0989	0.5330	-0.7230	-2.4001
ΔV01 Total travel time (min)	-0.0033 (-1.4706)	-0.0278 (-12.3009)	-0.0251 (-6.5026)	-0.0359 (-8.7561)
ΔV07 Total cost (RM)	-0.0853 (-6.5615)	-0.1235 (-7.0977)	-0.7661 (-5.0668)	-1.7094 (-12.4956)
INCOME	0.2298 (3.6303)	0.0288 (0.2892)	0.0417 (0.3317)	-0.0687 (-1.3288)
HIT RATE	63.0 %	56.9%	62.3%	61.2%

(5)   Policy Test on the Sample

Figure 4.4.9 shows the test results of several kinds of transport policies on the samples group.

Model A: Private vs. Public

This model predicts the probability of choosing private modes of transport.

Test Policy A1: Increase riding time of private modes

Probability associated with changes of riding time of private modes of transport assuming that there are no changes in that of public modes.   Similar to the basic analysis of the Opinion Survey, the sampled CPA workers do not seem to be very sensitive to changes in riding time.   A 27% share of public transport modes realised at the current level of services will increase to only 40% even if the riding time of the private modes increases by 80%.

Test Policy A2: Decrease riding time of public modes

Probability associated with changes of riding time of public modes of transport if there are no changes in that of private modes. The result is similar to that of Policy A1.

Test Policy A3: Charge on private modes

If a cost of 125RM / month is charged for the use of private modes (including cars and motorcycles), the share of public modes increases from 27 % to around 50%. Nevertheless, it should be noted that the test does not imply that the number of car users will decrease by 50% from the current level.

Figure 4.4.9   Predicted Modal Share in association with Test Policies

4 - 37
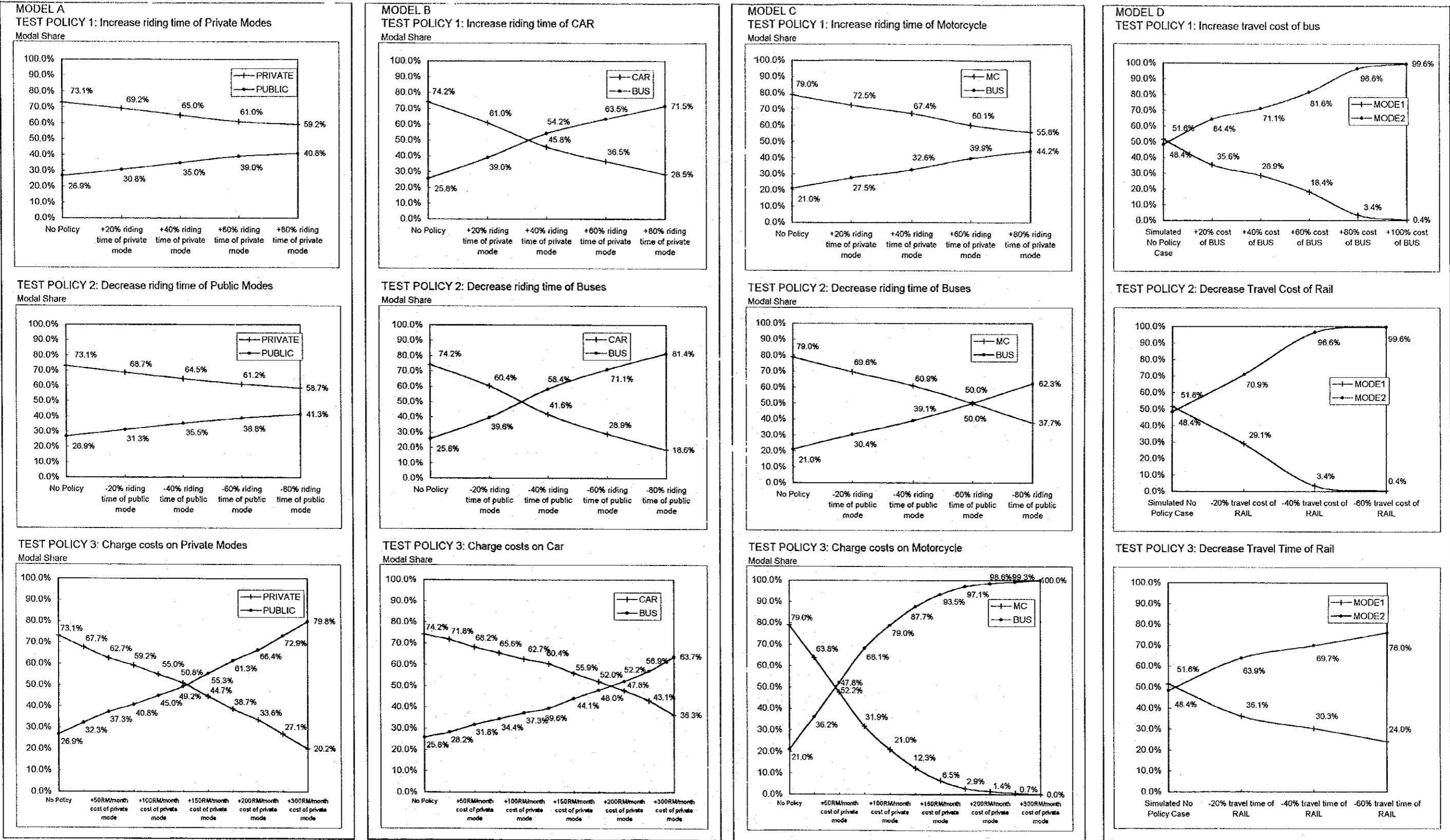
Model B: Car vs. Bus

It is safe to consider that this model will provide some degree of diversion from cars to other transport modes including motorcycle, buses, and rail transport.

Test Policy B1: Increase riding time

If the riding time for cars increases by 40% from the current level (from 61 minutes to 84 minutes), the share of car user will decrease from 74% to 46% assuming that there are no changes in the riding time of buses (88 minutes on average for the sample group). This change of modal share is equivalent to a diversion of 17.8% from the cars to other modes of transport as shown in Figure 4.4.10.
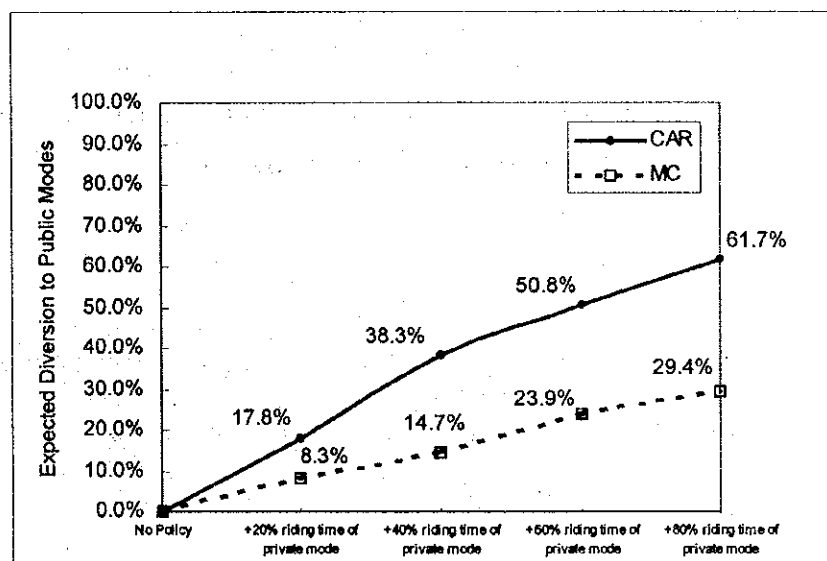
Figure 4.4.10 Predicted Diversion from Car to other modes of transport

(Increase riding time of Car)

Test Policy B2: Decrease riding time of buses

A decrease of 20% in riding time of buses will result in a 60% share of car use. This is equivalent to a diversion of 18.6% from car users to other transport mode user (see Figure 4.4.11).

Test policy B3: Charge costs on car

This case assumes a road pricing policy which charges car users from entering a certain area (CPA in this case). According to this model, a charge amount of RM 200 will affect around 50 % of the car users. This is equivalent to a diversion of 35.6% from car users to other transport mode (see Figure 4.4.12).
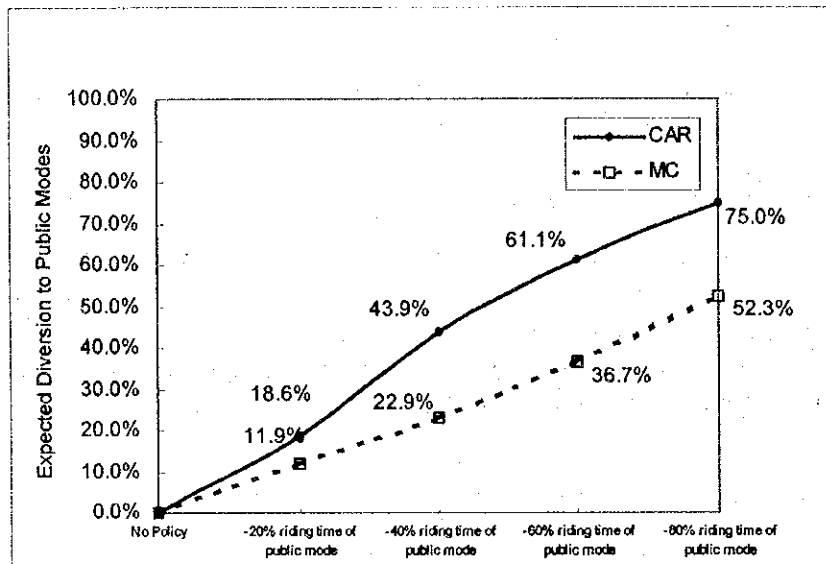
Figure 4.4.11   Predicted Diversion from Car to other modes of transport

(Decrease riding time of buses)
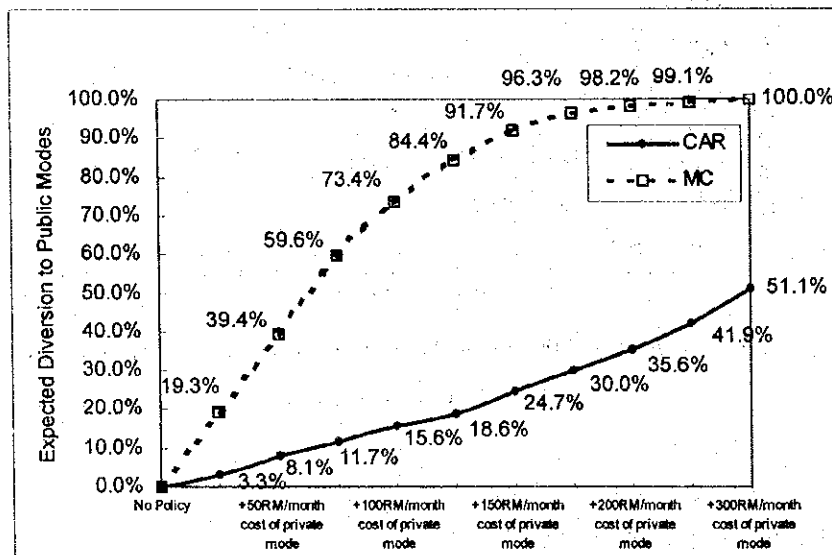
Figure 4.4.12   Predicted Diversion from Car to other modes of transport
(Charge on private modes)

Model C: Motorcycle vs. Bus

The results are similar to the corresponding case of Model B, though the degree of impact by the policies are greater than those of Model B.

(6) Preliminary Model Application to CPA (via MODEL B)

If the sample workers reflect the variety of characteristics of the CPA workers on the whole, the following simple model application can be made.

Table 4.4.4   Predicted Changes of Car Use

TEST POLICY	% INCREASE FROM NO POLICY	Car trips Attracted to CPA (person trip)
No Policy	---	133,165
+20% riding time of private mode	-17.8%	109,491
+40% riding time of private mode	-38.3%	82,118
+60% riding time of private mode	-50.8%	65,473
+80% riding time of private mode	-61.7%	51,047
-20% riding time of public mode	-18.6%	108,382
-40% riding time of public mode	-43.9%	74,720
-60% riding time of public mode	-61.1%	51,786
-80% riding time of public mode	-75.0%	33,291
+25RM/month cost of private mode	-3.3%	128,726
+50RM/month cost of private mode	-8.1%	122,438
+75RM/month cost of private mode	-11.7%	117,629
+100RM/month cost of private mode	-15.6%	112,450
+125RM/month cost of private mode	-18.6%	108,382
+150RM/month cost of private mode	-24.7%	100,244
+175RM/month cost of private mode	-30.0%	93,216
+200RM/month cost of private mode	-35.6%	85,817
+250RM/month cost of private mode	-41.9%	77,310
+300RM/month cost of private mode	-51.1%	65,103
-50% waiting time of public modes	-11.9%	117,259
-67% waiting time of public modes	-16.9%	110,601
+150RM/month cost of private mode -20% riding time of public mode -67% waiting time of public modes	-52.8%	62,883

The number of current trips by car attracted to the CPA (HBW purpose) is estimated to be around 133,000 trips.   If the above policy mix is applied to the CPA worker, the amount of traffic volume made by cars will decrease to almost half of the current figure.

However, it should be noted that the model should be applied to each OD pair (not to total zonal trips); thus the results may be different in some extent.

Chapter 5

Planning Framework
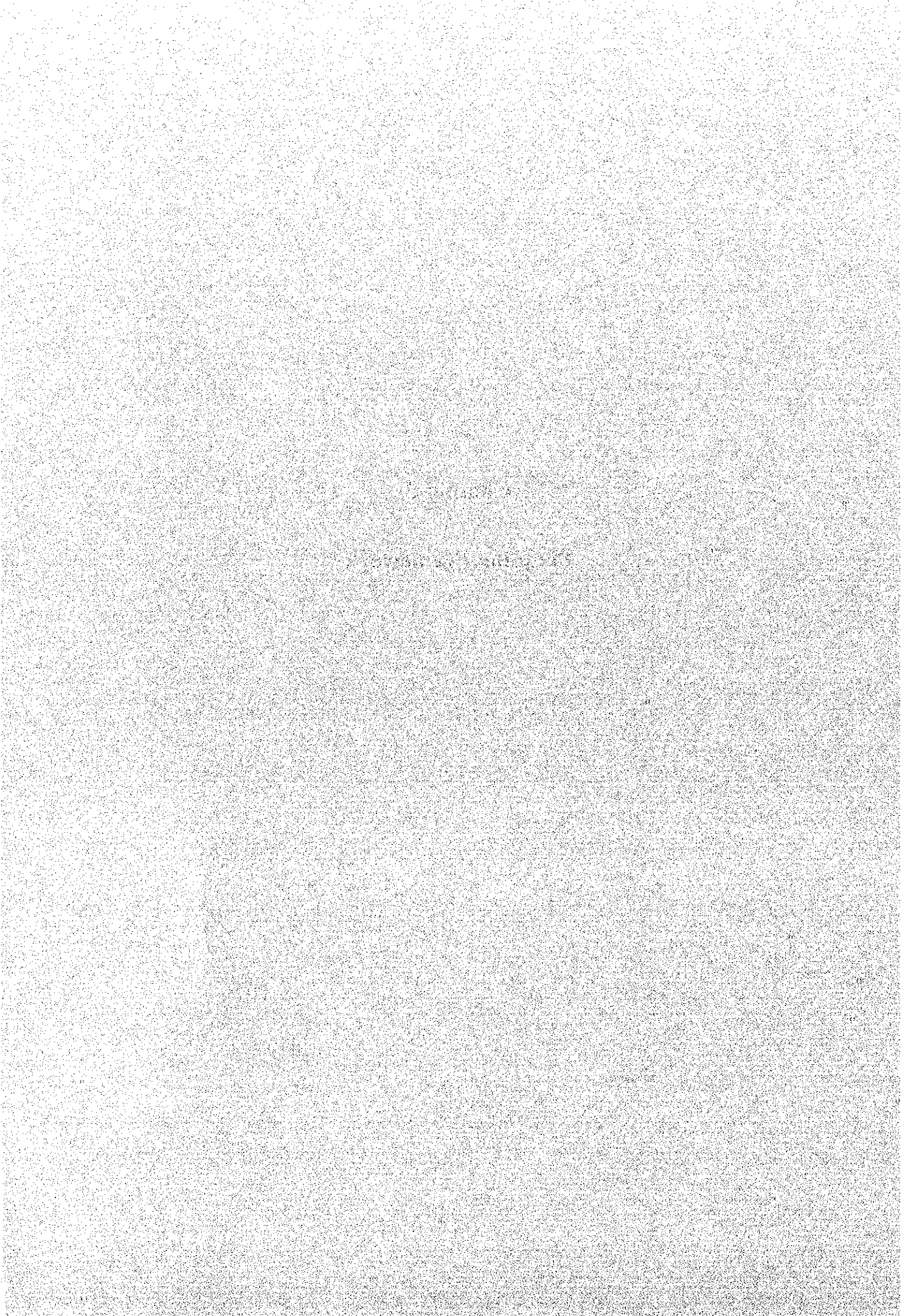
Chapter 5   Planning Framework

5.1   Urban and Regional Structure

5.1.1   Structure Plan

(1) Planning Issues

1) Regional Development Structure

There are at present three major economic activity centres in the Klang Valley region, that is, the CBD of Kuala Lumpur, Petaling Jaya and Shah Alam. In the coming decade, we will have another two major growth cores at Putra Jaya and Cyber Jaya in the MSC. In the end, two remarkable development corridors will be established, i.e. Port Klang - CBD of KL and the CBD of KL - Kuala Lumpur International Airport (KLIA).

Considering the development direction above discussed, it is very likely that the area between Subang Jaya and Kajang / Bangi will have a huge development potential. This aspect must be verified by the fact that large infrastructure development projects such as the Shah Alam Expressway and North-South Central Link which serve as a back-bone for the regional development are taking place (see Figure 5.1.1). Besides, many large-scale projects related to the Multimedia Super Corridor plan will be materialised, even though there has been some delay in the projects due to the recent economic stagnation.

2) Structure Plan in the Study Area

A guideline for regional and city development planning has been issued as a structure plan by the local government and municipal councils of Malaysia. The Klang Valley region is divided into the following eight municipal councils:

- Federal Territory of Kuala Lumpur

- Ampang Jaya Municipal Council

- Selayang Municipal Council

- Kajang Municipal Council

- Petaling Jaya Municipal Council

- Subang Jaya Municipal Council

- Shah Alam Municipal Council

- Klang Municipal Council

Figure 5.1.1 Spatial Regional Structure Framework

▬▬▬▬▬	Transport Corridor
─────	Major Expressway
─────	Planned Arterial
─ ─ ─ ─	Exsiting Arterial(or Under construction)
◯	Sub Center
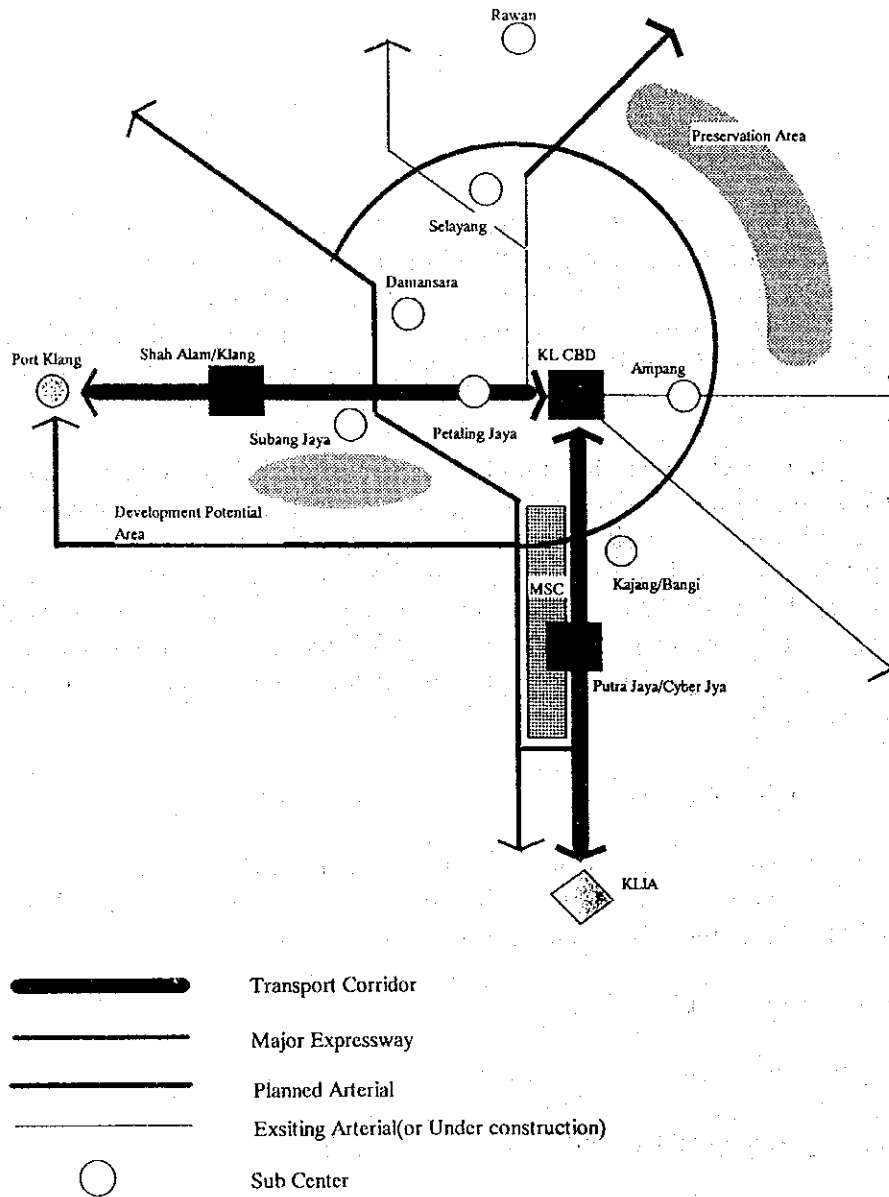
The current status of the structure plans in the Study area is summarised as follows:

a. Federal Territory of Kuala Lumpur

The first structure plan was formulated in 1984. A review is being carried out now and is expected to be completed by August in 1999.

b. Petaling Jaya, Subang Jaya and Shah Alam

The draft structure plan in these three municipal councils were compiled into one book and issued in September, 1991 in light of the Town and Country Planning Act. This draft report is still in use as a guideline for city planning in these regions.

c. Ampang Jaya, Selayang

The draft structure plan for Ampang Jaya and Selayang were issued in September, 1997 and were presented to the public for comments. The general content of both plans are still available at this stage although some minor amendments might have taken place based on the comments from the public.

d. Hulu Langat (Kajang)

The structure plan for Hulu Langat was issued at the same time as those for Ampang Jaya and Selayang. Kajang and Bangi, which make up a part of the Hulu Langat District are, however, excluded in this structure plan in view of local administration. The structure plan for Kajang and Bangi had been drawn up in 1985, which includes Mukim Dengkil, part of Sepang District in Selangor State, due to its regional characteristics.

Much attention has been paid to environmental preservation to protect the region from a degradation of the eco-system and wildlife, and also from contamination of water resources which furnishing drinking water to KL in the draft structure plan.

3) Planning Issues

a. Ampang Jaya

Ampang Jaya neighbours Kuala Lumpur and the densely populated area is spreading continuously from KL. This region is mainly a residential area. The following planning issues and policies are envisaged:

- to enhance secondary and tertiary industry sectors to maintain job opportunity

- to establish viable commercial activities

- to further promote the Bumiputra policy

The key issues are keeping the function of residential town of KL and to strengthen its self-sufficiency component.

b. Selayang and Hulu Langat

The regional characteristic of the Study area is quite different by regions. The eastern region, which includes Selayang and Hulu Langat, still continues to have a rural-area climate even at present, and the following are their planning issues and policies:

- to increase employment in the tertiary sector

- to attract key manufacturing factories

- to enhance tourism and commercial industries

- to preserve forest and its environment

c. Shah Alam, Petaling Jaya and Subang

These three regions, which form an integrated region, have been well developed in comparison to other areas except KL. Petaling Jaya seems to be one of the largest bed-town for KL having many office buildings and well-functioning small commercial outlets surrounded by the dense population.

Subang Jaya has characteristics very similar to those of Petaling Jaya. On the contrary, Shah Alam has slightly different facets showing a high religious centre by its mosque, an administrative centre for the Selangor State and a centre of highly integrated export-oriented manufacturing industries. The planning issues and policies can be listed as followings:

- to keep a role to support the bed town of KL

- to promote the current manufacturing industry

- to induce more information technology (IT) industry

- to create a core centre to cope with more integrated commercial activities

- to create tourism and recreation activities

(2) Land Use Plan

As mentioned in the previous sections, there are relatively new structure plans for the regions surrounding KL which are administered by the respective municipal councils. The land use plan in these structure plans have been fully incorporated into our planning process without any major changes. Figure 5.1.2 shows the land use plans and development policies in the Klang Valley.

On the other hand, the currently available structure plan for KL has become outdated, and review work is being conducted at present by DBKL. Even though it is not available for us to utilise in the latest structure plan of KL, two major issues should be considered in the context of future development in KL.

- What kind of functions and features has to be laid out after the relocation of the central government offices to Putra Jaya and how to use the vacated sites.

- How to control future excessive development to meet the urban transport infrastructure.

The relocation of government offices is scheduled to be completed by the year 2005 although some delay will take place due to the current economic stagnation. Much attention has to be paid to drawing up well co-ordinated plans for the sites of governmental offices so as not to cause additional traffic congestion after their relocation to Putra Jaya.

Attention also needs to be drawn to finding appropriate measures to control large-scale urban development projects in order not to generate excessive vehicle traffic volume. Such measures can be in the form of introducing the floor-area-ratio control method. Many investors appear to be facing some difficulties in continuing their projects these days due to the contraction in financial loans and credit. this might be an ideal time to introduce the floor-area-ratio control method as investors review and downsize their projects.

Although it is not the responsibility of the Study Team, SMURT-KL, to formulate the future land use plan for KL, a preliminary zoning system has been drawn up based on the past trend for the purpose of estimating the future socio-economic framework.

5.1.2 Current Development Project

(1) Urban Development Projects in KL

The development projects can generally be categorised into the following four stages in terms of the application procedure:

- under construction stage
- development order stage (some amendment may be requested by the uthorities)
- committed stage (application for development was committed by the authorities)
- not committed stage (just a plan)

Figure 5.1.3 shows the location of the development projects. Except for the non-committed projects, Table 5.1.1 sets forth the information on the site area and floor area of the projects and their development stage.

Table 5.1.1 Current Urban Development Project in KL

Unit: Square meters

Development Stage	Area	open space	Office	Hotel	Residence	Others	Total
Current	427,061	304,433	788,814	241,633	108,879	451,866	1,591,191
Under Construction	867,779	923,519	2,088,206	402,536	323,757	1,645,166	4,459,665
Development Order	575,330	526,186	1,144,435	469,052	206,145	850,964	2,670,596
Committed	1,005,921	1,746,892	1,621,941	335,183	133,590	1,579,765	3,670,479
Grand Total	2,876,091	3,501,029	5,643,396	1,448,404	772,371	4,527,760	12,391,931

Note: Projects of which floor area are more than 1 million square feet
Source: Master Plan Unit, DBKL

LEGEND

Boundaries

☐ District

☐ HIS Dzone

Structure Plan

Existing Residential Area

Approved Residential Area

Proposed Residential Area

Commercial Area

Existing Industrial Area

Approved Industrial Area

Proposed Industrial Area

Forest Reserve

Proposed Research / Educational Forest Zone

Proposed Buffer Zone / Recreational

Agricultural Area

Village Development Area

Recreational / Tourism / Religious Area

Water Catchment Area

Proposed Bumiputra Entrepreneur Park

Centralized Cemetary Area

Institute / Public Facilities

Undivided

Others

Figure 5.1.2
Land Use Plan in
Klang Valley

SMURT-KL

A STUDY ON
INTEGRATED URBAN TRANSPORTATION STRATEGIES
FOR ENVIRONMENTAL IMPROVEMENT
IN KUALA LUMPUR

Taman Mestiara

KTM Berhad

Sun Siong Industries

Sunrise
Kenny Height Devt.
Plaza Mont Kiara
Menera Dato' Onn (PWTC)
Medan Muda
Central Magnitude
Hotel The Legends
Yeyasan Selangor
Bander Wawasan (Vision City)
Hampshire Park
Menara Potential
Grand Hyatt Duta
Menara Lion / Hotel Nikko
Wisma Multi Purpose Fasa 1
Menara Petronas / Suria KLCC
Plaza Damansara
Capital Square
Komplek UBN
Hotel Guoman KL (Cashfull)
Menara Maybank
Pdapakat Bina
Pusat Bander Qmansara 1
Menara Berjaya (KL Plaza)
Hotel Park Royal
Komplek Dayabumi
Plaza Rakyat
Berjaya Star City
KL Sentral
Plaza Merdeka
KL Sentral
PBSM / LGI
Kuala Lumpur Sentral
Uachang Emas UE3
Kel - Pacific Devt.
Mega Mall - Mid Valley City (Fasa 1)
Menara Telekom (Ibu Pejabat STMB)
Pusat Iktisas dan Belia
Cheras Utama
Tenggara Teguh
Majlis Belia Malaysia Bhn
Parkar Devt.
Chai Yen Chong
Pearl Point
Why Devt.
Bander Tasik Selatan
Plaza Shencbd
Manelom
Alpha Lab

LEGEND

Sediada	Motorway
P. Pembangunan	Main Road
Dlm. Pembinaan	Rail1way
Lulus Dasar	

**Figure 5.1.3
Location of Development Project**

SMURT-KL

INTEGRATED URBAN TRANSPORTAION STRATEGIES
FOR ENVIRONMENTAL IMPROVEMENT
IN KUALA LUMPUR

JAPAN INTERNATIONAL COOPERATION AGENCY

(2) Multimedia Super Corridor

In line with Vision 2020, the Multimedia Super Corridor (MSC) has been planned with the aimed of making Malaysia a member of the advanced countries by the year 2020. The project area covers from Kuala Lumpur City Centre (KLCC) to Kuala Lumpur International Airport (KLIA), 15 km in width and 40 km. in length, and consists of several major planning components such as Putra Jaja, Cyber Jaya, High Tech Park and others.

According to the plan, all the governmental offices are scheduled to move to Putra Jaya. According to the initial schedule, the Prime Minister's Office is expected to move planned to move to Putra Jaya in the beginning of 1998 and all government functions are scheduled to relocate by the end of 2005. However, the progress of the project has been delayed so far. On the other hand, Cyber Jaya and High Tech Park is planned to create a leading edge multimedia centre that will attract world class multimedia information technology (IT) companies (see Figure 5.1.8).

In conjunction with the MSC, many major infrastructure projects such as the North South Link and the Shah Alam Expressway have already been implemented and are open for service. The dedicated Highway connecting KLCC to KLIA, the South Klang Valley Expressway and the Express Rail Link are to be constructed in the forthcoming year.

(3) Kuala Lumpur International Airport (KLIA)

As shown in Figure 5.1.8, KLIA is located at the southern part of MSC, around 50 km. from the centre of Kuala Lumpur. All the airport functions were relocated from the old Subang Airport to KLIA on June 29, 1998. KLIA has two 4,000 meters runways at present and has the capacity to handle more than 60 million passengers per annum including transit passengers. (see Figure 5.1.9) Table 5.1.2 sets forth the annual passenger forecast.

MULTIMEDIA SUPER CORRIDOR

LEGEND

- National Capital
- Strategic Centre
- Main Centre
- Regional Distributor
- Dedicated Highway
- District Distributor
- Express Rail Link
- Express Rail Link Terminal
- MSC Light Rail
- Green Network
- Green Reserves
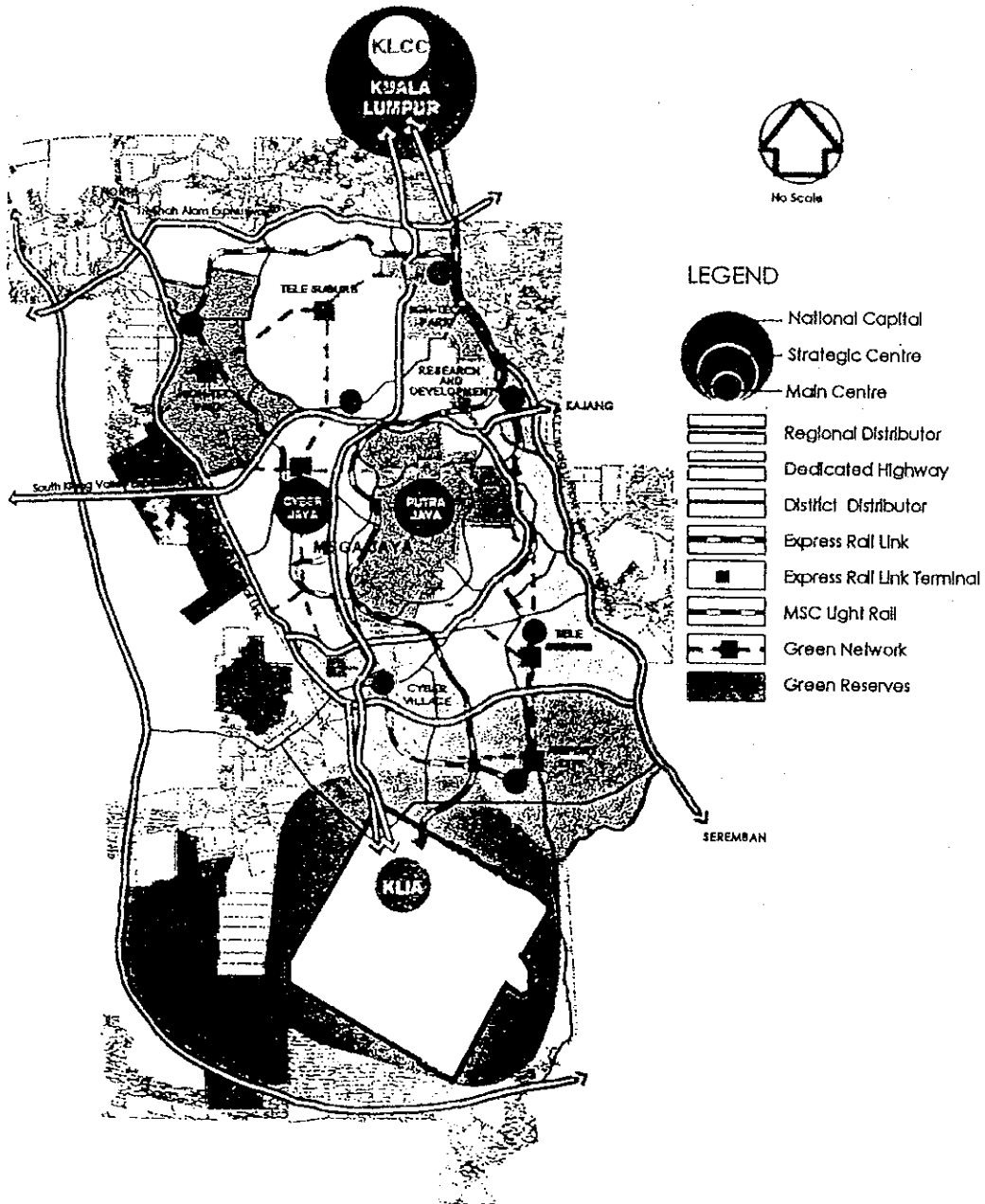
LEGEND

Figure 5.1.4   MSC Plan

SMURT-KL
Study on Integrated Urban Transportation Strategies
for
Environmental Improvement in Kuala Lumpur
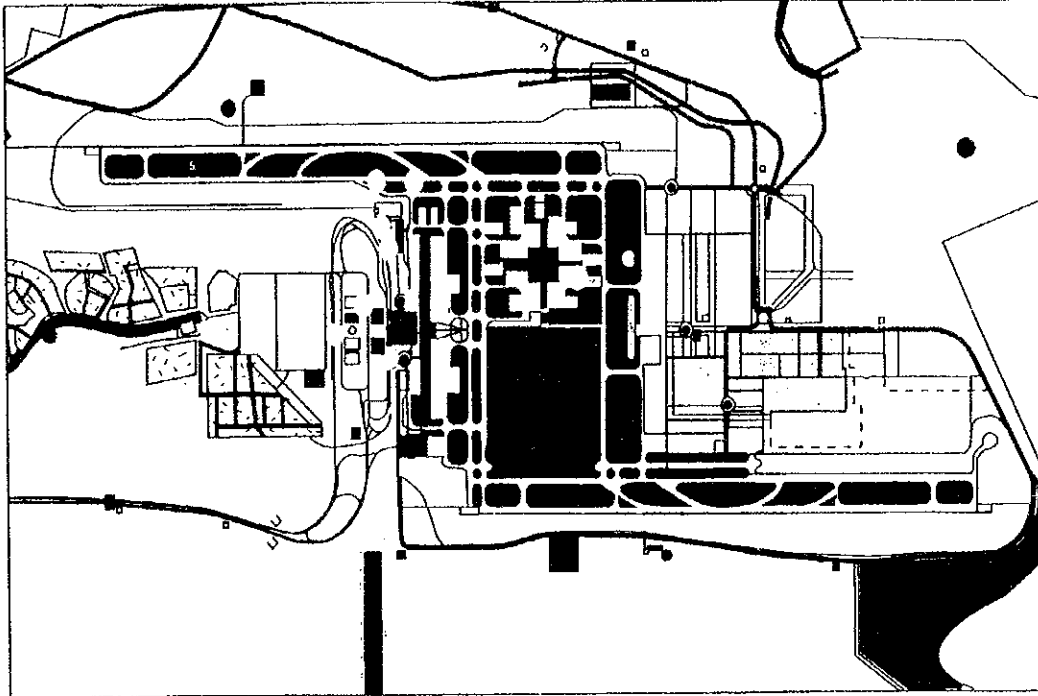
Figure 5.1.5   Layout of KLIA

Table 5.1.2   Projection of Annual Air Passengers

Unit: Million

Year	1991	2003	2008	2012	2020
Domestic	3.8	8.8	12.3	15	19.6
International	5	16.6	24.2	30.4	40.7
Singapore	2.3	5.5	7.1	8.1	9.4
Others	2.7	11.1	17.1	22.3	31.3
Total	8.8	25.4	36.5	45.4	60.3

Source: Ministry of Transport

5.2 Socio-economic Framework

5.2.1 Socio-economic Framework of Whole Malaysia and State

(1) Outline

In July 1997, the Baht, the currency of Thailand, dropped substantially against the US dollar. The currency drop has rapidly spread over to other Southeast Asian countries. Some economies received a severe blow from the currency drop.

The Malaysian economy received a blow with the decline of the Ringgit against major foreign currencies, as was the case in other South East Asia countries. The Malaysian currency, the Ringgit, went down to more than 4.6 against the US dollar in January 1998. Although the exchange rate had recovered to 3.7 against the US dollar by February 1998, the rate fell to approximately 4.1 in August 1998.

The effect of the currency devaluation is becoming increasingly apparent in the Malaysian economy. The Government unveiled the "National Economic Recovery Plan" in July 1998. The plan involves the following six actions:

- Stabilise the Ringgit;

- Restore market confidence;

- Maintain financial stability;

- Strengthen Economic Fundamentals;

- Continue the equity and socio-economic agenda; and

- Restore adversely affected sectors.

In October, the Government issued the 1998/99 Economic Report, after the fixing the exchange rate of the Ringgit at RM3.8 to US$1.0 on September 2nd. In the report, the growth rate projection of the national economy was revised further downwards.

Considering these drastic changes in the economic environment, the Study Team decided to revise the socio-economic framework again, which was presented in the Interim Report.

In Malaysia, statistical information is available on various aspects on a national level. However, when it comes to the regional level, it can be said that the reliability is not very high and that the available information is limited.

Therefore, the Study Team had to make efforts to estimate the future regional socio-economic indexes by utilising the available information and the results of our own survey for the purpose of transportation planning.

In this context, the Study team developed a new future socio-economic framework for the Study, referring to the socio-economic indexes in foreign countries.

The study team established the future socio-economic framework in three steps as follows:

    First step   : establishment of national indexes,

    Second step   : establishment of regional indexes, and

    Third step   : establishment of traffic zonal indexes.

In the third step, the Home Interview Survey results were fully used to develop the traffic zonal indexes.

Automobile ownership forecast is a very important future framework for urban transport planning. Automobile registration is carried out by the Road Transport Department, Ministry of Transport. However the information has almost nothing to do for understanding regional vehicle ownership because car registration is accepted at any registration offices of the department. Therefore, the registration information has no meaning with regard to where the car is owned and/or used. In addition, the road tax, which is levied on owners of registered cars every year or every six months, can be paid at any of the offices of the department, and it is even possible to pay it at post offices throughout the nation.

Therefore, the Study Team had no alternative but to use the Home Interview Survey results to examine car ownership within the Study area.

With regard to Putra Jaya, the new federal administration city, Cyber Jaya, the new information technology city, and Multimedia Super Corridor, the new integrated development strategy of Malaysia, they are in progress and are expected to be completed in near future. The Study Team took these projects into consideration in establishing the future socio-economic framework.

(2) Socio-economic Framework of Malaysia

1) Gross Domestic Product

Due to on the current economic problems described above, the future economic prospects of Malaysia have been revised since the crises, as shown in Table 5.2.1.

The table shows the prospects for the Malaysian economy for the period between the end of December 1997 and January 1998. All items were revised downward after the situation deteriorated. Generally speaking, the economic growth projections of Malaysia in terms of its Gross Domestic Product were revised to down to 4 to 5% for 1998 and around 6% for 1999, in February 1998. However, the prospects were revised again in the Economic Report issued in October 1998 as mentioned before. The GDP growth rate in 1998 was estimated to be negative by 4.8% and the rate in 1999 was forecasted to be 1%.

The Study Team revised the GDP prospect for the target years in the Interim Report as mentioned below based on the Economic Report 1998/99:

- Economic growth rate in 1997 was 7.8%;
- Economic growth rate in 1998 will be -4.8%;
- Economic growth rate in 1999 will be 1%;
- Economic growth rate from 2000 to 2009 will be 5%; and,
- Economic growth rate from 2010 to 2020 will be 6%.

Table 5.2.1   Revised Future Economic Growth Rate of Malaysia

In February 1998

(Unit: per cent per annum)

Institutes and \Year	1997	1998	1999-
Malaysian Government*1	7.70%	4 - 5%	-
The Malaysian Institute of Economic Research *2	7.80%	5.80%	6.10%
Wharton Econometric Forecasting Association*3	6.50%	4.50%	6.40%
Institure of Developing Economies in Japan*4	8.10%	6.60%	-

Source: *1 New Straits Times, Dec. 6, 1997
          *2 New Straits Times, Dec. 3, 1997
          *3 New Straits Times, Dec. 3, 1997
          *4 Institute of Developing   Economies, Dec. 12, 1997

The resulting future GDP of Malaysia in the target years of the Study is illustrated in Table 5.2.2.

Table 5.2.2 Future GDP Framework of Malaysia

(Unit:RM million in 1978 prices)

Year	2000	2010	2020
Gross Domestic Product	142,105	233,678	418,482
Average Annual Growth (per cent)	-	5.00	6.00

Source: SMURT-KL

2) Population

The future population framework at the national level was established by referring to the estimates developed by Department of Statistics as shown in Table 5.2.3.

Table 5.2.3 Future Population Framework of Malaysia

(Unit:000)

Year	2000	2010	2020
Population	23,264	28,072	33,873
Average Annual Growth (per cent)	-	1.90	1.90

Source: Department of Statistics
Note :Population in the year 2010 was obtained by an interpolation

3) Employment

Employment is one of the important key indicators in describing the economic development of a nation. Information on employment in Malaysia, however, is not detailed enough to conduct the necessary analyses for an urban transportation study. For instance, even information on regional employment distribution is not been available.

In the end, the Study Team developed the future employment framework of the nation basically according to the Seventh Malaysia Plan until 2000.

Between the years 2000 and 2020, the projected employment growth rate analysed by the Study Team will be about 2.8 %, which is the planned rate as mentioned above. However, the 2.8 % growth makes the ratio of employment against total population 46.6 % in 2020. The Study Team examined the results and concluded that it will be a little higher. After a series of examinations, the Study Team assumed the average annual growth rate of the national employment to be 2.6 %. This growth rate makes

the ratio against total population 44.8 %, which is almost equivalent to that of Korea in 1994.

The employment framework is exhibit in Table 5.2.4.

Table 5.2.4   Future Employment Framework of Malaysia

(Unit:000)

Year	2000	2010	2020
Employment	9,087	11,747	15,184
Percentage against total Population	39.2	41.8	44.8
Average Annual Growth (per cent)	-	2.60	2.60

Source: SMURT-KL

Table 5.2.5 summarises the future national socio-economic framework for the study.

Table 5.2.5   Future Socio-economic Framework of Malaysia

Socio-economic Framework \ Year	2000	2010	2020
Gross Domestic Product	142,105	233,678	418,482
(Unit:RM million in 1978 constant prices)			
Average Annual Growth(%)	-	5.00	6.00
Population	23,264	28,072	33,873
Average Annual Growth(%)	-	1.9	1.9
Employment	9,087	11,747	15,184
Percentage agains total Population	39.2	41.8	44.8
Average Annual Growth(%)	-	2.60	2.60
Per capita GDP(RM in '78 prices)	6,108	8,324	12,354

Source: SMURT-KL

The estimated GDP per capita amounts to RM 12,354 in 2020 at 1978 constant prices. The per capita GDP in 2020 at 1997 prices is estimated to be RM23,095, which is equivalent to US$6,078 based on the current exchange rate of one US dollar to 3.8 Ringgit in November 1998.

(3) Socio-economic Framework by State

1) Gross Regional Domestic Product

The gross regional domestic product (GRDP) by state has been estimated based on the GRDP per one employee, by utilising the EPU's estimate of GRDP by state for the year 2000. The future employment forecast is described in a later section.

After the estimation of the GRDP by state for the target years, the estimates were adjusted to meet the national total in the target years. Table 5.2.6 shows the resulting GRDP framework by State.

Table 5.2.6   Future GRDP Framework by State

(Unit:RM million in '78 prices)

State \ Year	2000	2010	2020
Perlis	933	1,542	2,766
Kedah	7,003	11,164	19,322
P. Pinang	11,011	16,385	26,472
Perak	11,887	17,387	27,609
Selangor	29,343	51,734	100,313
Kuala Lumpur	17,560	25,905	37,831
N.Sembilan	5,001	7,937	13,675
Melaka	3,822	5,804	9,568
Johor	17,209	28,526	51,337
Pahang	6,439	10,556	18,788
Terengganu	9,595	17,037	32,842
Kelantan	3,029	5,336	10,204
Sabah	9,388	18,449	39,934
Sarawak	9,885	15,916	27,820
Malaysia	142,105	233,678	418,482

Source: SMURT-KL Estimate

2) Population

The Study Team obtained the population framework by State through the Department of Statistics (DOS) for the years 2000 and 2020. For the year 2010, the Study Team estimated the framework by assuming a constant growth rate based on the DOS information for the above two years. Differences between the state total and the national population in 2010 was adjusted to the national figures.

The population framework is tabulated in Table 5.2.7.

Table 5.2.7   Future Population Framework by State

(Unit:000)

State \ Year	2000	2010	2020
Perlis	230.7	275.2	325.4
Kedah	1605.2	1847.2	2107.4
P. Pinang	1259.5	1352.9	1440.9
Perak	2130.1	2248.9	2354.1
Selangor	3287.6	4128.2	5139.4
Kuala Lumpur	1423.9	1561.2	1627.4
N.Sembilan	849.8	973.6	1105.8
Melaka	598.9	656.5	713.4
Johor	2731.5	3268.5	3877.5
Pahang	1319.0	1561.0	1831.5
Terengganu	1064.0	1363.7	1732.9
Kelantan	1561.5	1985.5	2503.1
Sabah	3136.6	4449.4	6349
Sarawak	2064.9	2399.9	2765.3
Malaysia	23,263	28,072	33,873

Source: Department of Statistics

3) Employment

To estimate future employment by State, the Study Team used the ratio of employment per population by state for the year 2000, which was estimated by EPU. The team then carried out the framework forecast by using the above ratio by state and the forecast population by State for the target years.

Differences between the estimated total employment against the national total employment was adjusted to the national total.

Table 5.2.8 exhibits the future employment framework by State.

Table 5.2.9 is the per capita GRDP by State in the target years for reference.

The frameworks described above were estimated without considering the major development projects in Malaysia such as the MSC, Putra jaya, Cyber jaya and many large scale developments in the Kuala Lumpur Metropolitan Area. The Study Team took these projects into account for the future traffic demand forecast of the Study Area.

Table 5.2.8 Future Employment Framework by State

(Unit:000)

State \ Year	2000	2010	2020
Perlis	82.1	105.8	135.5
Kedah	607.1	755.2	933.0
P. Pinang	561.4	651.9	751.8
Perak	854.1	974.8	1,104.9
Selangor	1294.3	1,780.7	2,464.7
Kuala Lumpur	697.7	803.2	837.3
N.Sembilan	345.1	427.4	525.7
Melaka	255.2	302.4	355.8
Johor	1116.9	1,444.7	1,856.0
Pahang	493.1	630.9	801.6
Terengganu	382.9	530.5	730.0
Kelantan	535.1	735.6	1,004.2
Sabah	952.8	1,461.1	2,257.7
Sarawak	909.4	1,142.6	1,425.7
Malaysia	9,087.0	11,747.0	15,184.0

Source: SMURT-KL Estimate

Table 5.2.9 Future per capita GRDP by State

(Unit:RM million in '78 prices)

State \ Year	2000	2010	2020
Perlis	4,045	5,604	8,501
Kedah	4,363	6,044	9,169
P. Pinang	8,742	12,111	18,372
Perak	5,581	7,731	11,728
Selangor	8,925	12,532	19,518
Kuala Lumpur	12,332	16,593	23,246
N.Sembilan	5,885	8,152	12,367
Melaka	6,382	8,841	13,412
Johor	6,300	8,728	13,240
Pahang	4,881	6,762	10,258
Terengganu	9,018	12,493	18,952
Kelantan	1,940	2,687	4,077
Sabah	2,993	4,146	6,290
Sarawak	4,787	6,632	10,060
Malaysia	6,109	8,324	12,354

Source: SMURT-KL Estimate

5.2.2 Initial Estimation by District

(1) Approach of Estimation

It is rather difficult to estimate all of the socio-economic indices by zone due the lack of basic data in Malaysia. For instance, no government agency has the number of employees in a work place by area. The Study Team estimated marginally required indices by using the available statistical data currently published or collected in the course of the Study, and also by making the most use of the results of the Home Interview Survey, which was conducted by the Study Team as well.

Firstly, the population data, number of employees, and other indices were estimated as an initial assessment. Then as second step these indices were amended by taking into account the impact of from the Multimedia Super Corridor.

With regard to the impact from the KLIA, the total trips generated to the KLIA by land transport which includes employees and others was estimated in accordance with the future number of passengers.

On the other hand, trip generated and attracted from large-scale urban development projects in KL were used to allocate the trips to the respective zones in KL, which were estimated in order to analyse the traffic demand forecast.

(2) Population

1) Population Before Adjustment due to MSC

The last population census was conducted in 1991. The Department of Statistics estimated the future population by district for the whole of Malaysia, based on observations about the change in the number of housing units by enumeration block. Each enumeration block consists of a basic zone in which there are approximately 100 households on average.

The estimated future population by district prepared by the Department of Statistics is shown in Table 5.2.10.

Table 5.2.10   Future Population (before adjustment by MSC)

Unit: '000

District	1997	2000	2010	2020
Kuala Lumpur	1,375	1,424	1,628	1,742
Gombak	477	530	698	807
Hulu Langat	568	634	786	866
Petaling	833	914	1,189	1,402
Kelang	520	565	727	886
Total	3,773	4,068	5,028	5,702

Source: SMURT-KL
Note: Population in 1997, 2000, 2020 were estimated by the DOS
and those in 2010 was obtained by interpolation by the growth rate

Table 5.2.11   Population Annual Growth Rate

District	1997-2000	2000-2010	2010-2020
Kuala Lumpur	1.18%	1.35%	0.68%
Gombak	3.60%	2.78%	1.47%
Hulu Langat	3.72%	2.17%	0.97%
Petaling	3.15%	2.66%	1.66%
Kelang	2.80%	2.54%	2.00%
Total	2.54%	2.14%	1.27%

2) Adjusted Population due to MSC

There is much uncertainty on the progress of the MSC due to its mega scale and the recent economic problems. Namely it takes a longer time than expected to reach initially targeted population and employment with such mega-projects. Taking this into consideration, the number of population and employees in the MSC was adjusted and estimated based on the following premises.

- total population will reache 500,000 in the year 2020
- 50,000 out of 500,000 will be expatriates and come from foreign countries
- 100,000 out of 500,000 will come from outside KL
- 350,000 out of 500,000 population will come from Klang Valley region
- the number of employees will reache 157,000 and will come from Klang Valley region
- progress of the projects is negligible in the year 2000
- progress of the project is 80% completed in the year 2010

According to the assumptions mentioned above, Table 5.2.12 sets forth the population adjustment for the MSC.

Table 5.2.12   Adjusted Population by MSC

Unit : 1000

District	1997	2000	2010	2020
Kuala Lumpur	1,375	1,424	1,516	1,602
Gombak	478	530	683	790
Hulu Langat	568	634	758	831
Petaling	833	915	1,077	1,262
Kelang	521	566	713	869
Total	3,774	4,068	4,747	5,353
MSC	-	-	40,000	50,000

Note:
Total population is 500,000 in 2020
        Expatriate 50,000
        100,000 come from outside KV
        350,000 come from KV
Progress is 80% completed in 2010 (total is 400,000 and 280,000 will be relocated   from KV)
Progress is 0% or negligible in 2000

(3) Number of Students

In terms of the number of students, the Ministry of Education provides statistics on enrolment in the primary and secondary public schools only. No reliable data is available for the private colleges and institutes.   In this Study, the total number of students by type of school was estimated based on the Home Interview Survey and the statistics.   Table 5.2.13-16 show the number of students by district in Klang Valley region.

Table 5.2.13   Current Number of Students in 1997

Unit: 1000 Persons

Type	Kuala. Lumpur	Gomback	Hulu Langat	Petaling	Klang	Klang Valley
Primary	134.1	57.7	64.0	87.6	52.7	396.1
Secondary 1-3	72.5	27.3	29.9	43.1	29.6	202.4
Secondary 4-5	49.9	15.9	16.9	24.9	21.1	128.6
Secondary 6	5.7	1.4	1.9	1.6	3.8	14.4
College	37.6	6.5	7.9	28.2	9.4	89.7
University	11.1	2.1	10.2	18.0	1.1	42.5
Total	310.9	110.9	130.7	203.3	117.6	873.5

Source: SMURT-KL, Home Interview Survey

Table5.2.14   Current Number of Students in 2000

Unit: 1000 Persons

Type	Kuala Lumpur	Gomback	Hulu Langat	Petaling	Klang	Klang Valley
Primary	148.0	61.1	70.9	93.6	70.8	444.4
Secondary 1-3	76.8	26.8	31.0	48.6	35.7	218.9
Secondary 4-5	46.1	14.9	17.1	32.1	20.9	131.1
Secondary 6	12.7	3.8	4.9	9.1	5.3	35.8
College	36.2	11.4	15.6	27.9	14.1	105.2
University	14.0	4.6	6.7	11.3	5.3	41.9
Total	333.8	122.6	146.2	222.6	152.1	977.3

Source: SMURT-KL, Home Interview Survey

Table 5.2.15   Current Number of Students in 2010

Unit: 1000 Persons

Type	Kuala Lumpur	Gomback	Hulu Langat	Petaling	Klang	Klang Valley
Primary	169.5	82.8	90.1	127.0	87.2	556.6
Secondary 1-3	78.3	35.8	38.5	54.9	42.9	250.4
Secondary 4-5	48.5	20.5	22.9	37.1	25.9	154.9
Secondary 6	13.6	5.7	6.9	11.3	6.9	44.4
College	38.6	16.8	21.8	35.5	18.6	131.3
University	15.1	6.6	9.1	14.3	7.0	52.1
Total	363.6	168.2	189.3	280.1	188.5	1,189.7

Source: SMURT-KL, Home Interview Survey

Table 5.2.16   Current Number of Students in 2020

Unit: 1000 Persons

Type	Kuala Lumpur	Gomback	Hulu Langat	Petaling	Klang	Klang Valley
Primary	171.1	94.4	102.9	126.3	104.4	599.1
Secondary 1-3	80.4	41.6	44.0	64.4	51.3	281.7
Secondary 4-5	48.6	23.8	26.9	44.8	31.7	175.8
Secondary 6	14.4	6.8	8.1	13.8	8.8	51.9
College	39.9	19.4	25.5	41.7	22.7	149.2
University	15.1	7.5	10.3	16.3	8.4	57.6
Total	369.5	193.5	217.7	307.3	227.3	1,315.3

Source: SMURT-KL, Home Interview Survey

(4) Employees in Work Place

1) Employees Before Adjustment by MSC

As there was no reliable data about the updated number of employees by work place by district in Malaysia, the results of Home Interview Survey was fully utilised to estimate those indices in co-ordination with the labour force participation rate.

The number of employees by work place in industrial sector was estimated in this section as the basic requirement to build up the traffic models.

Table 5.2.17-20 sets forth the current and future number of employees by work places before adjustment for the MSC.

Table 5.2.17   Employees in Working Place (1997)

Unit:000 persons

	Industrial Sector	Kuala Lumpur	Gomback	Hulu Langat	Petaling	Klang	Total
1	Agriculture, livestock, forestry and fishing	5.8	3.1	4.5	5.7	6.5	25.6
2	Mining and quarrying	3.8	1.1	1.1	2.4	0.7	9.1
3	Manufacturing	56.8	25.9	36.3	132.7	35.1	286.8
4	Electricity, gas and water	23.4	2.6	4.3	14.5	8.8	53.6
5	Construction	42.2	8.5	10.9	23.7	11.7	97.0
6	Whole sale and retail trade, Restaurants and hotel	119.6	18.4	20.4	46.4	14.6	219.4
7	Transport, storage and communication	64.5	9.7	11.3	52.2	25.2	162.9
8	Finance, insurance, real estate and business service	183.6	10.9	16.8	65.2	17.8	294.3
9	Federal government services	95.6	10.2	13.1	27.7	12.8	159.4
10	State and other government services	38.4	5.4	7.4	18.0	11.3	80.5
11	Personnel services	85.9	10.4	16.0	39.3	15.0	166.6
12	Others	15.3	2.5	2.3	8.5	3.4	32.0
999	Unknown	2.8	0.5	0.2	1.1	1.1	5.7
	Total	737.7	109.2	144.6	437.4	164.0	1,592.9

Note: SMURT-KL Estimate based on Home Interview Survey 1997

Table 5.2.18   Employees in Working Place (2000)

Unit:000 persons

	Industrial Sector	Kuala Lumpur	Gomback	Hulu Langat	Petaling	Klang	Total
1	Agriculture, livestock, forestry and fishing	5.8	3.1	4.5	5.7	6.5	25.6
2	Mining and quarrying	3.8	0.8	0.8	1.8	0.5	7.7
3	Manufacturing	59.7	29.6	41.5	151.6	40.1	322.5
4	Electricity, gas and water	25.7	2.8	4.7	15.8	9.5	58.5
5	Construction	48.1	9.4	12.1	26.1	12.9	108.6
6	Whole sale and retail trade, Restaurants and hotel	132.4	20.2	22.3	50.8	16.0	241.7
7	Transport, storage and communication	71.1	10.5	12.3	56.8	27.5	178.2
8	Finance, insurance, real estate and business service	206.8	12.1	18.5	72.0	19.6	329.0
9	Federal government services	112.8	12.0	15.5	32.7	15.1	188.1
10	State and other government services	45.3	6.3	8.8	21.3	13.3	95.0
11	Personnel services	99.9	12.5	19.3	47.4	18.1	197.2
	Total	811.4	119.3	160.3	482.0	179.1	1,752.1

Note: SMURT-KL Estimate based on Home Interview Survey 1997

Table 5.2.19   Employees in Working Place Before Adjustment (2010)

Unit: 1000 persons

	Industrial Sector	Kuala Lumpur	Gomback	Hulu Langat	Petaling	Klang	Total
1	Agriculture, livestock, forestry and fishing	5.4	3.4	4.8	6.2	7.0	26.8
2	Mining and quarrying	3.5	0.8	0.7	1.6	0.5	7.1
3	Manufacturing	63.8	36.6	51.4	187.7	49.6	389.1
4	Electricity, gas and water	36.5	3.3	5.4	18.4	11.1	74.7
5	Construction	63.8	11.7	14.9	32.4	16.0	138.8
6	Whole sale and retail trade, restaurants and hotel	196.8	24.7	27.4	62.3	19.6	330.8
7	Transport, storage and communication	100.6	12.3	14.3	66.3	32.1	225.6
8	Finance, insurance, real estate and business service	322.5	14.8	22.7	88.3	24.0	472.3
9	Federal government services	139.7	14.8	19.2	40.5	18.7	232.9
10	State and other government services	56.1	7.9	10.8	26.3	16.5	117.6
11	Personnel services	123.7	15.5	23.9	58.7	22.4	244.2
	Total	1,112.4	145.8	195.5	588.7	217.5	2,259.9

Note: SMURT-KL Estimate based on Home Interview Survey 1997

Table 5.2.20 Employees in Working Place Before Adjustment (2020)

Unit: 1000 persons

	Industrial Sector	Kuala Lumpur	Gomback	Hulu Langat	Petaling	Klang	Total
1	Agriculture, livestock, forestry and fishing	5.1	3.7	5.4	6.8	7.8	28.8
2	Mining and quarrying	3.4	0.7	0.7	1.6	0.4	6.8
3	Manufacturing	61.2	47.2	66.2	241.8	63.9	480.3
4	Electricity, gas and water	42.2	4	6.7	22.6	13.7	89.2
5	Construction	68.9	13.9	17.8	38.6	19	158.2
6	Whole sale and retail trade, restaurants and hotel	236.8	29.5	32.6	74.3	23.4	396.6
7	Transport, storage and communication	116.4	15.1	17.6	81.4	39.4	269.9
8	Finance, insurance, real estate and business service	411.3	18.3	28.1	109.3	29.8	596.8
9	Federal government services	152.4	16.2	20.9	44.2	20.4	254.1
10	State and other government services	61.1	8.6	11.8	28.7	17.9	128.1
11	Personnel services	134.9	16.9	26.1	64.1	24.5	266.5
	Total	1293.7	174.1	233.9	713.4	260.2	2675.3

Note: SMURT-KL Estimate based on Home Interview Survey 1997

(2) Adjustment to MSC

According to the premises mentioned above in the section on population, a total of 157,000 employees in work place was estimated in the MSC for 2020 and 125,600 employees for 2010 respectively. The adjusted number of employees for the MSC in Klang Valley region is tabulated in Table 5.2.21 and 22.

Table 5.2.21 Employees in Working Place Adjusted by MSC (2010)

Unit: 000 persons

	Industrial Sector	Kuala Lumpur	Gomback	Hulu Langat	Petaling	Klang	Total
1	Agriculture, livestock, forestry and fishing	5.4	3.4	4.8	6.2	7.0	26.8
2	Mining and quarrying	3.5	0.8	0.7	1.6	0.5	7.1
3	Manufacturing	62.3	35.8	50.2	183.4	48.5	380.2
4	Electricity, gas and water	35.7	3.2	5.3	18.0	10.8	73.0
5	Construction	62.3	11.4	14.6	31.7	15.6	135.6
6	Whole sale and retail trade, Restaurants and hotel	192.3	24.1	26.8	60.9	19.1	323.2
7	Transport, storage and communication	98.3	12.0	14.0	64.8	31.4	220.5
8	Finance, insurance, real estate and business service	315.1	14.5	22.1	86.3	23.5	461.5
9	Federal government services	59.7	14.8	19.2	40.5	18.7	152.9
10	State and other government services	54.8	7.7	10.6	25.7	16.1	114.9
11	Personnel services	120.9	15.1	23.3	57.4	21.9	238.6
	Total	1,010.3	142.8	191.6	576.5	213.1	2,134.3

Note: SMURT-KL Estimate based on Home Interview Survey 1997

Table 5.2.22   Employees in Working Place Adjusted by MSC (2020)

Unit:000 persons

	Industrial Sector	Kuala Lumpur	Gomback	Hulu Langat	Petaling	Klang	Total
1	Agriculture, livestock, forestry and fishing	5.1	3.7	5.4	6.8	7.8	28.8
2	Mining and quarrying	3.4	0.7	0.7	1.6	0.4	6.8
3	Manufacturing	59.2	45.7	64.1	234	61.8	464.8
4	Electricity, gas and water	40.8	3.9	6.5	21.9	13.3	86.4
5	Construction	66.7	13.5	17.2	37.4	18.4	153.2
6	Whole sale and retail trade, Restaurants and hotel	229.3	28.5	31.5	71.9	22.6	383.8
7	Transport, storage and communication	112.6	14.6	17	78.8	38.1	261.1
8	Finance, insurance, real estate and business service	398	17.7	27.2	105.8	28.8	577.5
9	Federal government services	72.4	16.2	20.9	44.2	20.4	174.1
10	State and other government services	59.1	8.3	11.4	27.8	17.3	123.9
11	Personnel services	130.5	16.4	25.3	62	23.7	257.9
	Total	1177.1	169.2	227.2	692.2	252.6	2518.3

Note: SMURT-KL Estimate based on Home Interview Survey 1997

(5) Trip Generation by KLIA

The following information, extracted from in the Master Plan report by the Ministry of Transport, was used to estimate trip generation by the KLIA (Table 5.2.23-26):

- passenger forecast

- transit ratio

- associated trip rate per a air passenger

- modal share

Table 5.2.23   Air Passenger Forecast

Unit: Million passengers/year

Year	1991	1995	2000	2010	2020
Domestic	3.8	4.7	6.5	10.6	14.2
International	5	7.5	11.7	22.7	31.3
Singapore	2.3	5.5	7.1	8.1	9.4
Others	2.7	2	4.6	14.6	21.9
Total	8.8	12.2	18.2	33.3	45.5

Source: Ministry of Transport

Table 5.2.24   Transit Ratio

Type	Ratio
Domestic	0.25
International	0.45

Source: Ministry of Transport

Table 5.2.25   Associated Trip Rate per a Air passenger

Type	Rate
Domestic	0.41
Singapore	0.13
Other Int'l	0.72

Source: Ministry of Transport

Table 5.2.26   Mode Share for Access Trips

Year	Share	Occupancy
Car	0.35	1.3
Taxi	0.25	0.7
Bus	0.05	10.0
Rail	0.35	-
Total	1.00	-

Source: Ministry of Transport

According to the above information, the number of trips coming to and generated from KLIA was estimated as shown in Table 5.2.27.

Table 5.2.27   Number of Trips

Type	2000	2010	2020
Domestic	6.87	11.21	15.02
International	8.76	18.85	26.56
Singapore	4.41	5.03	5.84
Others	4.35	13.81	20.72
Total	15.64	30.06	41.58

Source: SMURT-KL Air Passenger Interview Survey 1997

Using the modal share ratio, the average daily number of trips by mode was obtained and is tabulated in Table 5.2.28.

Table 5.2.28   Traffic to/from KLIA

Mode	Unit	2000	2010	2020
Car	Vehicle/day	11,500	22,200	30,700
Taxi	Vehicle/day	15,300	29,400	40,700
Bus	Vehicle/day	1,700	400	600
Rail	Passenger/day	0	28,800	39,900

ERL is not available in 2000

5.2.3 Zonal Parameters

As discussed in the previous chapter (Transport Modelling), zonal parameters should be estimated for the two different levels of detail, namely the D Zone (HIS zone system) and the Traffic Analysis Zone (TAZ) system. Four kinds of zonal parameters, that is, Population, Household, Job Opportunity, and Students, have been estimated for the year 1997, 2000, 2010, and 2020 under the control totals of the districts' figures. The estimate for the year 1997 at the D Zone level is the basis for estimating the expansion factors of the sampled zonal trips of the HIS. Zonal figures from the Traffic Analysis Zone should be utilised when OD matrices at D zone level need to be subdivided into more detail zones, that is, when you need to discuss the traffic within the KL metropolitan area (almost the same as the Study area). All of figures are attached in the Appendix of this report, and these are stored as part of a GIS (SMURT-GIS).

(1) Estimates of 1997 population

Three sources have been used to estimate the 1997 population at the level of traffic analysis zone (TAZ), namely, the 1991 census population data by merged enumeration block, the DBKL building database in 1997, and the Home Interview Survey conducted by the Study team in 1997. Figure 5.2.1 below shows the sequential steps in estimating the 1997 population by TAZ.
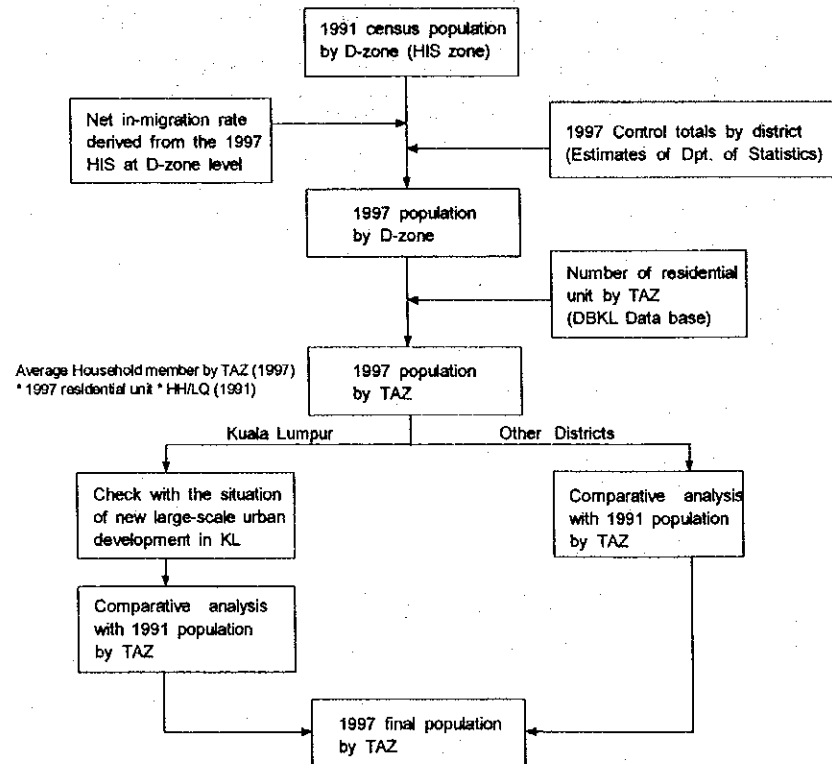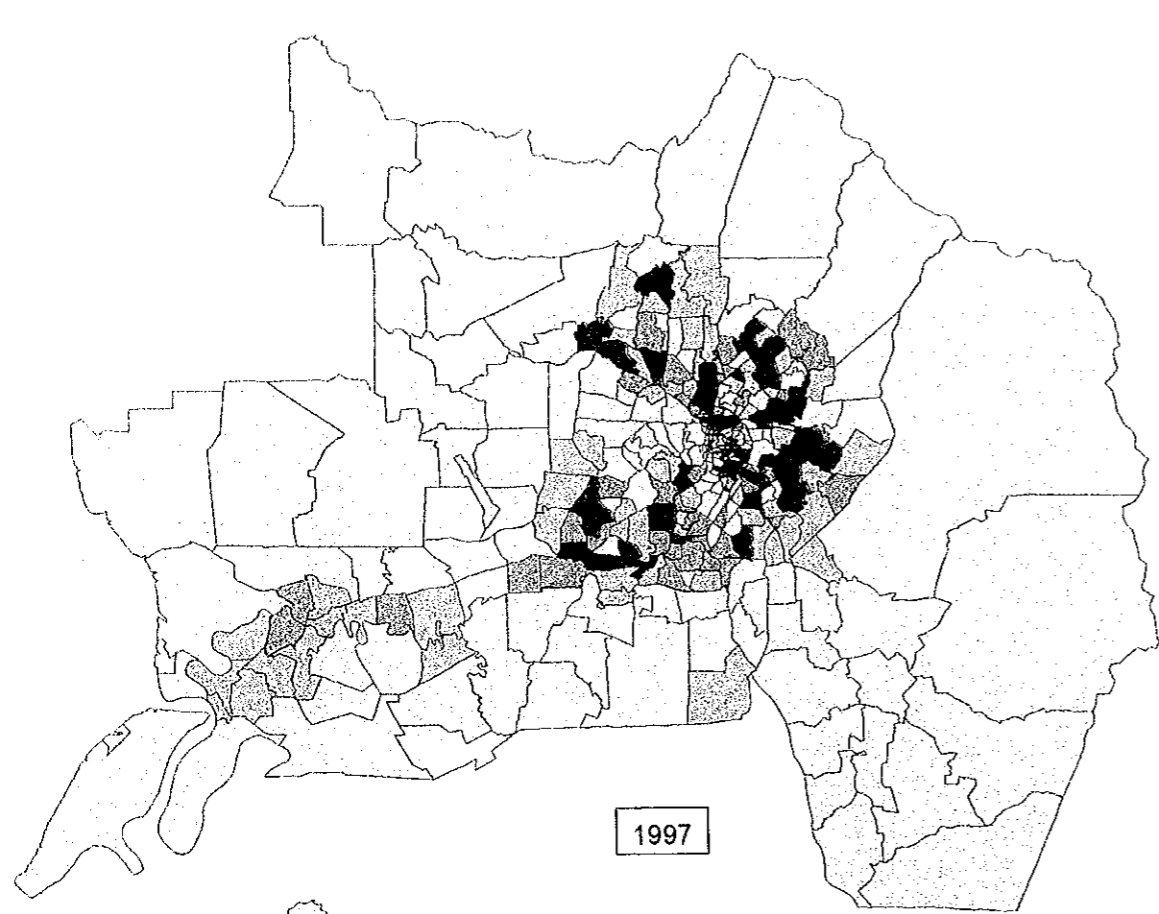

Figure 5.2.1   Flow Chart of Estimation of the 1997 Population

1997

2000

2010

2020

LEGEND

Population Density
unit : person / ha
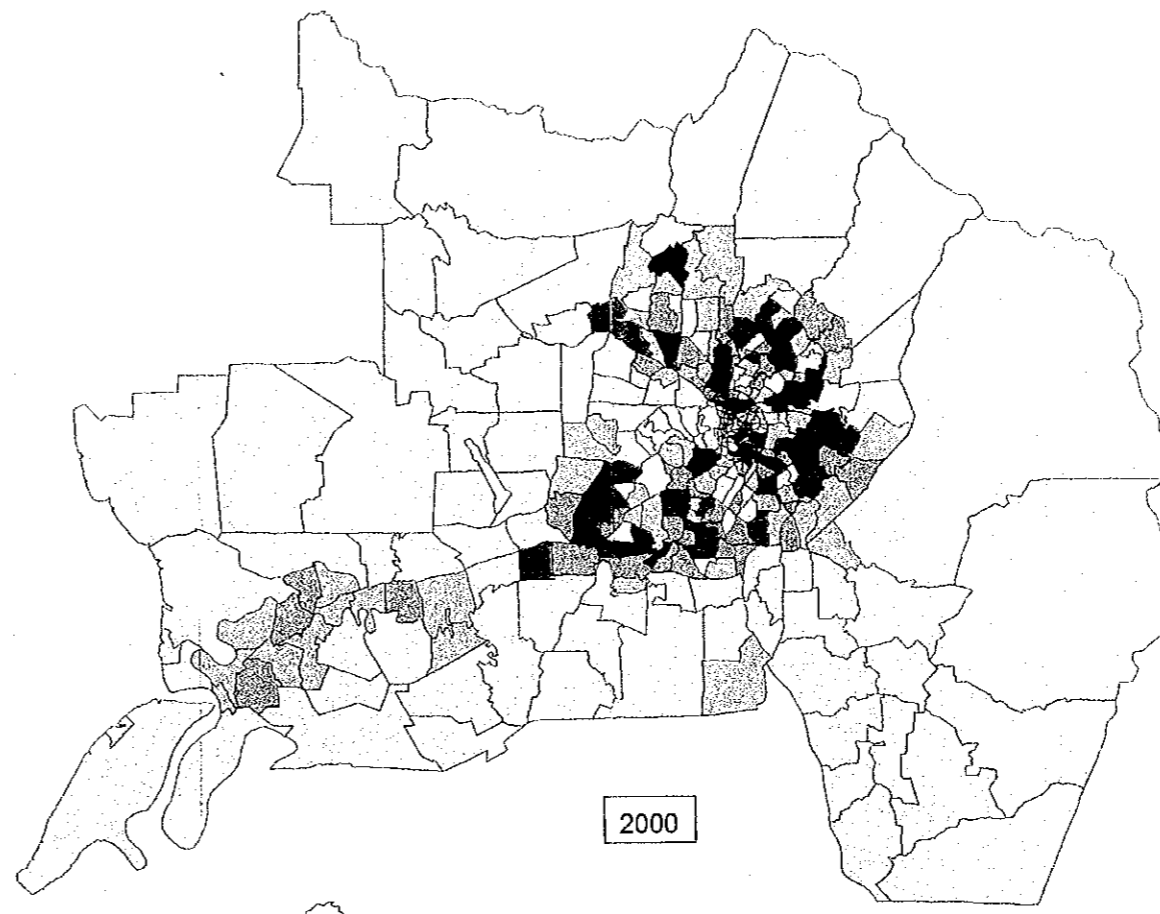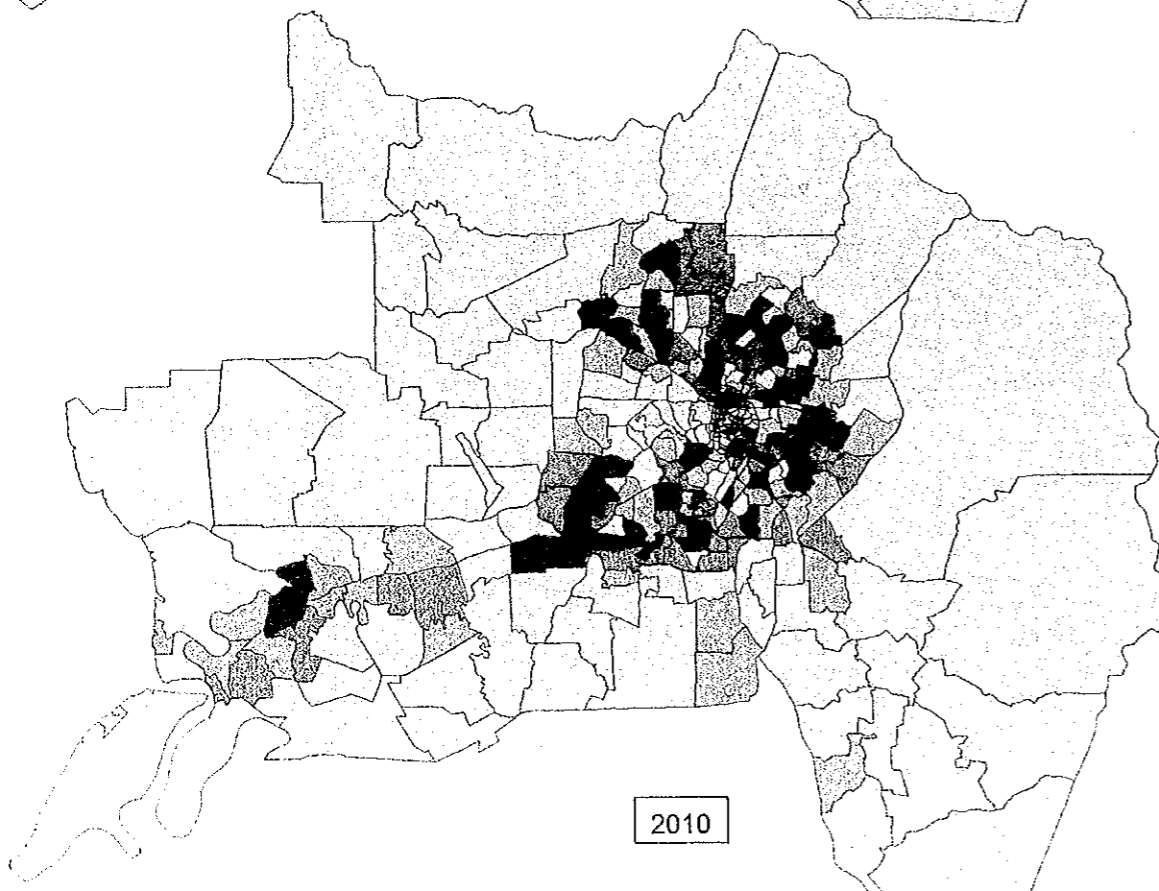
	0 - 30
	30 - 60
	60 - 90
	90 - 120
	120 - 150
	150 - 250
	250 - 350
	350 -

Figure 5.2.2 Population Density

SMURT-KL

INTEGRATED URBAN TRANSPORTATION STRATEGIES
FOR ENVIRONMENTAL IMPROVEMENT
IN KUALA LUMPUR

JAPAN INTERNATIONAL COOPERATION AGENCY

LEGEND
for INSET

25

10

1

000 population

LEGEND

1997 population

2000 population

2010 population

2020 population

10

5

1

0,000 population

Figure 5.2.3 Population Distribution

SMURT-KL

INTEGRATED URBAN TRANSPORTATION STRATEGIES
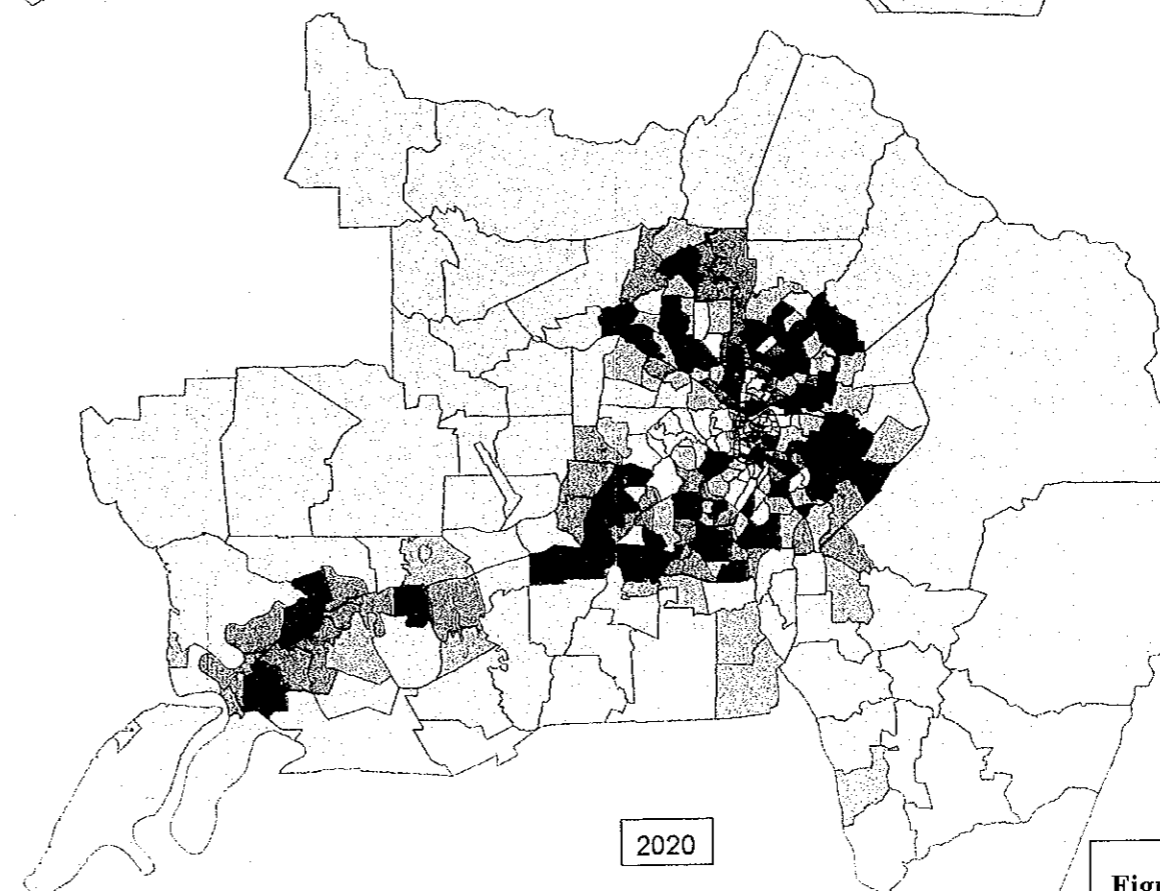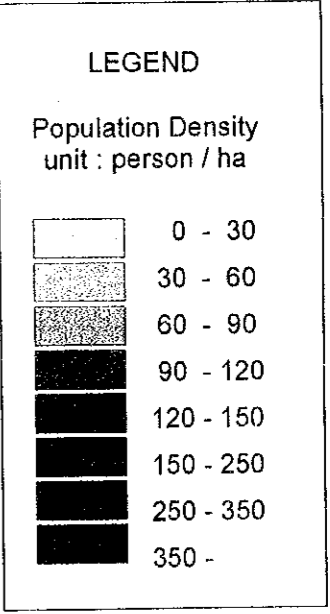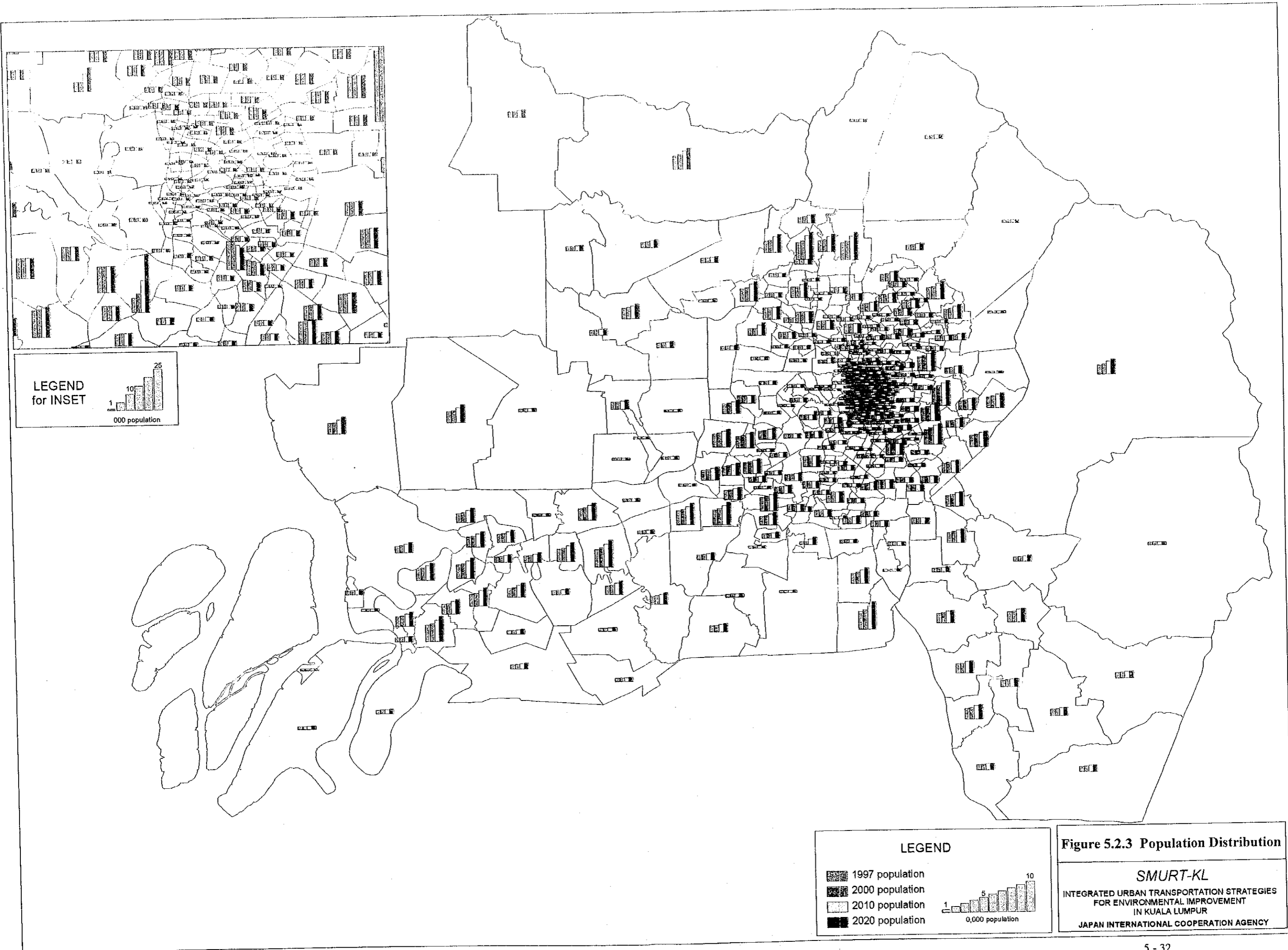FOR ENVIRONMENTAL IMPROVEMENT
IN KUALA LUMPUR

JAPAN INTERNATIONAL COOPERATION AGENCY

(2) Estimates of future population

Future zonal population estimates have been made under the framework reflecting the MSC project.   During the estimation process, a household income distribution model was developed in order to estimate the population by household income group. Because travel pattern, especially the people's modal choice, depends greatly on their income level according to the HIS and Opinion Survey conducted by the Study Team, population should be estimated by income level.   These figures are also important in assessing the impacts of the proposed transport policies by different income groups.

Zonal household numbers were broken down into four income-groups, namely, "Low", "Low Middle", "Upper Middle", and "High".   This classification was derived from a series of detail analyses of the HIS data, reflecting people's characteristics in the context of their modal choice at the most reliable level.   Such classification should be made relatively, that is, not by absolute, in general.   For example, "Low Middle" in 1997 may be "Low" in 2020.   However, to reflect the people's decision making in their modal choice, the absolute figures are commonly used among the different target years.

Table 5.2.29   Classification of Household Income Group

Income Group	Income Level (RM / Month)	# household in 1997	Share (%)
Low	Rank01: less than RM500	15,246	2.0
	Rank02: 501 – 1000	79,291	10.4
	Rank03: 1001 – 1500	117,242	15.4
Low Middle	Rank04: 1501 – 2000	120,199	15.8
	Rank05: 2001 – 3000	161,894	21.3
Upper Middle	Rank06: 3001 – 4000	106,896	14.1
	Rank07: 4001 – 5000	66,039	8.7
High	Rank08: 5001 – 10000	74,664	9.8
	Rank09: 10001 – 15000	10,742	1.4
	Rank10: more than 15000	7,534	1.0
Total		759,748	100.0

Income Distribution Model

Assuming that the income distribution pattern follows a log-normal distribution, the necessary parameters can be estimated.   The average monthly household income in the Klang Valley region is estimated to be 3,057 RM, and its variance is estimated as 2,460 RM.   Future growth rates of the region's household income is estimated via the following simple formula:

Household Income Growth Rate = GRDP Growth Rate in real term – Household Growth Rate

Finally, the region's average household income level is estimated as follows:

Year	Average Income Level
1997	3,057 RM/Month
2000	3,383 RM/Month
2010	5,214 RM/Month
2020	8,319 RM/Month

Extrapolating the above figures, the region's future population has been broken down into the four classes. These figures are the control totals for estimating the future population by income level at the district level. The same procedure was adopted in estimating the figures for B zone, D zone and Traffic Analysis Zone level of detail.

Table 5.2.30 Future Population by Household Income Group

Unit : 1000

Klang Valley	1997	2000	2010	2020	1997	2000	2010	2020
Low	966	864	385	109	25.6%	21.2%	8.1%	2.0%
Lower Middle	1,375	1,388	1,149	615	36.4%	34.1%	24.2%	11.5%
Upper Middle	906	997	1,301	1,134	24.0%	24.5%	27.4%	21.2%
High	527	820	1,912	3,495	14.0%	20.2%	40.3%	65.3%
Total	3,773	4,068	4,747	5,353	100.0%	100.0%	100.0%	100.0%

Kuala Lumpur	1997	2000	2010	2020	1997	2000	2010	2020
Low	357	269	100	24	26.0%	18.9%	6.6%	1.5%
Lower Middle	482	480	344	161	35.1%	33.7%	22.7%	10.0%
Upper Middle	330	364	418	321	24.0%	25.6%	27.5%	20.0%
High	205	311	655	1,096	14.9%	21.8%	43.2%	68.4%
Total	1,374	1,424	1,516	1,602	100.0%	100.0%	100.0%	100.0%

Gombak	1997	2000	2010	2020	1997	2000	2010	2020
Low	133	128	64	19	27.9%	24.1%	9.4%	2.4%
Lower Middle	175	189	180	102	36.6%	35.6%	26.3%	12.9%
Upper Middle	119	124	191	180	24.9%	23.4%	28.0%	22.8%
High	51	90	248	489	10.6%	17.0%	36.4%	61.8%
Total	478	530	683	790	100.0%	100.0%	100.0%	100.0%

Hulu Langat	1997	2000	2010	2020	1997	2000	2010	2020
Low	164	181	92	28	28.8%	28.6%	12.1%	3.4%
Lower Middle	243	230	221	131	42.7%	36.3%	29.2%	15.7%
Upper Middle	110	136	209	204	19.3%	21.4%	27.6%	24.6%
High	52	87	236	468	9.2%	13.7%	31.1%	56.3%
Total	568	634	758	831	100.0%	100.0%	100.0%	100.0%

Petaling	1997	2000	2010	2020	1997	2000	2010	2020
Low	174	134	52	13	20.9%	14.7%	4.8%	1.0%
Lower Middle	269	286	205	96	32.2%	31.3%	19.0%	7.6%
Upper Middle	223	247	285	221	26.8%	27.0%	26.4%	17.5%
High	168	247	536	933	20.1%	27.0%	49.7%	73.9%
Total	833	915	1,077	1,262	100.0%	100.0%	100.0%	100.0%

Kelang	1997	2000	2010	2020	1997	2000	2010	2020
Low	138	152	77	25	26.6%	26.8%	10.8%	2.9%
Lower Middle	207	204	199	125	39.7%	36.1%	27.9%	14.4%
Upper Middle	123	126	199	208	23.7%	22.2%	27.9%	23.9%
High	52	85	238	511	10.0%	14.9%	33.4%	58.8%
Total	521	566	713	869	100.0%	100.0%	100.0%	100.0%

In addition to the income level consideration, new urban developments that include residential units were taken fully into consideration in estimating the population at D zone and TAZ level of detail. Residents of these new development areas are assumed to be high income group people, thus, the initially allocated lower class population was removed from such the zones.
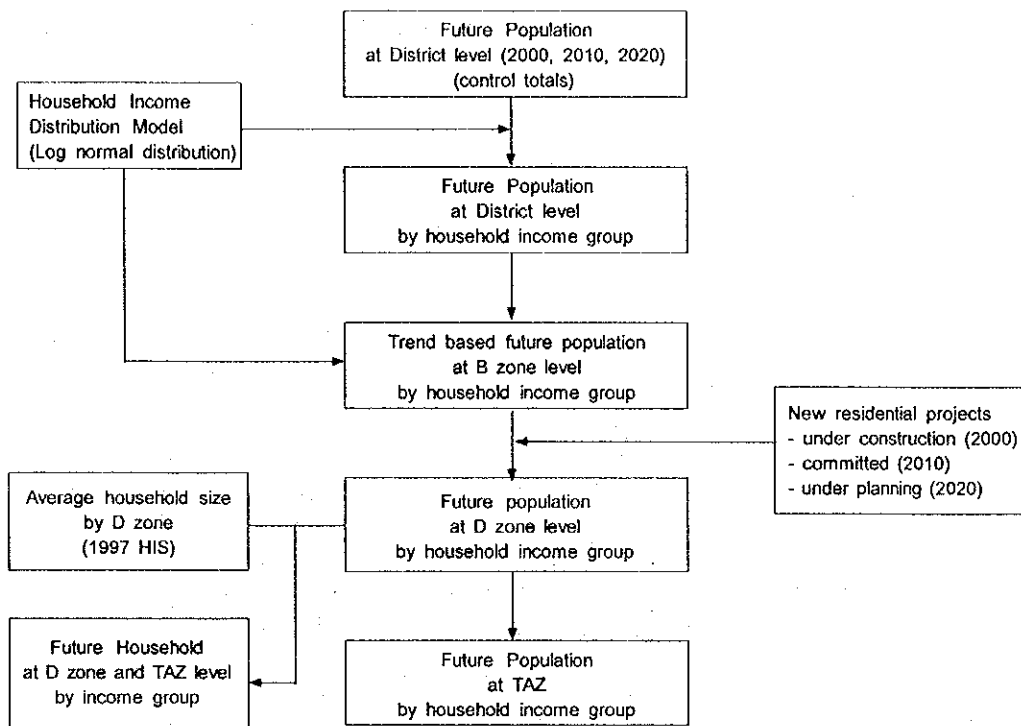
Figure 5.2.4   Flow Chart of Zonal Population Estimates

(3) Estimates of Job Opportunity

The number of job opportunity is essential for estimating attraction trips, especially for Home Based Work and Non Home Based Business trips.

1997 job figures were estimated via the HIS data together with the control totals of the district figures.   The job opportunity was estimated by sector and by facility type of work place.   In order to reflect the Putra Jaya project, the figure of the Federal Government Staffs was important.   The facility type was classified into two categories, namely, office and site.   For example, there were two types of workers in the agricultural sector, that is, working at the office and working on the field as a farmer.   The former figure was rather important in estimating the urban transport related figures.

Zonal distribution patterns of the office workers were made in accordance with the floor area by type obtained from the DBKL database.   Assuming that the average floor area per person was 15.8 square metres (this figure was obtained in the SMURT-KL Building Survey, 1997), initial estimates were made.   Those initial figures were controlled by the B zone figures and by the district figures.

The future job opportunity distribution pattern reflects new urban developments such as KLCC, KL Central, Star City, among others,
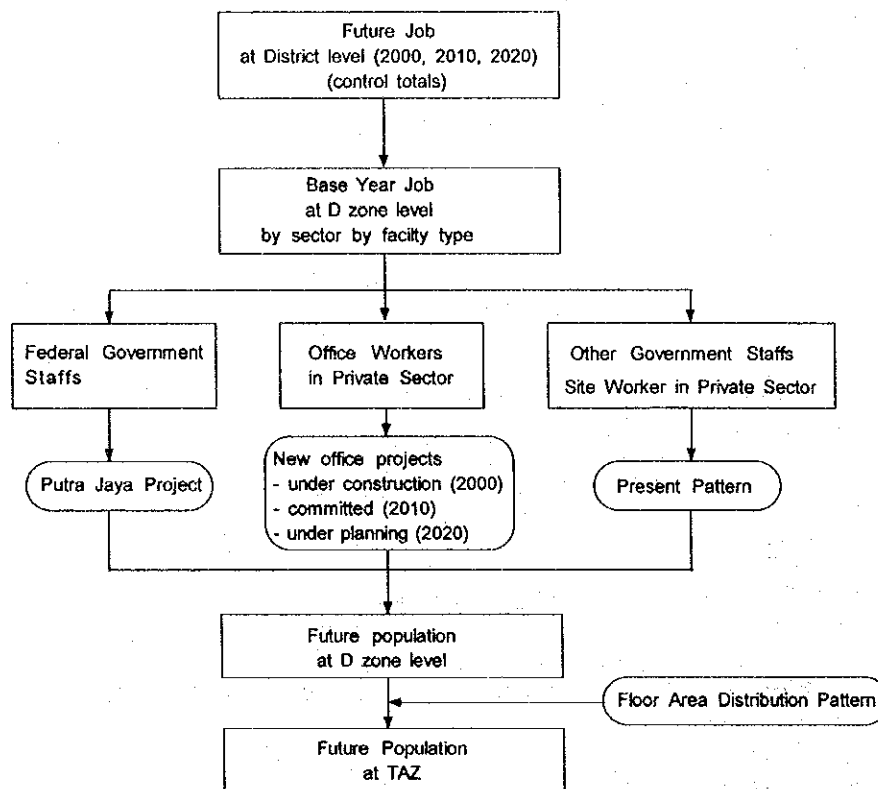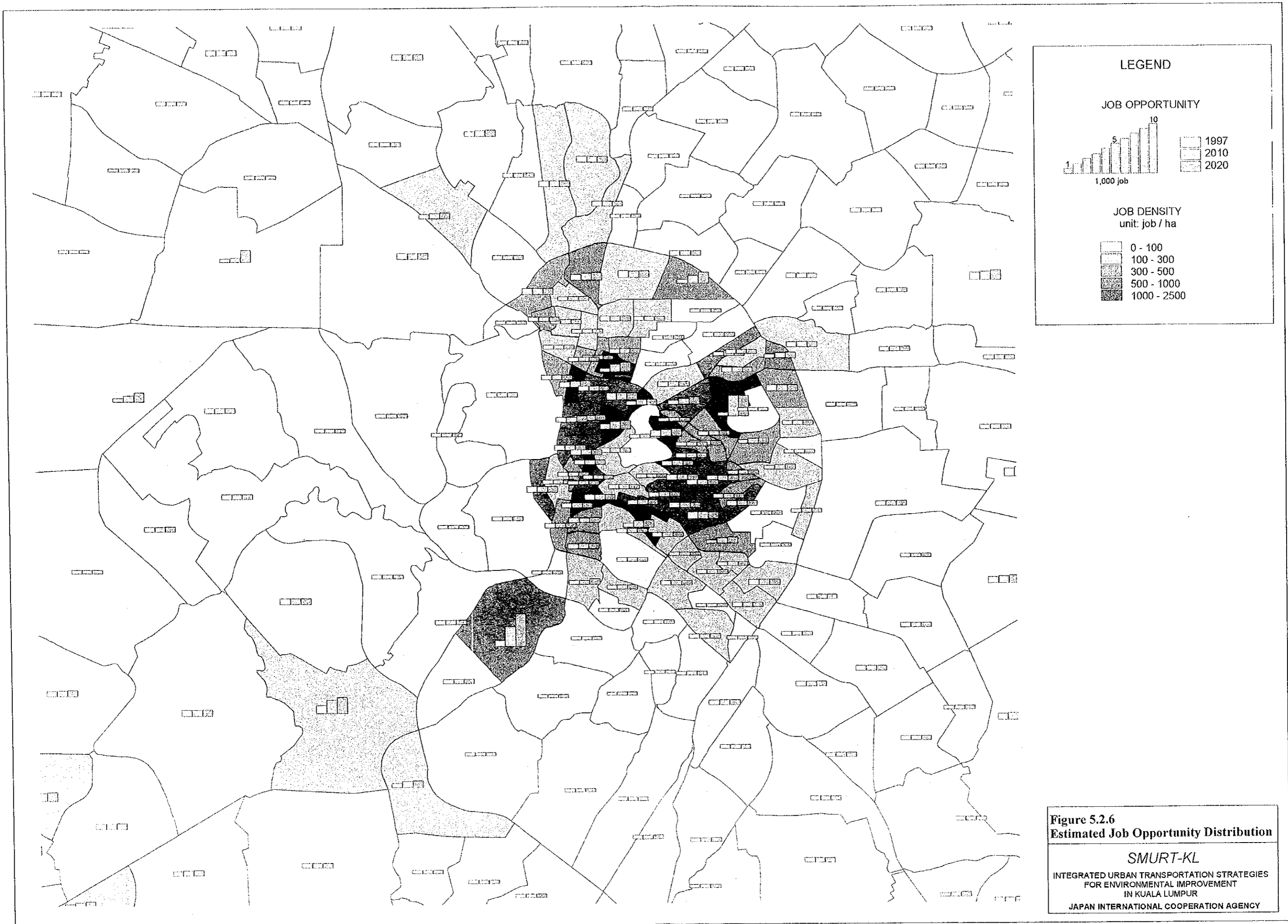

Figure 5.2.5   Flow Chart of Job Opportunity Estimates

As presented in Figure 5.2.6, a number of job opportunities is expected at the new urban development sites.   Future travel pattern, especially that for commuting purpose, should be largely inflected by such job allocation pattern.

LEGEND

JOB OPPORTUNITY

1997
2010
2020

1,000 job

JOB DENSITY
unit: job / ha

0 - 100
100 - 300
300 - 500
500 - 1000
1000 - 2500

Figure 5.2.6
Estimated Job Opportunity Distribution

SMURT-KL

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IN KUALA LUMPUR

JAPAN INTERNATIONAL COOPERATION AGENCY

(4) Estimates of Students (Education Opportunity)

As described in the previous section, the future education opportunity is forecasted based on the age structure estimated by the Statistics Department and by assuming the school enrolment rate. The distribution of the figures at the district level is estimated following the present pattern.
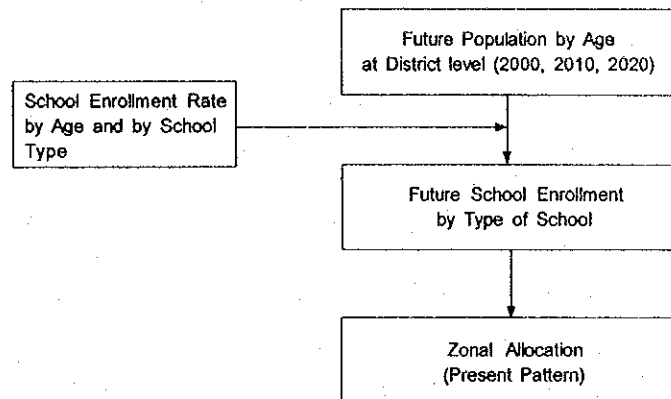

Figure 5.2.7   Flow Chart of Education Opportunity Estimates