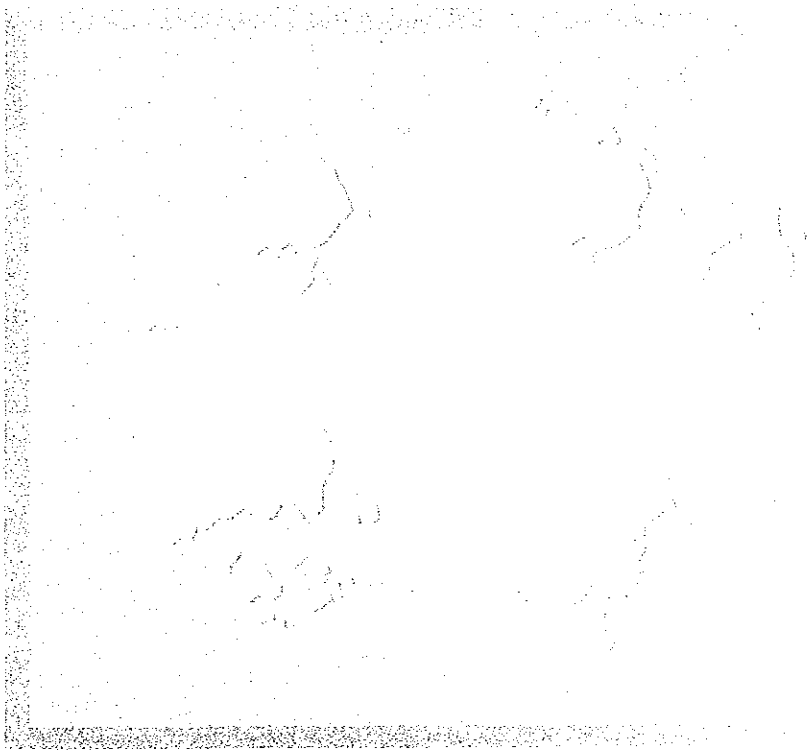
REPUBLIC OF SINGAPORE

SINGAPORE URBAN TRANSPORT IMPROVEMENT STUDY (SUTIS)

TECHNICAL REPORT No. 1

Supplemental Transport Surveys



NOVEMBER 1988

Japan International Cooperation Agency

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1. OBJECTIVES AND FRAMEWORK OF THE SUPPLEMENTAL TRANSPORT SURVEYS

1.1 SURVEYS CONDUCTED

The following supplemental surveys were conducted during the two-phase Singapore Urban Transport Improvment Study (SUTIS):

1) Phase I

   a) PWD Officials Transport Survey

   b) Bus Traffic Survey at Ang Mo Kio Bus Interchange

   c) Limited Home Interview Survey (HIS) for Residents in Ang Mo Kio New Town

2) Phase II

   a) PWD Officials Transport Survey

   b) Bus Traffic Survey at Ang Mo Kio Bus Interchange

   c) Bus Waiting Time Survey (for Feeder Bus Service in Ang Mo Kio Town)

   d) Limited HIS for Residents in Ang Mo Kio New Town

   e) Orchard Area Pedestrian Survey

The outline of these supplemental surveys are shown in Table 1.1

Table 1.1

Outline of Supplemental Transport Surveys

Study Stage	Name of Survey	Survey Period	Survey Outline	Major Purpose
Phase I	1. Limited HIS for Ang Mo Kio Residents	31 Oct - 7 Nov 1987	Interview with 739 housholds and their members	1. Trip characteristics of the residents. 2. Feeder bus utilization and assessment. 3. Opinions on new town environment.
	2. Bus Traffic Survey at Ang Mo Kio Bus Interchange	27 Oct - 29 Oct 1987	Bus traffic count, interview with 4700 bus passengers	1. Bus and bus passenger traffic volume at Ang Mo Kio Bus Interchange. 2. Characteristics of feeder bus passengers. 3. Distribution of bus passenger traffic demand.
	3. PWD officals Survey	16 Oct - 19 Oct 1987	Questionnaire survey with 613 PWD officils	1. Overall feeder transport utilization and its assessment by PWD officials. 2. Pre-survey for HIS.
Phase II	4. Limited HIS for Ang Mo Kio Residents	23 April - 9 May 1988	Interview with 1050 households and their members	1. The trip characteristics and their changes after the opening of MRT.
	5. Bus Traffic Survey at Ang Mo Kio Bus Interchange	8 April - 13 April 1988	Bus traffic count, Interview with 2600 bus passengers	1. Changes in bus traffic and utilization after the opening of MRT.
	6. PWD Officials Survey	30 March 1988	Interview with 370 PWD officials	1. Changes in travel pattren after the opoing of MRT.
	7. Bus Waiting Time Survey	13 April 1988	Observation at feeder bus stops in Ang Mo Kio	1. Comparison of actual waiting time and perceived waiting time.
	8. Orchard Road Pedestrian Survey	23 - 25 May & 1 July 1988	Interview with pedestrians at Orchard/Scotts Road	1. Pedestrian traffic volume in Orchard area. 2. Walk characteristics.

1.2 OBJECTIVES OF THE SUPPLEMENTAL SURVEYS

In general, the supplemental surveys aim to obtain detailed information on the present travel characteristics and demand of the feeder transport from its various aspects. The main objectives of each survey are as follows:

1) Official Transport Survey

This survey is intended to obtain overall information on the utilization of feeder transport. Although the sample size of this survey is small and biased, the survey may still be considered for its general and up-to-date information of feeder transport characteristics in various new towns. The major items of this survey are as follows:

a) General Information

- Household Characteristics

  Home Address, Household Size, Income, Vehicle Ownership, etc.

- Personal Characteristics

  Sex, Age, Position, Personal Income, etc.

b) Trip Information

- Travel Time
- Mode of Travel
- Place of Transfer

c) Usage and Assessment of Feeder Transport

- Usage of Feeder Transport

  Feeder Bus, Kiss and Ride, Park and Ride

- Assessment of Feeder Bus Services

  Bus Stop, Bus Interchange, Bus Operation.

Aside from the above items, the impact of the MRT were also surveyed in 1988.

2) Bus Survey

A bus survey was conducted to determine the present traffic volume and characteristics of feeder bus and bus passengers at Ang Mo Kio Bus Interchange. Especially, as feeder bus service is the most popular feeder transport mode in Singapore at present, the survey results could be used to

predict future feeder transport demand. The major items of this survey are as follows:

a) Bus and Bus Passenger Traffic at Bus Interchange

- Arriving and Departing Bus Traffic by Time Period
- Number of Boarding and Alighting Passengers by Time Period and Services

b) Characteristics of Bus Passengers

- Sex, Age, Occupation, Trip Purpose

c) Origin and Destination of Trips

d) Transfer Characteristics

- Previous and next mode of travel for bus passengers.

3) Limited Home Interview Survey (HIS)

The Home Interview Survey is the largest among the Supplemental Transport Surveys. Detailed information on the overall transport behavior of residents in Ang Mo Kio New Town can be derived from this survey. In addition, the results of this survey can be used to predict future feeder traffic and to examine the characteristics of future feeder transport systems that may be introduced in new towns. The major items of this survey are as follows:

a) Household Characteristics

- Home Address
- Household size
- Characteristics of Dwelling Units
- Household Income
- Vehicle Ownership

b) Household Members Characteristics

- Sex, Age, Occupation
- Car Usage

c) Trip Information

- Origin and Destination of Trips
- Travel Time
- Trip Purpose

- Mode of Travel
- Transfer Point
- Expenses for Trips

d) Assessment of Feeder Bus Services

- Usage of Feeder Bus Service
- Assessment of Waiting Conditions at Bus Stops
- Assessment of Waiting Conditions at Bus Interchange
- Assessment of Bus Operation

e) Assessment of Living/Environmental Condition

4) Bus Waiting Time Survey

This survey is intended to examine information on bus waiting time at bus stops.

5) Orchard Area Pedestrian Survey

Walking is the largest and most unavoidable feeder mode. However, there are not many studies nor information to determine the characteristics of walking in Singapore. This survey is intended to obtain information on the characteristics of walking in Orchard Area, which is the busiest place in Singapore. The major items of this survey are as follows:

a) Pedestrian Traffic Count

b) Characteristics of Pedestrians

c) Origin and Destination of Pedestrian Trips

d) Density of Pedestrians at Major Points

2. PWD OFFICIALS TRANSPORT SURVEYS

2.1 1987 PWD OFFICIALS TRANSPORT SURVEY

2.1.1 Introduction

1) Purpose of the Survey

This survey is intended to obtain information on the utilization and assessment of feeder transport made by PWD officials. It is basically designed to meet the following:

a) To obtain general and up-to-date information of feeder transport characteristics in various new towns.

b) To allow for the improvement of the proposed limited HIS, particularly on the design of questionnaire forms.

The survey covers trip information of residents more on the destination side of their travel, while the limited HIS covers those on the origin side.

2) Survey Implementation

The survey questionnaire was prepared by the Study Team with the assistance of PWD officials. It has three major sections:

a) General information on the personal characteristics of PWD officials.

b) Information of all trips made on a certain weekday.

c) Assessment of feeder bus service.

Approximately 1,100 questionnaires were distributed to PWD officials working in N.D. Building and SIA Building on 16th October; 613 forms were collected by 19th October. The delivery and collection of the questionnaires were carried out by PWD personnel.

3) Survey Zone and HDB New Towns

For the analysis of the survey, the address of PWD officials were coded into 16 zones and 20 new towns, respectively. Figure 2.1 indicates the location of PWD offices surveyed, the relevant zones, and new towns. Table 2.1 and 2.2 show the list of zone names and HDB new towns.

Figure 2.1
Location of PWD Offices, HDB New Towns and Zone

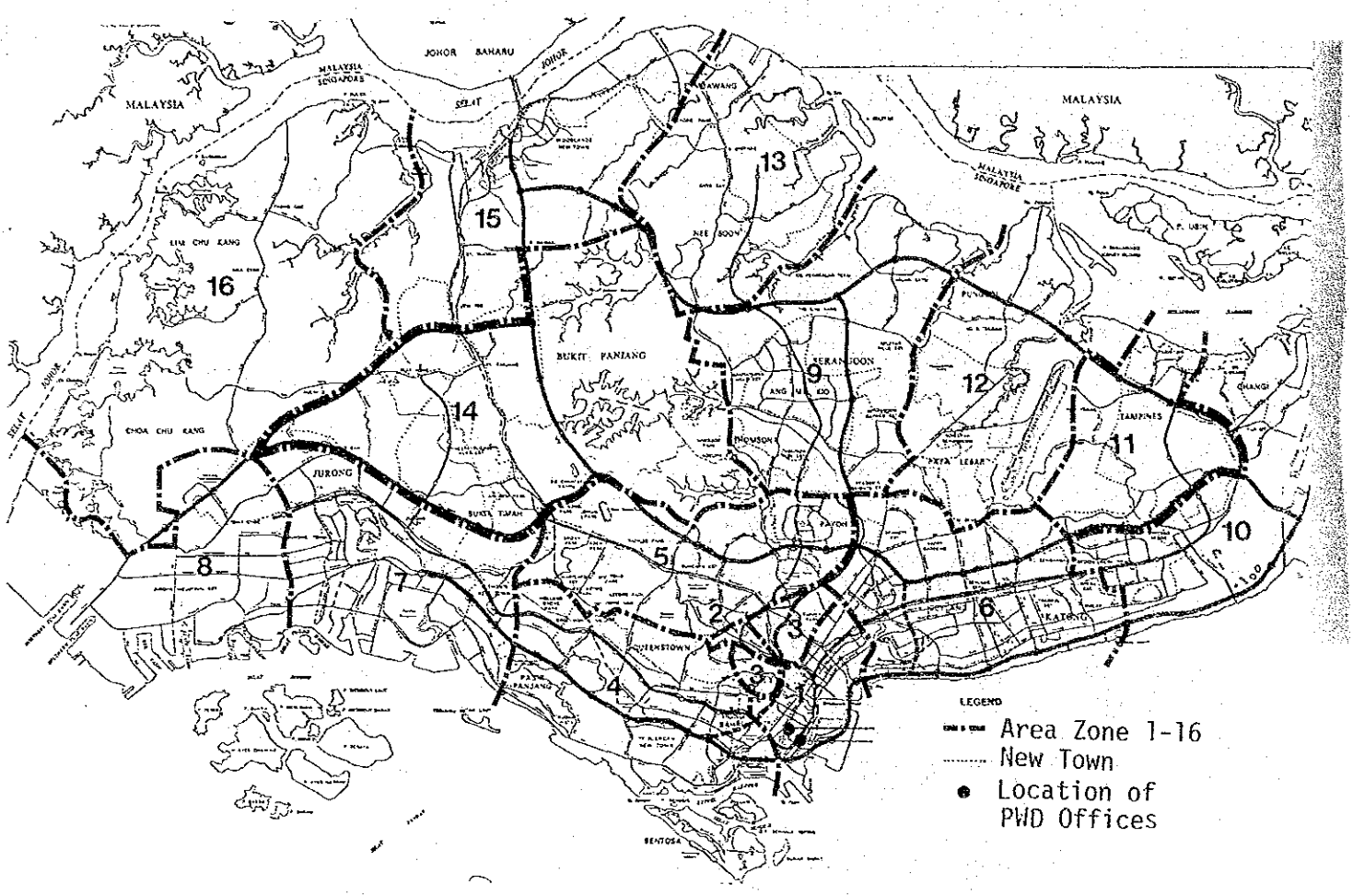


Table 2.1

List of Zones

Zone No.	Name of Zone	Zone No.	Name of Zone
1	CBD	9	Ang Mo Kio
2	Orchard Road	10	Bedok
3	Adjoining CBD	11	Tampines
4	West Coast	12	Hougang
5	Bukit Timah Road	13	Yishun
6	East Coast	14	Bukit Panjang
7	Jurong East	15	Woodlands
8	Jurong West	16	Lim Chu Kang

Table 2.2

List of HDB New Towns

No.	Name of New Town	No.	Name of New Town
1	Ang Mo Kio	11	Jurong East
2	Bedok	12	Jurong West
3	Bishan	13	Pasir Ris
4	Bukit Batok	14	Queenstown
5	Bukit Merah	15	Serangoon
6	Chua Chu Kang	16	Tampines
7	Clementi	17	Toa Payoh
8	Geylang	18	Woodlands
9	Hougang	19	Yishun
10	Jalan Besar	20	Bukit Panjang

2.1.2 Personal Characteristics

1) Work Place

The survey was carried out for PWD officials working in N.D. Building and SIA Building only. N.D. Building is situated at Maxwell Road and SIA Building at Robinson Road. Both are located in the southern part of the CBD area.

N.D. Building is accessible by public transport plying along South Bridge Road, New Bridge and Cecil Street, while SIA Building is served by public transport plying along Shenton Way and Robinson Road. It would appear that both offices are equally accessible by public transport.

Among the samples surveyed, about 87% of the total were obtained from N.D. Building and 12% from SIA Building. Table 2.3 shows the distribution of these samples by personal characteristics; namely, work category, sex, and age group. It shows that there are some differences in the proportion of personal characteristics between the sample groups of these two buildings.

The group from SIA Building has a higher proportion of administrative/ clerical staff (42%), while the group from N.D Building has more technical staff. The proportion of female officials in SIA Building is higher than that in N.D. Building. N.D. Building has a higher proportion of officials in the older age group.

2) Profile of Surveyed PWD Officials

From the survey, the profile of PWD officials were established, as shown in Table 2.4.

On the work category of PWD officials, majority are from the technical staff, both for male and female groups (70% and 47%). The proportion of administrative/clerical staff is exceptionally high in the female group because of the substantial number of female clerical staff in PWD. On the other hand, 70% of the professional staff are men.

Female PWD staff are also generally younger than their male counterparts.

Table 2.3

Distribution of Samples by Personal Characteristics and Work Place

(No. of Samples)

		N.D.Bldg	SIA Bldg	Unknown	Total
Total No. of Interviewees		528	74	6	608
Work Category	Professional Staff	60	9	1	70
	Adm./Clerical Staff	144	31	2	177
	Technical Staff	321	33	3	357
	Not known	3	1	0	4
Sex	Male	252	24	3	279
	Female	276	50	3	329
Age	Below 19	1	0	0	1
	20 - 29	152	22	4	178
	30 - 39	210	31	0	241
	40 - 49	66	7	0	73
	50 - 59	33	2	0	35
	60 & above	0	0	0	0
	Not Known	66	12	2	80

(%)

		N.D.Bldg	SIA Bldg	Unknown	Total
Total No. of Interviewees		86.8	12.2	1.0	100.0
Work Category	Professional Staff	85.7	12.9	1.4	100.0
	Adm./Clerical Staff	81.4	17.5	1.1	100.0
	Technical Staff	89.9	9.2	0.8	100.0
	Not known	75.0	25.0	0.0	100.0
Sex	Male	90.3	8.6	1.1	100.0
	Female	83.9	15.2	0.9	100.0
Age	Below 19	100.0	0.0	0.0	100.0
	20 - 29	85.4	12.4	2.2	100.0
	30 - 39	87.1	12.9	0.0	100.0
	40 - 49	90.4	9.6	0.0	100.0
	50 - 59	94.3	5.7	0.0	100.0
	60 & above	-	-	-	-
	Not Known	82.5	15.0	2.5	100.0

(%)

		N.D.Bldg	SIA Bldg	Unknown	Total
Total No. of Interviewees		100.0	100.0	100.0	100.0
Work Category	Professional Staff	11.4	12.2	16.7	11.5
	Adm./Clerical Staff	27.3	41.9	33.3	29.1
	Technical Staff	60.8	44.6	50.0	58.7
	Not known	0.6	1.4	0.0	0.7
Sex	Male	47.7	32.4	50.0	45.9
	Female	52.3	67.6	50.0	54.1
Age	Below 19	0.2	0.0	0.0	0.2
	20 - 29	28.8	29.7	66.7	29.3
	30 - 39	39.8	41.9	0.0	39.6
	40 - 49	12.5	9.5	0.0	12.0
	50 - 59	6.3	2.7	0.0	5.8
	60 & above	0.0	0.0	0.0	0.0
	Not Known	12.5	16.2	33.3	13.2

Table 2.4

Distribution of Samples by Work Category, Age Group, and Sex

(No. of Samples)

		N.D. Bldg. Male	N.D. Bldg. Female	SIA Bldg. Male	SIA Bldg. Female	Unknown Male	Unknown Female	Total Male	Total Female
Total No. of Interviewees		252	276	24	50	3	3	279	329
Work Category	Professional Staff	41	19	8	1	0	1	49	21
	Adm./Clerical Staff	25	119	2	29	1	1	28	149
	Technical Staff	185	136	14	19	2	1	201	156
	Not known	1	2	0	0	0	0	1	3
Age	Below 19	0	1	0	0	0	0	0	1
	20 - 29	73	79	6	16	2	2	81	97
	30 - 39	79	131	11	20	0	0	90	151
	40 - 49	41	25	2	5	0	0	43	30
	50 - 59	28	5	2	0	0	0	30	5
	60 & above	0	0	0	0	0	0	0	0
	Not Known	31	35	3	9	1	1	35	45

(%)

		N.D. Bldg. Male	N.D. Bldg. Female	SIA Bldg. Male	SIA Bldg. Female	Unknown Male	Unknown Female	Total Male	Total Female
Total No. of Interviewees		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Work Category	Professional Staff	16.3	6.9	33.3	2.0	0.0	33.3	17.6	6.4
	Adm./Clerical Staff	9.9	43.1	8.3	58.0	33.3	33.3	10.0	45.3
	Technical Staff	73.4	49.3	58.3	38.0	66.7	33.3	72.0	47.4
	Not known	0.4	0.7	0.0	2.0	0.0	0.0	0.4	0.9
Age	Below 19	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.3
	20 - 29	29.0	28.6	25.0	32.0	66.7	66.7	29.0	29.5
	30 - 39	31.3	47.5	45.8	40.0	0.0	0.0	32.3	45.9
	40 - 49	16.3	9.1	8.3	10.0	0.0	0.0	15.4	9.1
	50 - 59	11.1	1.8	8.3	0.0	0.0	0.0	10.8	1.5
	60 & above	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Not Known	12.3	12.7	12.5	18.0	33.3	33.3	12.5	13.7

3) Location of Residence

The location of residence of PWD staff are scattered over the whole country as shown in Table 2.5. However, more than half are concentrated in the following zones:

Zone No	Name of Zone	% of Total Samples
6	East Coast	20.4%
4	West Coast	12.0%
9	Ang Mo Kio	11.3%
10	Bedok	10.9%
7	Jurong East	10.4%
	TOTAL	65.0%

The results show that many of the PWD officials reside relatively near the CBD area: zones 4 and 6 or in the major HDB New Towns. The percentage of PWD officials residing in HDB New Towns is lower than the national average of 85% of its population.

The relationship between work category and location of residence is shown in Table 2.6. It shows that a significant proportion of professional staff reside near the CBD, particularly in zone 6 (East Coast). The location of residence for technical staff are, on the other hand, distributed over a wide area.

Table 2.7 shows the distribution of PWD staff who reside in HDB New Towns. It shows that about 40% reside in the three major HDB New Towns; namely, Ang Mo Kio (10.4%), Bedok (16.9%), and Tampines (14.3%).

Table 2.5

Location of Residence
of PWD Staff

(No. of Samples)

Zone No. (Area)	Name of Zone	N.D. Bldg.	SIA Bldg.	Unknown	Total
1	CBD	15	3	0	18
2	ORCHARD ROAD	4	0	0	4
3	ADJOINING CBD	12	1	0	13
4	WEST COAST	64	8	1	73
5	BKT. TIMAH ROAD	29	5	0	34
6	EAST COAST	107	16	1	124
7	JURONG EAST	58	5	0	63
8	JURONG WEST	0	0	0	0
9	ANG MO KIO	66	3	0	69
10	BEDOK	56	8	2	66
11	TAMPINES	32	6	0	38
12	HOUGANG	29	8	0	37
13	YISHUN	10	3	0	13
14	BKT. PANJANG	32	7	0	39
15	WOODLANDS	4	1	0	5
16	LIM CHU KANG	0	0	0	0
Not Known		10	0	2	12
Total		528	74	6	608
	in HDB New Town	268	37	2	307
	Elsewhere	260	37	4	301

(%)

Zone No. (Area)	Name of Zone	N.D. Bldg.	SIA Bldg.	Unknown	Total
1	CBD	2.8	4.1	0.0	3.0
2	ORCHARD ROAD	0.8	0.0	0.0	0.7
3	ADJOINING CBD	2.3	1.4	0.0	2.1
4	WEST COAST	12.1	10.8	16.7	12.0
5	BKT. TIMAH ROAD	5.5	6.8	0.0	5.6
6	EAST COAST	20.3	21.6	16.7	20.4
7	JURONG EAST	11.0	6.8	0.0	10.4
8	JURONG WEST	0.0	0.0	0.0	0.0
9	ANG MO KIO	12.5	4.1	0.0	11.3
10	BEDOK	10.6	10.8	33.3	10.9
11	TAMPINES	6.1	8.1	0.0	6.3
12	HOUGANG	5.5	10.8	0.0	6.1
13	YISHUN	1.9	4.1	0.0	2.1
14	BKT. PANJANG	6.1	9.5	0.0	6.4
15	WOODLANDS	0.8	1.4	0.0	0.8
16	LIM CHU KANG	0.0	0.0	0.0	0.0
Not Known		1.9	0.0	33.3	2.0
Total		100.0	100.0	100.0	100.0
	in HDB New Town	50.8	50.0	33.3	50.5
	Elsewhere	49.2	50.0	66.7	49.5

Table 2.6

Location of Residence by Work Category

(No. of Samples)

Zone No. (Area)	Name of Zone	Professional	Adm/Clerical	Technical	Not Known	Total
1	CBD	0	4	14	0	18
2	ORCHARD ROAD	1	1	2	0	4
3	ADJOINING CBD	2	1	10	0	13
4	WEST COAST	8	20	45	0	73
5	BKT. TIMAH ROAD	1	14	19	0	34
6	EAST COAST	23	38	63	0	124
7	JURONG EAST	8	10	44	1	63
8	JURONG WEST	0	0	0	0	0
9	ANG MO KIO	8	19	42	0	69
10	BEDOK	4	27	34	1	66
11	TAMPINES	2	12	23	1	38
12	HOUGANG	1	8	28	0	37
13	YISHUN	1	5	6	1	13
14	BKT. PANJANG	8	13	18	0	39
15	WOODLANDS	0	2	3	0	5
16	LIM CHU KANG	0	0	0	0	0
Not Known		3	3	6	0	12
Total		70	177	357	4	608
	in HDB New Town	17	92	194	4	307
	Elsewhere	53	85	163	0	301

(%)

Zone No. (Area)	Name of Zone	Professional	Adm/Clerical	Technical	Not Known	Total
1	CBD	0.0	2.3	3.9	0.0	3.0
2	ORCHARD ROAD	1.4	0.6	0.6	0.0	0.7
3	ADJOINING CBD	2.9	0.6	2.8	0.0	2.1
4	WEST COAST	11.4	11.3	12.6	0.0	12.0
5	BKT. TIMAH ROAD	1.4	7.9	5.3	0.0	5.6
6	EAST COAST	32.9	21.5	17.6	0.0	20.4
7	JURONG EAST	11.4	5.6	12.3	25.0	10.4
8	JURONG WEST	0.0	0.0	0.0	0.0	0.0
9	ANG MO KIO	11.4	10.7	11.8	0.0	11.3
10	BEDOK	5.7	15.3	9.5	25.0	10.9
11	TAMPINES	2.9	6.8	6.4	25.0	6.3
12	HOUGANG	1.4	4.5	7.8	0.0	6.1
13	YISHUN	1.4	2.8	1.7	25.0	2.1
14	BKT. PANJANG	11.4	7.3	5.0	0.0	6.4
15	WOODLANDS	0.0	1.1	0.8	0.0	0.8
16	LIM CHU KANG	0.0	0.0	0.0	0.0	0.0
Not Known		4.3	1.7	1.7	0.0	2.0
Total		100.0	100.0	100.0	100.0	100.0
	in HDB New Town	24.3	52.0	54.3	100.0	50.5
	Elsewhere	75.7	48.0	45.7	0.0	49.5

Table 2.7

Distribution of Samples by Location of HDB New Town

(No. of Samples)

Name of New Town	N.D. Bldg	SIA Bldg	Unknown	Total
1 Ang Mo Kio	29	3	0	32
2 Bedok	47	4	1	52
3 Bishan	10	0	0	10
4 Bukit Batok	18	3	0	21
5 Bukit Merah	4	2	0	6
6 Choa Chu Kang	0	0	0	0
7 Clementi	15	2	0	17
8 Geylang	19	0	0	19
9 Hougang	17	5	0	22
10 Jalan Besar	0	0	0	0
11 Jurung East	13	2	0	15
12 Jurung West	13	1	0	14
13 Pasir Ris	0	0	0	0
14 Queenstown	0	0	0	0
15 Serangoon	16	0	0	16
16 Tampines	37	6	1	44
17 Toa Payoh	20	5	0	25
18 Woodlands	1	1	0	2
19 Yishun	8	3	0	11
20 Bukit Panjang	1	0	0	1
Total	268	37	2	307

(%)

	N.D. Bldg	SIA Bldg	Unknown	Total
1 Ang Mo Kio	10.8	8.1	0.0	10.4
2 Bedok	17.5	10.8	50.0	16.9
3 Bishan	3.7	0.0	0.0	3.3
4 Bukit Batok	6.7	8.1	0.0	6.8
5 Bukit Merah	1.5	5.4	0.0	2.0
6 Choa Chu Kang	0.0	0.0	0.0	0.0
7 Clementi	5.6	5.4	0.0	5.5
8 Geylang	7.1	0.0	0.0	6.2
9 Hougang	6.3	13.5	0.0	7.2
10 Jalan Besar	0.0	0.0	0.0	0.0
11 Jurung East	4.9	5.4	0.0	4.9
12 Jurung West	4.9	2.7	0.0	4.6
13 Pasir Ris	0.0	0.0	0.0	0.0
14 Queenstown	0.0	0.0	0.0	0.0
15 Serangoon	6.0	0.0	0.0	5.2
16 Tampines	13.8	16.2	50.0	14.3
17 Toa Payoh	7.5	13.5	0.0	8.1
18 Woodlands	0.4	2.7	0.0	0.7
19 Yishun	3.0	8.1	0.0	3.6
20 Bukit Panjang	0.4	0.0	0.0	0.3
Total	100.0	100.0	100.0	100.0

2.1.3 Household Characteristics

1) Household Size

The average household size of surveyed PWD officials is 4.5 members which is slightly smaller than the 4.7 household members obtained in the 1980 census.

Table 2.8 shows the relationship between household size and work category of PWD officials. The professional staff has a rather small household size while the technical staff has a comparatively larger household size.

Table 2.8

Distribution of Household Size by Work Category

(No. of Samples)

No. of HH Members	Professional	Adm./Clerical	Technical	Unknown	Total
1	5	6	13	0	24
2	4	22	22	1	49
3	13	36	65	1	115
4	22	38	91	1	152
5	8	23	51	0	82
6	5	14	42	0	61
7	4	6	28	0	38
8	0	8	18	0	26
9	1	5	11	0	17
10 and above	0	6	4	1	11
Not Known	8	13	12	0	33
Total	70	177	357	4	608

(%)

No. of HH Menbers	Professional	Adm/Clerical	Technical	Total
1	7.1	3.4	3.6	3.9
2	5.7	12.4	6.2	8.1
3	18.6	20.3	18.2	18.9
4	31.4	21.5	25.5	25.0
5	11.4	13.0	14.3	13.5
6	7.1	7.9	11.8	10.0
7	5.7	3.4	7.8	6.3
8	0.0	4.5	5.0	4.3
9	1.4	2.8	3.1	2.8
10 & above	0.0	3.4	1.1	1.8
Not Known	11.4	7.3	3.4	5.4
Total	100.0	100.0	100.0	100.0
Average	4.0	4.4	4.6	4.5

2) Number of Wage Earners

The large majority of surveyed PWD officials have two or more wage earners among their household members. The average number of wage earners per household is 2.6 persons. Table 2.9 shows that the administrative/clerical and technical staff have, on the average, more wage earners in their household than those of the professional staff.

Table 2.9

Number of Wage Earners by Work Category

(No. of Samples)

No. of wage Earners/ Household	Professional	Adm./Clerical	Technical	Not Known	Total
1	20	21	42	0	83
2	31	90	172	3	296
3 & above	16	51	134	1	202
Not Known	3	15	9	0	27
Total	70	177	357	4	608

(%)

No. of wage Earners/ Household	Professional	Adm./Clerical	Technical	Not Known	Total
1	28.6	11.9	11.8	0.0	13.7
2	44.3	50.8	48.2	75.0	48.7
3 & above	22.9	28.8	37.5	25.0	33.2
Not Known	4.3	8.5	2.5	0.0	4.4
Total	100.0	100.0	100.0	100.0	100.0
Average	2.2	2.5	2.7	2.5	2.6

3) Household Income Level

The average monthly household income level of PWD officials was considerably high when compared with the data in the Household Expenditure Survey conducted in 1982, as shown in Table 2.10.

The survey shows that about 56% of PWD officials have a monthly household income exceeding S$2,000, 34% exceeding S$3,000 and 12% exceeding S$5,000.

The average household income for surveyed PWD officials is S$2,698 as shown in Table 2.11. The average monthly household income for professional staff amounted to S$4,735 while that for technical staff is S$2,517.

Table 2.10

Distribution of Household by Household Income

Household Income	PWD Officials Survey 1/	Household Expenditure Survey Conducted 2/ in 1982
Below 1,000	11.8%	44.0%
1,000 - 1,500	17.6	18.6
1,501 - 2,000	15.7	11.2
2,000 - 3,000	20.4	12.2
3,001 - 4,000	14.0	6.0
4,001 - 5,000	8.1	3.1
5,001 & Over	12.3	4.9

1/ Excluding Not Known
2/ Taken from the report on the household expenditure survey conducted 1982/83.

Table 2.11

Household Income Level by Work Category

Household Income Group (S$/month)	Professional	Adm./Clerical	Technical	Not Known	Total
Below 1,000	1	28	39	0	68
1,001-1,500	3	40	59	0	102
1,501-2,000	2	31	56	2	91
2,001-3,000	6	24	86	2	118
3,001-4,000	10	15	56	0	81
4,001-5,000	12	11	24	0	47
5,001-6,000	11	5	14	0	30
6,001-above	23	7	11	0	41
Not Known	2	16	12	0	30
Total	70	177	357	4	608
Average	4735	2238	2517	2125	2698

Household Income Group (S$/month)	Professional	Adm./Clerical	Technical	Not Known	Total
Below 1,000	1.5	41.2	57.4	0.0	100.0
1,001-1,500	2.9	39.2	57.8	0.0	100.0
1,501-2,000	2.2	34.1	61.5	2.2	100.0
2,001-3,000	5.1	20.3	72.9	1.7	100.0
3,001-4,000	12.3	18.5	69.1	0.0	100.0
4,001-5,000	25.5	23.4	51.1	0.0	100.0
5,001-6,000	36.7	16.7	46.7	0.0	100.0
6,001-above	56.1	17.1	26.8	0.0	100.0
Not Known	6.7	53.3	40.0	0.0	100.0
Total	11.5	29.1	58.7	0.7	100.0
Average	4735	2238	2517	2125	2698

Household Income Group (S$/month)	Professional	Adm./Clerical	Technical	Not Known	Total
Below 1,000	1.4	15.8	10.9	0.0	11.2
1,001-1,500	4.3	22.6	16.5	0.0	16.8
1,501-2,000	2.9	17.5	15.7	50.0	15.0
2,001-3,000	8.6	13.6	24.1	50.0	19.4
3,001-4,000	14.3	8.5	15.7	0.0	13.3
4,001-5,000	17.1	6.2	6.7	0.0	7.7
5,001-6,000	15.7	2.8	3.7	0.0	4.9
6,001-above	32.9	4.0	3.1	0.0	6.7
Not Know	2.9	9.0	3.4	0.0	4.9
Total	100.0	100.0	100.0	100.0	100.0
Average	4735	2238	2517	2125	2698

2.1.4 Vehicle Ownership

1) Type of Vehicle Ownership

Table 2.12 shows that among the households of PWD officials, 49.3% do not have any kind of vehicle, 1.8% have only bicycles, and about 7.7% own a motorcycle.It also shows that 51.1% of total households do not have any motorized vehicles, 36.7% own a single car and 4.4% have more than one car. Car owners having more than one car have, on the average, 2.1 cars per household as shown in Table 2.13.

Table 2.12

Vehicle Ownership by Work Place

(No of Households)

Ownership Type 1/	N.D. Bldg.	SIA Bldg.	Unknown	Total
No Vehicle	268	29	3	300
Bicycle Only	8	3	0	11
Motorcycle	38	7	2	47
Single Car	190	32	1	223
Multi-Car	24	3	0	27
Total	528	74	6	608

(%)

No Vehicle	50.8	39.2	50.0	49.3
Bicycle Only	1.5	4.1	0.0	1.8
Motorcycle	7.2	9.5	33.3	7.7
Single Car	36.0	43.2	16.7	36.7
Multi-Car	4.5	4.1	0.0	4.4
Total	100.0	100.0	100.0	100.0

(%)

No Car	59.5	52.7	83.3	58.9
Car Owner	40.5	47.1	0.0	4.4

1/ Car includes Van/Pick - Up

Table 2.13

Number of Units/Vehicle Owning Household

(No. of Units/Household)

Ownership Type	N.D. Bldg	SIA Bldg	Unknown	Total
Bicycle Only	1.0	1.0	0.0	1.0
Motorcycle	1.2	1.4	2.0	1.2
Single Car	1.0	1.0	1.0	1.0
Multi-Car	2.2	2.0	0.0	2.1

2) Vehicle Ownership by Work Category

Table 2.14 shows the distribution of car ownership by work category of the respondents. Among the professional staff, about 79% of the households have at least one car while 16% own more than one. On the other hand, for administrative/ clerical staff, 28% of the households possess at least one car, while only 2.3% have more than one car.

Table 2.14

Vehicle Ownership by Work Category

	Professional	Adm./Clerical	Technical	(No. of Samples) Not Known	Total
Bicycle Only	0	1	10	0	11
Motorcycle	0	10	35	2	47
Single Car	44	50	129	0	223
Multi Car	11	4	12	0	27

% of Vehicle Owned Household in Total No. of Households					(%)
Bicycle Only	0.0	0.6	2.8	0.0	1.8
Motorcycle	0.0	5.6	9.8	50.0	7.7
Single Car	62.9	28.2	36.1	0.0	36.7
Multi Car	15.7	2.3	3.4	0.0	4.4
No Vehicle	21.4	63.3	47.9	50.0	49.3
No Car	21.4	69.5	60.5	100.0	58.9

Average No. of Units/Vehicle Owning Household					(%)
Bicycle Only	0.0	1.0	1.0	0.0	1.0
Motorcycle	0.0	1.4	1.2	1.5	1.2
Single Car	1.0	1.0	1.0	0.0	1.0
Multi Car	2.3	2.0	2.1	0.0	2.1

Car includes Van/Pick-up

3) Vehicle Ownership by Household Income

The relationship between household income and car ownership is shown in Table 2.15 and Figure 2.2. Generally the higher the household income, the higher the proportion of car owners. Practically about three-fourth of owners who possess more than one car come from the household group earning more than $5,000 per month.

Table 2.15

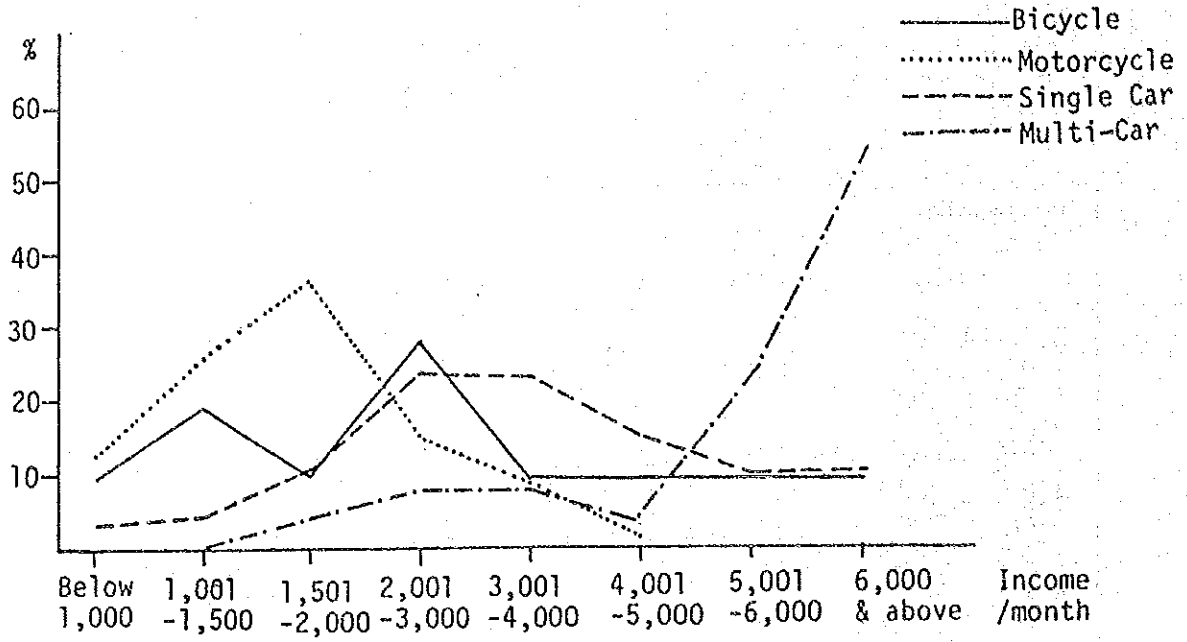
Vehicle Ownership by Household Income

Household Income Group ($ /month)	Bicycle	Motorcycle	Single Car	Multi Car	Car Total
			(No. of Samples)		
Below 1,000	1	6	7	0	7
1,001-1,500	2	12	9	0	9
1,501-2,000	1	17	22	1	23
2,001-3,000	3	7	51	2	53
3,001-4,000	1	4	50	2	52
4,001-5,000	1	1	33	1	34
5,001-6,000	1	0	21	6	27
6,001 above	1	0	22	14	36
Not Known	0	0	8	1	9
Total	11	47	223	27	250

Household Income Group ($ /month)	Bicycle	Motorcycle	Single Car	Multi Car	Car Total
			(%)		
Below 1,000	9.1	12.8	3.1	0.0	2.8
1,001-1,500	18.2	25.5	4.0	0.0	3.6
1,501-2,000	9.1	36.2	9.9	3.7	9.2
2,001-3,000	27.3	14.9	22.9	7.4	21.2
3,001-4,000	9.1	8.5	22.4	7.4	20.8
4,001-5,000	9.1	2.1	14.8	3.7	13.6
5,001-6,000	9.1	0.0	9.4	22.2	10.8
6,001 above	9.1	0.0	9.9	51.9	14.4
Not Known	0.0	0.0	3.6	3.7	3.6
Total	100.0	100.0	100.0	100.0	100.0

Figure 2.2

Relationship Between Income and Vehicle Ownership



4) Vehicle Ownership by Location of Residence

Table 2.16 shows the distribution of vehicle ownership by zone and HDB New Towns. It shows that car ownership is comparatively high in the following zones:

Zone No.	Name of Zone	Car Owners (%) 1/
2	Orchard Road	50.0 2/
3	Adjoining CBD	40.2
6	East Coast	57.3
9	Ang Mo Kio	47.8
10	Bukit Panjang	41.4

1/ Includes single car and multi-car owners.
2/ Only a few samples were taken.

There is no obvious relationship between the location of zones and car ownership.

Table 2.16

Vehicle Ownership by Location of Residence

		Bicycle	Motorcycle	Single Car	Multi Car	(No. of Persons) Total HH
ZONE	1 CBD	0	2	5	1	18
	2 Orchard Road	0	0	2	0	4
	3 Adjoining CBD	0	1	5	1	13
	4 West Coast	2	6	20	2	73
	5 Bkt. Timah Road	0	2	13	0	34
	6 East Coast	2	6	61	10	124
	7 Jurong East	0	4	21	4	63
	8 Jurong West	0	0	0	0	0
	9 Ang Mo Kio	2	5	28	5	69
	10 Bedok	1	8	25	0	66
	11 Tampines	0	5	11	1	38
	12 Hougang	3	3	14	0	37
	13 Yishun	0	2	4	0	13
	14 Bkt.Panjang	0	3	13	3	39
	15 Woodlands	0	0	1	0	5
	16 Lim Chu Kang	0	0	0	0	0
	Not Known	1	0	0	0	12
	Total	11	47	223	27	608
	1 Ang Mo Kio	1	5	22	0	52
	2 Bedok	0	0	7	1	10
	3 Bishan	0	2	4	2	21
	4 Bukit Batok	0	1	2	0	6
	5 Bukit Merah	0	0	0	0	0
	6 Choa Chu Kang	0	1	4	1	17
	7 Clementi	0	0	7	1	19
	8 Geylang	2	2	6	0	22
	9 Hougang	0	0	0	0	0
	10 Jalan Besar	0	3	7	0	15
	11 Jurong East	0	1	3	0	14
	12 Jurong West	0	0	0	0	0
	13 Pasir Ris	0	0	0	0	0
	14 Queenstown	1	1	6	1	16
	15 Serangoon	0	7	11	1	44
	16 Tampines	0	1	7	0	25
	17 Toa Payoh	0	0	0	0	2
	18 Woodlands	0	2	2	0	11
	19 Yishun	0	0	1	0	1
	20 Bukit Panjang	5	19	126	18	301
Sub Total		9	45	215	25	576
Other than HDB		2	2	8	2	32

5) Car Type

Table 2.17 shows the car types owned PWD officials households. It shows that the car capacity of most passenger car owners (85.8%) is less than 1,600 cc.

Table 2.17

Car Type Owned

(No. of Samples)

Car Type	N.D. Bldg	SIA Bldg	Unknown	Total
Car<1600cc	208	32	1	241
Car>1600cc	22	3	0	25
Van/Pick-Up	11	2	0	13
Others	1	1	0	2
Total	242	38	1	281

(%)

Car Type	N.D. Bldg	SIA Bldg	Unknown	Total
Car<1600cc	86.0	84.2	100.0	85.8
Car>1600cc	9.1	7.9	0.0	8.9
Van/ Pick-Up	4.5	5.3	0.0	4.6
Others	0.4	2.6	0.0	100.0
Total	100.0	100.0	100.0	100.0

6) Driver's Licence

Among the surveyed officials, 64.3% have a driver's licence. About 91.4% of the professional staff and 72.8% from the technical group possess a driver's licence. On the other hand, only 36.7% of the administrative/clerical staff carry a driver's licence, as shown in Table 2.18.

The type of driver's licence carried by PWD officials is shown in Table 2.19.

Table 2.18

Ownership of Driver's Licence
by Work Category

	Professional	Admin/ Clerical	Technical	Not Known	Total
Not holding	6	112	97	2	217
Holding	64	65	260	2	391
Total No. of Households	70	197	357	4	608
Not holding	8.6	63.3	27.3	50.0	35.7
Holding	91.4	36.7	72.8	50.0	64.3
Total No. of Households	100.0	100.0	100.0	100.0	100.0

Table 2.19

Ownership of Driver's Licence by Type and Work Place

(No. of persons)

Type		N.D. Bldg	SIA Bldg	Unknown	Total
Class 1	Invalid Carriages	3	0	0	3
Motor-cycle	Class 2B	12	3	1	16
	Class 2A	5	2	1	8
	Class 2	30	5	1	36
Class 3	Motor Cars	284	29	2	315
Class 4A	Omni Buses	0	0	0	0
Class 4	Heavy Motor Car	5	2	0	7
Class 5	Others	2	1	0	3
Not Known		3	0	0	3
Total		344	42	5	391

7) Availability of Cars Among Household Members

It appears that PWD officials do not always have the car for their own use. Table 2.20 shows that the availability of the car for the household members. It shows that about 41% of PWD officials have the household car for their own use.

Table 2.20

Availability of Cars to Household Members 1/

(No.of Persons)

	N.D. Bldg	SIA Bldg	Unkown	Total
For Self-Use	95	10	1	106
For Family	125	26	0	151
Not Known	2	0	0	2
Total	222	36	1	259

(%)

	N.D. Bldg	SIA Bldg	Unknown	Total
For Self Use	42.8	27.8	100.0	40.9
For Family use	56.3	72.2	0.0	58.3
Not Known	0.9	0.0	0.0	0.8
Total	100.0	100.0	100.0	100.0

1/ Include Van/Pick-up

8) "Kiss and Ride" Practice

"Kiss and Ride " is a practice where a person is sent by car to a bus stop/interchange and then transfers onto a public transport to continue the journey.

About 35% of surveyed PWD officials practice "Kiss and Ride", although their frequency for doing so is "seldom". Table 2.21 shows the use of "Kiss and Ride" by frequency, purpose, and car driver.

Table 2.21
Characteristices of "Kiss and Ride" Practice
of Surveyed PWD Officials

				(No. of Samples)	
		N.D. Bldg.	SIA Bldg.	Unknown	Total
Frequency	Daily	42	3	0	45
	3 - 4 days/week	7	2	0	9
	1 - 2 days/week	14	7	1	22
	Seldom	115	20	2	137
Main Purpose	To/from Work	56	11	0	67
	To/from School	4	1	0	5
	Other Purpose	9	1	1	11
	Not Known	109	19	2	130
Who Drive	Family Member	43	8	0	51
	Friend	6	2	0	8
	Neighbours	3	0	0	3
	Others	11	4	1	16
	Not Known	115	18	2	135
Total		178	32	3	213
Sample Total		528	74	6	608

				(Percentage)	
		N.D. Bldg.	SIA Bldg.	Unknown	Total
Frequency	Daily	23.6	9.4	0.0	21.1
	3 - 4 days/week	3.9	6.3	0.0	4.2
	1 - 2 days/week	7.9	21.9	33.3	10.3
	Seldom	64.6	62.5	66.7	64.3
Main Purpose	To/from Work	31.5	34.4	0.0	31.5
	To/from School	2.2	3.1	0.0	2.3
	Other Purpose	5.1	3.1	33.3	5.2
	Not Known	61.2	59.4	66.7	61.0
Who Drive	Family Member	24.2	25.0	0.0	23.9
	Friend	3.4	6.3	0.0	3.8
	Neighbours	1.7	0.0	0.0	1.4
	Others	6.2	12.5	33.3	7.5
	Not Known	64.5	56.3	66.7	63.4
Total		100.0	100.0	100.0	100.0
% of Sample Total		33.7	43.2	50.0	35.0

9) "Park and Ride" Practice

"Park and Ride" is a practice wherein a person leaves his/her car in a parking place and then transfers onto a car pool or public transport to continue a trip.

Only 4.8% of PWD respondents practice "Park and Ride". Table 2.22 shows the use of "Park and Ride" by frequency, purpose, and parking place.

Table 2.22

Characteristics of Park and Ride Practice of Surveyed PWD Officials

		(No. of Samples)			
		N.D. Bldg.	SIA Bldg.	Unknown	Total
Frequency	Daily	10	0	0	10
	3 - 4 days/week	3	0	0	3
	1 - 2 days/week	3	1	0	4
	Seldom	8	2	0	10
	Not Known	2	2	0	2
Main Purpose	To/from Work	24	1	0	25
	To/from School	1	0	0	1
	Other Purpose	1	0	0	1
	Not Known	0	2	0	2
Parking Place	Fringe Car Park	11	0	0	11
	Outside CBD	8	1	0	9
	Near Bus IC	1	0	0	1
	Not Known	6	2	0	8
Total		26	3	0	9
Car Owner Households Total		214	35	1	250
Sample Total		528	74	6	608

		(Percentage)			
		N.D. Bldg.	SIA Bldg.	Unknown	Total
Frequency	Daily	35.5	0.0	-	34.5
	3 - 4 days/week	11.5	0.0	-	10.3
	1 - 2 days/week	11.5	33.3	-	13.8
	Seldom	30.8	66.7	-	34.5
Main Purpose	To/from Work	92.3	33.3	-	86.2
	To/from School	3.8	0.0	-	3.4
	Other Purpose	3.8	0.0	-	3.4
	Not Known	0.0	66.7	-	6.9
Parking Place	Fringe Car Park	42.3	0.0	-	37.9
	Outside CBD	30.8	33.3	-	31.0
	Near Bus IC	3.8	0.0	-	3.4
	Not Known	23.1	66.7	-	27.6
Total		100.0	100.0	-	100.0
% of Car Owner Households		12.1	8.6	0.0	11.6
% of Sample Total		4.9	4.1	0.0	4.8

2.1.5 Trip Characteristics

1) Average Number of Trips

The average number of trips of surveyed PWD officials is 2.9 trips per day. Apart from trips made to and from the work place, the average number of additional trips made is 0.9 trips per day.

The number of trips per person by work place and category is as follows:

Work Place :	N.D. Building	:	3.0/person/day
	SIA Building	:	2.7
	Total	:	2.9
Work Category :	Professional Staff	:	3.6
	Administrative/ Clerical Staff	:	2.3
	Technical Staff	:	3.1

This shows that the professional and technical staff make more trips/day than the administrative/clerical staff.

2) Trip Purpose

The distribution of trips is shown in Table 2.23. About 75.6% of total trips are for "going to work" and "to home". purposes. The rest are mainly for "eating/social", personal business, and work-related trips.

3) Modal Choice

The modal choice of PWD officials surveyed is shown in Table 2.24. The proportion of those using public transport modes between two places is similar.

Table 2.25 shows the modal choice by work category. It shows that the percentage of trips made by the professional staff with private transport mode is significantly higher than the staff of other work categories.

Modal choice by trip purpose and household car ownership is shown in Table 2.26. For the work purpose, public bus and private car are the major transport modes.

Table 2.27 shows the distribution of modal choice by zone for work trips of the surveyed PWD officials. It shows that the high percentage of trips generated from zone 3 (Adjoining CBD) and zone 9 (Ang Mo Kio) is done by bus, while the high percentage of trips generated from zone 2 (Orchard Road) is by car/taxi.

Table 2.23

Number of Trips by Trip Purpose

	N.D Bldg	SIA Bldg	Not Known	Total
To Work	626	83	5	714
To School	44	5	0	49
Part of Work	64	10	0	74
Personal Business	59	7	3	69
Shopping	36	4	0	40
Recreation	12	3	0	15
Eating/Social	157	12	0	169
To Home	498	76	4	576
Not Known	2	0	0	2
Total	1498	200	12	1,710
Average	3.0	2.7	3.0	2.9

(%)

	N.D. Bldg	SIA Bldg	Not Known	Total
To Work	41.8	41.5	41.7	41.8
To School	2.9	2.5	0.0	2.9
Part of Work	4.3	5.0	0.0	4.3
Personal Business	3.9	3.5	25.0	4.0
Shopping	2.4	2.0	0.0	2.3
Recreation	0.8	1.5	0.0	0.9
Eating/Social	10.5	6.0	0.0	9.9
To Home	33.2	38.0	33.3	33.8
Not Known	0.1	0.0	f0.0	0.1
Total	100.0	100.0	100.0	100.0

Table 2.24

Modal Choice of PWD Officials by Work Place

(No. of Samples)

	N.D.Bldg	SIA Bldg	Not Known	Total
Walk	1036	99	4	1139
Bicycle	7	0	0	7
Motorcycle	44	11	2	57
Car	374	54	6	434
Car Pool Passenger	37	3	0	40
Taxi	19	0	0	19
Van/Pick-up	23	2	0	25
Bus	724	112	3	839
Scheme B or CCS	47	9	0	56
Company Contract	45	8	0	53
Others	18	0	2	20
Not Known	0	0	0	0
Total	2374	298	17	2689

(%)

	N.D.Bldg	SIA Bldg	Not Known	Total
Walk	43.6	33.2	23.5	42.4
Bicycle	0.3	0.0	0.0	0.3
Motorcycle	1.9	3.7	11.8	2.1
Car	15.8	18.1	35.3	16.1
Car Pool Passenger	1.6	1.0	0.0	1.5
Taxi	0.8	0.0	0.0	0.7
Van/Pick-up	1.0	0.7	0.0	0.9
Bus	30.5	37.6	17.6	31.2
Scheme B or CSS	2.0	3.0	0.0	2.1
Company Contract	1.9	2.7	0.0	2.0
Others	0.8	0.0	11.8	0.7
Not Known	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0

Table 2.25

Modal Choice of PWD Officials by Work Category

(No. of Samples)

	Professional Staff	Administrative/ Clerical Staff	Technical Staff	Not Known	Total
Walk	84	212	837	6	1,139
Bicycle	0	3	4	0	7
Motorcycle	1	6	50	0	57
Car	167	66	201	0	434
Car Pool Passenger	3	14	23	0	40
Taxi	6	0	13	0	19
Van/Pick-up	3	10	12	0	25
Bus	35	217	584	3	839
Scheme B or CSS	2	10	44	0	56
Company Contract	1	32	15	5	53
Others	3	3	14	0	20
Not Known	0	0	0	0	0
Total	305	573	1,797	14	2,689

(%)

	Professional Staff	Administrative/ Clerical Staff	Technical Staff	Not Known	Total
Walk	27.5	37.0	46.6	42.9	42.4
Bicycle	0.0	0.5	0.2	0.0	0.3
Motorcycle	0.3	1.0	2.8	0.0	2.1
Car	54.8	11.5	11.2	0.0	16.1
Car Pool Passenger	1.0	2.4	1.3	0.0	1.5
Taxi	2.0	0.0	0.7	0.0	0.7
Van/Pick-up	1.0	1.7	0.7	0.0	0.9
Bus	11.5	37.9	32.5	21.4	31.2
Sheme B or CSS	0.7	1.7	2.4	0.0	2.1
Company Contract	0.3	5.6	0.8	35.7	2.0
Others	1.0	0.5	0.8	0.0	0.7
Not Known	0.0	0.0	0.0	0.0	0.7
Total	100.0	100.0	100.0	100.0	100.0

Table 2.26

Modal Choice by Trip Purpose and Household Car Ownership

(No. of Samples)

	Car Owning Household							Non Car Owning Household						
	To Work	To School	Part of Business	Private	To Home	Not Known	Total	To Work	To School	Part of Business	Private	To Home	Not Known	Total
Walk	162	15	35	77	113	0	402	298	22	24	402	274	1	732
Bicycle	2	0	0	0	1	0	3	2	0	0	0	2	0	4
Motorcycle	5	3	1	1	5	0	15	24	0	2	2	13	0	42
Car	153	17	55	38	130	3	396	15	1	5	3	14	0	38
Car Pool Passenger	14	0	0	0	0	0	14	25	0	0	0	1	0	26
Taxi	0	0	1	2	2	0	5	2	0	3	5	4	0	14
Van/Pick-up	6	0	3	0	5	0	14	4	0	2	0	5	0	11
Bus	79	8	16	9	98	0	210	287	11	32	22	277	0	629
Sheme B or CSS	10	2	2	0	9	0	23	14	5	1	2	11	0	33
Company Contract	9	0	1	0	6	0	16	21	0	0	0	16	0	37
Others	4	0	0	0	3	0	7	6	0	3	0	4	0	13
Not Known	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	444	45	114	127	372	3	1105	698	39	82	138	626	1	1584

(%)

	Car Owning Household							Non Car Owning Household						
	To Work	To School	Part of Business	Private	To Home	Not Known	Total	To Work	To School	Part of Business	Private	To Home	Not Known	Total
Walk	36.5	33.3	30.7	60.6	30.4	0.0	36.4	42.7	56.4	45.5	74.6	44.9	100.0	46.5
Bicycle	0.5	0.0	0.0	0.0	0.3	0.0	0.3	0.3	0.0	0.0	0.0	0.3	0.0	0.3
Motorcycle	1.1	6.7	0.9	0.8	1.3	0.0	1.4	3.4	0.0	2.4	2.2	2.1	0.0	2.7
Car	34.5	37.8	48.2	29.9	34.9	100.0	35.8	2.1	2.6	6.1	2.2	2.2	0.0	2.4
Car Pool Passenger	3.2	0.0	0.0	0.0	0.0	0.0	1.3	3.6	0.0	0.0	0.0	0.2	0.0	1.6
Taxi	0.0	0.0	0.9	1.6	0.5	0.0	0.5	0.3	0.0	3.7	3.6	0.6	0.0	0.9
Van/Pick-up	1.4	0.0	2.6	0.0	1.3	0.0	1.3	0.6	0.0	2.4	0.0	0.8	0.0	0.7
Bus	17.8	17.8	14.0	7.1	26.3	0.0	19.0	41.1	28.2	39.0	15.9	44.2	0.0	39.7
Sheme B or CSS	2.3	4.4	1.8	0.0	2.4	0.0	2.1	2.0	12.8	1.2	1.4	1.8	0.0	2.1
Company Contract	2.0	0.0	0.9	0.0	1.5	0.0	1.4	3.0	0.0	0.0	0.0	2.6	0.0	2.3
Others	0.9	0.0	0.0	0.0	0.8	0.0	0.6	0.9	0.0	3.7	0.0	0.6	0.0	0.8
Not Known	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

	Car Owning Household							Non Car Owning Household						
	To Work	To School	Part of Business	Private	To Home	Not Known	Total	To Work	To School	Part of Business	Private	To Home	Not Known	Total
Walk	40.3	3.7	8.7	19.2	28.1	0.0	100.0	40.4	3.0	4.6	14.0	37.9	0.1	100.0
Bicycle	66.7	0.0	0.0	0.0	33.3	0.0	100.0	50.0	0.0	0.0	0.0	50.0	0.0	100.0
Motorcycle	33.3	20.0	6.7	6.7	33.3	0.0	100.0	57.1	0.0	4.8	7.1	31.0	0.0	100.0
Car	38.6	4.3	13.9	9.6	32.8	0.8	100.0	39.5	2.6	13.2	7.9	36.8	0.0	100.0
Car Pool Passenger	100.0	0.0	0.0	0.0	0.0	0.0	100.0	96.2	0.0	0.0	0.0	3.8	0.0	100.0
Taxi	0.0	0.0	20.0	40.0	40.0	0.0	100.0	14.3	0.0	21.4	35.7	28.6	0.0	100.0
Van/Pick-up	42.9	0.0	21.4	0.0	35.7	0.0	100.0	36.4	0.0	18.2	0.0	45.5	0.0	100.0
Bus	37.6	3.8	7.6	4.3	46.7	0.0	100.0	45.6	1.7	5.1	3.5	44.0	0.0	100.0
Scheme B or CSS	43.5	8.7	8.7	0.0	39.1	0.0	100.0	42.4	15.3	3.0	6.1	33.2	0.0	100.0
Company Contract	58.3	0.0	6.3	0.0	37.5	0.0	100.0	56.8	0.0	0.0	0.0	43.2	0.0	100.0
Others	57.1	0.0	0.0	0.0	42.9	0.0	100.0	46.2	0.0	23.0	0.0	30.6	0.0	100.0
Not Known	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	40.2	4.1	10.3	11.5	33.7	0.3	100.0	44.1	2.5	5.2	8.7	39.5	0.1	100.0

(No. of Samples)

		Representative Mode of Travel										
		Walk/ Bicycle	Motor-cycle	Car/ Taxi	Car Pool Passenger	Bus	Scheme B & CSS	Contract Bus	Van/ Pick-up	Others	Not Known	Total
	1 CBD	19	1	4	1	7	0	0	0	1	0	33
	2 ORCHARD ROAD	3	0	3	0	3	0	0	0	0	0	9
	3 ADJOINING CBD	13	0	4	2	14	0	0	0	0	0	33
	4 WEST COAST	60	0	16	7	44	8	0	0	0	0	135
	5 BKT. TIMAH ROAD	31	0	8	0	28	1	2	1	1	0	72
	6 EAST COAST	102	4	48	11	50	6	2	4	2	0	229
Zone	7 JURONG EAST	44	7	17	3	38	1	7	1	2	0	120
	8 JURONG WEST	0	0	0	0	0	0	0	0	0	0	0
	9 ANG MO KIO	46	8	21	1	55	1	1	2	0	0	135
	10 BEDOK	47	2	15	9	43	1	7	1	2	0	127
	11 TAMPINES	29	2	10	2	23	0	5	0	2	0	73
	12 HOUGANG	25	2	5	0	21	6	2	1	0	0	62
	13 YISHUN	11	0	4	0	8	0	1	0	0	0	24
	14 BKT. PANJANG	25	2	15	1	25	0	3	0	0	0	71
	15 WOODLANDS	4	1	0	2	3	0	0	0	0	0	10
	16 LIN CHU KANG	0	0	0	0	0	0	0	0	0	0	0
Not Known		5	0	0	0	4	0	0	0	0	0	9
Total		464	29	170	39	366	24	30	10	10	0	1142
	1 ANG MO KIO	29	0	4	1	32	1	0	1	0	0	68
	2 BEDOK	36	2	13	7	29	1	4	1	1	0	94
	3 BISHAN	8	0	5	0	10	0	0	0	0	0	23
	4 BUKIT BATOK	12	2	5	0	16	0	3	0	0	0	38
	5 BUKIT MERAH	7	1	0	0	5	1	0	0	0	0	14
	6 CHOA CHU KANG	0	0	0	0	0	0	0	0	0	0	0
	7 CLEMENTI	8	1	4	2	8	0	0	0	0	0	23
	8 GEYLANG	17	0	3	3	12	0	0	0	0	0	35
	9 HOUGANG	17	1	3	0	14	2	2	1	0	0	40
HDB	10 JALAN BESAR	0	0	0	0	0	0	0	0	0	0	0
New	11 JURONG EAST	15	6	3	0	7	1	1	0	2	0	35
Town	12 JURONG WEST	9	0	1	0	8	0	5	1	0	0	24
	13 PASIR RIS	0	0	0	0	0	0	0	0	0	0	0
	14 QUEENSTOWN	0	0	0	0	0	0	0	0	0	0	0
	15 SERANGOON	11	1	6	0	7	2	0	1	0	0	28
	16 TAMPINES	35	2	10	2	32	0	7	0	3	0	91
	17 TOA PAYOH	21	0	2	0	21	1	1	0	1	0	47
	18 WOODLANDS	1	0	0	2	1	0	0	0	0	0	4
	19 YISHUN	9	0	1	0	7	0	1	0	0	0	18
	20 BUKIT PANJANG	0	0	1	0	0	0	0	0	0	0	1
Subtotal		235	16	61	17	209	9	24	5	7	0	583
Other than HDB		229	13	109	22	157	15	6	5	3	0	559

(%)

		Representative Mode of Travel										
		Walk/ Bicycle	Motor-cycle	Car/ Taxi	Car Pool Passenger	Bus	Scheme B & CSS	Contract Bus	Van/ Pick-up	Others	Not Known	Total
	1 CBD	57.6	3.0	12.1	3.0	21.2	0.0	0.0	0.0	3.0	0.0	100.0
	2 ORCHARD ROAD	33.3	0.0	33.3	0.0	33.3	0.0	0.0	0.0	0.0	0.0	100.0
	3 ADJOINING CBD	39.4	0.0	12.1	6.1	42.4	0.0	0.0	0.0	0.0	0.0	100.0
	4 WEST COAST	44.4	0.0	11.9	5.2	32.6	5.9	0.0	0.0	0.0	0.0	100.0
	5 BKT. TIMAH ROAD	43.1	0.0	11.1	0.0	38.9	1.4	2.8	1.4	1.4	0.0	100.0
	6 EAST COAST	44.5	1.7	21.0	4.8	21.8	2.6	0.9	1.7	0.9	0.0	100.0
Zone	7 JURONG EAST	36.7	5.8	14.2	2.5	31.7	0.8	5.8	0.8	1.7	0.0	100.0
	8 JURONG WEST	-	-	-	-	-	-	-	-	-	-	-
	9 ANG MO KIO	34.1	5.9	15.6	0.7	40.7	0.7	0.7	1.5	0.0	0.0	100.0
	10 BEDOK	37.0	1.6	11.8	7.1	33.9	0.8	5.5	0.8	1.6	0.0	100.0
	11 TAMPINES	39.7	2.7	13.7	2.7	31.5	0.0	6.8	0.0	2.7	0.0	100.0
	12 HOUGANG	40.3	3.2	8.1	0.0	33.9	9.7	3.2	1.6	0.0	0.0	100.0
	13 YISHUN	45.8	0.0	16.7	0.0	33.3	0.0	4.2	0.0	0.0	0.0	100.0
	14 BKT. PANJANG	35.2	2.8	21.1	1.4	35.2	0.0	4.2	0.0	0.0	0.0	100.0
	15 WOODLANDS	40.0	10.0	0.0	20.0	30.0	0.0	0.0	0.0	0.0	0.0	100.0
	16 LIN CHU KANG	-	-	-	-	-	-	-	-	-	-	-
Not Known		55.6	0.0	0.0	0.0	44.4	0.0	0.0	0.0	0.0	0.0	100.0
Total		40.6	2.5	14.9	3.4	32.0	2.1	2.6	0.9	0.9	0.0	100.0
	1 ANG MO KIO	42.6	0.0	5.9	1.5	47.1	1.5	0.0	1.5	0.0	0.0	100.0
	2 BEDOK	38.3	2.1	13.8	7.4	30.9	1.1	4.3	1.1	1.1	0.0	100.0
	3 BISHAN	34.8	0.0	21.7	0.0	43.5	0.0	0.0	0.0	0.0	0.0	100.0
	4 BUKIT BATOK	31.6	5.3	13.2	0.0	42.1	0.0	7.9	0.0	0.0	0.0	100.0
	5 BUKIT MERAH	50.0	7.1	0.0	0.0	35.7	7.1	0.0	0.0	0.0	0.0	100.0
	6 CHOA CHU KANG	-	-	-	-	-	-	-	-	-	-	-
	7 CLEMENTI	34.8	4.3	17.4	8.7	34.8	0.0	0.0	0.0	0.0	0.0	100.0
	8 GEYLANG	48.6	0.0	8.6	8.6	34.3	0.0	0.0	0.0	0.0	0.0	100.0
	9 HOUGANG	42.5	2.5	7.5	0.0	35.0	5.0	5.0	2.5	0.0	0.0	100.0
HDB	10 JALAN BESAR	-	-	-	-	-	-	-	-	-	-	-
New	11 JURONG EAST	42.9	17.1	8.6	0.0	20.0	2.9	2.9	0.0	5.7	0.0	100.0
Town	12 JURONG WEST	37.5	0.0	4.2	0.0	33.3	0.0	20.8	4.2	0.0	0.0	100.0
	13 PASIR RIS	-	-	-	-	-	-	-	-	-	-	-
	14 QUEENSTOWN	-	-	-	-	-	-	-	-	-	-	-
	15 SERANGOON	39.3	3.6	21.4	0.0	25.0	7.1	0.0	3.6	0.0	0.0	100.0
	16 TAMPINES	38.5	2.2	11.0	2.2	35.2	0.0	7.7	0.0	3.3	0.0	100.0
	17 TOA PAYOH	44.7	0.0	4.3	0.0	44.7	2.1	2.1	0.0	2.1	0.0	100.0
	18 WOODLANDS	25.0	0.0	0.0	50.0	25.0	0.0	0.0	0.0	0.0	0.0	100.0
	19 YISHUN	50.0	0.0	5.6	0.0	38.9	0.0	5.6	0.0	0.0	0.0	100.0
	20 BUKIT PANJANG	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Subtotal		40.0	2.7	10.5	2.9	35.8	1.5	4.1	0.9	1.2	0.0	100.0
Other than HDB		41.0	2.3	19.5	3.9	28.1	2.7	1.1	0.9	0.5	0.0	100.0

2.1.6 Assessment of Feeder Transport Services

1) Use of Feeder Bus Services

Among the surveyed PWD officials, 27.8% use feeder bus services. For the non-household car owners, the percentage of feeder bus users is higher (34.8%) than that for household car owners (20.4%), as shown in Figure 2.3 and Table 2.28.

Figure 2.3

Use of Feeder Bus Services

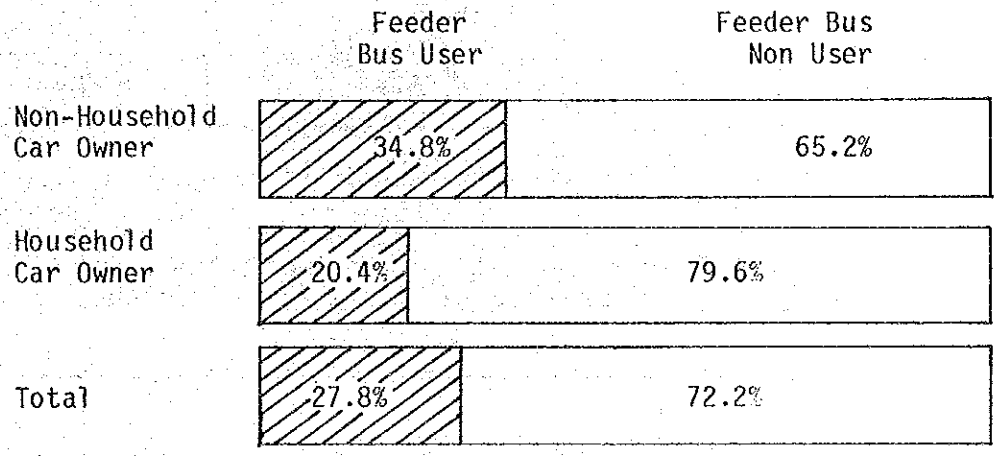


Table 2.28

Use of Feeder Bus Services

(No. of Samples) (%)

Feeder Bus	Non House-hold car Owner	Household Car Owner	Total	Non-House-hold Car Owner	Household Car Owner	Total
User	180	61	169	34.8	20.4	27.8
Non-User	202	238	440	65.2	79.6	72.2
TOTAL	310	299	609	100.0	100.0	100.0

2) Use of Feeder Bus Services by Zone

The zones which have a high percentage of feeder bus services usage are as follows:

Zone No.	Name of Zone	% of User
5	Bukit Timah Road	42.9
7	Jurung East	43.8
9	Ang Mo Kio	30.3
10	Bedok	40.3
11	Tampines	55.6
12	Hougang	37.8
13	Yishun	46.2
15	Woodlands 1/	40.0

1/ Only a few samples were taken.

For HBD New Towns which have feeder bus service, its usage by the surveyed PWD officials are as follows:

No.	Name of New Town	Number of Feeder Service	% of User
1	Ang Mo Kio	7	40.0
2	Bedok	10	43.4
4	Bukit Batok	4	22.7
5	Bukit Merah	5	0.0
7	Clementi	4	27.8
9	Hougang	5	43.5
11	Jurung East	4	56.3
12	Jurung West	7	61.5
15	Serangoon	3	20.0
16	Tampines	4	52.4
17	Toa Payoh	5	52.0
18	Woodlands	3	-
19	Yishun	2	45.5
	Total	63	41.5

Among these HBD New Towns, Jurong West (61.5%), Jurong East (56.3%), Tampines (52.4%), Toa Payoh (52.0%), Hougang (43.5%) and Bedok (43.4%) have significant percentages of surveyed PWD officials using feeder bus services.

3) Frequency of Feeder Bus Usage

Table 2.29 shows the frequency of feeder bus service usage by trip purpose. For work purpose, the average usage of feeder bus services is 5 to 6 times a week. For other purposes, the frequency is less than once a week.

Table 2.29

Frequency of Feeder Bus Service Usage by Trip Purpose (Multi-Answer)

Trip Purpose \ Usage Per Week	0	1-3	4-5	6-8	9-10
To/From Work	75	15	2	31	8
To/From School	164	1	1	3	0
Part of Work	162	5	0	1	1
Personal Business	148	12	5	3	1
Shopping	122	40	5	2	0
Recreation	147	19	2	1	0
Social	127	30	8	4	0
Total	945	122	23	45	10

Trip Purpose \ Usage Per Week	11-	Total	Average 1/
To/From Work	38	169	5.5
To/From School	0	169	0.1
Part of Work	0	169	0.1
Personal Business	0	169	0.4
Shopping	0	169	0.6
Recreation	0	169	0.3
Social	0	169	0.7
Total	38	1183	1.1

1/ includes 0 time

4) Assessment of Feeder Bus Service

For the study, the surveyed PWD officials using feeder bus service were asked to give an assessment of the bus service, such as the condition of bus stops, bus interchange, and bus operation. The results of the are as follows:

a) Present Condition

Figures 2.4 and 2.5 show the existing condition of feeder bus service at bus stops.

Figure 2.4

Existing Condition of Feeder Bus Service
(Path to Bus Stop)

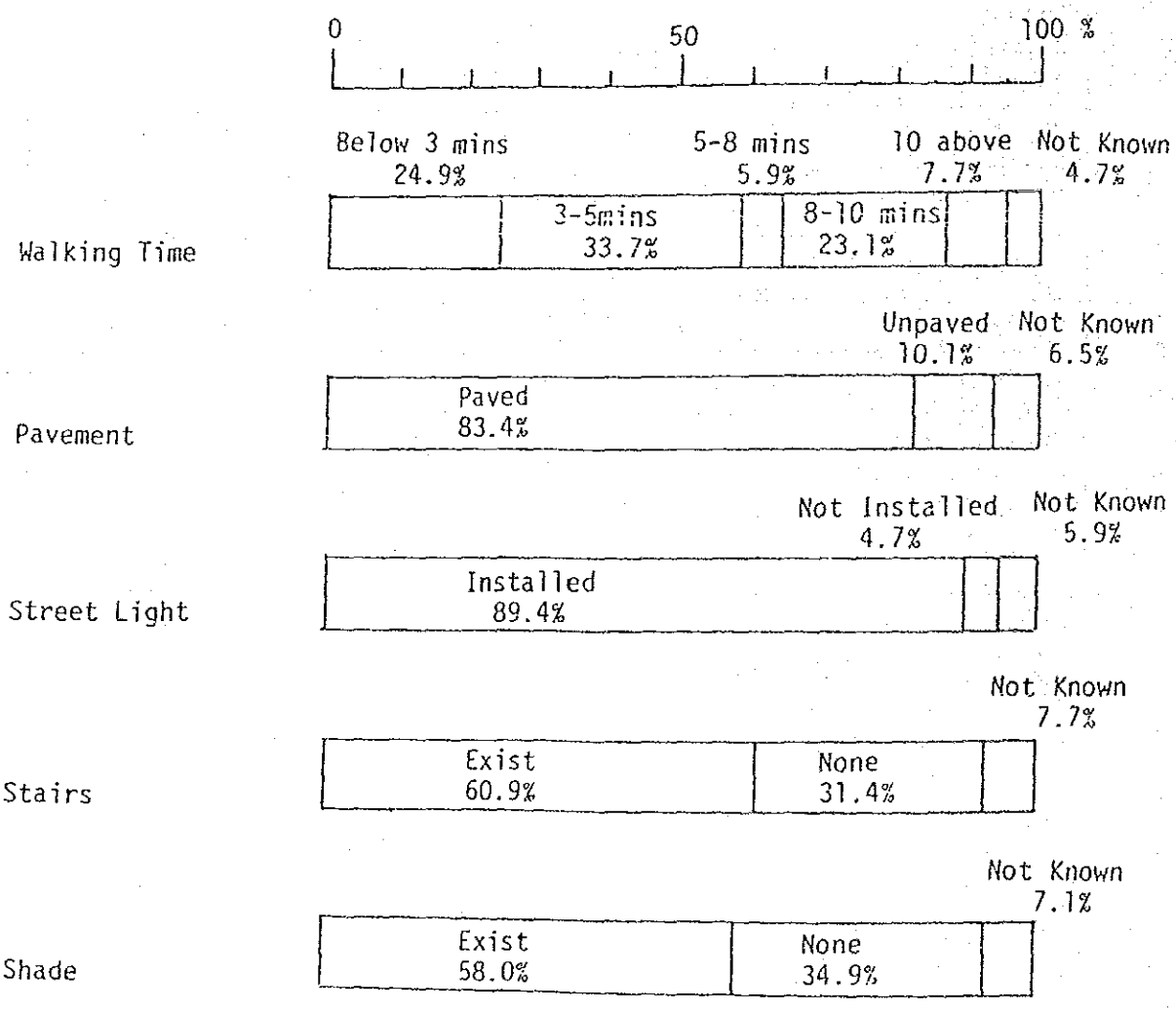
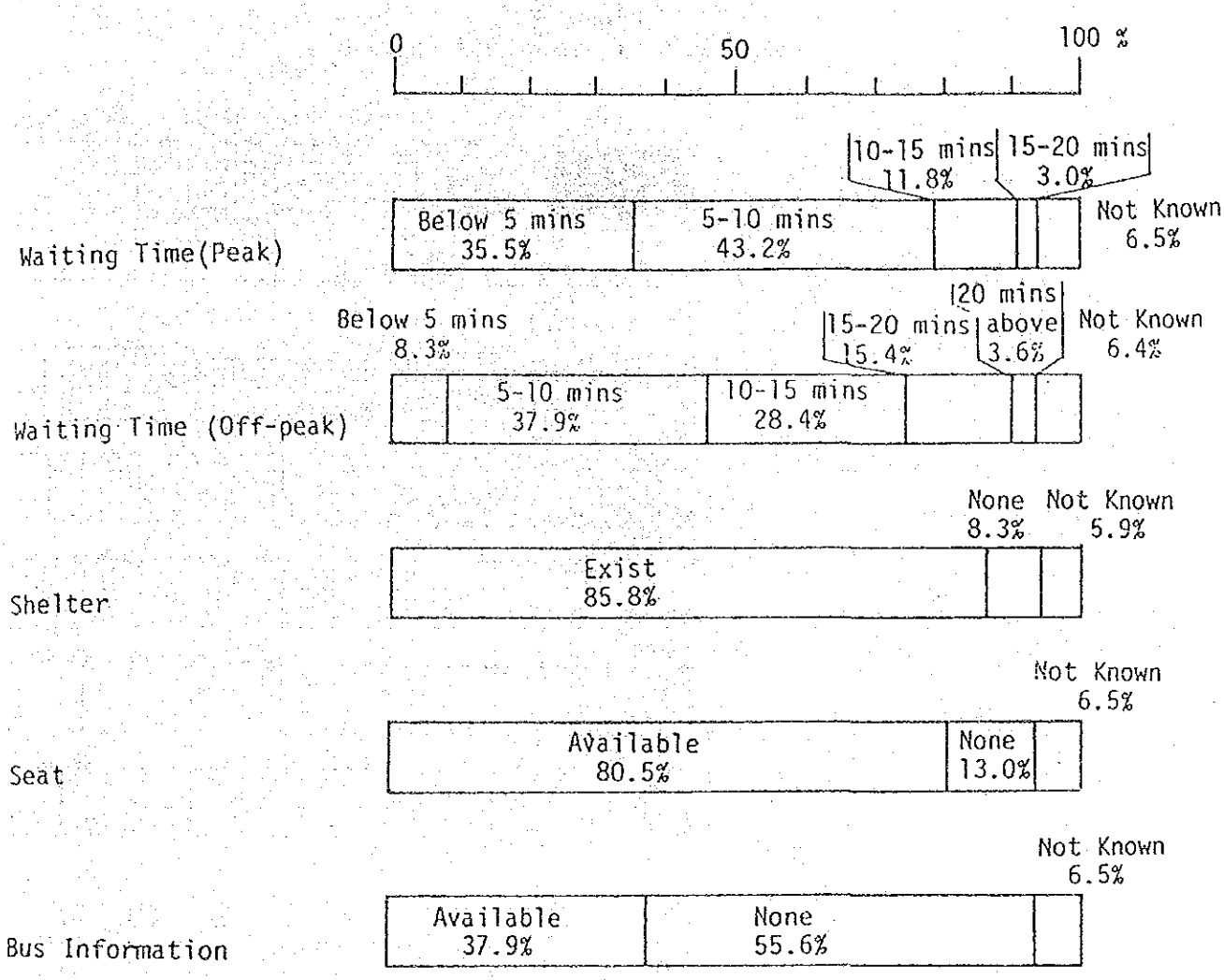


Figure 2.5

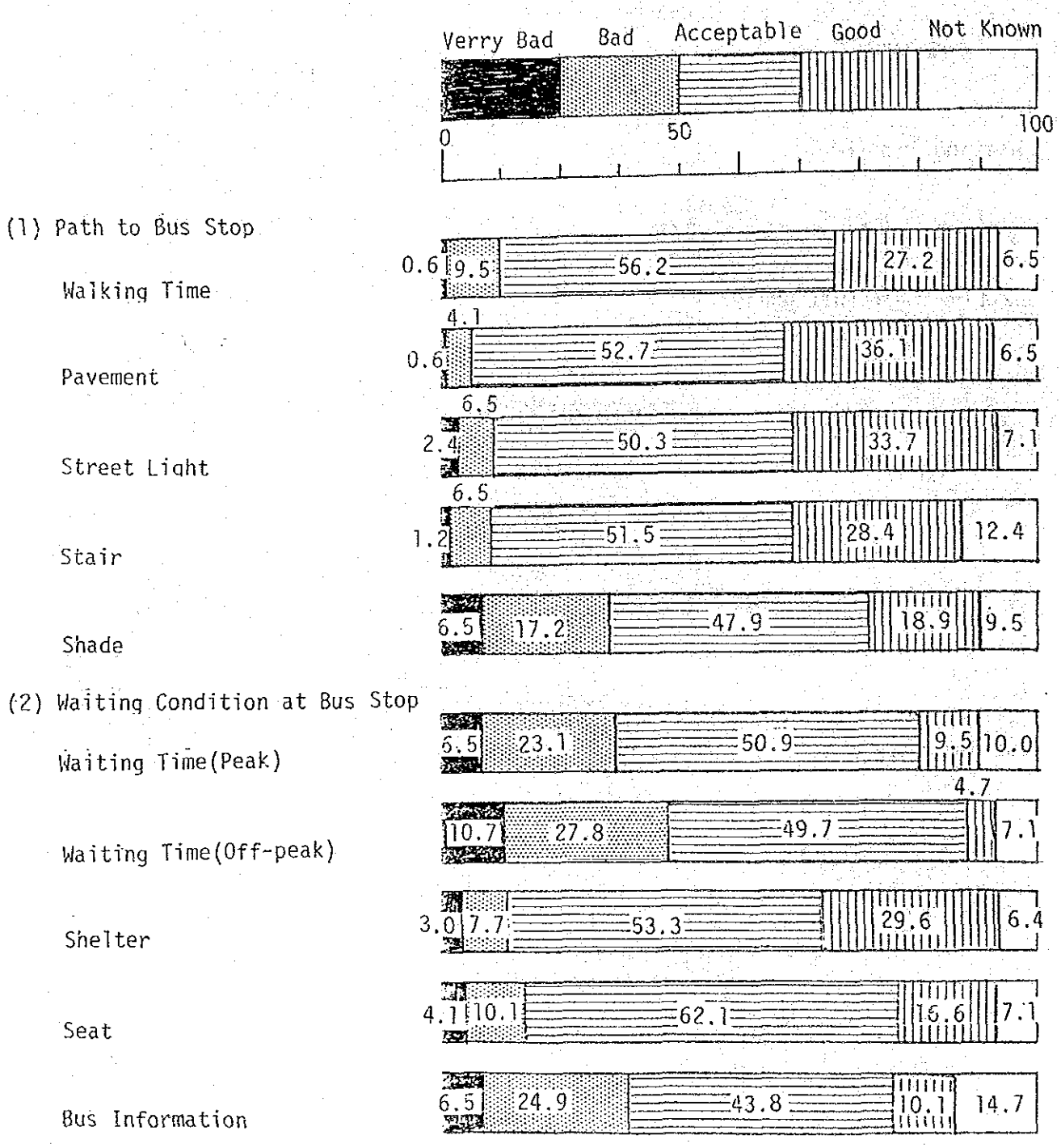
Existing Condition of Feeder Bus Services
(Waiting Condition at Bus Stop)

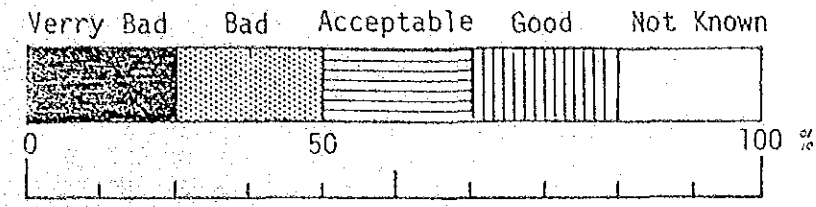


b) Assessment Ratings

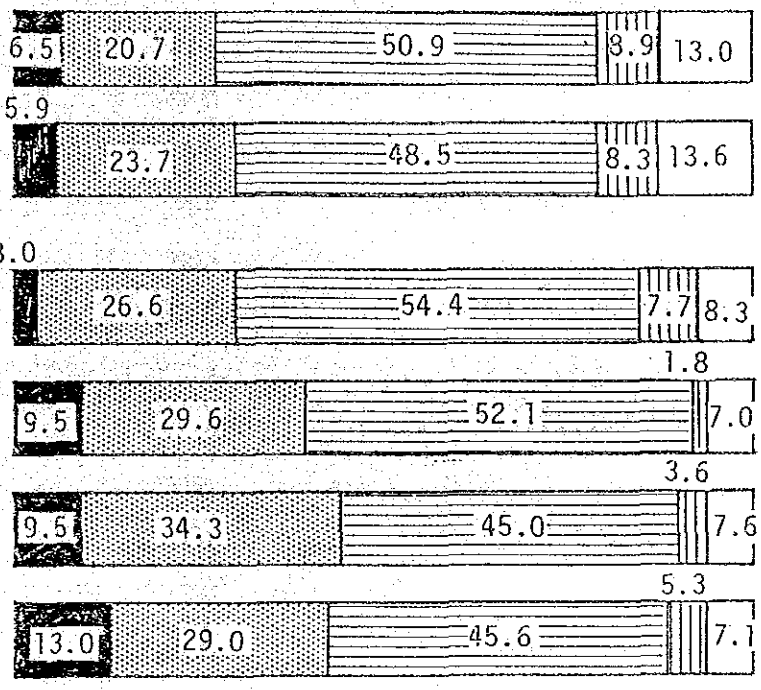
The assessment of feeder bus services is based on four criteria; namely, very bad, bad, acceptable and good. Figure 2.6 shows the assessment ratings.

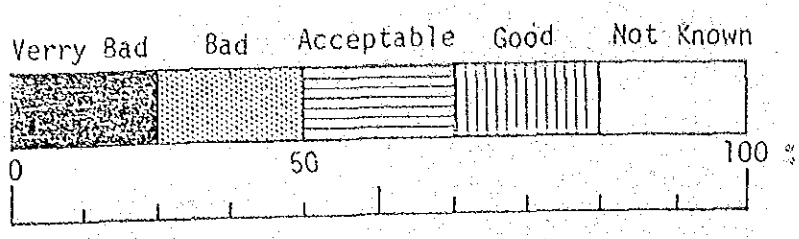
Figure 2.6
Assessment of Feeder Bus Service



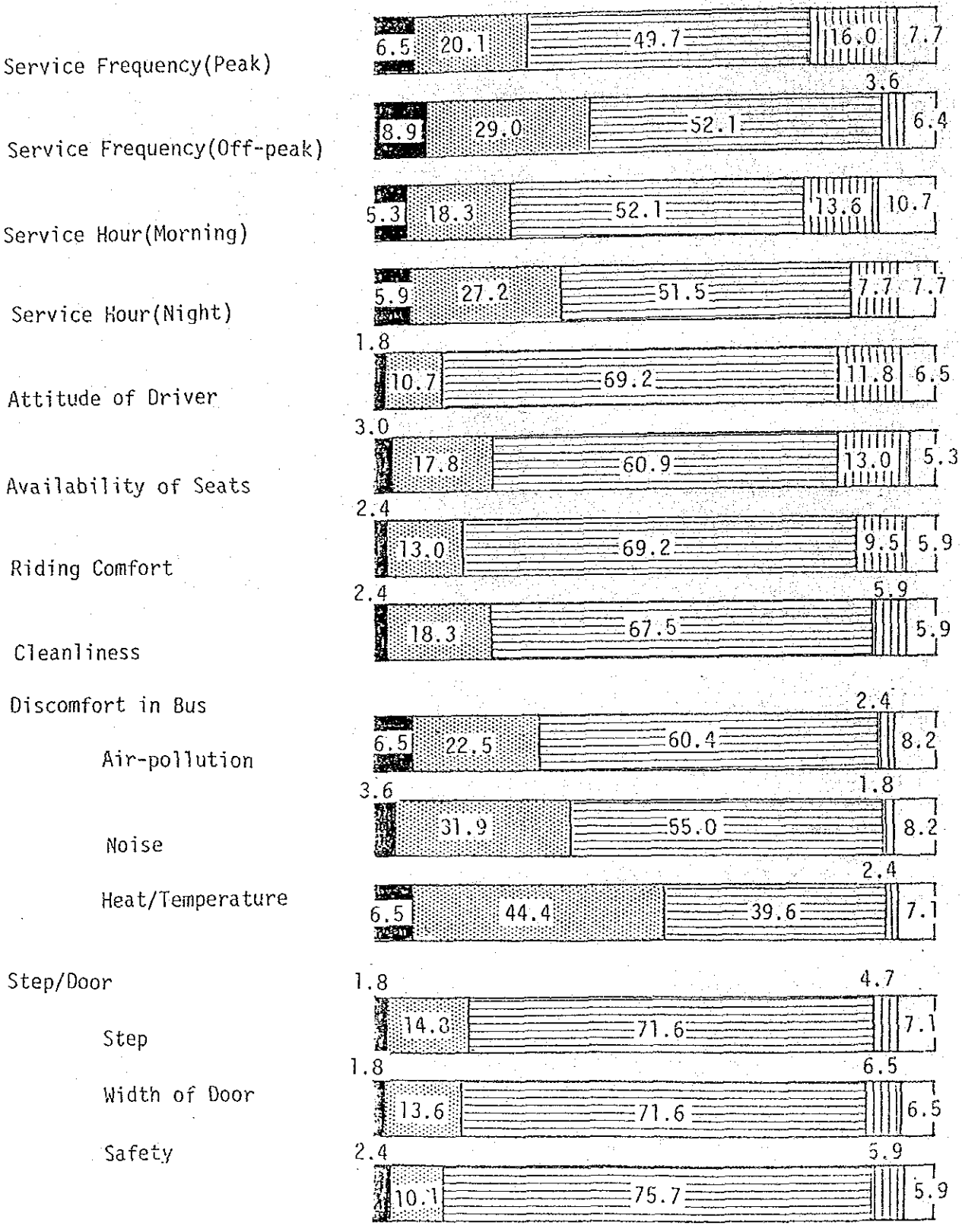


(3) Bus Interchange





(4) Feeder Bus Operation



2.2 1988 PWD OFFICIALS TRANSPORT SURVEY

2.2.1 Objectives

Due to the recent inauguration of the MRT, the travel pattern of the Singaporeans is considered to have changed considerably. In order to establish future transport strategy, this change needs to be checked and assessed. For this reason, a similar survey as the one conducted for PWD officials in 1987 was conducted on March 30, 1988.

The survey is intended to supplement the results of the limited HIS conducted in November 1987 and April/May 1988, also in the pre- and post-MRT context, which was conducted only for Ang Mo Kio residents. The PWD Officials survey covered the whole nation in terms of residence of the respondents; however, the number of samples is lesser.

2.2.2 Survey Methodology

1) Information Required

In the previous PWD Officials Transport Survey conducted in October 1987, a survey form similar to the HIS was used in order to obtain an overall information of trips made by PWD officials. Sufficient information has been extracted from the results of the survey, hence, the focus of the new survey dealt more in obtaining information on the use of the recently started MRT services and other ancillary trip information, including "Kiss and Ride" practice and feeder bus usage.

The following information was deemed necessary:

a) General Information

- Office Location
- Position
- Sex
- Age
- Home Address
- Vehicle Ownership
- Personal Income
- Household Income

b) Trip Information Between Home and Office

- Starting Time
- Finishing Time
- Mode of Travel
- Place of Transfer
- Waiting ime
- Travel Time

c) Trip Information During Office Hours

- Frequency
- Inside CBD or not
- Mode of Travel

d) Use of the MRT

- Previously Used Mode
- Reason for Using the MRT
- Evaluation of the MRT
- Evaluation of MRT Stations
- Potential Users

e) Impact of the MRT on Feeder Bus Services

f) "Kiss and Ride" Practice

- Frequency
- Place
- Change due to MRT

g) Car Use

- Frequency
- Purpose
- Perception on Car Expense
- Potential Users

2) Survey Design

Based on the above listed information required for planning purposes, survey forms were designed by the Study Team with the assistance of PWD counterpart staff. These are presented in Appendix 2.A.

2.2.3 Survey Implementation

1) Distribution of Survey Forms

Approximately 1,100 survey forms were distributed to PWD Officials in various branches of N.D. Building and SIA Building by PWD counterpart staff a few days prior to the targeted survey date of March 30, 1988. A letter requesting their cooperation was attached to each form.

2) Collection of Survey Forms

Similar to the distribution, the collection of survey forms was done also by PWD counterpart staff. By the end of the third week of April 1988, 370 filled out forms were returned. The rate of returned forms to the total distributed was about 34%.

3) Problems Encountered

The survey itself was no problem. However, the rate of returned forms (34%) was considered to be lower than expected (it was about 55% in the previous survey). This may be attributed to the following:

a) The survey questionnaires comprised 12 pages, which was much longer than the previous survey. Most of the PWD officials who did not answer were considered to have been discouraged with the lengthy form.

b) The second similar survey conducted in a relatively short period presumably made the respondents bored.

2.2.4 Coding and Data Processing

1) Coding/Editing of Survey Data

The returned forms were initially checked for logical errors. The possible errors were:

a) Inconsistency between "Postal Code" and "HDB New Town Name" where the residence is located.

b) Personal income is higher than that of household income.

c) Commuting trip starts with bus or MRT, neglecting walk trip to stop or station.

d) Inconsistency between destination name and type of transfer facility; that is, destination category for each unlinked trip.

e) Inconsistency between the previous travel mode to the MRT. The question relating to this appeared twice.

Most of the errors were corrected manually during the coding period. However, other errors or inconsistencies that were not detected or were detected but could not be corrected were left as they were. Although these errors might affect the accuracy of tabulation to some extent, no statistical problem was forseen due to the scarcity of detected errors. Moreover, the dubious samples were omitted from subsequent analysis.

2) Data Entry

The data edited and coded were stored in microcomputer diskettes using dBASE. Prior to data entry, a screen image that facilitates data input was designed by the built-in commands of dBASE.

3) Methodology of Data Processing

The data processing required to compile and analyze the results of this survey is two-fold: tabulation and analysis.

The former simply counts the number of samples by predetermined category for each specific question independently from the answers to other questions, while the latter does the same in relation to or in comparison with the answers to other questions. Hence, the former does not detect any logical error by itself and the latter automatically omits dubious answers by its nature..

For each data processing, a program was made in BASIC language. Due to the lengthy questions which branch out in several directions, the program became considerably long and it took six mandays for the systems analyst to make both programs.

2.2.5 Tabulation and Findings

1) Outline of Personal and Household Characteristics

About three-fourth of the samples were obtained from N.D. Building, as shown in Table 2.30.

The technicians make up 70% of the total, while the administrative and the professional groups constitute about 18% and 12%, respectively.

With regard to the sex of respondents, male share is slightly higher than female. Most of them belong to the age group of 30-39, followed by that of 20-29, then 40-49. No sample was obtained from the age group of "19 or less" and "60 and above"

Table 2.30

Outline of Respondents

	Number	%
Total No. of Samples	370	100
Office Location		
- N.D. Building	282	76
- SIA Building	88	24
Position		
- Professional	46	12
- Administrative	68	18
- Technical	256	70
Sex		
- Male	192	52
- Female	178	48
Age		
- 19 or less	0	0
- 20 - 28	118	31
- 30 - 39	189	51
- 40 - 49	36	10
- 50 - 59	12	3
- 60 and above	0	0
- No Answer	15	5
Average	33 years	

The home addresses of the respondents are scattered in the country, as shown in Table 2.31. About 59% live in HDB New Towns. Among the HDB New Towns, Bedok has the largest share (6.5%), followed by Hougang (5.6%), then Tampines (5.4%).

Table 2.31

Home Addresses of Respondents

Location	Number	%
HDB New Towns	218	58.7
Ang Mo Kio	19	5.1
Bedok	24	6.5
Bishan	10	2.7
Bukit Batok	19	5.1
Bukit Merah	9	2.4
Chua Chu Kang	0	0
Clementi	14	3.8
Geylang	14	3.8
Hougang	21	5.6
Jalan Besar	3	0.8
Jurong East	10	2.7
Jurong West	11	2.9
Pasir Ris	0	0
Queenstown	4	1.1
Serangoon	10	2.7
Tampines	20	5.4
Toa Payoh	13	3.5
Woodlands	6	1.6
Yishun	10	2.7
Bukit Panjang	1	0.3
Other Areas	152	41.3
Total	370	100.00

As presented in Table 2.32, about 45% own vehicle(s), 11% own a bicycle or motorcycle and 44% do not have any vehicle. It is noted that about 5% of the households own 2 or more cars.

Table 2.32

Household Vehicle Ownership

Type	Number	%
Non-Vehicle-Owning Household	203	54.9
- Without Any Vehicle	162	43.8
- Bicycle Only	10	2.7
- Motorcycle Only	31	8.4
Vehicle-Owning Household	167	45.1
- One Car	146	39.5
- More than One Car	18	4.9
- Other Vehicles	3	0.8
Total	370	100.0

Table 2.33 shows the distribution of personal income of the respondents in comparison with household income. From the table, it is deduced that majority of the respondents belong to the middle-income group.

Table 2.33

Personal Income and Household Income

Income Range (S$/month)	Distribution of Personal Income	%	Household Income	%
Below 1,000	110	29.7	42	11.4
1.001 - 1,500	119	32.2	55	14.9
1,501 - 2,000	62	16.8	48	13.0
2,001 - 3,000	42	11.4	69	18.6
3,001 - 4,000	24	6.5	68	18.4
4,001 - 5,000	10	2.7	40	10.8
5,001 - 6,000	2	0.5	18	4.9
Above 6,001	1	0.3	30	8.1
Total	370	100.0	370	100.0
Average Income (S$/month)	1.598	-	2.889	-

2) Characteristics of Morning Commuting Trips

As seen from Table 2.34, the peak hour for leaving home is from 7:01 - 8:00, and for arriving at the office, 7:31 - 8:30. This is most probable judging from the working hours. By 9:00 a.m. most of the staff are in the office.

Table 2.34

Distribution of Starting/Finishing Time of Morning Commuting Trips

Time	Number (Start)	%	Number (Arrival)	%
7:00	73	19.8	1	0.3
7:01 - 7:30	149	40.5	39	10.6
7:31 - 8:00	130	35.3	91	24.7
8:01 - 8:30	13	3.5	219	59.5
8:31 - 9:00	1	0.3	12	3.3
9:01 - 9:30	0	-	1	0.3
9:31 - 10:00	0	-	0	-
10-01 -	2	0.5	5	1.4
Total	368	100.0	368	100.0

Table 2.35 shows the distribution of total travel time of morning commuting trips. Most of the respondents take 16-45 minutes to reach their offices. Those who take more than one hour constitute about 16%.

Table 2.35

Distribution of Total Travel Time
of Morning Commuting Trips

Total Travel Time (Minutes)	Number	%
- 15	20	5.4
16 - 30	117	31.8
31 - 45	112	30.4
46 - 60	61	16.6
61 - 75	37	10.1
76 - 90	16	4.3
91 - 120	2	0.5
121 -	3	0.8
Total	368	100.0
Average Travel Time	42 minutes	

Out of a total of 357 respondents for this question, 10 or 2.8% answered "have gone to their offices directly by walking."

Table 2.36 shows the modal share of representative mode of travel made by 317 PWD officials (excluding those who walked all the way) for the morning commuting trips.

Table 2.36

Modal Share of Morning Commuting Trips
by Representative Mode of Travel

Representative Mode	Number of Samples	%
Bicycle/Motorcycle	18	5.7
Car	92	29.0
Car pool	18	5.7
MRT	31	9.8
SBS/TIBS Bus	157	49.5
Others	1	0.3
Total	317	100.0

Table 2.37 shows that the total number of unlinked trips made by 360 PWD officials (excluding those who walked all the way) is 967. Hence, the average number of unlinked trips is calculated at 2.7, indicating that the average number of mode transfer is 1.7, when PWD officials go to their office in the morning.

Table 2.37

Modal Share of Morning Commuting Trips in Terms of Unlinked Trips

Type	Number of Unlinked Trips	%
Walk	517	53.5
Bicycle	1	0.1
Motorcycle	19	2.0
Car	145	15.0
Car-pool	26	2.7
Taxi	0	-
MRT	48	5.0
SBS/TIBS Bus	157	16.2
Scheme B or CSS	24	2.5
Other Bus	27	2.8
Others	1	0.1
Not Known	2	0.2
Total	967	100.0

Table 2.38 shows the distribution of waiting time when travel mode was changed. Around 68% of PWD officials did not wait more than 6 minutes. Average waiting time for public transport is about six minutes.

Table 2.38

Distribution of Waiting Time at Transfer Points in Morning Commuting Trips

Waiting (Minutes)	Number	%
1 - 3	60	21.3
4 - 5	131	46.5
6 - 10	73	25.9
11 - 15	16	5.7
16 - 20	0	-
21 - 30	1	0.4
31 -	1	0.4
Total	282	100.0
Average Waiting Time	6 minutes	-

Table 2.39 shows the transfer matrix between modes. Among the transfers made between motorized modes of travel, "SBS/TIBS Bus" to "SBS/TIBS Bus" and "Car/Car Pool" to "Car/Car-pool" are practiced relatively frequently. However, transfers between "MRT" and "SBS/TIBS Bus" are not as often as has been previously predicted.

Table 2.39

Transfer Matrix between Modes in Morning Commuting Trips

Mode	Bicycle Motor-cycle	Car/ Car-pool	MRT	SBS/ TIBS Bus	Scheme B CSS/Other Bus	Total
Bicycle/ Motorcycle	-	-	-	-	-	-
Car/Car-pool	-	23	6	7	4	40
MRT	-	-	-	1	-	1
SBS/TIBS Bus	-	2	4	36	1	43
Scheme/CSS/ Other Bus	-	-	-	-	-	-
Total	-	25	10	44	5	84

3) Characteristics of Evening Return Trips

Out of 370 respondents, 281 or 75.9% answered "have gone home directly from their offices."

Table 2.40 indicates that more than 90% of the officials leave their offices by 17:30 and arrive home by 18:30. The total travel time of those who go home directly is presented in Table 2.41. This is almost comparable to the "go to work" trip.

Table 2.40

Distribution of Start/Arrival Time of Evening Return Trips

Time	Number (Start)	%	Number (Arrival)	%
16:00	2	0.7	2	0.7
16:01 - 16:30	41	14.6	0	-
16:31 - 17:00	98	34.9	11	3.9
17:01 - 17:30	114	40.6	70	24.9
17:31 - 18:00	20	7.1	119	42.3
18:01 - 18:30	5	1.8	56	19.9
18:31 - 19:00	1	0.4	18	6.4
19:01 - 19:30	0	-	4	1.4
19:31 - 20:00	0	-	1	0.4
20:01 -	0	-	0	-
Total	281	100.0	281	100.0

Table 2.41

Distribution of Total Travel Time of Evening Return Trips

Total Travel Time (min)	Number	%
10 - 15	11	3.9
16 - 30	72	25.6
31 - 45	82	29.2
46 - 60	59	21.0
61 - 75	29	10.3
76 - 90	17	6.0
91 -120	11	2.9
121 -	0	-
Total	281	100.00
Average Travel Time	47 minutes	

Out of the 281 respondents, 8 or 2.8% answered "have gone home directly by walking." An overwhelming majority of PWD officials use transport means other than "walking only", which is comparable to the morning trips.

Table 2.42 shows the share of representative mode of travel made by 241 PWD officials (excluding those who do not go home directly and those who go home directly only by walking). The share of car and car-pool trips decreased compared with those of morning commuting trips.

Table 2.42

Modal Share of Evening Commuting Trips
by Representative Mode of Travel

Representative Mode	No. of Samples	%
Bicycle/Motorcycle	18	7.5
Car	50	20.7
Car-pool	3	1.2
MRT	41	17.0
SBS/TIBS Bus	129	53.5
Others	0	0.0
Total	241	100.0

Table 2.43 shows that the total number of unlinked trips made by 273 PWD Officials (excluding those who do not go home directly and those who go home directly only by walking) is 729. Hence, the average number of unlinked trips per person is 2.7 and the average number of transfers is 1.7. This is the same as the morning trips.

Table 2.43
Modal Share of Evening Return Trips
in Terms of Unlinked Trips

Mode	Number of Unlinked Trips	%
Walk	419	57.5
Bicycle	0	-
Motorcycle	18	2.5
Car	65	8.9
Car-Pool	3	0.4
Taxi	0	-
MRT	43	5.9
SBS/TIBS Bus	131	18.0
Scheme B or CSS	27	3.7
Other Bus	21	2.9
Others	1	0.1
Not Known	1	0.1
Total	739	100.0

Table 2.44 shows the distribution of waiting time when travel mode was changed. Although the tendency is the same as the morning trips, the distribution seems to have shifted slightly to the longer side.

Table 2.44

Distribution of Waiting Time at Transfer
Points in Evening Return Trips

Waiting Time (Minutes)	Number	%
1 - 3	35	15.8
4 - 5	98	44.3
6 - 10	73	33.0
11 - 15	11	5.0
16 - 20	3	1.4
21 - 30	1	0.5
31 -	0	-
Total	221	100.0
Average Waiting Time	7 minutes	

Table 2.45 shows the transfer matrix between modes. It is noteworthy that the transfers made considerably often in the morning trips between "Car/Car-pool" and "Car/Car-pool" have almost disappeared in the evening trips.

Table 2.45

Transfer Matrix between Modes in Evening Return Trips

	Bicycle Motorcycle	Car/ Car-pool	MRT	SBS/ TIBS Bus	Scheme B CSS/Other Bus	Total
Bicycle/ Motorcycle	0	0	0	0	0	0
Car/Car-pool	0	1	0	0	0	1
MRT	0	1	0	3	0	4
SBS/TIBS Bus						
Bus	0	1	0	25	0	26
Scheme/CSS /Other Bus	0	1	0	3	0	4
Total	0	4	0	31	0	35

4) Trips During Office Hours

Frequency, purpose, and mode of trips made during office hours by PWD Officials were surveyed. In the questionnaire, nearly three-fourths of the respondents answered that they do not make any trip during office hours. The following tabulations are of the 98 respondents (26.5%) who answered to making trips during office hours.

Table 2.46 shows that majority of trips are those within CBD but trips going outside CDB are made as well.

Table 2.46

Trip Frequency of PWD Officials During Office Hours (98 Respondents)

	No. of Persons by Trip Frequency							
	Number of Times							Average Number
Type of Trips	1	2	3	4	5	6	Total	of Times
Outside CBD	32	7	1	2	3	5	50	2.2
Within CDB	42	16	0	1	1	3	63	1.7

With regard to the in-CBD trips, Table 2.47 shows trip purpose distribution and Table 2.48, modal shares in terms of unlinked trips. Judging from these tables, most of the in-CBD trips are made for "eating/social" and "part of work" purposes within a walking radius. However, the "eating/social" trips might be underrated considering the usual practice of office workers to go out for lunch.

Table 2.47

Purposes of In-CBD Trips Made During Office Hours

	No. of Persons by Trip Frequency							
	Number of Times							Average Number
Type of Trips	1	2	3	4	5	6	Total	of Times
Part of Work	17	4	0	0	1	2	24	1.8
Personal Business	2	0	0	0	0	0	2	1.0
Shopping	4	0	0	0	0	0	4	1.0
Eating/Social	33	5	0	1	0	0	39	1.2
Recreation	0	0	0	0	0	0	0	-
Others	2	0	0	0	0	0	2	1.0

Table 2.48

Modal Share of In-CBD Trips Made During Office Hours in Terms of Unlinked Trip

Mode	Number of Trips	%
Walk Only	135	72.6
Bicycle	0	-
Motorcycle	12	6.5
Car	24	12.9
Taxi	0	-
MRT	9	4.8
SBS/TIBS Bus	6	3.2
Other Bus	0	-
Total	186	100.0

5) MRT Trips

For the present MRT users, their previous mode of transport used before the MRT was surveyed. Table 2.49 shows that most of the regular users of the MRT were previously SBS/TIBS bus users. Diversion of usage from car (10%) and Scheme B bus (8%) is also seen.

Table 2.49

Transport Mode Previously Used by Present MRT Users

Previous Mode	Number	%
Walk Only	1	1.2
Bicycle	0	-
Motorcycle	1	1.2
Car	8	9.6
Taxi	0	-
Car-Pool	3	3.6
SBS/TIBS Bus	59	71.1
Scheme B Bus	7	8.4
Other Bus	4	4.8
Others	0	-
Total	83	100.0

Note: Number of regular users of MRT is 72

The reasons given for starting to ride the MRT are "decreased travel time", "increased reliability" and "increased punctuality" in spite of "increased fare" and "increased walking distance", as shown in Table 2.50.

Table 2.50

Reasons of Diversion to the MRT

(No. of Samples)

	Decreased	Same	Increased	No Answer	Total
Travel Time	56	12	2	2	72
Fare	6	7	52	7	72
Punctuality	2	18	44	8	72
Walking Distance	9	26	27	10	72
Reliability	0	17	49	6	72

Out of 72 regular users of the MRT, 53 or 74% answered that they also use it for purposes other than commuting, as presented in Table 2.51.

Table 2.51

Frequency and Purpose of MRT Utilization
(Excluding Commuting)

Purpose	Frequency of Utilization (Per Week)					
	5-7 days	3-4 days	1-2 days	Seldom	Not at all	Total
Part of Work	7	4	5	7	5	28
Personal Business	1	2	8	7	5	23
Shopping	1	3	26	11	1	42
Eating/Social	0	2	21	6	5	34
Others	1	0	8	7	5	21

6) Evaluation of the MRT by its Users

In general, MRT users appreciate the MRT in terms of "cleanliness", "service frequency", "riding comfort", "noise", "safety of travel" and "service hours". However, for "availability of seats" during peak hours, the users are not satisfied, as shown in Table 2.52.

Table 2.52

Evaluation of MRT by Users

No. of Sampes (%)

Item		Much Better	Better	Same	Worse	Much Worse	Answer	Total
Service Freqency	a) Peak Hour	37 (51.4)	25 (34.7)	9 (12.5)	0 (-)	0 (-)	1 (1.4)	72 (100.0)
	b) Off Hour	25 (34.7)	30 (41.7)	13 (18.1)	2 (2.8)	0 (-)	2 (2.8)	72 (100.0)
Service Hour	a) Morning	16 (22.2)	31 (43.1)	22 (30.6)	1 (1.4)	0 (-)	2 (2.8)	72 (100.0)
	b) Night	16 (22.2)	28 (38.9)	22 (30.6)	3 (4.2)	0 (-)	3 (4.2)	72 (100.0)
Availability of Seats	a) Peak Hour	6 (8.3)	14 (19.4)	20 (27.8)	28 (38.9)	4 (5.6)	0 (-)	72 (100.0)
	b) Off Hour	10 (13.9)	23 (31.9)	26 (36.1)	8 (11.1)	3 (4.2)	2 (2.8)	72 (100.0)
Riding Comfort		36 (50.0)	27 (37.5)	4 (5.6)	5 (6.9)	0 (-)	0 (-)	72 (100.0)
Cleanliness		41 (56.9)	26 (36.1)	4 (5.6)	1 (1.4)	0 (-)	0 (-)	72 (100.0)
Noise		18 (25.0)	36 (50.0)	11 (15.3)	7 (9.7)	0 (-)	0 (-)	72 (100.0)
Safety of Travel		24 (33.3)	30 (41.7)	15 (20.8)	3 (4.2)	0 (-)	0 (-)	72 (100.0)

7) Evaluation of MRT Station by Its Users

Firstly, the distribution of walking distance between home and the nearest MRT station was tabulated as shown in Table 2.53. Nearly half of MRT users directly walk to MRT stations. However, the walking distance is long; about 60% have to walk more than 300 meters.

Table 2.53

Distribution of Walking Distance Between Home and Its Nearest MRT Station

Walking Distance to MRT Station (M)	Number	%
1 - 100	3	8.8
101 - 200	7	20.6
201 - 300	3	8.8
301 - 400	3	8.8
401 - 500	8	23.5
501 -	10	29.4
Subtotal	34	100.0
Not Known/Do Not Walk	38	
Total	72	100.0
Average Walking Distance 704.5 meters		

Table 2.54 indicates the evaluation of MRT stations. Interchange between bus and MRT seems to be well planned while car users require improvement of MRT stations for parking/stopping cars.

Table 2.54

Evaluation of MRT Station Nearest to Home in Terms of Accessibility

		Bad	Acceptable	Good	Total
Walking between Home and MRT Station	- Distance	13 (30.2)	15 (34.9)	15 (34.9)	43 (100.0)
	- Condition	10 (23.8)	24 (57.1)	8 (19.0)	42 (100.0)
	- Location of entrance/ exit of MRT Station	3 (7.1)	30 (71.4)	9 (21.4)	42 (100.0)
Walking between Bus and MRT Station	- Distance	5 (10.6)	13 (27.7)	29 (61.7)	47 (100.0)
	- Condition	3 (6.4)	31 (66.0)	13 (27.7)	37 (100.0)
	- Waiting condition of bus	14 (29.8)	28 (59.6)	5 (10.6)	47 (100.0)
	- Location of bus stop	8 (17.0)	33 (70.2)	6 (12.8)	47 (100.0)
Car Use between Home and MRT Station	Parking at MRT Station	11 (55.0)	9 (45.0)	0 (-)	20 (100.0)
	Facilities of MRT Sta.	16 (80.0)	4 (20.0)	0 (-)	20 (100.0)

Table 2.55 shows the evaluation of the Tanjong Pagar MRT Station, which is the nearest to PWD offices. The station seems to be conveniently located.

Table 2.55

Evaluation of the Tanjong Pagar Station in Terms of Accessibility

		Bad/ Insufficient	Good/ Acceptable	Sufficient	Total
Walking between Office and MRT Station	- Distance	1 (1.5)	17 (25.8)	48 (72.7)	66 (100.0)
	- Condition	4 (6.2)	43 (66.2)	18 (27.7)	65 (100.0)
	- No. of Entrance/ Exit	2 (3.1)	62 (96.9)	0 (-)	64 (100.0)
	- Location of Entrance/Exit	3 (4.8)	36 (57.1)	24 (38.1)	63 (100.0)

8) Impact of the MRT on Non-MRT Users

Although the impact of the MRT on the travel patterns of those who do not regularly use the MRT was asked, most of them are not affected by the MRT operation, judging from Table 2.56.

Table 2.56

Travel Pattern Changes of Non-MRT Users due to the MRT

Change of Travel Pattern	Number	%
Considerably	7	2.3
A little	38	12.5
Not at all	259	85.2
Total	304	100.0

On the other hand, the possibility of using the MRT regularly was asked of non-MRT users. The result is presented in Table 2.57. Judging from the table, about 21% of those who do not regularly use the MRT consider it possible to shift to the MRT, and 45% also consider it possible though not convenient.

Table 2.57

Possibility of Using the MRT Regularly
by Non-MRT Users

Possibility	Number	%
- Yes	63	20.7
- Yes, but not so convenient	137	45.1
- Not at all	104	34.2
Total	304	100.0

Table 2.58 presents the reason for not using the MRT by these potential MRT users. The biggest reason is the bad access to MRT stations, followed by the inconvenient coverage of the MRT service, then by high fare.

Table 2.58

Reasons of Not Using MRT
of Potential MRT Users

Reason for Not Using MRT	Number	%
Too far away	93	49.2
Expensive	21	11.1
Longer travel time	8	4.2
Dislike MRT	2	1.1
Not cover area	49	25.9
Others	16	8.5
Total	189	100.0

Table 2.59 shows the percentage of those who have ridden the MRT and those who hope for the MRT to be extended to cover their area.

Table 2.59
Number of Persons Who Have Experienced Riding the MRT and Those who Hope for MRT Service in their Area

	Experience of Riding MRT		Hope for Extending MRT Service	
	No.	%	No.	%
Yes	272	89.5	266	87.5
No	32	10.5	38	12.5
Total	304	100.0	304	100.0

9) Impact of the MRT on Feeder Bus

Table 2.60 shows the respondents' perception of the change in feeder bus operation due to the MRT. Most of them do not notice any change in feeder bus operation.

Table 2.60

Perceived Change in Feeder Bus Operation

Change	Number	%
Considerably	9	2.4
Slightly	24	6.5
Not at all	235	63.5
No Answer	102	27.6
Total	370	100.0

For the 33 respondents who noticed a change, it was asked in which aspect the service changed and whether the service level became better or worse. The results are shown in Tables 2.61 and 2.62.

The impact of the MRT on feeder bus service is slight as a whole. But the impact took place mainly in the route structure of feeder bus services and about 1/3 of those who noticed the change claimed that the feeder bus service became worse.

Table 2.61

Perceived Change in Feeder Bus Service Due to MRT

Service Changed	Number	%
Route	20	60.6
Operating Hours	4	12.1
Others	3	9.1
No Answer	3	9.1
Total	33	100.0

Table 2.62

Perceived Change in Service Level of Feeder Bus Due to MRT

Change in Service Level	Number	%
Not at all	12	36.4
Become Worse	10	30.3
Become Better	7	21.2
No Answer	4	12.1
Total	33	100.0

10) "Kiss and Ride" with the MRT

About 22% (75 out of 370) practice "Kiss and Ride", but 48% seldom do it. The practice is mainly for "to/from work" trip and the car is driven mostly by other family members. These are shown in Table 2.63.

Table 2.63

Practice of "Kiss and Ride"

		Number	%
Frequency	5-7 days/week	26	24.7
	3-4 days/week	5	6.7
	1-2 days/week	6	8.0
	Seldom	36	48.0
	No Answer	2	2.7
Purpose	To/from work	44	58.7
	Others	26	34.7
	No Answer	5	6.7
Driver	Family Member	46	61.3
	Friend	12	16.0
	Neighbors	2	2.7
	Others	10	13.3
	No Answer	5	6.7
	Total	75	100.0

As a pick-up/drop-off point of "Kiss and Ride", the MRT station has already become as popular as the bus stop/interchange, as evidenced in Table 2.64.

Table 2.64

Pick-up/Drop-off Point of "Kiss and Ride"

	Number	%
MRT Station	12	16.0
Bus Stop/Interchange	17	22.7
Other Place	16	21.3
No Answer	30	40.0
Total	75	100.0

11) Car Utilization and Potential Car Ownership

Most of those who belong to car-owning households use the car everyday, as shown in Table 2.65.

Table 2.65

Frequency of Car Use

	No. of Samples (%)						
	5-7 day	3-4 day	1-2 day	Seldom	Not at all	No Answer	Total
Yourself	88 (53.7)	7 (4.3)	5 (3.0)	9 (5.5)	14 (8.5)	41 (25.0)	164 (100.0)
Household Head	60 (36.6)	9 (5.5)	4 (2.4)	2 (1.2)	14 (8.5)	75 (45.7)	164 (100.0)
Other Family Member	31 (18.9)	4 (2.4)	8 (4.9)	10 (6.1)	23 (14.0)	88 (53.7)	164 (100.0)

Most car-owning households have at least one or two driving licenses. It is noteworthy that about 18% have 3 or more licenses, as shown in Table 2.66.

Table 2.66

No. of Driving Licenses per Household

No. of Driving Licenses/Household	Number	%
0	7	4.3
1	51	31.1
2	76	46.3
3	16	9.8
4	8	4.9
5	6	3.7
Total	164	100.0

Cars are used mainly for daily commuting and weekly shopping/eating/social purposes, as presented in Table 2.67.

Table 2.67

Car Use Frequency by Purpose

	5-7 days	3-4 days	1-2 days	Seldom	Not at all	Total
To/From Work	95.3	2.7	0	0.7	1.3	100.0
To/From School	29.2	7.7	10.8	12.3	40.0	100.0
Part of Work	42.7	14.7	24.0	2.7	16.0	100.0
Personal Business	24.0	18.7	22.7	17.3	17.3	100.0
Shopping	12.5	11.5	57.3	15.6	3.1	100.0
Eating /Social	14.4	18.6	49.5	14.4	3.1	100.0
Others	20.3	14.1	29.7	26.6	9.4	100.0

The cost of owning and using cars, in most cases, constitute less than 20% of the total household expenditure. But nearly 10% spend more than 30%, as presented in Table 2.68.

Table 2.68

Cost of Owning/Using Cars

Expenditure in % to the Total Household Expenditure	Number	%
Less than 10%	41	25.0
10.1% to 15%	61	37.2
15.1% to 20%	20	12.2
20.1% to 25%	15	9.1
25.1% to 30%	10	6.1
30.1% and over	15	9.1
No Answer	2	1.2
Total	164	100.0

Nearly 10% of car-owning households considered car expenses to be a heavy financial burden. It is roughly deduced that if expenses on cars exceed 30% of the total household expenditure, it will become a heavy burden to households. The table below shows the perception of the respondents on car expenses.

Table 2.69

Perception on Car Expenses

Financial Burden	Number	%
Yes, very much	16	9.8
Yes, but not much	86	52.4
Not at all	57	34.8
No answer	5	3.0
Total	164	100.0

On the other hand, the reason for not owning cars was asked to non-car owning households. The major reason given is financial constraints. It is noted, however, that 18% consider it unnecessary to have a car.

Table 2.70

Reasons for Not Owning a Car

Reason for not Owning a Car	Number	%
Too expensive to own	158	43.8
Too expensive to use	121	33.5
Not necessary	66	18.3
No car park	8	2.2
Others	8	2.2
Total	361	100.0

Also for non-car-owning households, a hypothetical question was asked: if they own a car, for what purpose will they use it? Table 2.71 summarizes the result and the first likely use is "to/from work", followed by "family activities". This is quite consistent with Table 2.72.

Table 2.71

Possible Use of Car by Non-Car-Owning Households

Purpose	Number	%
To/From Work	136	72.3
To/From School	1	0.5
Family Activities	36	19.1
Private Business	6	3.2
Others	9	4.8
Total	188	100.0

12) Perception on Walking Distance/Time

In order to test the perception of PWD officials on walking distance/time, several questions were prepared. Table 2.72 shows the perception on walking distance of some typical sections that were supposed to be well-known among them. Most PWD Officials think it easy to walk the distance among SIA Building, MND Building and Tanjong Pagar MRT Station. Between CK Tang and Centerpoint, however, about one-fourth feel it is too long to walk.

Table 2.72

Perception on Walking Distance for Selected Sections

Section	No Problem	Tolerate	Too Long	Total
SIA - Tanjong Pagar (300m)	300 (81.7)	62 (16.9)	5 (1.4)	367 (100.0)
MND - Tanjong Pagar (600m)	303 (82.6)	62 (16.9)	2 (0.5)	367 (100.0)
SIA - MND (800m)	270 (73.8)	86 (23.5)	10 (2.7)	366 (100.0)
CK Tang - Centerpoint (1,700m)	131 (35.8)	148 (40.4)	87 (23.8)	366 (100.0)

For the same sections listed in Table 2.72, the perception on walking condition was asked. Most of the respondents consider it good or acceptable, as shown in Table 2.73.

Table 2.73

Perception on Walking Condition for Selected Sections

Section	Good	Acceptable	Bad	Total
SIA - Tanjong Pagar	151 (40.9)	207 (56.1)	11 (3.0)	369 (100.0)
MND - Tanjong Pagar	147 (39.9)	204 (55.4)	17 (4.6)	368 (100.0)
SIA - MND	120 (32.7)	225 (61.3)	22 (6.0)	367 (100.0)
CK Tang - Centerpoint	121 (33.1)	203 (55.5)	42 (11.5)	366 (100.0)

As seen in Table 2.74, the respondents have a stronger perception of time rather than distance. When walking time is less than 10 minutes, most people do not mind walking. Especially when it is less than 5 minutes, more than 98% do not care. However, if walking time is more than 20 minutes, more than one-half do not want to walk.

Table 2.74

Perception of Walking Distance/Time

		do not mind at all	willing to walk everyday	do not want to walk
Distance (m)	1 - 100	38	25	2
	101 - 200	19	23	10
	201 - 300	11	9	6
	301 - 400	6	7	9
	401 - 500	10	15	12
	501 - 600	0	1	5
	601 - 700	1	1	1
	701 - 800	1	2	0
	801 - 900	0	0	4
	901 - 1000	7	4	26
	1001 -	6	8	17
	No Answer	270	274	277
	Average Walking Distance	417.7 m	438.5 m	1021.5m
Time (Mins)	1 - 3	25	16	2
	4 - 5	142	91	7
	6 - 10	119	114	54
	11 - 15	32	61	64
	16 - 20	12	35	67
	21 - 30	7	23	100
	31 -	5	4	45
	No Answer	27	25	30
	Average Walking Time	9.3 min.	11.8 min	24.4 min.
	Total	369	369	369

The most influential factor on walking distance/time is weather, followed by "climbing up and down the stairs", "shade" and "environmental condition", as presented in Table 2.75.

Table 2.75

Influence Factors on Walking Distance/Time

Factor	Number	%
Weather	327	30.4
Trip Purpose	75	7.0
Physical Condition	61	5.7
Environmental Condition	137	12.7
Shade	149	13.8
With or Without Companion	39	3.6
Street Lighting	38	3.5
Climbing Up and Down Stairs	156	14.5
Adequancy of Pedestrian Road	65	6.0
Street Scape	30	2.8
Total	1,077	100.0

For most of the pedestrian facilities in the CBD, the assessment of PWD Officials is "acceptable" or "good". Especially, tiled walkway and malls are considerably appreciated. On the other hand, overhead bridges, foot path and traffic lights are not highly appreciated, as compared to tiled walkway and malls, as shown in Table 2.76.

Table 2.76

Perception on Pedestrian Facilities in the CBD

	Bad	Acceptable	Good	Total
Foot path	28	243	95	366
Tiled Walkway	9	231	127	367
Malls	12	215	140	367
Overhead Bridges	38	252	76	366
Traffic Lights	25	244	98	367

13) Perception of Bus Waiting Time

In order to assess the people's perception of bus waiting time, several questions were asked as to whether they usually take the first bus that comes along or not, and if not, whether they usually take the second or subsequent bus. Table 2.77 summarizes the distribution of bus waiting time near their home and Table 2.78, their usual behaviour when catching a bus.

During off-peak hours, waiting time for bus becomes longer. The waiting time for peak hours is mostly 4-10 minutes, while that for off-peak hours is 8-20 minutes. For most cases, the first bus is taken. But it is noticeable that 1/4 take the second or subsequent bus. This attitude may lengthen the waiting time at bus stop.

Table 2.77

Distribution of Bus Waiting Time
at Bus Stop Nearest to Home

Waiting Time (Minutes)	Peak Hours Number	%	Off-Peak Hours Number	%
1 - 3	11	8.3	1	0.8
4 - 5	42	31.8	6	4.5
6 - 7	5	3.8	6	4.5
8 - 10	55	41.7	43	32.6
11 - 15	15	11.4	40	30.3
16 - 20	4	3.0	28	21.2
21 - 30	0	-	6	4.5
31 -	0	-	1	0.8
No Answer	0	-	1	0.8
Total	132	100.0	132	100.0
Average Waiting Time	7.6 min.		12.7 min.	

Table 2.78

Behaviour When Catching a Bus
at Bus Stop Nearest to Home

Bus Number	Number	%
First Bus	97	75.8
Second Bus	22	17.2
Third or Subsequent	9	7.0
Total	128	100.0

The same questions were repeated to determine their behaviour at bus interchanges (not at bus stop nearest to home). Tables 2.79 and Table 2.80 show the results.

For most cases, the first bus is usually taken. But when the first bus is not taken, the percentage of "third or subsequent" bus is larger than that shown in Table 2.78. This might be attributed to the long queues seen at bus interchanges.

Table 2.79

Distribution of Bus Waiting Time
at Bus Interchange

Waiting Time (Minutes)	Peak Hours Number	%	Off-Peak Hours Number	%
1 - 3	6	4.6	0	-
4 - 5	58	43.9	7	5.3
6 - 7	3	2.3	8	6.1
8 - 10	25	18.9	44	33.3
11 - 15	11	8.3	27	20.5
16 - 20	6	4.6	8	6.1
21 - 30	0	-	13	9.8
31 -	0	-	0	-
No Answer	23	17.4	25	18.9
Total	132	100.0	132	100.0
Average Waiting Time	7.1 min.		12.2 min.	

Table 2.80

Behaviour When Catching a Bus
at a Bus Interchange

Bus Number	Number	%
First Bus	86	81.1
Second Bus	11	10.4
Third or Subsequent	9	8.5
Total	106	100.0

3. BUS SURVEY

3.1 INTRODUCTION

The first bus survey at Ang Mo Kio Bus Interchange was carried out on October 1987 as a survey for Phase I study. In this survey, the number of departing buses and the number of boarding and alighting bus passengers for 22 bus services (including 6 feeder services) were counted at the bus interchange. At the same time, a total of 4,500 sample bus passengers were interviewed for each bus services at bus boarding queues to determine the origin and destination of their trips and their personal particulars.

From the results of this survey, information on bus passenger traffic and bus passenger characteristics in Ang Mo Kio New Town before the running of the MRT were obtained. Due to the recent commencement of the MRT, however, the transport behaviors of residents are expected to have been changed considerably. This change should be checked and assessed for future transport study. For this reason, the second bus survey was conducted on April 1988 for Phase II study.

The two surveys were basically carried out using the same method. However, the survey questionnaire and forms were slightly simplified and improved in the second survey. Sample size of interview survey was also reduced in the second survey.

In the second survey, the bus traffic and number of boarding and alighting bus passengers were also counted for 22 bus services including 6 feeder services. However, one trunk service (Service 22, Ang Mo Kio to Tampines) was added and one trunk service (Service 138 Ang Mo Kio to Robinson Rd) was abolished between the period of October 1987 to April 1988. For Service 168 (Ang Mo Kio to Orchard Rd.), the aircon service was also abolished between the same period due to the running of the MRT. The second survey interviewed a total of 2,621 sample bus passengers.

Besides the bus traffic count and interview survey, bus waiting time was conducted at the same time to confirm the actual waiting time for feeder bus passengers at bus stops.

3.2 SURVEY METHODOLOGY

3.2.1 OBJECTIVES

The main objective of the bus survey is to collect the necessary information on demand and operational characteristics of present bus services, especially feeder bus services, in HDB New Towns. The result of the survey will be used to predict future feeder transport demand and to examine the characteristics of future feeder transport systems that may be introduced.

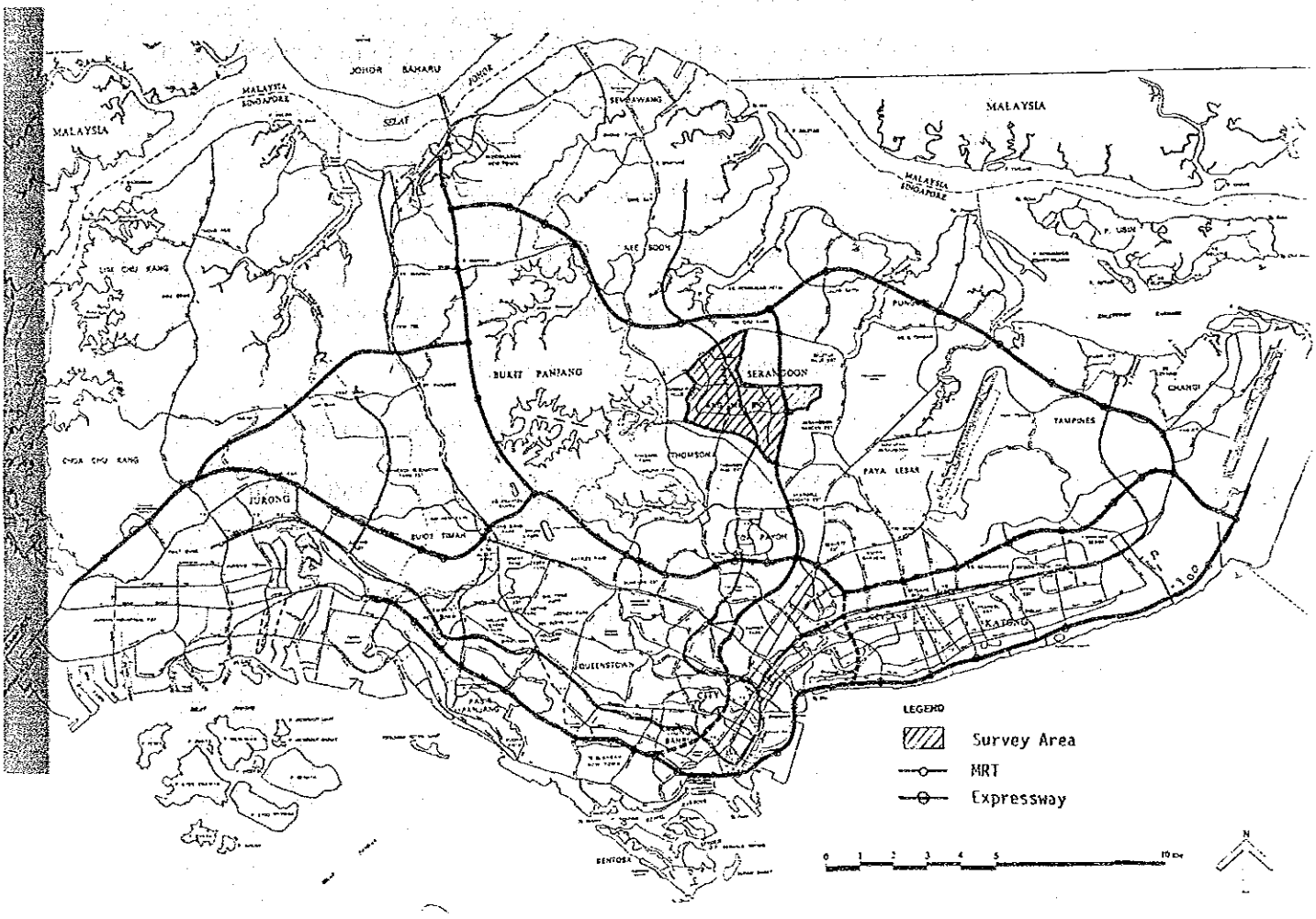
The objectives of the second survey is to obtain the necessary information with regards to:

1) bus and bus passenger traffic after running of MRT;
2) changes in transfer pattern of bus passengers; and
3) to ascertain the actual waiting time for feeder and services at bus-stops.

3.2.2 SURVEY AREA

Among the existing HDB New Towns, Ang Mo Kio New Towns was selected as a survey area. Ang Mo Kio Town is one of the larger new towns in Singapore and has a population of about 200,000. It has a bus interchange, two MRT stations and is serviced by an expressway. With regard to land use, three small industrial areas are located together with the residential area. Figure 3.1 shows the location of the survey area with major transport systems indicated.

Figure 3.1
Location of Survey Area



3.2.3 SURVEY METHOD

The survey consists of the following:

1) Bus Traffic Survey

   The number of departing/arriving buses and boarding/alighting bus passengers were counted by service and time period at bus interchange.

2) Bus Passengers Interview Survey

   Sample bus passengers were interviewed for each bus service at boarding queues.

3) Waiting Time Survey for Feeder Bus Service

   Observation survey for sample feeder bus passengers were conducted to determine the actual waiting time at bus stops.

3.2.4 *INFORMATION NEEDED*

Information required from each surveu works is as follows:

1) Bus Traffic Survey

   The following information was required for each arriving/departing bus at bus interchange:

   a) Bus service number

   b) Type of bus : Single deck or double deck

   c) Arrival time at bus interchange

   d) Number of alighting passengers from arriving bus

   e) Departure time at bus interchange

   f) Number of boarding passengers on departing bus

   g) Remarks in the case of arriving buses going to depot or changing their service number

2) Bus Passenger Interview Survey

The following data were required for each sample bus passenger:

a) Time when survey was made

b) Bus service number which interviewee was to take

c) Personal particulars of interviewee

- Sex, age and occupation
- Whether interviewee was a resident of Ang Mo Kio New Town or not

d) Origin and destination of travel made by interviewee

- Name of place (Block/Building number, Road/ Street name)

e) Purpose of the Trip

f) Transfer Information

- Mode of travel which interviewee took before this bus trip
- Bus service number in the case where interviewee took buses before this bus trip
- Walking time in the case where interviewee walked before this bus trip
- Mode of travel which interviewee was to take after this bus trip

g) Car ownership of interviewee's household

3) Bus Waiting Time Survey

a) Location of bus stops and direction of bus lines

b) Time when survey was made

c) Waiting time of sample bus passengers at bus stop

d) Bus service number which sample bus passenger took

e) Numbers of buses (same service number) passed before interviewee took

The questionnaire and survey sheets for each survey are attached as Appendix 3.A

3.2.5 BUS SERVICES COVERED

Ang Mo Kio Intechange serves a total of 22 bus services comprising 16 trunk services and 6 feeder services. Singapore Bus Service operates 21 bus services, including 6 feeder services, while Trans Island Bus Service operate one service plying to Woodlands (Service No. 169). The survey covered all these bus services for both bus traffic count and passenger interview survey work. Some operating information of each bus services are shown in Table 3.1 (1987) and 3.2 (1988). These bus routes are presented in Figures 3.2 and 3.3.

The bus interchange also serves some private buses irregularly. These private buses were excluded from the survey.

3.2.6 TRANSFER PATTERN COVERED BY INTERVIEW SURVEY

At Ang Mo Kio Bus Interchange, the many cases of transfer pattern betwwen different modes of travel are expected to occur. The bus passengers interview survey could not cover all the pattern of transfer. Table 3.3 shows the coverage of interview by transfer pattern.

Table 3.1
Bus Operation at Ang Mo Kio Bus Interchange (1987)

	Service No.	Fare System	Route	Operation Hour 1st Bus	Operation Hour Last Bus	Scheduled Frequency (Weekdays) Bus/Day	Peak Bus/Hour	Peak Bus/Hour
1.	24	OTS	- Changi Airport PTB	0530	2300	105	6	6
2.	25	"	- Bedok	0545	2300	142	10	7.5
3.	74	"	- Clementi	0530	2330	104	8.6	5
4.	130	"	- Prince Edward	0600	2300	111	6.7	6
5.	132	"	- Bukit Merah	0525	2315	89	8.6	4
6.	133	"	- North Bridge Rd	0530	2330	153	12	7.5
7.	134	"	- New Bridge Rd	0600	2300	145	12	7.5
8.	135	"	- Marine Parade	0530	2300	N.A.	N.A.	N.A.
9.	136	"	- Upper Serangoon Rd	0545	2300	151	12	7.5
10.	138	OMO	- Robinson Road	0600	1930	82	8.6	5
11.	159	"	- Toa Payoh	0550	2345	199	15	10
12.	162	OTS	- Sims Avenue	0545	2300	79	5	4.3
13.	165	"	- Jurong	0530	2320	131	12	6
14.	166	"	- Labrador	0530	2315	151	12	7.5
15.	168	"	- Orchard Rd	0545	2300	134	8.6	7.5
16.	Aircon 168	"	- Orchard Rd	0700	1900	N.A.	N.A.	N.A.
17.	169	OMO DRF	- Woodlands	0530	2345	134	12	6
18.	261	OMO	- Industrial Park 1	0510	0100	317	20	15
19.	262	"	- Ang Mo Kio Ave 2	0530	0015	167	10	8.6
20.	265	"	- Ang Mo Kio Ave 10	0530	0030	240	15	12
21.	266	"	- Ang Mo Kio Ave 4/5	0530	2400	205	15	10
22.	267	"	- Industrial Park 2	0530	2400	173	12	8.6
23.	269	"	- Ang Mo Kio St. 61	0530	0015	234	15	12
Total						3,246	236	164
(Feeder Service Out of total)						(1,336)	(87)	(66)

N.A. : Not available
Source : Bus Guide Book (1985)
Mini Bus Guide (1986)

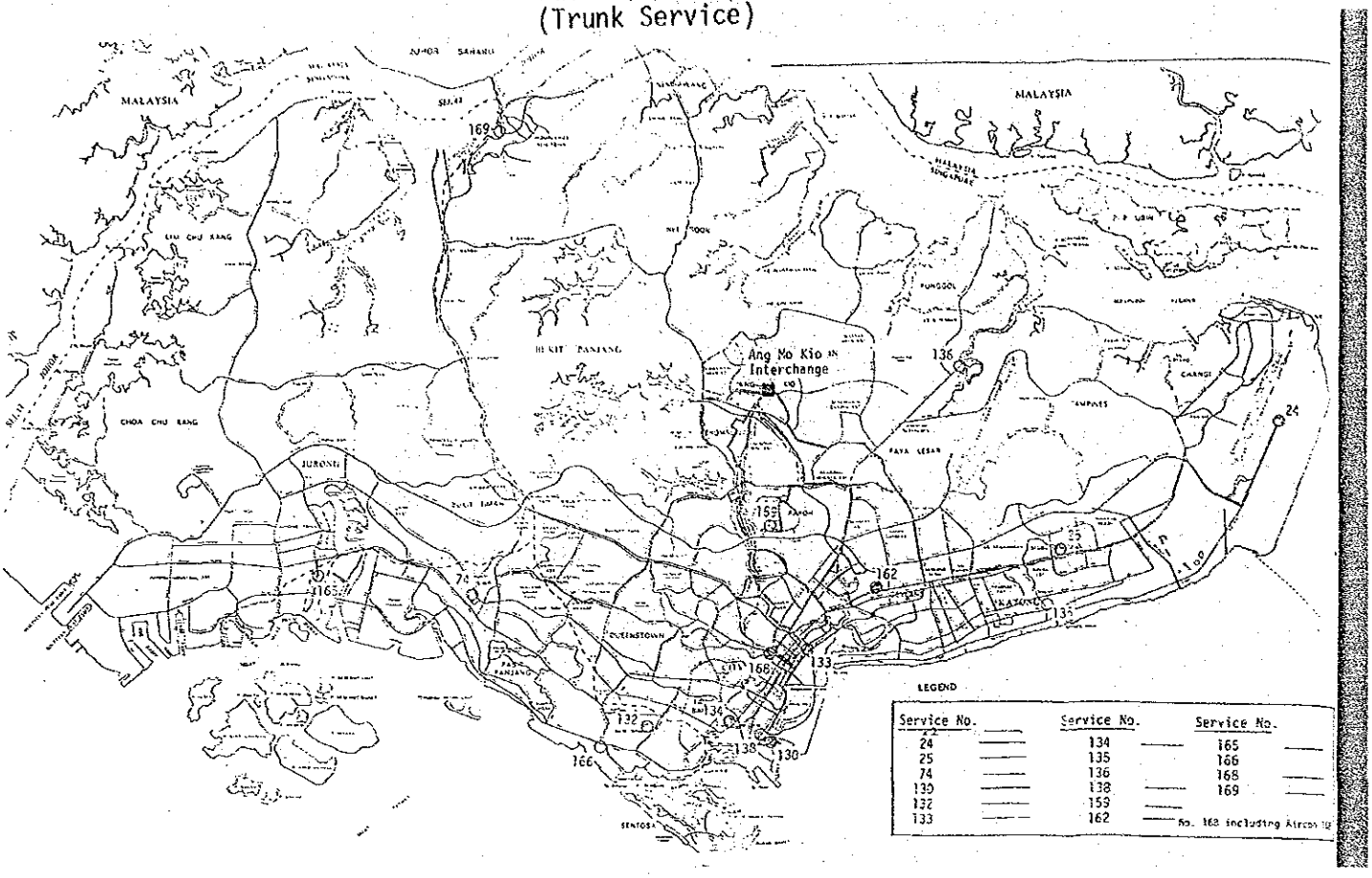
Table 3.2
Bus Operation at Ang Mo Kio Bus Interchang (1988)

	Bus Service Number	Fare System	Destination	1st Bus	Last Bus	Scheduled Frequency (minutes) Peak/Off Peak
1.	22	OTS	Tampines	0545	2330	9.5/11
2.	24	OTS	Changi Airport PTB	0530	2300	4/7
3.	25	OTS	Bedok	0530	2345	3/5
4.	74	OTS	Clementi	0530	2330	5/8.5
5.	130	OTS	Shenton Way	0530	2330	7.5/11
6.	132	OTS	Bukit Merah	0525	2315	8/10.5
7.	133	OTS	Marina Center	0530	2330	5/8
8.	134	OTS	New Bridge Road	0600	2300	5.5/8.5
9.	135	OTS	Marine Parade	0530	2330	7.5/10
10.	136	OTS	Upper Serangoon Rd.	0545	2330	5.5/9.5
11.	159	Flat Fare	Toa Payoh	0550	2345	5.5/7
12.	162	OTS	Sims Avenue	0540	2300	7.5/9.5
13.	165	OTS	Jurong	0530	2320	4.5/12
14.	166	OTS	Labrador	0530	2315	8.5/13
15.	168	OTS	Orchard Road	0545	2300	6/7.5
16.	169	OMO-DRF	Woodlands	0530	2345	
17.	261	Flat Fare	Industrial Park 1	0510	0100	2.5/4
18.	262	Flat Fare	Ang Mo Kio Ave 2	0530	0015	8/8.5
19.	265	Flat Fare	Ang Mo Kio Ave 10	0530	0030	3/5.5
20.	266	Flat Fare	Ang Mo Kio Ave 4/5	0530	2400	3/5
21.	267	Flat Fare	Industrial Park 2	0530	2400	2.5/7
22.	269	Flat Fare	Ang Mo Kio St. 61	0530	0015	3.5/6

Source: Bus Guide (1988), SBS

Figure 3.2

Bus Route Map
(Trunk Service)



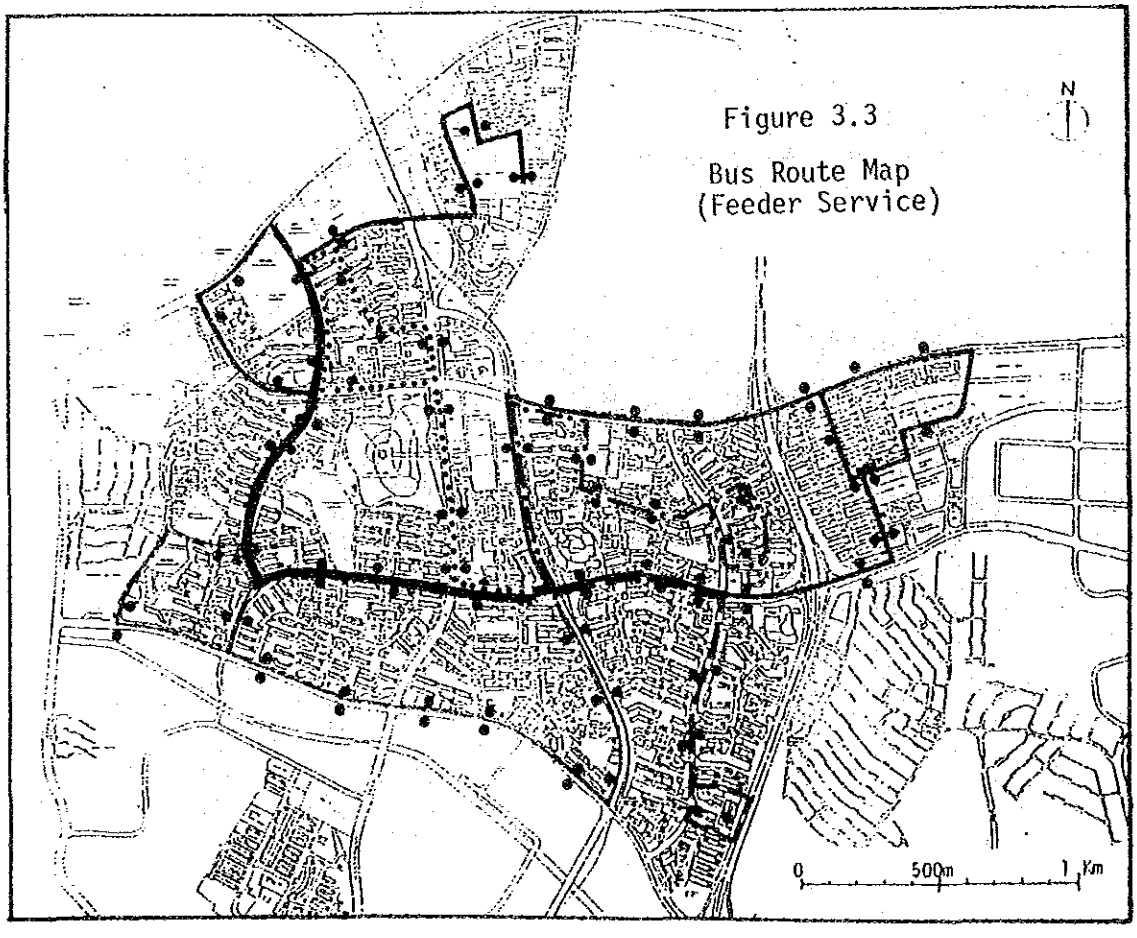


Figure 3.3

Bus Route Map
(Feeder Service)

Table 3.3
Coverage of Interview Survey by Transfer Pattern

Transfer Pattern for Residents			Interview Covered	Transfer Pattern for Non-Residents			Interview Covered
1. Feeder Bus	-->	MRT	No	1. MRT	-->	Trunk Bus	Yes
Feeder Bus	<--	MRT	Yes	MRT	<--	Trunk Bus	No
2. Feeder Bus	-->	Trunk Bus	Yes	2. Trunk Bus	-->	Trunk Bus	Yes
Feeder Bus	<--	Feeder Bus	Yes	MRT	<--	Feeder Bus	No
3. Feeder Bus	-->	Feeder Bus	Yes	3. MRT	-->	Feeder Bus	Yes
Feeder Bus	<--	Feeder Bus	No	MRT	<--	Feeder Bus	No
4. Walk & Others	-->	MRT	No	4. MRT	-->	Walk & Others	No
Walk & Others	<--	MRT	No	MRT	<--	Walk & Others	No
5. Walk & Others	-->	Trunk Bus	Yes	5. Trunk Bus	-->	Feeder Bus	Yes
Walk & Others	<--	Trunk Bus	No	Trunk Bus	<--	Feeder Bus	Yes
6. Walk & Others	-->	Feeder Bus	Yes	6. Walk & Others	-->	Feeder Bus	Yes
Walk & Others	<--	Feeder Bus	No	Walk & Others	<--	Bus	No

3.2.7 SURVEY TIME PERIOD

In Ang Mo Kio Bus Interchange, the first bus starts at 0510 hours and the last bus starts at 0100 hours on the following day. However, most services start at 0530 hours and ends their services at 2330 hours. The survey covered 16 hours, from 0600 hours to 2200 hours.

3.2.8 SAMPLING OF BUS PASSENGERS

For the Bus Passengers Interview Survey, approximately 4,500 sample bus passengers in the first survey and 2,500 in the second survey were interviewed. This is equivalent to about 5% and 3% of the total boarding passengers at Ang Mo Kio bus interchange.

3.3 PREPARATIONS FOR THE SURVEY

3.3.1 BUS BERTH NUMBERING

Ang Mo Kio Bus Interchange has a total of 36 bus berths and each berth has a berth member. Among these berths, 29 (Berths No. 1 to 29) are end-on berths and 7 (Berth No. 30 to 36) are sawtooth berths. End-on berths are used for trunk bus services and for both alighting and boarding of passengers, while sawtooth berths are used for feeder bus services and trunk services. Berth numbers 30 and 31 are for alighting only and berth numbers 32 to 36 are for boarding only.

The layout of these bus berths with corresponding bus service numbers are shown in Figure 3.4.

Figure 3.4
Layout of Bus Berths at Ang Mo Kio Bus Interchange