5

EVALUATION OF PLANS

5.0 EVALUATION OF PLANS

5.1 Introduction

In this Chapter an economic evaluation is performed on the proposed ATC System Expansion Plan in order to justify the capital investment for its implementation. In addition, financial analyses are performed on the two projects which will generate revenue in order to justify the financial viability of the projects to be undertaken as an enterprise. These projects are the proposed CBD Bus Terminal and a proposed medium-size parking building.

5.2 Evaluation of ATC System Expansion Plan

5.2.1 Economic Benefit from the Introduction of the Traffic Signal Control System (TSCS)

Benefit is derived from improvement in traffic flow patterns. This can be seen by the difference in delay time measured in traffic flow simulation for the cases of ‚with' and 'without' computerization.

The delay time can be converted to benefit in monetary value using the two aspects of time value and fuel consumption.

A. Outline of the Computer Simulation Model

A traffic flow simulation method which was developed by the committee members of The Association of Traffic Control Facility in Japan has been adopted.

Reference reports of the simulation method are:

* "Evaluation of Signal Control by Simulation Experiments" by Shinji Mukai, Masahiko Katakura and others in a lecture of Civil Engineering Planning Study in October 1986.

* "Evaluation of Signal Control by Simulation Model" in the report by The Association of Traffic Control Facility in Japan.

This simulation model has been developed mainly for the evaluation of coordinated signal control in strategies and timing.

The following describes briefly this simulation model :

1. Composition of the Model

The model comprises (1) Sector of traffic signal control, (2) Sector of traffic flow and (3) Sector of traffic detector. Figure 5.1 shows the flow chart of the model.

2. Description of Traffic Flow

In this simulation model, traffic flow on a link between intersections is divided into small blocks of unit length (A unit length is decided by the progressive speed or average speed). Traffic flow rate from a block to the adjacent downstream block is decided by interpretation of the number of vehicles existing in both blocks.

The traffic flow movement from a link to another link (at intersection) is treated as follows:

- the traffic flow is categorized by directions before hand,
- according to signal timing parameters, the categorized flows (for example, straight flow, turning flows) move to the downstream link if congestion is not present,
- the treatment of right-turning movement is different between the cases with or without right-turning lane and also between the cases with or without arrow signal for right-turn cars. In the case of without arrow signal for the right-turning cars, the gap acceptance criterion on the opposite traffic flow is adopted after converting from continuous traffic flow movement to each car movement.

3. Treatment of Traffic Detector Information

Detector information such as traffic volumes, headway and occupancy is given as output by the Detector Sector.

4. Signal Control

This simulation model is capable of treating dynamic programs of signal control timing such as split control, actuated control, etc., based on detector data output by the Detector Sector.

However, in the Study the signal control timing was entered as input beforehand using actual signal timings at intersections for no-improvement signal condition. As for area control signal condition, the signal timings, which are most likely to be exhibited under the traffic conditions where the simulation is executed, were prepared beforehand.

5. Output results

This model gives the following outputs at each approach of intersection:

- delay time and total delay time
- vehicle stops
- traffic volume
- occupancy on detectors
- queue length

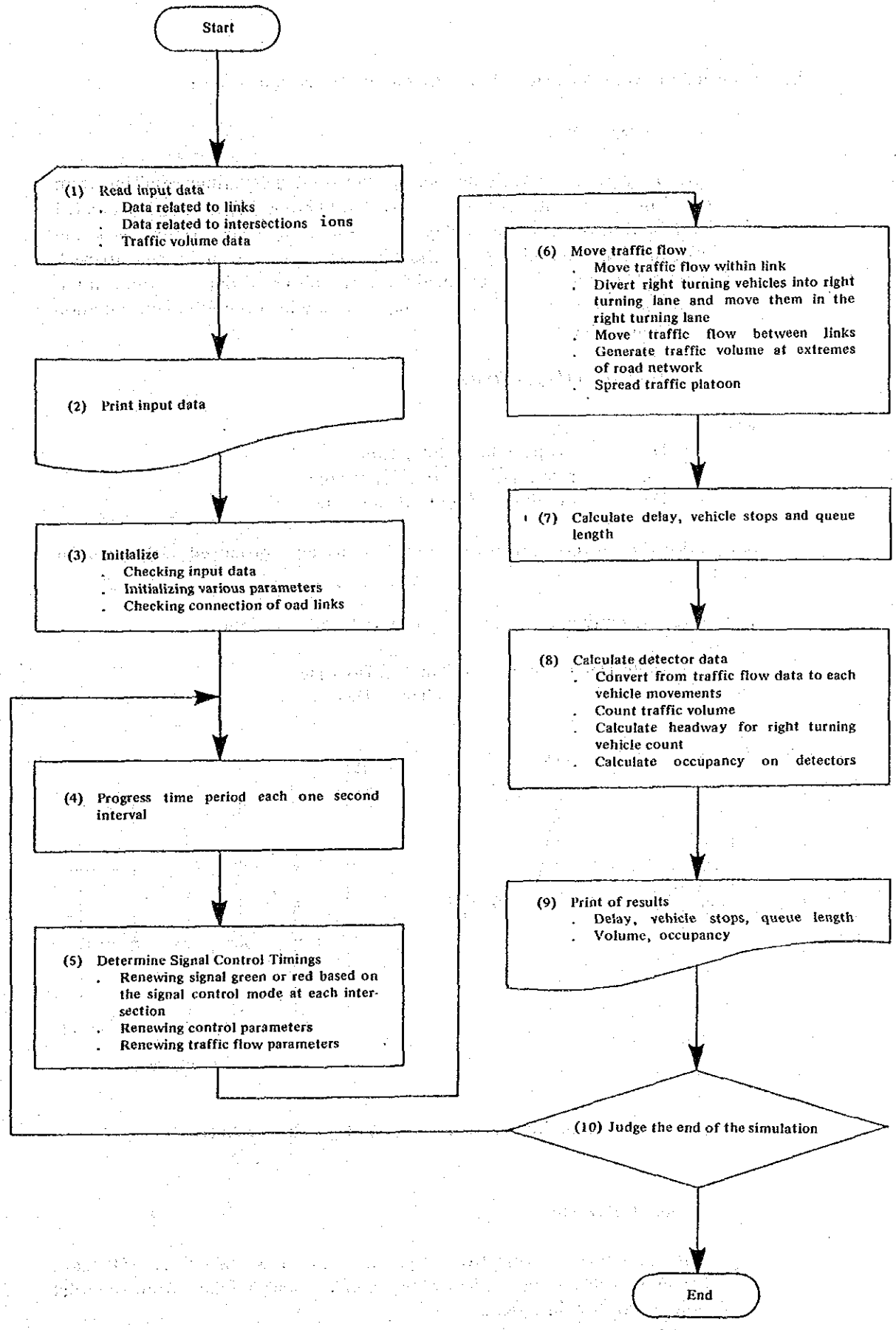


Figure 5.1 : Composition and Procedure of Simulation Model

B. Conversion From Peak Hour Delay to Annual Delay and Benefit

1. Daily Delay Time

The daily delay time is defined as the total delay time resulting from travel made by vehicles from 8:00 to 18:00 hours. This can be calculated by knowing the one hour delay time in morning peak, evening peak and off-peak. Furthermore, a relationship between peak hour and off-peak hour delay time can be obtained from the observed data at various intersections. Figure 5.2 shows an example from which the following equation is obtained, that is

$$Do = 0.75\ (Dm + De)/2$$

where:

Do : off-peak hour delay time
Dm : morning peak hour delay time
De : evening peak hour delay time

Calculations performed at other intersections also produced rather similar result.

Therefore, the daily delay time can also be calculated as follows:

$$\text{Daily Delay Time} = Dm + 8\ Do + De$$
$$= 4(Dm + De)$$

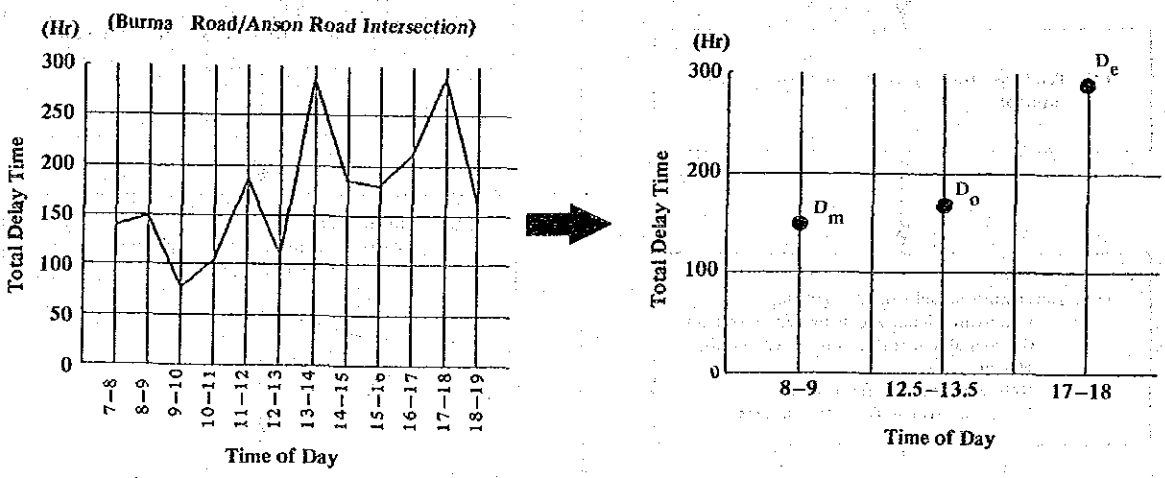


Figure 5.2 : Fluctuation of Total Delay Time During 7:00 – 19:00 Hours

2. Annual Delay Time

The number of effective days in a year is taken as 250 days having subtracted all the Saturdays, Sundays and holidays from the total number of days in a year.

3. Premises for Monetary Conversion

Benefit of the ATC System in monetary terms can be derived from the estimation of savings in transport cost if the system is implemented. In this simulation the following premises for monetary conversion of annual delay to annual transport cost are adopted.

The transport cost due to delay time can be measured using the time value for vehicle user and the cost of fuel consumption only when vehicle is idling.

The time values for car and motorcycle are M$4.57 and M$1.28 per vehicle hour respectively. Based on the composition ratio of car to motorcycle in the Study Area the weighted time cost in the Study Area is estimated as M$3.80 per PCU hour.

Fuel cost is estimated as follows : The fuel consumption when idling is assumed to be 0.6 litre/hr. Since the cost of gasoline in Penang Island is M$0.93 per litre, the fuel cost is obtaind as M$0.57 per PCU hour.

C. Comparison of Results Between The Field Survey Analysis and Computer Simulation Analysis.

To evaluate the improvement of traffic conditions by the introduction of the Stage I ATC system, and to check the result of computer simulation which the Study Team adopted for appraisal of an ATC System expansion plan, 'before and after Implementation' surveys were conducted.

Table 5.1 shows the comparison of annual delay time and transport cost (or benefit) due to delay time between field survey and computer simulation.

Table 5.1 : Comparison of results between field survey and computer simulation

	Annual Delay Time (thousand hour)		Annual Transport Cost (M$ Million)		Ratio of Annual Delay Time (B/A)
	Survey (A)	Simulation (B)	Survey	Simulation	
Before ATCS	3,490	3,184	15.3	13.9	0.91
After ATCS	2,520	2,384	11.0	10.4	0.94
Difference	970	800	4.3	3.5	0.82

From the comparison of both analyses, it appears that the values from the simulation are smaller than that of the field survey. This indicates that the simulation value is underestimated by about 18% compared to the field survey result. Likewise, the benefit due to reduction of delay time by the ATC System obtained from simulation is smaller than the field survey result.

This difference between the two analyses can be expected because the factors of geometric improvements at intersections and traffic engineering measures such as road markings, signs, etc. are not included in the estimate of delay time by the simulation analysis. If these effects are considered, it is expected that the simulation result would be close to the survey result.

Thus, it is understood that the simulation result in this Study is always underestimated by about 18%.

D. Economic Benefit

The economic benefit calculated by the computer simulation is shown in Figure 5.3 and Table 5.2. Savings in annual transport cost of about M$4.7 million would be expected with the implementation of Stage II consisting of forty-nine (49) intersections. The implementation of Stage III consisting of another fifty-nine (59) intersections would be expected to generate a cumulative savings of M$12.9 million in annual transport cost. After the implementation of Stage IV consisting of another twenty-five (25) intersections, a cumulative savings in transport cost of about M$15.3 million would be expected.

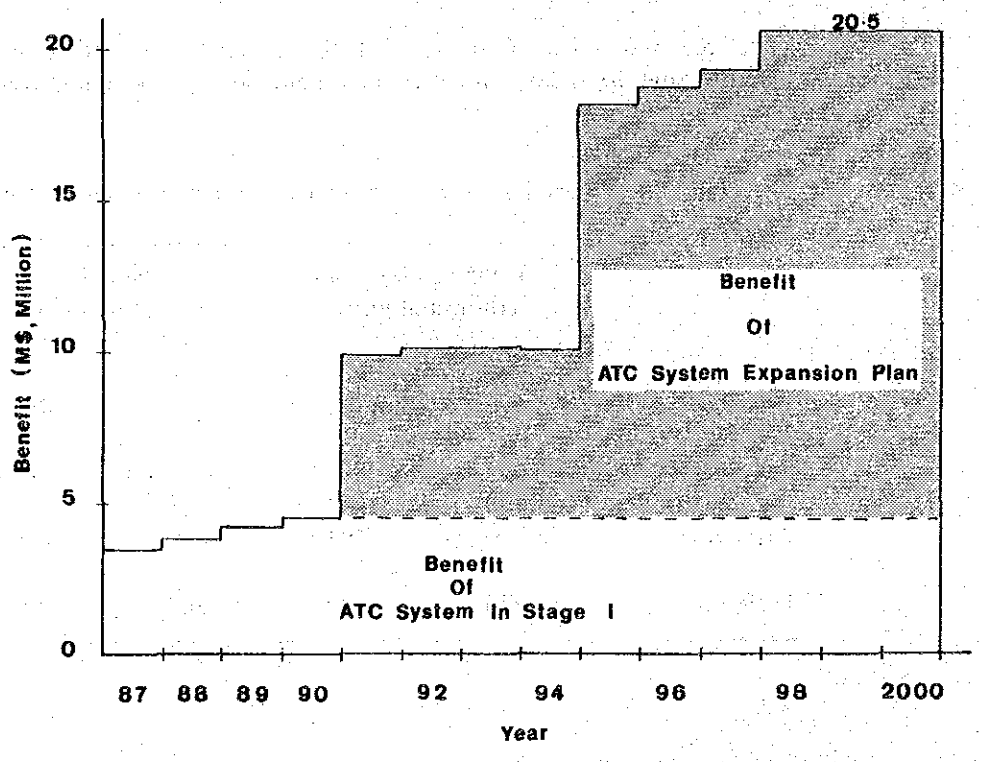


Figure 5.3 : Economic Benefit Obtained by Computer Simulation

Table 5.2 : Economic Benefit of ATC System

(M$ Million)

Year	Staging Plan		Annual Transport Cost			Benefit excluding Stage I
	Construction	No. of Intersection	Without TSCS	With TSCS	Difference (Benefit)	
1986	STAGE I (16)	–	–	–	–	–
1987		16	13.9	10.4	3.5	–
1988		16	16.4	12.6	3.8	–
1989		16	19.4	15.2	4.2	–
1990	STAGE II (49)	16	22.9	18.4	4.5	–
1991		65	68.0	58.1	9.9	4.7
1992		65	76.1	66.0	10.1	4.9
1993		65	85.2	75.0	10.1	4.9
1994	STAGE III (59)	65	95.3	85.3	10.0	4.8
1995		124	178.2	160.1	18.1	12.9
1996		124	195.1	176.5	18.7	13.5
1997	STAGE IV (25)	124	213.6	194.5	19.2	13.9
1998		149	263.8	243.3	20.5	15.3
1999		149	279.6	259.1	20.5	15.3
2000		149	295.4	274.9	20.5	15.3

5.2.2 Economic Cost

The economic cost of the ATC System Expansion Plan is composed of the following five items:

(1) Initial cost for ATC System
(2) Intersection improvement cost
(3) Renewal cost for ATC System
(4) Operation cost
(5) Residual cost

The breakdown for each cost item is shown in Table 5.3. The total initial cost for ATC System including the intersection improvement cost is about M$37.2 million at 1986 prices.

Table 5.3 : Economic Costs for ATC System

Unit : M$1000 at 1986 price

		Stage I	Stage II	Stage III	Stage IV	Total
Initial Cost for ATC System	Foreign	–	5,627	16,634	7,191	29,452
	Local	–	1,612	2,632	1,594	5,838
	Total	–	7,239	19,266	8,785	35,290
Intersection Improvement Cost	Total	–	611	721	373	1,705
Sub total			7,850	19,987	9,158	36,995
Renewal Cost for ATC System*	Total	(3,100)	6,893	18,372	–	25,265
Annual Operation Cost	Labour	(40)	104	144	108	356
	Others	(53)	114	248	149	511
	Total	(93)	218	392	157	867
Residual Cost		(Changeable by implementation program)				

Note : * Renewal period of the system is 10 years
The total cost does not include the cost of Stage I

5.2.3 Economic Evaluation

The implementation of the ATC System Expansion Plan involves substantial capital expenditure. Such expenditure has to be justified by an economic evaluation.

The economic evaluation will determine whether or not the economic benefit of the proposed ATC System Expansion Plan justifies its implementation.

The economic evaluation procedure involves a comparison of cost and benefit.

The comparison is expressed as:

(1) Internal rate of return (IRR)
(2) Benefit-cost ratio (B/C)
(3) Net present value (NPV)

A. Economic Evaluation

Table 5.4 shows the yearly stream of costs and benefits.

As a result of the economic evaluation, the investment in this plan could be expected to yield an internal rate of return of 22.7%, a benefit-cost ratio of 2.3 and a net present value of M$24.9 million. Table 5.5 depicts the economic indicators of the proposed ATC System Expansion Plan.

Therefore, the proposed ATC System Expansion Plan is found to be economically feasible and is recommended as the ATC System Plan 2000 for Penang.

Table 5.4 : Yearly Stream of Costs and Benefits

(M$1000 at 1986 prices)

Year	Undiscounted Costs by Stage								Total	Undiscounted Benefits	Discounted at 12%	
	Stage I		Stage II		Stage III		Stage IV				Costs	Benefits
	A	B	A	B	A	B	A	B				
1987									0	0	0	0
1988									0	0	0	0
1989									0	0	0	0
1990			7,850						7,850	0	4,989	0
1991				218					218	4,700	124	2,667
1992				218					218	4,900	110	2,482
1993				218					218	4,900	99	2,217
1994				218	19,987				20,205	4,800	8,160	1,939
1995				218		392			610	12,900	220	4,652
1996				218		392			610	13,500	196	4,347
1997				218		392	9,158		9,768	13,900	2,808	3,996
1998				218		392		257	867	15,300	223	3,927
1999				218		392		257	867	15,300	199	3,506
2000			6,893	218		392		257	7,760	15,300	1,588	3,131
2001				218		392		257	867	15,300	158	2,795
2002				218		392		257	867	15,300	141	2,496
2003				218		392		257	867	15,300	126	2,228
2004				218	18,372	392		257	19,239	19,300	2,502	1,990
2005			−3,447	218	−16,535	392	−1,676	257	−20,790	15,300	−2,414	1,776
Total									50,241	182,000	19,229	44,149

Note : A – Construction Cost
B – Operation Cost

Table 5.5 : Economic Indicators of Proposed ATC System Expansion Plan

Indicator	Value
Internal Rate of Return (%)	22.70
Benefit Cost Radio	2.30
Net Present Value (1000 M$)	24,919.00

B. Sensitivity Analysis

As a second step of the economic evaluation, a sensitivity analysis on the benefit and cost estimated is carried out.

The factors to be tested in this sensitivity analysis are considered as follows:

a. Benefit

  a.1 10% Reduction of benefit

  a.2 20% Reduction of benefit

b. Cost

  b.1 100% Increase of operation cost

  b.2 20% Increase of construction and maintenance cost

  b.3 50% Increase of construction and maintenance cost

c. Combination of Factors

  c.1 20% Reduction of benefit and
  20% Increase of cost

  c.2 20% Reduction of benefit and
  50% Increase of cost

Table 5.6 shows the results of the sensitivity analysis.

According to this table, the following observations can be made:

(1) Even when the benefit is reduced by 20% of the original estimate, the proposed ATC System Plan is still found to be economically feasible.

(2) Even when the cost is increased by 50% of the original estimate, the proposed plan is still economically feasible.

(3) Even when the benefit is reduced by 20% and the cost is increased by 50% of original estimates, the proposed plan is also found to be economically feasible.

Table 5.6 : Results of Sensitivity Analysis on the Benefit/Cost of the ATC System

Factors	IRR (%)	B/C Ratio	NPV (M$1000)
Proposed Plan	22.7	2.30	24,919
a.1	20.9	1.93	22,127
a.2	18.2	1.57	16,127
b.1	20.4	1.76	20,979
b.2	18.2	1.64	18,573
b.3	16.2	1.31	13,091
c.1	16.0	1.31	10,473
c.2	12.8	1.05	1,991

Notes :

a.1 10% Reduction of benefit
a.2 20% Reduction of benefit
b.1 100% Increase of operation cost
b.2 20% Increase of construction and maintenance cost
b.3 50% Increase of construction and maintenance cost
c.1 20% Reduction of benefit and 20% Increase of cost
c.2 20% Reduction of benefit and 50% Increase of cost

5.3 Financial Evaluation of CBD Bus Terminal

5.3.1 Premises for Financial Analysis

The financial evaluation of CBD Bus Terminal is undertaken to determine whether or not the project is financially viable as an enterprise.

The financial evaluation is based on the following premises.

(1) Project Cost is M$7.35 million

(2) Project life is assumed as 25 years with construction beginning in 1992 and project to be opened to the public in 1995.

(3) Interest on loan is assumed to be 6% per annum (long-term) for 50% of the loan and 12% per annum (short-term) for the rest.

(4) Operation and Maintenance Cost is assumed as 3% of building construction cost.

(5) The expected revenue from the bus terminal is as shown in Table 5.7.

Table 5.7 : Forecasted Revenue of CBD Bus Terminal in 2000 (at 1986 prices)

Item	Unit Revenue (per month)	Quantity	Revenue per month (M$)	Annual Revenue (M$ Million)
Bus Berth	M$500 per berth	33	16,500	0.19
Ticket Booth/ Office/Shops	M$ 15 per sq.m	500	7,500	0.09
Car Park	M$200 per bay	300	60,000	0.72
Total	–	–	84,000	1.01

5.3.2 Result of Financial Analysis

The financial rate of return is forecasted to be 10.4% indicating that the project is financially viable provided a low-interest loan is available. The cash flow of the project over a 25-year period is shown in Table 5.8. It can be observed that the annual profit/loss account shows a profit eight (8) years from the opening of the terminal building and a positive cumulative net balance twenty-three (23) years after opening.

Table 5.8 : Cash Flow Analysis on CBD Bus Terminal (Regional Bus Only)

START YEAR 1992
INTEREST RATE (LONG–TERM) AT 6% PER ANNUM FOR 50% OF LOAN
INTEREST RATE (SHORT–TERM) AT 12% PER ANNUM FOR 50% OF LOAN
INFLATION RATE AT 3% PER ANNUM

(in M$ million)

YEAR	REVENUE	OPERATION/ MAINTENANCE & DEPRECIATION	NET INCOME	INTEREST PAYMENT LONG	INTEREST PAYMENT SHORT	PROFIT/ LOSS	LOAN TAKEN LONG	LOAN TAKEN SHORT	TOTAL INFLOW	LOAN REPAYMENT LONG	LOAN REPAYMENT SHORT	TOTAL OUTFLOW	BALANCE AT YEAR	CUMULATIVE BALANCE	
1992				0.1	0.1	−0.2	1.1	1.1	2.0	0.0	0.0	2.2	−0.2	−0.2	
1993				0.2	0.3	−0.5	1.6	1.5	2.6	0.0	0.0	3.1	−0.5	−0.6	
1994				0.3	0.6	−0.9	1.9	2.0	3.0	0.0	0.0	3.9	−0.9	−1.6	
1995	1.0	0.6	0.4	0.3	0.6	−0.2			−0.5	0.0	0.5	0.5	−1.0	−2.8	
1996	1.1	0.6	0.5	0.3	0.5	0.0			−0.3	0.0	0.5	0.5	−0.8	−3.9	
1997	1.2	0.6	0.6	0.3	0.4	0.2			−0.1	0.0	0.5	0.5	−0.6	−4.9	
1998	1.3	0.6	0.7	0.3	0.4	0.3			0.0	0.0	0.5	0.5	−0.5	−6.0	
1999	1.4	0.6	0.8	0.3	0.3	0.6			0.2	0.1	0.5	0.6	−0.3	−7.0	
2000	1.5	0.6	0.9	0.3	0.3	0.7			0.3	0.2	0.5	0.7	−0.3	−8.2	
2001	1.7	0.6	1.1	0.3	0.2	1.0			0.6	0.3	0.5	0.8	−0.1	−9.3	
2002	1.8	0.7	1.2	0.2	0.1	1.2			0.9	0.3	0.5	0.8	0.1	−10.3	
2003	1.9	0.7	1.2	0.2	0.1	1.4			0.9	0.3	0.5	0.8	0.1	−11.4	
2004	2.1	0.7	1.4	0.2	0.0	1.7			1.2	0.3	0.1	0.4	0.8	−12.0	
2005	2.3	0.7	1.6	0.2	0.0	1.9			1.4	0.3	0.0	0.3	1.1	−12.2	
2006	2.4	0.7	1.7	0.2	0.0	2.0			1.5	0.3	0.0	0.3	1.3	−12.5	
2007	2.6	0.7	1.9	0.2	0.0	2.1			1.7	0.3	0.0	0.3	1.5	−12.5	
2008	2.9	0.7	2.2	0.2	0.0	2.2			2.0	0.3	0.0	0.3	1.8	−12.2	
2009	3.1	0.7	2.4	0.1	0.0	2.4			2.3	0.3	0.0	0.3	2.0	−11.7	
2010	3.3	0.7	2.6	0.1	0.0	2.5			2.5	0.3	0.0	0.3	2.2	−10.9	
2011	3.4	0.8	2.6	0.1	0.0	2.5			2.5	0.3	0.0	0.3	2.2	−9.9	
2012	3.5	0.8	2.7	0.1	0.0	2.6			2.6	0.3	0.0	0.3	2.4	−8.8	
2013	3.7	0.8	2.9	0.1	0.0	2.7			2.8	0.3	0.0	0.3	2.6	−7.3	
2014	3.8	0.8	3.0	0.1	0.0	2.8			2.9	0.3	0.0	0.3	2.7	−5.5	
2015	3.9	0.8	3.1	0.0	0.0	3.0			3.1	0.3	0.0	0.3	2.8	−3.4	↑
2016	4.0	0.8	3.2	0.0	0.0	3.1			3.2	0.3	0.0	0.3	2.9	−0.9	Loss
2017	4.1	0.9	3.3	0.0	0.0	3.2			3.3	0.2	0.0	0.2	3.1	2.1	Profit
2018	4.2	0.9	3.3	0.0	0.0	3.3			3.3	0.1	0.0	0.1	3.2	5.3	↓
2019	4.4	0.9	3.5	0.0	0.0	3.4			3.5	0.0	0.0	0.0	3.5	8.8	
TOTAL	66.6	18.0	48.8	4.5	3.9	45.2	4.6	4.6	49.6	4.6	4.6	18.4	31.2		

Note: Total does not add up due to rounding up of figures.

5.4 Financial Evaluation of a Parking Building

5.4.1 Premises for Financial Analysis

The financial viability of a parking building is examined based on the following premises:

(a) Capacity of parking building is 300 lots and required land space is about 1,500 square meters.

(b) Project life is assumed as 25 years with construction beginning in 1990 and project to be opened to the public in 1992.

(c) Construction cost, operation and maintenance cost and revenue are based on the data obtained from the existing public parking building at Hutton Lane. Thus the cost of parking facilities only (excluding land cost) will be M$3.7 million. The expected revenue in 1992 is estimated as M$0.7 million. Operation and maintenance cost is assumed to be 3% of the building cost.

(d) Interest on loan is assumed to be 6% per annum (long-term) for 50% of the loan and 12% per annum (short-term) for the rest.

5.4.2 Results of Financial Analysis

If a land cost of M$1,000 per square meter is assumed in the financial analysis, the financial rate of return is forecasted to be 10.8% indicating that the project is financially viable only if a low-interest rate loan is available. The cash flow of the project would be obtained as shown in Table 5.9. It can be observed that the annual profit/loss account shows a profit only nine (9) years after the opening of the parking building and a positive cumulative net balance twenty three (23) years after opening.

However, if the land cost is excluded, the financial rate of return (FIRR) is forecasted to be 14.8%. The cash flow of the project over a 25-year period, in this case, is shown in Table 5.10. It can be observed that the annual profit/loss account shows a profit right from the opening of the parking building and a positive cumulative net balance thirteen (13) years after opening.

The results of the financial anaysis of the project suggest that if a low interest rate on loan is made available, privatisation of public parking building construction can be encouraged.

Table 5.9 : Cash Flow Analysis on Parking Building (includes land cost)

START YEAR 1990
INTEREST RATE (LONG–TERM) AT 6% PER ANNUM FOR 50% OF LOAN
INTEREST RATE (SHORT–TERM) AT 12% PER ANNUM FOR 50% OF LOAN
INFLATION RATE AT 3% PER ANNUM

(in M$ million)

YEAR	REVENUE	OPERATION/ MAINTENANCE & DEPRECIATION	NET INCOME	INTEREST PAYMENT LONG	INTEREST PAYMENT SHORT	PROFIT/ LOSS	LOAN TAKEN LONG	LOAN TAKEN SHORT	TOTAL INFLOW	LOAN REPAYMENT LONG	LOAN REPAYMENT SHORT	TOTAL OUTFLOW	BALANCE AT YEAR	CUMULATIVE BALANCE	
1990				0.1	0.2	−0.3	1.9	1.9	3.4	0.0	0.0	3.7	−0.3	−0.3	
1991				0.2	0.4	−0.6	1.2	1.2	1.8	0.0	0.0	2.4	−0.6	−0.9	
1992	0.8	0.3	0.5	0.2	0.4	−0.1	0.0	0.0	−0.1	0.0	0.3	0.3	−0.4	−1.4	
1993	0.8	0.3	0.5	0.2	0.4	−0.1	0.0	0.0	−0.1	0.0	0.3	0.3	−0.4	−2.0	
1994	0.8	0.3	0.5	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.3	−0.3	−2.5	
1995	0.9	0.3	0.6	0.2	0.3	0.1	0.0	0.0	0.1	0.0	0.3	0.3	−0.2	−2.9	
1996	0.9	0.3	0.6	0.2	0.3	0.1	0.0	0.0	0.1	0.0	0.3	0.3	−0.2	−3.5	
1997	1.0	0.4	0.6	0.2	0.2	0.2	0.0	0.0	0.2	0.1	0.3	0.4	−0.2	−4.1	
1998	1.0	0.4	0.6	0.2	0.2	0.2	0.0	0.0	0.2	0.2	0.3	0.5	−0.3	−4.9	
1999	1.1	0.4	0.7	0.2	0.2	0.3	0.0	0.0	0.3	0.2	0.3	0.5	−0.1	−5.6	
2000	1.2	0.4	0.8	0.2	0.1	0.5	0.0	0.0	0.5	0.2	0.3	0.5	0.1	−6.2	
2001	1.3	0.4	0.9	0.1	0.1	0.7	0.0	0.0	0.7	0.2	0.4	0.6	0.1	−6.9	
2002	1.4	0.4	1.0	0.1	0.0	0.9	0.0	0.0	0.9	0.2	0.0	0.2	0.7	−7.0	
2003	1.5	0.4	1.1	0.1	0.0	1.0			1.0	0.2	0.0	0.2	0.8	−7.0	
2004	1.6	0.4	1.2	0.1	0.0	1.1			1.1	0.2	0.0	0.2	0.9	−6.9	
2005	1.7	0.4	1.3	0.1	0.0	1.2			1.2	0.2	0.0	0.2	1.0	−6.7	
2006	1.8	0.4	1.4	0.1	0.0	1.3			1.3	0.2	0.0	0.2	1.1	−6.3	
2007	1.8	0.4	1.4	0.1	0.0	1.3			1.3	0.2	0.0	0.2	1.1	−6.0	
2008	1.9	0.4	1.5	0.1	0.0	1.4			1.4	0.2	0.0	0.2	1.3	−5.4	
2009	1.9	0.4	1.5	0.1	0.0	1.4			1.4	0.2	0.0	0.2	1.3	−4.9	
2010	2.0	0.4	1.6	0.1	0.0	1.5			1.5	0.2	0.0	0.2	1.4	−4.1	
2011	2.1	0.4	1.7	0.0	0.0	1.7			1.7	0.2	0.0	0.2	1.5	−3.1	
2012	2.1	0.4	1.7	0.0	0.0	1.7			1.7	0.2	0.0	0.2	1.5	−2.0	↑
2013	2.2	0.4	1.8	0.0	0.0	1.8			1.8	0.2	0.0	0.2	1.6	−0.6	Loss
2014	2.2	0.5	1.7	0.0	0.0	1.7			1.7	0.2	0.0	0.2	1.5	0.8	Profit
2015	2.3	0.5	1.8	0.0	0.0	1.8			1.8	0.1	0.0	0.1	1.7	2.5	↓
2016	2.4	0.5	1.9	0.0	0.0	1.9			1.9	0.0	0.0	0.0	1.9	4.4	
TOTAL	38.7	9.8	28.9	3.1	3.1	23.1	3.1	3.1	28.8	3.1	3.1	12.3	16.5		

Note: Total does not add up due to rounding up of figures.

Table 5.10 : Cash Flow Analysis on Parking Building in CBD (excludes land cost)

START YEAR 1990
INTEREST RATE (LONG–TERM) AT 6% PER ANNUM FOR 50% OF LOAN
INTEREST RATE (SHORT–TERM) AT 12% PER ANNUM FOR 50% OF LOAN
INFLATION RATE AT 3% PER ANNUM

(in M$ million)

YEAR	REVENUE	OPERATION/ MAINTENANCE & DEPRECIATION	NET INCOME	INTEREST PAYMENT LONG	INTEREST PAYMENT SHORT	PROFIT/ LOSS	LOAN TAKEN LONG	LOAN TAKEN SHORT	TOTAL INFLOW	LOAN REPAYMENT LONG	LOAN REPAYMENT SHORT	TOTAL OUTFLOW	BALANCE AT YEAR	CUMULATIVE BALANCE	
1990				0.1	0.1	−0.2	1.0	1.0	1.8			2.0	−0.2	−0.2	
1991				0.1	0.3	−0.4	1.2	1.2	2.0			2.4	−0.4	−0.6	
1992	0.8	0.3	0.5	0.1	0.3	0.1			0.1		0.2	0.2	−0.1	−0.8	
1993	0.8	0.3	0.5	0.1	0.3	0.1			0.1		0.2	0.2	−0.1	−1.1	
1994	0.8	0.3	0.5	0.1	0.2	0.2			0.2		0.2	0.2	−0.0	−1.2	
1995	0.9	0.3	0.6	0.1	0.2	0.3			0.3		0.2	0.2	0.1	−1.2	
1996	0.9	0.3	0.6	0.1	0.2	0.3			0.3		0.2	0.2	0.1	−1.3	
1997	1.0	0.4	0.6	0.1	0.2	0.3			0.3	0.1	0.2	0.3	0.0	−1.4	
1998	1.0	0.4	0.6	0.1	0.1	0.4			0.4	0.1	0.2	0.3	0.0	−1.6	
1999	1.1	0.4	0.7	0.1	0.1	0.5			0.5	0.1	0.2	0.3	0.2	−1.6	
2000	1.2	0.4	0.8	0.1	0.1	0.6			0.6	0.1	0.2	0.3	0.3	−1.6	
2001	1.3	0.4	0.9	0.1	0.1	0.7			0.7	0.1	0.4	0.5	0.2	−1.6	
2002	1.4	0.4	1.0	0.1	0.0	0.9			0.9	0.1	0.0	0.1	0.8	−1.0	↑
2003	1.5	0.4	1.1	0.1	0.0	1.0			1.0	0.1	0.0	0.1	0.9	−0.2	Loss
2004	1.6	0.4	1.2	0.1	0.0	1.1			1.1	0.1	0.0	0.1	1.0	0.8	Profit
2005	1.7	0.4	1.3	0.1	0.0	1.2			1.2	0.1	0.0	0.1	1.1	1.9	↓
2006	1.8	0.4	1.4	0.1	0.0	1.3			1.3	0.1	0.0	0.1	1.2	3.1	
2007	1.8	0.4	1.4	0.1	0.0	1.3			1.4	0.1	0.0	0.1	1.2	4.3	
2008	1.9	0.4	1.5	0.1	0.0	1.4			1.4	0.1	0.0	0.1	1.3	5.6	
2009	1.9	0.4	1.5	0.0	0.0	1.5			1.5	0.1	0.0	0.1	1.3	6.9	
2010	2.0	0.4	1.6	0.0	0.0	1.6			1.6	0.1	0.0	0.1	1.4	8.4	
2011	2.1	0.4	1.7	0.0	0.0	1.7			1.7	0.1	0.0	0.1	1.5	9.9	
2012	2.1	0.4	1.7	0.0	0.0	1.7			1.7	0.1	0.0	0.1	1.6	11.5	
2013	2.2	0.4	1.8	0.0	0.0	1.8			1.8	0.1	0.0	0.1	1.7	13.1	
2014	2.2	0.5	1.7	0.0	0.0	1.7			1.7	0.1	0.0	0.1	1.6	14.7	
2015	2.3	0.5	1.8	0.0	0.0	1.8			1.8	0.1	0.0	0.1	1.7	16.4	
2016	2.4	0.5	1.9	0.0	0.0	1.9			1.9	0.0	0.0	0.0	1.9	18.3	
TOTAL	38.7	9.8	28.9	2.2	2.2	24.5	2.2	2.2	28.9	2.2	2.2	8.8	20.1	22.2	

Note: Total may not add up due to rounding up of figures.

IMPLEMENTATION PROGRAMME 6

6.0 IMPLEMENTATION PLAN

6.1 Introduction

The implementation programme for various measures proposed in the TSM Plan is separated into three (3) phases as shown in Table 6.1 and described as below:

(1) **Phase 1 (1988 – 1990)**

In this phase, existing on-going projects are expected to be continued. The major new works to be started in Phase 1 are projects under the Road Network Improvement Plan, Pedestrian Path Network Plan and ATC System Expansion Plan – Stage II.

(2) **Phase 2 (1991 – 1995)**

The construction of Coastal Road to link Penang Bridge to the Central Area is to be started and completed in Phase 2. Upon its completion, changes to the traffic circulation system in the Central Area will take place.

It is also necessary to begin work on various other measures proposed, such as road improvement in conjunction with the improvement of intersections, enforcement of on-street parking control and the provision of public parking space elsewhere, the construction of the new CBD Bus Terminal to accommodate the relocation of Prangin Bus Terminal the introduction of new buses to replace the old fleet, the completion of the proposed Pedestrian Path Network Plan and the implementation of the ATC System Expansion Plan – Stage III.

This period which will see the implementation and completion of many of TSM measures and also marks the maturity period of the proposed TSM Plan.

(3) **Phase 3 (1996 – 2000)**

The TSM Plan will be completed in this phase. The projects undertaken in this period are the final stages of the Road Network Improvement Plan, further enforcement of on-street parking control and the provision of public parking space to replace them, the construction of local bus terminals and replacement of old bus fleet under the Bus Transport Improvement Plan and the implementation of ATC System Expansion Plan – Stage IV.

(4) Beyond the year 2000

In this Study, transportation plans comprising the various TSM measures until the target year 2000 are proposed. Although the traffic demand and traffic flow pattern in the Study Area forecasted by the Study Team do not vary much from the results of the "Urban Transport Study" conducted by JICA in 1979, it is proposed that the construction of Outer Ring Road (proposed in the previous study) be delayed to beyond year 2000 considering that a slower economic growth rate is expected in Malaysia.

In addition, planning for improvement of urban streets or the introduction of a new transportation system, eg. Light Rail Transit, etc. would be necessary beyond year 2000.

Table 6.1 : Basic Implementation Programme

	Phase 1 1988–1990	Phase 2 1991–1995	Phase 3 1996–2000	Beyond 2000
Road Network Improvement	———	———	———	- - -
Traffic Circulation System Plan		———		
On-Street Parking Control	———	———	———	
Construction of Public Parking Facility		———	———	- - -
Construction of Bus Terminals		———	———	
Introduction of New Bus Fleet	———	———	———	- - -
Pedestrian Path Network Plan	———	———	- - -	
ATC System Expansion Plan	———	———	———	- - -

Note : The Traffic Circulation System Plan is to be implemented only after the completion of Coastal Road.

6.2 Implementation Programme

The implementation programme and project cost of each project proposed are listed in Table 6.2

The implementation programme for the main plans comprising the proposed TSM Plan, namely 'Public Parking Building Plan', 'CBD Bus Terminal Plan', 'Pedestrian Path Network Plan', and 'ATC System Expansion Plan' will be presented in detail here.

Table 6.2 : Implementation Programme for the TSM Plan

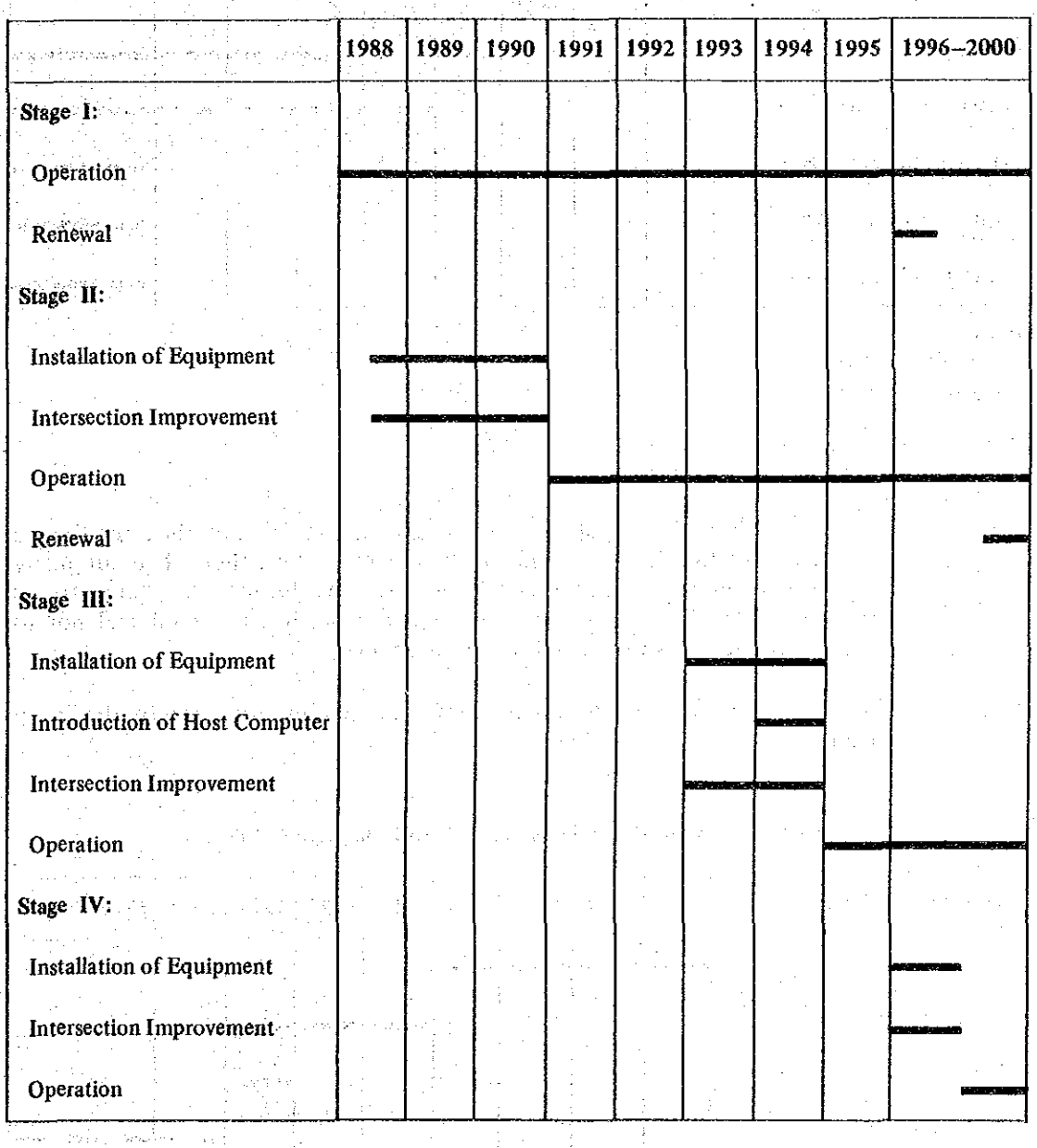
Name of Plan	Size	Unit	Phase 1 1988–1990	Phase 2 1991–1995	Phase 3 1996–2000	Project Cost M$ Million At 1986 Price	
ROAD IMPROVEMENT PLAN							
A. New Construction							
1. Coastal Road	4.3	km				70.00	
2. South Coastal Road	3.4	km				23.00	
3. New Pair Road	4.9	km				25.00	
4. Air Itam By-pass	4.0	km				3.70	
5. Weld Quay Extension	4.3	km	(5.00)	(20.00)	(35.00)	60.00	
6. Van Praagh Extension	0.8	km		(3.00)	(3.60)	6.60	
7. Free School Extension	0.8	km				2.36	
8. Trengganu Road Extension	0.4	km				1.41	
9. Boundary Road Extension	1.2	km				1.80	193.87
B. Improvement							
10. Dato Keramat Road	0.5	km				0.48	
11. Perak Road	0.5	km				0.55	1.03
Sub-total			6.03	98.50	90.37		194.90
CIRCULATION SYSTEM PLAN							
1. ATC System Modification	12	Intersection				0.36	
2. Intersection Improvement	4	Intersection				0.18	0.54
Sub-total			0	0.54	0		0.54
PARKING PLAN							
1. Public Parking Buildings	4	Building		(3.70)	(11.10)		14.80
Sub-total			0	3,70	11.10		14.80
BUS IMPROVEMENT PLAN							
A. Bus Terminal Buildings							
1. CBD Terminal	1	Building				7.35	
2. Gelugor Terminal	1	Building				0.40	
3. Ayer Itam Terminal	1	Building				0.32	8.07
B. Bus Terminals/Stops Improvement							
4. Local Bus Terminals	3	Lot				0.60	
5. Bus-stops in CBD	40	Stop	(0.10)	(0.10)		0.20	
6. Bus-stops in Other Area	80	Stop		(0.10)	(0.10)	0.20	1.00
C. Bus Fleet Improvement	140	Bus	(2.00)	(5.60)	(3.60)		11.20
D. Bus Transport Study Execution							1.00
Sub-total			3.10	13.15	5.02		21.27
PEDESTRIAN PATH NETWORK PLAN							
1. Stage I	4.08	km				1.69	
2. Stage II	6.77	km				2.06	3.75
Sub-total			1;69	2.06			3.75
ATC SYSTEM							
A. System Cost							
1. Stage II	49	Intersection				7.24	
2. Stage III	59	Intersection				19.27	
3. Stage IV	25	Intersection				8.78	
4. Stage I Renewal	16	Intersection				3.10	
5. Stage II Renewal	49	Intersection				6.89	45.28
B Intersection Improvement							
6. Stage II	49	Intersection				0.61	
7. Stage III	59	Intersection				0.72	
8. Stage IV	25	Intersection				0.37	1.70
C. Operation Cost		Lump Sum	(0.28)	(1.95)	(4.29)		6.52
Sub-total			8.13	21.93	23.44		53.56
GRAND TOTAL			18.95	139.88	129.93		288.76

Note : Numerals in brackets ( ) indicate the amount in each phase.

A. ATC System Expansion Plan

The effectiveness of a computerized traffic signal control system in reducing delay time has already been seen during the operation of the ATC System–Stage I. In this respect, the existing ATC system should be further expanded step by step as shown in Table 6.3 in order to achieve even more savings in delay time.

Table 6.3 : Implementation Programme for ATC System Expansion Plan



B. Public Parking Building Plan

In consideration of the increasing demand for parking space and the reduction of public parking space due to the strengthening of on-street parking control, the following implementation programme for providing public parking facilities is desirable (see Table 6.4).

Table 6.4 : Implementation Programme for Public Parking Building Plan

Car Park	1988	1989	1990	1991	1992	1993	1994	1995	1996–2000
Penang Road Car Park									
CBD Bus Terminal Car Park									
Downing Street Car Park									
Amoy Lane Car Park									
Brick Kiln Road Car Park									

Legend:

Construction

Operation

C. CBD Bus Terminal Plan

The new CBD Bus Terminal must be opened before or around the same time as the opening of Coastal Road scheduled for 1995. Until then, there are many tasks which must be undertaken, such as establishing the body to be responsible for the management, securing the necessary capital and not to mention, reclamation works and the preparation of site.

Table 6.5 shows the detail implementation programme proposed by the Study Team.

Table 6.5 : Implementation Programme for CBD Bus Terminal Plan

Construction Stage	1988	1989	1990	1991	1992	1993	1994	1995	1996–2000
Preparation									
Terminal Building									
Pedestrian Bridge									
Operation									

D. Pedestrian Path Network Plan

Improvement of pedestrian paths in the Central Area must be conducted earnestly. The implementation programme must also take into consideration the various stages of pedestrianization being undertaken already and the implementation schedule for the circulation system. An implementation programme (see Table 6.6) which requires about M$0.5 million annually is proposed.

Table 6.6 : Implementation Programme for Pedestrian Path Network Plan

Road Name	1988	1989	1990	1991 – 1995
Burma Road				
Dato Keramat Road				
King St/Bishop St				
Pitt St/Armenian St/Cannon St/Cannon Sq				
Penang Road (Btw Chulia St/Farquhar St)				
Carnarvon Street				
Market St/Market St Ght				
Campbell St/Buckingham St				
Sg Ujong Rd/Cintra St				
China St/China St Ghaut				
Beach Street				
Farquhar St/Light St				
Transfer Rd/Argyll St				
Penang Rd (Btw Magazine Circle & Chulia Street)				
Prangin Road				
Magazine Road				
Weld Quay				
Brick Kiln Road				

6.3 Expenditure Estimate of Implementation Programme

In accordance with the implementation programme set up for the proposed TSM Plan shown in Table 6.2 in the preceding section, during the thirteen (13) years between 1988 to 2000, a total of M$289 million (at 1986 prices) in capital investment is estimated. The MPPP, Federal/Penang State Government and the State's public corporation are identified as the three (3) possible implementing bodies for the projects.

A. Public Expenditure

The projects which will be implemented using public funds are those included in the following plans : Road Network Improvement Plan, Traffic Circulation System Improvement Plan, Pedestrian Path Network Plan and ATC System Expansion Plan.

Table 6.7 indicates the suggested implementing body to undertake each project and the estimated investment required in each phase.

B. Public Corporation Investment

Projects which will generate revenues can be undertaken by the State's public corporations or undertaken by the private sector through the availability of low-interest rate loans. In this case, the investment required by phase will be as indicated in Table 6.8.

Table 6.7 : Public Expenditure by Phase

(Unit : M$ million at 1986 prices)

Name of Plan	Implementing Body	Phase 1	Phase 2	Phase 3	Total Expenditure
		1988–1990	1991–1995	1996–2000	
Raod Network Improvedment Plan	Federal		70.00	23.00	93.00
	State		3.70	25.00	28.70
	MPPP	6.03	24.80	42.37	73.20
Traffic Circulation System Plan	MPPP	0	0.54	0	0.54
Pedestrian Path Network Plan	MPPP	1.69	2.06	0	3.75
ATC System Expansion Plan	MPPP	8.13	21.93	23.44	53.50
Total	Federal/State		73.70	48.00	121.70
	MPPP	15.85	49.33	65.81	130.99

Table 6.8 : Public Corporation Investment by Phase

(Unit : M$ million at 1986 prices)

Name of Plan	Phase 1	Phase 2	Phase 3	Total Investment
	1988–1990	1991–1995	1996–2000	
Parking Plan	–	7.35	7.35	14.80
CBD Bus Terminal Plan	–	7.35	–	7.35
Bus Transport Improvement Plan	3.1	5.80	5.02	13.92
Total	3.1	22.58	12.37	38.05

6.4 Financial Capabilities

The financial capabilities of the three implementing bodies are examined herein with a view to having them undertake specific components of the proposed TSM plan.

A. Federal and Penang State Government

Table 6.9 indicates that the allocation of federal funds to Penang State for roads and bridges development (for federal projects) constitutes 1.8% of the Fifth Malaysia Plan's (FMP) total allocation. This amount is by no means large. Nevertheless, a total amount of M$194 million in allocation is estimated for the ten (10) years period 1991 – 2000.

On the other hand, the allocation to roads and bridges in the Penang State Budget is estimated by the Study Team as about M$2.0 million in 1987. This amount for state projects is estimated to increase by 5% per annum thereafter. Thus, about M$30.6 million will be available from the State Budget for the period 1991 – 2000.

Projects under the Road Network Improvement Plan is estimated to cost M$122 million. Henceforth, with earnest attempts made to obtain a larger allocation of federal funds to Penang State it will be possible to implement the projects in the proposed TSM Plan.

Table 6.9 : Allocation to Roads and Bridges

(Unit : M$ million)

	Malaysia	Penang State	% Share
Economic Development Funds			
1986–1990 *	23,548.40	762.36	3.2%
1991–2000 **	68,408.10	2,189.06	3.2%
Federal Allocation to Roads and Bridges			
1986–1990 *	3,715.10	66.55	1.8%
1991–2000 **	10,792.36	194.26	1.8%
State Allocation to Roads and Bridges			
1991–2000 ***		30.6	

Notes: * Fifth Malaysia Plan (1986–1990)
** Figures estimated by the Study Team by using the growth rate of GDP (5.0%)
*** State Allocation to roads and bridges is estimated by the Study Team based on M$2.0 million in 1987, increasing by 5% per annum thereafter.

B. MPPP

Figure 6.1 shows the share of the estimated expenditure for the proposed TSM Plan as a percentage of the MPPP's Engineering Department's budgetary allocation for transportation improvements for the three (3) phases.

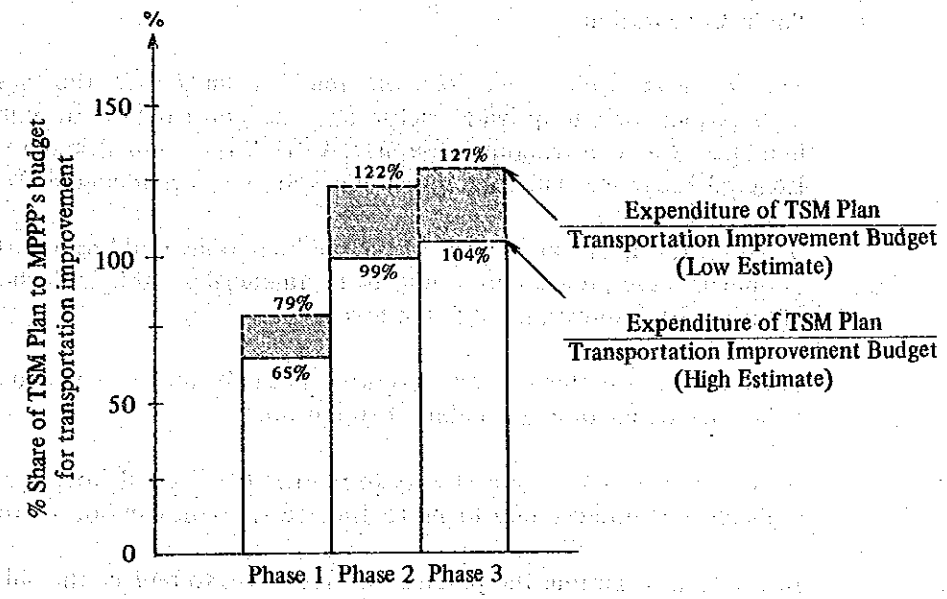


Figure 6.1 : % Share of TSM Plan to MPPP's Budget for Transportation Improvement in each Phase

In particular, the investment required for the TSM Plan, Phase 2 (1991 – 1995) and Phase 3 (1996 – 2000) will be slightly over the budgetary allocation of the Engineering Department even using the high estimate.

Taking into consideration of the above, the capital investment required for the TSM Plan is not expected to come solely from the MPPP's financial resources.

The possibility of MPPP implementing the TSM Plan will naturally be higher if federal funds can be obtained.

In particular, out of the total investment of M$49.3 million required for Phase 2, two projects account for a major portion of the requirements. These are the Weld Quay Extension Project using M$20.0 million (41% of total for Phase 2) and the ATC System Expansion Plan – Stage III using M$21.9 million (44%).

Next, in Phase 3, the Weld Quay Extension will consume another M$35.0 million or 53% of the total for that period and the ATC System Expansion Plan – Stage IV using M$23.4 million (36%).

Thus, it is necessary for the MPPP to begin negotiations for federal funds or subsidies for the Weld Quay Extension as soon as possible.

With regards the ATC System Expansion Plan which includes the introduction of a host computer for the ATC System, it is recommended that the MPPP requests the Federal Government for assistance by treating its installation as a federal project. Besides this, foreign government aids could be requested to finance this project.

C. **Public Corporation**

The projects which can rely on funds from either the State's public corporations or the private sector are the construction of public parking buildings, the construction of a new CBD Bus Terminal and the Bus Fleet Renewal Program. The total investment required is estimated as M$38 million.

Based on the financial analysis of the public parking building and the CBD Bus Terminal, these projects are found to be financially viable with the availability of loans with interest rate of 6% or lower.

Therefore, it is better if these two projects can be undertaken and managed by either an existing or a new public corporation.

In such a case, it will be necessary to request the Federal Government to make available low-interest rate loans to finance the construction of the buildings.

In addition, regarding the purchase of new buses to replace the old fleet, about M$11.0 million is estimated.

A detailed plan for the comprehensive improvement of the stage bus transport industry is beyond the scope of this Study. However, it is necessary for the MPPP to conduct a comprehensive Bus Transport Study in order to formulate a Bus Transport Masterplan. The implementation of the Bus Fleet Renewal Program then can be incorporated into this masterplan and various sources such as foreign government aids, etc. could be requested for the financing of this project.

6.5 Conclusion

Looking at the financial capabilities of the implementing bodies, with a view to having them undertake specific components of the proposed TSM Plan, it can be concluded that the TSM Plan should follow the implementation plan presented in Table 6.2.

However, for the implementation of the TSM Plan it is necessary to consider the following points:

(1) It is necessary to acquire federal funds or subsidies or even low-interest rate foreign loans secured through the Federal Government to finance the implementation of ATC System Expansion Plan. The total implementation cost of this plan is about M$54 million, of which the ATC system cost including intersection improvement cost is M$37 million.

(2) It is necessary to acquire federal funds or subsidies for the Weld Quay Extension project which costs a huge M$60 million.

(3) It is necessary to begin as soon as possible preparation work for the new CBD Bus Terminal such as determination of the implementing body, acquire the required land area and to seek long-term, low-interest loans for the project.

(4) The construction and management of a public parking building should be undertaken either by a public corporation or the private sector with special consideration given to the problem of high land cost in the CBD, such as leasing of public land to the project implementor.

(5) It is necessary to consider low-interest foreign loan for the purchase of a new bus fleet and at the same time to conduct a study to formulate a Bus Transport Masterplan.