6.5.3 Project Cost for Railway Commuter Service

This section contains of the analyses of capital investment and operation & maintenance costs. The operation cost sums up the expenditure for exclusive trains for commuter service.

The unit prices for the cost estimates were defined based on actual terms of local contractors, suppliers, government authorities and information of SRT. The resulting cost estimates were compared with similar projects in Thailand and foreign countries.

The methodology of cost calculation is shown in Fig. 6-6.

(1) Unit Capital Investment Costs (in Million Baht)

Cost Item (Unit Cost)	Financial Cost	Economic Cost
a) New Station (per unit)		
i) Case of Single Track	3.46	3.11
ii) Case of Double-Track	1.62	1.46
b) Double-Track (per km)	4.26	3.82
c) Signalling and Telecommunication (per km)	2.78	2.50
d) Improvement of Bangkok Station Yard	38.93	35.00
e) Expansion of Workshop	22.25	20.00
f) Purchase Price of Rolling Stock (per set)	7.65	6.50

(2) Annual Operation & Maintenance Unit Costs (in Million Baht)

Cost Item (Unit Cost)	Financial Cost	Economic Cost
a) Personnel cost		
i) Train driver and conductor (per train)	0.121	0.121
ii) Station staff (per station)	0.187	0.187
iii) Track maintenance (train/km)	0.003	0.003
iv) Others (per km)	0.003	0.003
b) Running cost		
i) Fuel and Lubricant (train/km)	0.002	0.002
ii) Others (per km)	0.001	0.001
c) Material cost for maintenance		
i) Permanent Way (train/km)	0.001	0.001
ii) Rolling stock (train/km)	0.001	0.001
iii) Others (per km)	0.001	0.001

(3) Capital Investment Cost and Annual Operation Cost

According to the facility plan, major investment items are summarized in Table 6-19. The project costs, classified into financial and economic costs, are shown in Table 6-20, and 6-21.

Fig. 6-6 WORK FLOW OF COST ESTIMATION

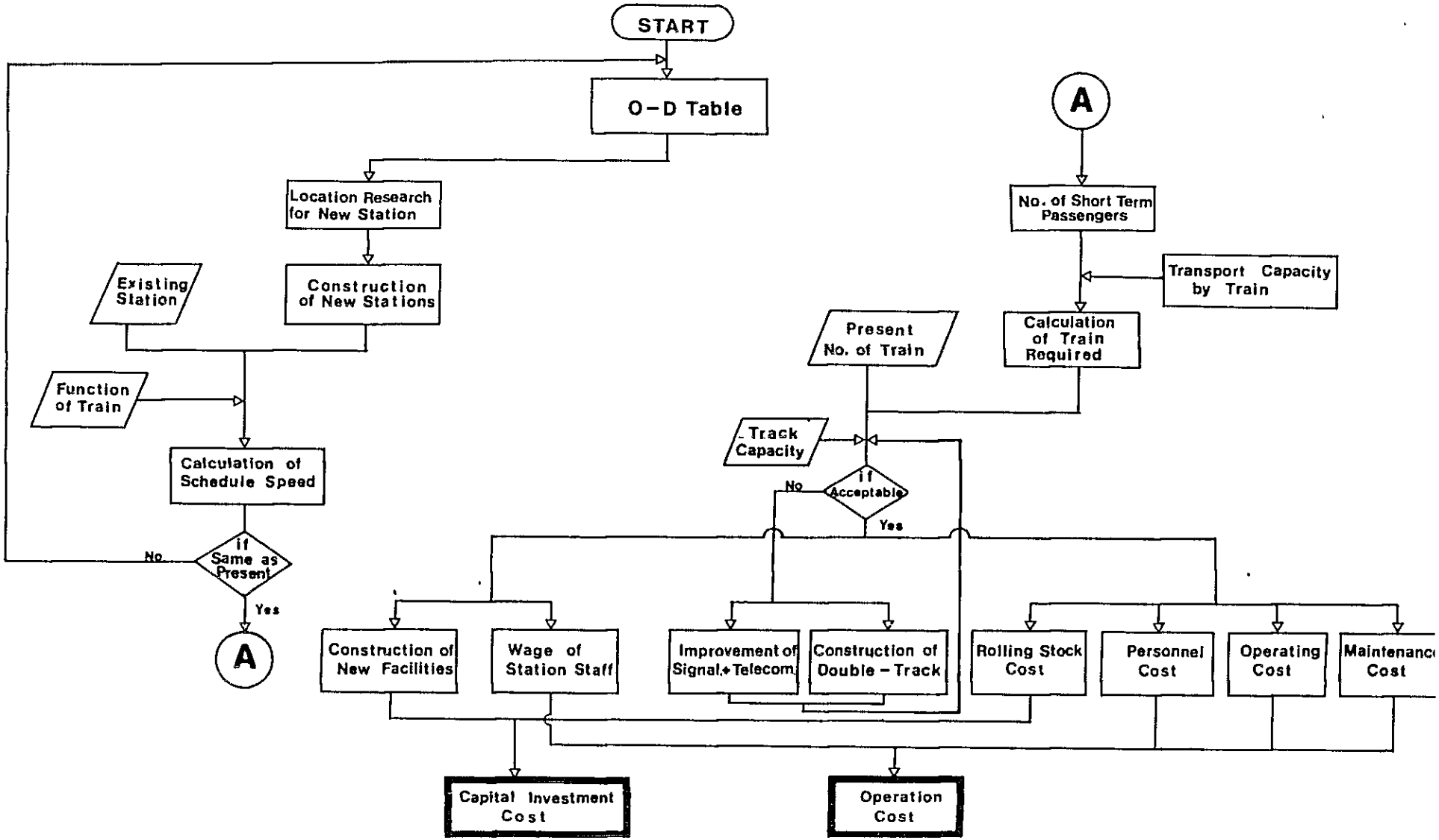


Table 6-19 TOTAL RAILWAY COMMUTER SERVICE INVESTMENT PROGRAM

	Southern Line		Northern & Northeastern Lines	Eastern Line	Other Items
	Alternative-1	Alternative-2			
1. Commuter Service Section	Nakhon Pathom - Bang Su	Nakhon Pathom - Thonburi	Bangkok - Ayuthaya	Bangkok - Hua Ta Khe	
2. Distance	56 km	48 km	72 km	31 km	
3. Construction Program					
1) New Station	None	None	5 stations	5 stations	
2) Double-Track	56 km	48 km	None	31 km	
4. Signalling and Telecommunication					
Case 2	Automatic Block System	Automatic Block System	None	Automatic Block System	
Case 14	Automatic Block System	Automatic Block System	Automatic Block System	Automatic Block System	
5. Bangkok Station Yard	-	-	-	-	Improvement
6. Makkasan Workshop	-	-	-	-	Expansion
7. Rolling Stock					
Case 2	135 sets	117 sets	80 sets	54 sets	
Case 4	135 sets	117 sets	94 sets	30 sets	

Note: These investment items are based on the traffic volume in the year 2000: Case 2 (lowest demand) and Case 14 (highest demand)

Table 6-20 TOTAL RAILWAY COMMUTER SERVICE (FINANCIAL COST) FOR CAPITAL INVESTMENT AND ANNUAL OPERATION

(Unit: million Baht)

	Southern Line		Northern & Northeastern Lines	Eastern Line	Other Items
	Alternative-1	Alternative-2			
1. Construction Program					
(1) New Station	None	None	8.10	8.10	
(2) Double-Track	314.42	205.00	None	136.32	
(3) Improvement of Bangkok Station Yard					38.93
(4) Engineering Fee (8%)	25.15	16.40	0.65	11.55	3.11
(5) Insurance Claim (1%)	3.14	2.05	0.08	1.44	0.39
(6) Contingencies (10%)	31.44	20.50	0.81	14.44	3.89
Sub-Total	374.15	243.95	9.64	171.85	46.32
2. Signalling and Telecommunications					
Case 2	155.70	133.50	None	86.20	
Case 14	155.70	133.50	200.20	86.20	
3. Expansion of Workshop	-	-	-	-	22.20
4. Rolling Stock					
Case 2	975.80	845.70	650.50	390.30	
Case 14	975.80	845.70	679.40	216.80	
5. Operating Costs					
(1) Case 2					
° Personnel Cost	48.87	46.16	25.46	16.33	
° Operating Cost	24.78	21.22	12.16	7.81	
° Material Cost	24.82	21.27	12.19	7.63	
Sub-Total	98.47	88.65	49.81	31.77	
(2) Case 14					
° Personnel Cost	48.87	46.16	53.53	13.87	
° Operating Cost	24.78	21.22	26.53	6.56	
° Material Cost	24.82	21.27	26.42	6.55	
Sub-Total	98.47	88.65	106.48	26.98	

Note: These investment items are based on the traffic volume in the year 2000: Case 2 (lowest demand) and Case 14 (highest demand)

Table 6-21 TOTAL RAILWAY COMMUTER SERVICE (ECONOMIC COST) FOR CAPITAL INVESTMENT AND ANNUAL OPERATION

(Unit: million Baht)

	Southern Line		Northern & Northeastern Lines	Eastern Line	Other Items
	Alternative-1	Alternative-2			
1. Construction Program					
(1) New Station	None	None	7.30	7.30	
(2) Double-Track	282.11	183.82	None	118.19	
(3) Improvement of Bangkok Station Yard					35.00
(4) Engineering Fee (8%)	22.57	14.71	0.58	10.04	2.80
(5) Insurance Claim (1%)	2.82	1.84	0.07	1.25	0.35
(6) Contingencies (10%)	28.21	18.38	0.73	12.55	3.50
Sub-Total	335.71	218.75	8.68	149.33	41.65
2. Signalling and Telecommunication					
Case 2	140.00	120.00	None	77.50	
Case 14	140.00	120.00	180.00	77.50	
3. Expansion of Workshop					20.00
4. Rolling Stock					
Case 2	877.50	760.50	585.00	351.00	
Case 14	877.50	760.50	611.00	195.00	
5. Operating Cost					
(1) Case 2					
◦ Personnel Cost	48.87	46.16	25.46	16.33	
◦ Operating Cost	24.78	21.22	12.16	7.81	
◦ Material Cost	24.82	21.27	12.19	7.63	
Sub-Total	98.47	88.65	49.81	31.77	
(2) Case 14					
◦ Personnel Cost	48.87	46.16	53.53	13.87	
◦ Operating Cost	24.78	21.22	26.42	6.56	
◦ Material Cost	24.82	21.27	26.42	6.55	
Sub-Total	98.47	88.65	106.48	26.98	

Note: These investment tiems are based on the traffic volume in the year 2000: Case 2 (lowest demand) and Case 14 (highest demand)

(4) Project Cost for Financial and Economic Analysis

The total project cost for railway commuter service are described in the proceeding section. However, the calculation of revenue or benefits for financial and economic analysis was only made for the GBA. Therefore, it is necessary to modify the project cost to match the area used for the financial and economic analyses. The commuter service sections in the GBA are as follows:

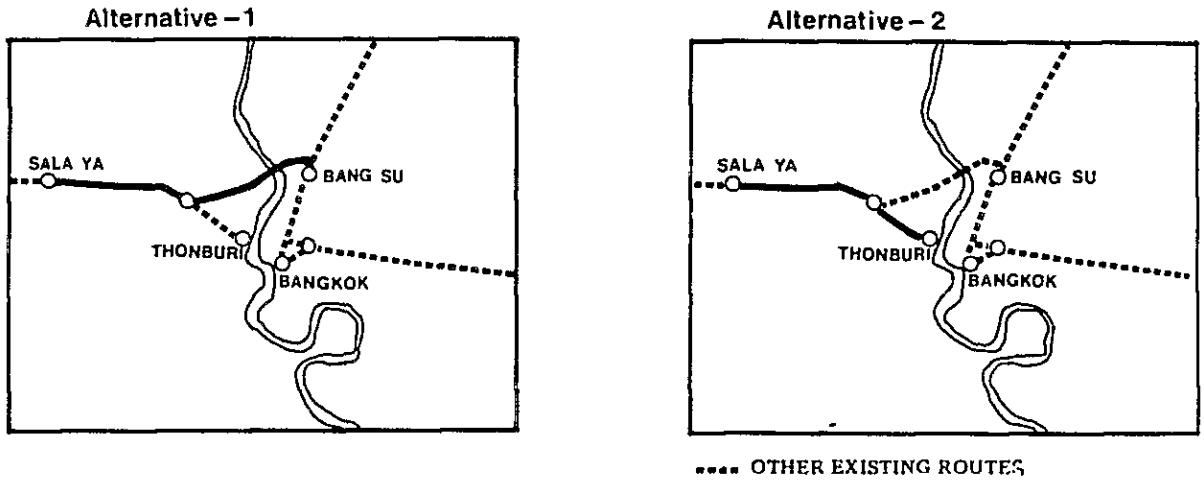
GBA Commuter Service Sections:

Southern Line	From/to Bang Su - Sala Ya	27.20km
Northern & Northeastern Line	From/to Bangkok - Khlong Ransit	28.50km
Eastern Line	From/to Bangkok - Hua Ta Khe	30.90km

The adjusted investment program is shown in Table 6-22, and the adjusted project cost is shown in Tables 6-23, 6-24.

In the case of Southern Line, two alternatives for the service have been selected according to the future traffic demand as follows:

SOUTHERN LINE UP-GRADING ALTERNATIVES



Alternatives for the Southern Line

Alternative-1	From/to Bang Su - Sala Ya	27.20 km
Alternative-2	From/to Thonburi - Sala Ya	19.10 km

According to the present train time table, there is no direct train connecting with Bangkok Station during the morning rush hours. Consequently, commuter passengers cross the Mae Nam Chao Phraya by ferry service from Thonburi Station to the Bangkok. In the year 2000, commuting passengers will be concentrated on the Bang Su - Sala Ya Route because there is no link service to

connect Thonburi Station with Bangkok. If there were a link service from Thonburi Station to Bangkok, the distance of this link service would be shorter than that of the Bang Su - Sala Ya route and eventually, the passengers will prefer this route. However, the route of Bang Su - Sala Ya was chosen for commuter service section at this stage; it will be necessary to make detailed study of the Thonburi - Sala Ya route in the next stage.

Table 6-22 RAILWAY COMMUTER SERVICE IN GBA INVESTMENT PROGRAM

	Southern Line	Northern & Northeastern Lines	Eastern Line	Other Items
1. Commuter Service Section	Bang Su ∿ Sala Ya	Bangkok ∿ Khlong Ransit	Bangkok ∿ Hua Ta Khe	
2. Distance	27.20 km	28.50 km	30.90 km	
3. Construction Program				
(1) New Station	None	3 Stations	5 Stations	
(2) Double-Track	27.20 km	None	30.90 km	
4. Signalling and Telecommunication				
Case 2	Automatic Block System	None	Automatic Block System	
Case 14	- " -	Automatic Block System	- " -	
5. Bangkok Station Yard	-	-	-	Improvement
6. Makkasan Workshop	-	-	-	Expansion
7. Rolling Stock				
Case 2	66 Sets	39 Sets	54 Sets	
Case 14	66 Sets	53 Sets	30 Sets	

Note: These investment items are based on the traffic volume in the year 2000: Case 2 (lowest demand) and Case 14 (highest demand)

Table 6-23 RAILWAY COMMUTER SERVICE IN GBA (FINANCIAL COST) FOR CAPITAL INVESTMENT AND ANNUAL OPERATION

(Unit: million Baht)

	Southern Line	Northern & Northeast-ern Lines	Eastern Line	Other Items
1. Construction Program				
(1) New Station	None	4.86	8.10	
(2) Double - Track	190.58	None	131.80	
(3) Improvement of Bangkok Station Yard	-	-		38.93
(4) Engineering fee (8%)	15.25	0.39	11.19	3.11
(5) Insurance claim (1%)	1.91	0.05	1.40	0.38
(6) Contingencies (10%)	19.06	0.49	13.99	3.89
Sub-Total	226.80	5.79	166.48	45.93
2. Signalling and Telecommunication				
Case 2	75.60	None	86.00	
Case 14	75.60	79.34	86.00	
3. Expansion of Workshop	-	-	-	22.20
4. Rolling Stock				
Case 2	504.70	298.20	412.90	
Case 14	504.70	405.30	229.40	
5. Operating Costs				
(1) Case 2				
°Personnel Cost	23.73	10.09	16.33	
°Operation Cost	12.03	4.82	7.81	
°Material Cost	12.05	4.83	7.63	
Sub-Total	47.81	19.74	31.77	
(2) Case 14				
°Personnel Cost	23.73	21.21	13.87	
°Operating Cost	12.03	10.47	6.56	
°Material Cost	12.05	10.47	6.55	
Sub-Total	47.81	42.15	26.98	

Note: These investment items are based on the traffic volume in the year 2000: Case 2 (lowest demand) and Case 14 (highest demand)

Table 6-24 RAILWAY COMMUTER SERVICE IN GBA (ECONOMIC COST) FOR CAPITAL INVESTMENT AND ANNUAL OPERATION

(Unit: million Baht)

	Southern Line	Northern & Northeast-ern Lines	Eastern Line	Other Items
1. Construction Program				
(1) New Station	None	4.38	7.30	
(2) Double - Track	171.06	None	118.19	
(3) Improvement of Bangkok Station Yard	-	-	-	35.00
(4) Engineering Fee (8%)	13.68	0.35	10.04	2.80
(5) Insurance Claim (1%)	1.71	0.04	1.25	0.35
(6) Contingencies (10%)	17.11	0.44	12.55	3.50
2. Signalling and Telecommunication				
Case 2	67.98	None	77.35	
Case 14	67.98	71.33	77.35	
3. Expansion of Workshop				20.00
4. Rolling Stock				
Case 2	429.00	253.50	351.00	
Case 14	429.00	344.50	195.00	
5. Operating Costs				
(1) Case 2				
°Personnel Cost	23.73	10.09	16.33	
°Operating Cost	12.03	4.82	7.81	
°Material Cost	12.05	4.83	7.63	
Sub-Total	47.81	19.74	31.77	
(2) Case 14				
°Personnel Cost	23.73	21.21	13.87	
°Operating Cost	12.03	10.47	6.56	
°Material Cost	12.05	10.47	6.55	
Sut-Total	47.81	42.15	26.98	

Note: These investment items are based on the traffic volume in the year 2000: Case 2 (lowest demand) and Case 14 (highest demand)

6.6 Construction Schedule

6.6.1 Construction Schedule

A tentative construction schedule for Suburban MTS and Railway Commuter Service by SRT is shown in Fig. 6-7 and 6-8. The priority of investment timing by route was chosen to correspond with future traffic demand and the tentative calculation of revenue. The planning of the construction schedule should take into account the period of time which is needed to prepare for start-up operation of suburban commuter service. The preparation for construction includes the following items:

(1) Establishment of an organization for coordination, supervision

(2) Revision of the relevant laws for the construction.

(3) Land acquisition.

(4) Engineering works.

(5) Establishment of finance.

Fig. 6-7 CONSTRUCTION SCHEDULE FOR SUBURBAN MASS TRANSIT

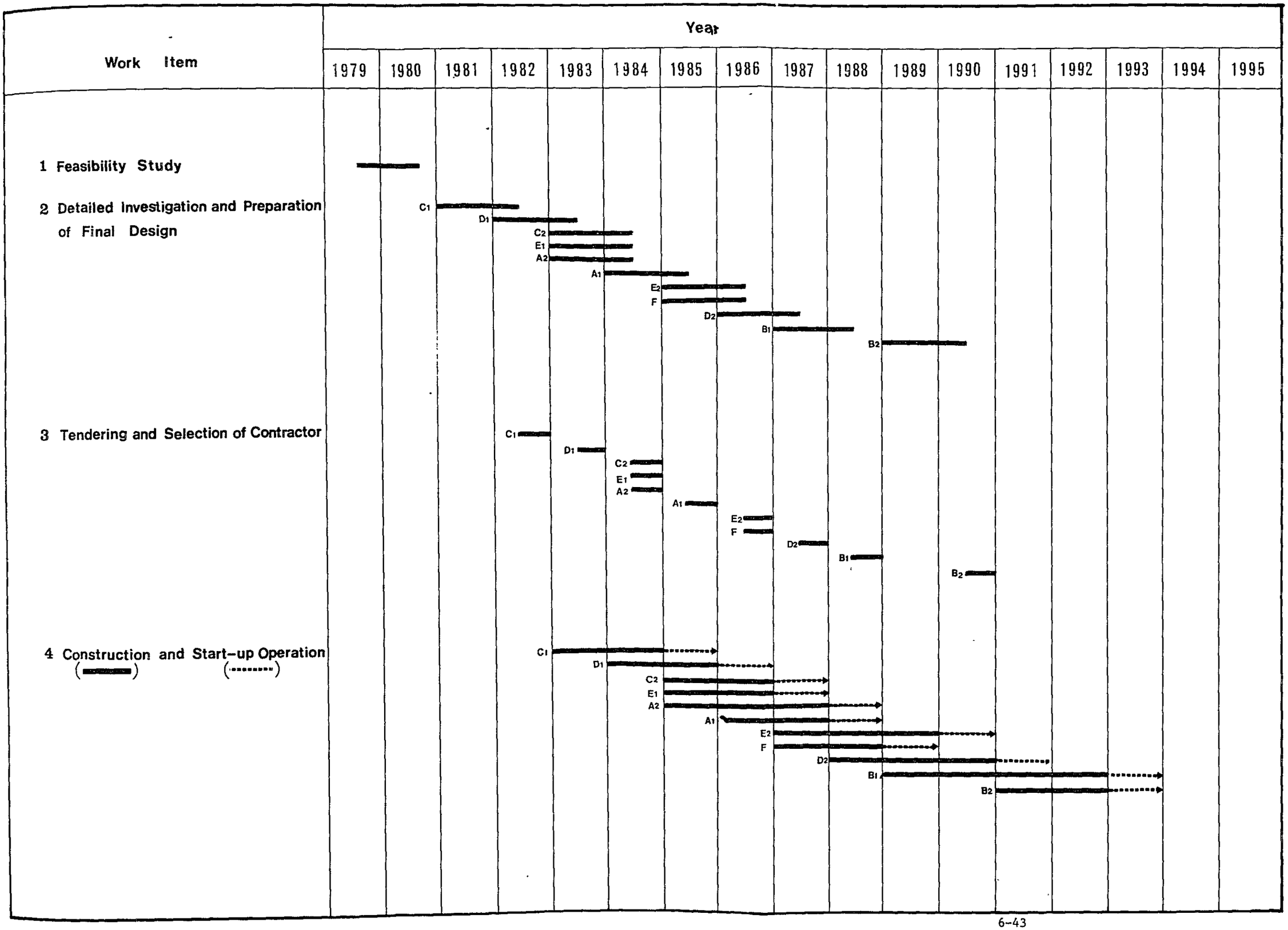


Fig. 6 – 8 CONSTRUCTION SCHEDULE FOR RAILWAY COMMUTER SERVICE

Work Item	Year																
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1 Feasibility Study																	
2 Detailed Investigation and Preparation of Final Design																	
(1) Southern Line																	
(2) Northern & Northeastern Lines																	
(3) Eastern Line																	
(4) Improvement of Bangkok Station and Expansion of Workshop																	
3 Tendering and Selection of Contractor																	
(1) Southern Line																	
(2) Northern & Northeastern Lines																	
(3) Eastern Line																	
(4) Improvement of Bangkok Station and Expansion of Workshop																	
4 Construction																	
(1) Southern Line																	
(2) Northern & Northeastern Lines																	
(3) Eastern Line																	
(4) Improvement of Bangkok Station and Expansion of Workshop																	

CHAPTER 7

ORGANIZATION AND ADMINISTRATION PLAN

7.1 Proposed Organization for Mass Transit System 7–1

7.1.1 Organization Chart 7–1
7.1.2 Non-administrative Staff 7–1
7.1.3 Administrative Staff 7–4
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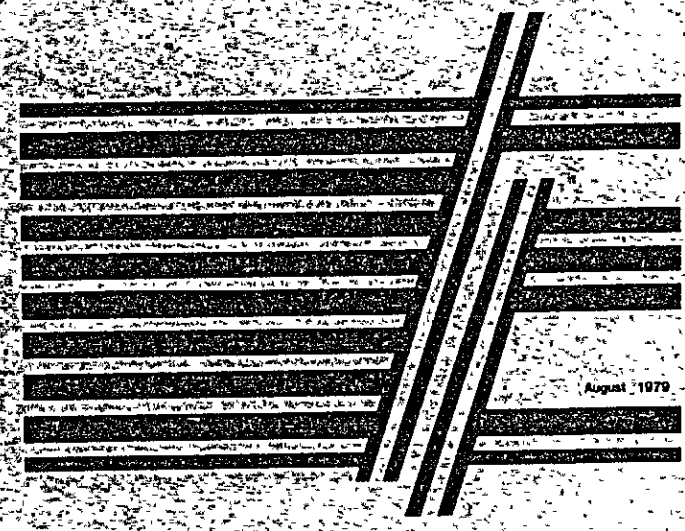
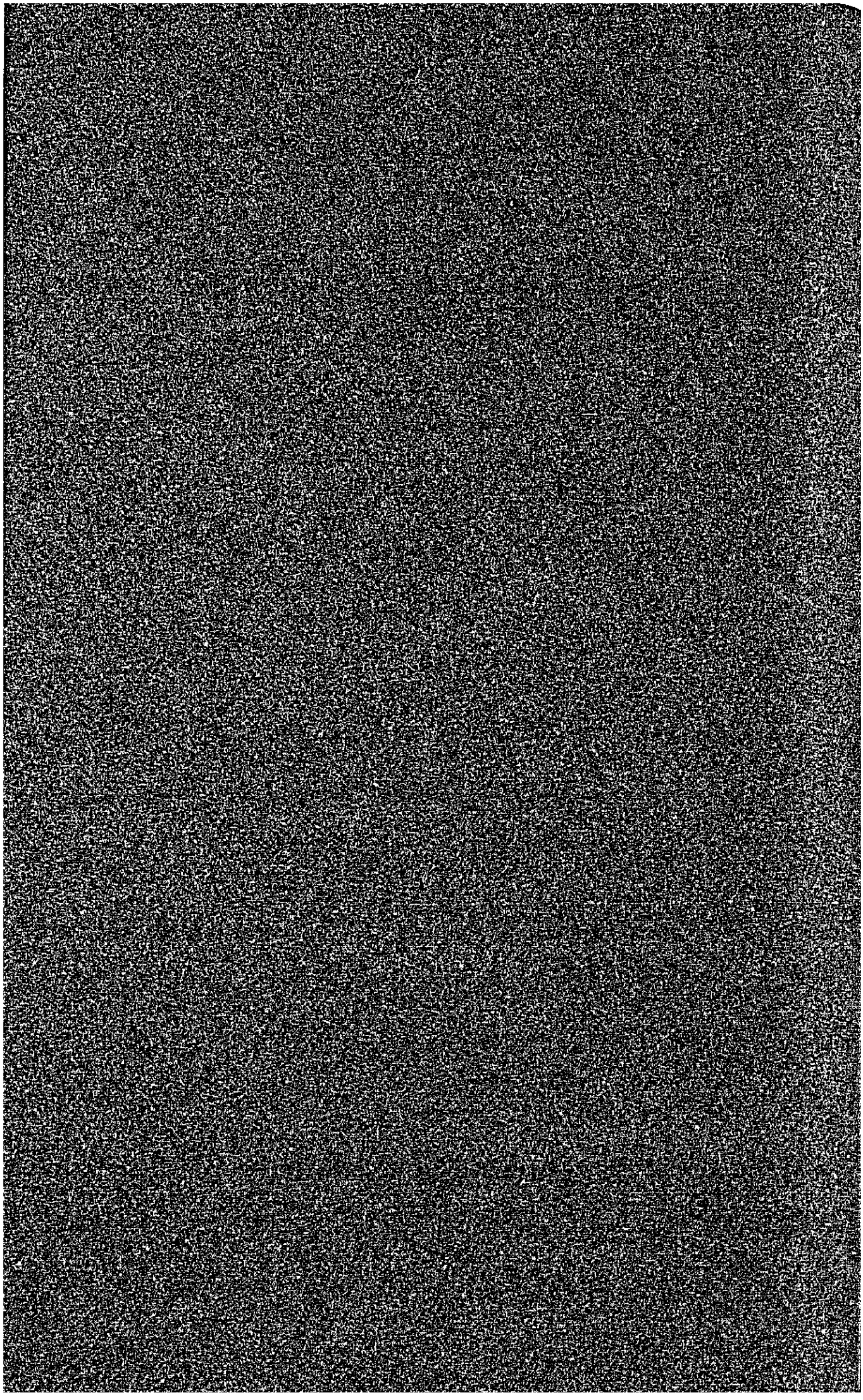
7.2 Organization for Railway Commuter Service 7–5





Chapter 7 ORGANIZATION

7.1 Proposed Organization for Mass Transit System

7.1.1 Organization Chart

The organization of the proposed MTS is as shown in Fig. 7-1. The First Stage MTS and the Suburban MTS should be controlled uniformly.

7.1.2 Non-Administrative Staff

(1) Classification of Non-Administrative Personnel

Each department includes non-administrative units as shown in Fig. 7-1 covering the following employees:

Station :	Station staff Conductor
Car Shed :	Drivers Car maintenance staff
Workshop :	Car inspection and repair staff
Facility Maintenance Office :	Track maintenance staff Signal and telecommunications maintenance staff

In each department, an appropriate number of operating and supervising staff shall be assigned:

(2) Number of Non-administrative Personnel

The necessary number of staff for each non-administrative organization mentioned in paragraph (1) for MTS of suburban area is as follows:

(a) Station Staff

$$S = 2 \times p \times k \times n$$

S: Total number of station staff
p: Average number of assigned staff per station
k: Coefficient against annual leave, rest, etc.
n: Number of stations

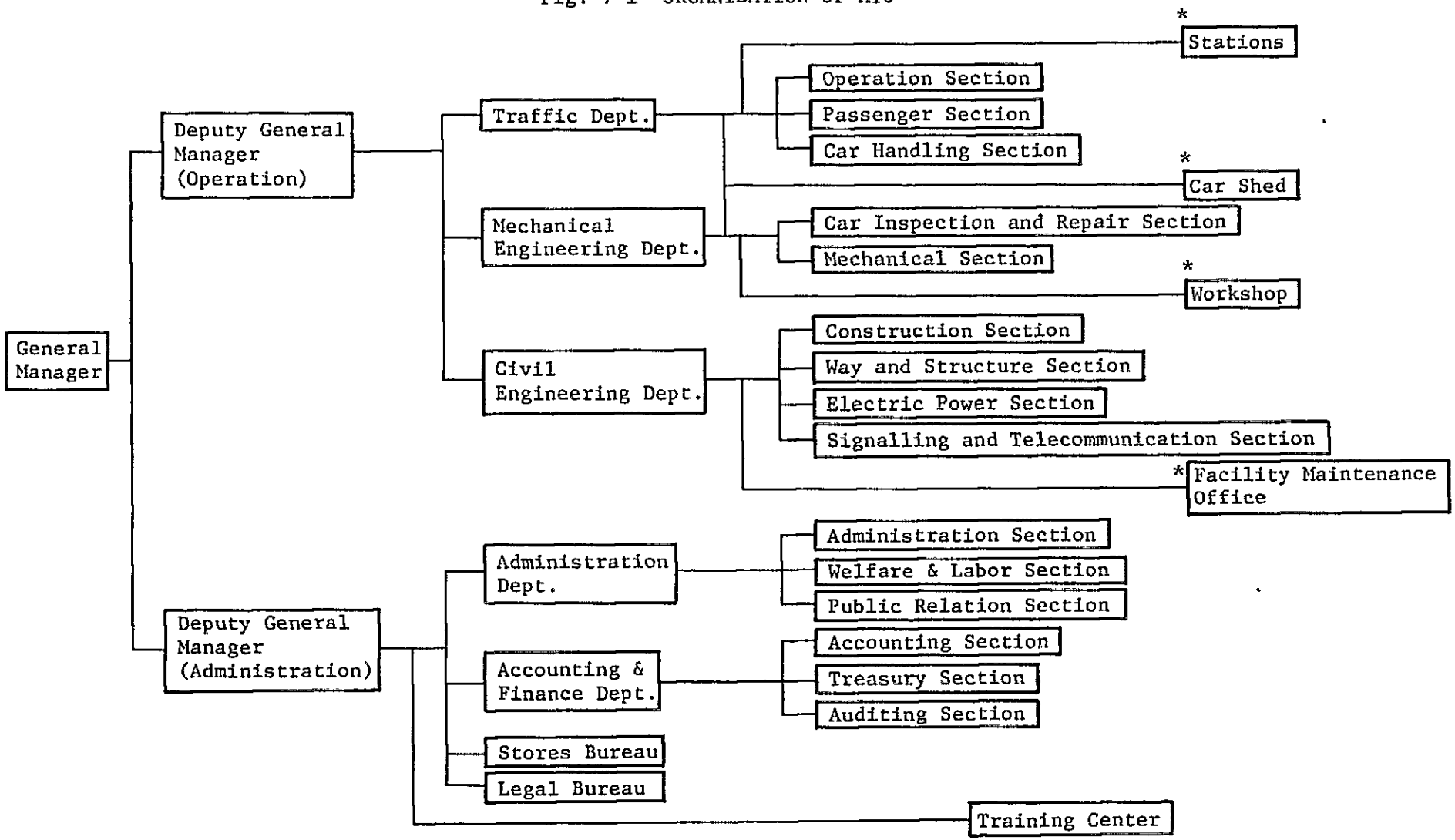
where P = 5, k = 1.34, n = 108

Therefore, $S = 2 \times 5 \times 1.34 \times 105 = 1,447$

(b) Drivers and Conductors

One driver and conductor per train shall be required. The total number required will be calculated as follows:

Fig. 7-1 ORGANIZATION OF MTS



Note * : Non-administrative staff.

$$D = \frac{T}{t} \times k'$$

D : Total number of drivers or conductors
T : Total number of train operating hours per year
t : Total working hours per person in a year
k': Coefficient against annual leave, rest, preparation and stand-by hours, etc.

Where

T = one of the following:

(case 2) = 56,078 minutes ÷ 60 minutes x 365 days
= 341,141 hours

(case 14) = 34,830 minutes ÷ 60 minutes x 365 days
= 211,883 hours

t = 8 hours x 6 days x 52 weeks = 2,496 hours
k'= 1,483

Therefore, D = one of the following:

(case 2) = 202
(case 14) = 125

(c) Car Maintenance Staff

One car maintenance staff shall be assigned per 10 cars. As number of cars in case 2 is 756, and 478 in case 14, the number of car maintenance is 76 in case 2 and 48 in case 14.

(d) Car Inspection and Repair Staff

One inspection and repair staff per car shall be assigned. Therefore, number of inspection and repair staff is 756 in case 2, and 478 in case 14.

(e) Track Maintenance Staff

One track maintenance staff per km of track length shall be assigned. Therefore, number of track maintenance staff is 102.

(f) Signal and Telecommunications Staff

One signal and telecommunications staff per km of track length shall be assigned. Therefore, the number of signal and telecommunications staff is 102.

(g) Operating and Supervising Staff

In each non-administrative organization, an appropriate number of operating and supervising staff for the above-mentioned (a) through (f) shall be assigned. The total

number of operating and supervising staff shall be 15% of the total number of the above-mentioned staff.

The number of non-administrative staff by route is shown in Table 7-1.

7.1.3 Administrative Staff

The recommended administrative organization of MTS system is as shown in Fig. 7-1. The number of personnel assigned in the administrative organization shown in Fig. 7-1 is 10% of the number of non-administrative personnel as calculated above.

Table 7-1 NUMBER OF NON-ADMINISTRATIVE STAFF BY ROUTE

		A1-A2	B1-B2	C1-C2	D1-D2	E1-E2	F	Total
Station staff:	Case 2	203	304	297	313	213	117	1,447
	Case 14	203	304	297	313	213	117	1,447
Driver:	Case 2	31	19	44	56	33	19	202
	Case 14	20	7	33	34	19	12	125
Conductor:	Case 2	31	19	44	56	33	19	202
	Case 14	20	7	33	34	19	12	125
Car maintenance staff:	Case 2	12	7	16	21	12	8	76
	Case 14	7	3	12	13	8	5	48
Car inspection and repair staff:	Case 2	118	70	160	208	124	76	756
	Case 14	76	22	124	132	76	48	478
Track maintenance staff:	Case 2	14	22	21	22	15	8	102
	Case 14	14	22	21	22	15	8	102
Signal and telecommunication maintenance staff:	Case 2	14	22	21	22	15	8	102
	Case 14	14	22	21	22	15	8	102
Operating and supervising staff:	Case 2	63	69	90	105	67	38	432
	Case 14	53	58	81	85	55	31	363
Total	Case 2	486	532	693	803	512	293	3,319
	Case 14	407	445	622	655	420	241	2,790

7.1.4 Training of Personnel

Prior to commencement of MTS operation, vocational training for drivers and technical staff will be needed.

For this training, it is preferable to cultivate key personnel to enable them to train other personnel. The above-mentioned training for the key personnel will be made by the entrusted foreign enterprises, if necessary.

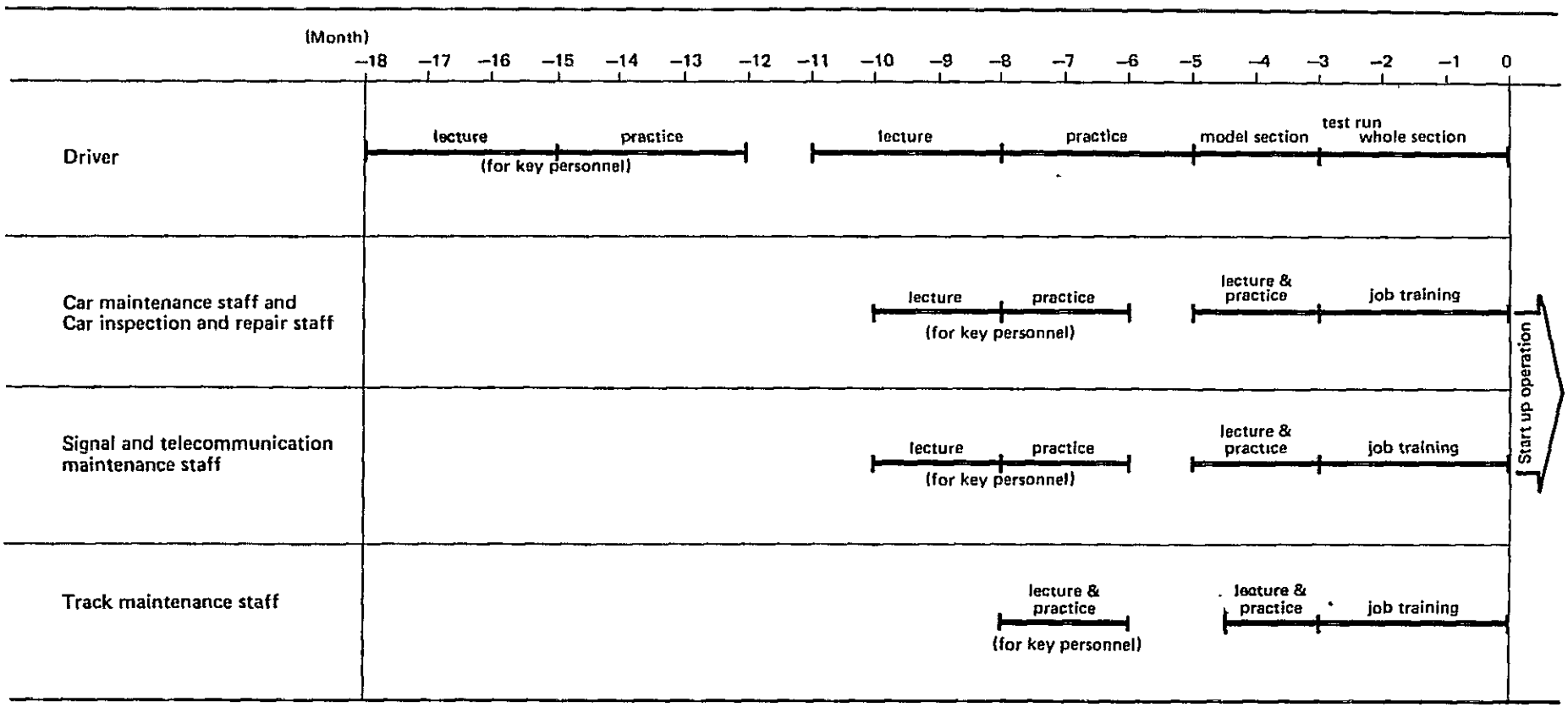
The appropriate number of the key personnel should be 4% of the total number of personnel to be trained.

An example of training schedule is shown in Fig. 7-2.

7.2 Organization for Railway Commuter Service

The administration for the railway commuter service should be provided by the present SRT organization and only necessary personnel should be increased.

Fig. 7-2 EXAMPLE OF TRAINING SCHEDULE



CHAPTER 8

ECONOMIC AND FINANCIAL EVALUATION

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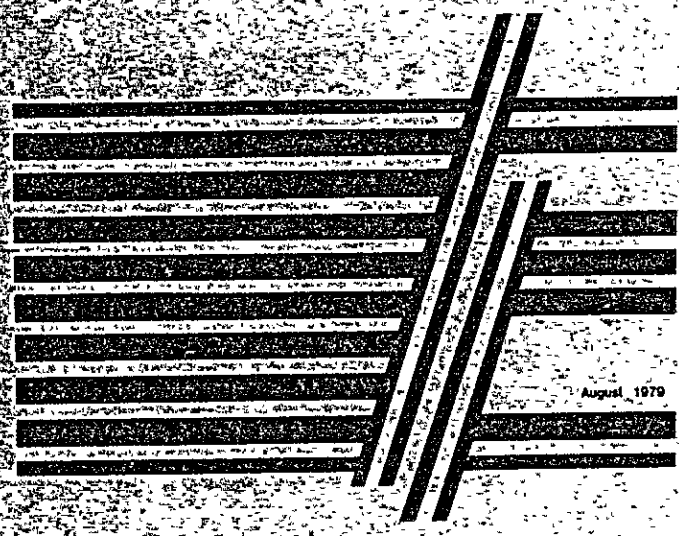

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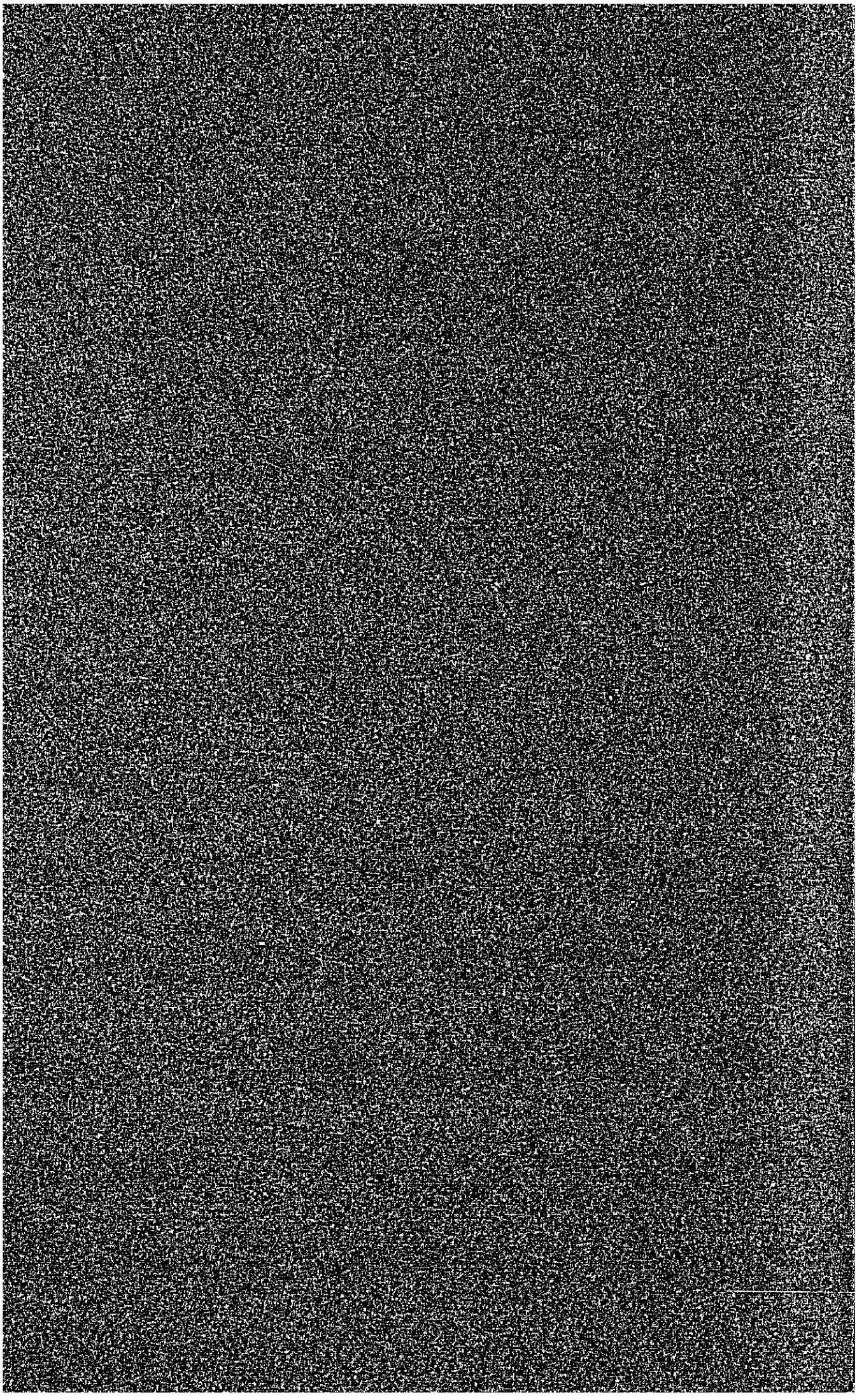


Chapter 8 ECONOMIC AND FINANCIAL EVALUATION

8.1 Economic Benefit

The benefit accruing from the project can be defined as the difference in socio-economic costs between the case where the project is implemented and the case where it is not. The socio-economic benefit attributable to the project includes various kinds of benefits whether these are tangible or not.

In this study, therefore, the benefit is calculated from the savings in vehicle operating costs, time costs and vehicle congestion costs.

For the calculation of these cost categories, reference was made to the Feasibility Study of the Outer Bangkok Ring Road Report and the Report of Road User Costs in Thailand prepared by the Ministry of Communication.

8.1.1 Vehicle Operating Costs

Various operating cost components enumerated in this analysis are derived on the basis of bench mark speed of vehicles. The bench mark speed are considered the normal or average speeds of passenger cars, trucks and buses on the good surface condition of the road, provided the traffic volume has not reached a level to cause congestion and consequently a slowing down of traffic. The road speed of 50 kilometers per hour was adopted as the bench mark speed of the vehicles.

(1) Vehicle Operating Cost Components

Among vehicle operating costs, the following cost components are taken to form the total vehicle operating cost at the bench mark speed.

1) Running Costs:
   - Ruel consumption,
   - Engine oil consumption,
   - Tyre wear,
   - Maintenance cost on spare parts,
   - Maintenance labour cost,
   - Vehicle depreciation and
   - Crew costs for commercial vehicles

2) Standing Costs:
   - Interest cost of a vehicle and
   - Overhead cost for commercial vehicles

The calculation of the above costs is based on 1978 prices and economic costs excluding the various taxes imposed on road users.

(2) Representative Vehicle

By the observation of vehicle traffic on major streets in the study area and interview with dealers of vehicles, the following vehicles are selected to represent the existing as well as future traffic flow component.

Passenger car ..... Toyota Corona, Ford Cortina with a 1600 cc engine, approximately 80 HP.

Light truck ..... Toyota Hilux, Nissan 1300 and Mazda 1200 with a load capacity of 1.0 ton.

Heavy truck ..... 10-wheel Isuzu TWD8HJ with an engine of 6,100 cc, 130 HP.

Heavy Bus ..... Isuzu BF40 with an engine of 6400 cc, 140 HP.

(3) Fuel and Engine Oil Costs

The prices of fuel and engine oil in Bangkok are found as shown in Table 8-1.

Table 8-1 FUEL AND ENGINE OIL COSTS IN 1978

(Unit: Baht/liter)

Cost Item	Retail Price	Duty & Tax	Economic Cost
Gasoline: Regular	4.69	2.02	2.67
Super	4.98	2.02	2.96
Diesel	2.64	0.32	2.32
Engine Oil	18.00	1.56	16.44

Source: Outer Bangkok Ring Road Report in 1978

Passenger cars are consumming both regular and super gasoline in the proportion of 20 percent and 80 percent respectively. Therefore, an average economic cost of the gasoline is to be 2.90 Baht/liter. The fuel and engine oil consumption of each representative vehicle type at the bench mark speed were found as given in Table 8-2.

Table 8-2 PERFORMANCE OF FUEL AND ENGINE OIL CONSUMPTION

Vehicle Type	Fuel Consumption* L/1000 km	Oil Consumption* L/1000 km
Passenger Car	90	1.0
Light Truck	130	1.3
Heavy Truck	220	2.2
Heavy Bus	170	2.2

Note: * The study results of "Outer Bangkok Ring Road" and "Road User Costs in Thailand, 1974" by Ministry of Communications were compared and the lesser consumption volume per 1000 km was taken for each type of the vehicles.

(4) Tyre Wear

The tyre wear cost per 1000 km were obtained as shown below:

Table 8-3 TYRE WEAR COSTS IN 1978

Vehicle Type	Tyre life (x1000 km)	No. of Tyre	Economic Cost of One Tyre (B)	Economic Tyre Cost (B/1000 km)
Passenger Car	40	4	399	39.90
Light Truck	50	4	711	56.88
Heavy Truck	60	10	1,961	327.49
Heavy Bus	60	6	2,782	278.20

Source: "Outer Bangkok Ring Road Report" in 1978

(5) Maintenance and Repair Costs

Maintenance and repair costs are divided into the spare parts cost and labour cost. By making reference to the report of "Quantification of Road User Savings" by Jan de Weille, these cost rates were determined as shown below. The average maintenance labour cost per hour, including salary, tools, overheads, etc. is assumed to be 20 Baht/hour.

Table 8-4 MAINTENANCE PARTS AND LABOUR COSTS* IN 1978

Vehicle Type	Hours of labour per 1000 km	Parts consm. (as % of economic cost of veh. per 1000 km)	Labour Costs (B/1000 km)	Parts Costs (B/1000 km)
Passenger Car	1.34	0.13	26.80	105.30
Light Truck	1.59	0.14	31.80	89.18
Heavy Truck	3.45	0.08	69.00	268.00
Heavy Bus	3.45	0.08	69.00	489.60

Note: Reference was made to "Quantification of Road User Savings" by Jan De Weille and "Road User Costs in Thailand, 1974" by Ministry of Communications.

(6) Depreciation Cost

According to the Technical Report No. 36 & 42 ("Road User Costs in Thailand"), the average annual mileage and the average service life of the vehicles were given as in Table 8-5. The depreciation cost per 1000 km was estimated based on an average year-round speed of the representative vehicle type. Making reference of the travel speed survey results, the average year-round speed were assumed to be 45 km/h for passenger car, 40 km/h

for light truck and 35 km/h for both heavy truck and heavy bus. The assumption was also made for the relationship between the road speed and depreciation costs that a higher road speed is reflected in a higher annual mileage, assuming a constant rate of vehicle utilization in hours per annum/ and a curvilinear relationship between annual mileage and total years of service. Specifically, two-thirds of the average service life of the vehicle is assumed to amount to the life-time mileage corresponding to the annual mileage, whereas one-third of the average service life is correlated to the annual mileage inversely. That means, higher speeds (above the year round road speeds) shorten the service life of the vehicle. The calculation of depreciation cost was thus established and formulated as shown in Table 8-5.

Table 8-5 DEPRECIATION COSTS OF VEHICLES

Vehicle Type	Av. year-round speed 1/ (km/h)	Av. annual mileage 2/ (1000 km)	Av. service life 2/ (year)	Life time mileage (1000km)	Economic Cost of the vehicle 3/ (B)	Depreciation Cost at the Specific Speeds km/h (B/1000 km)
Passenger car	45	18	9	162	81,000	$\frac{81,000}{2.4S + 54}$
Light truck	40	25	8	235	63,700	$\frac{63,700}{3.333S + 6.667}$
Heavy truck	35	70	7	490	335,000	$\frac{335,000}{9.334S + 163.333}$
Heavy bus	35	70	7	490	612,000	$\frac{612,000}{9.334S + 163.333}$

Note 1/ : By the observation of road traffic in the GBA
2/ : Source – "Road User Costs in Thailand, 1974" by Ministry of Communications
3/ : Source – "Outer Bangkok Ring Road Report" in 1978

(7) Crew Cost

The crew hours and crew cost rate of a heavy bus were obtained by interview with the Bangkok Mass Transit Authority. Regarding truck operation, these costs were quoted from the Outer Bangkok Ring Road Report.

Table 8-6 CREW HOURS AND COST RATE

Vehicle Type	Crew member		Av. annual working hours per crew member	Annual mileage (1000 km)	Av. crew hours per 1000 km	Hourly rate (B)		Crew Cost (B/1000km)
	Driver	Assistant or Conductor				Driver	Assistant or Conductor	
Light truck	1	0	2,000	0.625S	3200/S	10	–	32000/S
Heavy truck	1	1	2,500	2.000S	1250/S	12	8	25000/S
Heavy bus	1	1	2,500	2.000S	1250/S	15	8	28750/S

(8) Interest Cost

The interest cost to purchase a vehicle was found to be 14% per annum and was calculated based on an average value of 50 per cent of the price of a new vehicle.

Table 8-7 INTEREST COSTS OF VEHICLES

Vehicle Type	Annual mileage (1000 km)	as % of the 1/2 depreciable value of vehicle per 1000 km	Interest Cost (₧/1000 km)
Passenger car	0.400S	$\frac{14}{0.400S}$	14,175/S
Light truck	0.625S	$\frac{14}{0.625S}$	7,134/S
Heavy truck	2.000S	$\frac{14}{2.000S}$	11,725/S
Heavy bus	2.000S	$\frac{14}{2.000S}$	21,420/S

(9) Overhead Cost

The overhead cost is assumed to include other cost components such as rent for a building or a land, labour costs of administrative personnel, etc. This means that the overhead cost differs due to the size and type of operators. Therefore, the overhead cost was assumed to be 10 per cent of the running cost for light truck, while 20 per cent of the running cost for heavy truck and heavy bus.

(10) Vehicle Operating Cost by Speed

For the variation of operating costs for different vehicle speeds, reference was made to the Bangkok Transportation Study and Outer Bangkok Ring Road. Particularly, the conversion factors used there were retained for the calculation of consumption of fuel, engine oil, tyre and also for the maintenance and repair costs.

The vehicle operating cost is summarized in Table 8-8 in respect to vehicle types and different road speeds. In this table, the operating costs of a light truck and a heavy truck and consolidated as one category of truck. The consolidation was made in conjunction with the vehicle composition rate derived from the traffic count surveys conducted in the major roads by the Department of Highways and the Department of Town and Country Planning. According to the survey results light trucks and heavy trucks account for 47.3 per cent and 52.7 per cent respectively of the total truck flow per day. Consequently, it was taken that both light and heavy trucks constitute equally parts (each 50 per cent) of the total truck traffic in the future as well as at present.

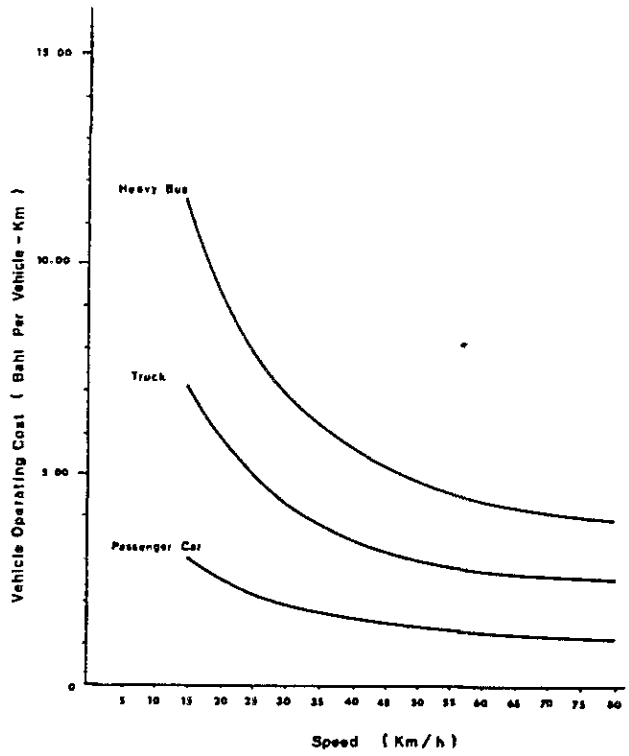
The resulting vehicle operation costs by speed and vehicle type are shown in Table 8-8 and graphically presented in Fig. 8-1.

Table 8-8 VEHICLE OPERATING COSTS BY SPEEDS IN 1978

(Unit: Baht/Veh-km)

Speed (km/h)	Passenger Car	Truck	Heavy Bus
15	2.955	7.072	11.223
20	2.481	5.797	9.277
25	2.148	4.927	7.923
30	1.912	4.317	6.958
35	1.721	3.828	6.183
40	1.569	3.454	5.596
45	1.461	3.245	5.156
50	1.378	2.966	4.798
55	1.309	2.821	4.566
60	1.260	2.722	4.392
65	1.217	2.659	4.270
70	1.179	2.606	4.169
75	1.146	2.567	4.083
80	1.116	2.530	3.930

Fig. 8-1 VEHICLE OPERATION COSTS BY SPEEDS



8.1.2 Value of Travel Time Savings

In this study, two different methods of calculating time value will be examined. The first method (A) directly derives an undifferentiated time value from the regional income, and the second method (B) expands the estimate by incorporating the difference in trip purposes between working time and non-working time for car owners and non-car owners into the estimate. Future time values are then projected for key project years. In order to verify the time value determined in this study, the Herbert D. Mohring's method was examined and is explained in Appendix AP8-1.

(A) The first method used here is basically the National or Regional Income approach which is applied in Japan in similar instances. A reduction in travel time during working hours would enable employers to use the manpower released for additional productive purposes. In this manner travel time savings will be reflected in the Gross Regional Product. The value of time savings is calculated regardless of trip purposes and income levels for two cases using the following formulas.

1. for private vehicle passengers = $\frac{\text{Gross Regional Product (in GBA)}}{\text{No. of workers x working hours/Yr.}}$

2. for public transport passengers = $\frac{\text{Gross Regional Product (in GBA)}}{\text{GBA population x Working hours/Yr.}}$

According to the "Report of Labour Force Survey" - National Statistical Office, the population 11 years of age and over in Metropolitan Bangkok was found in 1976 to be about 3,987 thousand or 87.6 percent of the total population of 4,550 thousands. Of the above, the economically active population (persons working for pay and profit and also unpaid family workers) account for about 53 percent. Accordingly, the workers in Metropolitan Bangkok were estimated to be 46.4 percent of the total population. The number of workers in the Greater Bangkok Area in 1978 was estimated by taking the same proportion (46.4%) of its population, or 2,697 thousand workers.

According to the National Statistical Office, the Gross Regional Product in the Greater Bangkok Area is estimated for 1977 at 128,200 million Baht at 1977 current prices and also it is estimated for 1979 at 148,712 million Baht at 1978 current prices. The nominal growth rate used of 16% for the GBA is based on a real economic growth from 1977 to 1978 estimated by NESDB (in the Gross Provincial Product 2520 - 2524) at 8.9% for the GBA plus an inflation rate in this period of 7.1%.

The average annual income per worker, therefore, was 55,140 Baht provided that the gross regional product is equivalent to the regional income. Based on the annual working hours which was found to be 2000 hours on an average, an average hourly time value for a private vehicle passenger was calculated to be 27.6 Baht.

The time value of a public transport passenger was calculated by dividing the regional income by the total population of the GBA as follows:

Regional income in 1977 ..... 128,200 million Baht
Population in 1977 ..... 5.56 million
Average working hours per annum..2000 hours

Therefore, time value of the public transport passenger is calculated to be $\left(\frac{128,200}{5.56 \times 2000}\right)$ = 11.53 Baht/hr.

Assuming that the time value increases proportionally to the growth of income per capita (4.3%) the time value in 1978 is estimated at 12.03 Baht/hr. (=11.53 x 1.043).

Thus, the time value in 1978 terms of a private vehicle passenger and a public transport passenger were estimated at 27.6 Baht/hr. and 12.03 Baht/hr. respectively.

(B) Compared to the prevailing wage rate in the GBA, the calculated hourly rates are high. This is because the distribution of the regional income not only includes the compensation of employees, but also income from unincorporated enterprises, income from property, direct taxes and charges on private corporations, savings of private corporations, general government income from property and entrepreneurship and so on. Therefore, the average annual income per worker of 55,140 Baht, which is based on GRP, includes salary, direct tax on income, and the savings and taxes mentioned above.

The valuation of paid working time is taken to be the marginal value attached by employers to an hour's work by an an employee, subject to the qualification that wages are not only cost of labour; paid working time includes social insurances, overhead costs, other supporting costs and wages. These costs input are finally expected to increase the output and to be reflected in the Gross Regional Product.

In order to more precisely calculate working time value, an attempt was made to differentiate the time value during working hours from that during non-working hours. Trip hours saved during working time (business or paid time) is valued at 100 percent of the hourly income (27.6 Baht/hr.) of the workers, while hours saved during non-working time is valued at 25 percent of the hourly income (6.9 Baht/hr.).

In addition, the income levels of car owners and non-car owners are assumed to be different. It was assumed that the time value for car owners is 50 percent higher, while for other transport users 25 percent lower than the average hourly income of 27.6 Baht.

Based on the above assumptions, the value of time cost savings were differentiated as follows:

Car owners:

Working time ..... 27.6 x 1.5 x 1.0 = 41.4 (Baht/hr.)
Non Working time ..... 27.6 x 1.5 x 0.25 = 10.4 (Baht/hr.)

Non-car owners:

Working time ..... 27.6 x 0.75 x 1.0 = 20.7 (Baht/hr.)
Non Working time ..... 27.6 x 0.75 x 0.25 = 5.2 (Baht/hr.)

Distribution of the trip purposes was estimated based on the Bangkok Transportation Study as 20 percent for business purposes and 80 percent for other purposes. Based on trip purpose and the differences examined above, the time value of a person making a trip was calculated and is presented in Table 8-9.

Table 8-9 UNIT TIME VALUES BY TRIP PURPOSE FOR CAR OWNERS AND NON-CAR OWNERS

	Hourly Rate (Baht)		Trip Purpose		Average Hourly Rate (Baht)
	Paid Time	Unpaid Time	Business	Others	
Car owners	41.4	10.4	20 %	80 %	16.6
Non-car owners	20.7	5.2	20 %	80 %	8.3

Source: Estimate by the Team as described herein based on 1978 prices.

By comparison, the time values from the second method were lower than those from the first method as shown below:

PASSENGER TIME VALUES: Summary of Calculation Results

(Unit: Baht/hr.)

	First Method (A)	Second Method (adopted) (B)
Private vehicle passenger	27.6	16.6
Public Transport passenger	12.0	8.3

Although the second method is based on more assumptions, the results from the second method were adopted in this study in order to be on the conservative side.

(C) Future time values were projected based on the growth rates for per capita income. Future growth rate of the income per capita from 1978 to 1980 has been assumed at 4.3 percent based on the NESDB estimates for those years, 3.5 percent from 1981 to 1990, and 3.0 percent from 1991 to 2000. Applying these growth factors to the time value for 1978, future unit time values per passenger hour were estimated as shown in Table 8-10.

In addition to passenger time values, vehicle time values were calculated based on the vehicle occupancy rates which were estimated in the Bangkok Transportation Study: 1.75 persons per passenger car and 20.00 persons per bus. The unit time values per vehicle are summarized in Table 8-10, assuming that there is no change in vehicle occupancy rates for the future.

Table 8-10 FUTURE TIME VALUES AT 1978 PRICES

(Unit: Baht)

Type of Transport	Time Value Basis	1978	1990	2000
Private Car	Per Passenger Hour	16.6	25.5	34.2
	Per Vehicle Hour	29.1	44.6	59.9
Public Transport	Per Passenger Hour	8.3	12.7	17.1
	Per Vehicle Hour	166.0	254.0	342.0

8.1.3 Total Benefits

Generally speaking, the construction of a mass transit system will primarily benefit passenger car users who will change their mode of transport from sedan to mass transit.

The direct benefits are assumed to consist of savings in vehicle operating costs, travel time costs and vehicle congestion cost. Indirect benefits such as impact on city development, increasing job opportunities, etc., are not included as benefits in this study.

In this study, the benefits from Suburban MTS and Railway are calculated by comparing two alternative cases: urban MTS with suburban MTS and urban MTS without the suburban MTS.

(1) Types of Benefits

Two types of direct benefits were considered for the calculation of total benefit:

a) Time Benefit

i) Benefit for passengers diverted to the suburban MTS: the total number of passenger-hours on the total MTS network including the time on the approach road to the station.

ii) Benefit for passengers not diverted to the suburban MTS: The total number of vehicle-hours on the total road network (calculated by type of vehicle).

b) Running Benefit

Benefit for car, bus and truck owners based on the vehicle-kilometers spent on the total road network including benefits resulting from reduced traffic congestion.

(2) Summary of Benefit Calculations

Comparing with the cases of the urban MTS with and without the suburban links, the direct benefits for the alternative cases were calculated as follows (Note: Calculations were actually made by computer):

CASE 2 (Rate of tariff of MTS: 0.078 Baht/km)

a) HOURLY PASSENGER-HOURS

MTS with Suburban links	417,828
MTS without Suburban links	396,074
Difference	-21,754

b) HOURLY VEHICLE-HOURS

	SEDAN	BUS	TRUCK	TOTAL
MTS with Suburban links	45,786	2,633	43,634	92,093
MTS without Suburban links	63,346	3,068	44,336	110,750
Difference	17,560	435	702	18,697

c) HOURLY VEHICLE-kms

	SEDAN	BUS	TRUCK	TOTAL
MTS with Suburban links	2,057,005	125,540	1,759,046	3,941,591
MTS without Suburban links	2,716,885	141,493	1,761,950	4,620,328
Difference	659,880	15,953	2,904	678,737

CASE 14 (Rate of tariff of MTS: 0.296 Baht/km)

a) HOURLY PASSENGER-HOURS

MTS with Suburban links	424,390
MTS without Suburban links	369,059
Difference	-55,331

b) HOURLY VEHICLE-HOURS

	SEDAN	BUS	TRUCK	TOTAL
MTS with Suburban links	46,009	3,570	43,669	93,248
MTS without Suburban links	63,484	3,547	44,347	111,378
Difference	17,475	-23	678	18,130

c) HOURLY VEHICLE-kms

	SEDAN	BUS	TRUCK	TOTAL
MTS with Suburban links	2,059,516	168,271	1,759,208	3,986,995
MTS without Suburban links	2,719,289	161,530	1,762,026	4,642,845
Difference	659,773	-6,741	2,818	655,850

By multiplying the above figures times the unit cost values from tables 8-8 and 8-10, the total benefit for each category was calculated as shown in Table 8-11.

Table 8-11 TOTAL BENEFITS, 2000

(Unit: Baht/Hr)

Tariff of MTS	Time Benefit	Running Benefit	Total Benefit
B/km			
0.296	88,203	1,069,363	1,157,566
0.078	914,186	1,191,031	2,105,217

Using the expansion ratio for average daily traffic (See page 5-67) and growth rates for the passenger traffic (See Table 5-38), the total benefit for each year of operation was calculated and the results are presented in Table 8-12. Hereupon the calculation was made based on the assumption 365 days per year.

Table 8-12 ANNUAL BENEFIT FLOW
(1978 present values)

Tariff of MTS / Year	0.078 Baht/km (Case 2)	0.296 Baht/km (Case 14)
1985	477.49	289.76
86	1,052.36	647.26
87	1,892.30	1,161.20
88	2,689.98	1,643.69
89	3,361.11	2,044.33
1990	3,827.23	2,327.46
91	4,432.45	2,654.13
92	4,664.00	2,757.36
93	6,597.75	3,855.19
94	6,909.80	3,994.29
95	7,221.85	4,133.39
96	7,533.90	4,272.49
97	7,845.95	4,411.59
98	8,158.00	4,550.69
99	8,470.05	4,689.79
2000	8,782.09	4,828.89
01	8,938.12	4,898.43
02	9,094.15	4,967.98
03	9,250.18	5,037.53
04	9,406.21	5,107.08
05	9,562.24	5,176.63
06	9,718.27	5,246.18
07	9,874.30	5,315.73
08	10,030.33	5,385.28
09	10,186.36	5,454.83
2010	10,342.39	5,524.38
11	10,498.42	5,593.93
12	10,654.45	5,663.48
13	10,810.48	5,733.03

(3) Priority for the Construction of the Suburban MTS alignment

The construction priority for sections of the Suburban MTS alignment is mainly based on the following considerations:

a) The volume of future traffic demand on the section.

b) The amount of reduction in total traffic volume on the road network produced by the section.

c) The contribution to total revenue of the mass transit system from the section.

d) The service to high potential development areas based on future land use patterns of housing estates and industrial complexes by the section.

e) The service to traffic congested areas and areas with low road densities.

In this study, the construction priority for suburban MTS sections was based on the traffic assignment results; i.e., the difference between construction of the total alignment minus the section being examined. The results are presented in Table 8-13.

Table 8-13 RANK PRIORITIES FOR SUBURBAN MTS LINKS, 2000

Link No. of Suburban MTS	Alternative Case No. for Traffic Assignment	Average Cross-sectional Passenger Volume (Person/Hr)	Rank A	*1 Project Revenue Loss (%)	Rank B	*2 Person-Hours Lost (%)	Rank C	Sum of Rankings	Cumulative Rank
A_1, A_2	9	23,822	4	24.9	4	8.1	4	12	4
B_1, B_2	10	6,524	7	20.4	6	8.0	5	18	6
C_1, C_2	11	36,497	1	31.2	1	8.5	3	5	1
C_3	12	19,680	5	27.5	3	7.5	7	15	5
D_1, D_2	6	24,579	3	29.8	2	11.1	1	6	2
E_1, E_2	7	29,616	2	29.4	5	8.9	2	9	3
F	8	16,682	6	20.2	7	7.9	6	19	7

*1 Project revenue loss without a specified link being constructed.
*2 Person-hours lost from the MTS without a specified link being constructed.

In order to determine the priority of individual MTS sections, passenger-kilometers were examined as shown in following Table 8-14.

Table 8-14 RANKED ASSIGNMENT OF PASSENGER-KMS ON SUBURBAN MTS SECTIONS, 2000

(Unit: Passenger-km/Hr.)

Suburban MTS Section No.	Tariff of MTS				Rank
	Case No. 2 (0.078 Baht/km)	(%)	Case No. 14 (0.296 Baht/km)	(%)	
A_1	204,913	6.4	78,971	4.5	2
A_2	205,137	6.4	141,098	8.0	1
B_1	298,529	9.3	85,305	4.9	2
B_2	8,021	0.2	-	0.0	5
C_1	498,604	15.5	197,310	11.2	6
C_2	374,083	11.6	244,517	13.9	4
C_3	425,379	13.2	260,467	14.8	6
D_1	425,097	13.2	274,039	15.5	4
D_2	234,225	7.3	152,709	8.7	3
E_1	172,705	5.4	106,655	6.1	1
E_2	235,791	7.3	131,541	7.5	5
F	136,093	4.2	86,106	4.9	7
Total	3,218,577	100.0	1,758,718	100.0	-

In addition, non-quantifiable considerations were given to the following sections as presented in Table 8-15.

Table 8-15 ADDITIONAL CONSIDERATIONS FOR CONSTRUCTION PRIORITY DETERMINATION

Suburban MTS Section No.	Additional Considerations
C_1	Housing estate now under construction nearby
F	Low density road area without alternative MTS facilities
E_2	Section not directly attached to urban MTS
D_2	Low development priority area not attached to urban MTS
C_3	Parallels SRT service route (Possibility using present SRT lines)
A_2	In order for Sections A_1 and A_2 to open at the same time, the longer route (A_2) must begin construction earlier.

According to tables 8-13, 8-14 and 8-15 the construction priority for sectors of the suburban MTS was determined as shown in Table 8-16.

Table 8-16 SUBURBAN MTS SECTOR CONSTRUCTION PRIORITY

Priority	1	2	3	4	5	6	7	8	9	10	11	12
Suburban Mass Transit Section	C_1	D_1	C_2	E_1	A_2	A_1	F	E_2	D_2	* (C_3)	B_1	B_2
Construction Commencement Year	1983	1984	1985			1986	1987		1988	1989		1991

* Section C_3 should make use of existing SRT facilities.

8.2 Economic Viability of the Project

The initial economic investment, operation and maintenance costs have been analysed using 1978 values in Chapter 6. The total economic costs for the construction of suburban mass transit system according to the priorities established in table 8-16 and the improvement of railway commuter services were discounted against the total economic benefits created by the project to derive the benefit-cost ratios and the internal rate of return for each alternative case considered as shown in Table 8-17.

Table 8-17 PROJECT ECONOMIC BENEFIT/COST RATIO AND INTERNAL RATES OF RETURN

Case No.	Construction Alternatives	Tariff of MTS (Baht/km)	Discount Rate	Discounted Total Benefit (Million Baht)	Discounted Total Economic Cost (Million Baht)	Benefit/Cost Ratio	Internal Rate of Return (%)
1	Elevated	0.078	30 35	1,830.95 1,119.54	1,751.45 1,267.42	1.04 0.88	31.3
2	At-Grade	0.078	35 40	1,119.54 714.45	1,053.58 775.37	1.06 0.92	37.1
3	Elevated & At-Grade	0.078	30 35	1,830.95 1,119.54	1,635.86 1,184.34	1.12 0.95	33.5
4	Using SRT Lines	0.078	30 35	1,830.95 1,119.54	1,721.85 1,236.13	1.06 0.91	32.0
5	Elevated	0.296	20 30	3,403.25 1,086.32	3,104.23 1,529.02	1.10 0.71	22.6
6	At-Grade	0.296	25 30	1,860.40 1,086.32	1,748.05 1,236.78	1.06 0.88	26.7
7	Elevated & At-Grade	0.296	20 25	3,403.25 1,860.32	2,801.75 1,937.14	1.21 0.96	24.2

The results above show that this project is economically feasible and will yeild a high rate of return, over 20%. The tariff rate of the suburban MTS should be as low as possible or the same as the existing railway (0.078 Baht/km), but even if the tariff rate should be increased to twice the existing bus tariff rate (i.e. 0.296 Baht/km), the economic feasibility of the project is verified.

For the purpose of considerating the economic sensitivity of the project, the costs and benefits were varied by 10% in several combinations to examine the best and worst possible outcomes of adopting Alternative 1 (an Elevated System) with a high tariff of 0.296 Baht/km (Case 14).

The results of sensitivity analysis, summarized in the Table 8-18 indicate from the economic viewpoint that the project will not be particularly sensitive to price escalation since a 20% variation in project benefits and cost will only produce a 4.4% loss of return. Since the suburban MTS is economically feasible, the project is recommended in order to alleviate traffic congestion and realize its benefits for the nation.

Table 8-18 ECONOMIC INTERNAL RATE OF RETURN (Case 14)

		Cost Sensitivity Range		
		-10%	0	+10%
Benefit Sensitivity Range	-10%		19.9(-2.7)	18.2(-4.4)
	0	24.3(+1.7)	22.6(Base)	20.0(-2.6)
	+10%	26.5(+3.9)	24.1(+1.5)	

The economic investment cost stream is shown in the appendix (Table AP8-5) in each alternative cases.

8.3 Financial Evaluation

In this chapter the financial feasibility of the suburban MTS is examined. For the financial evaluation, the revenues and costs of the project were discounted to 1978 present values for the total project life-span of 20 years (28 years after completion of the first priority section C1).

8.3.1 Revenue Calculation

The revenue from both the suburban MTS and SRT were calculated at different rates of tariff for two alternatives: the urban MTS with suburban links and the urban MTS without suburban links. The basic rates of tariff for revenue calculation were the same rates chosen for the traffic assignment: namely Case 2 (0.078 Baht/km) and Case 14 (0.296 Baht/km). The total revenue was calculated by computer using the following formula:

$$\text{Total Revenue} = \sum_{i=1}^{n} Pvij \cdot Dij \cdot Ta$$

where : Pvij = Passenger volume between station i and j (Passenger/Hr)

Dij = Travel distance between station i and j (km)

Ta = Unit tariff (Baht/km)

The results of the computer calculation were divided into Revenues for the Suburban MTS and Suburban SRT in tables 8-19 and 8-20 respectively.

(1) Revenue from the Suburban MTS in 1978 Present Values

Table 8-19 REVENUE FROM SUBURBAN MTS

(Unit: Baht/Hr)

Tariff of MTS (Baht/km)	Revenue		
	Urban MTS with Suburban links	Urban MTS without Suburban links	Difference
0.078	402,209	124,426	277,783
0.296	774,926	252,215	522,711

(2) Revenue from the Suburban SRT in 1978 Present Value

Table 8-20 REVENUE FROM SUBURBAN SRT

(Unit: Baht/Hr)

Basic Tariff of SRT (Baht/km)	Tariff of MTS	Revenue
0.078	0.078	175,139
	0.296	220.813

The total annual revenues according to the construction schedule for the life of the project are shown in Table 8-21.

In addition, the alternatives to increase the tariff rate of MTS as a contingency for possible price escalation were examined.

In this study, based on the rate of tariff escalation of SRT during the past ten-years, the escalation rate was settled at 0.4 percent per year.

Table 8-21 ANNUAL REVENUE FLOW*
(1978 present values)
(Unit=million Baht)

Year	0.078 Baht/km (Case 2)	0.296 Baht/km (Case 14)
1985	112.66	179.29
86	241.12	489.89
87	454.24	841.18
88	644.72	1,199.34
89	812.70	1,479.97
1990	932.86	1,691.03
91	1,050.69	1,869.55
92	1,089.10	1,937.86
93	1,525.70	2,504.61
94	1,577.66	2,589.94
95	1,629.62	2,675.20
96	1,681.57	2,760.50
97	1,733.53	2,845.79
98	1,785.49	2,931.09
99	1,837.45	3,016.38
2000	1,889.41	3,101.68
01	1,915.39	3,144.33
02	1,941.37	3,186.98
03	1,967.35	3,229.62
04	1,993.33	3,272.27
05	2,019.31	3,314.92
06	2,045.29	3,357.57
07	2,071.27	3,400.22
08	2,097.25	3,442.86
09	2,123.73	3,485.51
2010	2,149.21	3,528.16
11	2,175.18	3,570.81
12	2,201.16	3,613.46
13	2,227.14	3,656.10

* Based on a fixed tariff rate for the project life.

Using this method, the future Revenues both of suburban MTS and SRT were calculated as shown in Table 8-22.

Table 8-22 SUMMARY AND COMPARISON OF ALTERNATIVE REVENUE BASES

1) PROJECT REVENUE WITH ESCALATING TARIFF RATE (0.4% p.a.), 2000

(Unit: Baht/Hr)

Base Tariff of MTS (Baht/km)	Suburban MTS	SRT	Total
0.078	303,282	191,217	494,499
0.296	570,694	241,083	811,777

2) PROJECT REVENUE WITH FIXED TARIFF RATE, 2000

Fixed Tariff of MTS	Suburban MTS	SRT	Total
0.078	277,783	175,139	452,922
0.296	522,711	220,813	743,524

Whether the tariff rate is the same as the SRT tariff (0.078 Baht/km) or double the bus rate (i.e. 0.296 Baht/km), the result of a 0.4% tariff escalation is a 9% increase in total project revenues.

8.3.2 Financial Revenue Cost Ratio

For the financial evaluation the revenues, the costs of the project was discounted to 1978 present values at different discount rates and compared over the project life span of 20 years. The resulting financial revenue-cost ratios and financial internal rates of return for the complete project are shown in Table 8-23. Although the financial revenue-cost ratio and internal rates of return in Table 8-23 are lower than the economic benefit-cost ratio and economic internal rates of return, the financial internal rate of return shows more than 10 percent in the case of an MTS tariff rate of 0.296 Baht/km. If the tariff rate will increase at the rate of about 0.4% p.a, the financial internal rate of return should increase to more than 15 percent.

The results of sensitivity analysis, summarized in Table 8-24 indicate for the financial analysis of that the project will not be particularly sensitive to price escalations since a 20% variation in benefits and cost only produce a 3% loss of return.

Table 8-24 FINANCIAL INTERNAL RATE OF RETURN
(Case 14)

Revenue Sensitivity Range	Cost Sensitivity Range: -10%	0	+10%
-10%		12.0(-1.7)	10.7(-3.0)
0	15.4(+1.7)	13.7(Base)	12.2(-1.5)
+10%	17.1(+3.4)	15.2(+1.5)	

The financial investment cost stream is shown in the appendix (Table AP8-6) in each alternative cases.

Table 8-23 PROJECT FINANCIAL REVENUE/COST RATIO AND INTERNAL RATES OF RETURN

	Case No.	Construction Alternatives	Tariff of MTS (Baht/km)	Discount Rate	Discounted Total Revenue (Million Baht)	Discounted Total Financial Cost (Million Baht)	Revenue/ Cost Ratio	Internal Rate of Return (%)
Fixed Tariff Rate	1A	Elevated	0.078	1 5	36,358.15 15,159.14	28,803.13 17,053.32	1.26 0.89	3.8
	2A	At-Grade	0.078	4 5	18,651.88 15,159.14	17,332.51 15,256.17	1.08 0.99	4.9
	3A	Elevated & At-Grade	0.078	3 5	23,110.45 15,159.14	20,911.79 16,211.12	1.11 0.94	4.2
	4A	Using SRT Lines	0.078	3 5	24,445.06 16,111.15	23,713.50 18,271.35	1.03 0.88	3.4
	5A	Elevated	0.296	12 15	7,221.74 4,570.52	6,511.88 4,972.53	1.11 0.92	13.7
	6A	At-Grade	0.296	15 17	4,570.52 3,444.94	4,182.00 3,514.20	1.09 0.98	16.6
	7A	Elevated & At-Grade	0.296	14 15	5,298.51 4,570.52	5,055.95 4,628.48	1.05 0.98	14.7
Escalating Tariff Rate (0.4% p.a.)	1B	Elevated	0.078	2 5	31,488.60 16,550.66	25,026.30 17,053.32	1.26 0.97	4.7
	2B	At-Grade	0.078	5 7	16,550.66 11,155.13	15,256.17 11,971.58	1.08 0.93	6.1
	3B	Elevated & At-Grade	0.078	5 6	16,550.66 13,543.08	16,211.12 14,366.20	1.21 0.94	5.3
	4B	Using SRT Lines	0.078	3 4	25,231.86 20,364.01	23,713.50 20,770.70	1.06 0.98	3.8
	5B	Elevated	0.296	15 16	4,990.06 4,323.30	4,972.53 4,564.73	1.00 0.95	15.1
	6B	At-Grade	0.296	18 20	3,284.97 2,533.38	3,231.10 2,746.31	1.01 0.92	18.4
	7B	Elevated & At-Grade	0.296	15 18	4,990.06 3,284.97	4,628.48 3,595.22	1.08 0.91	16.4