CHAPTER 6
ROAD USER BENEFITS

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Road user benefits were quantified in terms of vehicle operating cost (VOC) savings and time savings, valued at economic prices, between "with" and "without" project cases.

6.1 VOC SAVINGS

In the feasibility study phases of the Study, vehicle operating costs in Thailand were thoroughly reviewed and updated. The Programing Section of DOH has been carrying out an exercise of updating DOH's standard VOC data including field data collection for various VOC components. The Study Team closely collaborated in the DOH effort and has utilized the results of their latest surveys.

6.1.1 Typical Vehicles

Vehicles were classified into motorcycle (MC), passenger car (PC), light bus (LB), medium bus (MB), heavy bus (HB), light truck (LT), medium truck (MT) and heavy truck (HT) categories, as in the Master Plan Study.

The basic characteristics of typical vehicles are shown in Table 6.1.1.

Table 6.1.1 CHARACTERISTICS OF TYPICAL VEHICLES

(Unit: Baht)

Type of Vehicle	Typical Vehicle	No.of Tires	Selling Price	Economic Cost	Economic Cost less Tires
MC	Honda TG 125 Suzuki TRZ	2	33,500	24,187	23,895
PC	Toyota Corona (1600 cc)	4	470,000	218,742	215,052
LB	Toyota Hilux	4	251,500	194,550	190,130
MB	Isuzu MPR59LU	6	489,500	414,628	399,424
HB	Hino BY341	6	1,500,000	1,284,011	1,252,479
LT	Toyota Hilux	4	245,500	189,144	184,724
MT	Isuzu MPR59LU	6	477,500	403,816	388,612
HT	Hino FM176	10	999,000	823,223	787,550

6.1.2 VOC Under Ideal Conditions

1) Components of VOC

VOC was analyzed by the following components:

- Fuel
- Oil
- Tires
- Maintenance
- Capital
- Overhead

2) Road Classification

The basic costs of each VOC component were estimated for a level tangent road, paved and laterite, by speed. The following classes of roads were considered:

Classification	Surface Condition
Paved Road	Good
	Good/Fair
	Fair
	Fair/Poor
	Poor
Laterite Road	Good
	Fair
	Poor

3) Basic Cost Components

The basic VOC component costs were calculated for a paved road in good condition and a laterite road in good and poor conditions, based on the latest information.

a) Fuel Costs

According to the retail prices fixed by the Fiscal Policy Office, Ministry of Finance in 1988, the prices of premium petrol, regular petrol and high-speed diesel were 8.9, 8.2 and 6.3 Baht per liter, respectively. The taxes and oil fund included in these prices are shown in the table below:

FINANCIAL AND ECONOMIC COST OF FUEL

(Unit: Baht/liter)

	ECONOMIC COST				TAXES			FINANCIAL COST
Type of Fuel	Ex-refinery Price	Import Price	Marketing Margin	Total	Import Duty	Business Excise & Municipal Taxes	Oil Fund	Retail Price
PREMIUM PETROL								
Locally Refined	3.6984		0.6220	4.3204		4.4440	0.1356	8.90
Imported		3.1431	0.6220	3.7651	0.0100	4.4440	0.6809	8.90
REGULAR PETROL								
Locally Refined	3.1206		0.5809	3.7015		4.4440	0.0545	8.20
Imported		2.5655	0.5809	3.1464	0.0100	4.4440	0.5996	8.20
HIGH-SPEED DIESEL								
Locally Refined	3.4562		0.4858	3.9420		2.5250	0.1670	6.30
Imported		3.1483	0.4858	3.6341	0.0100	2.5250	0.1309	6.30

From this table, economic unit costs of fuel were estimated at 4.32, 3.70 and 3.94 Baht per liter, for premium petrol, regular petrol and high-speed diesel, respectively, for locally refined products and 3.77, 3.15 and 3.63 Baht per liter, respectively, for imported products.

The average economic costs of fuel were calculated at 4.18, 3.57 and 3.83 Baht per liter, respectively, for premium petrol, regular petrol and high-speed diesel on the basis of the shares of locally refined and imported fuel in the Thai market as shown below:

AVERAGE COSTS OF FUEL

(Unit: Baht/liter)

Type of Fuel		Financial Cost	Economic Cost
PREMIUM PETROL			
Locally Refined	76%	8.90	4.32
Imported	24%	8.90	3.76
Average Price		8.90	4.18
REGULAR PETROL			
Locally Refined	76%	8.20	3.70
Imported	24%	8.20	3.15
Average Price		8.20	3.57
HIGH-SPEED DIESEL			
Locally Refined	65%	6.30	3.94
Imported	35%	6.30	3.63
Average Price		6.30	3.83

The unit costs of fuel, including average financial and economic transport costs of 0.20 and 0.15 Baht per liter for 250 km transportation, respectively, are shown below:

FUEL COSTS

(Unit: Baht/liter)

Type of Fuel	Financial Cost	Economic Cost
Premium Petrol	9.1	4.33
Regular Petrol	8.4	3.72
High-speed Diesel	6.5	3.98

Considering the kind of fuel used by vehicle type, the fuel costs by vehicle type were calculated as shown below:

USAGE OF DIFFERENT KINDS OF FUEL BY VEHICLE TYPE

(Unit: %)

Vehicle Type	Premium Petrol	Regular Petrol	High-Speed Diesel
MC	—	100	—
PC	65	25	10
LB	10	10	80
LT	10	10	80
MB, HB, MT, HT	—	—	100

FUEL COSTS BY VEHICLE TYPE

(Unit: Baht/liter)

Vehicle Type	Economic Cost
MC	3.72
PC	4.14
LB	3.99
LT	3.99
MB, HB, MT, HT	3.98

DOH's current standards for variations in fuel consumption by speed on paved roads (good condition) and laterite roads (good and poor condition) were reviewed and found sound, and therefore adopted as shown in Appendix 6.1.1.

Fuel costs per kilometer by vehicle type and speed were calculated by combining the fuel consumption data and fuel costs per liter as shown in Table 6.1.2.

Table 6.1.2 FUEL COSTS BY VEHICLE TYPE AND SPEED

(Unit: Baht/km)

Speed	MC	PC	LB	MB	HB	LT	MT	HT
Paved Road (Good Condition)								
20	0.123	0.571	0.622	0.784	1.239	0.622	0.784	1.362
30	0.119	0.448	0.488	0.638	1.131	0.488	0.638	1.244
40	0.117	0.395	0.431	0.588	1.053	0.431	0.588	1.158
50	0.118	0.371	0.405	0.638	1.131	0.405	0.638	1.244
60	0.124	0.357	0.389	0.708	1.298	0.389	0.708	1.427
70	0.132	0.354	0.392	0.806	1.516	0.392	0.806	1.667
80	0.145	0.367	0.407	0.971	1.744	0.407	0.971	1.918
90	-	0.390	-	-	-	-	-	-
Laterite Road (Good Condition)								
20	0.135	0.628	0.697	0.933	1.480	0.697	0.933	1.635
30	0.131	0.492	0.551	0.760	1.352	0.551	0.760	1.493
40	0.129	0.435	0.488	0.700	1.258	0.488	0.700	1.375
50	0.130	0.407	0.457	0.760	1.352	0.457	0.760	1.481
60	0.138	0.403	0.439	0.850	1.557	0.439	0.850	1.713
70	0.152	0.407	0.450	0.968	1.819	0.450	0.968	1.713
80	-	0.422	-	-	-	-	-	-
Laterite Road (Poor Condition)								
20	0.152	0.676	0.796	1.066	1.672	0.796	1.066	1.853
30	0.145	0.542	0.628	0.868	1.538	0.628	0.868	1.679
40	0.140	0.482	0.555	0.812	1.453	0.555	0.812	1.560
50	0.142	0.464	0.526	0.894	1.572	0.526	0.894	1.692

b) Oil Costs

The average price of motor oil for motorcycles, petrol-driven and diesel-powered vehicles are 39, 42 and 35 Baht per liter, respectively. The economic unit costs of oil were calculated at 30.95, 34.01 and 27.65 Baht per liter for motorcycles, petrol-driven and diesel-powered vehicles, respectively, by deducting the customs duty and business tax on oil from the average price of oil.

Based on the economic unit costs of motor oil for each type of fuel and the percentage shares of each kind of fuel used for each vehicle type, the oil costs per liter by vehicle type were calculated as shown below:

OIL COSTS BY VEHICLE TYPE

(Unit: Baht/liter)

Vehicle Type	Economic Cost
MC	30.95
PC	33.37
LB	28.92
LT	28.92
MB, HB, MT, HT	27.65

DOH's current standards for variations in oil consumption by speed on paved roads (good condition) and laterite roads (good and poor condition) were reviewed and then adopted in this study as shown in Appendix 6.1.2.

The oil costs per kilometer by vehicle type were calculated by combining the oil costs per kilometer and the oil consumption data as shown in Table 6.1.3.

Table 6.1.3 OIL COSTS BY VEHICLE TYPE AND SPEED

(Unit: Baht/km)

Speed	MC	PC	LB	MB	HB	LT	MT	HT
Paved Road (Good Condition)								
20	0.003	0.017	0.020	0.039	0.055	0.020	0.039	0.055
30	0.003	0.017	0.020	0.039	0.055	0.020	0.039	0.055
40	0.003	0.017	0.020	0.039	0.055	0.020	0.039	0.055
50	0.003	0.017	0.020	0.039	0.055	0.020	0.039	0.055
60	0.003	0.017	0.020	0.039	0.055	0.020	0.039	0.055
70	0.003	0.017	0.020	0.039	0.055	0.020	0.039	0.055
80	0.003	0.017	0.020	0.039	0.055	0.020	0.039	0.055
90	-	0.017	-	-	-	-	-	-
Laterite Road (Good Condition)								
20	0.003	0.020	0.029	0.053	0.072	0.029	0.053	0.072
30	0.003	0.020	0.029	0.053	0.072	0.029	0.053	0.072
40	0.003	0.020	0.029	0.053	0.072	0.029	0.053	0.072
50	0.003	0.020	0.029	0.053	0.072	0.029	0.053	0.072
60	0.003	0.020	0.029	0.053	0.072	0.029	0.053	0.072
70	0.003	0.020	0.029	0.053	0.072	0.029	0.053	0.072
80	-	0.020	-	-	-	-	-	-
Laterite Road (Poor Condition)								
20	0.006	0.033	0.040	0.075	0.111	0.040	0.075	0.111
30	0.006	0.033	0.040	0.075	0.111	0.040	0.075	0.111
40	0.006	0.033	0.040	0.075	0.111	0.040	0.075	0.111
50	0.006	0.033	0.040	0.075	0.111	0.040	0.075	0.111

c) Tire Costs

Data on the unit prices of tires were obtained from interviews with major tire manufacturers conducted by DOH, and the results are shown below:

FINANCIAL AND ECONOMIC COST OF TIRES

(Unit: Baht)

Vehicle Type	SINGLE TIRES				SET OF TIRES INC. SPARE		
	List Price	Typical Discount (%)	Av. Selling Price/ Financial Cost	Tax	Economic Cost	Financial Cost	Economic
MC	261	13	227	81	146	454	292
PC	1,170	25	878	140	738	4,390	3,690
LB	1,410	25	1,058	174	884	5,290	4,420
MB	3,460	25	2,595	423	2,172	18,165	15,204
HB	7,180	25	5,386	881	4,505	59,246	49,555
LT	1,410	25	1,058	174	884	5,290	4,420
MT	3,460	25	2,595	423	2,172	18,165	15,204
HT	5,170	25	3,878	635	3,243	42,658	35,673

Based on the unit economic costs of tires and the tire consumption rate data currently adopted by DOH (see Appendix 6.1.3), tire costs by vehicle type and speed were calculated as shown in Table 6.1.4. Conversion indices for variations due to speed and road conditions were taken from "Quantification of Road User Savings IBRD Occasional Paper No. 2, 1966", as shown in Appendix 6.1.4.

Table 6.1.4 TIRE COSTS BY VEHICLE TYPE AND SPEED

(Unit: Baht/km)

Speed	M/C	P/C	L/B	M/B	H/B	L/T	M/T	H/T
Paved Road (Good Condition)								
20	0.005	0.031	0.044	0.161	0.301	0.044	0.161	0.328
30	0.006	0.035	0.049	0.181	0.338	0.049	0.181	0.369
40	0.007	0.041	0.057	0.211	0.394	0.057	0.211	0.430
50	0.008	0.048	0.068	0.248	0.464	0.068	0.248	0.506
60	0.010	0.056	0.079	0.289	0.541	0.079	0.289	0.590
70	0.011	0.066	0.092	0.338	0.633	0.092	0.338	0.691
80	0.013	0.078	0.110	0.402	0.753	0.110	0.402	0.822
90	-	0.094	-	-	-	-	-	-
Laterite Road (Good Condition)								
20	0.010	0.069	0.082	0.303	0.570	0.082	0.327	0.673
30	0.012	0.077	0.093	0.341	0.641	0.093	0.368	0.758
40	0.013	0.090	0.108	0.396	0.745	0.108	0.428	0.880
50	0.016	0.106	0.126	0.465	0.874	0.126	0.502	1.032
60	0.018	0.124	0.148	0.544	1.023	0.148	0.587	1.208
70	0.022	0.144	0.173	0.635	1.195	0.173	0.686	1.411
80	-	0.172	-	-	-	-	-	-
Laterite Road (Poor Condition)								
20	0.031	0.224	0.260	0.958	1.846	0.260	0.958	1.985
30	0.032	0.235	0.272	1.003	1.933	0.272	1.003	2.079
40	0.034	0.244	0.284	1.046	2.014	0.284	1.046	2.166
50	0.036	0.259	0.300	1.107	2.132	0.300	1.107	2.293

d) Maintenance Costs

Economic vehicle maintenance costs per kilometer were estimated on the basis of monthly maintenance costs and annual kilometerages by vehicle type.

Monthly maintenance costs and annual kilometerages were obtained from the results of the DOH survey as shown below:

MONTHLY MAINTENANCE COSTS

(Unit: Baht/month)

	MC	PC	LB	MB	HB	LT	MT	HT
Financial	190	1,100	1,050	2,600	9,200	1,050	2,600	4,600
Economic	150	900	880	2,100	7,700	880	2,100	3,800

ANNUAL KILOMETERAGE AND AVERAGE SPEED BY ROAD TYPE

Vehicle Type	Paved (Good Condition)		Laterite (Good Condition)		Laterite (Poor Condition)	
	Annual Kilometrage	Average Speed	Annual Kilometrage	Average Speed	Annual Kilometrage	Average Speed
MC	13,000	55	12,000	45	10,500	30
PC	23,000	70	20,000	50	16,250	25
LB	34,000	60	31,800	50	27,400	30
MB	40,000	60	37,800	50	33,400	30
HB	100,000	60	94,000	50	60,000	30
LT	30,000	60	28,000	50	24,000	30
MT	40,000	60	36,700	45	33,400	30
HT	75,000	60	67,500	45	60,000	30

Appendix 6.1.5 shows the maintenance costs by road type, and Table 6.1.5 shows the maintenance costs by vehicle type and speed by using the indices of maintenance requirements on different types of road and speed as shown in Appendix 6.1.6.

Table 6.1.5 MAINTENANCE COSTS BY VEHICLE TYPE AND SPEED

(Unit: Baht/km)

Speed	MC	PC	LB	MB	HB	LT	MT	HT
Paved Road (Good Condition)								
20	0.168	0.512	0.350	0.708	1.304	0.396	0.889	0.858
30	0.148	0.454	0.310	0.629	1.049	0.351	0.715	0.690
40	0.136	0.413	0.293	0.593	0.877	0.331	0.598	0.577
50	0.132	0.400	0.284	0.576	0.823	0.322	0.561	0.542
60	0.141	0.435	0.311	0.630	0.924	0.352	0.630	0.608
70	0.153	0.470	0.332	0.673	1.029	0.376	0.702	0.677
80	0.162	0.497	0.353	0.715	1.173	0.400	0.799	0.772
90	-	0.529	-	-	-	-	-	-
Laterite Road (Good Condition)								
20	0.191	0.681	0.400	0.804	1.502	0.455	1.050	1.034
30	0.167	0.603	0.357	0.716	1.208	0.405	0.845	0.831
40	0.153	0.549	0.336	0.674	1.011	0.381	0.706	0.695
50	0.151	0.540	0.332	0.667	0.983	0.377	0.688	0.677
60	0.161	0.577	0.357	0.718	1.069	0.406	0.747	0.735
70	0.173	0.623	0.380	0.764	1.188	0.432	0.831	0.818
80	-	0.702	-	-	-	-	-	-
Laterite Road (Poor Condition)								
20	0.197	0.706	0.432	0.847	1.914	0.494	0.937	0.945
30	0.171	0.624	0.385	0.754	1.540	0.440	0.754	0.760
40	0.160	0.569	0.362	0.710	1.287	0.414	0.630	0.635
50	0.156	0.559	0.358	0.702	1.252	0.410	0.613	0.618

e) Capital Costs

Capital costs were calculated in terms of the annual capital cost and annual kilometerage. The annual capital costs of typical vehicles were calculated by using the following equation:

$$A = (P-L) * CRF + L * i$$

where,
- A: Annual capital cost
- P: Economic value of vehicle
- L: Salvage value of vehicle
- i: Annual rate of interest, 12%
- CRF: Capital recovery factor

$$CRF = \frac{i * (1 + i)^n}{(1 + i)^n - 1}$$

where, n: Vehicle life in years

The results of the calculation are shown in Table 6.1.6, and Appendix 6.1.7(1)-(6) shows relevant data.

Table 6.1.6 CAPITAL COSTS BY VEHICLE TYPE AND SPEED

(Unit: Baht/km)

Speed	MC	PC	LB	MB	HB	LT	MB	HT
Paved Roads (Good Condition)								
20	0.447	1.989	1.190	1.917	2.459	1.322	1.865	2.125
30	0.413	1.837	1.110	1.809	2.304	1.230	1.760	1.973
40	0.384	1.707	1.040	1.713	2.169	1.150	1.667	1.843
50	0.359	1.596	0.980	1.627	2.050	1.081	1.583	1.729
60	0.337	1.498	0.926	1.550	1.944	1.020	1.508	1.630
70	0.318	1.413	0.878	1.480	1.849	0.965	1.440	1.542
80	-	1.336	0.835	1.416	1.763	0.917	1.378	1.463
90	-	1.268	-	-	-	-	-	-
Laterite Road (Good Condition)								
20	0.500	2.352	1.380	2.247	2.865	1.532	2.186	2.493
30	0.463	2.182	1.291	2.126	2.694	1.431	2.069	2.323
40	0.431	2.036	1.213	2.019	2.545	1.341	1.964	2.176
50	0.403	1.909	1.145	1.922	2.411	1.264	1.870	2.049
60	0.379	1.798	1.084	1.834	2.291	1.195	1.785	1.935
70	0.358	1.699	1.030	1.754	2.183	1.133	1.707	1.834
80	-	1.611	-	-	-	-	-	-
Laterite Road (Poor Condition)								
20	0.583	3.252	1.991	2.988	3.838	2.215	2.907	3.327
30	0.540	3.030	1.870	2.835	3.621	2.075	2.758	3.112
40	0.502	2.834	1.762	2.697	3.429	1.952	2.624	2.922
50	0.471	2.663	1.668	2.573	3.256	1.843	2.503	2.736

f) Overhead Costs

Overhead costs per km were calculated as shown in Table 6.1.7 by dividing the annual overhead costs obtained from the results of the DOH survey by the annual kilometerages shown in Appendix 6.1.7(5).

ANNUAL OVERHEAD COSTS

(Unit: Baht/year)

LB	MB	HB	MT	HT
2,700	12,900	2,300	7,600	38,000

Table 6.1.7 OVERHEAD COSTS BY VEHICLE TYPE AND SPEED

(Unit: Baht/km)

Speed	M/C	P/C	L/B	M/B	H/B	L/T	M/T	H/T
Paved Road (Good Condition)								
20	-	-	0.107	0.413	0.557	-	0.244	0.691
30	-	-	0.099	0.386	0.516	-	0.228	0.633
40	-	-	0.091	0.362	0.481	-	0.213	0.585
50	-	-	0.085	0.341	0.450	-	0.201	0.543
60	-	-	0.079	0.323	0.423	-	0.190	0.507
70	-	-	0.075	0.306	0.399	-	0.180	0.475
80	-	-	0.070	0.291	0.378	-	0.171	0.447
90	-	-	-	-	-	-	-	-
Laterite Road (Good Condition)								
20	-	-	0.107	0.413	0.557	-	0.244	0.691
30	-	-	0.099	0.386	0.516	-	0.228	0.633
40	-	-	0.091	0.362	0.481	-	0.213	0.585
50	-	-	0.085	0.341	0.450	-	0.201	0.543
60	-	-	0.079	0.323	0.423	-	0.190	0.507
70	-	-	0.075	0.306	0.399	-	0.180	0.475
80	-	-	-	-	-	-	-	-
Laterite Road (Poor Condition)								
20	-	-	0.107	0.413	0.557	-	0.244	0.691
30	-	-	0.099	0.386	0.516	-	0.228	0.633
40	-	-	0.091	0.362	0.481	-	0.213	0.585
50	-	-	0.085	0.341	0.450	-	0.201	0.543

4) Cost Variation by Road Condition

The basic operating costs of vehicles on paved good condition roads (RC1), laterite good and poor condition roads (RC4 and RC7) were determined as described above. The basic costs of VOC components for other road conditions such as paved good/fair, paved fair, paved poor and laterite fair were calculated by means of interpolation assuming an appropriate order in VOC by surface conditions. The assumed order is shown below:

$$RC2 = RC1 + 1/3\ (RC4 - RC1)$$
$$RC3 = RC1 + 2/3\ (RC4 - RC1)$$
$$RC5 = RC4 + 1/2\ (RC4 - RC1)$$
$$RC6 = RC4 + 1/3\ (RC7 - RC4)$$

where, RC1: VOC for paved good
RC2: VOC for paved good/fair
RC3: VOC for paved fair
RC4: VOC for paved fair/poor or laterite good
RC5: VOC for paved poor
RC6: VOC for laterite fair
RC7: VOC for laterite poor

Table 6.1.8 shows VOC on a level tangent road by road class at different speeds.

Table 6.1.8 VOC ON LEVEL TANGENT ROAD

(Unit: Baht/km)

Speed	Road Type RC1	RC2	RC3	RC4	RC5	RC6	RC7
MC							
20	0.746	0.777	0.808	0.839	0.886	0.883	0.969
30	0.689	0.718	0.747	0.776	0.820	0.816	0.894
40	0.647	0.675	0.701	0.729	0.771	0.767	0.842
50	0.620	0.648	0.675	0.703	0.745	0.739	0.811
60	0.615	0.643	0.671	0.699	0.741		
70	0.617	0.647	0.678	0.708	0.754		
80							
90							
PC							
20	3.120	3.330	3.540	3.750	4.066	4.130	4.891
30	2.791	2.985	3.180	3.374	3.666	3.738	4.464
40	2.573	2.759	2.944	3.130	3.409	3.474	4.162
50	2.432	2.615	2.799	2.982	3.258	3.314	3.978
60	2.363	2.549	2.736	2.922	3.202		
70	2.320	2.511	2.702	2.893	3.180		
80	2.295	2.506	2.716	2.927	3.244		
90	2.298						
LB							
20	2.333	2.453	2.575	2.695	2.876	3.006	3.626
30	2.076	2.190	2.306	2.420	2.593	2.711	3.294
40	1.932	2.043	2.154	2.265	2.432	2.541	3.094
50	1.842	1.953	2.063	2.174	2.341	2.441	2.977
60	1.804	1.915	2.025	2.136	2.302		
70	1.789	1.905	2.021	2.137	2.311		
80	1.795						
90							
MB							
20	4.022	4.266	4.509	4.753	5.119	5.284	6.347
30	3.682	3.916	4.148	4.382	4.733	4.895	5.921
40	3.506	3.739	3.971	4.204	4.553	4.703	5.702
50	3.469	3.715	3.962	4.208	4.578	4.703	5.692
60	3.539	3.800	4.061	4.322	4.714		
70	3.642	3.921	4.201	4.480	4.899		
80	3.834						
90							

Table 6.1.8 VOC ON LEVEL TANGENT ROAD (Cont'd)

(Unit: Baht/km)

Speed	Road Type RC1	RC2	RC3	RC4	RC5	RC6	RC7
HB							
20	5.915	6.292	6.669	7.046	7.612	8.010	9.938
30	5.393	5.756	6.120	6.483	7.028	7.408	9.259
40	5.029	5.390	5.751	6.112	6.654	7.000	8.775
50	4.973	5.362	5.753	6.142	6.727	7.019	8.773
60	5.185	5.602	6.018	6.435	7.061		
70	5.481	5.939	6.398	6.856	7.544		
80	5.866						
90							
LT							
20	2.404	2.534	2.665	2.795	2.991	3.132	3.805
30	2.138	2.262	2.385	2.509	2.695	2.825	3.455
40	1.989	2.109	2.227	2.347	2.527	2.647	3.245
50	1.896	2.015	2.134	2.253	2.432	2.542	3.119
60	1.860	1.979	2.098	2.217	2.396		
70	1.845	1.969	2.093	2.217	2.403		
80	1.854						
90							
MT							
20	3.982	4.252	4.523	4.793	5.199	5.257	6.187
30	3.561	3.815	4.069	4.323	4.705	4.778	5.686
40	3.316	3.565	3.815	4.064	4.439	4.509	5.400
50	3.270	3.538	3.806	4.074	4.477	4.514	5.393
60	3.364	3.646	3.930	4.212	4.637		
70	3.505	3.812	4.118	4.425	4.886		
80	3.760						
90							
HT							
20	5.419	5.812	6.205	6.598	7.188	7.369	8.912
30	4.964	5.346	5.728	6.110	6.683	6.865	8.374
40	4.648	5.026	5.405	5.783	6.351	6.515	7.979
50	4.519	5.031	5.442	5.854	6.472	6.567	7.99
60	4.817	5.268	5.719	6.170	6.847		
70	5.107	5.512	5.918	6.323	6.931		
80	5.477						
90							

6.1.3 VOC on Actual Road Links

The basic costs of VOC components were estimated for the ideal condition of level tangent roads. Actual VOCs should in principle be obtained by modifying basic VOCs for additional costs caused by road geometry such as grades and curves, and by speed changes by traffic restrictions.

1) Gradients and Curves

For the study routes, no additional costs due to gradients and curves were considered, because only very minor changes were planned in geometry, and there would be little difference between with and without project cases as far as additional VOCs due to gradients and curves are concerned.

2) Speed Changes

In this study, the speed change cycle due to narrow and wooden bridges was considered, and corresponding additional costs were determined by the coefficients given in SVOCT as in the Master Plan Study. Additional costs due to stops at intersections were considered wherever interchanges were proposed.

The number of vehicles stopped at intersections was estimated based on the relationship between forecasted traffic volume and intersection capacity and intersection waiting time. Appendix 6.1.8 shows details. Additional costs due to stops at intersections were calculated by applying the coefficients given in SVOCT as shown in Appendix 6.1.9.

6.1.4 VOC Savings

The savings were calculated as the difference in total VOCs in the related road network of with or without project cases. They were calculated by vehicle type and then summed up.

As described in Chapter 3, heavy bus traffic was forecasted, by including medium bus traffic. It was, therefore, divided by using the percentages of heavy and medium buses as a result of the O/D survey conducted by the Study Team, which were estimated to be 80.2% and 19.8%, respectively.

In the calculation of VOCs on ML Projects, whose procedures are illustrated in Figure 6.1.1, unit VOCs were estimated based on the travel speed as determined by the relationship between traffic volume and travel speed as shown in Appendix 6.1.10.

As seen in Appendix 6.1.10, in this relationship, traffic volumes are expressed in terms of the number of passenger car units per hour. Therefore, they were estimated by the following

procedures:

- Known daily traffic volumes by vehicle type were translated into hourly traffic volumes by applying hourly traffic variation data obtained from the results of the traffic survey conducted by the Study Team.

- The hourly traffic volumes were converted into passenger car units (PCU) by equivalent factors by vehicle type shown below:

Vehicle Type	PCU
MC	0.5
PC	1.0
LB	1.5
MB	2.0
HB	2.5
LT	1.5
MT	2.0
HT	3.0

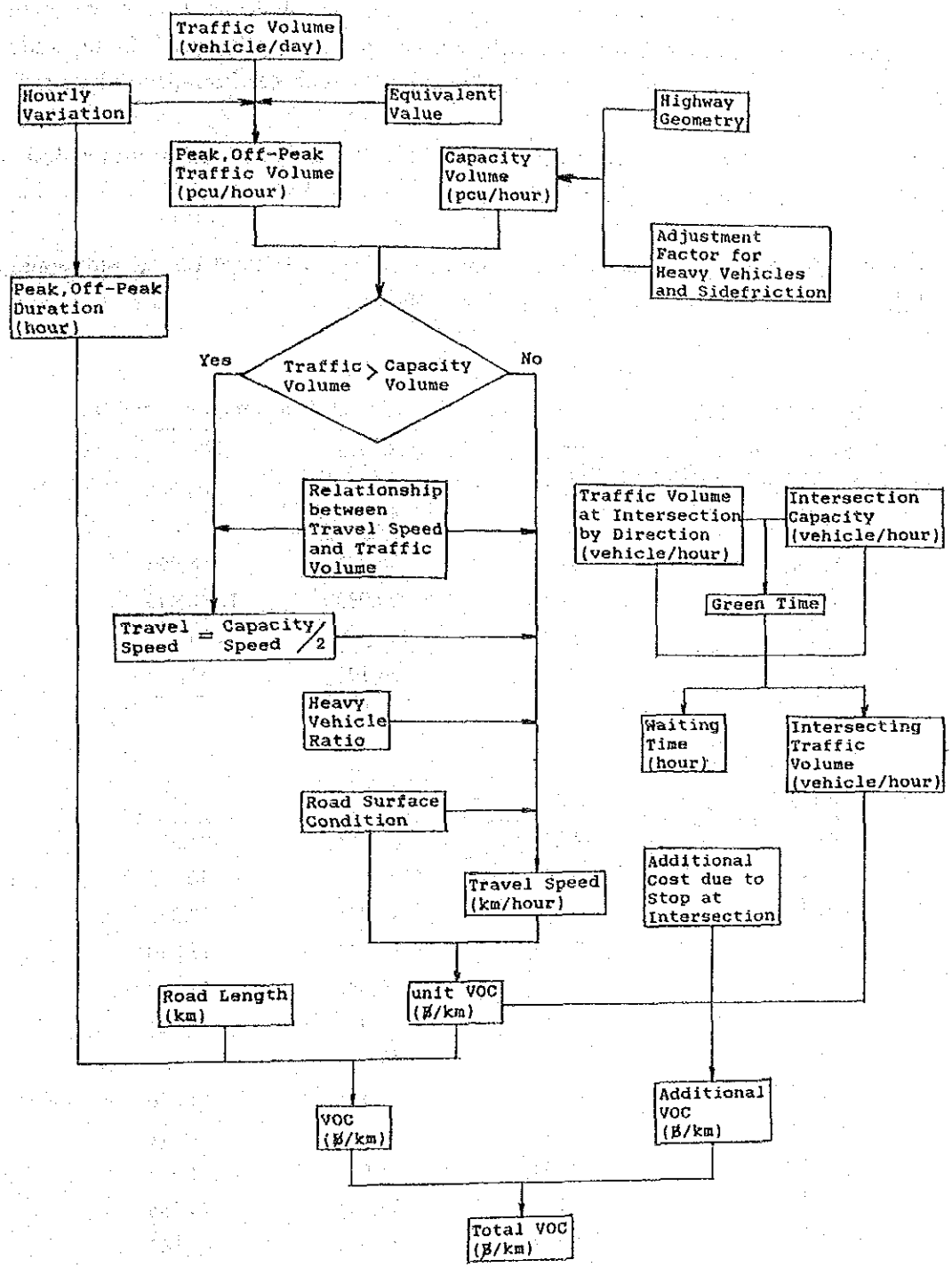

Figure 6.1.1. ELEMENTS AND FLOW OF CALCULATION OF VOCs FOR ML PROJECTS

When traffic volume exceeds road capacity, heavy congestion will occur. This causes an unstable flow, and travel speeds may vary anywhere from 0 to the capacity speed. In this study, the travel speed in this case was assumed to be about one half of the capacity speed.

In the calculation of VOC for IM Projects, unit VOCs were estimated based on the design speed and the travel speed on the existing road.

The results of the calculation of VOC savings are summarized in Table 6.1.9 by study route, and the details are shown separately in the Route Report.

Table 6.1.9 VOC SAVINGS

(Unit: thousand Baht)

PHASE I PROJECTS			
Project No.	1994	2000	2008
ML-1	77,362	239,797	404,206
ML-2	28,562	39,535	89,418
ML-4	65,543	88,702	358,698
ML-5	105,206	320,988	1,548,475
ML-7	105,799	151,219	238,926
IM-23	27,961	36,196	51,124

PHASE II PROJECTS			
Project No.	1994	2000	2008
ML-3	74,227	109,363	182,535
ML-9	540,204	2,097,793	6,044,138
IM-1	9,986	12,936	18,350
IM-2	9,785	12,629	17,880
IM-11	27,513	36,489	51,199
IM-12	28,683	38,930	54,921
IM-13	11,580	15,706	22,752
IM-14	28,645	37,333	52,246
IM-15	37,355	50,505	72,791
IM-16	15,933	21,675	34,412
IM-17	21,233	29,982	46,568
IM-22	18,219	27,068	42,606
RH-2	36,886	46,260	46,260
RH-3	45,648	61,185	-
RH-5	85,832	117,434	-

6.2 TIME SAVINGS

Time values were estimated separately for drivers and assistants and for passengers, as illustrated in Figure 6.2.1.

6.2.1 Time Values of Drivers and Assistants

Time values of drivers and assistants were estimated based on their monthly wages and working hours as shown in Table 6.2.1

Table 6.2.1 TIME VALUES OF DRIVERS AND ASSISTANTS

Vehicle Type	Monthly Wages* (Baht/month)	Working Hour (hour/month)	Time Value (Baht/hour)
MC	2,390	240	10.0
PC	2,390	185	12.9
LB	2,390	200	12.0
MB	4,920	200	24.6
HB	8,450	200	42.3
LT	2,390	220	10.9
MT	3,850	220	17.5
HT	5,240	220	23.8

* : DOH Survey results

Note : Wages of MC, PC, LT were assumed to be the same as in LB. Working hours are the same as in the Master Plan Study.

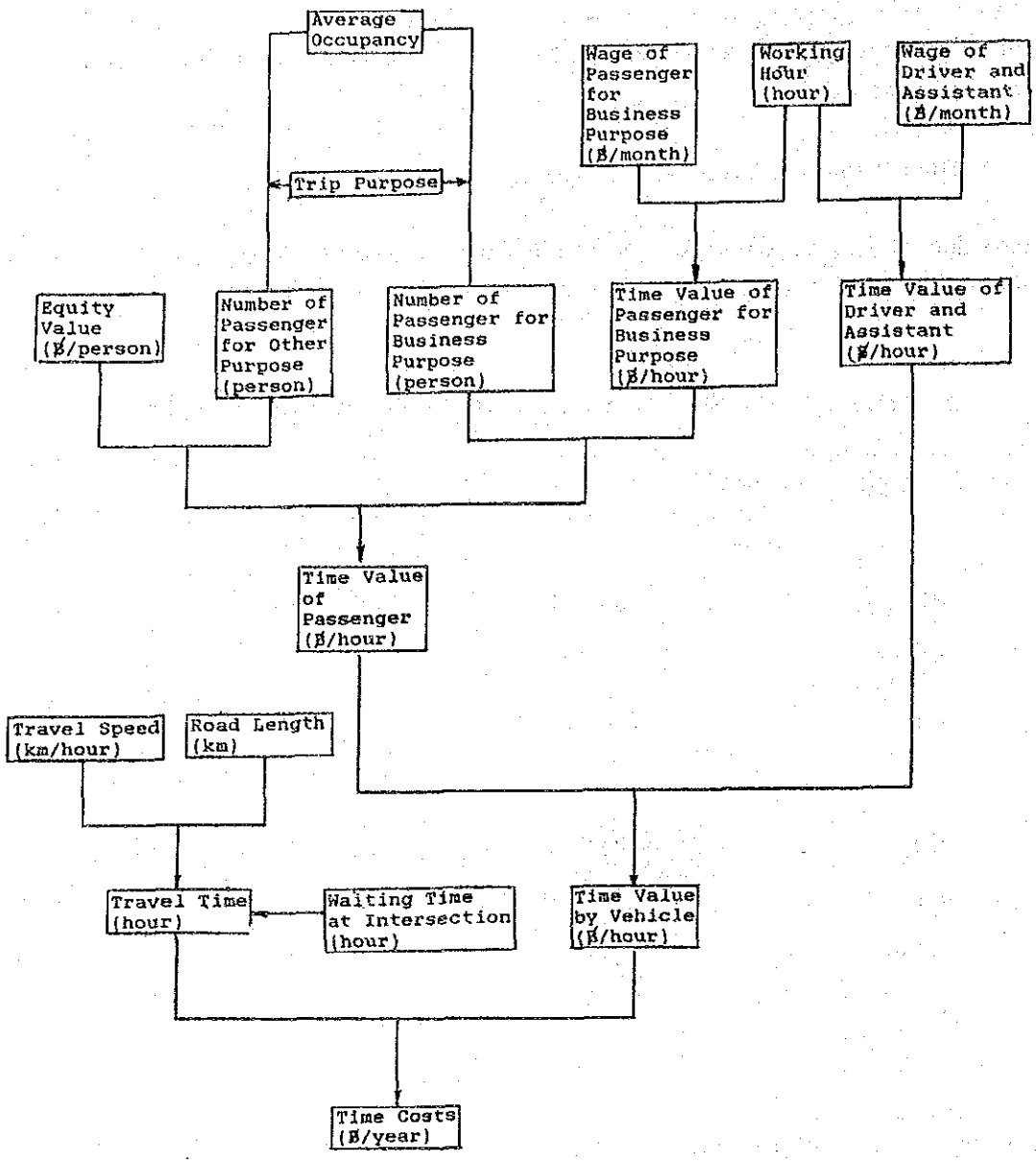

Figure 6.2.1 ELEMENTS AND FLOW OF CALCULATION OF THE COST

6.2.2 Time Values of Passengers

The time values of passengers were estimated for business purpose trips and for trips for all other purposes. The former could be considered to reflect economic productivity. For the latter, the so-called equity value is often used.

Time values of passengers for business purpose trips were estimated based on the wages by type of employment and occupation prepared by Department of Labour, Ministry of Interior, and by working hours as shown below:

TIME VALUES OF PASSENGERS FOR BUSINESS PURPOSE TRIPS

Vehicle Type	Monthly Wages (Baht/month)	Working Hour (hour/month)	Time Value (Baht/hour)
MC	2,490	200	12.5
PC	6,040	185	32.6
LB	2,490	200	12.5
MB	2,490	200	12.5
HB	2,490	200	12.5

The equity value of time was estimated to be 25 % of the overall average wage of Baht 4.13 per hour.

The number of passengers for business purpose trips was estimated on the basis of vehicle occupancy and the percentage of business trips.

Occupancy rates by vehicle type and the percentage of business trips were calculated based on the latest results of the O/D surveys conducted by the Study Team as shown below:

AVERAGE OCCUPANCY AND PERCENTAGE OF BUSINESS TRIPS

Vehicle Type	Number of Persons		Business Trips (%)
MC	1.2	(1.0)	15.0
PC	2.4	(1.0)	45.5
LB	6.2	(1.1)	37.7
MB	17.6	(1.6)	32.0
HB	32.3	(2.4)	35.9

Note: Figures in parentheses show number of drivers and assistants.

The number of persons and the percentage of business trips are the same as in the Master Plan Study.

Table 6.2.2 shows the time values of passengers:

Table 6.2.2 TIME VALUES OF PASSENGERS

Vehicle Type	Number of Passenger (person) (A)	Percentage of Business Trip % (B)	Time Value (Baht/hour) (C)	Time Values (Baht/hour)		
				Business Trip $(D)=\frac{(A)\times(B)\times(C)}{100}$	Other Trip $(E)=\frac{(A)\times[100-(B)]\times 4.13}{100}$	Total
MC	0.2	15	12.5	0.4	0.7	1.1
PC	1.4	45.5	32.6	20.8	3.2	24.0
LB	5.1	37.7	12.5	24.0	13.1	37.1
MB	16.0	32.0	12.5	64.0	25.1	89.1
HB	29.9	35.9	12.5	134.2	79.2	213.4

6.2.3 Time Values by Vehicle Type

Time values by vehicle type were estimated by combining the time values of drivers and assistants and those of passengers with average vehicle occupancy rates, as shown in Table 6.2.3

Table 6.2.3 TIME VALUES BY VEHICLE TYPE

Vehicle Type	Time Values (Baht/hour)		
	Drivers & Assistants	Passengers	Total
MC	10.0	1.1	11.1
PC	12.9	24.0	36.9
LB	12.0	37.1	49.1
MB	24.6	89.1	113.7
HB	42.3	213.4	255.7
LT	10.9	—	10.9
MT	17.5	—	17.5
HT	23.8	—	23.8

6.2.4 Time Savings

Time savings were estimated as the difference in total time costs in the related road network of with or without project cases.

In the calculation of time savings on ML Projects, travel times in the cases of with or without project were calculated based on the study route length and the travel speed obtained by the relationship between traffic volume and travel speed. In the case of without project, waiting time at intersections was also considered.

In the calculation of time savings on IM Projects, travel times were calculated based on the study route length and on the design and travel speeds on the existing road.

The difference in time values on ML Projects and IM Projects due to the difference in road users was taken into consideration. However, the difference between the average wage of the Region and that of each Changwat was found to be within 20 %. Therefore the time values shown in Table 6.2.3 were used in the calculation of time savings on ML Projects and IM Projects.

The results of the calculation of time savings are summarized in Tables 6.2.4, and the details are shown separately in the Route Report.

Table 6.2.4 TIME SAVINGS

(Unit: thousand Baht)

PHASE I PROJECTS

Project No.	1994	2000	2008
ML-1	52,542	103,234	137,475
ML-2	16,493	24,871	88,961
ML-4	25,072	37,676	228,231
ML-5	115,967	428,365	1,348,348
ML-7	56,237	84,719	142,219
IM-23	7,737	10,196	14,673

PHASE II PROJECTS

Project No.	1994	2000	2008
ML-3	35,595	56,855	107,074
ML-9	864,164	1,635,826	3,780,942
IM-1	4,027	5,298	7,663
IM-2	4,630	6,110	8,780
IM-11	6,603	8,770	12,023
IM-12	7,205	9,577	13,227
IM-13	5,665	7,760	11,151
IM-14	3,118	4,107	5,910
IM-15	4,872	6,719	9,902
IM-16	6,190	8,441	13,526
IM-17	6,368	9,080	14,332
IM-22	3,122	4,859	7,722
RH-2	22,061	28,542	-
RH-3	31,372	41,799	-
RH-5	48,462	63,962	-

CHAPTER 7
EVALUATION

CHAPTER 7
EVALUATION

7.1 ECONOMIC EVALUATION

An economic evaluation was made for each project road to determine whether its construction would generate benefits large enough to justify the investment. Items considered in the economic evaluation are described below:

7.1.1 Costs

The methods of estimating construction costs, financial and economic, are explained in Section 5.1. Residual values and economic costs were estimated component by component. The disbursement schedule of construction was assumed to be 15% in the first year, 35% in the second year and 50% in the third year for all ML Projects starting at the beginning of 1991. For IM Projects, all except IM-2 and IM-12 were assumed to have a disbursement schedule of 35% in 1992 and 65% in 1993. For IM-2, this was assumed to be 45% in 1992 and 55% in 1993. For IM-12, because of its size, this was assumed to be 15% in 1991, 35% in 1992 and 50% in 1993. All RH Projects were assumed to be done in 1993. The cost of a 5-cm asphalt overlay was added in the 10th year for all projects with AC pavement. Since RH Projects were designed for seven years, no overlay was assumed within the project life.

7.1.2 Benefits

1) VOC and Time Savings

Economic benefits arise from projects because improved roads allow vehicles to have lower operating costs and shorter travel times. Benefits were taken as the difference in vehicle operating cost and travel time for with and without cases. The methods of determining vehicle operating costs and time values are presented in Chapter 6. Vehicle operating costs were determined as a function of surface type, speed and number of stop-go operations for each of eight vehicle types. In the calculation of benefits on ML Projects, vehicle operating speed was determined for each of five road surface conditions as a function of volume/capacity ratio. Capacity in terms of passenger car units of carriageway was determined by the num-

ber of lanes, side clearance width and heavy vehicle ratio in the traffic stream. A maximum speed of 80 kp/h was taken for heavy and medium trucks. Traffic volume was calculated on the hourly basis for peak hours and off-peak hours. Intersection capacity was determined by the number of approach lanes and the length of green time available for each direction, which in turn was determined proportionate to the ratio of intersecting traffic volumes. Speed of traffic when exceeding capacity was assumed to be one half of the saturation speed. VOC and travel time savings were calculated for peak hours and off-peak hours. The results were multiplied by respective duration to obtain daily and annual amounts.

The same procedures of benefit estimation were applied for IM and RH Projects, except for travel speed for which predetermined values were assigned depending on road class and surface condition.

2) Maintenance Savings

It was assumed that the amount as allocated by means of DOH's K-Factor Method would be needed to maintain the existing surface conditions of the existing roads as they are now. This is a realistic assumption that allows a comparison with the prevailing situation rather than with an imaginary ideal situation. For the new project roads, similar routine maintenance would keep the surfaces in good condition, except in the 10th year when an overly is needed. The difference in routine maintenance costs for cases with and without the project was taken as maintenance cost savings. However, since ML-1, ML-2, ML-3, ML-4, and ML-7 require the construction of additional two-lane carriageways, their routine maintenance costs turned out to be higher than in the cases without projects. Thus maintenance cost savings for these cases turned out to be negative. In the case of ML-5 and ML-9, there is no existing road. Therefore, a parallel section of Route 3 was included for both with and without cases for the purpose of comparison. The difference in routine maintenance cost of Route 3 for the cases of with or without ML-5 or ML-9 was minor and was disregarded in the evaluation process.

7.1.3 Evaluation Results

Cost and benefits were calculated on a yearly basis from 1991 to 2008. Conventional economic evaluation criteria were examined, i.e., internal rate of return, benefit cost ratio and net present value with an interest rate of 12% p.a.. Tables 7.1.1 and 7.1.2 summarize the results. For ML-1 and ML-5, the case with the opening year of 1992 was also tested, and the results are shown in Table 7.1.1. A cost and benefit statment for each project is shown in the Route Report.

Table 7.1.1 ECONOMIC EVALUATION SUMMARY

PHASE I PROJECTS

(Unit: thousand Baht)

Project	Economic Construction Cost	Total Benefit	Net Present Value (Discounted at 12%)	Benefit Cost Ratio	Internal Rate of Return (%)
ML-1	317,675	5,291,228 (4,417,663)	1,635,055 (1,532,943)	5.54 (4.40)	36.5 (30.8)
ML-2	197,763	1,406,009	283,476	2.25	22.2
ML-4	534,823	3,832,328	644,678	2.03	19.7
ML-5	1,020,239	19,029,843 (13,880,510)	4,907,436 (3,939,115)	5.23 (3.71)	30.6 (25.6)
ML-7	664,890	3,926,336	821,595	2.10	21.9
IM-23	147,322	748,996	151,534	1.95	21.5

PHASE II PROJECTS

Project	Economic Construction Cost	Total Benefit	Net Present Value (Discounted at 12%)	Benefit Cost Ratio	Internal Rate of Return (%)
ML-3	373,297	2,852,331	689,450	2.60	25.6
ML-9	3,214,898	75,240,330	22,392,735	7.20	39.6
IM-1	43,295	294,867	72,659	2.46	26.7
IM-2	40,627	301,212	79,041	2.72	28.1
IM-11	122,930	723,162	159,912	2.14	23.9
IM-12	216,902	774,679	70,074	1.28	15.1
IM-13	71,884	376,733	74,655	1.93	21.7
IM-14	120,628	662,029	142,006	2.07	22.9
IM-15	101,977	920,963	263,797	3.29	32.5
IM-16	104,335	503,968	88,278	1.76	19.9
IM-17	85,744	644,332	163,509	2.69	27.7
IM-22	85,714	524,402	116,910	2.26	23.7
RH-2	47,511	469,177	257,177	6.99	74.2
RH-3	21,257	630,502	382,502	20.91	150.1
RH-5	38,360	1,105,136	669,655	20.26	147.1

Note : ( ) Shows Openning year assumed at 1992 for ML-1 and ML-5.

7.2 IMPACT OF PROJECTS

None of the project roads is expected to become a major cause of changes in agricultural production, since the existing constraints on agriculture in the respective areas do not include land accessibility, with the possible exception of IM-16, although its impact on agricultural production would still be very minor. The impact of the project roads on industry, however, could be quite significant. They will certainly influence industrialists in selecting plant location. Combined with Government measures to discourage new industrial location within the Bangkok Metropolitan Region, these new highways will help the dispersion of industrial facilities away from Bangkok. They will, however, contribute to the further strengthening of the Central Region relative to other regions. They will also help tourism development, which has already been spreading rapidly in the area, along the Eastern Seaboard shoreline.

An inevitable consequence of an obvious development prospect is a rapid rise in land price. This has already been taking place at an alarming scale. The project roads may accelerate the process.

7.3 IMPLEMENTATION PROGRAM

7.3.1 Construction Schedule

Considering the necessary period for detailed design and tender and contract negotiations, the construction of the project roads was assumed to start at the beginning of 1991 for ML Projects and IM-12. For IM Projects, the start of construction was assumed to be one year later. Figures 5.1.1 , 5.1.2 and 5.1.3 show the respective construction schedules by work category. For ML-1 and ML-5 in the case of an opening year of 1992, all work should be advanced by two years.

7.3.2 Fund Requirements

The first half of 1988 was an extraordinary period. A sudden construction boom triggered by a surge in exports and foreign investment caused a shortage of construction materials and an ensuing price escalation on a massive scale. Government countermeasures and industry efforts succeeded in holding down inflation since then, but at a higher level than before the start of the boom. The construction cost estimates shown in Section 5.1.3 incorporate recent price levels which are considered reasonable. It is unlikely that price increases on a scale comparable to those of 1988 will be repeated in the near future. Domestic prices of construction materials and other inputs were assumed to increase at a rate of 4% per year, considering past trends under normal circumstances and the proven prudence in the management of the Thai economy. Price increases of foreign components were also assumed at 4%

a year, considering the general inflation and exchange rate changes under medium term prospects. Fund requirements were calculated from the construction costs at 1988 prices and the assumed price increases. The results are shown in Tables 7.3.1.

Table 7.3.1 shows the fund requirements in the case of an opening year of 1994 for all project roads, and in the case of an opening year of 1992 for ML-1 and ML-5.

Table 7.3.1 FUND REQUIREMENT FOR PROJECTS

(Unit: million Baht)

Priject	Total at 1988 Price	1989			1990			1991			1992			1993			Total		
		Local	For.	Total	Local	For.	Total	Local	For.	Total	Local	For.	Total	Local	For.	Total	Local	For.	Total
ML PROJECTS																			
ML-1	347.9	-	-	-	-	-	-	29.8	28.9	58.7	86.8	84.0	170.8	107.5	104.1	211.6	209.7	203.1	412.8
		(27.6)	(26.7)	(54.3)	(67.0)	(64.8)	(131.8)	(99.3)	(96.3)	(195.6)	-	-	-	-	-	-	(193.9)	(187.8)	(381.7)
ML-2	224.5	-	-	-	-	-	-	19.2	18.6	37.8	46.7	45.2	91.9	69.4	67.2	136.6	135.3	131.0	266.3
ML-3	417.2	-	-	-	-	-	-	35.8	34.6	70.4	86.8	84.0	170.8	128.9	124.9	253.8	251.5	243.5	495.0
ML-4	593.3	-	-	-	-	-	-	50.9	49.2	100.1	123.4	119.5	242.9	183.3	177.6	360.9	357.6	346.3	703.9
ML-5	1105.0	-	-	-	-	-	-	94.7	91.8	186.5	229.9	222.6	452.5	341.5	330.7	672.2	666.1	645.1	1311.2
		(87.6)	(84.8)	(172.4)	(212.5)	(205.8)	(418.3)	(315.7)	(305.7)	(621.4)	-	-	-	-	-	-	(615.8)	(596.3)	(1212.1)
ML-7	754.0	-	-	-	-	-	-	64.6	62.6	127.2	156.8	151.9	308.7	233.0	225.7	458.7	454.4	440.2	894.6
ML-9	3569.7	-	-	-	-	-	-	408.0	395.1	803.1	954.6	924.6	1879.2	772.2	747.9	1520.1	2134.8	2067.6	4202.4
TOTAL	7011.6	-	-	-	-	-	-	703.0	680.8	1383.8	1685.0	1631.8	3316.8	1835.8	1778.1	3613.9	4209.4	4076.8	8286.2
	(7011.6)	(115.2)	(111.5)	(226.7)	(279.5)	(270.6)	(550.1)	(993.5)	(962.1)	(1955.6)	(1368.3)	(1325.2)	(2693.5)	(1386.8)	(1343.3)	(2730.1)	(4143.3)	(4012.7)	(8156.0)
IM PROJECTS																			
IM-1	49.3	-	-	-	-	-	-	-	-	-	10.3	9.9	20.2	19.8	19.2	39.0	30.1	29.1	59.2
IM-2	46.4	-	-	-	-	-	-	-	-	-	12.4	12.0	24.4	15.8	15.3	31.1	28.2	27.3	55.5
IM-11	139.2	-	-	-	-	-	-	-	-	-	29.0	28.0	57.0	55.9	54.2	110.1	84.9	82.2	167.1
IM-12	245.3	-	-	-	-	-	-	21.0	20.4	41.4	51.0	49.4	100.4	75.8	73.4	149.2	147.8	143.2	291.0
IM-13	81.0	-	-	-	-	-	-	-	-	-	16.8	16.3	33.1	32.5	31.5	64.0	49.3	47.8	97.1
IM-14	136.4	-	-	-	-	-	-	-	-	-	28.4	27.5	55.9	54.8	53.1	107.9	83.2	80.6	163.8
IM-15	115.3	-	-	-	-	-	-	-	-	-	24.0	23.2	47.2	46.3	44.9	91.2	70.3	68.1	138.4
IM-16	118.3	-	-	-	-	-	-	-	-	-	24.6	23.8	48.4	47.5	46.0	93.5	72.1	69.8	141.9
IM-17	97.5	-	-	-	-	-	-	-	-	-	20.3	19.6	39.9	39.2	37.9	77.1	59.5	57.5	117.0
IM-22	95.8	-	-	-	-	-	-	-	-	-	19.9	19.3	39.2	38.5	37.3	75.8	58.4	56.6	115.0
IM-23	164.0	-	-	-	-	-	-	-	-	-	39.0	37.8	76.8	60.8	58.9	119.7	99.8	96.7	196.5
TOTAL	1288.5	-	-	-	-	-	-	21.0	20.4	41.4	275.7	266.8	542.5	486.9	471.7	958.6	783.6	758.9	1542.5
RH PROJECTS																			
RH-2	52.9	-	-	-	-	-	-	-	-	-	-	-	-	32.7	31.7	64.4	32.7	31.7	64.4
RH-3	23.7	-	-	-	-	-	-	-	-	-	-	-	-	14.6	14.2	28.8	14.6	14.2	28.8
RH-5	42.4	-	-	-	-	-	-	-	-	-	-	-	-	26.2	25.4	51.6	26.2	25.4	51.6
TOTAL	119.0	-	-	-	-	-	-	-	-	-	-	-	-	73.5	71.3	144.8	73.5	71.3	144.8
GRAND TOTAL	8419.1	-	-	-	-	-	-	724.0	701.2	1425.2	1960.7	1898.6	3859.3	2396.2	2321.1	4717.3	5066.5	4907.0	9973.5
	(1407.5)	(115.2)	(111.5)	(226.7)	(279.5)	(270.6)	(550.1)	(1014.5)	(982.5)	(1997.0)	(1644.0)	(1592.0)	(3236.0)	(1947.2)	(1886.3)	(3833.5)	(5000.4)	(4842.4)	(9843.3)

Note : ( ) shows opening year assumed at 1992 for ML-1 and ML-5.

CHAPTER 8
CONCLUSION

CHAPTER 8
CONCLUSION

1) Ranking of ML Projects by IRR is shown in Table 8.1.

Table 8.1 RANKING BY IRR OF ML PROJECTS

Project No.	Origin - Destination	Length (km)	IRR (%)
ML-9	Bangkok - Chon Buri New Highway	81.7	39.6
ML-1	Chon Buri Bybass	13.6	36.5
ML-5	Chon Buri Pattaya New Highway	50.3	30.6
ML-3	A.Sattahip - C.Rayong	44.6	25.6
ML-2	M.Pattaya - A.Sattahip	27.3	22.2
ML-7	A.Min Buri - C.Chachoengsao	40.9	21.9
ML-4	A.Klaeng - C.Chanthaburi	61.9	19.7

ML-9 shows the highest IRR of 39.6% and ML-4 the lowest IRR of 19.7%. All seven projects are therefore worth implementing with the opening year of 1994.

For the opening year of 1992, the IRRs of ML-1 and ML-5 are 30.8% and 25.6%, respectively, still high figures.

It is highly desirable to construct ML-5 and ML-9 as early as possible, since these new highways will connect Bangkok and the Eastern Seaboard area to support the development of the latter.

The preliminary design of ML-9 was done with the possibility of making it a toll road in mind. The design speed was set at 120 kp/h, and all intersections with major roads were assumed to be grade separated.

2) IM Projects

Ranking of IM Projects by IRR is shown in Table 8.2.

Table 8.2 RANKING BY IRR OF IM PROJECTS

Project No.	Origin - Destination	Length (km)	IRR (%)
IM-15	B.Klong Lunang - A.Min Buri	24.7	32.5
IM-2	B.Nong Pru - A.Lao Khawn	35.9	28.1
IM-17	A.Lat Krabang - B.Khlong Tha Thua	19.2	27.7
IM-1	A.Bang Len - B.Bang Noi Nai	18.7	26.7
IM-11	B.Channa Soot -A.Pho Thong	40.7	23.9
IM-22	A.Nong Chok - A.Bang Nam Prieo	15.9	23.7
IM-14	A.Wang Noi - A.Thanyaburi	25.6	22.9
IM-13	A.Bang Pa-in - C.Ayutthaya	17.8	21.7
IM-23	J.R.32 - J.R.3022	26.9	21.5
IM-16	A.Lam Luk Ka - B.Khlong 16	20.8	19.9
IM-12	A.Pho Thong - A.Sena	51.0	15.1

IM-15 shows the highest IRR of 32.5% and IM-12 the lowest IRR of 15.1%. All 11 IM Projects are therefore worth implementing with the opening year of 1994.

3) RH Projects

Ranking of RH Projects by IRR is shown in Table 8.3.

Table 8.3 RANKING BY IRR OF RH PROJECTS

Project No.	Link No.	Length (km)	IRR (%)
RH-3	325 0200	17.9	150.1
RH-5	344 0200	39.3	147.1
RH-2	225 0100	39.5	74.2

All RH Projects shows high IRR and are worth implementing with the opening year of 1994.

A detailed summary of all ML, IM and RH Projects is shown below:

SUMMARY OF FEASIBILITY STUDY
FOR ROAD DEVELOPMENT STUDY IN THE CENTRAL REGION OF THAILAND

NO.	ORIGIN - DESTINATION	LOCATION	JURISDICTION UNDER:	LENGTH (km)	PROPOSED ROAD CLASS	PROJECTED AADT IN 2000	MAJOR CONSTRUCTION WORK QUANTITIES: EARTHWORK Excavation & Embank't (thousand m³)	PAVEMENT AC or PCC Thickness (cm)	BRIDGE Accumulative Length (m)	PROJECT COST (thousand Baht)	IRR (%)	REMARKS
ML PROJECTS*												
ML-1	Chon Buri Bypass	Chon Buri	DOH (Rt. 3)	13.6	PD	23,000-30,000	312	PCC: 30.0	520	348,000	36.5	3 grade separated intersections
ML-2	M. Pattaya - A. Sattahip	Chon Buri	DOH (Rt. 3)	27.3	PD	11,000-13,000	768	AC: 5.0	218	225,000	22.2	
ML-3	A. Sattahip - C. Rayong	Chon Buri/ Rayong	DOH (Rt. 3)	44.6	PD	9,000-12,000	1,010	AC: 10.0	210	418,000	25.6	
ML-4	A. Klaeng - C. Chanthaburi	Rayong/ Chanthaburi	DOH (Rt. 3, Rt. 316)	61.9	PD/SD	14,000-18,000	1,762		872	594,000	19.7	
ML-5	Chon Buri-Pattaya New Highway	Chon Buri	DOH (Rt. 36)	50.3	PD/P1 FD	26,000/7,000 21,000	2,417	PCC: 28.0 (24 km) 23.0 (18 km) 25.0 (8 km)	1,252	1,105,000	30.6	2 grade separated intersections
ML-7	A. Min Buri - C. Chachoengsao	Bangkok - Chachoengsao	DOH (Rt. 304)	40.9	SD	11,000-14,000	1,389	AC: 10.0	1,909	754,000	21.9	
ML-9	Bangkok - Chon Buri New Highway	Bangkok/ Samut Prakarn/ Chachoengsao/ Chon Buri	DOH (Rt. 36)	81.7	PD	17,000-40,000	5,973[1]	AC: 10.0 (66 km) PCC: 28.0 (16 km)	6,522[2]	3,570,000	39.6	4 grade separated intersections and 1 junction [1] Includes sand mat volume [2] 3,261 m (one way) × 2
			Subtotal	320.3								
IM PROJECTS**												
IM-1	A. Bang Len - B. Bang Noi Nai	Nakhon Phathom	PWD	18.7	F4	600-1,000	80	AC: 5.0	37	50,000	26.7	
IM-2	B. Nong Pru - A. Lao Khwan	Kanchanaburi	DOH (Rt. 3306)	35.9	F4	500-600	230	DBST	—	47,000	28.1	
IM-11	B. Channasut - A. Pho Thong	Sing Buri/ Ang Thong	RID	40.7	F2	500-2,000	234	AC: 7.5	27	140,000	23.9	
IM-12	A. Pho Thong - A. Sena	Ang Thong/ Ayutthaya	RID	51.0	F2	1,000-1,600	575	AC: 10.0	88	246,000	15.1	New construction: 1.7 km
IM-13	A. Bang Pa-In - C. Ayutthaya	Ayutthaya	DOH (Rt. 3059)	17.8	F2	1,500	160	AC: 10.0	—	81,000	21.7	
IM-14	A. Wang Noi - A. Thanyaburi	Ayutthaya/ Phathum Thani	Rural Municipality (Partly of DOH Rt. 3189)	25.6	F3	900-1,000	276	AC: 10.0	140	137,000	22.9	New construction: 5.0 km
IM-15	B. Khlong Luang - A. Min Buri	Phathum Thani/ Bangkok	Rural Municipality	24.7	F2/F1	2,500/5,200	147	AC: 10.0	72	116,000	32.5	North section: F2 Class South section: F1 Class
IM-16	A. Lam Luk Ka - B. Khlong 16	Phathum Thani/ Nakhon Nayok	DOH (Rt. 3312)	20.8	F3	600-1,200	180	AC: 5.0	337	119,000	19.9	
IM-17	A. Lat Krabang - B. Khlong Tha Thua	Bangkok/ Samut Prakhan/ Chachoengsao	PWD	19.2	F2	400-2,100	208	AC: 7.5	65	98,000	27.7	
IM-22	J.R. 304 - A. Bang Nam Prieo	Bangkok/ Chachoengsao	Rural Municipality	15.9	F3	1,100	182	AC: 7.5	225	96,000	23.7	New construction: 5.0 km
IM-23	J.R. 32 -J.R. 3022	Ayutthaya	DOH (Rt. 3267)	26.9	F1	4,000-6,000	124	PCC: 23.0	-	164,000	21.5	
			Subtotal	297.2								
PH PROJECTS***												
RH-2	Rt. 225 Link 0100	Nakhon Sawan	DOH	39.7	S2		—	AC: 5.0	—	53,000	74.2	
RH-3	Rt. 325 Link 0200	Samut Songkram	DOH	17.9	S2		—	AC: 5.0	—	24,000	150.1	
RH-5	Rt. 34 Link 0200	Chon Buri	DOH	39.3	S1		—	AC: 5.0	—	42,000	147.1	
			Subtotal	96.2								
			Grand Total	713.7								

Note: * Multi lanes highway construction projects. ML-5 and ML-9 are new construction projects.
** Improvement projects of existing roads.
*** Pavement rehabilitation projects

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