

Figure 7.3.1-2 Staffing in the BMA in FY1991

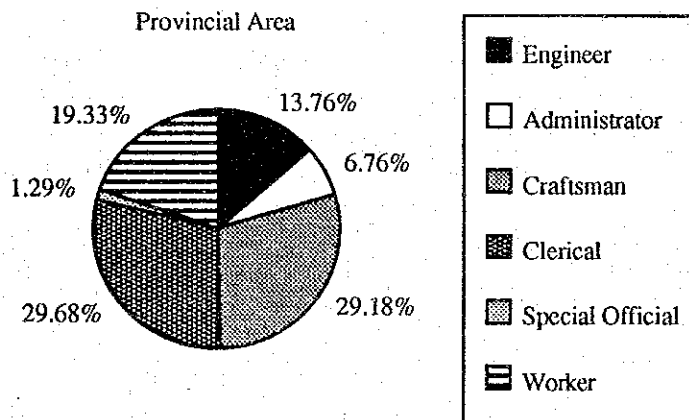


Figure 7.3.1-3 Staffing in the Provincial Areas in FY 1991

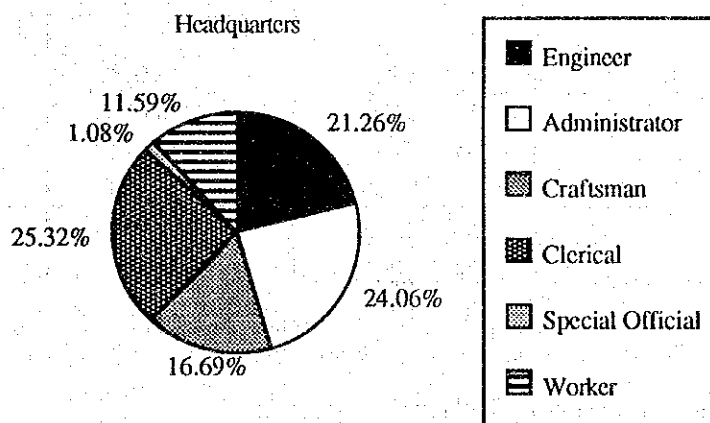


Figure 7.3.1-4 Staffing in the Headquarters in FY 1991

2) Labor Productivity in TOT

Table 7.3.1-3 shows the number of main telephone lines per employee of twenty-seven countries. The number of lines per employee of TOT is fairly low for an operating entity which provides mainly telephone services and makes a wide use of digital exchanges.

Table 7.3.1-3 The Number of Main Telephone Lines per Employee

Country	Main Lines	Employees	Line / Employee
SRI LANKA	105,483	9,587	11
KENYA	168,683	12,714	13
Thailand (Other Area) '91	438,656	9,189	48
PERU	530,674	15,926	33
PHILIPPINES	570,643	19,053	30
CHILE *88	625,466	11,315	55
PAKISTAN *88	636,590	44,690	14
INDONESIA	863,814	41,815	21
SINGAPORE	981,723	10,112	97
Thailand (Study Area) '91	1,020,535	9,696	105
THAILAND (Total)	1,158,014	18,885	61
MALASIA *88	1,247,687	28,168	44
NEW ZEALAND	1,451,743	18,326	79
VENEZUELA *88	1,457,771	17,913	81
NORWAY	2,070,249	16,252	127
HONGKONG *88	2,153,776	12,800	168
INDIA *87	3,487,908	312,303	11
GREECE	3,786,429	29,654	128
MEXICO	4,702,439	49,203	96
CHINA	5,680,400	404,400	14
AUSTRALIA	7,602,572	88,003	86
BRAZIL	8,852,540	104,560	85
SPAIN	11,797,159	71,155	166
KOREA (REPUBLIC OF)	12,003,839	53,033	226
CANADA	13,919,840	103,010	135
ITALY	21,265,518	116,391	183
UNITED KINGDOM *87	22,137,000	223,084	99
FRANCE	26,942,452	157,313	171
JAPAN	52,034,176	276,992	188

Source: ITU, Yearbook of Common Carrier Telecommunication Statistics (18th edition) (Chronological Series 1980-1989).

Note: Data with no asterisk is as of 1989.

7.3.2 Training

It is expected that TOT will have five or six times larger number of subscribers in the next 15 years. It is inevitable that the work volume of the operation and maintenance in the Study Area will become larger and more complicated in the near future. Therefore, it is urgent to develop skills and abilities of the staff up to a sufficient level to be able to operate its own complex, massive, and sophisticated facilities, as well as utilization of the computerized maintenance and operation systems and tools.

1) Situation of Trainings in TOT

TOT has one training center in Bangkok. The center has provided necessary training opportunities and courses for their staff in TOT since its establishment in FY 1965. TOT has a plan to establish three other training centers in the provincial areas in order to cope with the increasing demand for training and to provide more training opportunities for their staff in the provincial areas. Figure 7.3.2-1 shows the organization of TOT's training center.

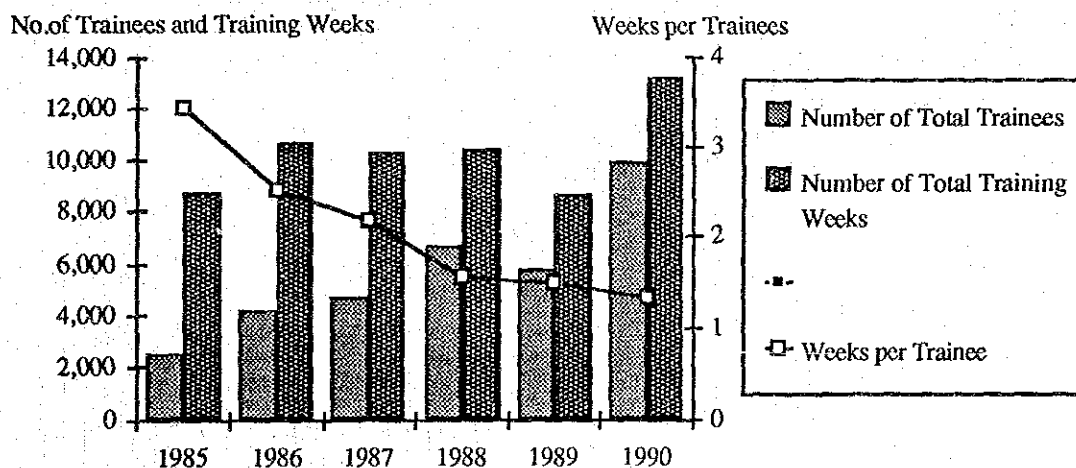


Figure 7.3.2-2 Trainees, Training Weeks and Weeks per Trainee

Figure 7.3.2-2 shows the total number of trainees, training weeks and the weeks per trainee of TOT in the past 6 years. The Number of trainees and training weeks have been increasing; however, the weeks per trainee has been decreasing for the last 6 years. The total training volume has been stable for these years.

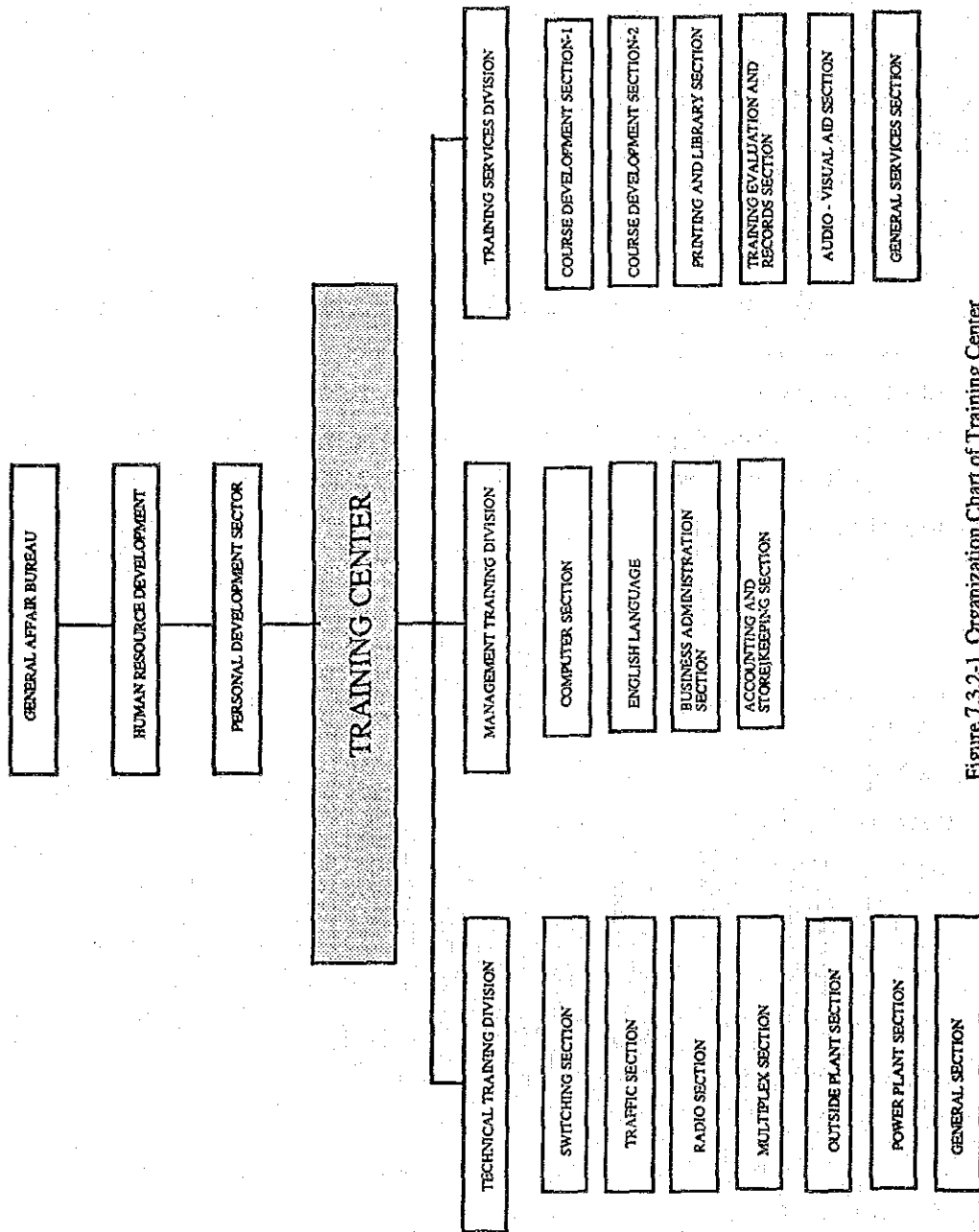


Figure 7.3.2-1 Organization Chart of Training Center

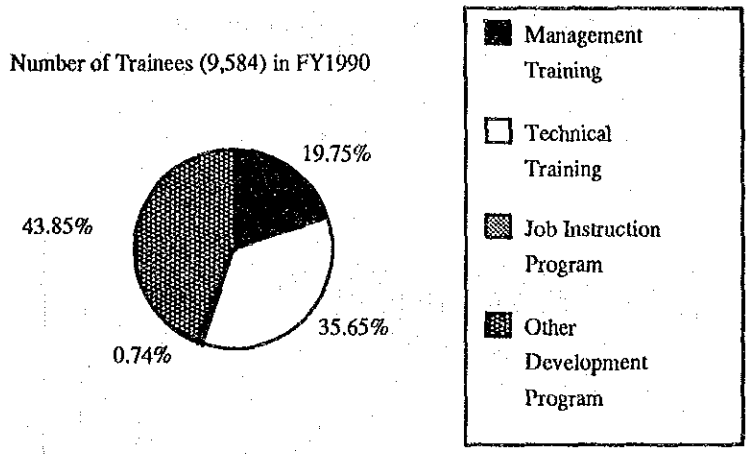


Figure 7.3.2-3 Number of Trainees per Training Course in FY1990

Figure 7.3.2-3 shows the number of trainees for each training course in FY 1990. The technical training is the biggest in the number of trainees.

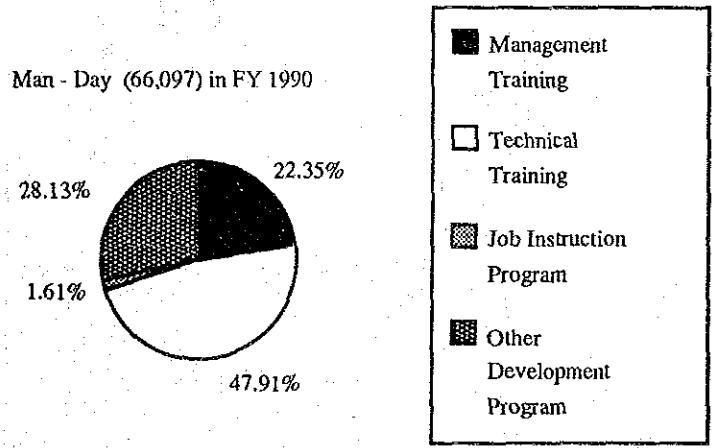


Figure 7.3.2-4 Percentage Shares of Training Categories per Trainee in FY 1990

Figure 7.3.2-4 shows Percentage Shares of Training Categories per trainee in FY 1990. It is evident that the technical training takes up a considerable length of a training period, almost 50%.

Figure 7.3.2-5 shows the total number of trainees, the total number of training days and the total number training days per trainee for each program in FY 1990. The

total number of training days per trainee shows that the numbers for radio, general, and job instruction courses have high enrollment.

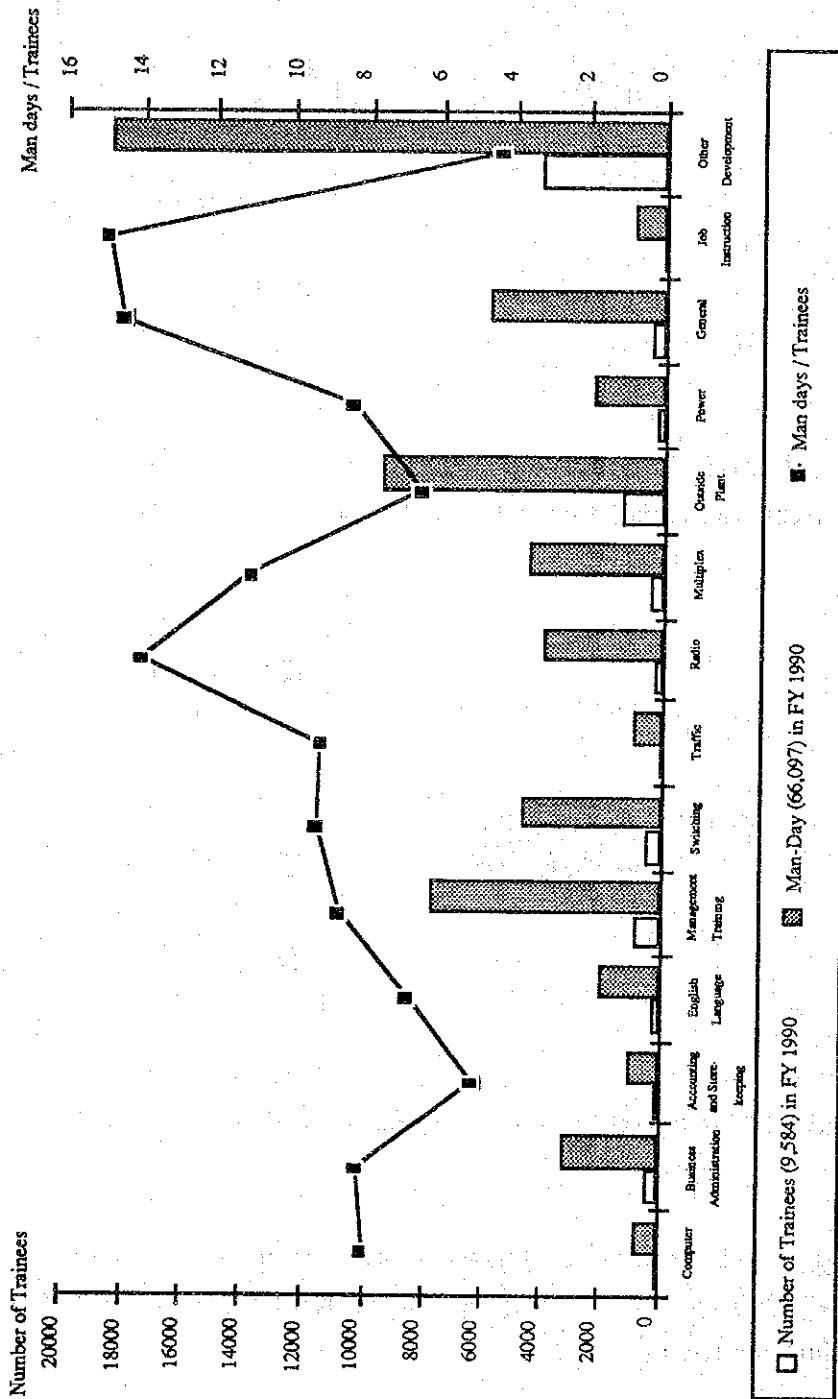


Figure 7.3.2-5 Comparison of Training Course

7.4 Financial Situation of TOT

This section focuses on the past and the present financial situations of TOT. The objective is to grasp the present trend of financial performance of TOT.

7.4.1 Financial Statements of TOT (1985~1990)

1) Balance Sheet of TOT

Table 7.4.1-1 Balance Sheet of TOT

(Unit: Million Baht)

Assets	1985	1986	1987	1988	1989	1990
1. Land, Building, Telephone Exchange and Equipment						
	11,963	15,660	23,139	27,374	31,156	35,700
Less Accumulated Depreciation	4,053	4,782	6,206	7,676	9,406	11,762
Fixed Assets - Net	7,910	10,878	16,933	19,698	21,750	23,938
2. Plant under Construction and Work in Progress	12,491	15,276	11,663	12,210	16,583	23,239
3. Right of the Thai-Malaysia Submarine Cable Usage				314	293	277
4. Investment	1	1	1			
5. Current Assets	6,277	5,158	4,226	5,283	7,706	9,841
6. Other Assets	1,217	1,383	1,713	2,652	4,041	5,178
Total Assets	27,894	32,696	34,536	40,157	50,373	62,472
Liabilities and Equity						
1. Total Equity	5,859	5,781	5,169	7,059	12,882	18,318
1.1 Total Capital	586	628	696	749	808	974
1.2 Total Retained Earnings	6,763	9,017	10,114	11,800	16,426	22,163
1.3 Loss from Baht Devaluation	-1,490	-3,865	-5,641	-5,490	-4,351	-4,819
2. Total Long-Term Debt	16,896	20,728	23,015	25,315	27,897	29,751
2.1 Foreign Loan	12,040	15,673	15,422	19,593	21,557	25,127
2.2 Local Loan				150	994	1,483
2.3 Loss on Exchange Risk Pooling System			1,810	724	612	756
2.4 Yen Private Placement Bonds	611	853	799	764	648	
2.5 Subscriber Bonds	4,245	4,202	4,985	4,085	4,085	2,385
3. Deposit	1,599	2,013	2,320	2,675	3,338	4,006
4. Customer Advance Payments	332	127	62	49	42	66
5. Unclaimed Accounts Payable				5	5	7
6. Accrued Bond Interest	580	926	1,307	1,721	2,174	2,666
7. Total Current Liabilities	2,597	3,102	2,651	3,332	3,871	7,658
8. Other Liabilities	31	21	12	2	165	0
Total Liabilities and Equity	27,894	32,696	34,536	40,157	50,373	62,472

Source: Office of the Auditor General of TOT, Financial Statement and Auditors Report, 1986, 1988, and 1990

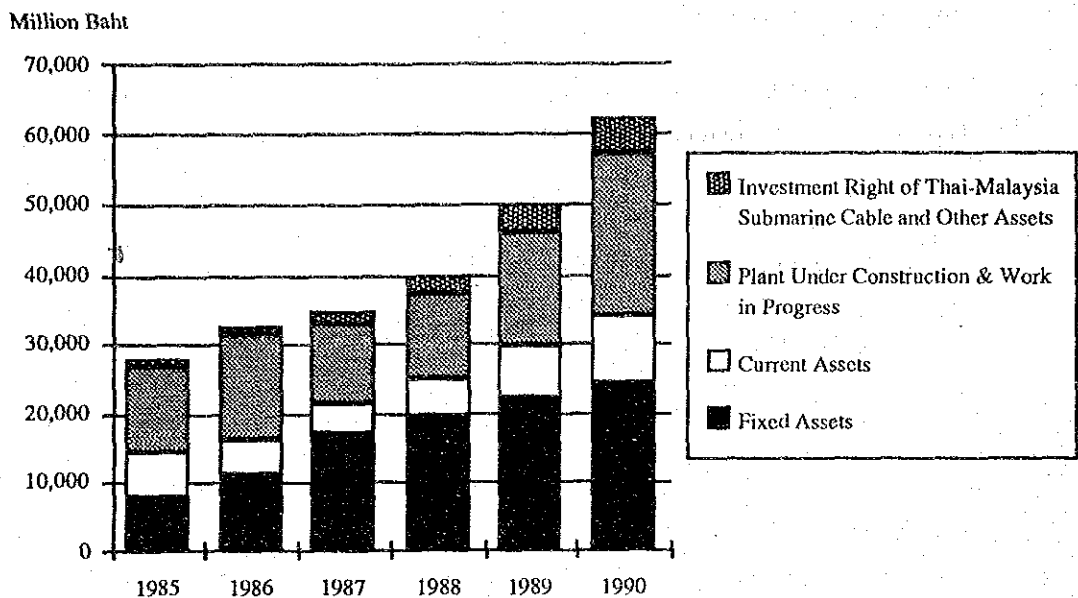


Figure 7.4.1-1 Assets of TOT

Table 7.4.1-1 and Figure 7.4.1-1 show the balance sheets of TOT from FY 1985 to 1990. The amount of "Plant under Construction and Work in Progress" is almost the same size as the existing Fixed Assets due to the delay of process from Work in Progress to Fixed Assets.

This large amount of "Plant under Construction and Work in Progress" is partly because the large volume of the fifth ESDP project compared with the previous fixed assets before the project. However, there exist some issues in project coordination and acceptance procedure of completion. Due to the lack of project coordination between outside plant construction and inside plant installation, and smooth acceptance procedure of completion, there is unnecessary long time lag between completion of constructions and fixed asset accounting.

This delay in the fixed assets accounting brings short falls of depreciation, which makes operating expenses lower and operating incomes higher than they should be. Hence, the internal cash generation becomes smaller than it should be.

It is necessary to improve the procedures of acceptance tests and approvals and the fixed asset accounting to recover the fixed asset investment.

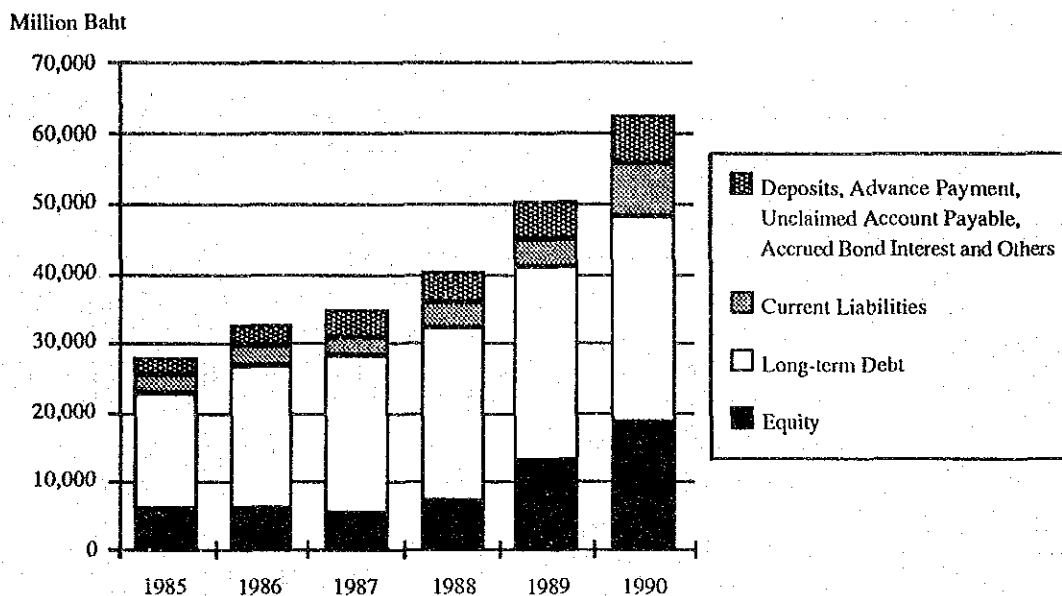


Figure 7.4.1-2 Comparison of Liabilities and Equities during the Past 6 Years

The total amount of the assets of TOT at the end of FY 1990 has increased by 2.24 times larger than that of FY 1985; however, the total long-term debt has become 1.76 times larger within the same period. The long-term debt had 60.6% share on the total assets at the end of FY 1985 but 47.6% at the end of FY 1990. On the other hand, the total equity has become 3.13 times larger within the same period.

This relatively low increase of the long-term debt is a result of the strict debt control by the Ministry of Finance. A financial policy on the state enterprises made by the Government is that investment from state enterprise revenues should not fall below 25 % of the total investment, and their debt service coverage ratios should be maintained at 1.5:1 (internal cash generation to debt).⁴¹

This investment budget policy guideline is to keep a sound financial position of the state enterprises. However, it has brought one of the causes that the period for the TOT fifth ESDP has become longer than initially planned.⁴²

⁴¹ NESDB, *Government of Thailand The Sixth National and Social Development Plan (1987 - 1991)*, p. 200

⁴² The TOT fifth ESDP plan period was five year from FY 1984 to FY 1988 initially but prolonged to nine year until FY 1992 later.

2) Income Statement of TOT

Table 7.4.1-2 Income Statement

(Unit: Million Baht)

Revenue	1985	1986	1987	1988	1989	1990
1. Local Service	2,703	3,931	5,052	5,870	6,845	8,383
2. Trunk Service	1,900	2,834	3,565	4,490	5,457	6,980
3. Revenue from Other Service	614	1,062	789	678	904	1,047
4. Total Operating Revenues	5,217	7,828	9,407	11,039	13,206	16,410
5. Other Income	288	277	147	252	390	626
6. Total Revenues	5,505	8,105	9,553	11,291	13,596	17,036
7. Total Revenue Increase Rate		47.24%	17.87%	18.19%	20.42%	25.30%

Expenses of TOT	1985	1986	1987	1988	1989	1990
1. Administrative Expenses	1,774	1,921	2,213	2,465	2,701	3,217
2. Bad Debt Expenses	34	9	19	0	8	9
3. Repair and Maintenance	261	349	358	363	393	501
4. Depreciation	687	971	1,714	1,656	1,777	2,130
5. Right of the Thai-Malaysia Submarine Cable System				14	16	16
6. Total Operating expenses	2,757	3,250	4,305	4,498	4,895	5,873
7. Other Expenses	1,839	2,092	2,744	4,066	2,913	3,122
8. Total Expenses	4,595	5,342	7,049	8,563	7,808	8,995
9. Total Expenses Increase Rate		16.25%	31.95%	21.48%	-8.81%	15.20%

Operating Income	2,460	4,578	5,101	6,541	8,311	10,537
Net Profit	910	2,763	2,504	2,728	5,788	8,041
Remittance to the Treasury	370	1,105	751	819	1,737	2,413
Net Income Transferred to Retained Earning	401	1,356	1,462	1,565	3,481	4,862
Operating Ratio	52.85%	41.52%	45.77%	40.74%	37.07%	35.79%

Source: Same as Table 7.4.1-1.

Average annual increase rate of the total revenue during the past six years from FY 1985 is 25.3%, while that of the total expenses is 14.4%. Because of this high increase rate of the revenue, the net profit became approximately 9 times larger within 6 years from 910 million Baht at FY 1985 to 8,041 million Baht at FY 1990.

This high rate of revenue increase is a result of the increasing subscription demand and call traffic demand stimulated by the recent high economic growth.

Operating ratio, which is derived by dividing the operating expenses by the operating revenue, improved from 52.85% in FY 1985 to 35.79% in FY 1990.

Total revenue increased 47% in FY 1986 compared with the previous year. This is mainly because the telephone tariff increase in FY 1986 around 50% higher than before. Table 7.4.1-3 shows the telephone tariff revision in FY 1986.

Table 7.4.1-3 Telephone Tariff Revision in FY 1986

	before Increase	after Increase
Installation Fee	3,500 Baht	with telephone set *: 5,000 Baht
		with in-house wiring *: 3,700 Baht
		without in-house wiring: 3,350 Baht
Deposit	3,000 Baht	3,000 Baht
Subscription Fee (Monthly Charge)	50 Baht	rotary dial line: 50 Baht
		tone dial line: 100 Baht
Local Call Charge	One Call: 2 Baht	One Call: 3 Baht
Trunk Call Charge		140 % Increase

Source: TOT, Telephone Directory

Note: * At present, there is no such service.

The detail telephone service tariff at present is shown in APPENDIX.

Figure 7.4.1-3 and Figure 7.4.1-4 show the comparison of operating revenue and operating expenses during the past 6 years from FY 1985 to FY 1990.

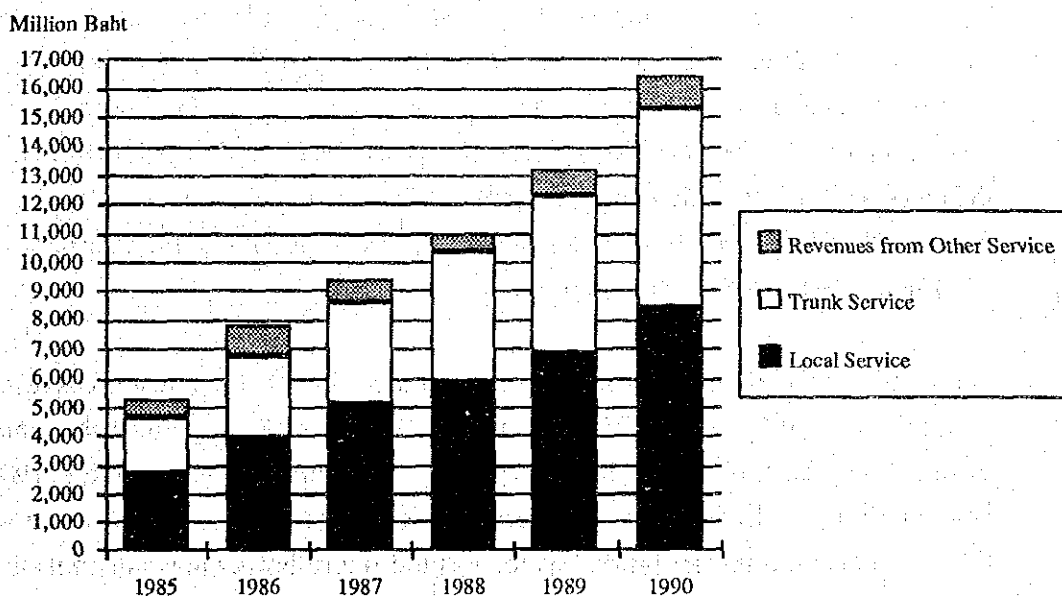


Figure 7.4.1-3 Comparison of Operating Revenues during the Past 6 Years

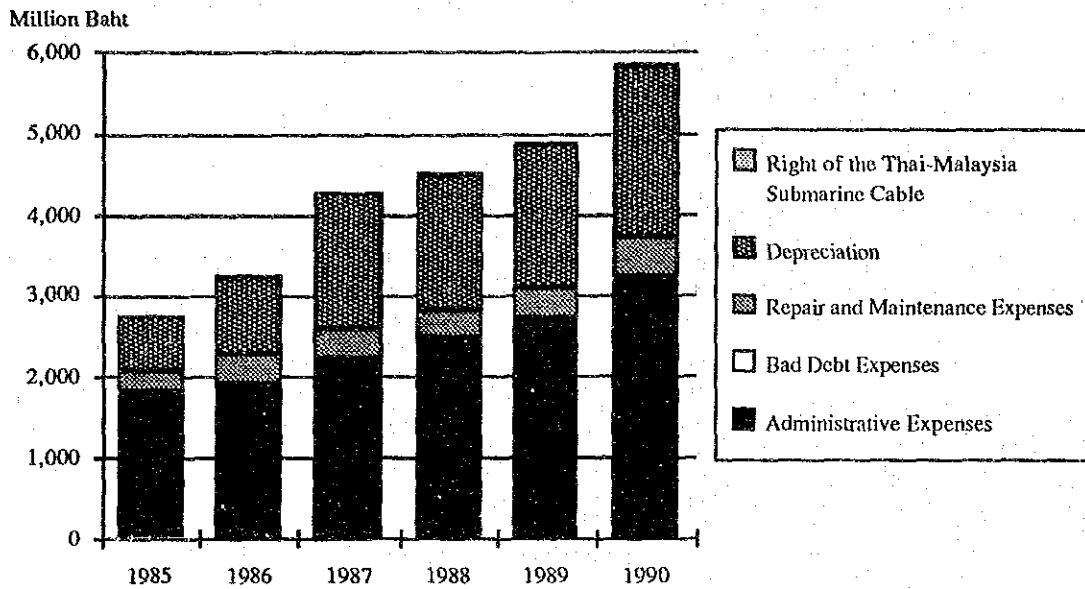


Figure 7.4.1-4 Comparison of Operating Expenses during the Past 6 Years

3) Resources Provided and Used: Sources and Application of Funds

Figure 7.4.1-5 and Figure 7.4.1-6 show the resources provided and used during the past 6 years from FY 1985 to FY 1990. The resource provided from operation increased 4.69 times during these 6 years while the foreign loan increased 2.24 times.

The total resources used increased around 3 times while the resources used for investment in fixed assets and other concerned increased 2 times. Long-term debt amortization and fund for long-term debt service increased with rapid speed during these years because TOT has made a prepayment on IBRD loan in FY 1988 by refinancing in the amount of 3,750 million Baht, and fund for long-term debt service increased rapidly because TOT has reserved the money for the redemption of subscriber bonds in FY 1991 in the amount of 3,500 million Baht.

While the share of long-term loan amortization in the total resources used was approximately 10% in FY 1985, that of FY 1990 was 18.4%. Since the amount of foreign debt increased double in these 6 years from FY 1985 to FY 1990, the amortization is expected to increase further in the next few years. However, it will not become a heavy financial burden as long as the future borrowings are controlled and restrained in a proper level, with the assistance of the increasing fund from operation.

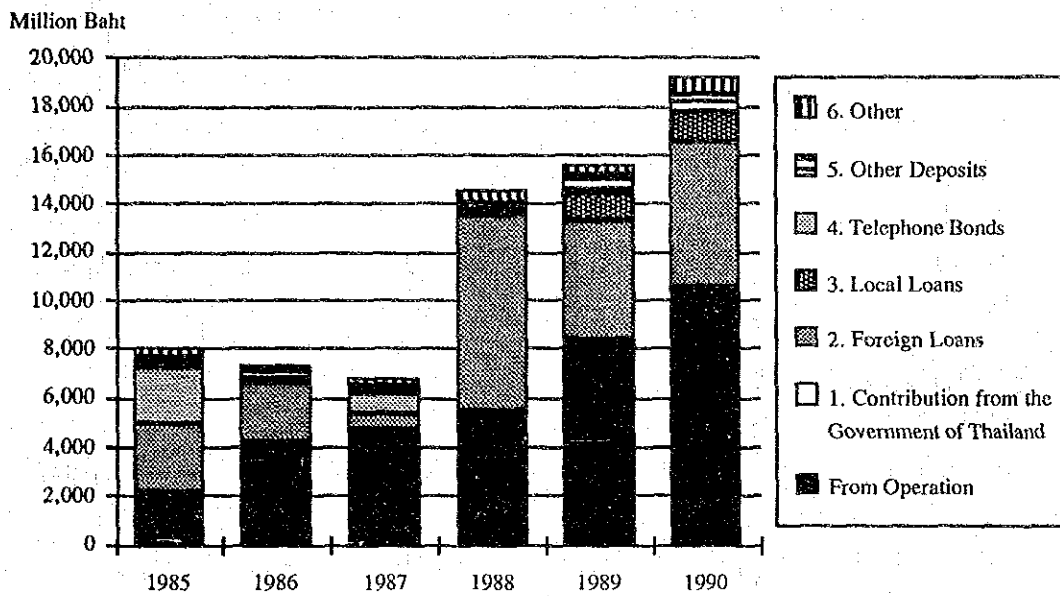


Figure 7.4.1-5 Sources of Fund during the Past 6 Years

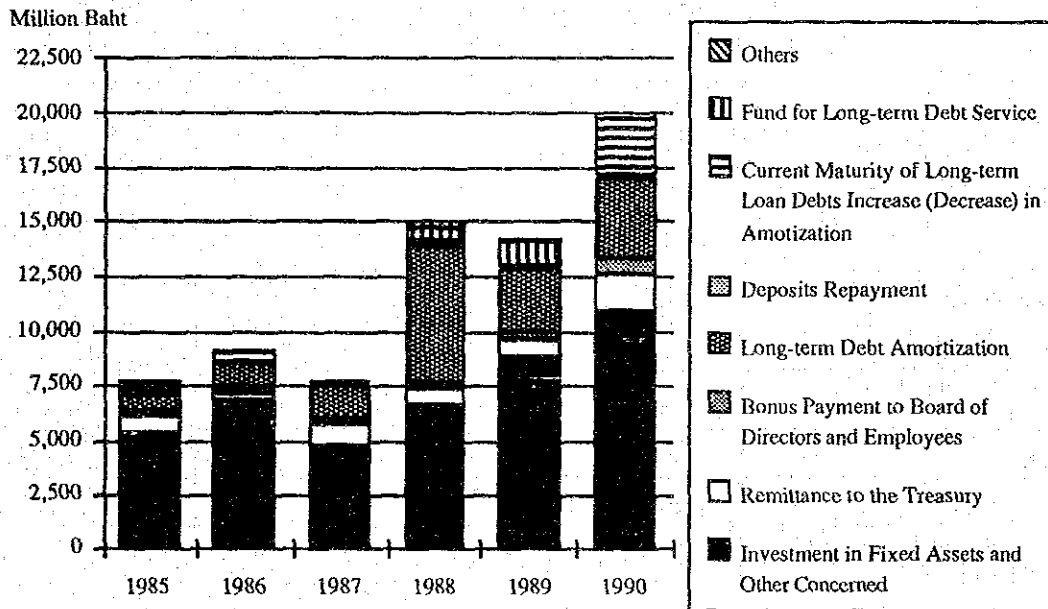


Figure 7.4.1-6 Applications of Fund during the Past 6 Years

Table 7.4.1-4 Resources Provided and Used during the Past 6 Years

(Unit: Million Baht)

Resources Provided	1985	1986	1987	1988	1989	1990
From Operation	2,257.581	4,237.394	4,790.166	5,499.404	8,399.705	10,594.157
1. Net Profit	909.670	2,763.186	2,504.293	2,727.670	5,787.732	8,041.206
2. Depreciation	687.283	971.017	1,714.215	1,656.110	1,776.942	2,129.643
3. Others	660.628	503.190	571.659	1,115.624	835.031	423.308
From Other Sources	5,839.970	3,195.993	2,204.794	9,133.928	7,320.865	8,660.790
1. Contribution from the Government of Thailand						
2. Foreign Loans	2,671.440	2,336.439	646.667	8,130.427	4,934.309	5,985.699
3. Local Loans				150.000	1,186.860	1,314.076
4. Telephone Bonds	2,293.332	257.017	783.000			
5. Other Deposits	424.536	423.700	321.349	377.355	680.662	689.730
6. Other	450.662	178.837	453.757	476.146	519.034	671.285
Total Resources Provided	8,097.551	7,433.387	6,994.960	14,633.332	15,720.570	19,254.947

Resources Used	1985	1986	1987	1988	1989	1990
Investment in Fixed Assets and Other Concerned	5,227.708	6,778.773	4,607.166	6,556.718	8,717.754	10,908.820
Remittance to the Treasury	850.000	370.000	1,105.300	751.300	818.500	1,737.000
Bonus Payment to Board of Directors and Employees	162.937	139.166	301.597	290.508	343.804	569.312
Long-term Debt Amortization	718.127	1,266.143	1,454.239	6,223.560	2,924.390	3,853.929
Deposits Repayment	8.038	10.178	14.214	22.548	17.466	21.284
Current Maturity of Long-term Loan Debts Increase (Decrease) in Amortization	526.077	334.939	-79.165	334.087	155.462	2,927.711
Fund for Long-term Debt Service	68.227	77.378	77.004	479.147	1,047.740	1,438.765
Others	-177.701	79.352	-4.149	-400.250	-187.750	-550.395
Total Resources Used	7,383.413	9,055.929	7,496.207	14,257.618	13,837.366	20,906.426
Working Capital Increases During the Year	714.138	-1,622.542	-481.247	375.714	1,883.204	-1,651.479

Source: Same as Table 7.4.1-1.

7.4.2 Financial Status Analyses of TOT

1) Profitability Analysis

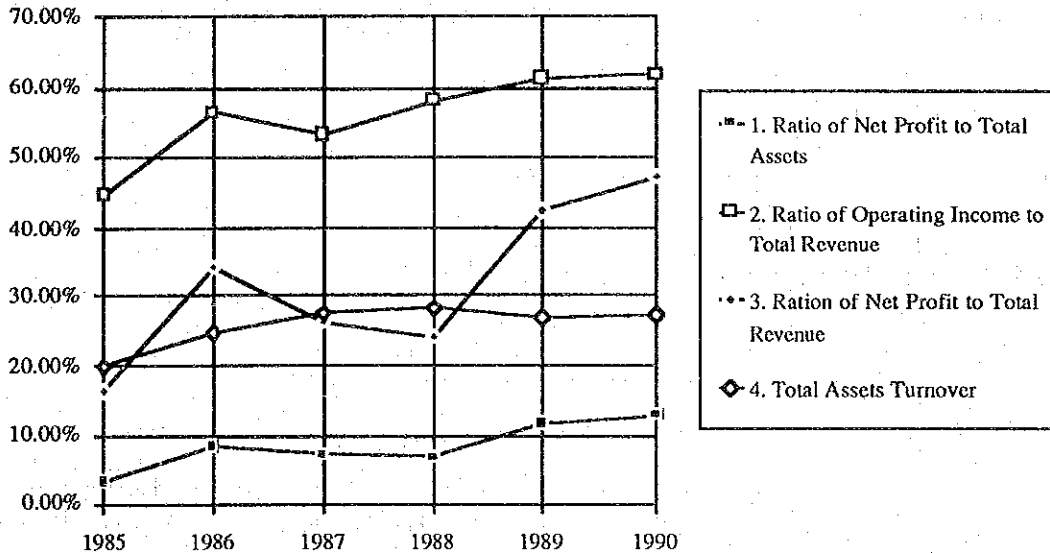


Figure 7.4.2-1 Profitability Analysis

Table 7.4.2-1 Profitability Analysis

Indicators	1985	1986	1987	1988	1989	1990
1. Ratio of Net Profit to Total Assets	3.26%	8.45%	7.25%	6.79%	11.49%	12.87%
2. Ratio of Operating Income to Total Revenue	44.68%	56.48%	53.40%	57.93%	61.13%	61.85%
3. Ratio of Net Profit to Total Revenue	16.52%	34.09%	26.21%	24.16%	42.57%	47.20%
4. Total Assets Turnover (Total Revenue/Total Assets)	19.74%	24.79%	27.66%	28.12%	26.99%	27.27%

Ratio of Net Profit to Total Assets indicates the profitability of the total assets. The ratio shows that the assets profitability is the lowest in FY 1985 but then turns to be rising, and more than 10 percent in these two years, FY 1989 and 1990.

Ratio of Operating Income to Total Revenue also indicates the profitability. It shows that the ratio of TOT is increasing in these 4 years from FY 1987.

Ratio of Net Profit to Total Revenue is also increasing recently and more than 40 percent in these two years.

However, it should be noted that the net profit becomes larger than it should be because of the smaller depreciation due to the delay in fixed assets accounting.

2) Growth Analysis

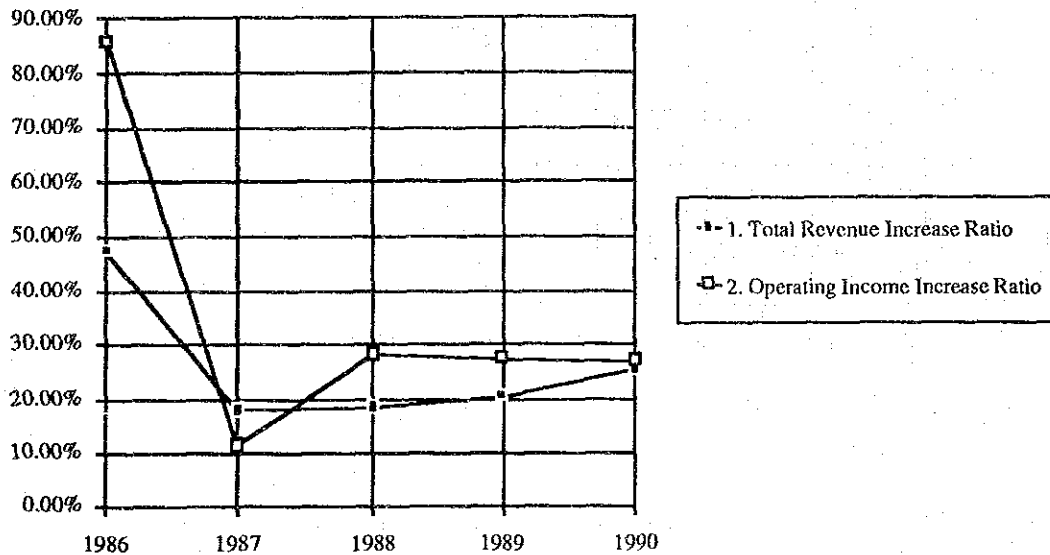


Figure 7.4.2-2 Total Revenue and Operating Income Increase Ratios

Table 7.4.2-2 Growth Analysis

Indicators	1986	1987	1988	1989	1990
1. Total Revenue Increase Ratio	47.24%	17.87%	18.19%	20.42%	25.30%
2. Operating Income Increase Ratio	86.10%	11.44%	28.22%	27.06%	26.79%
3. Net Profit Increase Ratio	203.76%	-9.37%	8.92%	112.19%	38.94%
4. Total Assets Increase Ratio	17.21%	5.63%	16.28%	25.44%	24.02%
5. Equity Capital Increase ratio	-1.34%	-10.58%	36.57%	82.49%	42.20%

Total revenue, operating income, and net profit increased dramatically in FY 1986 due to the tariff increase. While the total revenue increase ratio is growing from FY 1987 to FY 1990, the operating income increase ratio is slightly decreasing in these years. However, 25.3% as of total revenue increase ratio and 26.79% as of operating income increase ratio at FY 1990 maintain a quite high growth level. This high increase ratio is caused by the

increasing subscription demand and call traffic demand growth stimulated by the recent high economic growth.

3) Financial Stability Analysis

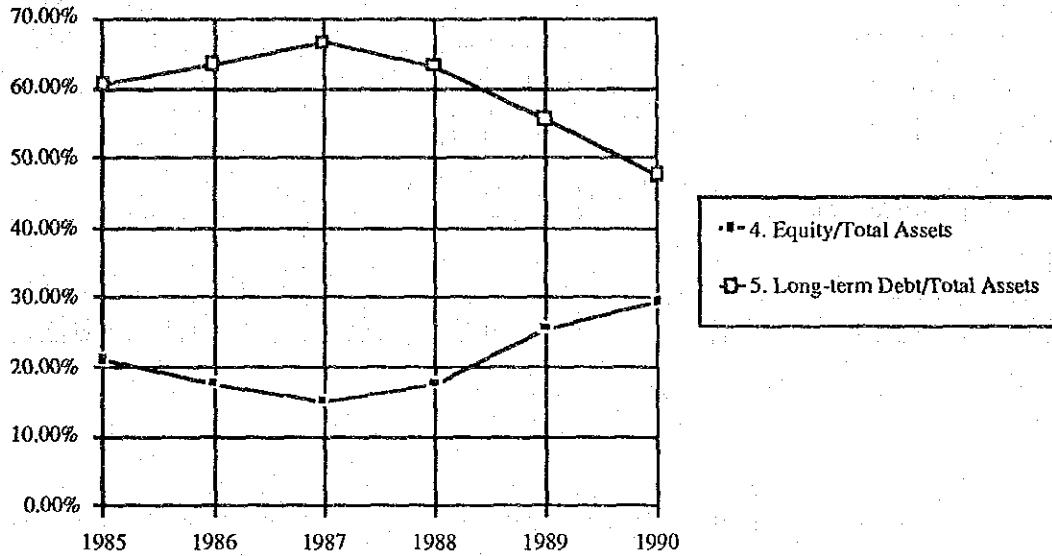


Figure 7.4.2-3 Equity to Total Assets Ratio and Long-term Debt Ratio

Table 7.4.2-3 Financial Stability Analysis

	1985	1986	1987	1988	1989	1990
1. Liquidity Ratio	241.65%	166.31%	159.43%	158.56%	199.04%	128.51%
2. Ratio of Fixed Assets to Total Assets	28.36%	33.27%	49.03%	49.05%	43.18%	38.32%
3. Ratio of Fixed Assets to Equity and Long-term Debt	34.76%	41.04%	60.08%	60.85%	53.34%	49.80%
4. Equity to Total Assets Ratio	21.01%	17.68%	14.97%	17.58%	25.57%	29.32%
5. Long-term Debt/Total Assets	60.57%	63.39%	66.64%	63.04%	55.38%	47.62%

Liquidity ratio is the share of current assets on total current liabilities. When it is more than 100%, payment ability can be regarded to be all right, and it can be said to be in a safety level when this ratio shows more than 150%.

Equity to total assets ratio was decreased from FY 1985 to FY 1987 and then turned to increase.

4) Labor Productivity

Table 7.4.2-4 Labor Productivity of TOT in the Past 6 Years

	1985	1986	1987	1988	1989	1990
1. Number of Employee	16,926	17,399	17,746	17,956	18,243	18,788
2. Increase Ratio of 1		2.79%	1.99%	1.18%	1.60%	2.99%
3. Main Telephone Line	626,498	798,912	901,622	1,005,872	1,158,014	1,324,522
4. Main Tel. Line/Employee	37.01	45.92	50.81	56.02	63.48	70.50
5. Operating Income (Million Baht)	2,459.735	4,577.678	5,101.227	6,540.933	8,310.889	10,537.340
6. Operating Income per Employee (Thousand Baht)	145.323	263.100	287.458	364.276	455.566	560.855
7. Increase Ratio of 6		81.05%	9.26%	26.72%	25.06%	23.11%

Source: TOT, Telephone Statistical Report, 1989, 1990.

The number of employee of TOT was 18,788 in FY 1990. The rate of average growth was 2.1% per year during FY 1985 to FY 1990. The number of main telephone line per employee was 37.01 in FY 1985, which was improved to become 70.50 in FY 1990. Operating income per employee was 145 thousand baht in FY 1985, which was increased to become 561 thousand Baht in FY 1990. The average increase ratio was 31% per year during these years.

7.4.3 Revenues of TOT

1) Operating Revenue

The revenue of TOT has been increased according with the increase of the main telephone station in Thailand. Figure 7.4.3-1 shows the past 6 years' growth of main telephone line in the Metropolitan Telecommunication Area and Provincial Telecommunication Area.

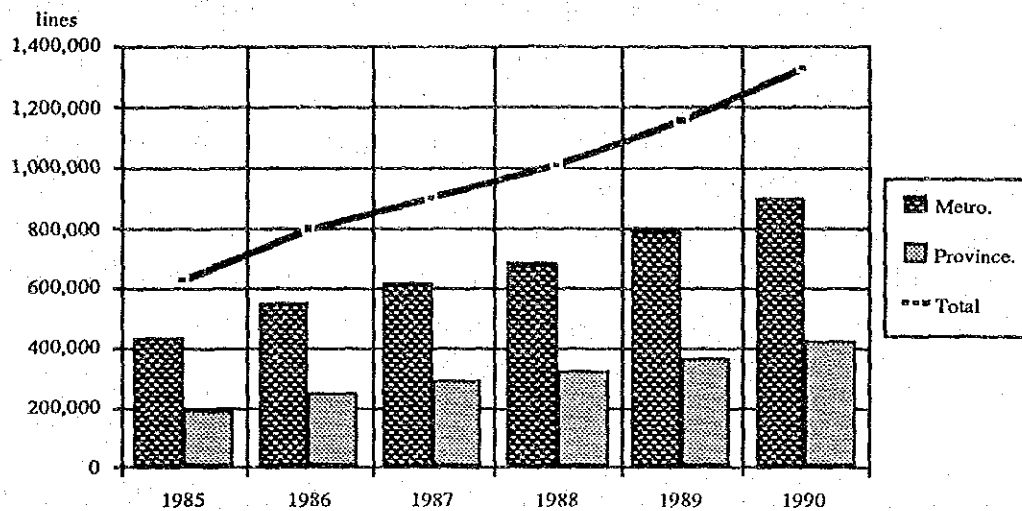


Figure 7.4.3-1 Number of Main Telephone Station for Metro and Provincial Telephone Area in the past 6 years

The operating revenue mainly consists of three parts: local service, trunk service, and other service.

Revenues from local service are revenues from subscription fee (for telephone lines, PBX and extension to different premise), pulse metered service, and trunk service within the same secondary area.

Subscription fee means subscription fee of regular telephone line (dial or push button set), cellular mobile telephone, direct line telephone, two party-line telephone, extension telephone, local leased line, leased trunk circuit (monthly), maintenance fee for PBX, radio telephone, and other equipment connected to telephone system.

Revenue from trunk service are revenues from trunk service between secondary areas and international trunk service (Laos, and Malaysia), This revenue consists of revenue from domestic trunk service, international trunk service, and international trunk service for Malaysia and Laos. Revenue from domestic trunk service means service charge of domestic trunk of regular telephone, main telephone line of PBX, cellular mobile telephone, long-distance public telephone, and rural long-distance public telephone attended by TOT and private.

Revenue from other service are revenue from:

- 1) leased circuit service (including local leased lines),

- 2) installation of telephone equipment (including construction of teletype lines, installation of cables, receptacles, plugs and extension telephones and changing of PBX size),
- 3) relocation and transfer of telephone and telephone equipment (including fees for changing telephone set and telephone line),
- 4) telephone directories advertisement and sale,
- 5) other revenues (from telephone equipment, repair service, private telephone permission fee, PBX inspection fee and fee for changing name).

Table 7.4.3-1 Revenues of TOT in the past 6 years

(Unit: Million Baht)

	1985	1986	1987	1988	1989	1990
1. Local Service	2,702.853	3,931.245	5,052.440	5,870.430	6,844.848	8,382.714
2. Trunk Service	1,899.571	2,834.305	3,564.902	4,489.874	5,457.437	6,980.206
3. Revenue from Other Service	614.113	1,062.477	789.161	678.298	903.933	1,047.319
4. Total Operating Revenues	5,216.537	7,828.027	9,406.503	11,038.602	13,206.218	16,410.239
5. Other Income	288.453	277.256	146.855	252.239	389.977	626.053
6. Total Revenues	5,504.990	8,105.283	9,553.358	11,290.841	13,596.195	17,036.292

Source: TOT, Telephone Statistical Report, 1989, 1990.

- Note: 1 Revenues mean all kind of earnings from local service, trunk service, other service and other revenues.
- 2 Other revenues consist of gains on sale of fixed assets, interest income, special jobs, fine and other income (maintenance fee, cable repair, sale of bid forms, miscellaneous and adjusted item in Income Statement).
- 3 Operating Revenues = Revenues less Other Income.

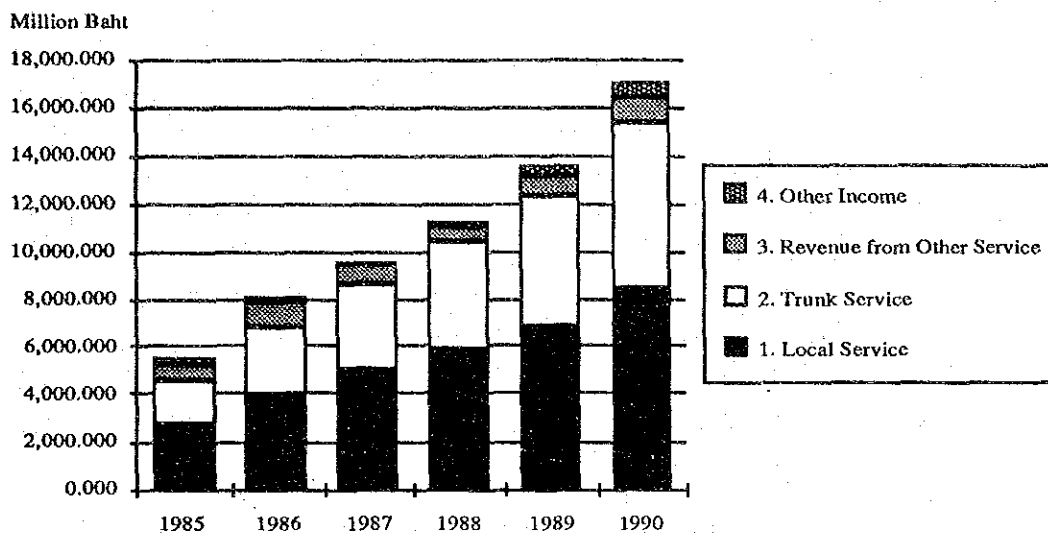


Figure 7.4.3-2 Revenue of TOT in the past 6 years

Figure 7.4.3-3 shows the annual growth rate of the total number of main telephone station and the total revenues of TOT. As the figure shows, the annual growth rates of the revenue are always larger than that of the number of the main telephone line in these six years.

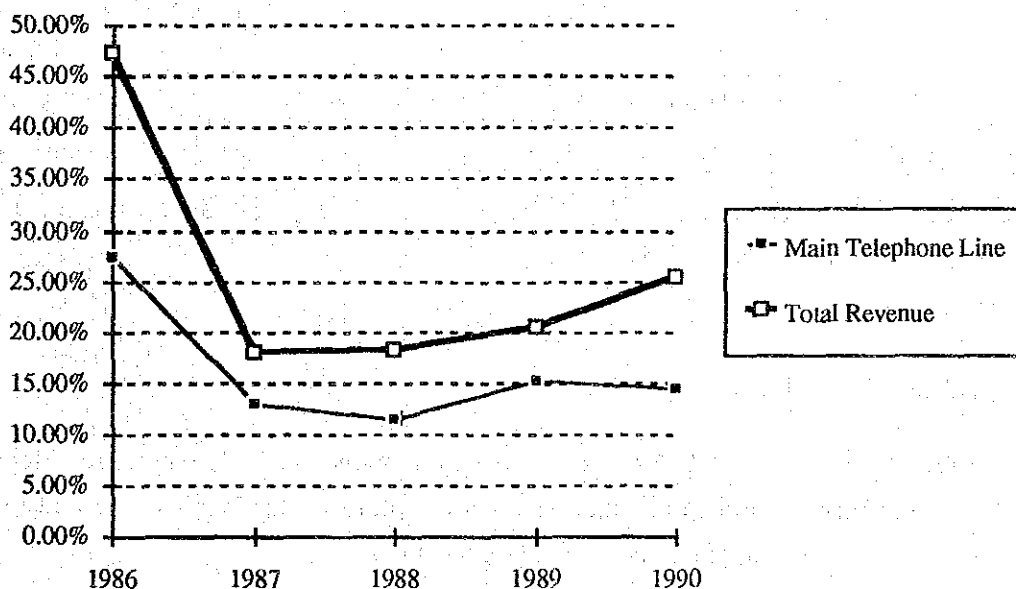


Figure 7.4.3-3 Annual Growth Rate of the Revenue and the Number of Main Telephone Line

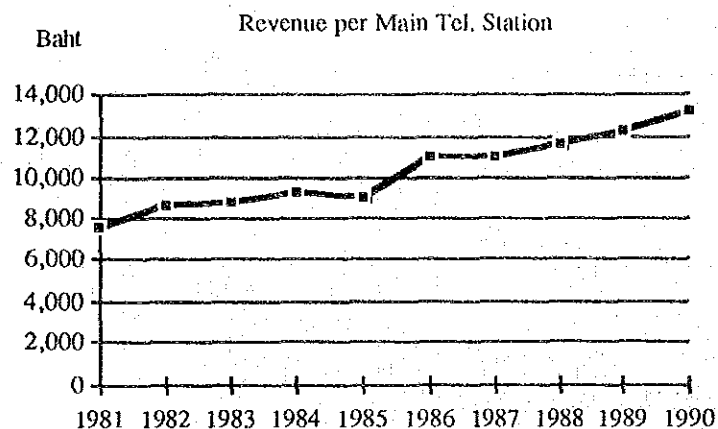


Figure 7.4.3-4 The Average Operating Revenue per Main Telephone Station

Figure 7.4.3-4 shows the past growth of the average operating revenue per average main telephone station. The average operating revenue increases 5.88% annually in these 10 years.

The operating revenue of FY 1990 is divided into Metropolitan Telecommunication Area and Provincial Telecommunication Area as follows:

Table 7.4.3-2 Operating Revenue from BMA and Province in FY 1990

(Unit: Million Baht)

FY 1990	Whole Kingdom	Metro. Tel. Area	Prov. Tel. Area
Operating Revenue	16,410.239	10,309.840	6,100.399
Share (%)	100.00%	62.83%	37.17%

Source: Financial Department of TOT.

2) Telephone Service Revenue

Table 7.4.3-3 and Table 7.4.3-4 show the telephone service revenue for Metropolitan area and Provincial area and their shares of total, respectively. The share of revenue in Province is larger than that of main telephone line.

Table 7.4.3-3 Telephone Service Revenue for Metropolitan and Provincial Telecommunication Area
(Unit: Million Baht)

Year	Metro. Telecom. Area	Prov. Telecom. Area	Whole Kingdom
1985	2,758.228	1,855.863	4,614.091
1986	3,926.382	2,768.874	6,695.256
1987	4,942.985	3,416.449	8,359.434
1988	5,622.812	4,028.127	9,650.939
1989	6,626.838	4,829.622	11,456.460
1990	8,066.369	5,906.098	13,972.467

Source: TOT, Telephone Statistics, 1985, 1986, 1987, 1988, 1989, 1990.

Table 7.4.3-4 Share of Revenue and Main Telephone Line by Metro. and Province

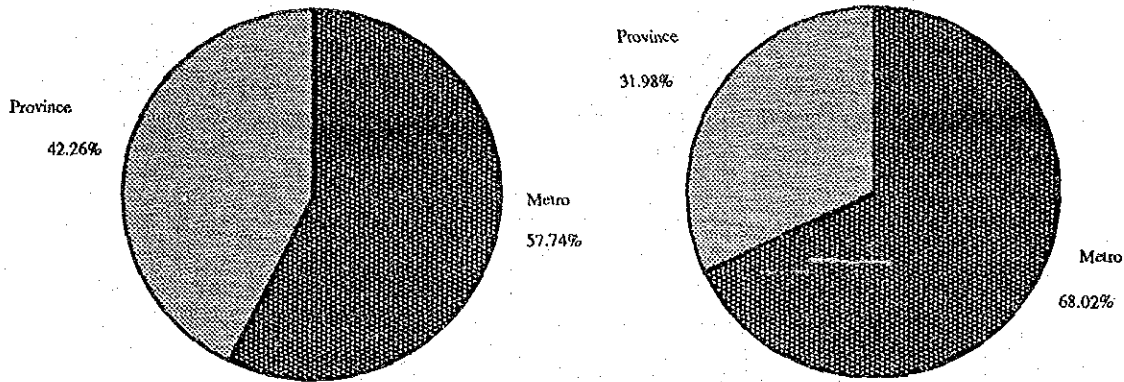
Year	Revenue		Main Tel. Station	
	Metro	Province	Metro	Province
1985	59.78%	40.22%	69.20%	30.80%
1986	58.64%	41.36%	68.60%	31.40%
1987	59.13%	40.87%	68.18%	31.82%
1988	58.26%	41.74%	68.21%	31.79%
1989	57.84%	42.16%	68.41%	31.59%
1990	57.73%	42.27%	68.02%	31.98%

Table 7.4.3-5 Detail of Revenues from Telephone Service

(Unit: Million Baht)

	1985	1986	1987	1988	1989	1990
Subscription Fee	596.351	833.131	1,002.614	1,136.682	1,324.768	1,538.096
Metro. Telecom. Area	453.932	624.331	730.693	813.370	938.011	1,082.288
Prov. Telecom. Area	142.419	208.800	271.921	323.312	386.757	455.808
Local Service	2,200.129	3,305.322	4,087.829	4,719.408	5,442.724	6,816.669
Metro. Telecom. Area	1,717.651	2,467.882	3,153.826	3,622.537	4,164.997	5,116.142
Prov. Telecom. Area	482.478	837.440	934.003	1,096.871	1,277.727	1,700.527
Trunk Service	1,817.611	2,556.803	3,268.991	3,834.849	4,688.968	5,617.702
Metro. Telecom. Area	586.645	834.169	1,058.466	1,226.905	1,523.830	1,867.939
Prov. Telecom. Area	1,230.966	1,722.634	2,210.525	2,607.944	3,165.138	3,749.763
Total	4,614.091	6,695.256	8,359.434	9,690.939	11,456.460	13,972.467
Metro. Telecom. Area	2,758.228	3,926.382	4,942.985	5,662.812	6,626.838	8,066.369
Prov. Telecom. Area	1,855.863	2,768.874	3,416.449	4,028.127	4,829.622	5,906.098

Source: Financial Department, TOT



Telephone Service Revenue in FY 1990

Number of Main Telephone Line at the end of FY 1990

Figure 7.4.3-5 The Telephone Service Revenue and the Number of Main Telephone Line at the End of FY 1990 for Metropolitan and Provincial Telecommunication Area

Figure 7.4.3-5 shows the telephone service revenue in FY 1990 and the number of main telephone line at the end of FY 1990. The share of the Metropolitan Telecommunication Area in terms of the revenue is 57.74% while 68.02% in terms of main telephone line.

Table 7.4.3-6 shows the average subscription fee and call charge, average trunk revenue, average total revenue per number of main telephone station; and the growth rate of average total revenue, number of main telephone station, and the growth rate of number of main telephone station for each telecommunication area in Metro. and the study area in the Province.

Table 7.4.3-6 Average Revenue per Main Telephone Station in Each Telecommunication Area

(Unit: Baht)

Metro. 1	1. Ave. Sub. & Local Call Charge	2. Average Trunk Revenue	3. Average Total Revenue	4. Growth Rate of Average Total Revenue	5. Number of Main Telephone Station	6. Growth Rate of Main Telephone Station
1985	6,065	1,755	7,820		144,146	
1986	7,620	2,037	9,657	23.49%	167,874	16.46%
1987	8,362	2,315	10,677	10.56%	182,023	8.43%
1988	8,597	2,421	11,018	3.19%	196,777	8.11%
1989	8,639	2,648	11,287	2.44%	218,119	10.85%
1990	9,204	2,891	12,095	7.16%	242,996	11.41%
85-90				9.11%		11.01%
Metro. 2	1	2	3	4	5	6
1985	4,313	1,057	5,369		112,856	
1986	4,558	1,127	5,685	5.88%	152,399	35.04%
1987	4,907	1,297	6,204	9.13%	172,040	12.89%
1988	5,228	1,416	6,644	7.10%	190,530	10.75%
1989	5,464	1,611	7,076	6.50%	216,842	13.81%
1990	6,280	1,821	8,101	14.49%	247,944	14.34%
85-90				8.58%		17.05%
Metro. 3	1	2	3	4	5	6
1985	3,874	838	4,711		80,432	
1986	4,868	992	5,860	24.38%	98,909	22.97%
1987	4,909	1,146	6,055	3.33%	110,190	11.41%
1988	4,810	1,142	5,952	-1.71%	131,652	19.48%
1989	4,762	1,186	5,948	-0.07%	161,479	22.66%
1990	5,561	1,325	6,886	15.78%	183,623	13.71%
85-90				7.89%		17.95%
Metro. 4	1	2	3	4	5	6
1985	3,935	1,294	5,228		96,083	
1986	4,836	1,483	6,319	20.86%	128,898	34.15%
1987	4,870	1,627	6,498	2.83%	150,454	16.72%
1988	5,078	1,697	6,775	4.27%	167,192	11.12%
1989	5,087	1,826	6,913	2.03%	195,763	17.09%
1990	5,979	2,069	8,048	16.42%	226,378	15.64%
85-90				9.01%		18.70%
Total Metro.	1	2	3	4	5	6
1985	5,009	1,315	6,324		433,517	
1986	5,658	1,530	7,187	13.65%	548,080	26.43%
1987	6,319	1,722	8,041	11.88%	614,707	12.16%
1988	6,465	1,788	8,253	2.63%	686,151	11.62%
1989	6,442	1,924	8,365	1.36%	792,203	15.46%
1990	6,880	2,073	8,953	7.03%	900,941	13.73%
85-90				7.20%		15.75%

Table 7.4.3-6 Average Revenue per Main Telephone Station in Each Telecommunication Area (Continued)
(Unit: Baht)

Prov. 034 (incl. Nakhon Pathom & Samut Sakhon)

	1. Ave. Sub. & Local Call Charge	2. Average Trunk Revenue	3. Average Total Revenue	4. Growth Rate of Average Total Revenue	5. Number of Main Telephone Station	6. Growth Rate of Main Telephone Station
1985	2,603	3,617	6,220		16,579	
1986	3,579	5,499	9,078	45.94%	17,995	8.54%
1987	3,449	6,163	9,612	5.88%	21,016	16.79%
1988	3,743	6,920	10,663	10.94%	23,065	9.75%
1989	3,625	6,507	10,133	-4.97%	28,656	24.24%
1990	4,186	5,633	9,819	-3.10%	34,552	20.58%
85-90				9.56%		15.82%

Prov. 035 (incl. Ayutthaya)

	1	2	3	4	5	6
1985	2,892	5,591	8,483		4,396	
1986	2,390	5,057	7,447	-12.21%	9,478	115.61%
1987	2,837	6,182	9,019	21.11%	11,603	22.42%
1988	2,967	6,281	9,248	2.54%	13,999	20.65%
1989	3,135	7,148	10,283	11.19%	15,616	11.55%
1990	3,417	6,169	9,586	-6.78%	21,654	38.67%
85-90				2.48%		37.56%

Total Province

	1	2	3	4	5	6
1985	3,238	6,324	9,562		192,981	
1986	3,867	6,868	10,734	12.26%	250,832	29.98%
1987	4,203	7,704	11,908	10.93%	286,915	14.39%
1988	4,442	8,157	12,599	5.81%	319,721	11.43%
1989	4,550	8,652	13,203	4.79%	365,811	14.42%
1990	5,101	8,870	13,970	5.81%	422,767	15.57%
85-90				7.88%		16.98%

Source: TOT, Telephone Statistics, 1985, 1986, 1987, 1988, 1989, 1990.

When the revenue of Metro and Province are compared, the average total revenue of Province is 1.56 times larger than that of Metro in FY 1990. The proportion of "subscription fee and local call charge" and "trunk revenue" in Province, is 1:2, while 3:1 in Metro in FY 1990, which means that the trunk call revenue shares major portion in the Province.

Metropolitan telecommunication area is divided into 4 telecommunication areas. The average revenue in Metro. telecom. area No.1 is 12,095 Baht per year in FY 1990 which is 75% larger than that of Metro. No. 3, whose figure is 6,886 Baht.

The number of main telephone station in Metro. No.1 is growing 11% annually during FY 1985 and 1990, while that of Metro.3 and Metro.4 increase around 18% and 19% respectively.

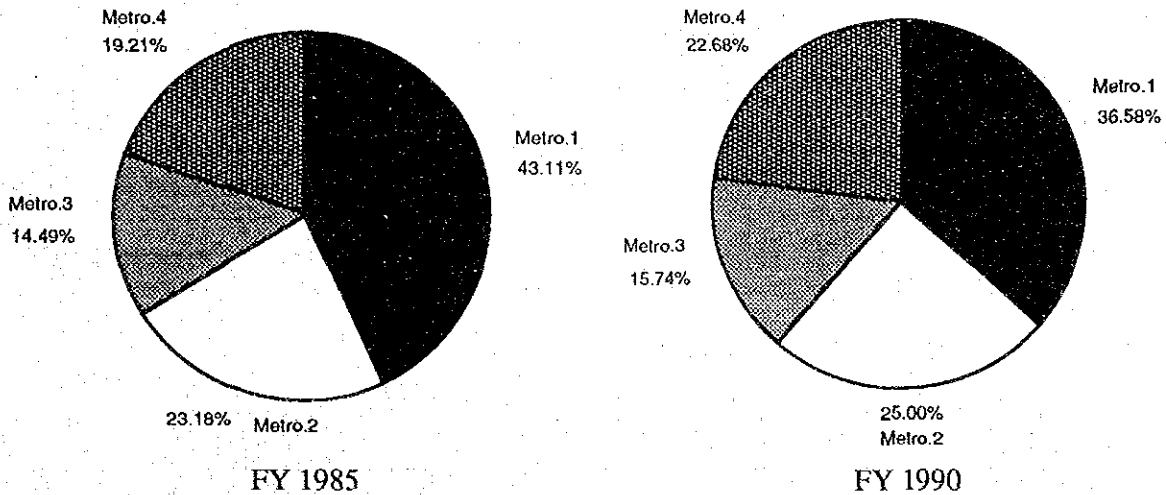


Figure 7.4.3-6 Telephone Service Revenue for Each Metropolitan Telecommunication Area in FY 1985 and FY 1990

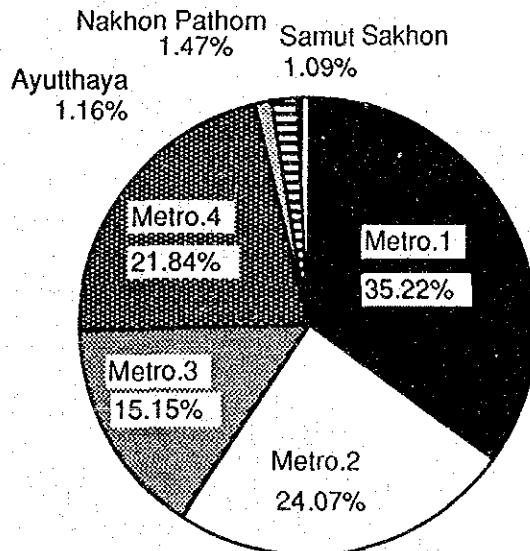


Figure 7.4.3-7 Telephone Service Revenue of Each Study Area in FY 1990

3) Revenue from Cellular Mobile Telephone Service

Revenue from cellular mobile telephone service is included in the "Trunk Service Revenue" in the operating revenue of TOT. The revenue per line is different from normal telephone service. The following tables shows the past trend of cellular mobile telephone service from FY 1986.

Table 7.4.3-7 Statistics of Cellular Mobile Telephone Service by TOT

1. Number of Cellular Mobile Telephone Station

Year	Metro. Telecom. Area	Prov. Telecom. Area	Total	Growth Rate
1986	790	32	822	
1987	2,871	1,542	4,413	436.86%
1988	6,667	3,945	10,612	140.47%
1989	12,659	8,277	20,936	97.29%
1990	18,865	13,116	31,981	52.76%

2. Cellular Mobile Telephone Call

(Unit: Call)

Year	Metro. Telecom. Area	Prov. Telecom. Area	Whole Kingdom	Growth Rate
1986	137,364	5,314	142,678	N.A.
1987	2,033,404	1,424,443	3,457,847	2323.53%
1988	6,676,940	6,478,886	13,155,826	280.46%
1989	13,492,113	10,891,618	24,383,731	85.35%
1990	21,044,009	18,723,509	39,767,518	63.09%

3. Cellular Mobile Telephone Minute

(Unit: Minute)

Year	Metro. Telecom. Area	Prov. Telecom. Area	Whole Kingdom	Growth Rate
1986	334,069	16,092	350,161	
1987	5,407,059	4,127,493	9,534,552	2622.91%
1988	18,635,411	18,901,798	37,537,209	293.70%
1989	38,629,143	32,290,652	70,919,795	88.93%
1990				

Table 7.4.3-7 Statistics of Cellular Mobile Telephone Service by TOT (Continued)

4. Cellular Mobile Telephone Revenue

4.1 Subscription Fee

(Unit: Million Baht)

Year	Metro. Telecom. Area	Prov. Telecom. Area	Whole Kingdom	Growth Rate
1986	0.902	0.017	0.919	N.A.
1987	10.407	3.317	13.724	1393.36%
1988	27.176	15.941	43.117	214.17%
1989	58.279	33.985	92.264	113.99%
1990				

4.2 Telephone Usage

(Unit: Million Baht)

Year	Metro. Telecom. Area	Prov. Telecom. Area	Whole Kingdom	Growth Rate
1986	1.091	0.052	1.143	N.A.
1987	18.988	14.350	33.338	2816.71%
1988	62.506	69.822	132.328	296.93%
1989	142.143	118.961	261.104	97.32%
1990				

4.3 Total Cellular Mobile Telephone Revenue

(Unit: Million Baht)

Year	Metro. Telecom. Area	Prov. Telecom. Area	Whole Kingdom	Growth Rate
1986	1.993	0.069	2.062	N.A.
1987	29.395	17.667	47.062	2182.35%
1988	89.682	85.763	175.445	272.80%
1989	200.422	152.946	353.368	101.41%
1990				

5. Average Revenue per Average Cellular Mobile Telephone

(Unit: Baht)

Year	Metro. Telecom. Area	Prov. Telecom. Area	Whole Kingdom
1987	16,058	22,449	17,980
1988	18,805	31,260	23,354
1989	20,741	25,028	22,402
1990			

Source: TOT, Telephone Statistical Report, 1990; Annual Report, 1989

The average revenue per cellular mobile telephone in Metro.in FY 1989 is 2.5 times larger than that of the normal telephone and 1.9 times larger in Province.

7.4.4 Expenses of TOT

Table 7.4.4-1 shows the expenses of TOT in the past 6 years.

Table 7.4.4-1 Expenses of TOT in the past 6 years

(Unit: Million Baht)

	1985	1986	1987	1988	1989	1990
1. Administrative Expenses	1,773.733	1,920.744	2,213.481	2,464.982	2,701.423	3,216.801
2. Bad Debt Expenses	34.328	9.108	19.213	0.028	8.013	8.973
3. Repair and Maintenance	261.458	349.480	358.367	362.895	393.065	501.369
4. Depreciation	687.283	971.017	1,714.215	1,656.109	1,776.942	2,129.643
5. Right of the Thai-Malaysia Submarine Cable System				13.655	15.886	16.113
6. Total Operating expenses	2,756.802	3,250.349	4,305.276	4,497.669	4,895.329	5,872.899
7. Other Expenses	1,838.518	2,091.748	2,743.789	4,065.501	2,913.134	3,122.187
8. Total Expenses	4,595.320	5,342.097	7,049.065	8,563.170	7,808.463	8,995.086

Source: Same as Table 7.4.1-2

- Note: 1 Expenses mean all kind of expenses including administrative expenses, bad debt expenses, repair and maintenance expenses, depreciation and other expenses.
- 2 Administrative expenses include staff remuneration, welfare expenses and other expenses on employee, vehicles, renting, ceremonies, consultants, premium, advertising, turn-key contracts, instruments and equipment, office equipment, public utility services and other miscellaneous expenses.
- 3 bad debt expenses mean the valuation account reserved for the expected uncollectable debts.
- 4 Repair and maintenance Expenses mean expenses on land, land development, buildings, inside plant, subscriber plant, large PBX, poles, cables, conduits and manholes, stationeries, office equipment, computers, data processors, vehicles, equipment, printing shop, garage and unclassified assets.
- 5 Depreciation means depreciation on buildings, inside plant, subscriber plant, large PBX, poles, cables, conduits, manholes, stationeries, office equipment, computers and data processors, vehicles, equipment and plant equipment.
- 6 Other Expenses include expenses on loan interest, commitment charge, loss from disposal of written off assets, loss on foreign currencies exchange, loss from depreciation of inventory, other expenditures.

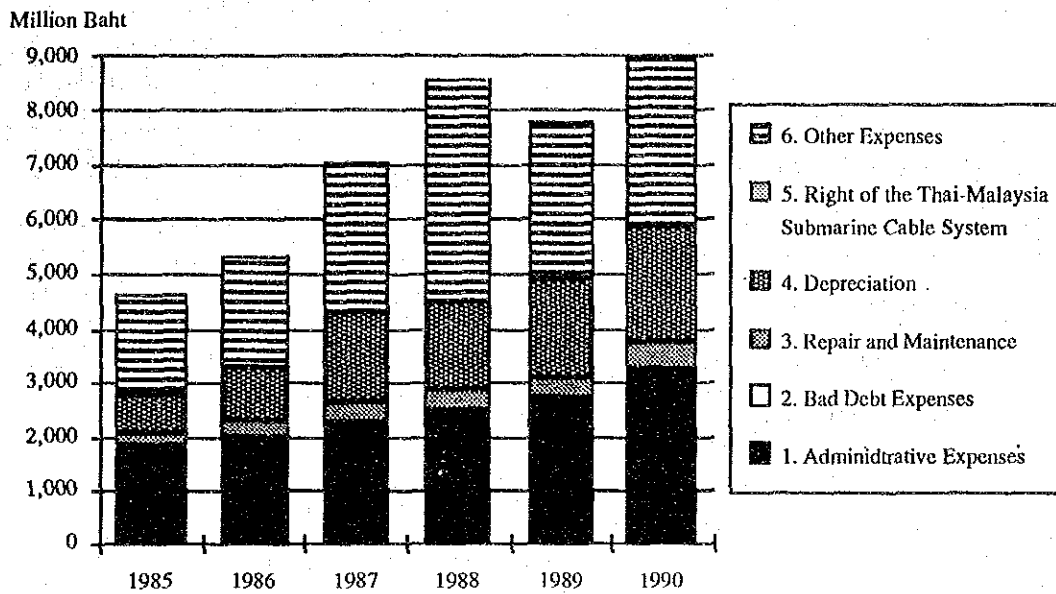


Figure 7.4.4-1 Comparison of the Expenses of TOT in the past 6 years

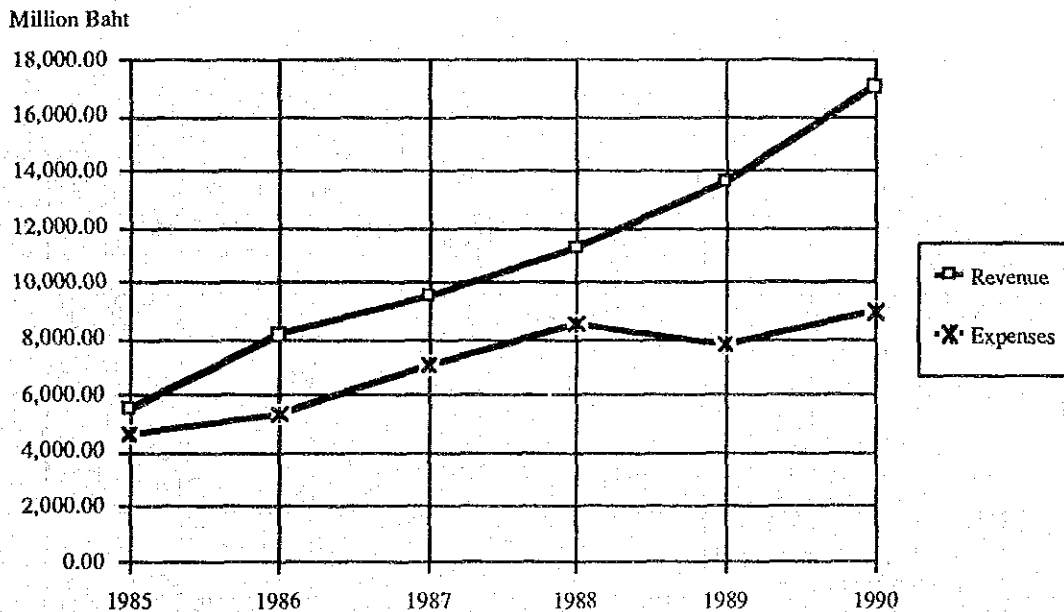


Figure 7.4.4-2 Total Revenue and Total Expenditure of TOT in the Past 6 Years

Breakdown data of the operating expenses into Metropolitan Telecommunication Area and Provincial Telecommunication Area are obtained only for the item of "1. Administrative Expenses" and "3. Repair and Maintenance Expenses" in FY 1990, which is shown in Table 7.4.4-2. Approximately 70% of the expenses is born in Metro.

Table 7.4.4-2 Breakdown of Expenses into Region in FY 1990

	Total	Metro. Tel. Area	Provincial. Tel. Area
1. Administrative Expenses (Share)	3,216.801	2,351.269	865.532
	100.0%	73.1%	26.9%
3. Repair and Maintenance Expenses (Share)	501.369	347.765	153.604
	100.0%	69.4%	30.6%

Source: Department of Finance, TOT

7.4.5 Annual Budget of TOT

Table 7.4.5-1 shows the annual budget of TOT in the past 6 years from FY 1985. The project investment budget increased more than double within these 6 years.

Table 7.4.5-1 Annual Budget of TOT in the Past 6 Years

Year	1985	1986	1987	1988	1989	1990
Annual Budget	5016.51	6257.29	4000.335	6800.785	8486.995	10431.621
1. Non-Project Investment	297.380	457.864	645.333	703.070	444.994	629.280
2. Project Investment	4,719.130	5,799.426	3,355.002	6,097.715	8,042.001	9,802.341
2.1 The EDP 1972-1980						
2.2 The EDP 1977-1987	4,427.500	2,979.480	1,075.032	180.854	116.484	
2.3 Special Telephone Project for the Immediate Need('80-'81)	0.020	28.520				
2.4 The Local Telephone Service Improvement Project 82-83	3.720	0.290				
2.5 Urgent Provincial Telephone Development Project 82-83	40.920	0.250	1.433			
2.6 Relief of Shortage of Cable Pair for Subscriber Installation Project '83	0.040	0.002				
2.7 The EDP 1984-1992 *	246.930	2,790.884	2,278.537	5,916.861	7,925.517	9,189.373
2.8 Urgent Telephone Service Expansion Project 1989-1992						612.968

Note: * The figures in FY 1985-1987 were calculated by the project rate and the figures in FY 1988-1990 were calculated by the present rate.

The following tables shows the detail of the expenditures of expansion project budgets.

Table 7.4.5-2 Summary of the Expenditures of All Expansion Project

(Unit: Million Baht)

	Local	Foreign	Total
1. Total Disbursed up to 1989.9.30			
1.1 EDP Project 1977-1987	8,316.771	11,073.476	19,390.247
1.2 EDP Project 1984-1992	8,242.989	12,237.460	20,480.449
1.3 Total	16,559.760	23,310.936	39,870.696
1.4 Share	41.53%	58.47%	100.00%
2. Total Disbursed up to 1990.9.30			
2.1 EDP Project 1984-1992	12,340.292	17,329.530	29,669.822
2.2 Urgent Telephone Service Expansion Project 1989-1992	199.635	413.333	612.968
2.3 Total	12,539.927	17,742.863	30,282.790
2.4 Share	41.41%	58.59%	100.00%

Table 7.4.5-3 Summary of the Expenditures of Project Budget Disbursed up to Sep. 30, 1989 (I)

(Unit: Million Baht)

	Local	Foreign	Total	Share (%)
1. Metropolitan Work				
1.1 EDP Project 1977-1987	4,249.961	4,272.512	8,522.473	
1.2 EDP Project 1984-1992	8,242.989	12,237.460	20,480.449	
Total Metropolitan Work	12,492.950	16,509.972	29,002.922	72.74%
2. Provincial Work				
2.1 EDP Project 1977-1987	1,772.162	2,213.915	3,986.077	10.00%
3. Long Distance Work				
3.1 EDP Project 1977-1987				
3.1.1 Long Distance Work	482.758	1,054.948	1,537.706	
3.1.2 Rural Public Long Distance Telephone	1,603.221	1,534.114	3,137.335	
3.1.3 Trunk Work	98.846	466.193	565.039	
Total Long Distance Work	2,184.825	3,055.255	5,240.080	13.14%
Total Category 1-3	16,449.937	21,779.142	38,229.079	95.88%
4. Contingency Fund				
4.1 EDP Project 1977-1987	109.823	133.817	243.640	
4.2 EDP Project 1984-1992			0.000	
Total Contingency fund	109.823	133.817	243.640	0.61%
5. Investment Increased by the Adjustment of Exchange Rate				
5.1 EDP Project 1977-1987	0.000	1,397.977	1,397.977	3.51%
6. The Effect of Exchange Rate				
6.1 EDP Project 1977-1987	0.000	0.000	0.000	
Grand Total	16,559.760	23,310.936	39,870.696	100.00%

Table 7.4.5-4 Summary of the Expenditures of Project Budget Disbursed up to Sep. 30, 1989 (II-1/2)

(Unit: Million Baht)

	Local	Foreign	Total	Share (%)
1. Land and Civil Work Cost				
1.1 EDP Project 1977-1987	1,809.655		1,809.655	
1.2 EDP Project 1984-1992	985.573		985.573	
Sub Total	2,795.228		2,795.228	7.01%
2. Inside Plant Cost				
2.1 EDP Project 1977-1987	1,195.827	4,227.248	5,423.075	
2.2 EDP Project 1984-1992	1,313.616	5,885.985	7,199.601	
Sub Total	2,509.443	10,113.233	12,622.676	31.66%
3. Outside Plant Cost				
3.1 EDP Project 1977-1987	2,806.716	2,841.592	5,648.308	
3.2 EDP Project 1984-1992	4,605.697	2,986.481	7,592.178	
Sub Total	7,412.413	5,828.073	13,240.486	33.21%
4. Transmission Equipment Cost				
4.1 EDP Project 1977-1987	1,018.213	2,397.625	3,415.838	
4.2 EDP Project 1984-1992	793.044	2,717.123	3,510.167	
Sub Total	1,811.257	5,114.748	6,926.005	17.37%
5. Subscriber Plant Cost				
5.1 EDP Project 1977-1987	1,027.827	72.529	1,100.356	
5.2 EDP Project 1984-1992	374.384	3.256	377.640	
Sub Total	1,402.211	75.785	1,477.996	3.71%
6. Vehicle Cost				
6.1 EDP Project 1977-1987	137.868		137.868	
6.2 EDP Project 1984-1992	3.282		3.282	
Sub Total	141.150	0.000	141.150	0.35%
7. Miscellaneous Work & Equipment Cost				
7.1 EDP Project 1977-1987	25.196		25.196	
7.2 EDP Project 1984-1992			0.000	
Sub Total	25.196	0.000	25.196	0.06%
8. Project Implementation Cost				
8.1 EDP Project 1977-1987	185.646	2.688	188.334	
8.2 EDP Project 1984-1992	10.612	4.049	14.661	
Sub Total	196.258	6.737	202.995	0.51%

Table 7.4.5-4 Summary of the Expenditures of Project Budget Disbursed up to Sep. 30, 1989 (II-2/2)

(Unit: Million Baht)

	Local	Foreign	Total	Share (%)
9. Videotex Service				
9.1 EDP Project 1984-1992			0.000	
10. Consultant Fee				
10.1 EDP Project 1984-1992	156.781	640.566	797.347	2.00%
11. Contingency Fund				
11.1 EDP Project 1977-1987	109.823	133.817	243.640	
11.2 EDP Project 1984-1992			0.000	
Sub Total	109.823	133.817	243.640	0.61%
12. Investment Increased by the Adjustment of Exchange Rates				
12.1 EDP Project 1977-1987		1,397.977	1,397.977	3.51%
13. The Effect of Exchange Rate				
13.1 EDP Project 1984-1992			0.000	
Grand Total	16,559.760	23,310.936	39,870.696	100.00%

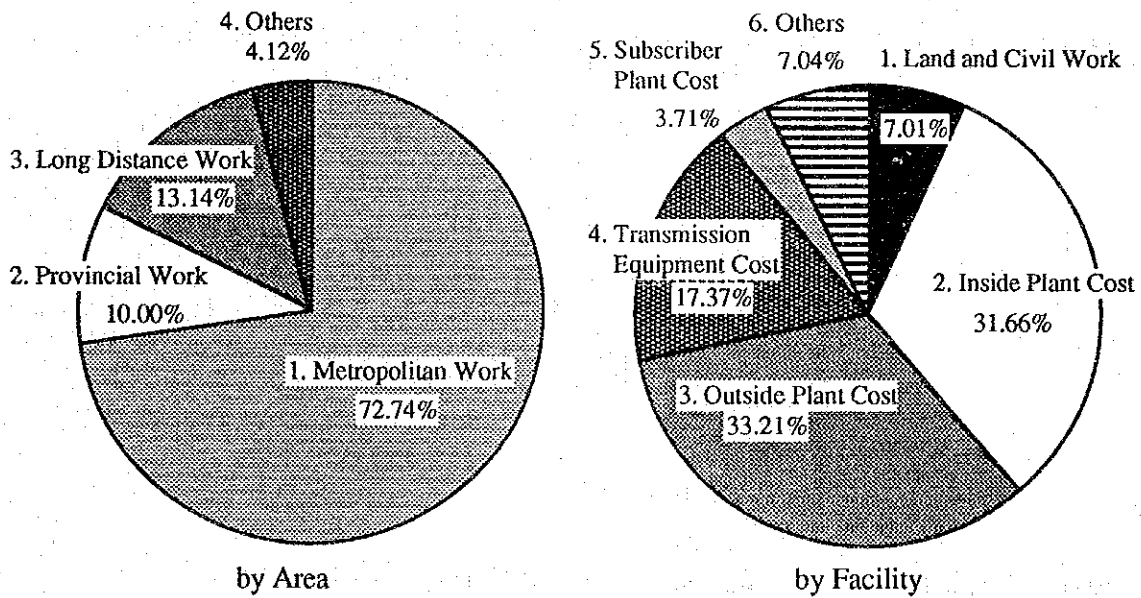


Figure 7.4.5 Expenditures of Project Budget Disbursed up to Sp. 30, 1989

Table 7.4.5-5 Construction Budget for Urgent Telephone Service Expansion Project (1989-1992)
(Unit: Million Baht)

UETP Budget	Local	Foreign	Total
1. Land and Building	127.0		127.0
2. Telephone Exchange Facilities	920.7	1,999.0	2,919.7
3. Outside Plant	1,366.0	435.1	1,801.1
4. Transmission Equipment	350.0	1,528.6	1,878.6
5. Public Terminal Equipment	75.5	226.0	301.5
6. Installation Cost	223.6		223.6
7. Data Transmitter	173.0	507.0	680.0
8. Spare Parts	540.0	0.0	540.0
9. Others	58.0		58.0
10. Contingency	191.0	235.0	426.0
Total	4,024.8	4,930.7	8,955.5

Source: TOT, Telephone Statistics, 1990

Target of Urgent Telephone Service Expansion Project (1989-1992) is as follows:

Local Line Installation	Lines
- Metro.	167,936
- Province.	39,424
- Whole Kingdom	207,360
Leased Circuit Installation	Lines
- Metro.	5,000
- Province.	1,600
- Whole Kingdom	6,600

Note: This is the adjusted data at the end of FY 1991 (at Sep. 30, 1990).

CHAPTER 8

DEMAND FORECAST

CHAPTER 8 DEMAND FORECAST

8.1 Telephone Service Subscription Demand

8.1.1 Methodology

In this study, the future demand is forecasted through two steps. The first step is a macro level forecast for the BMA and the Surrounding Area (Nakhon Pahtom, Samut Sakhon, Ayutthaya), which is hereinafter called the macro forecast. The second step is a micro level forecast for each individual telephone service area which has a node of the telephone network, which is hereinafter called the micro forecast. Figure 8.1.1 shows the forecast procedure for the subscription demand.

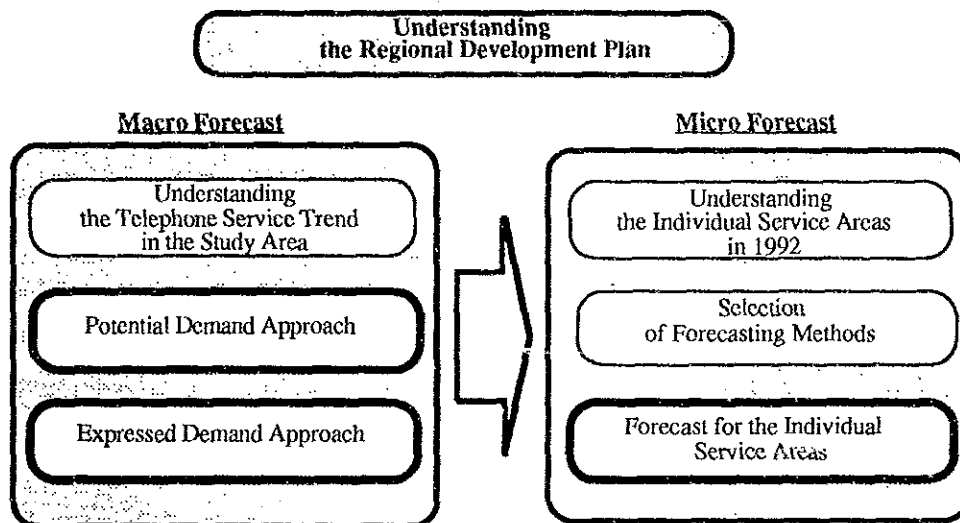


Figure 8.1.1 Telephone Subscription Demand Forecast Procedure

8.1.2 Macro Forecast

1) Understanding Telephone Service Trend

a) Whole Kingdom

In the Kingdom of Thailand, the telephone demand is increasing as the economy grows. Especially, the rapid growth of the demand began from 1988. Furthermore, the growth rate of the demand has exceeded that of the per capita GDP since 1988. As a result of the rapid increase of the demand, the number of waiting applicants became more than one million in 1990. Table 8.1.2-1 shows the

telephone service and socioeconomic development in the Whole Kingdom. Figure 8.1.2-1 and 2 show the telephone service demand in the Whole Kingdom.

Table 8.1.2-1 Telephone Service and Socioeconomic Development in the Whole Kingdom

Year	Telephone Service					Socioeconomic Development		
	Residential Subscriber	Business Subscriber	Waiting	Demand	Demand/100 persons	Per Capita GDP*	Population	GDP (10 ³ Baht)
1979	158,292	168,622	N.A.	N.A.	N.A.	N.A.	46,113,756	N.A.
1980	178,106	182,030	N.A.	N.A.	N.A.	N.A.	46,961,338	N.A.
1981	192,262	190,113	N.A.	N.A.	N.A.	6,651	47,875,002	318,438,765
1982	212,276	204,682	N.A.	N.A.	N.A.	6,784	48,846,927	331,379,228
1983	241,084	212,721	441,363	895,168	1.81	7,171	49,565,074	355,408,396
1984	281,441	227,164	483,574	992,179	1.96	7,682	50,583,105	380,738,730
1985	357,074	255,102	406,366	1,018,542	1.97	7,791	51,795,651	394,113,016
1986	488,779	292,413	353,228	1,134,420	2.14	7,983	52,969,204	413,490,152
1987	565,221	316,289	318,419	1,199,929	2.23	8,545	53,873,172	452,636,241
1988	640,643	344,593	403,076	1,388,312	2.53	9,512	54,960,917	512,466,435
1989	758,086	378,592	585,503	1,722,181	3.08	10,274	55,888,393	574,194,915
1990	881,061	421,177	1,016,628	2,318,866	4.12	11,210	56,341,660	631,610,000

Legend *: Gross Domestic Product at 1972 Prices.
 Source : Data of telephone service : TOT
 Population : Local Administration Department / Ministry of Interior
 GDP : National Accounts Division / NESDB

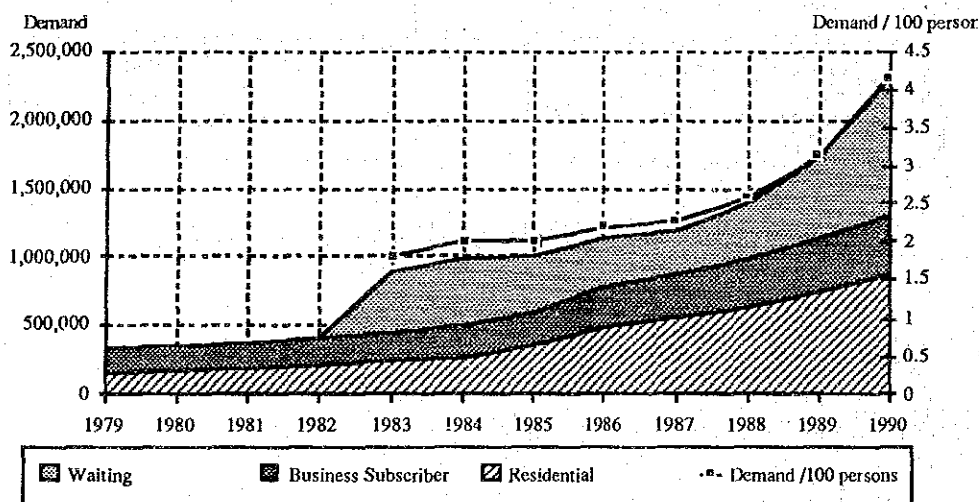


Figure 8.1.2-1 Telephone Service Demand in the Whole Kingdom

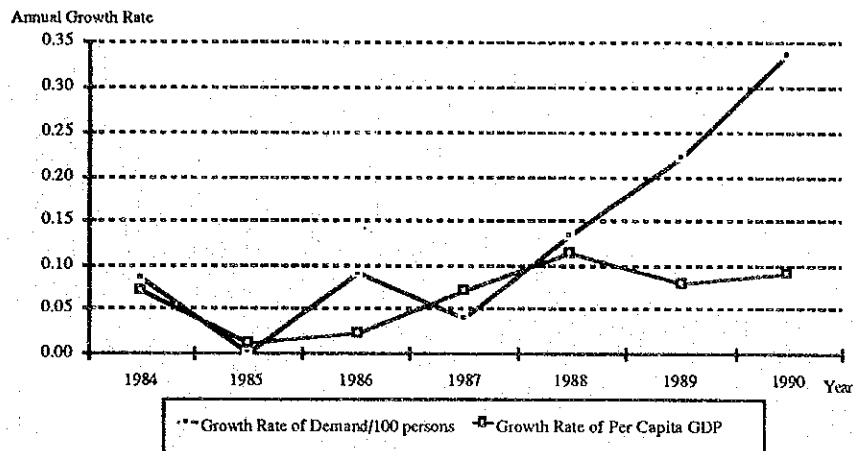


Figure 8.1.2-2 Annual Growth Rate of Demand per 100 Persons and Per Capita GDP in the Whole Kingdom

b) BMA

In the BMA, the telephone demand is increasing due to the economic growth. Especially, the growth speed of the demand has accelerated since 1988. As a result of the rapid increase of the demand, the number of waiting applicants became approximately eight hundred thousands in 1990. Table 8.1.2-2 shows the telephone service demand and the socioeconomic development in the BMA. Figure 8.1.2-3 and 4 show the telephone service development in the BMA.

Table 8.1.2-2 Telephone Service and Socioeconomic Development in the BMA

Year	Telephone Service					Socioeconomic Development		
	Residential Subscribers	Business Subscribers	Waiting Applicants	Demand	Demand/100 persons	Per Capita GRP*	Population	GRP (10 ³ Baht)
1979	133,328	105,917	N.A.	N.A.	N.A.	N.A.	6,201,337	N.A.
1980	149,758	114,616	N.A.	N.A.	N.A.	N.A.	6,400,969	N.A.
1981	160,980	120,160	N.A.	N.A.	N.A.	19,716	6,624,614	130,613,989
1982	173,797	130,620	N.A.	N.A.	N.A.	19,498	6,817,334	132,921,659
1983	196,683	134,651	292,892	624,226	9.67	22,993	6,456,238	148,450,489
1984	212,825	139,839	324,421	677,085	10.17	23,312	6,659,964	155,257,172
1985	263,328	158,891	307,684	729,903	10.56	22,891	6,915,127	158,294,888
1986	352,887	181,964	298,318	833,169	11.76	23,510	7,086,101	166,595,196
1987	403,191	197,081	279,960	880,232	12.00	26,115	7,338,321	191,639,800
1988	454,890	216,776	346,219	1,017,885	13.50	29,654	7,537,629	223,521,872
1989	538,076	239,594	477,941	1,255,611	16.24	32,981	7,731,852	255,001,459
1990	618,531	267,745	800,062	1,686,338	22.41	N.A.	7,523,273	N.A.

Legend *: Gross Regional Product at 1972 Prices.
Source : Data of telephone service : TOT
Population : Local Administration Department / Ministry of Interior
GRP : National Accounts Division / NESDB

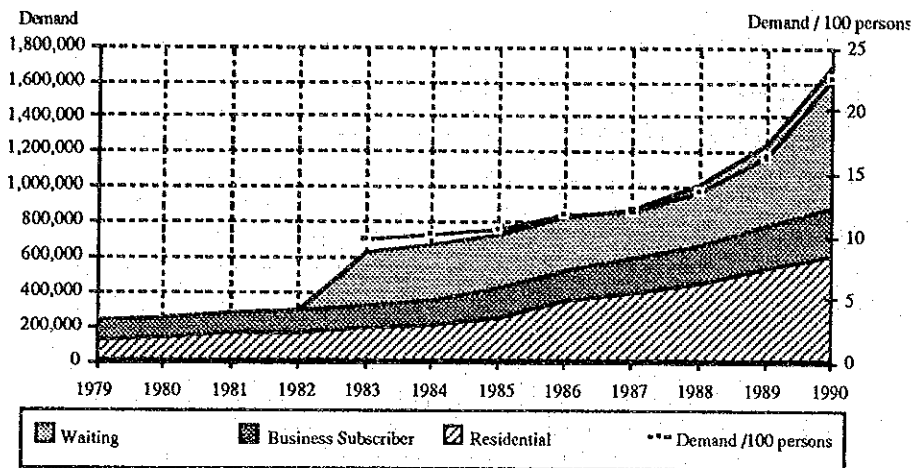


Figure 8.1.2-3 Telephone Service Demand in the BMA

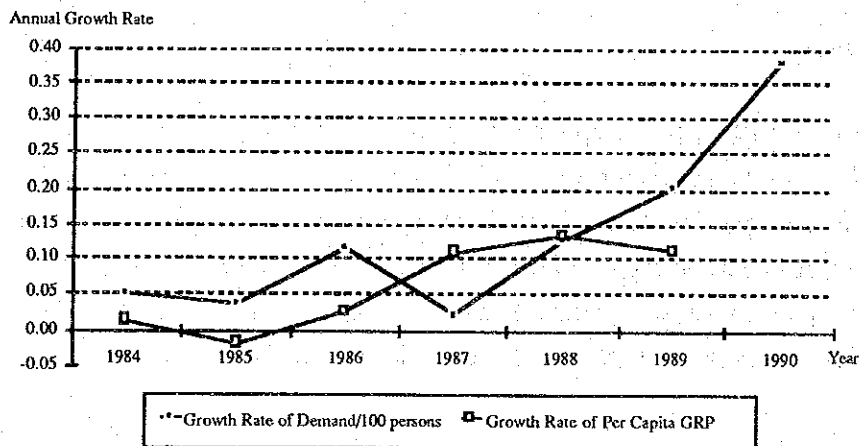


Figure 8.1.2-4 Annual Growth Rate of Demand per 100 persons and Per Capita GRP in the BMA

c) The Surrounding Area

While the large number of waiting applicants appeared in the BMA, the similar phenomenon occurred in Nakhon Pathom. The number of waiting applicants in this area was over eight thousands in 1990. Table 8.1.2-3 shows the telephone service demand and the socioeconomic development in the area. Figure 8.1.2-5 and 6 show the telephone service development in Nakhon Pathom.

Table 8.1.2-3 Telephone Service and Socioeconomic Development in Nakhon Pathom

Year	Telephone Service					Socioeconomic Development		
	Residential Subscriber	Business Subscriber	Waiting Demand	Demand	Demand/100 persons	Per Capita GPP*	Population	GPP (10 ³ Baht)
1979	1,046	1,724	N.A.	N.A.	N.A.	N.A.	552,758	N.A.
1980	1,055	1,721	N.A.	N.A.	N.A.	N.A.	561,346	N.A.
1981	1,058	1,720	N.A.	N.A.	N.A.	7,063	569,649	4,023,343
1982	1,066	1,720	N.A.	N.A.	N.A.	6,907	590,588	4,079,058
1983	1,088	1,711	7,606	10,405	1.78	7,157	585,931	4,193,246
1984	3,422	2,081	5,462	10,965	1.84	7,719	596,257	4,602,677
1985	5,812	2,582	4,325	12,719	2.09	8,912	609,316	5,430,330
1986	5,926	2,772	3,750	12,448	2.02	9,087	617,596	5,612,129
1987	6,045	2,824	3,922	12,791	2.06	9,545	619,518	5,913,428
1988	6,148	2,905	5,642	14,695	2.33	10,047	630,805	6,337,600
1989	8,109	3,182	7,079	18,370	2.84	10,783	646,803	6,974,343
1990	10,878	3,453	8,468	22,799	3.47	N.A.	657,182	N.A.

Legend *: Gross Provincial Product at 1972 Prices.
 Source : Data of telephone service : TOT
 Population : Local Administration Department / Ministry of Interior
 GPP : National Accounts Division / NESDB

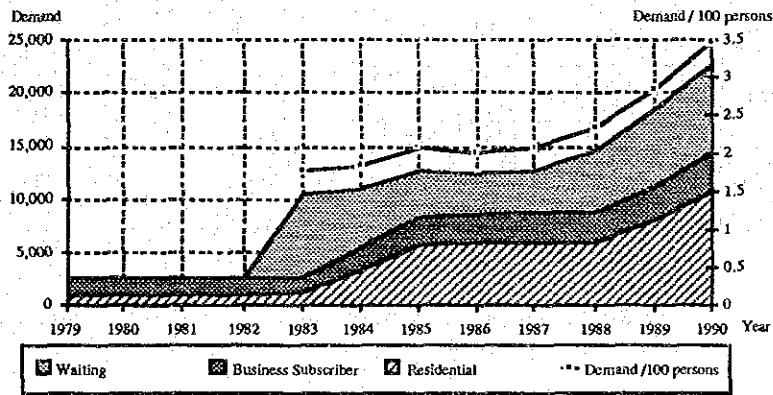


Figure 8.1.2-5 Telephone Service Demand in Nakhon Pathom

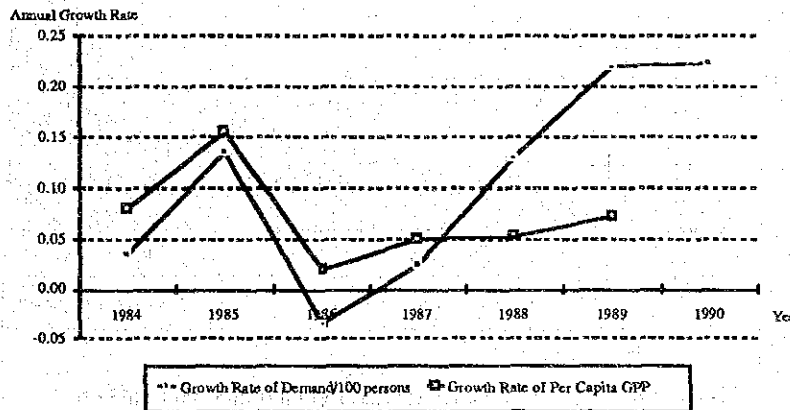


Figure 8.1.2-6 Annual Growth Rate of Demand per 100 persons and Per Capita GPP in Nakhon Pathom

In Samut Sakhon, the telephone demand has been increasing since 1988. The growth rate of the demand has exceeded that of the per capita GPP since 1988. The number of waiting applicants in this area became approximately nine thousand seven hundreds in 1990. Table 8.1.2-4 shows the telephone service demand and socioeconomic development in Samut Sakhon. Figure 8.1.2-7 and 8 show the telephone service development in Samut Sakhon.

Table 8.1.2-4 Telephone Service and Socioeconomic Development in Samut Sakhon

Year	Telephone Service					Socioeconomic Development		
	Residential Subscriber	Business Subscriber	Waiting	Demand	Demand/100 persons	Per Capita GPP*	Population	GPP (10 ³ Baht)
1979	549	419	N.A.	N.A.	N.A.	N.A.	259,022	N.A.
1980	558	425	N.A.	N.A.	N.A.	N.A.	265,464	N.A.
1981	818	447	N.A.	N.A.	N.A.	10,418	270,744	2,820,580
1982	1,460	495	N.A.	N.A.	N.A.	9,473	278,949	2,642,398
1983	1,455	507	5,150	7,112	2.40	9,607	296,714	2,850,426
1984	2,705	603	4,832	8,140	2.70	10,663	301,631	3,216,203
1985	2,878	633	4,515	8,026	2.54	14,626	315,373	4,612,696
1986	2,876	652	4,432	7,960	2.43	17,762	327,677	5,820,041
1987	4,674	728	3,062	8,464	2.53	20,129	334,170	6,726,497
1988	5,369	928	4,670	10,967	3.22	20,730	340,952	7,068,030
1989	7,071	1,176	5,248	13,495	3.86	22,080	349,680	7,720,906
1990	7,853	1,323	9,744	18,920	5.28	N.A.	358,155	N.A.

Legend *: Gross Provincial Product at 1972 Prices
 Source : Data of telephone service : TOT
 Population : Local Administration Department / Ministry of Interior
 GPP : National Accounts Division / NESDB

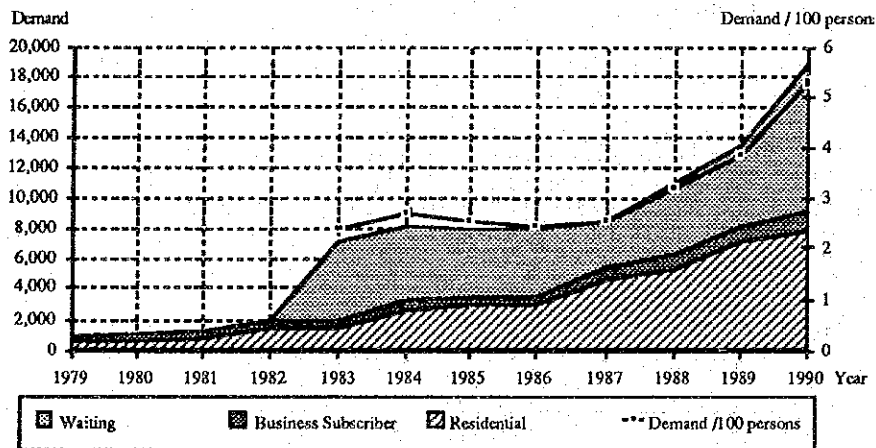


Figure 8.1.2-7 Telephone Service Demand in Samut Sakhon

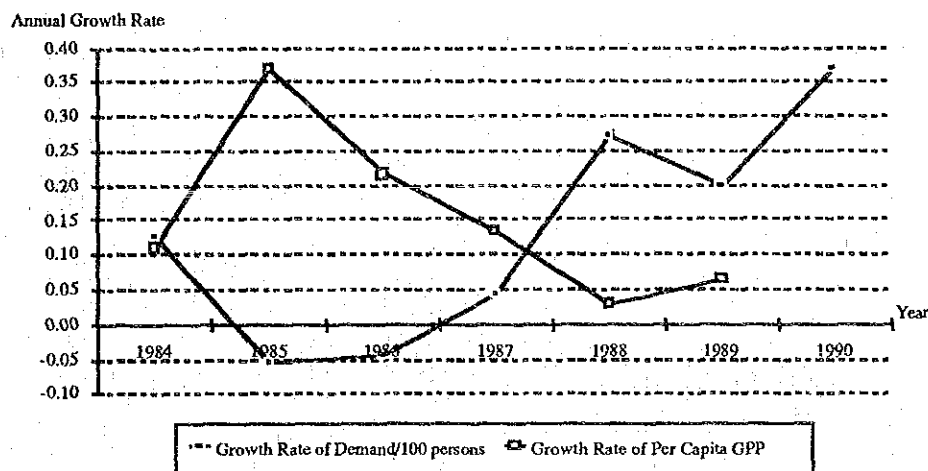


Figure 8.1.2-8 Annual Growth Rate of Demand per 100 persons and Per Capita GPP in Samut Sakhon

In Ayutthaya, the telephone demand is increasing along with the economic growth. Especially, the growth of the demand has accelerated since 1989. Although the number of waiting applicants was reduced year by year until 1987, since then, the number has been gradually increasing again. The growth rate of the telephone demand in this area has exceeded that of the per capita GPP since 1986. In 1990, the number of waiting applicants went up to approximately three thousand two hundreds. Table 8.1.2-5 shows the telephone service demand and socioeconomic development in Ayutthaya. Figure 8.1.2-9 and 10 show the telephone service development in Ayutthaya.

Table 8.1.2-5 Telephone Service and Socioeconomic Development in Ayutthaya

Year	Telephone Service					Socioeconomic Development			
	Residential Subscriber	Business Subscriber	Waiting	Demand	Demand/100 persons	Per Capita GPP*	Population	GPP (10 ³ Baht)	
1979	598	1,002	N.A.	N.A.	N.A.	N.A.	620,216	N.A.	
1980	702	1,171	N.A.	N.A.	N.A.	N.A.	623,242	N.A.	
1981	718	1,188	N.A.	N.A.	N.A.	5,531	626,590	3,465,609	
1982	769	1,221	N.A.	N.A.	N.A.	5,618	631,285	3,546,422	
1983	776	1,229	2,418	4,423	0.70	5,315	630,799	3,352,514	
1984	776	1,231	2,967	4,974	0.78	5,624	637,845	3,587,185	
1985	781	1,258	3,659	5,698	0.87	6,526	652,977	4,261,202	
1986	2,599	1,879	1,455	5,933	0.89	6,502	664,245	4,318,878	
1987	3,554	2,183	477	6,214	0.93	6,435	668,611	4,302,342	
1988	3,968	2,401	785	7,154	1.06	6,836	677,626	4,632,024	
1989	4,687	2,693	1,860	9,240	1.36	7,678	680,100	5,221,757	
1990	8,366	3,537	3,233	15,136	2.21	N.A.	685,394	N.A.	

Legend *: Gross Provincial Product at 1972 Prices.

Source : Data of telephone service : TOT

Population : Local Administration Department / Ministry of Interior

GPP : National Accounts Division / NESDB

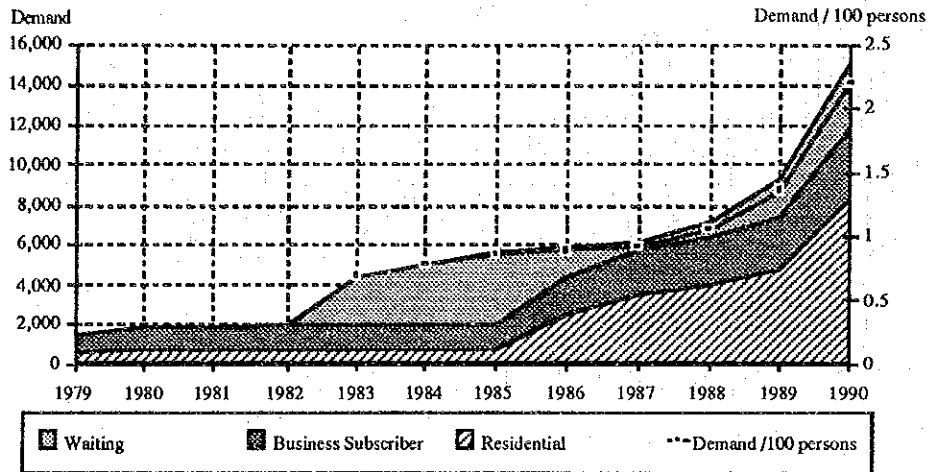


Figure 8.1.2-9 Telephone Service Demand in Ayutthaya

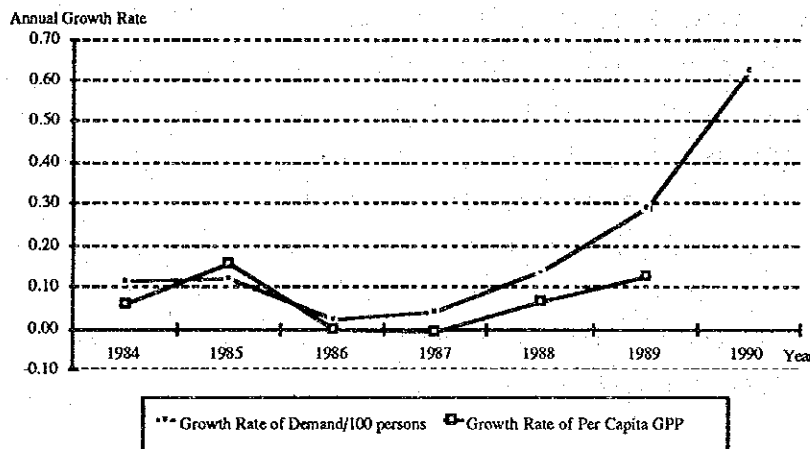


Figure 8.1.2-10 Annual Growth Rate of Demand per 100 persons and Per Capita GPP in Ayutthaya

2) Potential Demand Approach

The potential demand is forecasted by estimating the number of potential residential subscribers and the number of potential business subscribers for each area, the same procedure employed in the Master Plan.

a) Potential Residential Subscriber

The number of potential residential subscribers is estimated by the same model in the Master Plan which is formulated on the basis of a household monthly income

distribution. The number of potential residential subscribers is obtained by the following formula:

$$RD_{it} = P(X \text{ Baht})_{it} \cdot H_{it}, \text{-----} (8.1)$$

where

- RD_{it} : The number of potential residential subscribers in area i in period t ,
- $P(X \text{ Baht})_{it}$: The percentage of potential residential subscribers in area i in period t ,
- H_{it} : The number of households in area i in period t ,
- X : Threshold value of total household monthly income level for potential residential subscribers.

The percentage of potential residential subscribers, $P(X \text{ baht})$ is

$$P(X \text{ Baht}) = 100 - f(x_{it}), \text{-----} (8.2)$$

where

- $f(x_{it})$: accumulated percentage of households whose income levels are not more than x Baht in area i in period t .

$f(x_{it})$ will be obtained by the following formula:

$$f(x_{it}) = \frac{100}{1 + m \exp(a \cdot y_{it}) \cdot x_{it}^b}, \text{-----} (8.3)$$

where

- x_{it} : Monthly income level in area i in period t ,
- y_{it} : Per capita GPP at 1972 price in area i in period t ,
- m, a, b : Coefficients.

The mode is rearranged in the following log-linear form for estimation.

$$\ln\left(\frac{100}{f(x_{it})} - 1\right) = \ln(m) + a \cdot y_{it} + b \cdot \ln(x_{it}) \text{-----} (8.4)$$

The coefficients were estimated by using the household income data in "Household Socio-Economic Survey in 1986, 1988" by National Statistical Office of Thailand and the other socio-economic data by NESDB. The results are shown as follows:

$$\ln \left(\frac{100}{f(x_{it})} - 1 \right) = 16.5119266 + 0.0000778 \cdot y_{it} - 2.4649242 \cdot \ln(x_{it}). \text{----- (8.5)}$$

In this estimation, the following statistical test results were obtained:

<u>Variable Name</u>	<u>Coefficient</u>	<u>Std. Err. Estimate</u>	<u>t Statistics</u>	<u>Probability of t.</u>
Constant	16.5119266	0.2927719	56.3986053	0.000,
y _{it}	0.0000778	0.0000048	16.2145882	-0.000,
ln(x _{it})	-2.4649242	0.0405650	-60.7647858	0.000,

Coefficient of Determination (R ²)	0.9571366,
Adjusted Coefficient R ²	0.9566681,
Standard Error of Estimate	0.5561178,
Degree of Freedom	185.

In this study, the threshold value, X, is assumed 7,000 Baht and 4,000 Baht in the BMA and the Surrounding Area respectively, taking the average of the total monthly household income data in 1986 from "Household Socio-Economic Survey in 1986" by National Statistical Office into consideration.

The average monthly incomes per household are

the BMA : 6,949 Baht,
the Surrounding Area : 4,006 Baht.

H_{it}, the number of households in the future is estimated on the basis of the future population size. The estimation method of the number of households is described in Chapter 2.

b) Potential Business Subscribers

In the Master Plan, the number of potential business subscribers was estimated on the basis of the number of employees, who have no less than upper secondary school education level. However, in this study, a model is formulated on the basis of the number of persons to be employed in establishments in order to forecast the number of potential business subscribers. The number of potential business subscribers will be estimated as follows:

$$BD_{it} = G(z_{it}) \cdot E_{it} \text{-----} (8.6)$$

where

- BD_{it} : The number of potential business subscribers in area i in period t,
 $G(z_{it})$: The number of main telephone stations per employee in area i in period t,
 E_{it} : The number of employees in area i in period t.

$G(z_{it})$, the number of business main telephone stations per employee is estimated by the following model.

$$G(z_{it}) = a \cdot z_{it}^b \text{-----} (8.7)$$

where

- z_{it} : Per capita GPP at the current market prices in area i in period t,
 a, b : Coefficients.

The mode is rearranged in the following log-linear form for estimation.

$$\ln(G(z_{it})) = \ln a + b \cdot \ln(z_{it}) \text{-----} (8.8)$$

The coefficients were estimated by using twelve country data which are shown in the ANNEX-8. The estimated results are shown in the following model.

$$\ln(G(z_{it})) = -5.6799999 + 0.4493933 \cdot \ln(z_{it}) \text{-----} (8.9)$$

In this estimation, the following statistical test results were obtained:

<u>Variable Name</u>	<u>Coefficient</u>	<u>Std. Err. Estimate</u>	<u>t. Statistics</u>	<u>Probability of 1.</u>
Constant	-5.6799999	0.2853938	-19.9023247	0.000,
ln (z _{it})	0.4493933	0.0306328	14.6703424	0.000,

Coefficient of Determination (R^2)	0.8145477,
Adjusted Coefficient R^2	0.8107630,
Standard Error of Estimate	0.1122735,
Degree of Freedom	50.

E_{it} , the number of employees in the future is estimated by a model described in the Chapter 2.

3) Expressed Demand Approach

The expressed demand approach is formulated by two models on the basis of the number of subscribers and waiting applicants. The first model forecasts the number of subscribers in the BMA. The second model forecasts the number of subscribers in the Surrounding Area.

a) Expressed Demand in the BMA

From the reason stated in the Master Plan for the BMA, a logistic curve will be fitted to the number of people who actually expressed their desire to subscribe the telephone service. The model is expressed as follows:

$$\frac{D_t}{N_t} = \frac{K}{1 + m \cdot \exp(a \cdot \frac{GRP_t}{N_t})} \quad (8.10)$$

where

- D_t : The number of people who actually expressed their desire to subscribe the telephone service in period t ,
- N_t : Population size in period t ,
- K : Saturation level (number of telephones per person),
- GRP_t : Gross Regional Products at 1972 price in period t ,
- m, a : Coefficients.

K , the saturation level of the telephone demand is assumed to be 0.6, taking the result of the macro forecast and the telephone densities of major cities in the world into consideration. Table 8.1.2-6 shows the telephone densities of major cities in the world in 1989.

Table 8.1.2-6 Telephone Densities of Major Cities in the World in 1989

Name of City	Country	Total Exchange Access Line	Population	Lines per 100 Population
Washington	United States	804,000	628,500	127.9
Helsinki	Finland	369,938	492,491	75.1
Geneva	Switzerland	222,132	307,189	72.3
Oslo	Norway	312,581	455,632	68.6
Tokyo	Japan	5,558,000	8,261,000	67.3
Osaka	Japan	1,769,000	2,634,000	67.2
Frankfurt	Germany, Fed. Rep.	448,663	698,496	64.2
Dallas	United States	639,414	1,002,060	63.8
New York	United States	4,614,645	7,290,587	63.3
Berlin	Germany, Fed. Rep.	1,174,443	1,881,788	62.4
Hamburg	Germany, Fed. Rep.	1,047,493	1,764,602	59.4
Houston	United States	1,096,619	1,847,558	59.4
Brussels	Belgium	80,680	135,979	59.3
Wine	Austria	880,996	1,531,346	57.5
Milwaukee	United States	573,296	1,007,434	56.9
Nagoya	Japan	1,202,000	2,139,000	56.2
Tel Aviv	Israel	379,740	682,000	55.7
Munich	Germany, Fed. Rep.	903,094	1,628,969	55.4
Detroit	United States	832,062	1,515,085	54.9
Bonn	Germany, Fed. Rep.	171,700	325,806	52.7
Milano	Italy	1,115,202	2,119,989	52.6
Cleveland	United States	934,538	1,854,000	50.4
Fukuoka	Japan	587,000	1,200,000	48.9
Kyoto	Japan	713,000	1,464,000	48.7
Berlin	German Dem. Rep.	613,314	1,260,921	48.6
Sapporo	Japan	780,000	1,624,000	48.0
Indianapolis	United States	590,493	1,233,600	47.9
Auckland Metro.	New Zealand	353,699	741,123	47.7
Melbourne	Australia	1,422,072	3,001,200	47.4
Rome	Italy	1,328,822	2,849,868	46.6
Caracas	Venezuela	585,968	1,261,116	46.5
Kobe	Japan	651,000	1,449,000	44.9
Sydney	Australia	1,578,605	3,594,000	43.9
Antwerpen	Belgium	206,433	476,044	43.4
Columbus	United States	569,016	1,336,000	42.6
Taipei	China (Taiwan)	1,131,983	2,681,857	42.2
Yokohama	Japan	1,306,000	3,158,000	41.4
Athens	Greece	1,334,216	3,295,937	40.5
Madrid	Spain	1,896,000	4,894,000	38.7
Hong Kong	Hong Kong	2,153,776	5,736,100	37.5
Barcelona	Spain	1,755,000	4,719,000	37.2
Lisboa	Portugal	320,276	879,450	36.4
Praha	Czechoslovakia	464,957	1,291,106	36.0
Singapore	Singapore	924,022	2,670,000	34.6
Seoul	Korea, Rep. of	3,489,856	10,685,968	32.7
Jerusalem	Israel	161,500	505,000	32.0
Pusan	Korea, Rep. of	1,047,864	3,750,626	27.9
Kuala Lumpur	Malaysia	228,864	919,610	24.9
Durban	Republic of S. Africa	271,792	1,175,838	23.1
La Coruna	Spain	247,000	1,106,000	22.3
Istanbul	Turkey	1,234,385	6,311,134	19.6
Pretoria	Republic of S. Africa	197,333	1,031,086	19.1
Rio de Janeiro	Brazil	913,812	5,603,000	16.3
Cape Town	Republic of S. Africa	368,922	2,447,835	15.1
Sao Paulo	Brazil	1,470,706	10,063,000	14.6
Bangkok Metro.	Thailand	686,151	7,537,629	9.1
Tehran	Iran	564,970	7,500,000	7.5
Metro Manila	Philippines	385,324	8,197,823	4.7
Johannesburg	Republic of S. Africa	75,946	4,775,081	1.6

Source: AT&T, "THE WORLD'S TELEPHONES" 1989

The model is rearranged in the following log-linear form for estimation.

$$\ln\left(\frac{\frac{K}{D_t}}{N_t} - 1\right) = \ln(m) + a \cdot \frac{GRP_t}{N_t} \text{-----(8.11)}$$

The results are shown in the following model.

$$\ln\left(\frac{\frac{K}{D_t}}{N_t} - 1\right) = 2.82982 - 0.00006 \cdot \frac{GRP_t}{N_t} \text{-----(8.12)}$$

In this estimation, the following statistical test results were obtained:

<u>Variable Name</u>	<u>Coefficient</u>	<u>Std. Err. Estimate</u>	<u>t Statistics</u>	<u>Probability of t.</u>
Constant	2.82982	0.19918	14.20720	0.000,
$\frac{GRP}{N} t$	-0.00006	0.000001	-7.24289	0.001,

Coefficient of Determination (R^2)	0.91298,
Adjusted Coefficient R^2	0.89558,
Standard Error of Estimate	0.07383,
Degree of Freedom	6.

b) Expressed Demand in the Surrounding Area

For the Surrounding Area, an income elasticity model is formulated on the number of people who actually expressed their desire to subscribe the telephone service. The model is expressed as follows:

$$\frac{D_{it}}{N_{it}} = a \cdot \left(\frac{GRP_{it}}{N_{it}}\right)^b \cdot \exp(b \cdot D), \text{-----(8.13)}$$

where

- D_{it} : The number of people who actually expressed their desires to subscribe the telephone service in period t,
- N_{it} : Population size in period t,
- GRP_{it} : Gross Regional Products at 1972 price in period t,
- a,b,b : Coefficients,
- D : Dummy variable for the BMA.

The model is rearranged in the following log-linear form for estimation.

$$\ln\left(\frac{D_{it}}{N_{it}}\right) = \ln(a) + b \cdot \ln\left(\frac{GRP_t}{N_t}\right) + b \cdot D \text{-----}(8.14)$$

The results are shown in the following model.

$$\ln\left(\frac{D_{it}}{N_{it}}\right) = -13.2795 + 1.0066 \cdot \ln\left(\frac{GRP_t}{N_t}\right) + 0.92294 \cdot D \text{-----}(8.15)$$

In this estimation, the following statistical test results were obtained:

<u>Variable Name</u>	<u>Coefficient</u>	<u>Std. Err. Estimate</u>	<u>t Statistics</u>	<u>Probability of L</u>
Constant	-13.27950	1.09696	-12.10578	0.000,
ln(GPP/N)	1.00660	0.11941	8.42954	0.000,
Dummy	0.92294	0.15603	5.91509	0.000,

Coefficient of Determination (R^2)	0.94257,
Adjusted Coefficient R^2	0.93798,
Standard Error of Estimate	0.23722,
Degree of Freedom	27.

4) Results of Demand Forecasted

In this study, the potential demand is estimated on the basis of three development scenarios which are described in Chapter 2. Figure 8.1.2-11 to 14 show the results of estimation for the telephone demand.

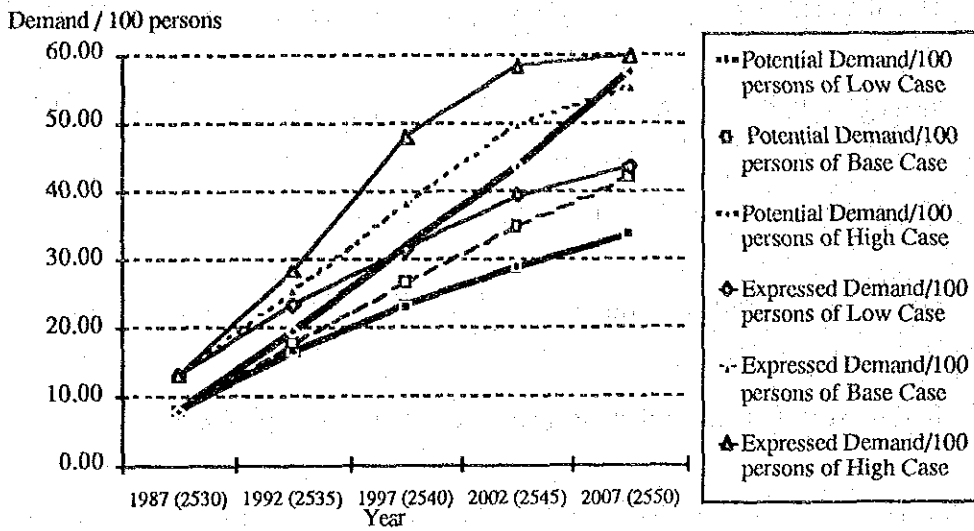


Figure 8.1.2-11 Results of Estimation of Demand in the BMA

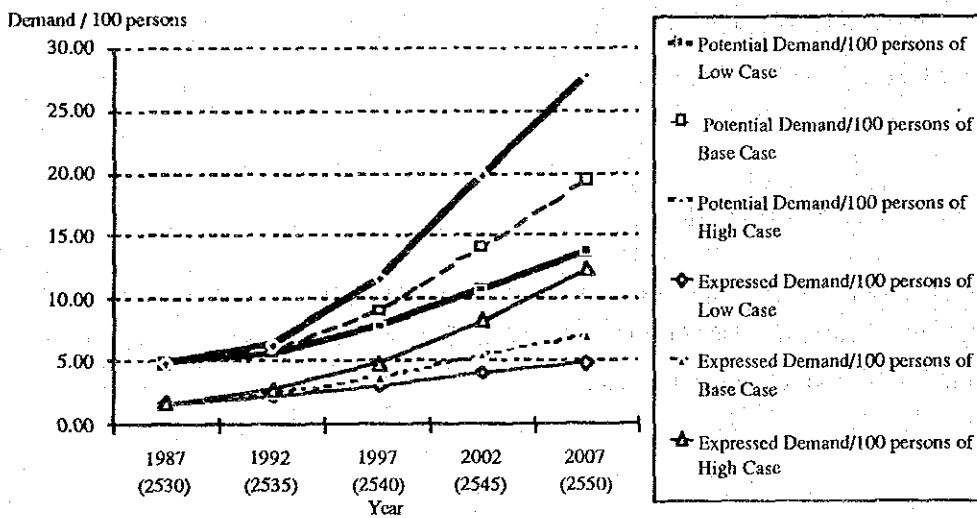


Figure 8.1.2-12 Results of Estimation of Demand in Nakhon Pathom

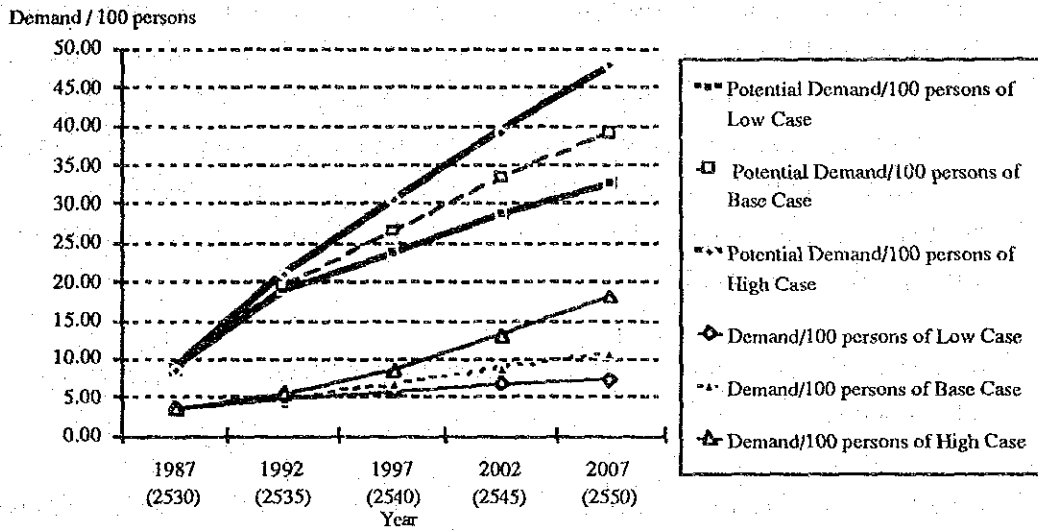


Figure 8.1.2-13 Results of Estimation of Demand in Samut Sakhon

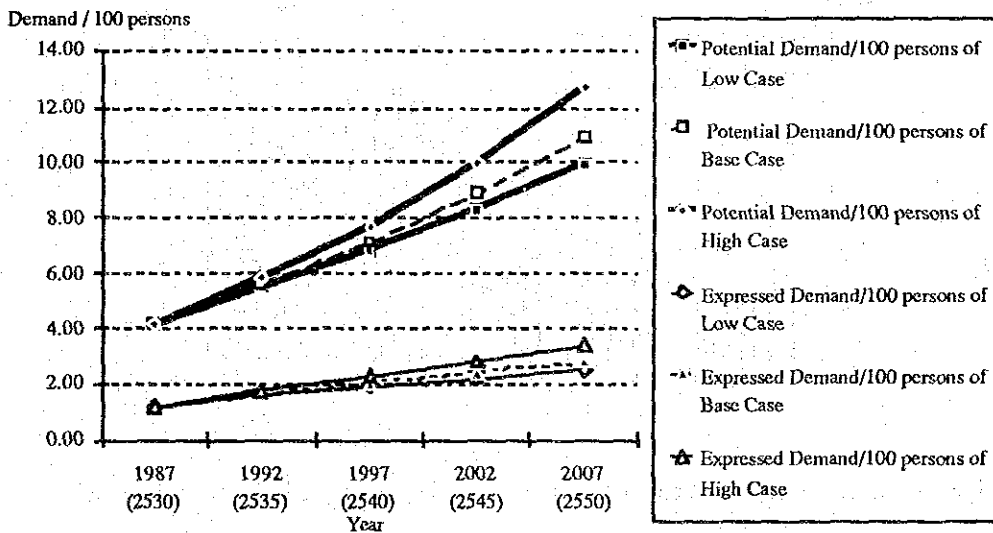


Figure 8.1.2-14 Results of Estimation of Demand in Ayuthaya

5) Examination of the Results

- i) In the BMA, the forecasted potential demand is smaller than the forecasted expressed demand for the base case scenario. The reason is that the potential demand by business subscribers in the BMA may be higher than the forecasted figure by the model.

- ii) The forecasted potential demand for the base case scenario is larger than the forecasted expressed demand in the Surrounding Area. The reason may be that a large part of the potential demand has been discouraged and has not been registered as waiting applicants because of the long waiting time in the past. Therefore, the forecasted potential demand can be considered more appropriate for the study because the discouraged demand will very likely show up once the network accessibility is improved.
- iii) Results of the base case scenario may have higher accuracy of forecast than the other results.
- iv) Hence, for the Surrounding Area, the base case results of the potential demand approach are applied as the demand for the macro forecast and the base case result of the expressed demand approach is applied for the BMA. The demand figures for the macro forecast are shown as follows.

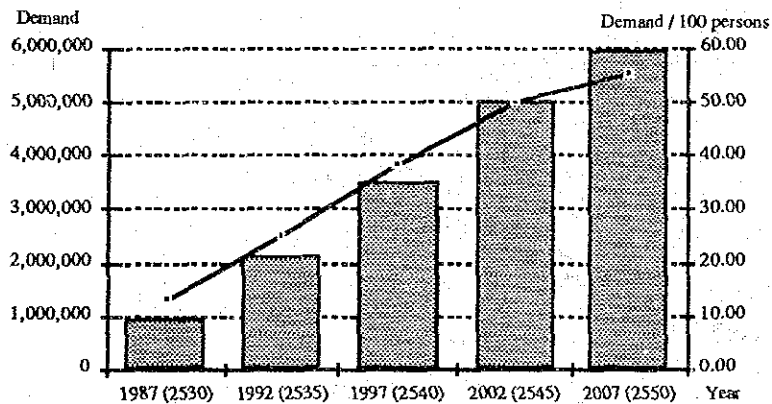


Figure 8.1.2-15 Telephone Subscription Demand and Demand per 100 Persons in the BMA

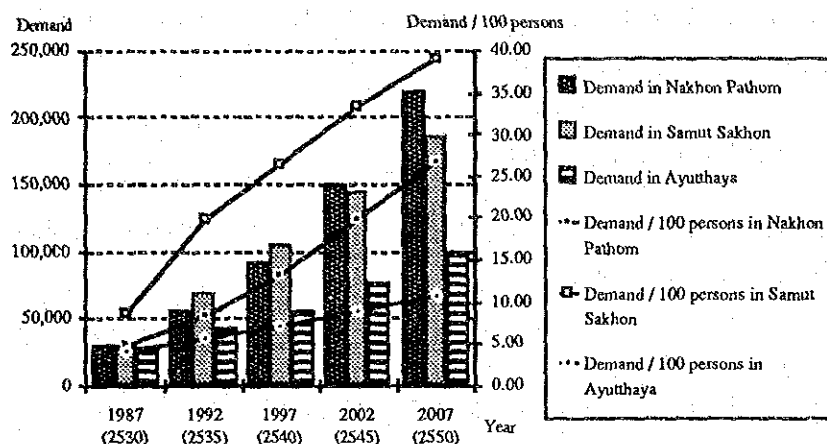


Figure 8.1.2-16 Telephone Subscription Demand and Demand per 100 Persons in the Surrounding Area

Table 8.1.2-7 Forecasted Telephone Demand and Demand per 100 Persons

		1992 (2535)	1997 (2540)	2002 (2545)	2007 (2550)
Telephone Demand	BMA	2,103,989	3,511,014	4,961,677	5,955,994
	Nakhon Pathom	55,055	91,883	150,299	220,360
	Samut Sakhon	69,616	103,992	144,425	185,847
	Ayuthaya	41,621	57,133	76,618	100,511
Telephone Demand per 100 persons	BMA	25.21	38.28	49.80	55.44
	Nakhon Pathom	8.54	13.07	19.75	26.87
	Samut Sakhon	19.83	26.60	33.43	39.21
	Ayuthaya	5.61	7.11	8.85	10.87

8.1.3 Micro Forecast

1) Understanding the Individual Service Area

In this study, the micro forecast is made for two area groups, the BMA and the Surrounding Area. The telephone demand in the BMA is estimated by each local exchange area basis which has a node of the telephone network in 1992. The telephone demand for the Surrounding Area is basically estimated by each district (Amphoe) basis because the boundaries of exchange areas are not specified in this area.

In the BMA, the local exchange areas are obtained from the TOT 5th ESDP Expansion Plan and 6th ESDP Expansion Plan. However, some exchange areas are not specified. Therefore, the boundaries of the local exchange areas will be assumed by taking the administrative boundaries into consideration. Furthermore, the BMA is expanded into

some Tambons in Samut Sakhon and Nakhon Pahtum. Figure 8.1.3-1 shows the local exchange areas in the BMA.

2) Selection of the Forecasting Method

Forecasting methods applied in the individual service area such as an exchange area are generally classified as follows:

- i) Time series method,
- ii) Demand density per person method,
- iii) Demand density per social unit method.

In short term forecast, the time series method is mainly used, while in long term forecast, the method ii) and iii) are generally used.

The time series method is essentially based on the assumption that the time series trend in the past will be extended into the future.

The demand density per person method and demand density per social unit method are estimated on the basis of population size and social units such as number of households and number of employees, respectively.

In this study, the demand density per person method is used because the data of household numbers and employee numbers in the individual service area were not obtained.

The telephone demand for the individual service area is estimated by the following formula:

$$D_{it} = P_{it} \cdot N_{it} \quad \text{-----} \quad (8.16)$$

where

- D_{it} : telephone demand in the individual service area i in period t ,
 P_{it} : demand density per person in the individual service area i in period t ,
 N_t : forecasted population size in the individual service area i in period t .

P_{it} , the demand density per person of each area is estimated by the following logistic curve formula.

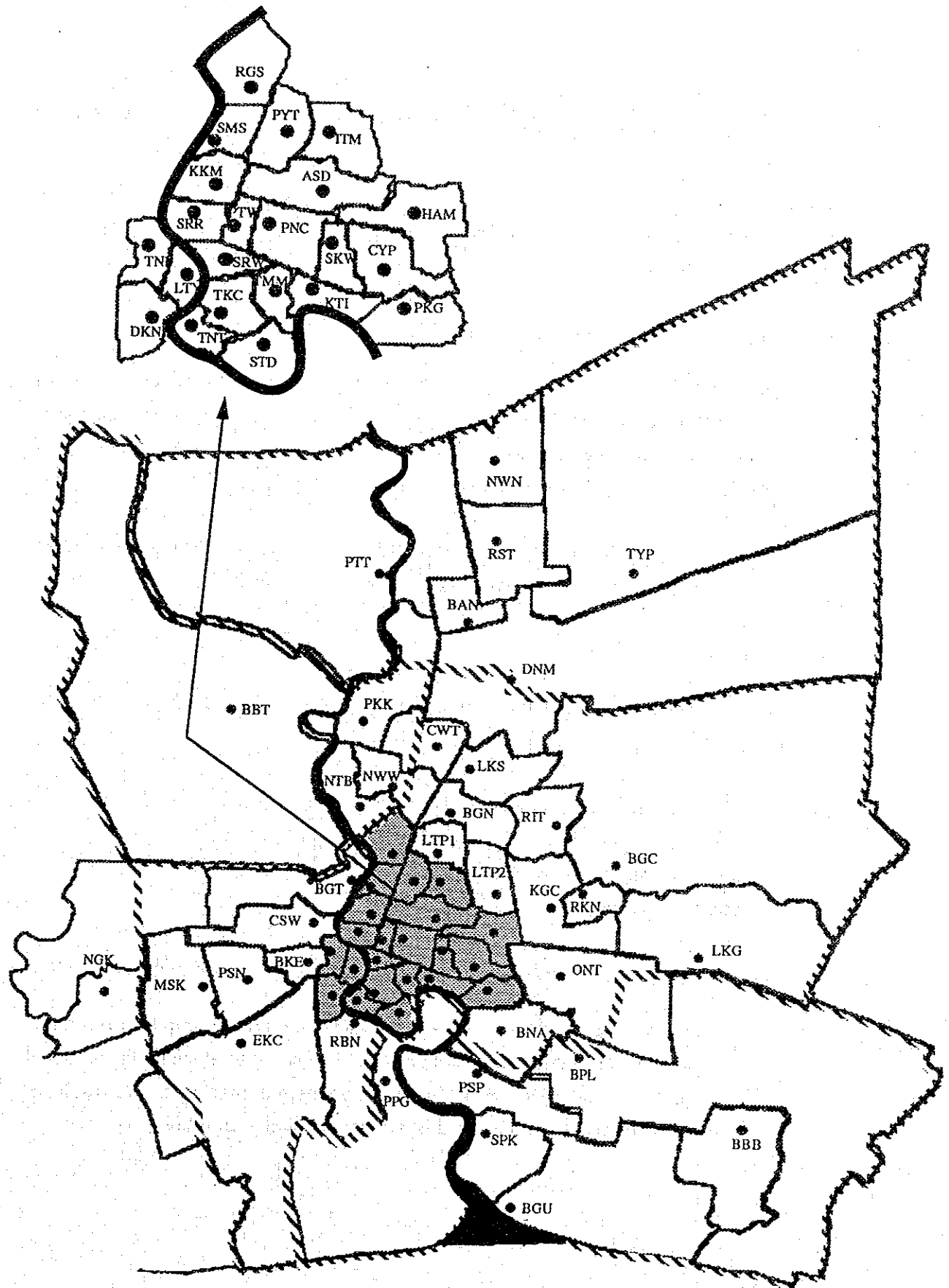


Figure 8.1.3-1 Map of Local Exchange Areas in the BMA

$$P_{it} = \frac{D_{it}}{N_{it}} = \frac{K}{1 + m \cdot \exp(-a \cdot t)} \quad \text{-----(8.17)}$$

where

K : Saturation level (number of telephones per person),

m, a : Coefficients.

a) Estimation of Population Size for the Individual Service Area

N_{it} , in the BMA, the number of people in an exchange area in the future is obtained by proportionating the forecasted Tambon population size with the percentage figure of exchange area size to Tambon area size. The forecasting methodology of the Tambon population size in the future is described in Chapter 2.

N_{it} , in the Surrounding Area, the number of people in each Amphoe in the future will be the same as the figure which is estimated in Chapter 2.

b) Setting K in the BMA

K, the saturation level of the telephone demand for the local exchange areas in the BMA is set by taking the following items into consideration.

- Telephone densities of branch offices in the Tokyo metropolitan area in 1991,
- Telephone densities for the local exchange areas in 1990,
- Land use plan for the Bangkok Metropolitan Region (BMA),
- Population growth rate from 1992 to 2007.

i) Telephone densities of branch offices in the Tokyo metropolitan area in 1991

A regression analysis is employed to analyze the relationship between ratios of the number of business telephone lines for that of total telephone lines and telephone density (per person) in the Tokyo metropolitan area. The results of the analysis and a formula for this purpose are shown as follows:

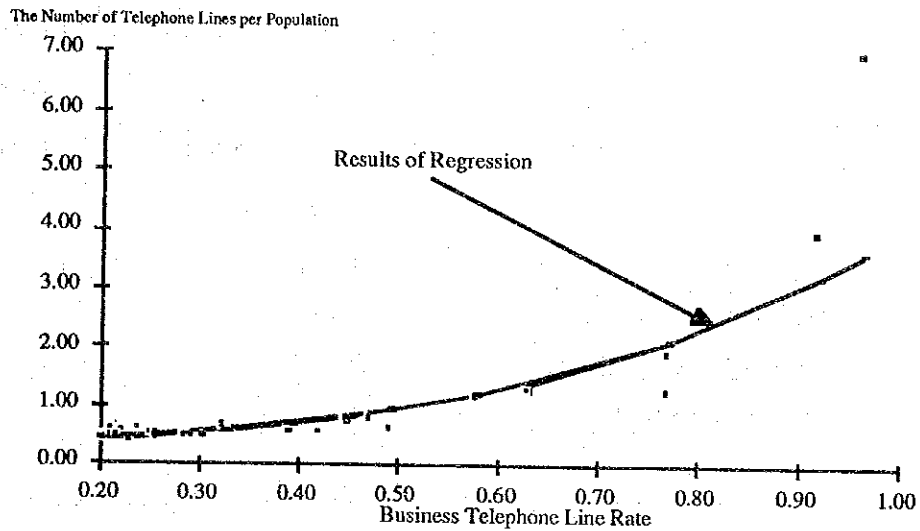


Figure 8.1.3-2 Relationship between Business Telephone Line Rate and Telephone Density (per person) in the Tokyo Metropolitan Area

$$\frac{TTL}{N} = a \cdot \left(\frac{BTL}{TTL}\right)^b \quad \text{-----(8.18)}$$

where

- TTL : The number of total telephone lines,
- BTL : The number of business telephone lines,
- a, b : Coefficients.

The formula is rearranged in the following log-linear form for estimation.

$$\ln\left(\frac{TTL}{N}\right) = \ln(a) + b \cdot \ln\left(\frac{BTL}{TTL}\right) \quad \text{-----(8.19)}$$

The results are shown as follows:

$$\ln\left(\frac{TTL}{N}\right) = 0.942 + 1.205 \cdot \ln\left(\frac{BTL}{TTL}\right) \quad \text{-----(8.20)}$$

In this estimation, the following statistical tests were obtained:

<u>Variable Name</u>	<u>Coefficient</u>	<u>Std. Err. Estimate</u>	<u>t Statistics</u>	<u>Probability of t</u>
Constant	0.942	0.152	6.184	0.000,
$\ln\left(\frac{BTL}{TTL}\right)$	1.205	0.136	8.884	0.000,

Coefficient of Determination (R^2)	0.752,
Adjusted Coefficient R^2	0.743,
Standard Error of Estimate	0.338,
Degree of Freedom	27.

As a result of the analysis, it is obtained that the telephone density in the Tokyo metropolitan area increases according to the increase of the business telephone line rates.

Table 8.1.3-1 shows groups which are classified by area characteristics in the Tokyo metropolitan area, and the average telephone density for each group in 1991.

Table 8.1.3-1 Characteristics of Group and Average of Telephone Density in the Tokyo Metropolitan Area in 1991

Group	Characteristics	Average Telephone Density(per population)
City Core	Population gap between nighttime and daytime is large. Revenue of voice telephone service is decreasing.	3.51
Sub City Core A	Population gap between nighttime and daytime is large. Revenue of voice telephone service is decreasing. However, the decrease is lower than that of City Core	0.97
Sub City Core B	The area is neighbored with Sub City Core A. The nighttime population is small in this area	0.64
Residential Area A	The area is not inner district area. The nighttime population is large in this area.	0.55
Residential Area B	The nighttime population in the area is larger than that of Residential Area B.	0.50
Suburb	The nighttime population of this area is large and the growth rate of population is high.	0.46
Tokyo Metropolitan Area		0.64

Source : NTT Tokyo Regional Head Office.

ii) Actual conditions of the local exchange areas in 1990

As Figure 8.1.3-3 shows, the relationship between the business telephone line rates and telephone demand per person in 1990 is not very clear. The reason may be that a large part of waiting applicants in 1990 has been included as business telephone users.

Figure 8.1.3-4 shows the relationship between the business telephone line rates and the annual revenue per telephone line in 1990. In the areas of high business telephone line rates, telephone lines were frequently used. Therefore, it is conjectured that the areas of high business telephone line rates are commercial areas or business areas.

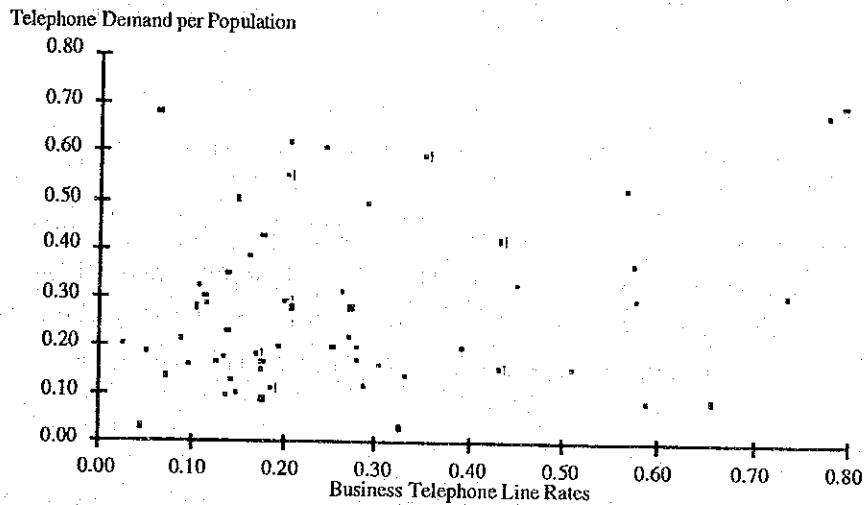


Figure 8.1.3-3 Relationship between Business Telephone Line Rates and Telephone Demand per person in the BMA

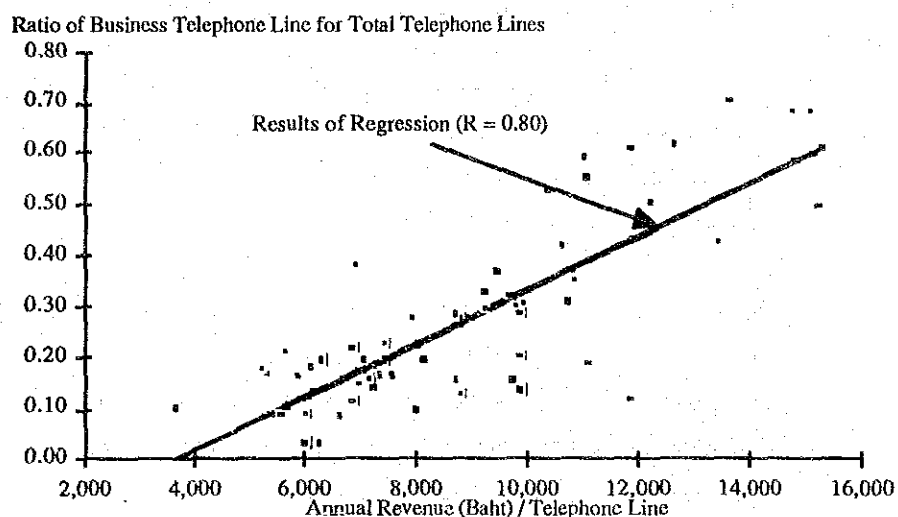


Figure 8.1.3-4 Relationship between Ratio of Business Telephone Lines for Total Telephone Lines and Annual Revenue per Telephone Line in the BMA

iii) Estimation of K for each Local Exchange Area in the BMA

The level of K for each local exchange area is estimated on the basis of the results of the analysis in i). After the estimation, the results are revised by taking the demand density per person for each exchange area in 1990 into consideration. Table 8.1.3-2 shows the results of estimation.

Table 8.1.3-2 Results of Estimation for K level for each Local Exchange Area (1/2)

No.	Local Exchange Area	Revenue per line in 1990	Business Line Rate for Total Line	Demand per population	Population Annual Growth Rate 92 -2007	Estimated K level	Revised K level
1	PNC	13,636	0.70	0.80	1.03%	1.67	1.67
2	SRR	11,054	0.59	0.35	2.92%	1.36	1.36
3	KKM	11,104	0.55	0.20	1.39%	1.25	1.25
4	SRW	15,064	0.68	0.78	4.21%	1.61	1.61
5	SMS	9,804	0.30	0.11	-0.92%	0.60	0.60
6	ASD	9,243	0.33	0.45	0.30%	0.67	0.67
7	PTW	12,630	0.61	0.21	1.17%	1.43	1.43
8	SKW	10,370	0.53	0.57	0.64%	1.18	1.18
9	CYP	9,264	0.29	0.58	0.22%	0.59	0.59
10	BNA	7,406	0.19	0.28	2.48%	0.36	0.45
11	KGC	7,207	0.14	0.33	1.63%	0.23	0.45
12	TMM	8,921	0.28	0.27	1.50%	0.54	0.54
13	STD	9,467	0.37	0.58	2.32%	0.77	0.77

Table 8.1.3-2 Results of Estimation for K level for each Local Exchange Area (2/2)

No.	Local Exchange Area	Revenue per line in 1990	Business Line Rate for Total Line	Demand per population	Population Annual Growth Rate 92 -2007	Estimated K level	Revised K level
14	TNT	6,139	0.18	0.17	0.92%	0.32	0.45
15	BGC	6,298	0.19	0.19	2.43%	0.36	0.45
16	PKG	5,887	0.16	0.30	2.61%	0.28	0.45
17	HAM	9,873	0.29	0.20	1.66%	0.57	0.57
18	TKC	7,990	0.10	0.14	1.43%	0.15	0.45
19	LKG	6,897	0.38	0.16	3.12%	0.80	0.80
20	KTI	13,435	0.42	0.18	0.86%	0.91	0.91
21	ONT	5,316	0.17	0.28	1.24%	0.30	0.45
22	RKN	5,983	0.03	0.05	4.08%	0.04	0.45
23	SPK	7,918	0.28	0.11	4.11%	0.55	0.55
24	PSP	10,748	0.31	0.26	1.66%	0.62	0.62
25	BPL	10,875	0.35	0.14	3.10%	0.72	0.72
26	BGU	14,754	0.68	0.06	3.21%	1.61	1.61
27	BBB	15,246	0.49	0.29	3.12%	1.10	1.10
28	TNB	5,665	0.21	0.09	0.17%	0.40	0.45
29	BKE	5,247	0.18	0.14	0.88%	0.32	0.45
30	DKN	7,404	0.22	0.14	-0.24%	0.42	0.45
31	BGT	6,831	0.22	0.27	1.50%	0.40	0.45
32	PSN	8,116	0.19	0.39	0.36%	0.35	0.45
33	CSW	6,930	0.15	0.18	1.10%	0.26	0.45
34	RBN	7,301	0.17	0.13	0.54%	0.29	0.45
35	LTY	7,047	0.19	0.25	-0.51%	0.36	0.45
36	MSK	3,665	0.10	0.15	3.10%	0.16	0.45
37	EKC	6,845	0.11	0.19	0.45%	0.19	0.45
38	NGK	8,800	0.28	0.21	3.30%	0.54	0.54
39	PPG	9,667	0.32	0.11	1.96%	0.65	0.65
40	BBT	11,140	0.19	0.05	3.32%	0.34	0.45
41	PYT	12,201	0.50	0.15	-0.27%	1.11	1.11
42	IIM	9,752	0.15	0.43	0.21%	0.27	0.45
43	BGN	9,929	0.31	0.74	1.23%	0.61	0.84
44	BGS	7,135	0.16	0.10	0.52%	0.28	0.45
45	DNM	7,547	0.16	0.18	2.73%	0.29	0.45
46	LKS	8,788	0.13	0.14	1.35%	0.21	0.45
47	RIT	6,256	0.03	0.33	2.33%	0.04	0.45
48	LTP1	8,686	0.15	0.51	1.01%	0.27	0.61
49	LTP2	6,635	0.09	0.59	1.79%	0.13	0.69
50	CWT	6,027	0.09	0.66	2.25%	0.14	0.76
51	NIB	9,878	0.14	0.07	3.67%	0.23	0.45
52	NWW	11,881	0.12	0.29	2.04%	0.19	0.45
53	PKK	5,592	0.09	0.18	2.79%	0.14	0.45
54	PTT	8,683	0.28	0.12	2.01%	0.56	0.56
55	RST	10,659	0.42	0.43	3.79%	0.90	0.90
56	TYB	9,878	0.20	0.03	1.75%	0.37	0.45
57	NWN	11,881	0.61	0.24	3.79%	1.41	1.41
58	BAN	N.A.	N.A.	N.A.	5.85%	N.A.	0.45

iv) Setting of K for each Local Exchange Area in BMA

The level of K for each local exchange area is set on the basis of the results of estimation of the K levels taking the future land use plan in the BMR into consideration. The local exchange areas in the BMA can be classified into the following groups according to the area features such as the land use plan, the business telephone line rates in 1990. Results of setting for the levels of K for the local exchange areas are shown in Figure 8.1.3-5.

Table 8.1.3-3 The Groups of the Characteristic Area in the BMA

Group	Characteristics of Area	K level
Central Business Area	i) Demand density, business telephone line ratio and revenue per line were high in 1990 ii) This area consists of big commercial or business districts.	2.0
Business Area A	i) In 1990, the demand density was high, or either of business telephone line ratio or revenue per line was high. ii) This area consists of commercial districts and high residential districts or medium residential districts in the future.	1.0
Business Area B	i) One of the demand density, business telephone line ratio and revenue per line is high in 1990. ii) This area consists of big commercial districts or big industrial districts in the future.	0.65
Residential Area A	i) The revenue per line is comparatively high in 1990. ii) This area consists of commercial districts or big industrial districts and high or medium density residential districts in the future.	0.55
Residential Area B	i) In the land use plan, this area consists of commercial districts or industrial districts, and residential districts.	0.50
Suburb	This area will mainly consists of residential districts.	0.45

c) Setting the level of K in the Surrounding Area

The K level is estimated by the following formula.

$$K = K_R + K_B \text{-----(8.21)}$$

where

- K_R : The level of K of residential telephone lines,
 K_B : The level of K of residential telephone lines.

v) Classified Local Exchange Areas in the BMA

Classified local exchange areas in the BMA are shown in the table below.

Group	K level	Classified Exchange Area	Remark
Central Business Area	2.0	PNC*1(1.67), SRW(1.61)	2 Offices
Business Area A	1.0	PYT(1.11), KKM(1.25), SRR(1.36), PTW(1.43), ASD(0.67) CWT(0.76), BGN(0.84)	7 Offices
Business Area B	0.65	ITM(0.45), HAM(0.57), CYT(0.59), SKW(1.18*2), PKG(0.45), KTI(0.91), TMM(0.54), STD(0.77), RST(0.90), NWW(0.45), NTB(0.45), LTP1(0.61), LTP2(0.69), KGC(0.45), BBB(1.10*3), NGK(0.65)	16 Offices
Residential Area A	0.55	BGS(0.45), SMS(0.60), TNB(0.45), LTY(0.45), TKC(0.45), TNT(0.45), NWN(1.41*4), PKK(0.45), LKS(0.45), BGT(0.45), ONT(0.45), BNA(0.45), PPG(0.65), PSP(0.62), SPK(0.55), BPL(0.72)	16 Offices
Residential Area B	0.50	DKN(0.45), BAN(0.45), DNM(0.45), RIT(0.45), LKG(0.80), MSK(0.45), BKE(0.45), PSN(0.45), RBN(0.45)	9 Offices
Suburb	0.45	TYB(0.45), PTT(0.56), BBT(0.45), BGC(0.45), EKC(0.45), BGU(1.61*5), CSW(0.45), RKN(0.45)	8 Offices

Note; *1 Values in parentheses are the revised K levels in Table 8.1.3-2.

*2 The revised K level of SKW is 1.18; however, this area is classified as 'Business Area B' because of the residential districts in the area.

*3 The revised K level of BBB is 1.10; however, this area is classified as 'Business Area B' in accordance with 'General Town Plan of the BMA in Figure 2.3.3-2.

*4 The revised K level of NWN is 1.41; however, this area is classified as 'Residential Area A' because of using for residence.

*5 The revised K level of BGU is 1.61, however, this area is classified 'Suburb' because it is located outside of the BMA and classified as a low density residential area by 'General Town Plan of the BMA in Figure 2.3.3-2.

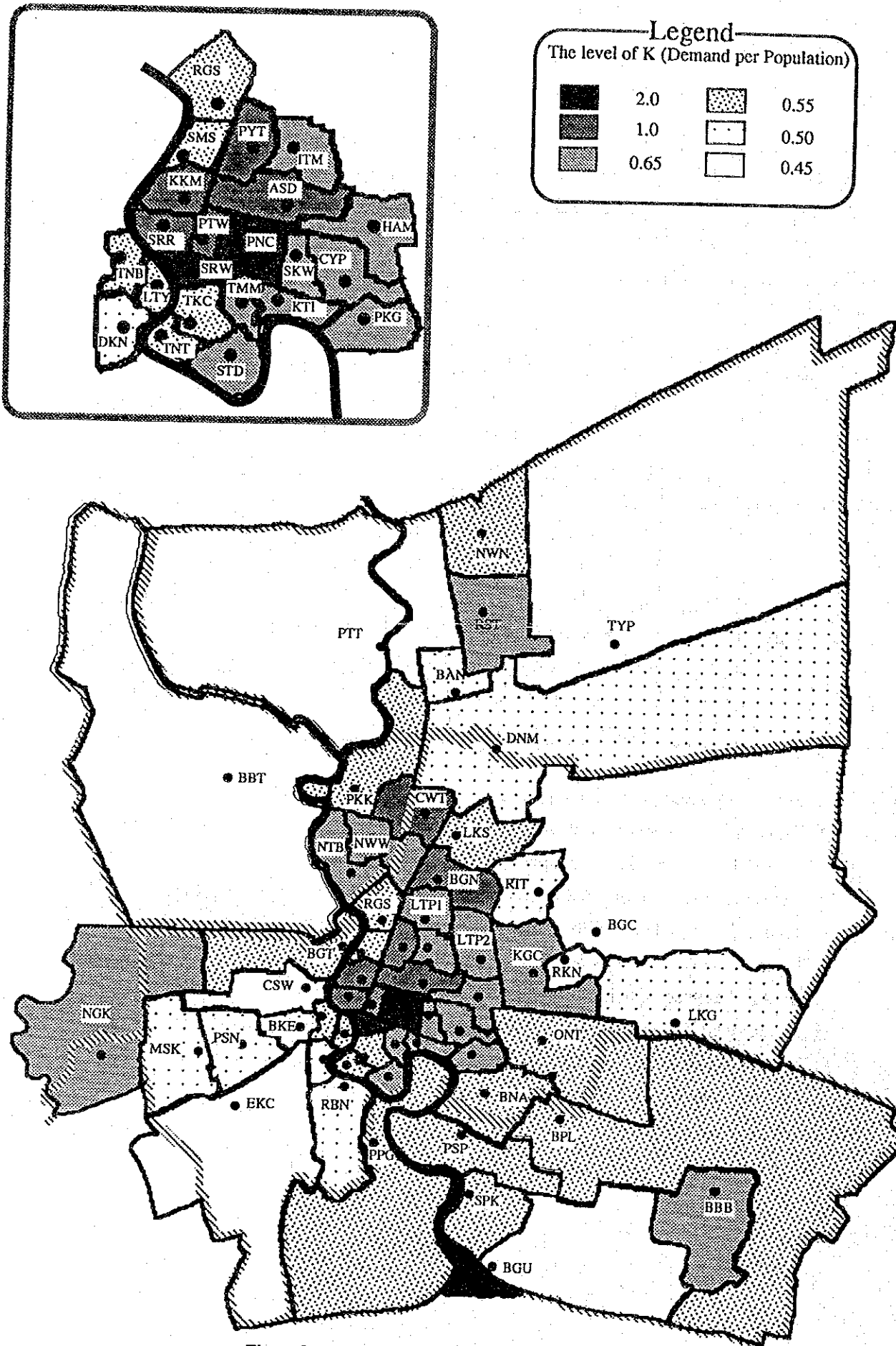


Figure 8.1.3-5 The level of K for Each Local Exchange Area in the BMA

i) Estimation of K_R

K_R is estimated as follows:

$$K_R = \frac{1}{\text{Average size of households in 2007}} \quad (8.22)$$

The calculation results according to the above formula are shown as follows:

Nakhon Pahtom	:	0.30,
Samut Sakhon	:	0.34,
Ayutthaya	:	0.26.

ii) Estimation of K_B

K_B is estimated as follows:

$$K_B = \frac{\text{Number of business telephone lines}}{\text{Number of employees}} \cdot \frac{\text{Number of employees in 2007}}{\text{Population size in 2007}} \quad (8.23)$$

Maximum value, average value and minimum value for the number of business telephone lines per employee are estimated by the following country data as shown in ANNEX 8.

Hong Kong	:	0.67 (Maximum),
USA	:	0.33,
Canada	:	0.31,
Japan	:	0.29,
Sweden	:	0.28 (Minimum).

Average : 0.38

$\frac{\text{Number of employees in 2007}}{\text{Population size in 2007}}$ for the Surrounding Area are estimated as follows:

Nakhon Pahtom	:	0.27,
Samut Sakhon	:	0.37,
Ayutthaya	:	0.12.

The results of estimation for K_B of the Surrounding Area are as follows:

	<u>Maximum</u>	<u>Average</u>	<u>Minimum</u>
Nakhon Pahtom	0.18	0.10	0.08,
Samut Sakhon	0.25	0.14	0.10,
Ayutthaya	0.08	0.05	0.03.

iii) Setting of K

The results of estimation for K of the Surrounding Area are as follows:

	<u>Maximum</u>	<u>Average</u>	<u>Minimum</u>
Nakhon Pahtom	0.48	0.40	0.38
Samut Sakhon	0.59	0.48	0.35
Ayutthaya	0.34	0.31	0.29

In this study, the level of K is assumed by taking above results of estimation and the future development into consideration. Table 8.1.3-4 shows the level of K of the Surrounding Area.

Table 8.1.3-4 K level of the Surrounding Area

Changwat	City Area	Consisting of Industrial Area	Other Area
Nakhon Pahtum	0.50	0.45	0.35
Samut Sakhon	0.60	0.50	0.35
Ayutthaya	0.50	0.40	0.35

d) Setting α

a, the growth rate of telephone demand per person is set by taking the past growth rate from 1987 to 1990 into consideration.

e) Calculation of m

The m is calculated as follows:

$$m = \frac{K}{\frac{D_{it}}{N_{it}}} - 1 \quad (\text{base year } (t = 0) \text{ is } 1990) \quad \text{-----} \quad (8.24)$$

3) Forecast for the Individual Service Areas

The future demand for the individual service area is forecasted by the following procedure.

- i) Estimation of the demand for the individual service areas,
- ii) Adjustment of the differences between the macro forecast results and the estimation results for the individual service area,
- iii) Examination of the results.

a) Estimation of the demand for the Individual Service Areas

The demand for the individual service area is estimated by the model as mentioned above. Figure 8.1.3-6 shows the estimation result of the demand for the local exchange areas in the BMA. Figure 8.1.3-7 shows the estimation result of the demand for Amphoes in the Surrounding Area.

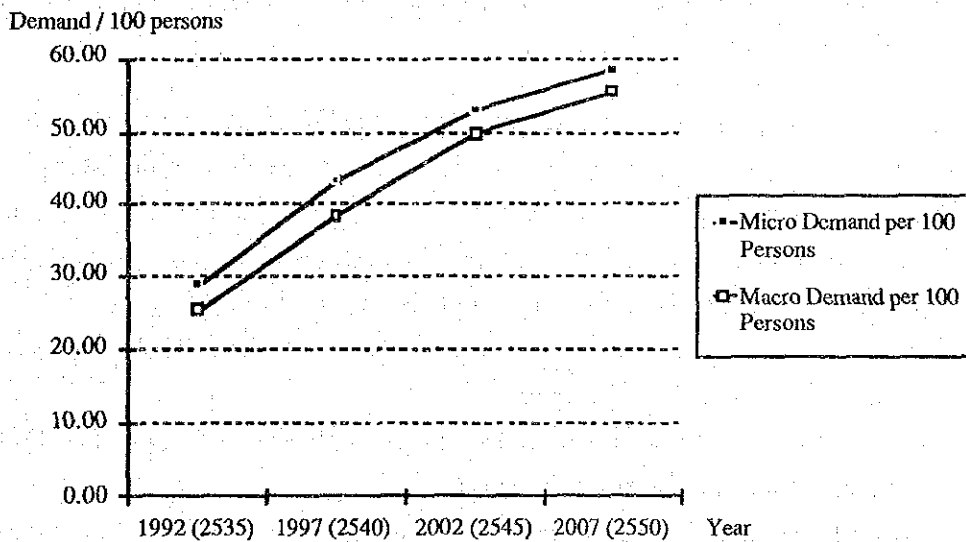


Figure 8.1.3-6 Estimation Result for Micro Forecast in the BMA

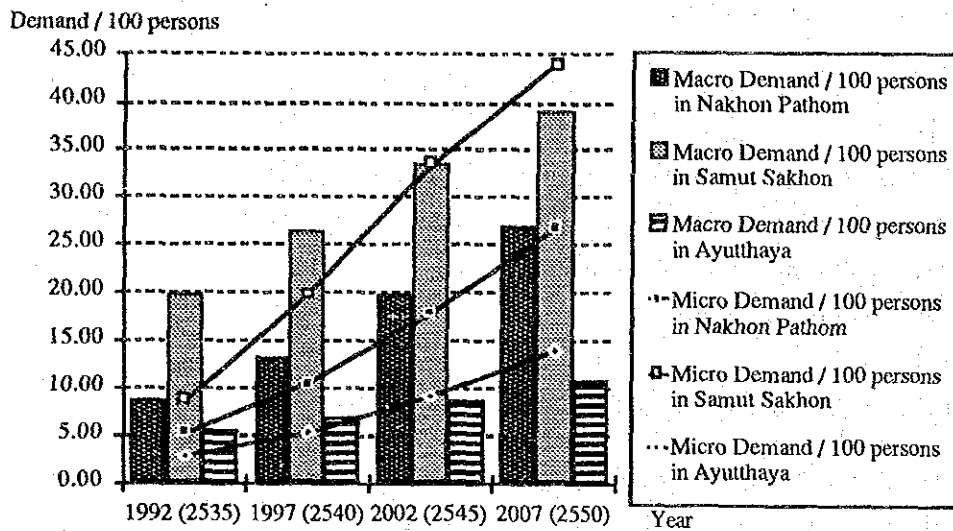


Figure 8.1.3-7 Estimation Results for Micro Forecast in the Surrounding Area

b) Adjustment of Differences between the Macro Forecast Results and the Estimation Results for the Individual Service Area

The results for the macro forecast may have higher forecasting accuracy than the results of estimation for the individual service area. Because in this study, in the macro forecast the demand is estimated according to socioeconomic development, while in the micro forecast, the demand was estimated according to population growth in the future. Therefore, the results of estimation for the individual service areas is adjusted to the results of the macro forecast through the following process.

- Revise for the macro forecast demand,
- Calculation of differences between the macro forecast demand and the estimated demand of the individual service areas,
- Adjustment of differences between the macro forecast demand and the estimated demand of the individual service areas.

i) Revise for Macro Forecast Demand

As mentioned above, the BMA is expanded to include some Tambons in Samut Sakhon and Nakhon Pathum. Therefore, the population of the BMA is larger than the total population of Bangkok Metropolis, Nonthaburi, Samut Prakan and Pathum Thani. Hence, the macro forecast demand is revised by the following formula.

$$D_t = \sum_{i=1}^n x_{it} \cdot P_t \text{-----(8.25)}$$

where

- D_t : Revised macro demand of the BMA and the Surrounding Area in period t,
- x_{it} : Population of the individual service area i in period t,
- P_t : Demand per person of the macro forecast in period t,
- n : Number of the individual service area.

ii) Calculation of Differences between the Macro Forecast Demand and Estimated Demand of the Individual Service Area

The rate of the estimated micro demand for the revised macro demand will be calculated by the following formula.

$$R_t = \frac{\sum_{i=1}^n d_{it}}{D_t} \text{-----(8.26)}$$

where

- R_t : Rate of the estimated micro demand for the revised macro demand for the BMA and the Surrounding Area in period t,
- d_{it} : Estimated demand of the individual service area i in period t.

iii) Adjustment of Differences between the Macro Forecast Damned and the Estimated Demand of the Individual Service Area.

Adjusted demand of the individual service area i in period t, Ad_{it} , is calculated by the following formula.

$$Ad_{it} = R_t \cdot d_{it} \text{-----(8.27)}$$

c) Examination of Results

In general, the result of the micro forecast is larger than that of the macro forecast. However, in the Surrounding Area, the estimated micro demand is mostly smaller than the macro demand form 1992 to 2002. The reason may be that the macro demand was forecasted on the basis of the potential demand, while the micro

demand was estimated on the basis of the expressed demand. Hence, this report employs the results of the adjusted micro demand. Figure 8.1.3-8 to 10 show the results of the adjusted micro demand.

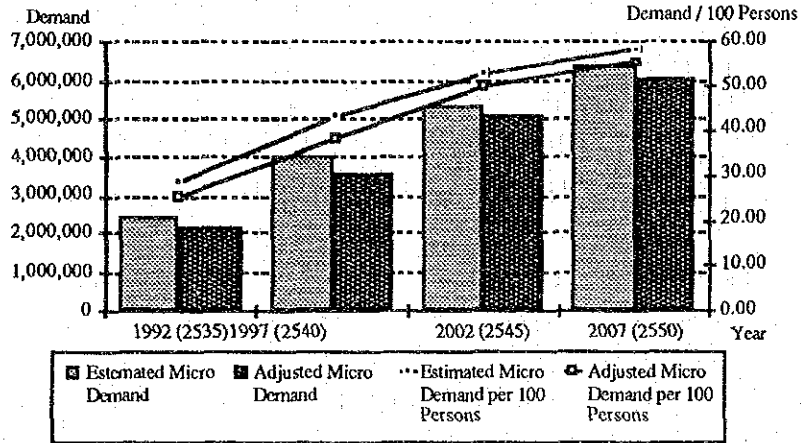


Figure 8.1.3-8 Adjusted Micro Demand and Demand per 100 persons in the BMA

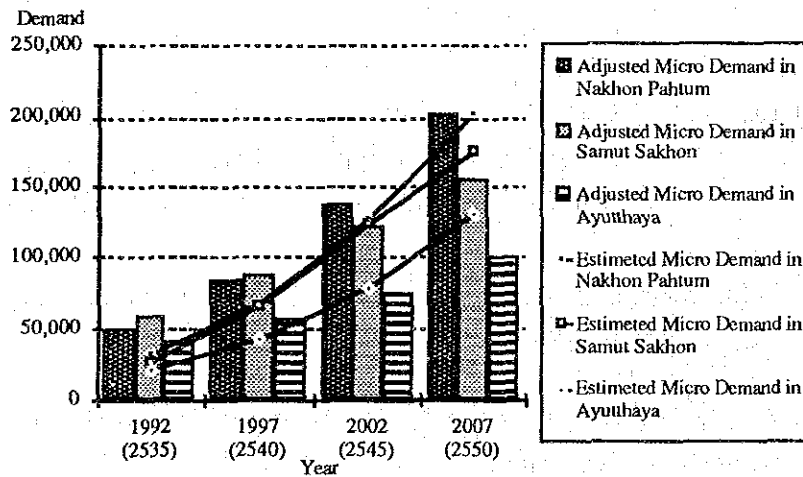


Figure 8.1.3-9 Adjusted Micro Demand in the Surrounding Area