- The replacement of local XB switching capacity is proposed to be 245 thousand lines during the Phase-1, 110 thousand lines during the Phase-2, and the total 355 thousand lines,
- The replacement of tandem switching capacity is proposed to be 1.5 thousand circuits during the Phase-1, 4.2 thousand circuits during the Phase-2, and the total 5.7 thousand circuits,
- The replacement of SPC switching capacity is proposed to be 710 thousand lines during the Phase-2, 533 thousand lines during the Phase-3, and the total 1,243 thousand lines.

Table 13.3.1 shows the outline of the expansion and replacement plan for switching facilities.

Table 13.3.1 The Outline of the Expansion Plan for Switching Facility

	Switch Type		Area	Phase-1		Phase-2		Phase-3		Total	
				Volume	Cost	Volume	Cost	Volume	Cost	Volume	Cost
Expan-sion	SPC	Local Switch (Lines)	BMA	2,600	18,083	1,305	9,076	1,014	7,052	4,920	34,211
			SA	261	1,817	113	788	122	852	496	3,457
			Sub Total	2,861	19,900	1,418	9,864	1,136	7,904	5,416	37,668
		Tandem Switch	BMA	83	812	30	292	13	125	126	1,229
		Toll Switch	BMA	19	102	12	63	6	30	37	195
		Total			20,814		10,219		8,059		39,092
		Land & Building	BMA	5.1	78	2.5	39	0.8	12	8.4	129
			SA	1	16	0.6	9	0.4	6	2	31
			Sub Total	6.1	94	3.1	48	1.2	18	10.4	160
	Total Investment Cost				20,908		10,267		8,077		39,252
Replace-ment	XB	Local Switch (Lines)	BMA	235	1,671	110	780	0	0	345	2,451
			SA	10	82	0	0	0	0	10	82
			Sub Total	245	1,753	110	780	0	0	355	2,533
		Tandem Switch	BMA	1.5	33	4.2	118	0	0	5.7	151
	SPC	Local Switch (Lines)	BMA	0	0	683	4,820	509	3,948	1,192	8,768
			SA	0	0	27	200	24	204	51	404
			Sub Total	0	0	710	5,020	533	4,152	1,243	9,172
	Total Investment Cost				1,786		5,918		4,152		11,856
Grand Total Investment Cost					22,694		16,185		12,229		51,108

Unit: Volume of Switch: thousand line
Volume of Land & Building: thousand square meter
Cost: million Baht

Note: The summation of each volume is not equal to the total volume because of the rounding off the figures.

13.3.2 Expansion Plan for Switching Facilities

1) SPC Switching Facilities

The local switching capacity to be expanded up to the year 2007 is shown in Table 13.3.2-1 and total switching capacity is shown in Table 13.3.2-2.

Table 13.3.2-1 Local Switching Capacity to be Increased

	Phase-1	Phase-2	Phase-3	Total
Increasing Capacity	2,861,311	1,418,192	1,136,432	5,415,935
BMA	2,600,497	1,305,420	1,014,461	4,920,378
Surrounding Area	260,814	112,772	121,971	495,557
Nakhon Pathom	98,944	57,662	63,887	220,493
Samut Sakhon	100,620	33,862	34,192	168,674
Ayutthaya	*61,250*	*21,248*	*23,892*	*106,390*

Table 13.3.2-2 Total Local Switching Capacity

	Phase-1	Phase-2	Phase-3
Total Capacity in each Phase	4,461,025	5,879,217	7,015,649
BMA	4,136,953	5,442,373	6,456,834
Surrounding Area	324,072	436,844	558,815
Nakhon Pathom	124,208	181,870	245,757
Samut Sakhon	114,884	148,746	182,938
Ayutthaya	84,980	106,228	130,120

The tandem switching circuits to be expanded up to the year 2007 is shown in Table 13.3.2-3 and total switching capacity is shown in Table 13.3.2-4.

Table 13.3.2-3 Tandem Switching Circuit to be Increased

	Phase-1	Phase-2	Phase-3	Total
Increasing Circuit	82,560	29,670	12,690	124,920
KKM T1	7,860	900	-390	8,370
PYT T2	5,850	6,240	5,790	17,880
PNC T3	6,630	-300	-1,470	4,860
LKS T4	28,050	9,870	4,350	42,270
PKG T6	13,350	6,210	3,060	22,620
LTY T8	20,820	6,750	1,350	28,920

Table 13.3.2-4 Total Tandem Switching Circuit

	Phase-1	Phase-2	Phase-3
Total Circuits	204,218	232,383	240,915
KKM T-1	18,897	19,797	19,407
PYT T-2	15,381	21,621	27,411
PNC T-3	31,524	31,224	29,754
LKS T-4	54,359	64,229	68,579
PKG T-6	37,575	43,785	46,845
LTY T-8	40,819	47,569	48,919
KKM T1 (XB)	1,505	0	0
PYT T2 (XB)	849	849	0
TNB T5 (XB)	1,357	1,357	0
SRW T7 (XB)	1,952	1,952	0

The toll switching circuit to be expanded up to the 2007 is shown in Table 13.3.2-5 and total switching capacity in Table 13.3.2-6.

Table 13.3.2-5 Toll Switching Circuit to be Increased

	Phase-1	Phase-2	Phase-3	Total
Increasing Circuit	19,122	11,898	5,580	36,600
LKS TC	6,282	4,998	1,110	12,390
PKG TC	4,950	2,070	1,650	8,670
LTY TC	7,890	4,830	2,820	15,540

Table 13.3.2-6 Total Toll Switching Circuit

	Phase-1	Phase-2	Phase-3
Total Circuit in each Phase	27,612	39,510	45,090
LKS TC	9,072	14,070	15,180
PKG TC	7,260	9,330	10,980
LTY TC	11,280	16,110	18,930

As shown in Table 13.3.2-1, Table 13.3.2-3 and Table 13.3.2-5, there are considerable differences in three phases. Because this expansion plan follows a strategy of the Master Plan by placing an emphasis on elimination of waiting applicants in the Phase-1.

2) Building

Table 13.3.2-7 shows necessary floor spaces. If many remote switching terminals such as RSUs are installed in the future, these floor spaces may be not required.

Table 13.3.2-7 Building and Land Expansion Plan (BMA)

Item	Phase-1	Phase-2	Phase-3	Total
No. of Exchange Offices	38	26	27	91
Space (m^2)	5,081	2,553	798	8,432
Construction Costs (m B)	78	39	12	129

Table 13.3.2-7 Building and Land Expansion Plan (Provincial Area)

Item	Phase-1	Phase-2	Phase-3	Total
No. of Exchange Offices	14	15	15	44
Space (m^2)	1,059	579	365	2,003
Construction Costs (m B)	16	9	6	31

The estimation procedure for the floor spaces is described in APPENDIX.

13.3.3 Replacement Plan of Analog Facility

Recently, TOT has carried out many projects to introduce a large number of SPC switches and to replace the XB switches; however, many XB switches are still working especially in the BMA, Table 13.3.3-1 shows when XB switch units were started to use in the BMA. Figure 13.3.3 shows how many XB switch units were started to use in the BMA. The points to be considered on the replacement of the XB switches are described as follows.

Table 13.3.3-1 Situation of XB Switches in the BMA

Opening Year	1964	1965	1966	1967	1968	1969	1970	1971	1972
Number of Line Capacity	5,000	0	0	12,000	10,000	8,610	103,730	66,250	0
Number of Unit	1	0	0	1	1	2	10	7	0

Opening Year	1973	1974	1975	1976	1977	1978	1979	1980	Total
Number of Line Capacity	0	0	0	42,800	7,000	20,000	57,800	11,184	344,374
Number of Unit	0	0	0	5	1	2	9	2	41

After 25 Years

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997
Number of Line Capacity	5,000	0	0	12,000	10,000	8,610	103,730	66,250	0
Number of Unit	1	0	0	1	1	2	10	7	0

Year	1998	1999	2000	201	2002	2003	2004	2005	Total
Number of Line Capacity	0	0	0	42,800	7,000	20,000	57,800	11,184	344,374
Number of Unit	0	0	0	5	1	2	9	2	41

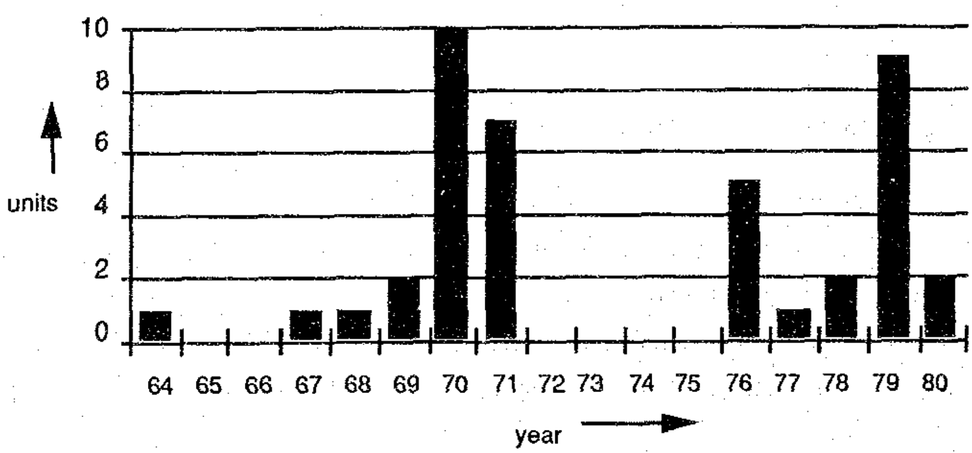


Figure 13.3.3 Inauguration Year of XB Switches in the BMA

1) Conditions of the Replacement

Which and when XB switches should be replaced must be considered by examining the following conditions.

A) Space requirement for facility expansion to meet the telephone demand,

B) Demands for new services,
C) Spare parts,
D) Efficiency of O & M
E) Smooth and even replacement.

a) Space Requirement for Facility Expansion to Meet Telephone Demand

A XB switch requires more than 3 times larger than space a SPC switch. So if the existing XB switches can be replaced with SPC switches, more than 3 times more subscribers can be accommodated by using the same space. According to our demand forecast in the BMA, 2,146,751 subscriber lines are due to be accommodated by 1997, and 3,792,151 subscriber lines by 2007.

Table 13.3.3-2 shows the switching room space of each XB switch offices and space requirement in the study period for new subscribers. The table shows only offices in which XB switches are located at present. Out of 35 telephone offices, 30 telephone offices will have the space shortage by 1997 and the other 5 offices will have the space shortage by 2007.

Table 13.3.3-2 Switching Room Space of XB switch offices in the BMA

Area	Unit Name	Open Year	Line Capacity	Required line 1997	Room Space Required	Room Space Remained	Shortage Space	Required line 2002+2007	Required Space
1	PNC-1	1971	12,000	142,973	489	370	-119	74,811	284
1	PNC-2	1971	10,000						
1	SRR-1	1970	10,000	97,251	352	20	-332	98,765	356
1	SRR-2	1970	10,000						
1	SRR-3	1978	10,000						
1	KKM-2	1970	10,000	38,553	176	50	-126	60,050	240
1	SRW-1	1976	10,000	223,415	730	97	-633	209,732	689
1	SRW-2	1976	10,000						
1	SRW-3	1978	10,000						
1	SMS-1	1980	5,800	44,081	192	84	-108	13,141	99
1	ASD-1	1979	10,000	113,261	400	240	-160	33,758	161
1	PTW-1	1980	5,384	33,346	160	288	128	49,342	208
	Sub Total		113,184	692,880				539,599	
2	CYP-2	1970	13,000	18,447	115	110	-5	5,562	77
2	BNA-1	1970	12,000	79,930	300	70	-230	27,304	142
2	KGC-1	1971	13,000	99,605	359	105	-254	46,923	201
2	TMM-1	1968	10,000	46,600	200	40	-160	26,622	140
2	STD-1	1971	3,250	11,906	96	294	198	8,277	85
2	TNT-1	1970	5,250	22,047	126	0	-126	22,244	127
2	PKG-1	1979	8,000	30,066	150	96	-54	30,507	152
2	HAM-1	1979	8,000	71,718	275	126	-149	59,880	240
2	TKC-1	1979	10,000	24,616	134	280	146	29,792	149
2	SPK-1	1964	5,000	50,620	212	80	-132	77,372	292
2	PSP-1	1977	7,000	79,551	299	132	-167	29,124	147
	Sub Total		94,500	535,106				363,607	
3	TNB-1	1970	20,000	38,743	176	217	41	36,387	169
3	BKE-1	1971	6,000	27,896	144	271	127	27,427	142
3	DKN-1	1971	12,000	28,051	144	150	6	22,983	129
3	BGT-1	1976	11,000	67,835	264	210	-54	55,095	225
3	PSN-1	1979	5,000	10,328	91	224	133	3,386	70
3	CSW-1	1979	5,100	52,760	218	90	-128	32,812	158
3	PPG-1	1969	3,310	41,414	184	83	-101	59,112	237
	Sub Total		62,410	267,027				237,202	
4	PYT-1	1967	12,000	115,511	407	0	-407	104,031	372
4	PYT-2	1976	5,800						
4	ITM-1	1971	10,000	37,231	172	224	52	7,848	84
4	BGN-1	1970	10,000	26,573	140	0	-140	11,611	95
4	BGS-1	1970	10,000	102,951	369	96	-273	61,803	245
4	DNM-1	1970	3,480	139,003	477	48	-429	82,575	308
4	LKS-1	1976	6,000	36,918	171	156	-15	49,429	208
4	LTP-1	1979	5,200	67,030	261	60	-201	9,061	87
4	LTP-2	1979	3,200	24,160	132	60	-72	14,413	103
4	NTB-1	1979	3,300	50,462	211	129	-82	122,358	427
4	NWW-1	1969	5,300	51,899	216	144	-72	41,863	186
	Sub Total		74,280	651,738				504,992	
	TOTAL		344,374	2,146,751				1,645,400	

Continued on the following page.

Note :
- Required lines in 1997 : XB switch capacity and expansion lines
- Required line 2002+2007 : Expansion lines in Phase-2 and Phase-3
- Calculation method for required space
  Required space = Ba + {Ex X (Re - 10,000 subscriber line) / 10,000 }
  Re : Required number of lines
  Ba : Basic space with 90 m^2 per 10,000 subscriber lines
  Ex : Expansion space with 30 m^2 per 10,000 subscriber lines

b) Demand for New Service

TOT has been offering several services for users. The subscribers accommodated to the SPC switch units can enjoy the new services but those accommodated to the XB switches cannot .

In order to satisfy the demands for new services, the XB switches must be replaced. The exchange offices which have the highest priority for the new services are PNC, SRR, KKM, SRW, ASD, PTW and PYT. The second highest priority exchange offices are TMM, STD, HAM, PSP and LTP-1.

c) Spare Parts

Table 13.3.3-3 shows the total number of faults and fault rate of each category in the XB switches.

The plant control target values (fault number per 1,000 subscriber lines) are as follows:

- Switch 0.3,
- Register................................ 0.1,
- Common control equipment 0.1,
- Trunk................................ 0.05.

Comparing the actual fault rates with the target values, the register and common control equipment faults occur more frequently than those in other categories in the XB Switch units. This suggests what parts will be deteriorated in the near future. If there are not enough spare parts to repair them the XB switches can not be kept in a good condition.

TOT has already restrained the extension of the XB switch systems. But the spare parts should be kept until all the XB switch systems in the whole country have been replaced. Though the number of subscribers accommodated to the XB switches will decrease, the traffic volume in the remaining switches will increase. Therefore, the supply of the spare parts or assemblies must be secured for keeping the service quality.

In order to keep the spare parts, it is suitable to reuse some parts or assemblies in the removed XB switches. That is called a S&B (Scrap and Build) method. By using this method, the XB switches can be continuously used as far as the supply of the spare parts is concerned. So the replacement plan also should be studied from the viewpoint of the supply of the spare parts.

Table 13.3.3-3 Faults of XB Switch Units in BMA in FY 1989

		Openning	Line	Switch		Register		Common control Equipment		Trunk		
Area	Unit Name	Year	Capacities	TOTAL	Averag	TOTAL	Averag	TOTAL	Averag	TOTAL	Averag	TOTAL
1	PNC-1	1971	12000	38	0.32	34	0.28	58	0.48	3	0.02	133
1	PNC-2	1971	10000	35	0.32	43	0.39	18	0.16	2	0.02	98
1	SRR-1	1970	10000	23	0.21	34	0.30	45	0.40	4	0.04	106
1	SRR-2	1970	10000	34	0.30	23	0.21	14	0.13	4	0.04	75
1	SRR-3	1978	10000	2	0.02	30	0.27	14	0.12	4	0.04	50
1	KKM-2	1970	10000	50	0.45	22	0.20	14	0.13	6	0.05	92
1	SRW-1	1976	10000	1	0.01	31	0.28	16	0.14	1	0.01	49
1	SRW-2	1976	10000	5	0.04	27	0.24	38	0.34	5	0.04	75
1	SRW-3	1978	10000	2	0.02	17	0.15	9	0.08	5	0.04	33
1	SMS-1	1980	5800	3	0.04	7	0.10	4	0.06	1	0.01	15
1	ASD-1	1979	10000	2	0.02	23	0.20	4	0.04	1	0.01	30
1	PTW-1	1980	5384	2	0.03	9	0.14	2	0.03	2	0.03	15
2	BNA-1	1970	12000	4	0.03	20	0.15	13	0.10	5	0.04	42
2	CYP-2	1970	13000	42	0.27	21	0.14	50	0.33	3	0.02	116
2	KGC-1	1971	13000	19	0.13	71	0.48	19	0.13	6	0.04	115
2	TMM-1	1968	10000	27	0.23	32	0.28	70	0.61	1	0.01	130
2	STD-1	1971	3250	0	0.00	5	0.13	11	0.29	0	0.00	16
2	TNT-1	1970	5250	34	0.57	51	0.85	13	0.22	8	0.13	106
2	PSP-1	1977	7000	7	0.08	7	0.08	3	0.04	3	0.04	20
2	PKG-1	1979	8000	2	0.02	7	0.08	6	0.07	2	0.02	17
2	HAM-1	1979	8000	11	0.12	14	0.15	13	0.14	3	0.03	41
2	TKC-1	1979	10000	13	0.11	4	0.03	9	0.08	10	0.09	36
2	TNB-1	1970	20000	32	0.16	84	0.42	29	0.15	3	0.02	148
3	BKE-1	1971	6000	3	0.05	2	0.03	11	0.17	3	0.05	19
3	DKN-1	1971	12000	10	0.07	15	0.11	27	0.19	5	0.04	57
3	PPG-1	1969	3310	1	0.05	3	0.14	6	0.28	0	0.00	10
3	PSN-1	1979	5000	0	0.00	8	0.14	6	0.10	6	0.10	20
3	CSW-1	1979	5100	2	0.04	10	0.18	13	0.23	0	0.00	25
3	BGT-1	1976	11000	4	0.03	7	0.06	14	0.12	4	0.03	29
4	ITM-1	1971	10000	6	0.05	39	0.33	12	0.10	4	0.03	61
4	BGN-1	1970	10000	0	0.00	0	0.00	0	0.00	0	0.00	0
4	BGS-1	1970	10000	3	0.03	18	0.16	5	0.04	2	0.02	28
4	NWW-1	1969	5300	2	0.03	2	0.03	1	0.02	1	0.02	6
4	DNW-1	1970	3480	18	0.48	18	0.48	25	0.66	7	0.19	68
4	PYT-1	1967	12000	7	0.05	47	0.33	24	0.17	3	0.02	81
4	PYT-2	1976	5800	6	0.08	13	0.18	76	1.07	2	0.03	97
4	LKS-1	1976	6000	3	0.04	7	0.10	8	0.11	4	0.06	22
4	NTB-1	1979	3300	0	0.00	8	0.21	4	0.10	0	0.00	12
4	LTP-1	1979	5200	0	0.00	7	0.11	3	0.05	3	0.05	13
4	LTP-2	1979	3200	0	0.00	0	0.00	0	0.00	0	0.00	0
		Total	339374	453	0.12	820	0.21	707	0.18	126	0.03	2106

Note: Data source from Monthly Report in 1989 by TOT
(Average = Fault number per 1,000 subscriber lines)
(Total = Total number of faults)

d) Efficiency of O & M

From the viewpoint of efficiency of O&M, the XB switches are inferior to that of the SPC switches as described below;

i) The XB switches can be monitored from the maintenance center, but it can only transfer alarm signals.

ii) The number of maintenance persons for the XB switches is more than three times larger than that of the SPC switches.

iii) The XB switch units frequently broke down. The number of faults per 1,000 subscribers per month for the XB switches is 0.53 in 1991 and that of the SPC switches is 0.32 in 1991.

e) Smooth and even replacement

In which year, which switch will be replaced is principally determined according to the above 4 factors. But we also have to consider about leveling the volume of the replacement work during the study period.

Table 13.3.3-1 and Figure 13.3.1-1 show the XB switch construction year and its volume. From the figure, it is apparent that the replacement year will be concentrated into specific years, if it is assumed that the life time is constant. So in making the replacement plan, to make the replacement work smooth should be considered.

2) Study Results

The results of the study is summarized in Table 13.3.3-4. The replacement of each XB switch unit is shown in APPENDIX. Other matters which have been taken into consideration in the study are described in Section 17.2.3.

Table 13.3.3-4 Replacement Plan of XB switches

		Phase-1 Execution	Phase-2 Execution	Phase-3 Execution	Total
Metro.1	XB	113,184	0	0	113,184
Metro.2	XB	36,250	58,250	0	94,500
Metro.3	XB	34,310	28,100	0	62,410
Metro.4	XB	51,080	23,200	0	74,280
Sub Total	XB	234,824	109,550	0	344,374
NPT, SKN	XB	6,000	0	0	6,000
AYT	XB	4,426	0	0	4,426
Sub Total	XB	10,426	0	0	10,426
Study Area	XB	245,250	109,550	0	354,800
Tamdem Switch					
Circuit		1,505	4,158	0	5,663

13.3.4 Replacement Plan of Existing SPC

As the replacement time of the SPC switches will come up all at once just like the XB switches, the SPC switches also will have to be replaced according to a plan studied from various aspects. But, in the present long-term plan, the replacement plan of the existing SPC switches in the Study Area is not examined in detail like that of XB switches, because the matters to be studied such as the evolution of technology and the trend of new services are not defined at present. However, the investment cost in the long-term plan contains the replacement cost of some SPC switches, the term of use of a switch will be sixteen years (The replacement of SPC switch capacity is 709,990 lines in the Phase-2 and 532,896 lines in the Phase-3). To offer ISDN services, some existing SPC switches shall be modified to be equipped with more functions. In order to solve this problem, a further detailed study will be considered.

13.3.5 Management of Floor Plan for Exchange

In the future, many new kinds of equipment to introduce new services, not to mention ordinary telephone switching equipment for meeting ever increasing demand, will be installed much more than the present state in every exchange.

Therefore, the present floor conditions must be always monitored to be able to make a precise future floor plan for building new exchange offices so that unnecessary investment can be avoided as much as possible.

The detailed data on the required space is described in ANNEX.

13.4 Transmission Facilities

As described in Chapter 6, TOT is executing the fifth and sixth expansion projects in accordance with the national "ESDP"; however, TOT has now the significant number of waiting applicants as described in Chapter 9. Therefore, an expansion of the transmission network is required to reduce the number of waiting applicants in the Phase-1. In this section, the transmission network development plan is described.

13.4.1 Introduction

The main issues of the transmission network development plan are as follows:

1) Fulfillment of Telephone Demand

For this purpose, necessary transmission systems are installed and expanded in accordance with the telephone demand and traffic forecasts. As described in Chapter 9, the waiting applicants are completely eliminated in the Phase-1; therefore, the necessary number of trunk circuits has to be installed in this phase, particularly, in the BMA. However, the number of circuits in the long distance transmission system between the BMA and the Surrounding Area can not be estimated because some provinces in the SC areas such as Suphan Buri, Ang Thong, Kanchanaburi, Samut Songkram are located outside of the Study Area.

Necessary transmission systems are also installed and expanded in accordance with the telephone demand forecast, described in Chapter 8, during the Phase-2 and the Phase-3.

2) Upgrade of the Service Quality

In order to upgrade the telecommunications service quality, the network reliability improvement plans are proposed in the long-term plan as follows:

a) Looped and doubled transmission route expansion plan,
b) Trunk circuit accommodation plan,
c) Facility replacement plan.

3) Diversification of the Services

New telecommunication technology will be evolving rapidly every year in the world. They will be rather quickly introduced into telecommunications systems. Telecommunications services are not just for domestic uses but also for international uses. It is, therefore, important to pay more attentions to the trend of telecommunication technology and also CCITT recommendations.

For this purpose, Synchronous Digital Hierarchy (SDH) introduction is considered.

13.4.2 Long Distance Transmission System Expansion Plan

For estimating a necessary number of systems in the long distance transmission systems, the number of circuits in the whole Kingdom should be estimated at first because trunk circuits to the southern part of the country pass through Nakhon Pathom and to the northern part pass through Ayutthaya. Trunk circuits to other areas are excluded in this study; therefore, the necessary number of systems are estimated with the data used in the former Master Plan. The required number of systems in 2007 is shown in Figure 13.4.2.

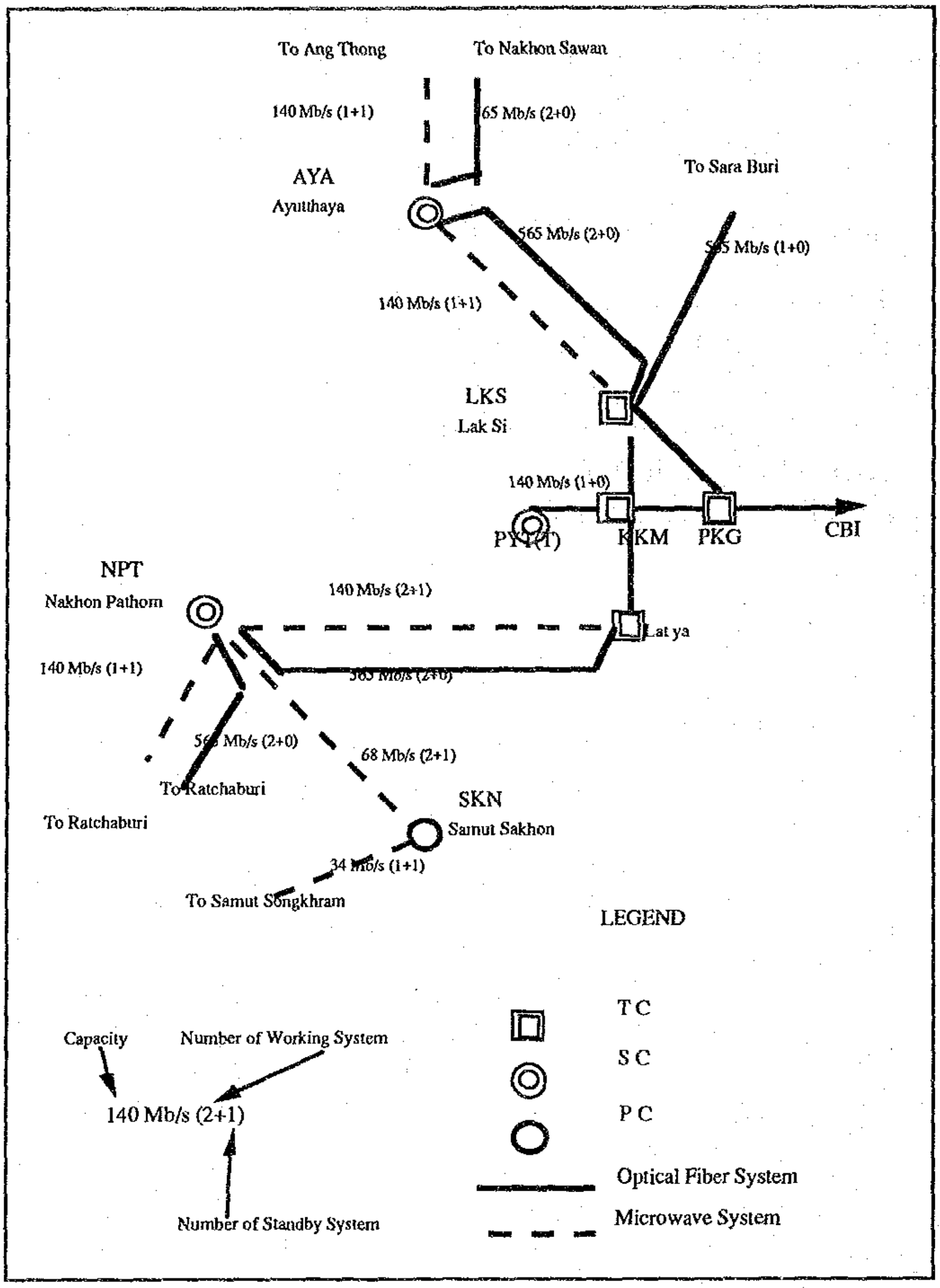


Figure 13.4.2 Number of Systems in Long Distance Transmission (end of 2007)

13.4.3 Metropolitan Junction Transmission System Expansion Plan

The seventh expansion project is executed by a private firm; however, the necessary number of trunk circuits is estimated in accordance with the traffic forecast.

1) Required Number of Circuits

The circuits have to be allocated for doubled or looped transmission routes from the viewpoint of improving their reliability. The method of allocating the trunk circuits is described in a later section. Table 13.4.3 shows the number of trunk circuits expanded in the Phase-1 in accordance with the subscriber line expansion plan to eliminate the waiting applicants.

Table 13.4.3 Expanded Number of Circuits in the BMA

Span	Phase-1	Phase-2	Phase-3
Junction Trunk Circuits	137,913	73,726	44,460
Long Distance (in BMA)	17,193	10,867	3,636
Total	155,106	84,593	48,096
Construction Cost (million Baht)	4,214	2,298	1,307

Note: 1. Unit price :7.17 thousand Baht.
2. A same unit price are used for both the junction trunk circuits and the long distance circuits

2) System Expansion Plan

The configuration of the transmission network in the Phase-3 is shown in Figure 13.4.3.

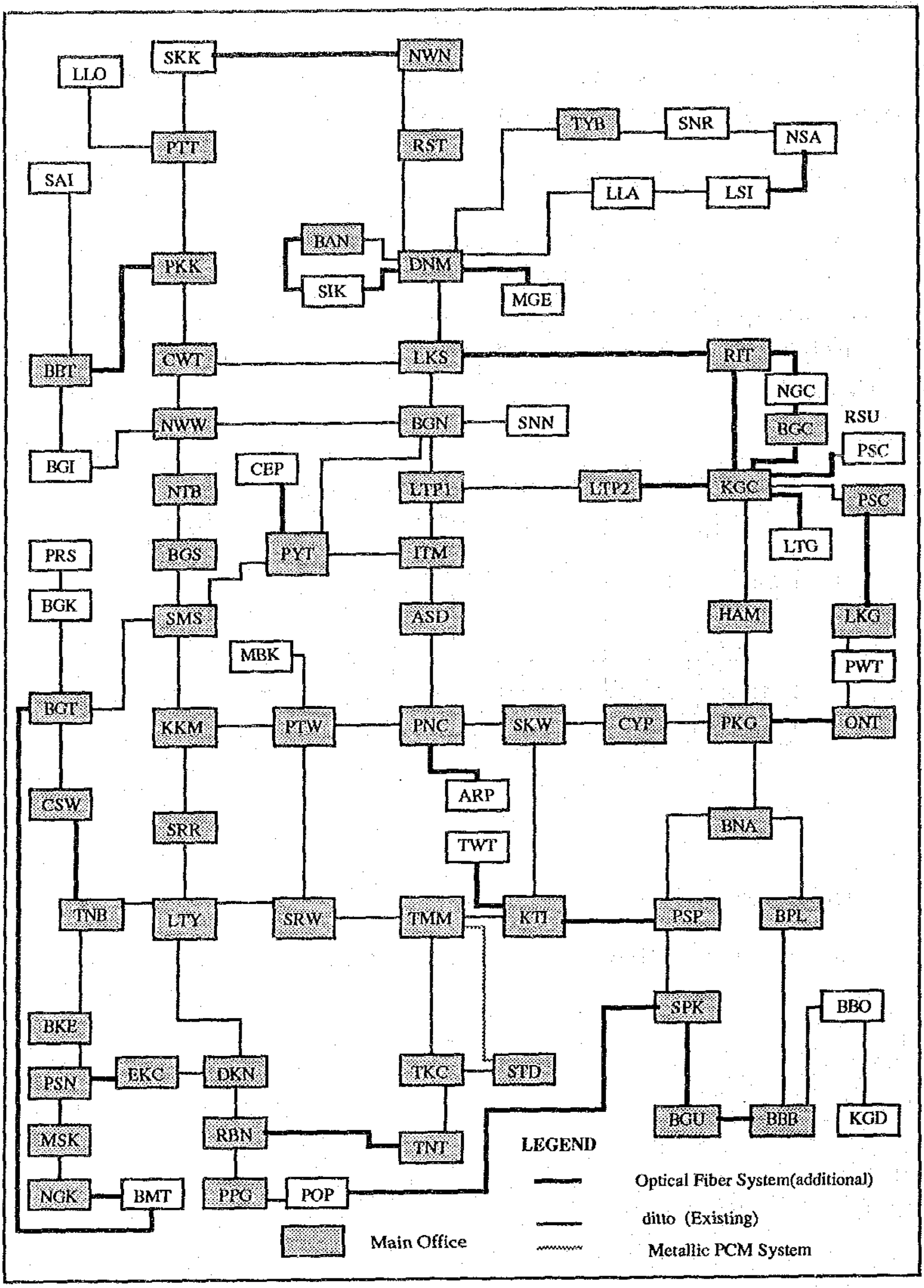


Figure 13.4.3 Configuration of Junction Transmission Network (end of 2007)

13.4.4 Spur Route Transmission System Expansion Plan

The necessary number of circuits for the Spur routes transmission systems in the Study Area is estimated in accordance with the telephone traffic volume. The expansion of the existing microwave system can be planed during Phase-1, however, optical fiber systems are required to install during Phase-1 and Phase-2 from viewpoint of both full assignment of microwave system and transmission network reliability. The total number of circuits in each area is shown in Table 13.4.4.

Table 13.4.4 Number of Circuits in Spur Route Transmission System

Area Name	No. of Circuits		
	Phase-1	Phase-2	Phase-3
Ayutthaya	5,638	6,943	5,754
Nakhon Pathom	7,444	12,110	20,918
Samut Sakhon	5,688	5,528	3,439
Total	18,770	24,581	30,111
Construction Cost (million Baht)	499	2,694	2,430

note:
1. Unit price : Phase-1, 26.57 thousand Baht (expansion of microwave system).
2. Unit price : Phase-2, 109.60 thousand Baht. (optical fiber installation and expansion cost is estimated.)
2. Unit price : Phase-3, 80.70 thousand Baht. (optical fiber installation and expansion cost is estimated. But they are cheaper than Phase-2. Because the route length will be shorter than Phase-2.)

13.4.5 Reliability of Transmission Network Plan

1) Looped and Duplicated Transmission Plan

a) Long Distance Network

In the long distance digital transmission system in the Study Area, the Secondary Centers (SCs) have been connected to Bangkok with doubled routes by microwave transmission systems and optical fiber transmission systems as described in Chapter 6; however, Samut Sakhon is still connected to Bangkok with a single route microwave transmission system. Samut Sakhon located next to Bangkok is expected to be an important PC because many industrial estates and residences have been recently constructed. Additional Transmission routes should be, therefore, considered to secure the Samut Sakhon PC from disasters and transmission route troubles. An additional route is shown in Figure 13.4.5, in which a microwave transmission system between Samut Sakhon, Samut Songkram and Petchaburi should be installed. However, it is necessary to conduct another study for determining the actual additional route.

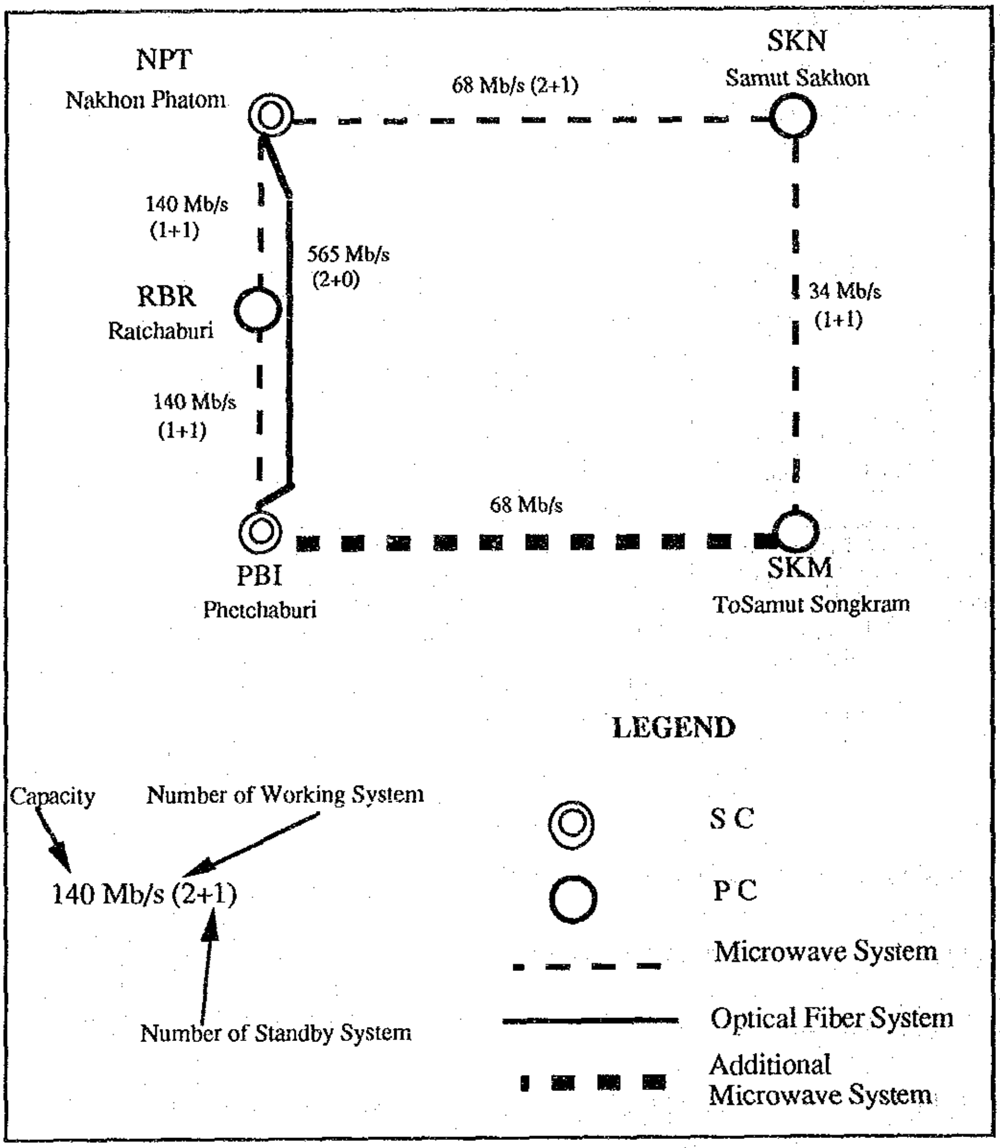


Figure 13.4.5 Looped Transmission Route for Samut Sakhon

b) Metropolitan Junction Network and Spur route Transmission Network

As shown in Figure 13.4.3, main switching offices in the BMA are connected each other with doubled or looped transmission routes; however, transmission routes between RSUs are neglected in the figure. It is expected that installation of RSUs will be increased in the near future in the BMA. Junction transmission systems between RSUs and MSUs should be constructed effectively in the view point of both cost and network reliability. For connecting RSUs to MSUs, optical fiber transmission systems will be installed in the BMA and microwave transmission systems will be installed in the provincial areas. Doubled or looped transmission routes should also be considered for connecting RSUs to the MSUs from the viewpoint of the network reliability.

c) Circuits Accommodation Plan

As mentioned above, duplicated and looped transmission routes are planned for the improvement of the telecommunication network reliability. However, the trunk circuit accommodation method also has to be established for dividing the circuits into these duplicated or looped routes. Some designing systems for circuit apportioning into plural routes will be necessary in the near future.

13.4.6 Introduction of Synchronous Digital Hierarchy (SDH)

As mentioned in Chapter 6, TOT has not introduced the SDH in its telecommunication network yet; however, it is necessary to consider how to introduce the SDH effectively and economically into the telecommunication networks as prescribed in the CCITT recommendations. In this section, the introduction plan is described.

1) The Required SDH Multiplexers

For introducing the SDH system, some kinds of equipment for adding, dropping and cross-connecting circuits should be introduced by taking account of the CCITT recommendations. The type of equipment for the SDH system will be also decided by the sectors depending on the network size, present situation of telecommunications in the country. One required equipment is shown in Figure 13.4.6-1.

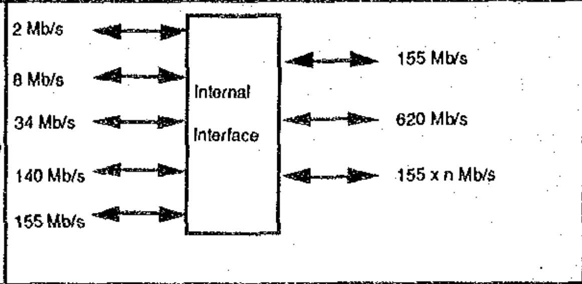
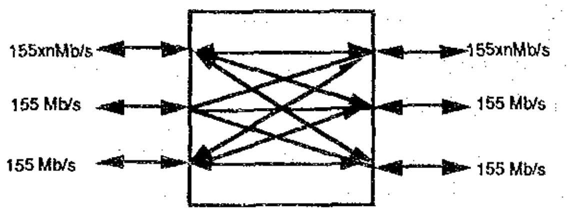
Synchronous Multiplexer	Composition	Remarks
ADM (ADD/DROP Type Module)		*Many low speed bit rate streams can be directly multiplexed to high speed bit rate streams with transfering time slots. *ADD, DROP and THROUGH circuits are simply multiplied /demultiplexed.
XCM (digital Cross connects Module)		*Many kinds of digital streams are re-routined without demultiplexing. (access level e.g.; 2 Mb/s, 8 Mb/s, etc.) *Digital stream can be switched over the emergent route when a normal route is in the event of a transmission path failure. (switch level; e.g. 8 Mb/s, 155 Mb/s, etc.)

Figure 13.4.6-1 A Required Equipment for SDH System

2) Features of SDH

As described in Chapter 6, the SDH system has many merits for both TOT and the customers. In this section, two features are described.

a) Simplicity of Telecommunications Networks

i) BMA

In most countries, transmission networks are mesh type networks in metropolitan areas; therefore, it is very difficult to operate, expand, maintain and design the networks. Introduction of the SDH system will be able to simplify network structures as shown in Figure 13.4.6-2 through adopting cross connect modules (XCM) and add/drop modules (ADM).

ii) Long Distance

In long distance telecommunication network, it is expected that the introduction of the SDH system will make the present rather complex network to a simplified network as shown in Figure 13.4.6-3.

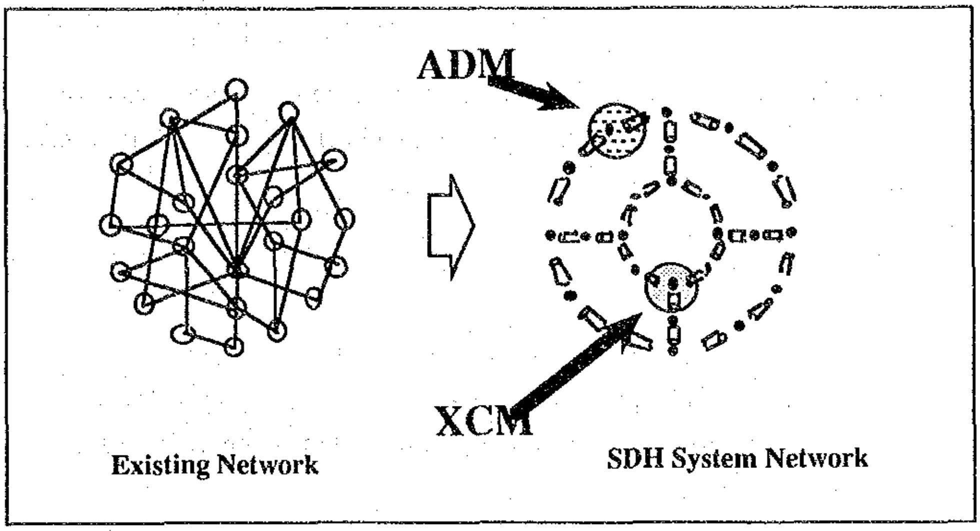


Figure 13.4.6-2 Feature of SDH System in the BMA

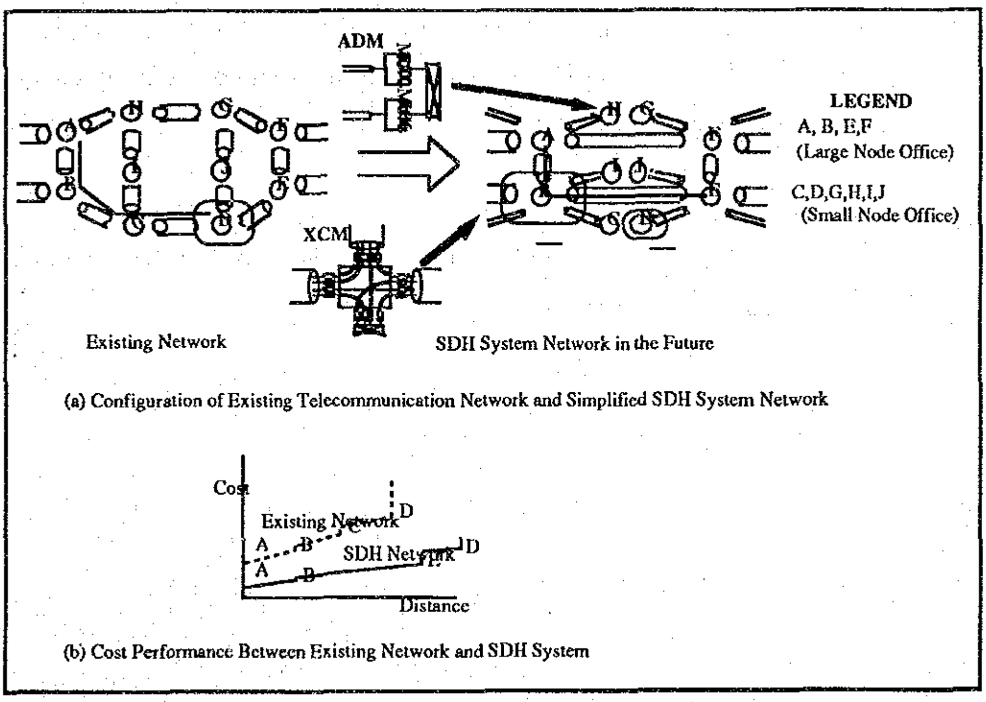


Figure 13.4.6-3 Features of SDH System in Long Distance Network

As shown in the figure, the simplified network is not only very convenient for operation and maintenance but also it makes more efficient investment possible.

b) Enhancement of Operation, Administration and Maintenance (OAM) Capability

A Composition of the SDH network management system is shown in Figure 13.4.6-4. In the SDH system, the operation and maintenance will be expected to be extremely easy as follows.

i) Operational Function

- Routing and re-routing are done quickly and simply.
- All the SDH facilities can be always monitored by operators.
- Any assigned channel for measurement can be always accessed and tested in the SDH system.

ii) Remote Control

As shown in Figure 13.4.6-4, the SDH system can be controlled remotely with work stations through data links such as packet circuit networks, etc.. Various jobs such as re-routing and monitoring can be done by a centralized control center.

iii) Man-machine Interface
Improvement of man-machine interface can make the access to the SDH systems easier with work stations.

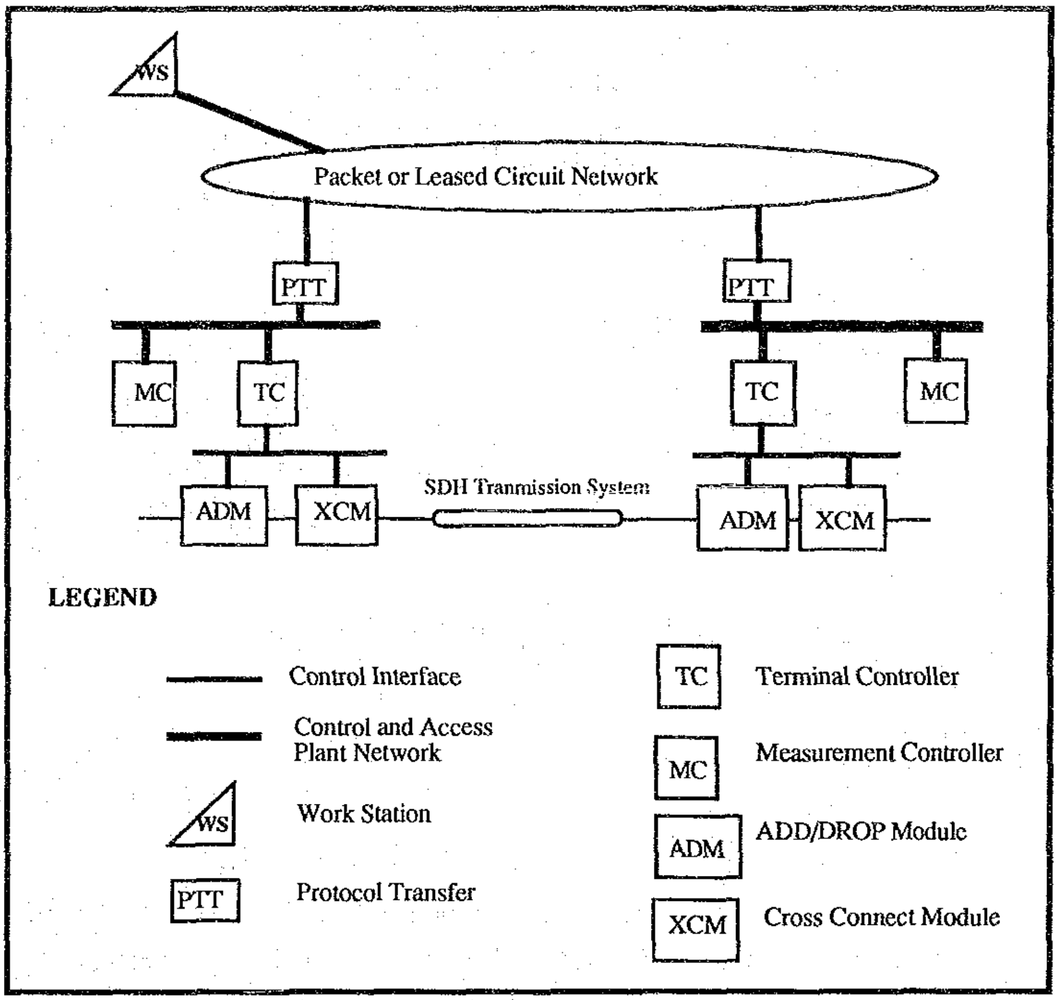


Figure 13.4.6-4 SDH Network Control System

3) Introduction Method

The SDH system to the existing telecommunication networks can easily be made through the overlay method as shown in Figure 13.4.6-5 because the existing networks have already been synchronized in 2 Mb/s signal. It is recommended to introduce the SDH system in accordance with expansion of trunk circuits and replacement of outworn equipment.

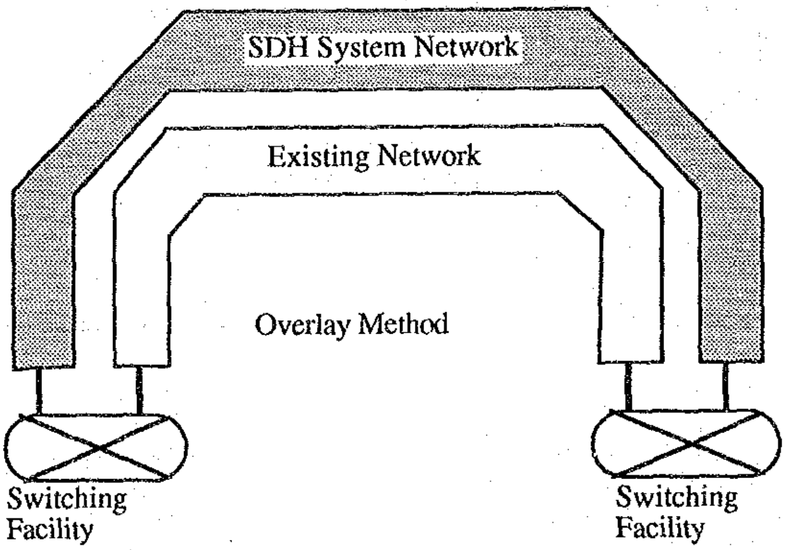


Figure 13.4.6-5 Introduction Method of SDH System

4) SDH System Implementation Plan

a) Implementation Procedure

As mentioned above, it is practical to introduce the SDH system into the existing telecommunication networks through the overlay method in accordance with trunk circuit increase. The introduction procedure is recommended in the following.

i) Long Distance Routes

In the long distance transmission network, the SDH system will be initially introduced in the principal routes such as routes between the SCs and the TCs. Figure 13.4.6-6 shows an example of the SDH system introduction plan for the long distance transmission network in the north and northeastern parts. As shown in the figure, it is effective that digital cross connect modules (XCM) are applied in large node offices such as the SCs and the TCs and that ADD/DROP modules (ADM) are applied in small node offices such as small PCs.

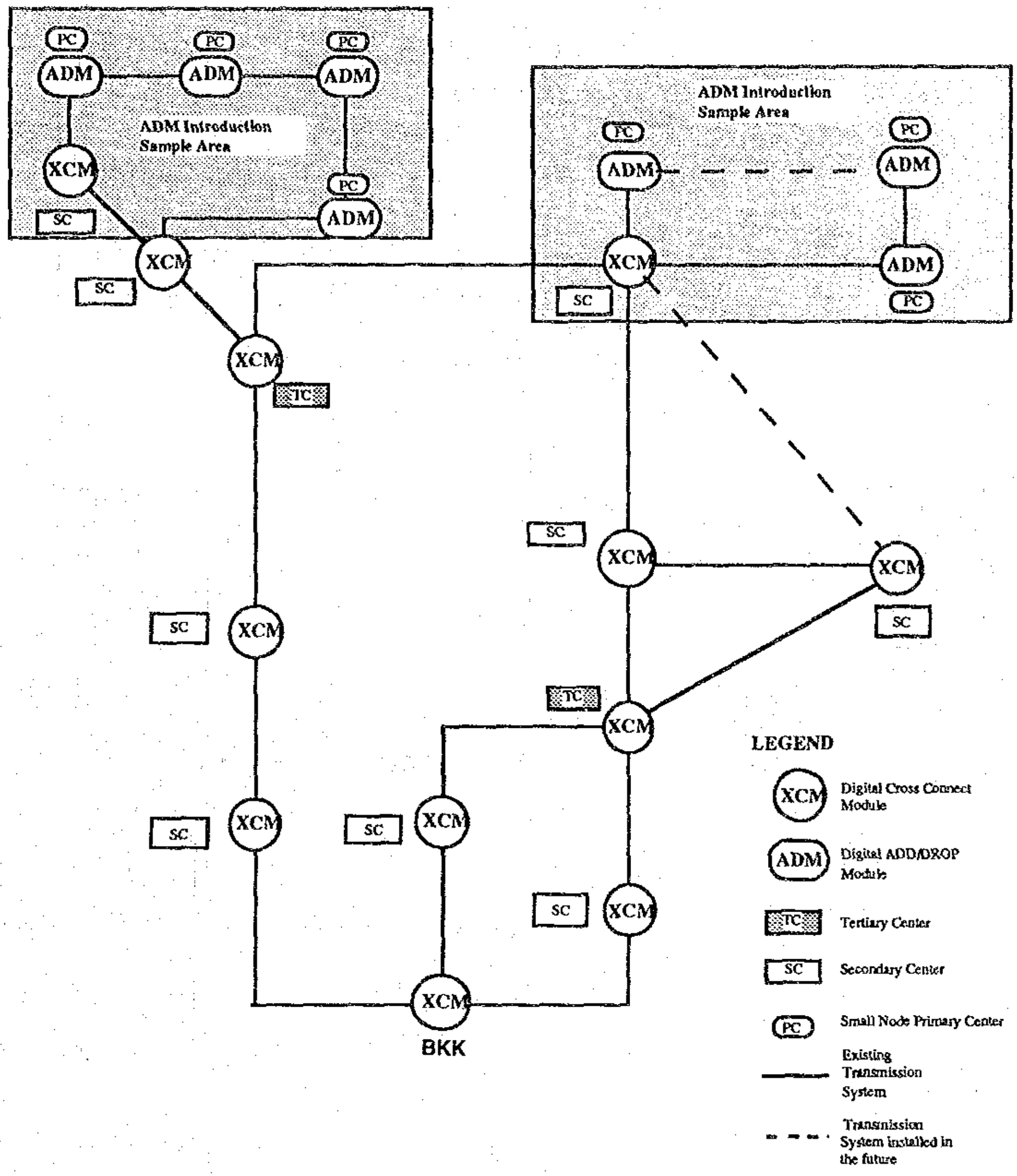


Figure 13.4.6-6 SDH System Introduction Procedure (Long Distance, North & North-East)

ii) Bangkok Metropolitan Area

Figure 13.4.6-7 shows an example of the SDH system introduction plan for the Bangkok Metropolitan transmission routes. As shown in the figure, it is effective that XCMs are applied in large node offices such as tandem switching offices and large size local switching offices and that ADMs are applied in small node offices such as small size local switching offices and RSUs.

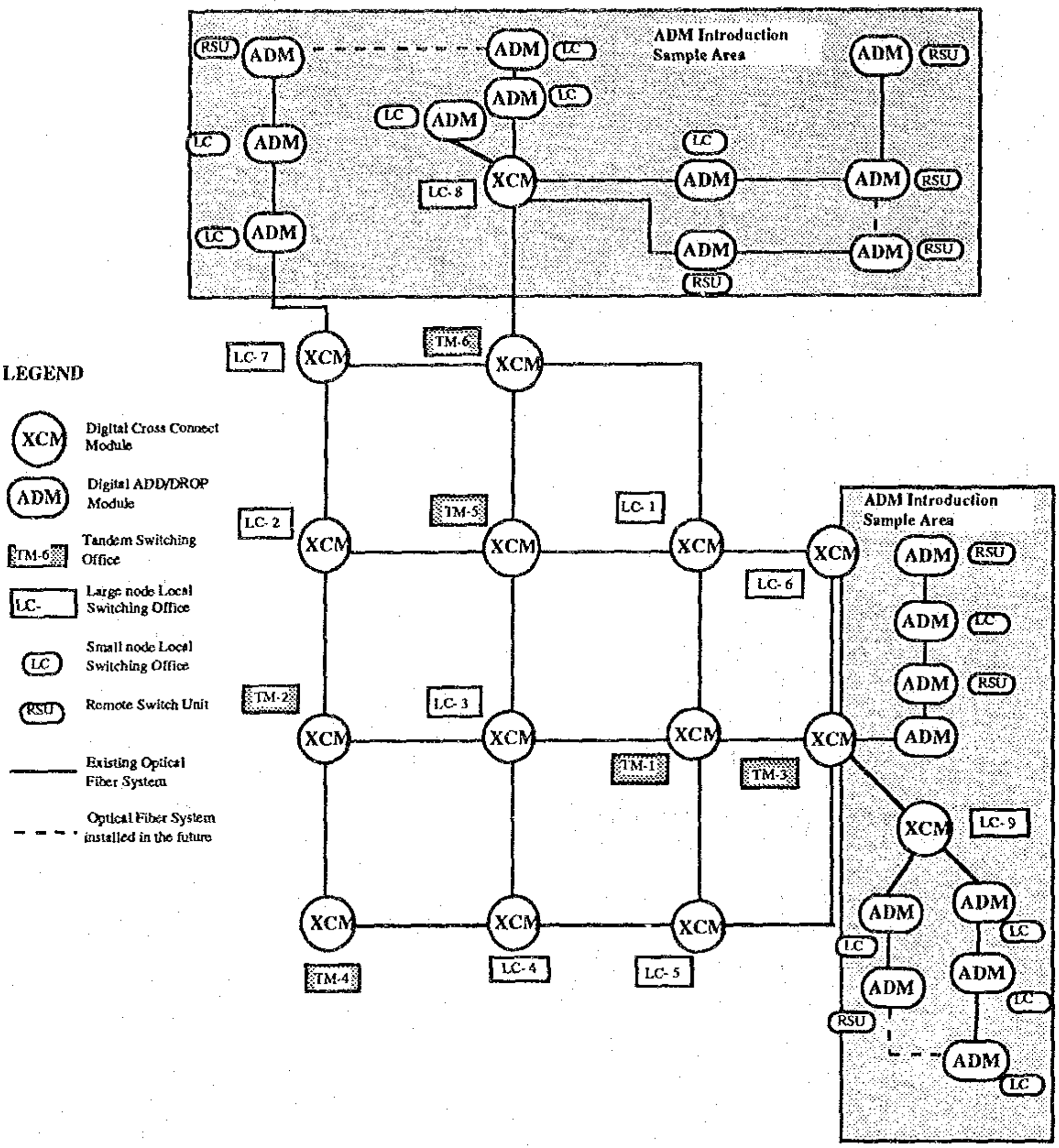


Figure 13.4.6-7 SDH System Introduction Procedure (Metropolitan Area)

b) Implementation Plan

Which routes the SDH system should be installed in the BMA is shown in Table 13.4.6. However, when the SDH system introduction project is started, a further study will be required. Even if a new telephone network is constructed during the TOT seventh ESDP separately from the TOT's existing networks, it is very easy to introduce the SDH system. As mentioned above, the introduction of the SDH system is quite beneficial for both the sector and the customers. Therefore, it is recommended to introduce the SDH system as early as possible.

Table 13.4.6 SDH System Introduction Priority

Period	Introduction Office	Remarks
Phase-1	1) Tandem (KKM, PNC, PKG, LTY, LKS, PYT) 2) Large node LE (SRW, KTI, SKW, HAM, ASD, PTW, SMS, CWT, ITM) 3) Newly installed RSU 4) International broad band leased circuits 5) PCM-30 Replacement (PNC, KKM, SRW, SMS, ASD, PTW, BNA, KGC, SPK, TNB, CSW, PPG, PYT, BGS, LPT-1, LPT-2,)	Further study will be required
Phase-2	1) Large node LE (the remained LE in Phase-1) 2) Newly installed RSU (the installed RSU in Phase-2) 3) International broad band leased circuits 4) PCM-30 Replacement	Further study will be required
Phase-3	1) Newly installed RSU 2) International Broad band leased circuits 3) PCM-30 Replacement	Further study will be required

13.4.7 Facility Replacement Plan

The transmission section has three kinds of facility replacement plans, which are replacement plans of the analog facilities, the metallic PCM-30 facilities and the existing digital facilities. According to the TOT replacement policy, these facilities are supposed to be completely depreciated in twenty years; however, it is very difficult to judge the timing of facility replacement. Therefore, the replacement costs of the existing facilities will be estimated in each phase in accordance with the number of circuits.

1) Analog Facility Replacement Plan

a) Existing Analog Facilities

As described in Chapter 6, the approximate number of analog transmission systems are shown in Table 13.4.7-1.

b) Replacement Plan

In the BMA, the replacement of the crossbar switch facilities is planned in each area. 68 percent and 32 percent of them will be replaced in the Phase-1 and the

Phase-2. The replacement of the analog transmission and phase facilities is also planned in accordance with the replacement of the crossbar switching facilities. The plan of the analog transmission facilities is shown in Table 13.4.7-2. A detail study will be required to determine when the facility replacement plan is carried out.

Table 13.4.7-1 Existing Analog Circuits

Span		No. of System	Required No. of DTI	Remarks
Long Distance	AYA - SRI	6G (1+1) 960 CH	32	
	SRI - KKM	6G (3+1) 960 CH	96	
	NPT - KKM	6G (4+1) 960 CH	128	
	CCO - KKM	6G (3+1) 960 CH	96	
	Sub Total	960 CH (11 SYS.)	352	
Bangkok Metropolitan	KKM - PYT	COAX (2) 2700 CH	180	Long distance circuits are also accommodated.
	KKM - PYT	5G (2+0)	0	
	Sub Total		180	
Grand Total			532	

Table 13.4.7-2 Analog Facilities Replacement Plan

Span	Phase-1 (No. of DTI)	Phase-2 (No. of DTI)	Phase-3 (No. of DTI)	Total
Long Distance	224	128		352
Metropolitan Area	122	58		180
Total	346	186		
Percentage (%)	65	35		100

Note : The replacement cost of the long distance analog facilities is not estimated. Because they are planed to replace from viewpoint of the whole country.

2) PCM-30 System Replacement Plan

According to the fault data in 1990 - 1991 of TOT, the fault rate of the PCM-30 facilities is in the target figure range; however, it is extremely higher than that of the optical fiber systems in the BMA. Some PCM-30 facilities have been used for more than 20 years with the crossbar switching facilities. The replacement of the PCM-30 systems is planned in accordance with the replacement of the crossbar switching facilities. It is also described in detail in Chapter 17.

a) Existing PCM-30 Facilities

3,102 systems are operating now in the BMA as described in Chapter 6. Their replacement is planned by the same way as the analog facilities are replaced

b) Replacement Plan

The replacement of the PCM-30 system facilities is basically planned in accordance with the replacement plan of the crossbar switching facilities as shown in Table 13.4.7-3.

Table 13.4.7-3 PCM-30 Facilities Replacement Plan

Span	Phase-1 (No. of DTI)	Phase-2 (No. of DTI)	Phase-3 (No. of DTI)
Metropolitan Area	1,144	1,109	662
Percentage (%)	39	38	23
Construction Cost (million Baht)	912	834	528

Note: Unit price : 797.1 thousand Baht.

3) Replacement of Existing Digital Facilities

Working channels of the optical fiber system in the BMA are estimated to reach 5,646 DTIs by the end of the fifth and sixth ESDP of TOT. On the other hand, the optical fiber system has been applied to the transmission in the BMA since the fifth ESDP project of TOT started in 1984. It has already passed around ten years since the optical fiber system was used in the BMA. The Study Team, therefore, considered those transmission facilities which were used for ten years should be rehabilitated.

Approximately one third of the existing optical fiber system are planned to be rehabilitated in each Phase during the long-term period as shown in Table 13.4.7-4.

Table 13.4.7-4 Optical Fiber System Replacement Plan

Span	Phase-1 (No. of DTI)	Phase-2 (No. of DTI)	Phase-3 (No. of DTI)
Metropolitan Area	560	560	560
Percentage (%)	33.3	33.3	33.3
Construction Cost (million Baht)	1,510	1,510	1,510

Note: Unit Price : 269.6 thousand Baht.

CHAPTER 14

OPERATION AND MAINTENANCE PLAN

CHAPTER 14 OPERATION AND MAINTENANCE PLAN

Emphases of the telecommunications facility operation and maintenance (O & M) management have been placed on improving the network quality (less break downs and shorter down time). The telecommunications services depend on effectiveness of O & M efforts. The maintenance activities will become more important for telecommunications businesses in the future. However, on the other hand, the effectiveness of telecommunications maintenance activities largely depends on the quality and efforts of individual engineers and technicians who are responsible for maintaining telecommunications facilities and softwares.

Figure 14 shows a concept of the O & M management. An "Operation and Maintenance Plan" will be studied on the basis of Figure 14. In order to provide good telecommunication services, O & M activities need to be improved from the points of reliability, maintainability and good customer services based on the analysis of the present conditions at all times. In accordance with these improvements, structural changes, personnel reshuffle and human development will be needed.

Operation and Maintenance

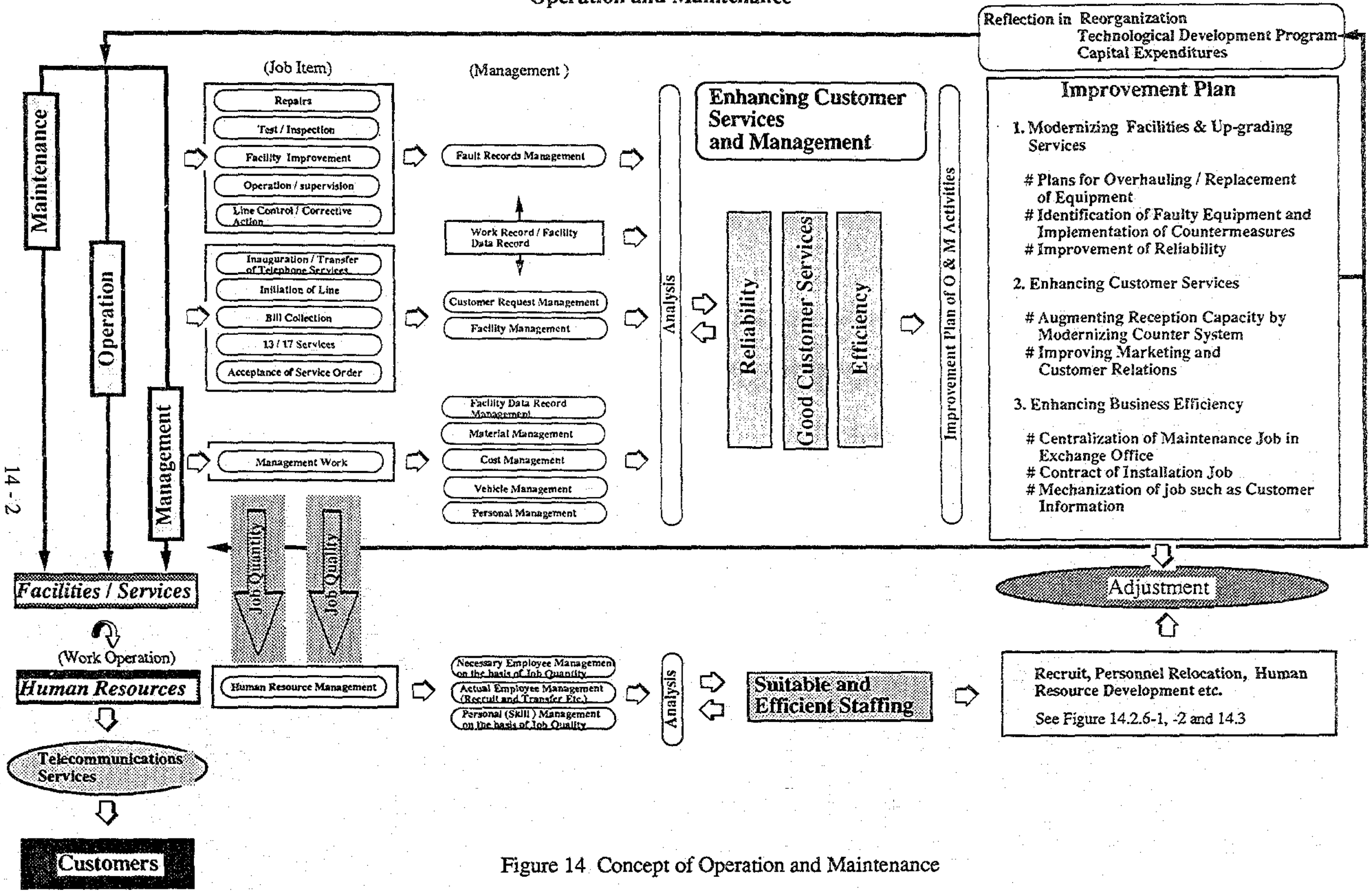


Figure 14 Concept of Operation and Maintenance

14.1 Operation and Maintenance Works

This section proposes an O & M work method to improve telecommunications facilities and services to enhance customer services and business operations. The O & M work methods for the Transmission, Switching, Outside Plant and Commercial sections as described in Figure 7.1.

14.1.1 Transmission

Interruptions of information flows will bring confusions and losses to the society; therefore, it is necessary to control telecommunications networks according to traffic volume and frequency of accidents. The centralization of the supervisory systems will be completed by FY1992. All the transmission systems will be integrated in the Phase -2.

1) Centralized Operation System

   This operation system covers not only the long distance transmission systems but also the spur routes and the metropolitan junction transmission systems. It consists of an alarm collecting system, alarm processing and transmitting system and supervisory and operation system. Figure 14.1.1 shows an integration plan of the O & M work of the transmission systems.

2) Required Manpower

   The transmission networks will be also expanded in the future. The O & M works at the same time will increase. However, the work efficiency will be enormously improved by using this centralized operation system; therefore, the requirement for additional manpower is not so large even though the network expands three times larger in size. Because the network expansion will be offset by the improved work efficiency. The O & M works can be handled by a smaller number of highly qualified staff.

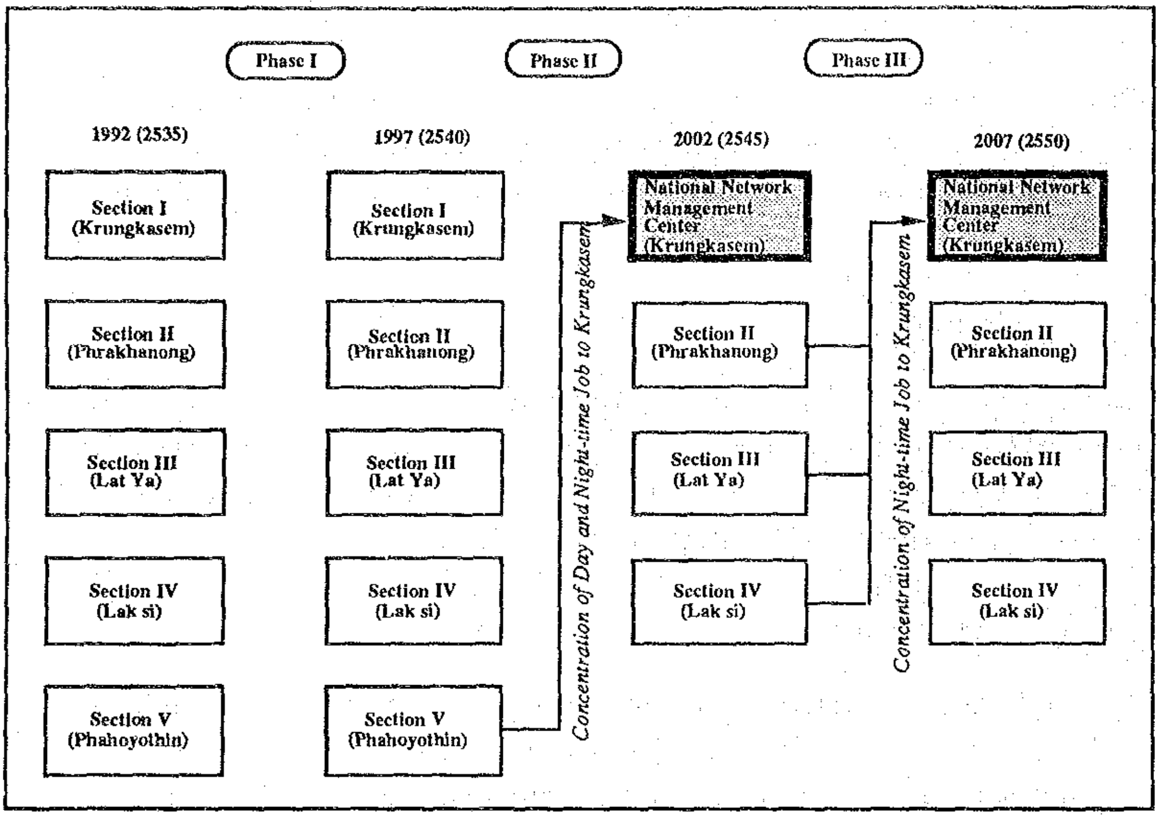


Figure 14.1.1 Centralization of Transmission Jobs

14.1.2 Switching

The number of switches will increase in the Study Area. SPC switches will replace all the existing XB switches before FY2000. As the networks expand, they will be enhanced gradually through the offerings of many new services. Many new network functions will be added by softwares. Therefore, knowledge and skill of softwares will become more important for the maintenance and operation specialists.

1) Maintenance Job

a) Centralization

Figure 14.1.2-1 shows a centralized switching maintenance system. In order to manage the telecommunications networks effectively and economically, the centralized telecommunications network management system is necessary. It has mainly two merits. One is to monitor and supervise all the networks on traffic volume and troubles. The other is to improve the technical level of the O & M specialists so that they can carry out efficient operation and maintenance jobs.

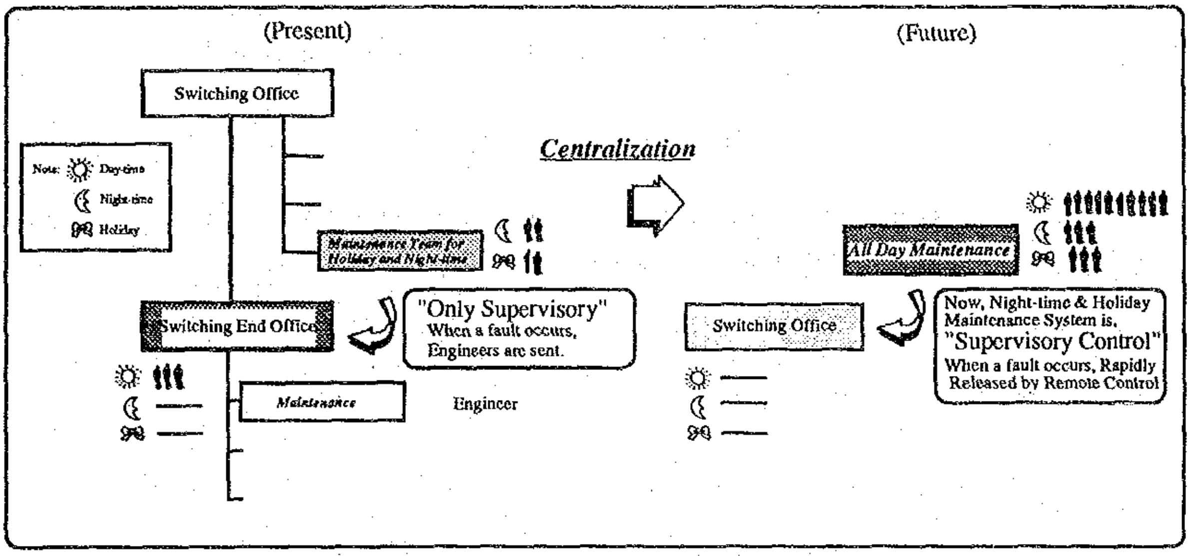


Figure 14.1.2-1 Centralization of Switching Maintenance Jobs

After replacing all XB switches with SPC switches, TOT should concentrate on switching maintenance which excludes test and jumper works in several exchange offices. The reasons are as follows:

- When exchange offices with faults can be remote-controlled (hereinafter referred to as "unmanned exchange office") at any time, troubles will be quickly solved by remote-control from an operator controlling exchange office (hereinafter referred to as "manned exchange office").

- In the human resource aspects, under the integrated maintenance system, the necessary number of maintenance people can be smaller than the present one. Furthermore, high level SPC switch maintenance engineers (technicians) can be mainly allocated in the manned exchange offices.

Figure 14.1.2-2 and Figure 14.1.2-3 show a tentative centralization plan of day-time maintenance jobs in the switching section in the Study Area. Conditions are as follows:

i) Manned Exchange Office

- Tandem Exchange Office (KKM, PNC, PYT, LKS, PKG, LTY and TNB)
- Large Scale Exchange Office (BGT, NTB,DNM, KGC and BNA)

ii) Centralization Time

The exchange offices in the following areas are integrated in accordance with the completion of replacement

- Maintenance Area 1 Phase 1
- Maintenance Area 2, 3 and 4 Phase 2

b) Operation (Test and Jumper Job)

The number of RSU switches will increase in the Study Area. Every time a new subscriber comes in or moves out, an operation team needs to go out to each unmanned RSU office for jumpering at MDFs. The cost and time for this job will become big in the future. Remote controlled MDF or automated MDF is now under development.

3) Required Skill

a) Digital Exchange Maintenance

At present, software maintenance jobs on the digital switches are carried out by the software support center of TOT. However, there are some occasions in which TOT depends on suppliers in performing the maintenance jobs. When the software maintenance jobs increase in accordance with the installation of new SPC switches, which support new services, it is doubtful whether or not TOT can constantly and timely receive services from the suppliers.

Since there exist different and incompatible types of SPC switches in Thailand, it may be difficult for TOT to provide intelligent network services to customers. In order to avoid this problem, TOT should be able to make switch specifications by itself.

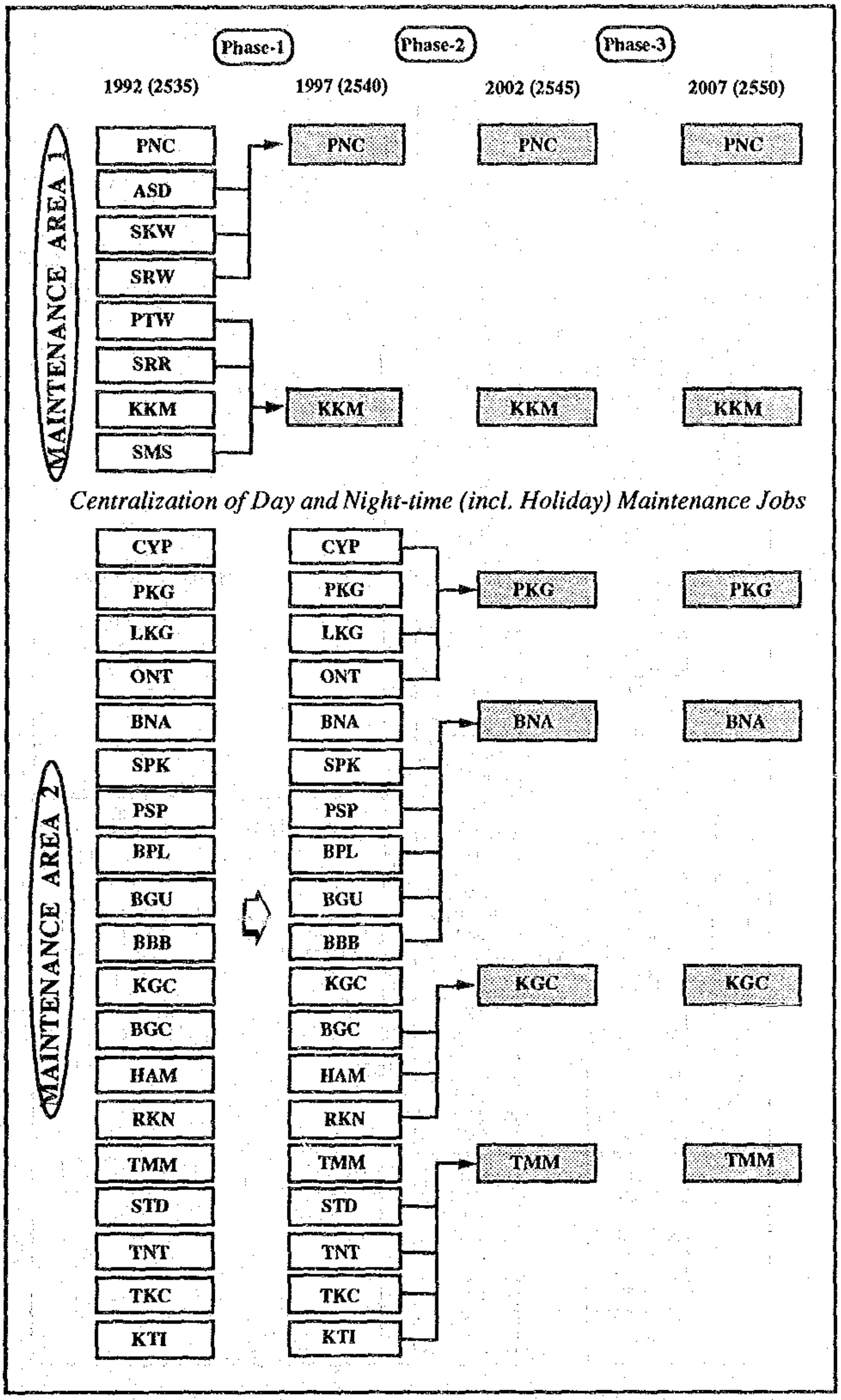


Figure 14.1.2-2 Centralization of Day and Night-time (Including Holiday) Maintenance Jobs (Area 1-2)

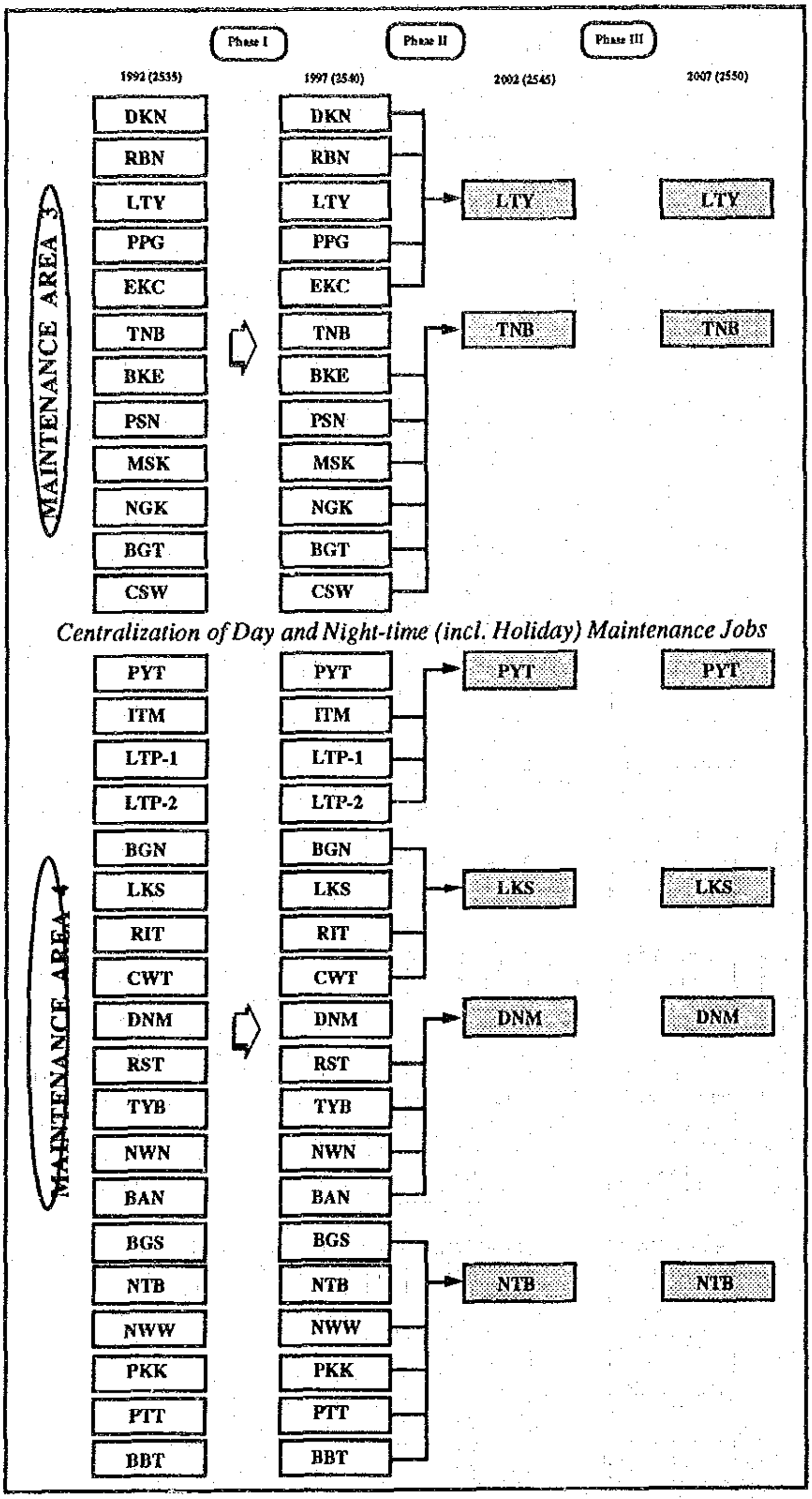


Figure 14.1.2-3 Centralization of Day and Night-time (Including Holiday)Maintenance Jobs (Area 3-4)

b) Design

As the number of switches increases, design jobs (functional and detailed level switches design) for switch set up switches will also increase. This has been mainly carried out in the headquarters. It is very useful to experience switch design jobs to carry out proper maintenance in the switching field; therefore, TOT should move system design jobs from the headquarters to the lower offices. If impossible, TOT needs to carry out *"On-the-Job-Training"* in the headquarters.

14.1.3 Outside Plant

In the near future, the outside plant facilities will increase by a enormous scale. Therefore, it is necessary for TOT to establish a more effective maintenance system.

Additionally, the technology progresses is very fast and new technology such as optical fiber cables network certainly come into the outside plant field soon. Hence, new technology maintenance should be urgently established.

On the other hand, the telephone installation works will reach its peak in the Phase-1, and decreases suddenly after the elimination of waiting applicants. How to manage the big installation work in the Phase-1 and how to provide the necessary technicians for the work should be considered from the viewpoint of the future management of TOT.

1) Telephone Installation Works

Figure 14.1.3-1 and Figure 14.1.3-2 show the estimated number of telephone installation jobs in the long-term period. The figures were calculated by using a regression analysis between the number of connected lines and the number of installation in the past ten years.

These figures mean that approximately three to six times more manpower will be required for the telephone installation jobs until the target year of eliminating waiting applicants. But at the end of 2007, the necessary man power will drop down to about one third of the required man power in the peak period. The telephone installation jobs are mainly easy installation of drop wires. Therefore, the telephone installation job s should be carryed out by subcontractors.

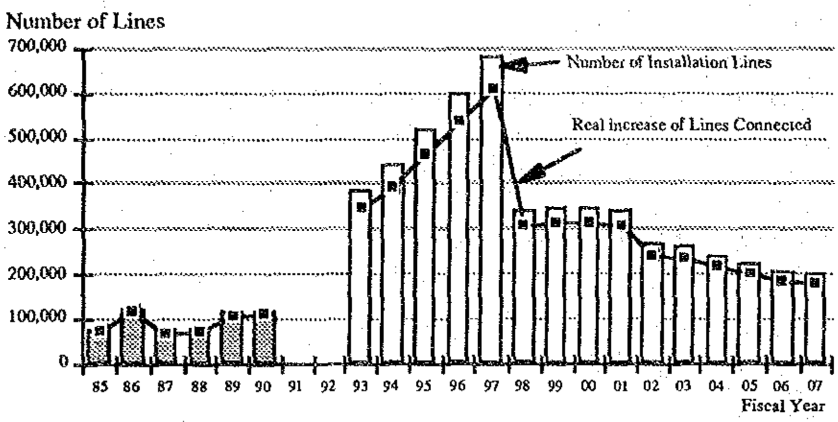


Figure 14.1.3-1 Estimated Number of Installation in the BMA

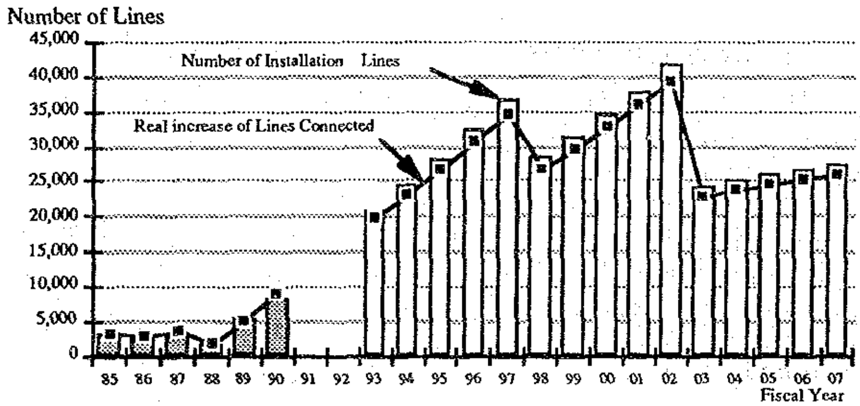


Figure 14.1.3-2 Estimated Number of Installation in the Surrounding Area

2) Maintenance

Figure 14.1.3-3 and Figure 14.1.3-4 show the estimated total number of fault repairs. These figures were calculated by the fault rate set at 2.0%, 1.3% and 1.0% in 2007. The fault rates before 2007 were assumed by the declining balance method. The target fault rate in this long-term plan is 1.3% of the lines connected per month as mentioned in Chapter 13.

Quick repair jobs are very important to keep the confidence of the customers on TOT. However, temporary repairs must be avoided because they are one of the major causes of the frequent faults.

Therefore, the following measures should be carryed out to improve the telecommunications service quality and save the maintenance cost.

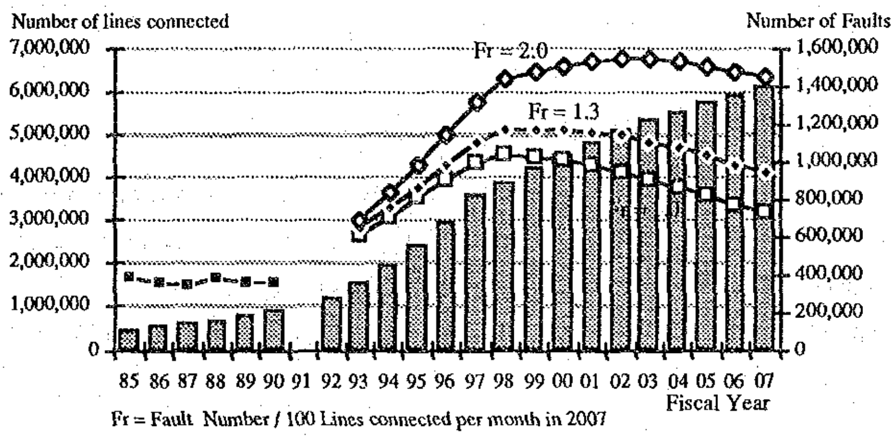


Figure 14.1.3-3 Estimated Number of Repairs in the BMA

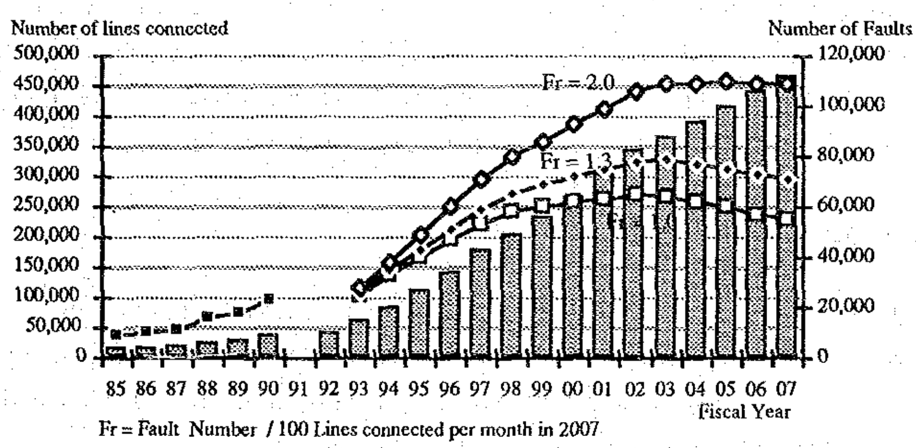


Figure 14.1.3-4 Estimated Number of Repairs in the Surrounding Area

a) The execution of preventive maintenance activities based on the analysis of the present conditions,
b) The improvement of outside plant maintenance techniques,
c) The training of maintenance techniques for the maintenance staff,
d) The development and improvement of materials of the outside plant facilities,
e) The introduction and improvement of the facility management system such as the COLNETR and plant record keeping.

Hence, the Test and Development Sector should be improved to carry out the countermeasures a) and c). The Maintenance Sections should be improved for quicker repair jobs together with the introduction of the facility management system.

14.1.4 Commercial

With the increase of telephone subscribers, they demand better and more diversified telecommunications services. In other words, the telecommunications business will be getting more successful by satisfying customers' needs; therefore, without more extension and improvement of this section, it seems difficult that the telecommunications business in the Study Area will be able to develop more.

1) Customer Services

People involved in the subscriber services directly contact with customers. Customer appraisals toward TOT are designed by this section; therefore, from now on, the customer service field should augment the reception capacity by modernizing the counter system for enhancing the customer services. However, it needs to give more attentions on its staffing so that employees will not be expanded beyond the necessity.

2) Promotion of Office Automation

At present, TOT is preparing for introducing the COLNETR system for systematically managing customers information. This system is expected to enhance the customer service level not only in the commercial field but also in the outside plant and switching fields. It is necessary to complete it at the early stage.

3) Marketing

Marketing and customer relations are one of the least developed management areas in TOT. In order to improve the marketing and customer relations, the immediate efforts should be primarily concentrated on their improvement. The marketing becomes very important to make customers being fully aware that modern and sophisticated telecommunication services are not just to transmit voice messages, but also to transmit, store, and process all kind of information and to support people in making intelligent decisions. TOT should promote "Informationization" of the society and become the primary promoter of the telecommunication services.

4) Required Skill

As described above, without strategical marketing, it cannot be expected that the telecommunications business will become successful in the Study Area.

Required skills are as follows:

a) Marketing Experts,

b) Professional Sales Expert.

14.2 Manpower

14.2.1 Issues of Manpower Management

When telecommunications facilities and services are expanded, the manpower to construct, operate and maintain them must be also expanded at the same time. Massive telecommunications facilities and services will be just wasted without proper expansion and allocation of the manpower. The manpower costs are major expense items in business operations; therefore, they must be efficiently and carefully managed.

It seems that TOT lacks the human resource management policies; therefore, it is difficult for TOT to create strategic targets in the human resource field. If TOT does not have them in the human resource field which should be directly linked with the over-all management policies at the early expansion stage, it is quite possible that the total management of TOT will become weaker. The reasons are as follows:

a) In the financial aspect, it can be foreseen that the portion of the labor cost will increase in the total expenditure, unless TOT strategically manages the manpower. It will give a severe negative impact on the total management of TOT.

b) In the staffing aspect, if TOT does not have staffing standards which can properly reflect amount of works in the offices, it cannot make an efficient use of the manpower. In other words, it is difficult for TOT to carry out suitable recruiting and transferring for the efficient human resource management. It may create imbalance and decrease the service quality.

The Operation Bureau of TOT has a staffing standard of own employees. However, it has not been working properly. There are two reasons. One is that the amount of works changes everyday; however, the standard remains as of five years ago. The other is that there is a big difference between the actual allocation of employees and the standard. In order to control the total number of employees properly, TOT should have a macro manpower plan and employee allocation micro policies.

14.2.2 Manpower Policy Guideline

Figure 14.2.2 and Table 14.2.2 show a manpower policy guideline in the future. This guideline is estimated by using the number of subscribers in each year and the past growth rate of the subscriber lines per employee (hereinafter referred to as "Annual Manpower Efficiency Index (MEI) Increase Rate").

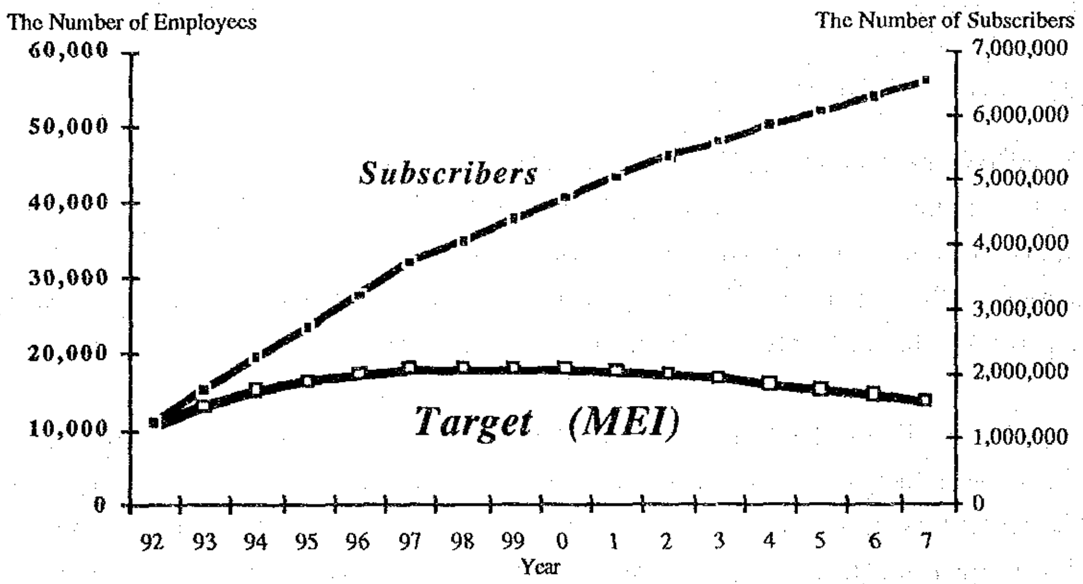


Figure 14.2.2 Manpower Policy Guideline

This guideline is certainly challenging. It can be observed that the target MEI tends to decrease after FY2000. TOT should give a serious consideration to the forecast because it may address an important potential problem that will affect the TOT business in the future.

Table 14.2.2 Manpower Policy Guideline

ITEM / YEAR	1992 (2535)	1997 (2540)	2002 (2545)	2007 (2550)	'7 / '92
Subscribers	1,251,000	3,736,000	5,377,000	6,513,000	5.21
Manpower Policy Guideline	**10,190**	**17,280**	**16,920**	**13,320**	1.31
Efficiency	123	216	318	489	3.98
Annual MEI Rate	1.15	1.12	1.08	1.09	

Note: Data of each year is described ANNEX
Efficiency means the subscriber lines per employee

14.2.3 Method of Manpower Policy Guideline Estimation

In the last Master Plan study by JICA in 1989, the number of employees was calculated by using the MEI increase rate of 1.066. This was based on the TOT's past growth rate of the number of subscribers per employee. However, at present, the MEI increase rate in the Study Area is set at 1.150 for the mass installation. If this figure is used throughout the study period, we run into the risk of undermining the manpower plan.

As described in Figure 14.2.6-1, the MEI is expected to play an important role in managing the future manpower. Therefore, the annual MEI increase rate should be carefully estimated by using not only the past MEI of TOT but also those of other countries.

1) Past MEI and Annual MEI Increase Rates in Developed Countries

This section discusses the MEI of developed countries.

a) Trend of MEI

Table 14.2.3-1 and Figure 14.2.3-1 show the trend of the past MEI in the thirteen (13) developed countries. The MEI gradually increased.

Table 14.2.3-1 Past MEI and Annual MEI Increase Rates in Developed Countries

		Stage I						Stage II					Stage III						Stage I	Stage II	Stage III	Average	Km2
		1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1974 to 1979	1980 to 1984	After 1985		
Germany	Main Line	12,167,000	12,834,000	14,212,000	15,748,000	17,305,000	18,917,000	20,535,000	21,769,000	22,712,580	23,549,856	24,602,734	25,588,585	26,399,284	27,221,756	28,078,614							248,717
	Line Increase		667,000	1,378,000	1,536,000	1,557,000	1,612,000	1,618,000	1,234,000	943,580	837,276	1,052,878	985,851	810,699	822,472	856,858							
	Employee	190,000	185,000	177,000	178,000	183,000	190,000	195,020	199,774	203,751	204,718	207,693	212,364	214,346	216,020	216,156							
	Efficiency	64	69	80	88	95	100	105	109	111	115	118	120	123	126	130			84	112	125	104	
	MEI Inc Rate		1.08	1.16	1.10	1.07	1.05	1.06	1.03	1.02	1.03	1.03	1.02	1.02	1.02	1.03			1.09	1.04	1.02	1.05	
Australia	Main Line	3,361,000	3,539,000	3,700,000	3,907,000	4,166,000	4,449,000	4,752,278	5,225,374	5,479,561	5,719,870	6,032,554	6,361,422	6,668,006	6,964,661	7,267,618	7,602,572						7,682,300
	Line Increase		178,000	161,000	207,000	259,000	283,000	303,278	473,096	254,187	240,309	312,684	328,868	306,584	296,655	302,957	334,954						
	Employee	88,400	89,100	87,500	87,400	87,400	87,400	87,300	90,000	88,100	89,324	93,326	92,238	93,495	92,487	84,270	88,003						
	MEI Inc Rate	38	40	42	45	48	51	54	58	62	64	65	69	71	75	86	86		44	61	78	60	
	Up Rate		1.04	1.06	1.06	1.07	1.07	1.07	1.07	1.07	1.03	1.02	1.06	1.03	1.06	1.15	1.00		1.05	1.05	1.06	1.06	
Brazil	Main Line	1,706,000	1,954,000	2,457,000	2,997,000	3,583,000	3,829,000	4,677,000	5,081,000	5,588,000	6,064,167	6,519,664	6,927,918	7,249,741	7,892,383	9,081,649							8,511,965
	Line Increase		248,000	503,000	540,000	586,000	246,000	848,000	404,000	507,000	476,167	455,497	408,254	321,823	642,642	1,189,266							
	Employee	70,000	75,000	85,000	86,000	92,000	94,000	97,000	98,000	100,984	101,902	103,572	105,318	104,023	105,492	104,420							
	MEI Inc Rate	24	26	29	35	39	41	48	52	55	60	63	66	70	75	87			32	56	74	51	
	Up Rate		1.07	1.11	1.21	1.12	1.05	1.18	1.08	1.07	1.08	1.06	1.05	1.06	1.07	1.16			1.11	1.09	1.09	1.10	
Canada	Main Line	7,899,000	8,278,000	8,614,000	8,920,000	9,271,000	9,595,000	9,979,000	10,294,500	10,335,442	10,468,344	11,403,068	11,814,000	12,250,680	13,206,233	13,280,333	13,919,840						9,220,974
	Line Increase		379,000	336,000	306,000	351,000	324,000	384,000	315,500	40,942	132,902	934,724	410,932	436,680	955,553	74,100	639,507						
	Employee	88,400	90,000	90,800	94,400	100,000	103,800	108,100	108,593	111,088	113,612	100,497	99,765	99,400	102,581	99,342	103,010						
	Efficiency	89	92	95	94	93	92	92	95	93	92	113	118	123	129	134	135		93	97	126	105	
	MEI Inc Rate		1.03	1.03	1.00	0.98	1.00	1.00	1.03	0.98	0.99	1.23	1.04	1.04	1.04	1.04	1.01		1.01	1.05	1.04	1.03	
Korea	Main Line	876,000	1,058,000	1,271,000	1,537,000	1,812,000	2,341,000	2,761,000	3,325,000	4,150,000	4,898,000	5,696,451	6,517,395	7,659,000	8,625,000	10,486,193	12,003,839						99,022
	Line Increase		182,000	213,000	266,000	275,000	529,000	420,000		825,000	748,000	798,451	820,944	1,141,605	966,000	1,861,193	1,517,646						
	Employee									37,000	41,000	40,501	45,521	48,470	50,700	51,383	53,033						
	Efficiency									112	119	141	143	158	170	204	226			124	169	159	
	MEI Inc Rate										1.07	1.18	1.02	1.10	1.08	1.20	1.11			1.12	1.10	1.11	
Spain	Main Line	4,255,000	4,698,000	5,118,000	5,679,000	6,185,000	6,698,000	7,229,000	7,654,000	8,017,690	8,456,707	8,881,727	9,340,458	9,801,009	10,236,408	10,971,635	11,797,159						504,750
	Line Increase		443,000	420,000	561,000	506,000	513,000	531,000	425,000	363,690	439,017	425,020	458,731	460,551	435,399	735,227	825,524						
	Employee	63,620	65,820	65,900	66,970	68,620	68,840	70,610	70,960	71,170	71,461	71,199	72,086	63,021	63,311	66,062	71,155						
	Efficiency	67	71	78	85	90	97	102	108	113	118	125	130	156	162	166	166		81	113	153	115	
	MEI Inc Rate		1.07	1.09	1.09	1.06	1.08	1.05	1.05	1.04	1.05	1.05	1.04	1.20	1.04	1.03	1.00		1.08	1.05	1.08	1.06	
United States	Main Line	78,744,000	80,515,000	82,802,000	85,426,000	88,431,000	91,265,000	94,282,000	94,429,000	94,905,850		99,981,000	111,545,000	115,214,000	119,090,000	122,275,000	125,835,921						9,363,123
	Line Increase		1,771,000	2,287,000	2,624,000	3,005,000	2,834,000	3,017,000	147,000	476,850			11,564,000	3,669,000	3,876,000	3,185,000	3,560,921						
	Employee	885,400	895,100	849,900	868,900	910,300	945,400	956,600	963,360														
	Efficiency	89	90	97	98	97	97	99	98										95			96	
	MEI Inc Rate		1.01	1.08	1.01	0.99	0.99	1.02	0.99										1.02			1.01	
France	Main Line	6,197,000	7,099,000	8,390,000	9,996,000	11,936,000	13,871,000	15,898,000	17,743,000	19,478,000	20,942,000	22,086,286	23,030,564	23,911,097	24,803,609	25,827,282	26,942,452						545,998
	Line Increase		902,000	1,291,000	1,606,000	1,940,000	1,935,000	2,027,000	1,845,000	1,735,000	1,464,000	1,144,286	944,278	880,533	892,512	1,023,673	1,115,170						
	Employee		130,000	136,000	142,400	149,900	157,800	161,300	161,200	165,000	167,000	167,130	166,788	165,198	163,682	159,521	157,313						
	Efficiency		55	62	70	80	88	99	110	118	125	132	138	145	152	162	171		71	117	149	114	
	MEI Inc Rate			1.13	1.13	1.13	1.16	1.12	1.12	1.07	1.06	1.05	1.04	1.05	1.05	1.07	1.06		1.12	1.09	1.05	1.09	
Greece	Main Line	1,573,000	1,687,000	1,806,000	1,905,000	2,025,000	2,156,000	2,270,000	2,401,160	2,534,410	2,714,395	2,926,885	3,116,798	3,291,971	3,465,815	3,615,526	3,786,429						131,990
	Line Increase		114,000	119,000	99,000	120,000	131,000	114,000	131,160	133,250	179,985	212,490	189,913	175,173	173,844	149,711	170,903						
	Employee	24,100	24,900	26,800	28,600	28,700	28,800	30,200	31,680	31,148	30,995	30,602	30,571	29,595	29,444	30,327	26,645						
	Efficiency	65	68	67	67	71	75	75	76	81	88	96	102	111	118	119	142		69	83	113	89	
	MEI Inc Rate		1.04	0.99	0.99	1.06	1.06	1.00	1.01	1.07	1.08	1.09	1.07	1.09	1.06	1.01	1.19		1.03	1.05	1.06	1.05	
Japan	Main Line		29,502,000	32,377,000	34,444,000	35,837,000	37,214,000	38,611,000	39,934,000	41,190,000	42,429,000	43,811,000	45,370,000	44,861,000	46,325,000	48,014,000	49,946,000	52,034,176					377,815
	Line Increase			2,875,000	2,067,000	1,393,000	1,377,000	1,397,000	1,323,000	1,256,000	1,239,000	1,382,000	1,559,000	-509,000	1,464,000	1,689,000	1,932,000	2,088,176					
	Employee		316,000	323,000	328,000	332,000	334,000	335,000	333,000	333,416	330,000	324,000	321,000	311,000	305,000	300,000	286,000	276,992					
	Efficiency		93	100	105	108	111	115	120	124	129	135	141	144	152	160	175	188	104	125	149	131	
	MEI Inc Rate			1.07	1.05	1.03	1.03	1.03	1.04	1.03	1.04	1.05	1.05	1.02	1.05	1.05	1.09	1.08	1.05	1.04	1.04	1.05	
United Kingdom	Main Line		12,789,000	13,323,000	14,059,000	15,173,000	16,462,000	17,696,000	18,323,000	19,083,000	19,550,000	20,192,894	20,921,000	21,653,639	22,137,000								244,030
	Line Increase			534,000	736,000	1,114,000	1,289,000	1,234,000	827,000	560,000	467,000	642,894	728,106	732,639	483,361								
	Employee		247,200	237,700	228,100	228,400	234,000	240,700	247,400	246,600	246,700	241,816	235,178	226,700	223,084								
	Efficiency		52	56	62	66	70	74	75	77	79	84	89	96	99				61	78	95	75	
	MEI Inc Rate			1.08	1.10	1.08	1.06	1.05	1.02	1.03	1.02	1.05	1.07	1.07	1.04				1.08	1.03	1.06	1.06	
Italy	Main Line	9,090,000	9,660,000	10,166,000	10,778,000	11,456,000	12,172,000	13,017,000	13,860,000	14,597,780	15,601,029	16,520,763	17,396,113	18,252,973	19,104,828	20,091,523	21,265,518						301,338
	Line Increase		570,000	506,000	612,000	678,000	716,000	845,000	843,000	837,780	903,249	919,734	875,350	856,860	851,855	986,705	1,173,985						
	Employee	98,000	100,000	101,000	100,000	101,000	102,000	104,000	104,000	104,480	107,040	108,782	109,792	110,232	109,680	113,676	116,391						
	Efficiency		97	101	108	113	119	125	133	141	146	152	158	166	174	177	183		108	139	169	139	
	MEI Inc Rate			1.04	1.07	1.05	1.05	1.05	1.06	1.06	1.04	1.04	1.04	1.05	1.05	1.01	1.03		1.05	1.05	1.04	1.05	
Norway	Main Line	863,000	896,000	939,000	984,000	1,030,000	1,090,000	1,197,287	1,297,653	1,425,512	1,554,194	1,657,403	1,757,656	1,861,412	1,948,680	2,016,213	2,070,249						323,886
	Line Increase		33,000	43,000	45,000	46,000	60,000	107,287	100,366	127,859	128,682	103,209	100,253	103,756	87,268	67,533	54,036						
	Employee	15,400	15,700	16,500	17,300	17,800	18,100	18,300	18,123	17,933	17,897	17,302	17,618	17,692	17,373	16,457	16,252						
	Efficiency		57	57	57	58	60	65	72	79	87	96	100	105	112	123	127		58	80	110	84	
	MEI Inc Rate			1.00	1.00	1.02	1.04	1.09	1.09	1.11	1.09	1.10	1.04	1.05	1.07	1.09	1.04		1.01	1.10	1.06	1.06	
Average	Efficiency																		75	99	126	102	
	MEI Inc Rate																		1.06	1.06	1.06	1.06	

Source : ITU, Yearbook of Common Carrier Telecommunication Statistics

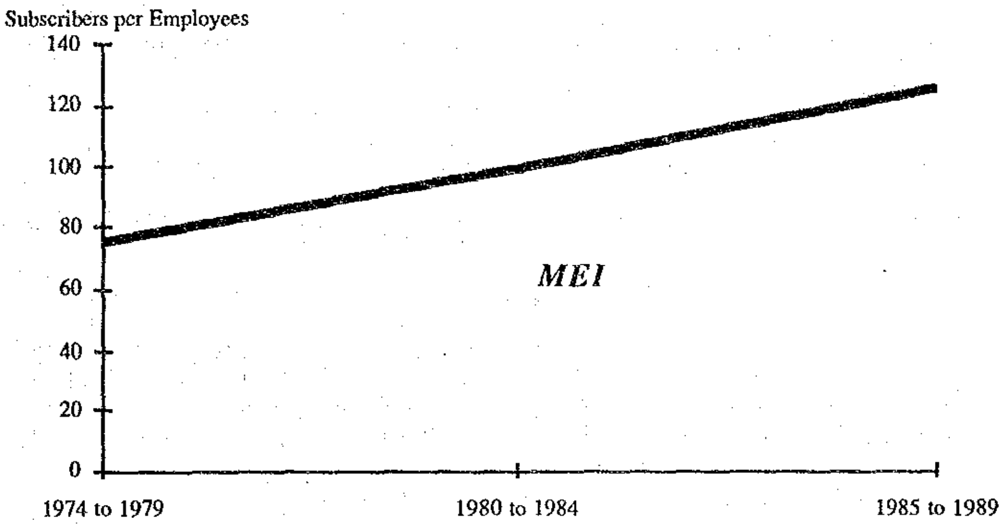


Figure 14.2.3-1 Trend of MEI in Developed Countries

Stage I (1974 to 1979)........................	75
Stage II (1980 to 1984)......................	99
Stage III (1985 to 1989).....................	126

b) MEI increase rate in each Stage

Stage I (1974 to 1979)	1.06
Stage II (1980 to 1984)	1.06
Stage III (1985 to 1989)	1.06

c) The MEI of the large countries with respect to the area size such as Australia and Brazil tend to be low in general.

d) Countries which have high digital switch rates do not always have high MEI.

2) Comparison of The Annual MEI Increase Rates between The Whole Country and The Metropolitan Area

Table 14.2.3-2 shows the annual MEI increase rates of the BMA, the whole Thailand, the Tokyo metropolitan area and the whole Japan. The purpose of this section is to examine whether the annual MEI increase rates of the whole countries can be applied to the metropolitan areas or not.

The conclusion is that MEI increase rate of the whole country can be applied to the metropolitan area.

Table 14.2.3-2 Comparison of the Rates Between the Whole Countries and the Metropolitan Areas

Item	Average MEI Increase Rate	
	(1982 to 1991)	(1963 to 1987)
The Bangkok Metropolitan Area	**1.08**	
The Whole Thailand	**1.08**	
The Tokyo Metropolitan Area		**1.07**
The Whole Japan		**1.08**

Note: Regarding the detail data, refer to ANNEX

3) Examination of Annual EMI Increase Rate in Case of Fixing the Basic Year on the Basis of Fulfillment Year of Telephone Demand

Figure 14.2.3-2 and Table 14.2.3-3 show the past changes of the annual EMI increase rates of five developed countries. **The year that waiting applicants are eliminated is set as the base year (0 year) of the Table.** Regarding the annual MEI increase rate in each Stage, the followings can be pointed out:

a) The annual MEI increase rate of the First and Second Stages tend to be high for the mass installation,

b) In the Third Stage, it tends to decrease not only for small-installation after the elimination of waiting applicants but also for not being able to rapidly decrease employees,

c) In the last stage it increases again because of mechanization, establishment of integrated operation systems such as the network management system in the recent years, and increasing demand of telecommunications new services.

First Stage	1.110
Second Stage	1.080
Third Stage	1.040
Fourth Stage	1.050

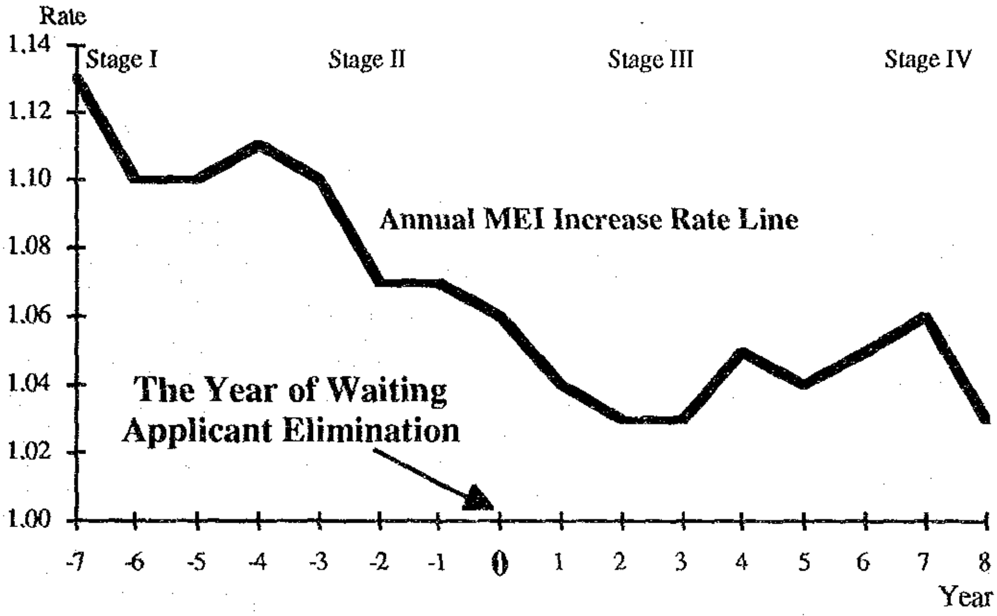


Figure 14.2.3-2 The Changes of Annual MEI Increase Rate in Five Developed Countries

d) **Furthermore, it is worthy of an attention that the actual employees in France, Japan and United Kingdom decreased after the elimination of the waiting applicants.**

Therefore, the annual MEI increase rate in this study, regarding the average MEI increase rate in the whole country in the First Stage as the starting point, is estimated by using the average MEI increase rate of five developed countries after the First Stage.

First Stage .... $Ir = S\ (1.15)$

After the First Stage .... $Ir = S \cdot \frac{D}{F}$

where

Ir	:	(MEI) Increase rate
D	:	(MEI) Increase rate of five developed countries in each Stage
S	:	(MEI) Increase rate of the Study Area in the first Stage
F	:	(MEI) Increase rate of five developed countries in the first Stage

Table 14.2.3-3 The Past changes of the Annual MEI Increase rates of Five Developed Countries

		-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	Stage I	Stage II	Stage III	Stage IV
Thailand	Main Line	985	1,137	1,302	1,541	1,806																			
	Line Increase		152	165	239	265																			
	Employee	18	18	18	19	19																			
	Line per Emp.	55	63	72	81	95																			
	MEI Inc. Rate		1.15	1.15	1.12	1.17																1.15	1.12	1.08	1.09
Germany	Main Line				12,167	12,834	14,212	15,748	17,305	18,917	20,535	21,769	22,712	23,550	24,603	25,589	26,399	27,222	28,079						
	Line Increase					667	1,378	1,536	1,557	1,612	1,618	1,234	943	838	1,053	986	810	823	857						
	Employee				190	185	177	178	183	190	195	200	204	205	208	212	214	216	216						
	Line per Emp.				64	69	80	88	95	100	105	109	111	115	118	121	123	126	130						
	MEI Inc. Rate					1.08	1.16	1.10	1.07	1.05	1.06	1.03	1.02	1.03	1.03	1.02	1.02	1.02	1.03			1.08	1.09	1.03	1.03
Australia	Main Line			3,361	3,539	3,700	3,907	4,166	4,449	4,752	5,225	5,480	5,720	6,033	6,361	6,688	6,965	7,268	7,603						
	Line Increase				178	161	207	259	283	303	473	255	240	313	328	327	277	303	335						
	Employee			88	89	88	87	87	87	87	90	88	89	92	92	93	92	84	88						
	Line per Emp.			38	40	42	45	48	51	55	58	62	64	66	69	72	76	87	86						
	MEI Inc. Rate				1.04	1.06	1.07	1.07	1.07	1.07	1.06	1.07	1.03	1.02	1.05	1.04	1.05	1.14	1.00			1.05	1.07	1.04	1.06
France	Main Line		6,197	7,099	8,390	9,996	11,936	13,871	15,898	17,743	19,478	20,942	22,086	23,031	23,911	24,804	25,827	26,942							
	Line Increase			902	1,291	1,606	1,940	1,935	2,027	1,845	1,735	1,464	1,144	945	880	893	1,023	1,115							
	Employee			130	136	142	150	158	161	161	165	167	167	167	165	164	160	157							
	Line per Emp.			55	62	70	80	88	99	110	118	125	132	138	145	151	161	172							
	MEI Inc. Rate				1.13	1.14	1.13	1.10	1.12	1.12	1.07	1.06	1.05	1.04	1.05	1.04	1.07	1.06				1.14	1.11	1.05	1.07
Japan	Main Line	12,044	14,000	16,403	19,228	22,472	25,633	28,869	29,502	32,377	34,444	35,837	37,214	38,611	39,934	41,190	42,429	43,811	45,370	44,861	46,325				
	Line Increase		1,956	2,403	2,825	3,244	3,161	3,236	633	2,875	2,067	1,393	1,377	1,397	1,323	1,256	1,239	1,382	1,559	509	1,464				
	Employee	260	270	280	290	300	305	310	316	323	328	332	334	335	333	333	330	324	321	311	305				
	Line per Emp.	46	52	59	66	75	84	93	93	100	105	108	111	115	120	124	129	135	141	144	152				
	MEI Inc. Rate		1.12	1.13	1.13	1.13	1.12	1.11	1.00	1.07	1.05	1.03	1.03	1.03	1.04	1.03	1.04	1.05	1.05	1.02	1.05	1.13	1.07	1.03	1.04
United Kingdom	Main Line					12,789	13,323	14,059	15,173	16,462	17,696	18,523	19,083	19,550	20,192	20,921	21,654	22,137							
	Line Increase						534	736	1,114	1,289	1,234	827	560	467	642	729	733	483							
	Employee					247	238	228	228	234	241	247	247	247	242	235	227	223							
	Line per Emp.					52	56	62	67	70	73	75	77	79	83	89	95	99							
	MEI Inc. Rate						1.08	1.10	1.08	1.06	1.04	1.02	1.03	1.02	1.05	1.07	1.07	1.04					1.07	1.04	1.06
Average	Main Line			8,954	10,831	12,358	13,802	15,343	16,465	18,050	19,476	20,510	21,363	22,155	23,000	23,838	24,655	25,476	27,017			10,715	16,627	22,173	25,716
	Line Increase			1,653	1,431	1,420	1,444	1,540	1,123	1,585	1,425	1,035	853	792	845	838	816	821	917			1,501	1,423	873	852
	Employee			205	176	192	191	192	195	199	204	207	208	209	208	207	205	201	208			191	196	208	205
	Line per Emp.			57	58	62	69	76	81	87	92	96	99	103	107	111	117	124	119			59	81	103	120
	MEI Inc. Rate			1.13	1.10	1.10	1.11	1.10	1.07	1.07	1.06	1.04	1.03	1.03	1.05	1.04	1.05	1.06	1.03			1.11	1.08	1.04	1.05

14.2.4 Necessary Number of Employees by Microscopic Estimation

This section presents the estimated results of the necessary number of employees during the study period on the basis of "O & M Work Plan" of Section 14.1 and **"Telecom Variables"** in **"each O & M work field"**. The estimation method is described in the next section.

Note : <u>Telecom variables</u> is "Number of Subscriber Lines", "Number of Switching Lines" and "Number of Faults" etc.
<u>O & M work field</u> is "Transmission Section", "Switching Section", "Outside Plant Section", "Commercial Section", "General Affairs Section" and "Staff" etc.

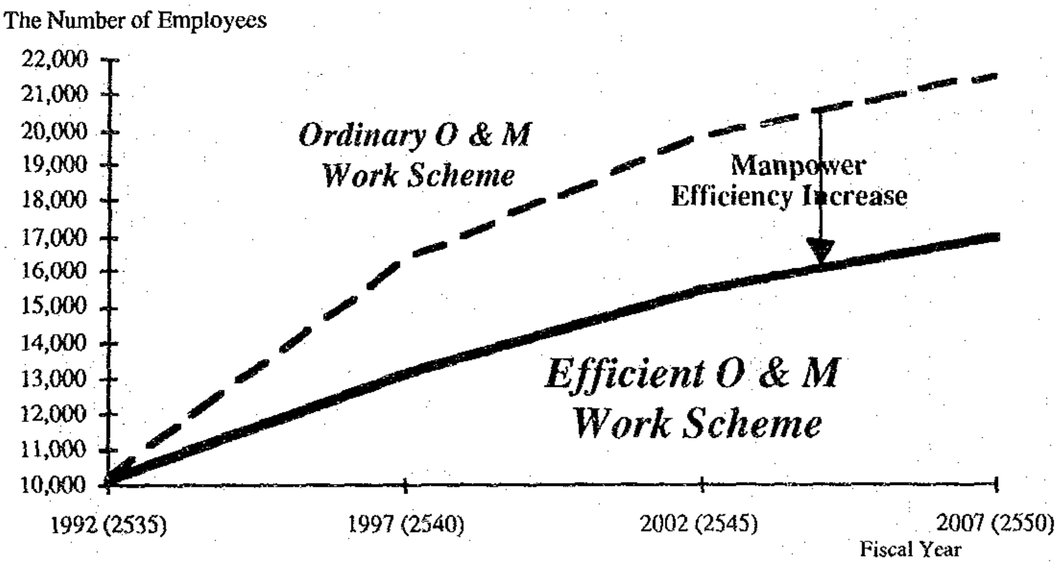


Figure 14.2.4-1 Necessary Manpower Forecast in the Future

Figure 14.2.4-1 shows the estimated necessary number of employees of two cases. The two cases are "The Efficient O & M Work Scheme" and "The Ordinary O & M Work Scheme". **If TOT employs the efficient O & M work scheme, it can cut about 5,000 employees at the end of FY2007.**

Note : The efficient O & M work scheme adopts efficient policies such as "Centralization of Maintenance Work in Switching Offices", "Contract of Installation Work" and "Improvement of Administration Work" etc.

1) The Necessary Number of Employees in each O & M Work Field in the Future

a) Necessary Number of Employees

Figure 14.2.4-2 and Table 14.2.4-1 show the necessary number of employees under the efficient O & M work scheme. Figure 14.2.4-3 and Table 14.2.4-2 show the necessary number of employees under the ordinary O & M work scheme. It can be observed that there is a significant difference between the two schemes.

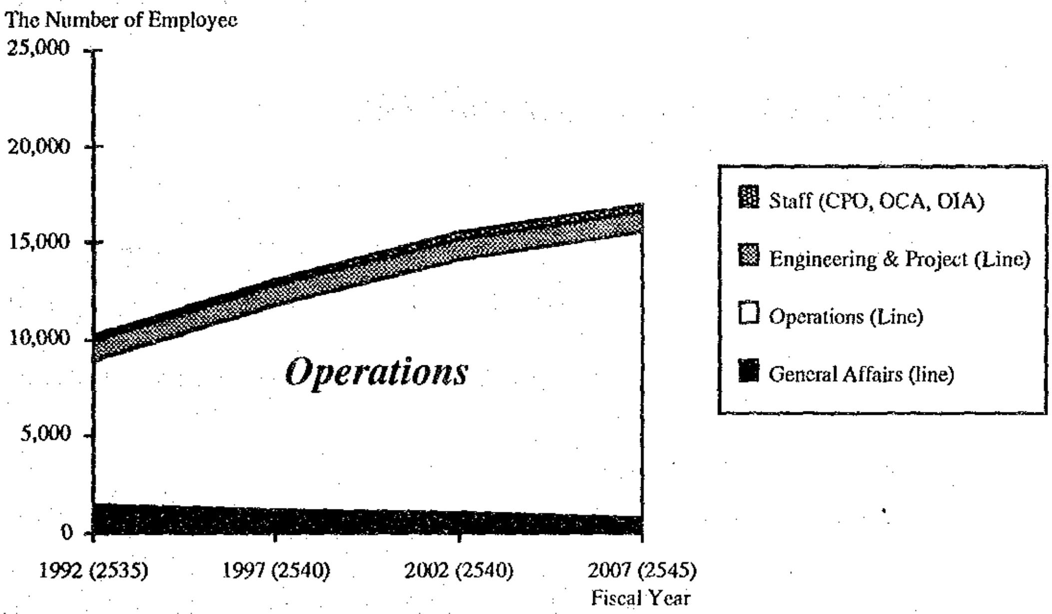
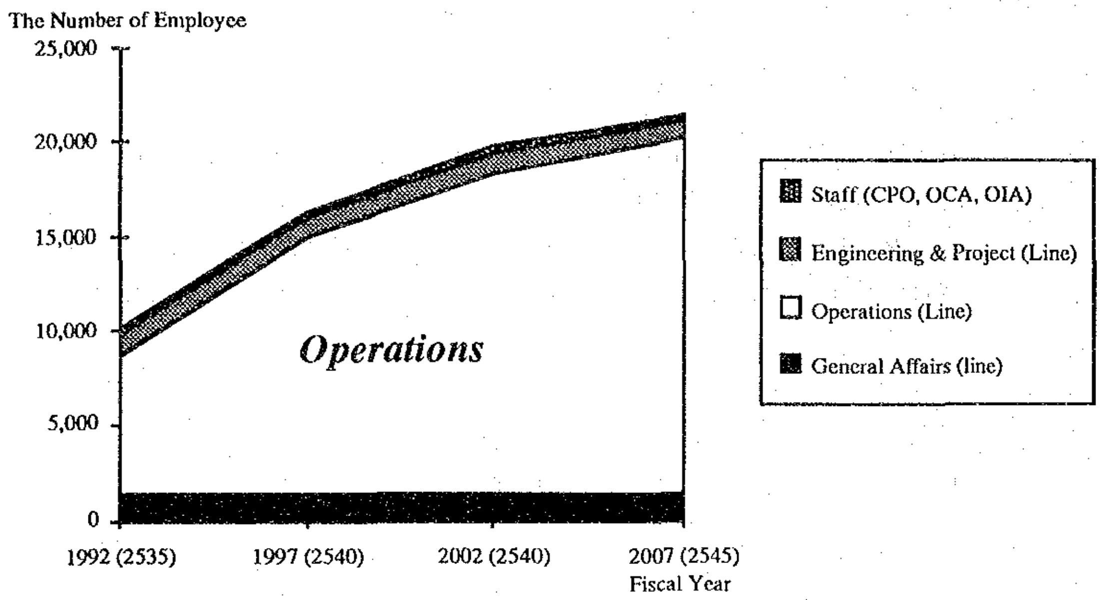


Figure 14.2.4-2 The Necessary Number of Employees under the Efficient O & M Work Scheme

Table 14.2.4-1 The Necessary Number of Employees under the Efficient O & M Work Scheme

	1992 (2535)	1997 (2540)	2002 (2540)	2007 (2545)
General Affairs (line)	1,340	1,139	968	823
Operations (Line)	7,470	10,592	13,172	14,759
Engineering & Project (Line)	1,080	1,080	1,080	1,080
Staff (CPO, OCA, OIA)	300	300	300	300
Total	**10,190**	**13,111**	**15,520**	**16,962**



Note: Figure 14.2.4-3 is described the necessary number of employees under the ordinary O & M work scheme.
However, in the study, the necessary number of employees in the headquarters is fixed in the future.

Figure 14.2.4-3 The Necessary Number of Employees under the Ordinary O & M work Scheme

Table 14.2.4-2 The Necessary Number of Employees under the Ordinary O & M work Scheme

	1992 (2535)	1997 (2540)	2002 (2540)	2007 (2545)
General Affairs (line)	1,340	1,340	1,340	1,340
Operations (Line)	7,470	13,590	17,030	18,760
Engineering & Project (Line)	1,080	1,080	1,080	1,080
Staff (CPO, OCA, OIA)	300	300	300	300
Total	**10,190**	**16,310**	**19,750**	**21,480**

b) Necessary Number of Employees in the Operations Field

Figure 14.2.4-4 and Table 14.2.4-3 show the necessary number of employees in the operations field under the efficient O & M work scheme. Figure 14.2.4-5 and Table 14.2.4-4 show the necessary number of employees under the ordinary O & M work scheme. Especially, there is a significant difference between the switching and installation fields.

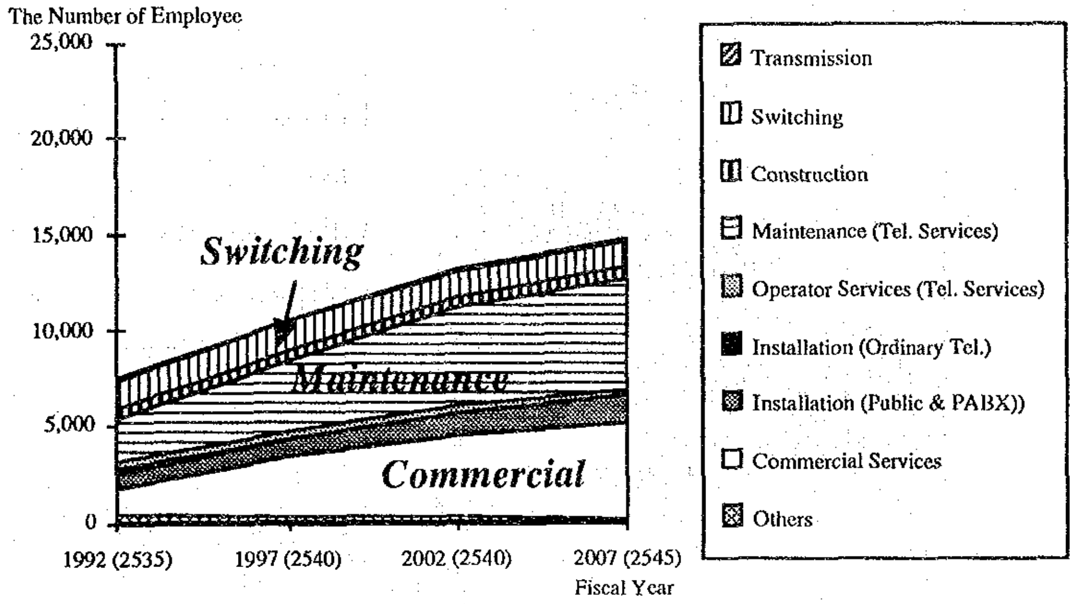


Figure 14.2.4-4 The Necessary Number of Employees in Operations Field under the Efficient O&M Work Scheme

Table 14.2.4-3 The Necessary Number of Employees in Operations Field under the Efficient O&M Work Scheme

	1992 (2535)	1997 (2540)	2002 (2540)	2007 (2545)
Others	390	332	282	239
Commercial Services	1,290	3,040	4,210	4,930
Installation (Public & PABX))	790	930	1,230	1,380
Installation (Ordinary Tel.)	320	0	0	0
Operator Services (Tel. Services)	340	340	340	340
Maintenance (Tel. Services)	2,220	3,720	5,060	5,720
Construction	580	580	580	580
Switching	1,390	1,500	1,320	1,420
Transmission	150	150	150	150
Total	**7,470**	**10,592**	**13,172**	**14,759**

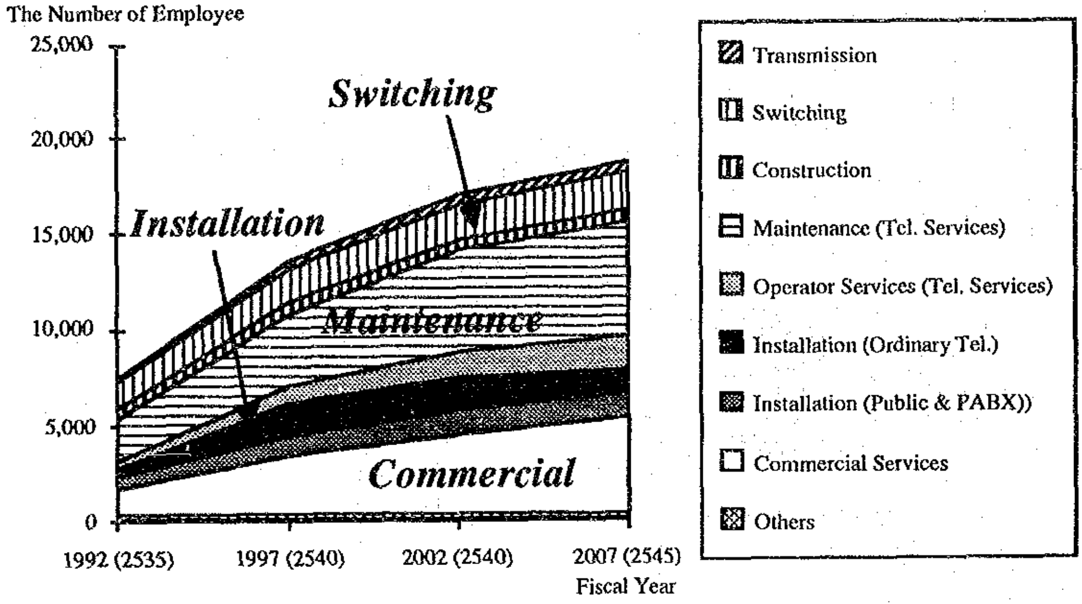


Figure 14.2.4-5 The Necessary Number of Employees in Operations Field under the Ordinary O & M Work Scheme

Table 14.2.4-4 The Necessary Number of Employees in Operations Field under the Ordinary O & M Work Scheme

	1992 (2535)	1997 (2540)	2002 (2540)	2007 (2545)
Others	390	390	390	390
Commercial Services	1,290	3,040	4,210	4,930
Installation (Public & PABX))	790	970	1,290	1,470
Installation (Ordinary Tel.)	320	1,750	1,590	1,120
Operator Services (Tel. Services)	340	990	1,420	1,730
Maintenance (Tel. Services)	2,220	3,780	5,200	5,940
Construction	580	580	580	580
Switching	1,390	1,730	1,860	2,020
Transmission	150	360	490	580
Total	**7,470**	**13,590**	**17,030**	**18,760**

2) Manpower Policy Guideline and Necessary Employees

Figure 14.2.4-6 and Table 14.2.4-5 show the target derived from the manpower policy guideline and the necessary number of employees estimated by the microscopic forecasting method.

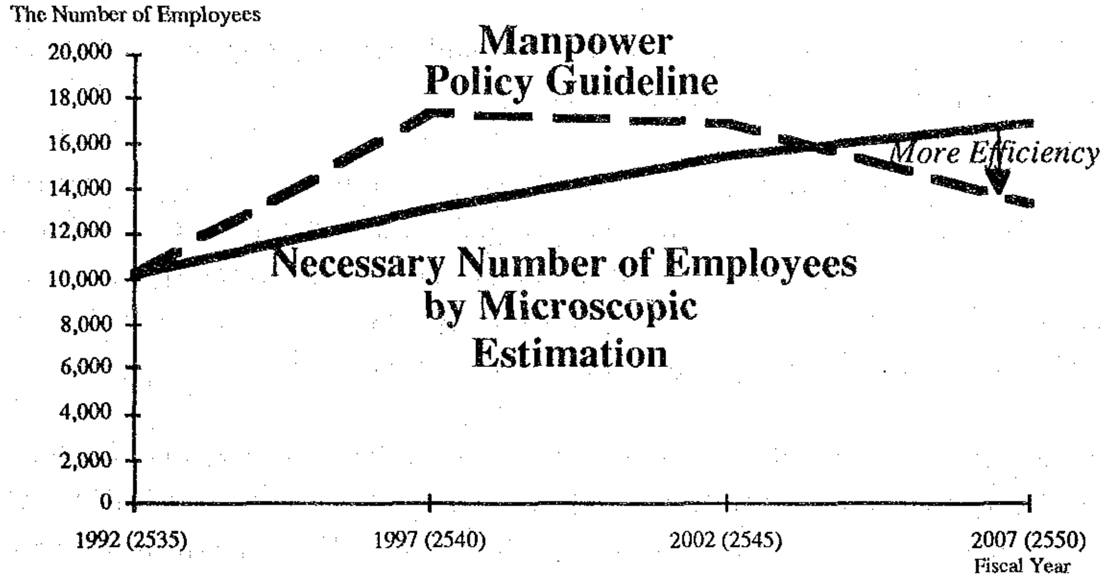


Figure 14.2.4-6 Manpower Policy Guideline and the Necessary Number of Employees

Table 14.2.4-5 Manpower Policy Guideline and the Necessary Number of Employees

	1992 (2535)	1997 (2540)	2002 (2545)	2007 (2550)
Manpower Policy Guideline by Macroscopic Estimation	10,190	17,280	16,920	13,320
Necessary Number of Employees by Microscopic Estimation	10,190	13,111	15,520	16,962

In the Phase 3, the necessary number of employees is expected to become higher than the manpower policy guideline. This is because the microscopic forecasting method employes the efficiency increase policies and measures within the present business scheme. More drastic policies and measures to improve the efficiency and productivity should be employed to follow the policy guideline. Further, utilization of external resources is indispensable to reduce simple and labor concentrated jobs in TOT.

14.2.5 Microscopic Estimation Method

The microscopic estimation method is described in APPENDIX

14.2.6 Human Resource Management for TOT

The Fifth, Sixth and Seventh National ESDP have pointed out the necessity of management improvement in state enterprise management efficiency.

TOT has a plan to recruit more people than ever before. The two million line expansion project in the BMA is carried out by a private firm using the BTO method from 1992 to 1996. It can be foreseen that the present work volume of each department in TOT will not increase except the commercial departments (it is not clear whether TOT will take care of the maintenance work of drop wires expand in the seventh project or the private sectors will do it).

There is a possibility that the Thai government will deregulate the telecommunications business not only for the present concession bases but also for carriers. In the near future, TOT can no longer keep its monopolistic position as it used to be, and TOT will face competition in market.

In order to compete, TOT will have to save its expenditures, minimize the operating (including manpower) cost, reduce its rate and increase the share and the net profits. The staff remuneration is not the exception and needs to be reduced. However, it is not easy to reduce the staff and the salary level.

1) Establishment of Human Resources Management System

The Human Resources Department of TOT needs to establish a proper human resources management plan that should have:

a) the service level as target for staff allocation,
b) the size of required manpower reflected on the work volume, service level, and cost,
c) job classification for the switching, outside plant, commercial sections,
d) close linkage with the TOT total management plan and O & M plan of each department and unit,
e) macroscopic personnel plan which should be a part of the manpower management and development policy and the plan of TOT and should be a guideline to coordinate requirements of the staff increase from each department and unit.

In order to set the proper human resources management plan, it is necessary at first to monitor business activities such as work volume, service level, and capability of the staff at present. Second, it is necessary to forecast business situations in the future and try to adjust for them.

2) Establishment of Staff Relocation and Re-assignment System

It is necessary for TOT to vitalize the staff, develop the capacity of the staff, and utilize the present personnel as much as possible. TOT is also required to save the manpower cost for efficient business operations. In order to achieve this, TOT needs the staff relocation and re-assignment and job enrichment program.

Figure 14.2.6-1 shows the concept of the proposed human resource management.

Figure 14.2.6-2 shows the concept of the efficiency and staff relocation system.

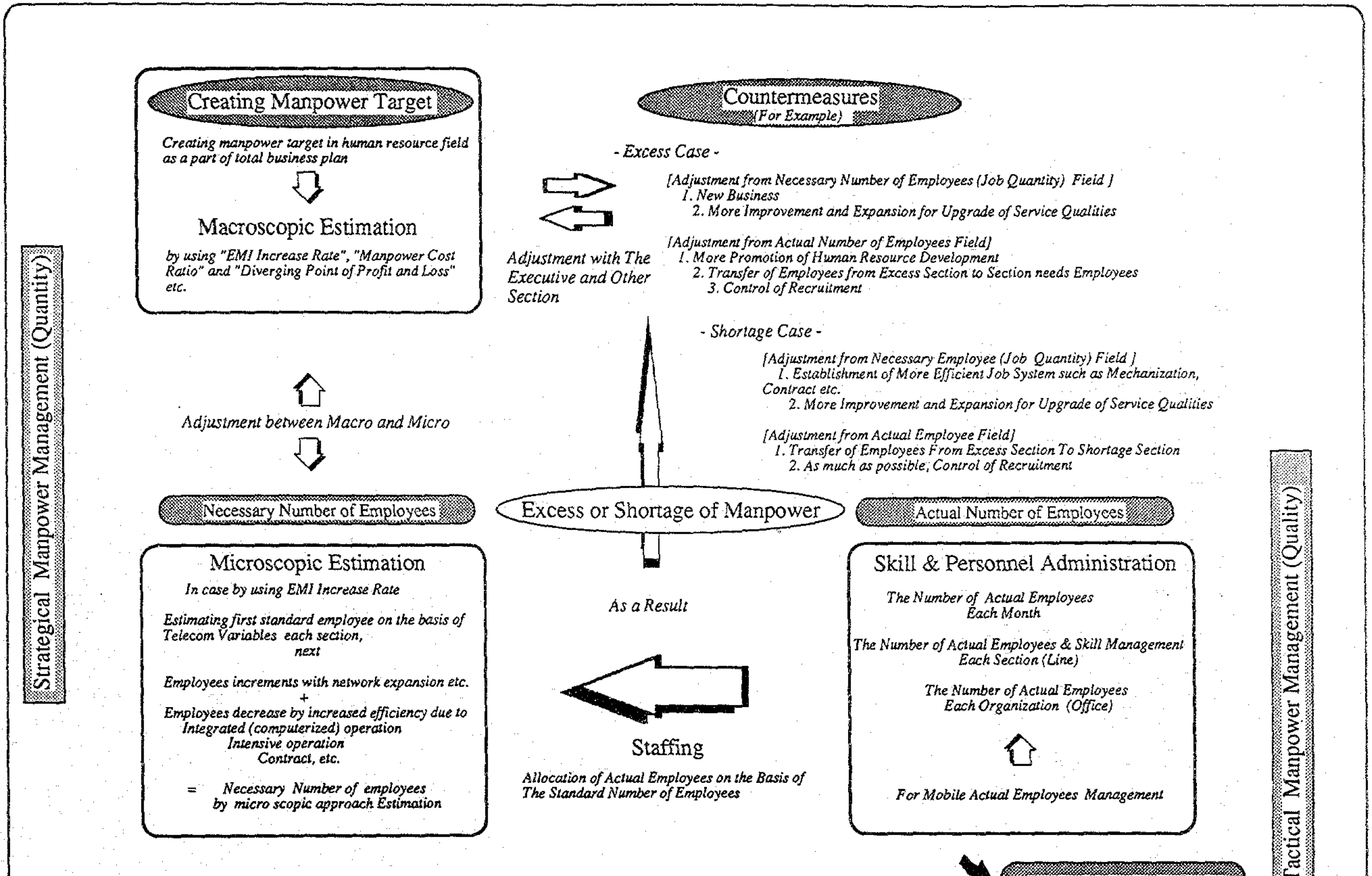


Figure 14.2.6-1 Human Resource Management

Efficiency (in accordance with centralization of Switching Maintenance Job) and Staff Transfer

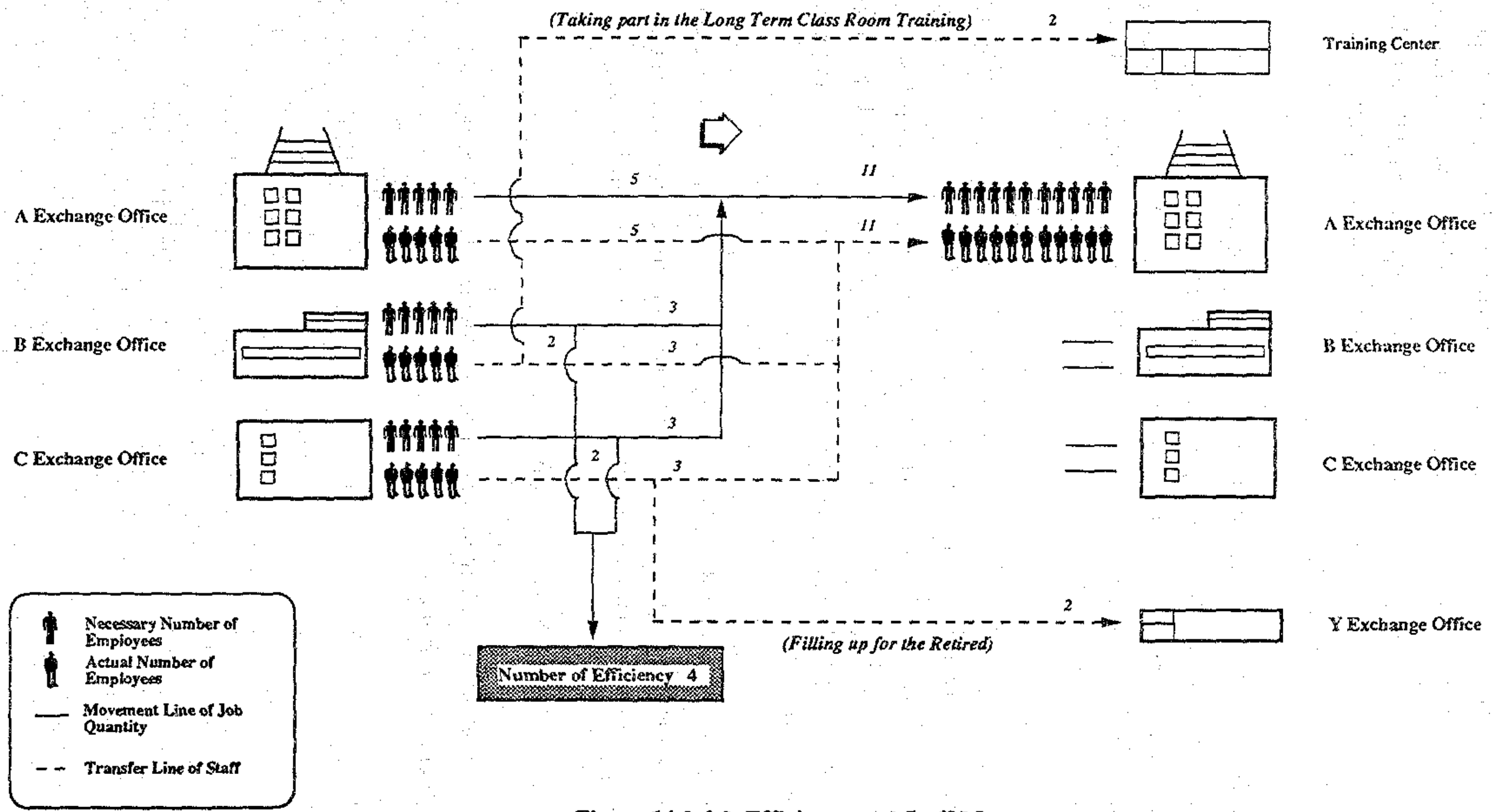


Figure 14.2.6-2 Efficiency and Staff Movement

14.3 Human Resource Development

The success of TOT depends on the efforts and quality of individuals because people are the most important organization resource. It is expected that the works in the Study Area will become larger and more complicated in order to improve the telecommunications networks and to provide new telecommunication services; therefore, TOT must develop skills and abilities of its employees up to the sufficient level so that they can operate the complex, massive, and sophisticated facilities.

TOT emphasizes the class room training for human resource development. However, in order to improve the quality of the employees, TOT should promote not only the class room training but also "On-the-Job-Training" programs. The most important thing is whether or not the training system of TOT will be directly linked to O & M jobs in the future, and can improve individual skills.

Figure 14.3 shows an ideal human resource development system. This describes that a method of human resource development which dynamically links to the business and work systems of TOT in the future. A first, it is necessary to figure out how many employees with what qualifications are needed in which field. It is recommended for TOT to make career development plans in which specific qualifications to be obtained and training methods are clearly defined and described.

A training method recommended can educate and train these employees by making them go through different training programs such as class room training, suppliers training, training in different departments and organization stages and training at construction-sites.

14.3.1 Required Skills in the O & M Field

As described in Figure 14.3, the human resource development is considered on the basis of O & M work systems in the future.

Human Resource Development

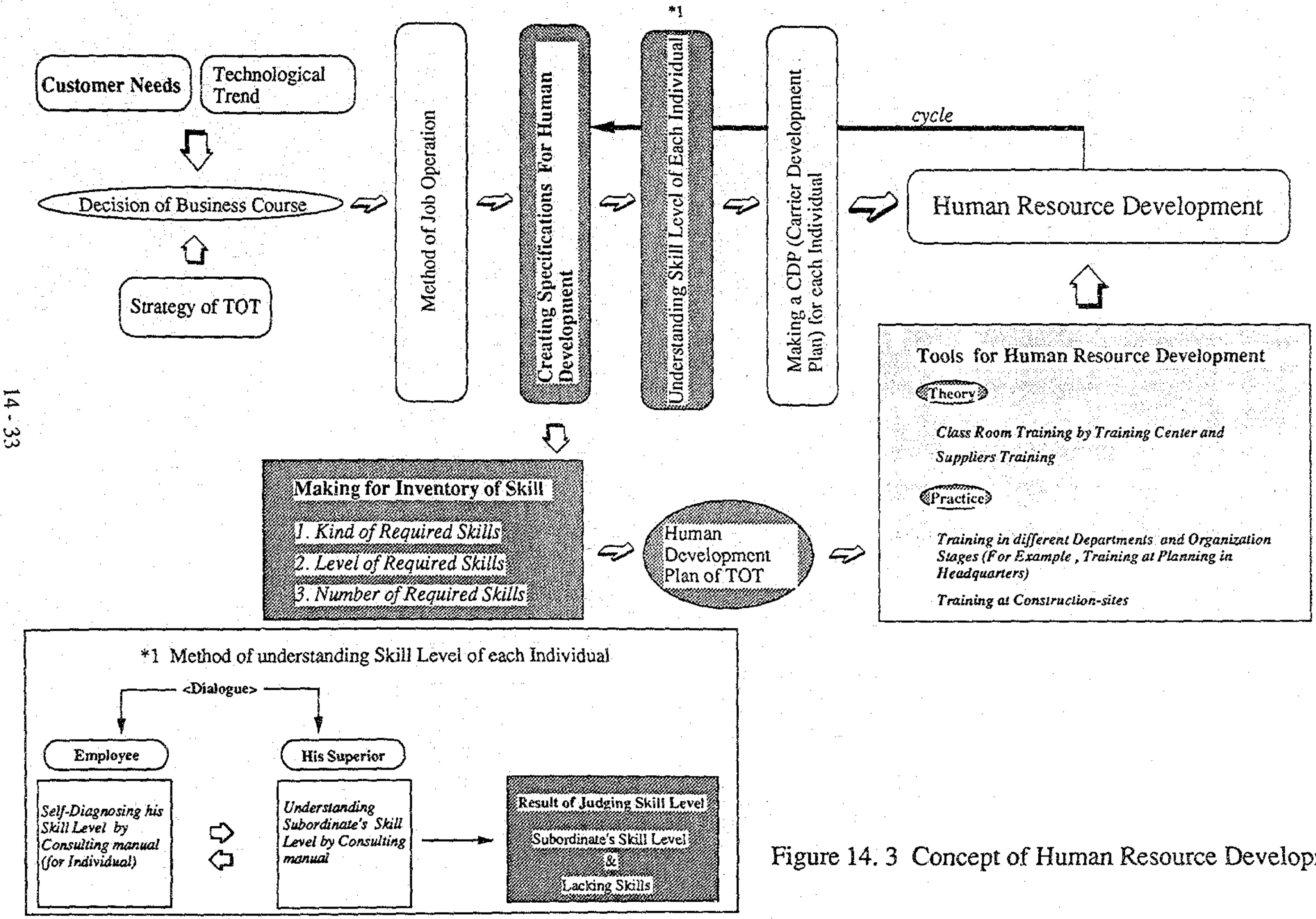


Figure 14. 3 Concept of Human Resource Development

1) Transmission

This section is based on the discussion of Chapter 14.1.1. The necessary number of employees will not change in the future. The O & M work systems will be operated by experts. It is necessary to develop high level engineers in an early stage.

a) Kind and Level of the Required Skill

As the O & M work systems are operated by experts, they should be developed by all-around transmission experts in an early stage. Table 14.3.1-1 shows the kind and level of the required skills in the transmission field.

Table 14.3.1-1 Kind and Level (Quality) of Required Skill

Low Level	Middle Level	High Level	Special Level
-	-	Network design (Limited area)	Network design (Nationwide)
Basic testing	Emergency patching	Recovery of fault (middle scale)	Recovery of fault (large scale)
Simple repair	Usual repair	Abnormal repair	Technical guidance
	Regular testing	Planning	

b) The Number of Employee and the Required Skills

Figure 14.3.1-1 indicates the necessary number of employees and their required skills in the transmission field. Judging from the manpower plan, the necessary number of employees in the future is one hundred fifty for each Phase; therefore, the required training is for all transmission members except employees who are in charge of administration jobs and motor vehicle drivers.

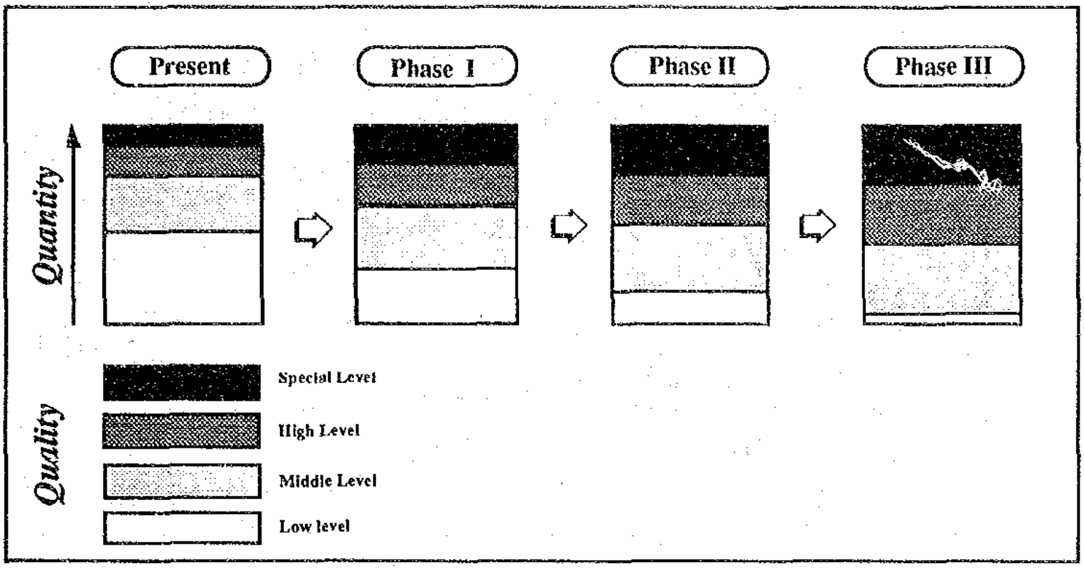


Figure 14.3.1-1 The Number of Employee and the Required Skill (Transmission Field)

2) Switching

As the networks expand, they will be enhanced gradually though offerings of many new services. Many hardware functions will be replaced by softwares. Therefore, the knowledge of the softwares will become more important for the maintenance and operation people.

a) Kinds and Level of the Required Skills

The required experts are classified into two broad categories. One is "Digital Switching (Software) Maintenance Experts". The other is "System Design Experts". Figure 14.3.1-2 shows an "Experience Enrichment Program" for the digital switching maintenance experts. Table 14.3.1-2 shows the kinds and level of the required skills in the switching field.

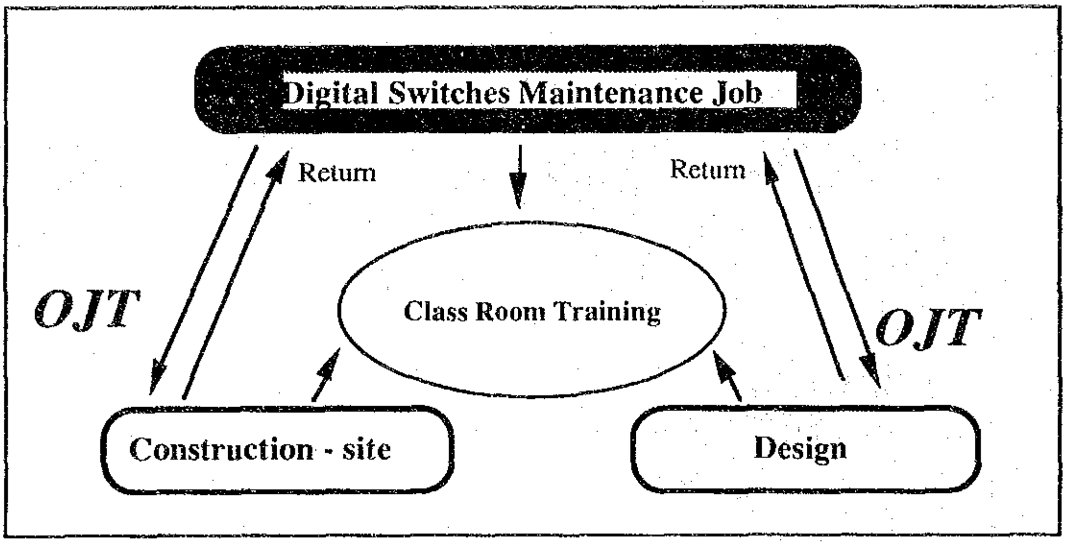


Figure 14.3.1-2 Experience Enrichment Training Program

Table 14.3.1-2 Kinds and Level of Required Skills

Low Level	Middle Level	High Level	Special Level
-	-	System design (expansion)	System design (installation)
Service order work	Emergency patching	Recovery of unusual fault	Recovery of system down
Daily operation	Usual repair	Abnormal repair	Technical guidance
Basic testing	Data In-put (small scale)	Data In-put (large scale)	
Simple repair	Regular testing	Planning	

b) The Number of Employees and the Required Skills

Digital switch engineers in Thailand will be certainly in great demand. However, it is difficult to foresee how many digital switch engineers will be required in the study area because the operation and maintenance jobs largely depend on supplier conditions.

The study proposes a centralized switching maintenance system. As a result, the necessary number of digital switching engineers may become less than the present number. However, as mentioned in Section 14.1.2, higher level digital switching engineers are needed by TOT. If this situation is taken into consideration, the necessary number of digital switching engineers can be foreseen as Figure 14.3.1-3.

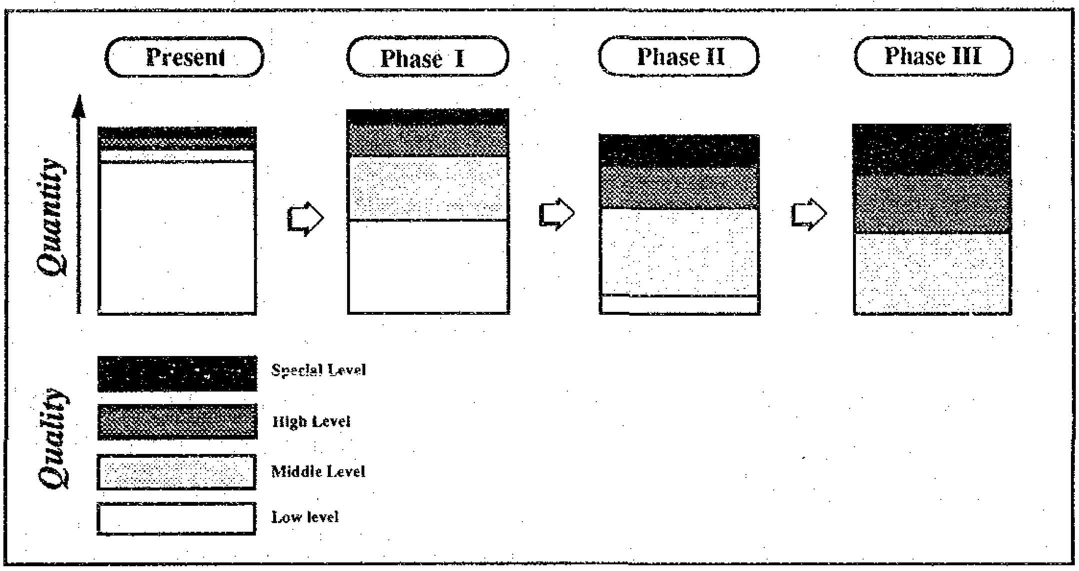


Figure 14.3.1-3 The Number of Employees and the Required Skills (Switching Field)

3) Outside Plant (Maintenance)

As mentioned in Section 14.1.3, the number of repairs in the future can be foreseen to increase rapidly; therefore, more outside maintenance experts needs to be developed.

a) Kind and Level of the Required Skills

Required experts in the outside plant field also are classified into two broadly categories; One is "Outside Plant Maintenance Experts". The other is "Design Experts". Figure 14.3.1-4 shows the kinds and level of the required Skills in the outside plant maintenance field.

Table 14.3.1-3 Kind and Level (Quality) of Required Skill

Low Level	Middle Level	High Level	Special Level
-	-	Detailed design	Basic design
Simple repair	Abnormal repair	Optical Fiber Repair	Technical guidance
-	-	Planning	Management
Service order work	-	-	-

b) The Number of Employees and the Required Skills

Figure 14.3.1-4 shows the number of employees and the required skills in the outside plant field. This field needs to develop a large number of people of the low and the middle levels.

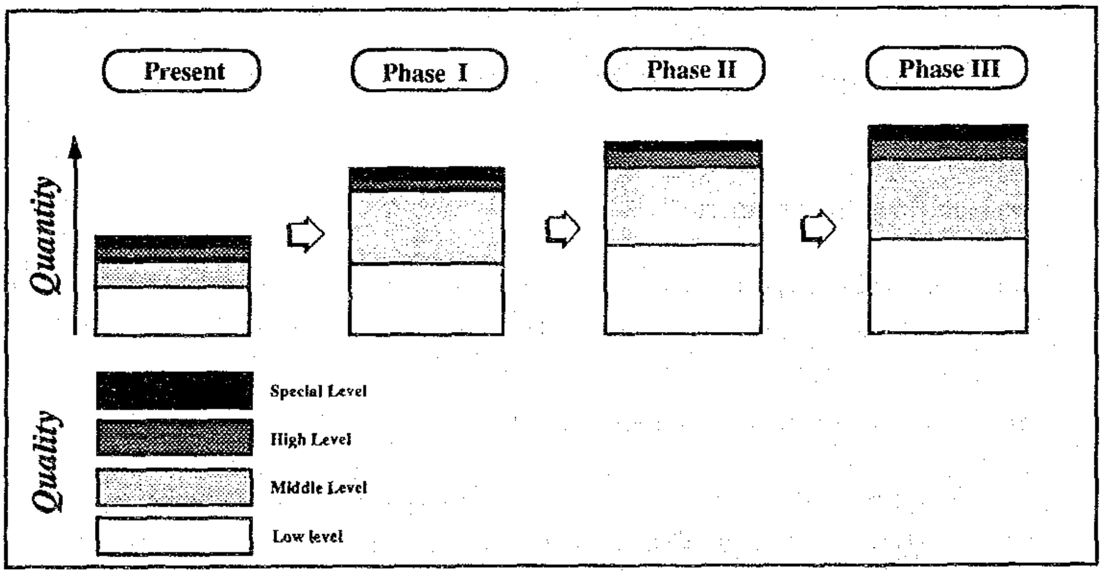


Figure 14.3.1-4 The Number of Employees and the Required Skill (Outside Plant Maintenance Field)

4) Other Required Experts

a) Marketing Experts
b) Telecommunication Consulting and Sales Experts
c) Management Analysts for Finance and Human Resource

14.3.2 Role of Training Center

The training center of TOT performs important roles in teaching O & M work methods. Without proper training programs for the O & M work systems, the O & M jobs cannot be properly performed.

TOT has a plan to establish three more training centers in the provincial areas. The provincial areas need to be given more training opportunities. On the other hand, TOT needs to take into consideration not only the new training center plan in the provincial areas but also an expansion plan of the Bangkok training center.

1) Training Courses

a) Transmission Courses

Table 14.3.2-1 shows the transmission training course program in the Bangkok training center. It is not known how many employees in the transmission section have finished this eight training course program; however, judging from this table, forty employees can complete all training courses in a year. The number of transmission engineers in the Study Area is estimated to be about one hundred thirty. Employees of the outside plant field can be educated by these courses. The training center needs to set more high level training courses.

Table 14.3.2-1 Annual Transmission Training Course Program

Item	Course Name	Total Trainees	Total Days per Total Trainee
MULTIPLEX	Optical Fiber Transmission System	30	10
MULTIPLEX	Data Transmission System	54	15
MULTIPLEX	Digital Transmission System of ISDN	100	10
MULTIPLEX	Digital Multiplex Technics	40	10
MULTIPLEX	Digital Multiplex Equipment W-6 / W-8	40	10
MULTIPLEX	NEC Fiber Optic Transmission System	36	10
MULTIPLEX (CONT)	Supervisory Equipment for junction Fiber Optic	60	10
MULTIPLEX (CONT)	Transmission Systems Optical Fiber Transmission	5	40
MULTIPLEX (CONT)	FDM Sub-Carrier Equipment	30	10
Total		**395**	**11**
70% • of Total		**277**	

Source : Telecommunication Training Center of TOT, Annual Training Course Program, 1991

b) Switching Courses

Table 14.3.2-2 shows the year-round switching training course program in the Bangkok training center of TOT. Judging from this table, if fifty employees can complete all the switching training courses every year, the number of operation and maintenance employees for SPC switches become about three hundreds in the Study Area. This can provide sufficient maintenance engineers.

Many hardware functions will be replaced by softwares, and the software knowledge will become more important for switching maintenance. As mentioned in Chapter 14.1.3, TOT should improve the quality of digital switching maintenance engineers. TOT needs to offer more advanced courses, including computer programing courses.

Table 14.3.2-2 Annual Switching Training Courses

Item	Course Name	Total Trainees	Total Days per Trainee
SWITCHING	Basic Telephony	120	7
SWITCHING	Fundamentals of SPC Exchange	72	10
SWITCHING	Time Zone metering E 400	20	10
SWITCHING	AXE 10 Survey	48	10
SWITCHING	AXE 10 O & M Basics I	12	10
SWITCHING	AXE 10 O & M Basics II	12	15
SWITCHING (CONT)	AXE 10 O & M Basics III	12	10
SWITCHING (CONT)	AXE 10 O & M Exchange Data	36	15
SWITCHING (CONT)	NEAX 61 E O & M Part I	72	20
SWITCHING (CONT)	NEAX 61 E O & M Part II	72	20
SWITCHING (CONT)	Crossbar P 1000C Part I	24	10
SWITCHING (CONT)	Crossbar P 1000C Part II	15	20
SWITCHING (CONT)	Crossbar ARF 102 Part I	24	15
SWITCHING (CONT)	Crossbar ARF 102 Part II	15	20
SWITCHING (CONT)	Crossbar ARF 102 Part III	15	15
SWITCHING (CONT)	Direct Inward Dialling for NEAX 61 (DID)	60	30
SWITCHING (CONT)	NCOM Hardware Maintenance (S3400)	12	40
SWITCHING (CONT)	ISDN Overview	144	10
Total		**785**	**14**
Item	**Basic Course Total X 70%**	**185**	
Item	**SPC Course (NEAX 4 Course)**	**216**	

Source : Telecommunication Training Center of TOT, Annual Training Course Program, 1991

c) Computer Courses

Without understanding softwares from now on, O & M engineers cannot perform operation jobs in the switching, transmission and other field. Table 14.3.2-3 shows the computer program courses of TOT. They need to be developed more.

Table 14.3.2-3 Computer Program Courses

Item	Course Name	Total Trainees	Total Days per Trainee
COMPUTER	Basic Programing	60	8
COMPUTER	File Organization	24	8
Total		**84**	**8**
70% • of Total		**59**	

Source : Telecommunication Training Center of TOT, Annual Training Course Program, 1991

d) Outside Plant Courses

The outside plant courses are shown in Table 14.2.4. It is not known how many employees in this section have finished these eight training courses. Judging from this table, fifty employees can complete all training courses. The number of outside plant maintenance engineers at work-site operations can be estimated to be about two thousand five hundreds. The necessary number of employees will be expected to rapidly increase by the manpower plan discussed in Chapter 14.2.4. TOT needs more courses in the future.

Table 14.3.2-4 Outside Plant Course

Item	Course Name	Total Trainees	Total Days per Trainee
Outside Plant	Line Construction	80	25
Outside Plant	Cable Splicing	80	20
Outside Plant	Cable Gas Pressurization	32	15
Outside Plant	Cable Maintenance	100	10
Outside Plant	Local Line Planning	60	10
Outside Plant	Safety Precaution	160	5
Outside Plant	Station Installation	80	7
Total		**592**	**6**
70% • of Total		**414**	

Source : Telecommunication Training Center of TOT, Annual Training Course Program, 1991

2) Shortage of Instructors

Regarding the future instructor shortage, if TOT does not consider countermeasures, it will create serious problems. University professors in telecommunications are also in great demand. TOT engineers have not been transferred into the training center from other field as instructors.

Hence, to solve the instructor shortage problem in the future, TOT needs to have a routine transfer system of the instructors as shown in Figure 14.3.2 so that engineers with practical knowledge and working experiences can work as instructors in the training center.

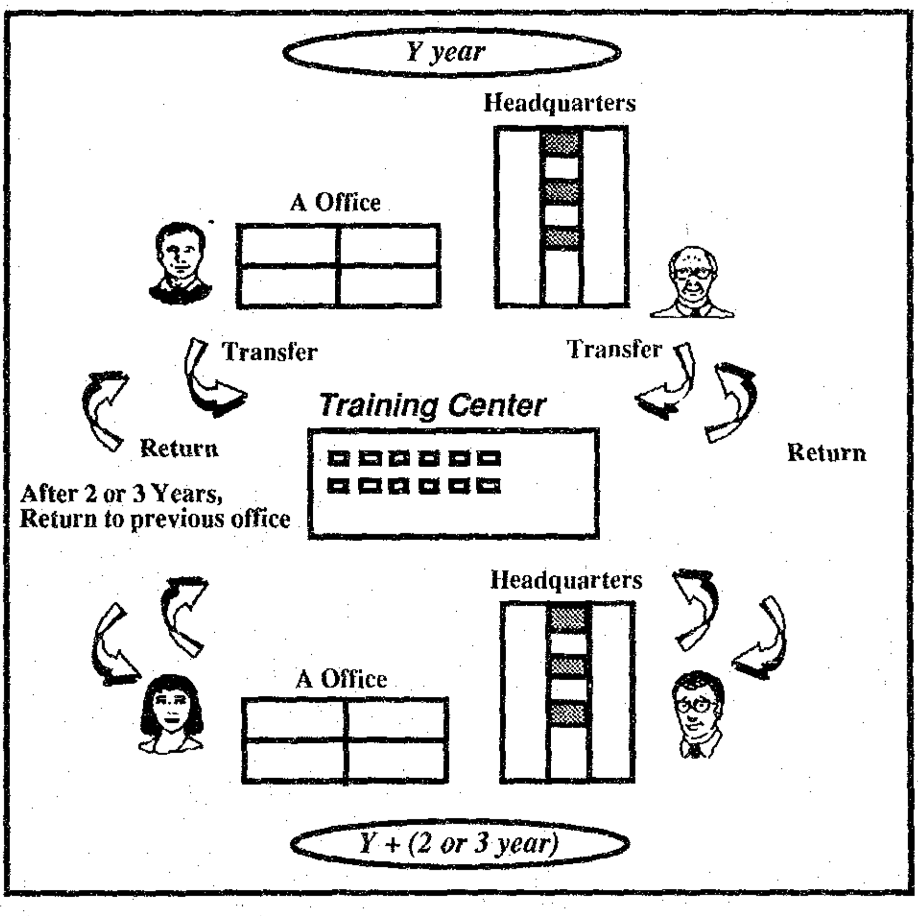


Figure 14.3.2 Routine Transfer System

3) Establishment of an Intensive Engineering Education and Training Program

It is expected that a large number of O & M engineers and technicians will be in great demand in the future, especially, during the 7th TOT ESDP periods pointed out in many sections of this report. The education and training programs in the training center are designed for rather medium to long-term human resource development.

Hence, the establishment of an intensive engineering and technical training program, one year crush program, is greatly needed to produce the necessary number of engineers and technicians with minimum required knowledge and skills to temporary meet the immediate challenge of the mass expansion, new services and the O & M jobs to be followed.

CHAPTER 15

IMPLEMENTATION OF THE LONG-TERM PLAN

CHAPTER 15 IMPLEMENTATION OF THE LONG-TERM PLAN

TOT has already decided to let the private sector participate in supporting the part of TOT's operation. As the seventh TOT's ESDP states, TOT has allowed a private firm to install and operate telecommunications facilities in both the BMA and the provincial areas. It is possible that other projects, described in this chapter, may be carried out by private firms. Therefore, in this chapter, the matters relating to implementation of the long-term plan such as guidelines for the project implementation are described.

15.1 Assignment of Strategies and Targets

According to the objectives and strategies set forth in Chapter 9, factor to formulate the long-term telecommunications network development plan have been examined in each related chapter. At the final stage of the long-term plan formulation, appropriate projects are selected and assigned to each phase and each telecommunications area.

The following items must be considered in accordance with the development targets and strategies:

1) Market of service,
2) Investment efficiency,
3) Telecommunications trend in the world,
4) Coordination with national development, and
5) To offer impartial services.

15.2 Project Implementation Priority

Considering the above factors, the following main priority order is selected in the project implementation for the Study Area:

1st: Reduction of waiting applicants and increase of public telephones,
2nd: Replacement of deteriorated facilities,
3rd: Introduction of ISDN services and extension of various services,
4th: Improvement of operation and maintenance (O&M),
5th: Others.

The reasons for the selection of the priority order are as follows:

1) The basic telephone service should be firstly provided for realizing the information oriented society. TOT has been having a large number of waiting applicants in the whole Kingdom, especially in the Bangkok Metropolitan area. Therefore, the projects to meet the demand and eliminate the waiting applicants are selected as the first priority projects.

2) TOT has installed huge telecommunications facilities during the fourth, fifth and sixth project periods to meet the rapidly increasing telephone demand. Furthermore, the service quality should be improved for realizing the diversification of telecommunications services. Because high quality telecommunications networks should be provided for the advanced telecommunications services such as ISDN service. Therefore, "Replacement of deteriorated facilities" are selected as the second priority projects.

3) Almost all major local and foreign firms have located their offices in the BMA. They demand the sufficient provision of new international telecommunications services and other new services such as high-speed and large-capacity data transmission services and ISDN services. Therefore, "Introduction of ISDN services and extension of various services" are selected as the third priority projects.

4) Improvement of O&M is indispensable to keep networks and facilities in a good operational condition and provide customers with better quality of services. O&M improvement includes both management tools and human resources. This is selected as the forth priority project; however, it should be considered from the total management viewpoint of the telecommunications sector.

15.3 Area Ranking

The strategic target areas should be selected and ranked from the viewpoint of project implementation by taking the following matters into consideration.

1) Central Business area (P1)
2) Rapidly Growing Area (P2)
3) Industrial Area (P3)
4) Outer area (P4)

15.4 Project Implementation Programs in the Long-term Plan

Contents of the project implementation programs for the long-term development plan are shown in Figure 15.4-1 and Figure 15.4-2.

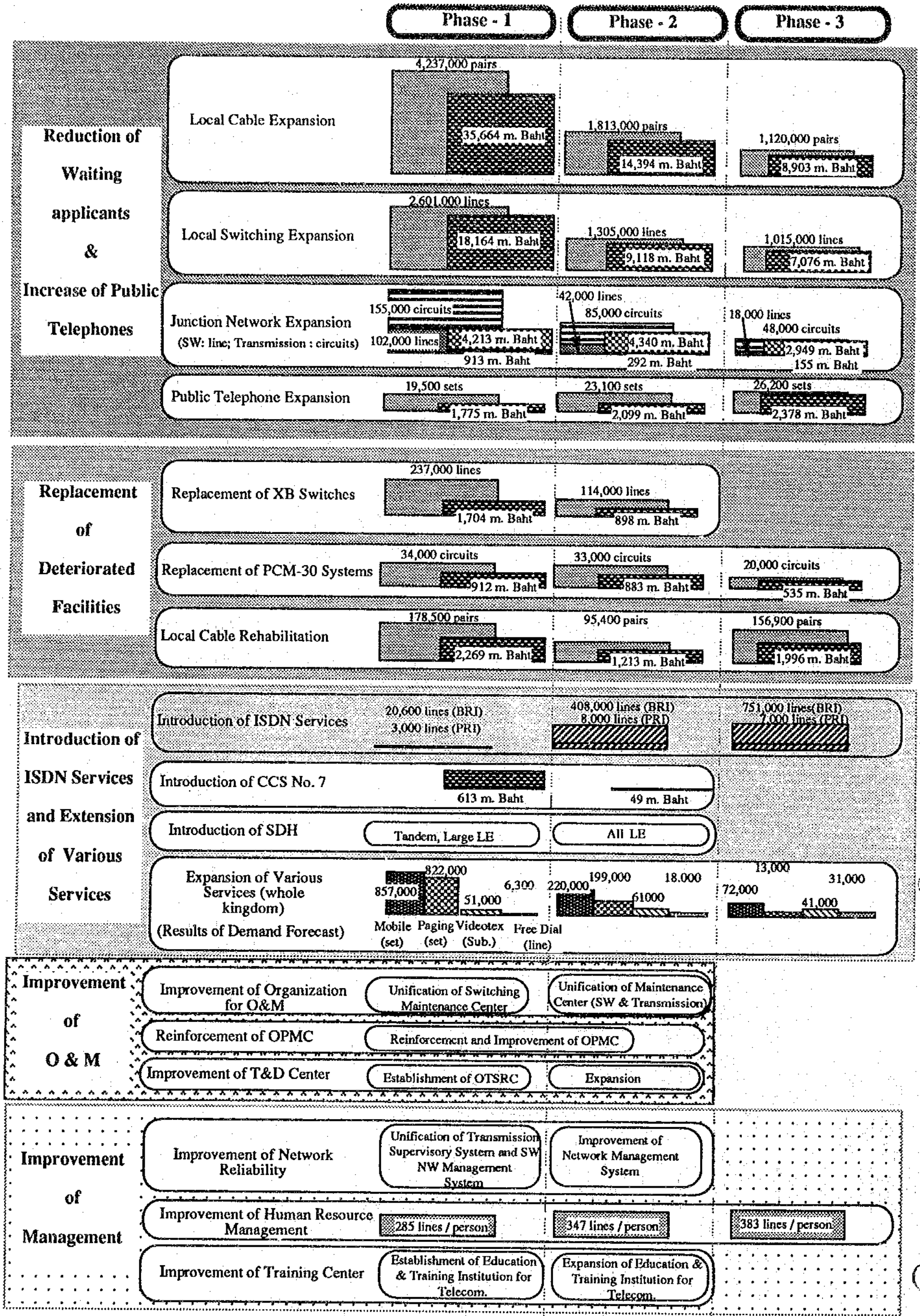


Figure 15.4.-1 Implementation Programs in the BMA

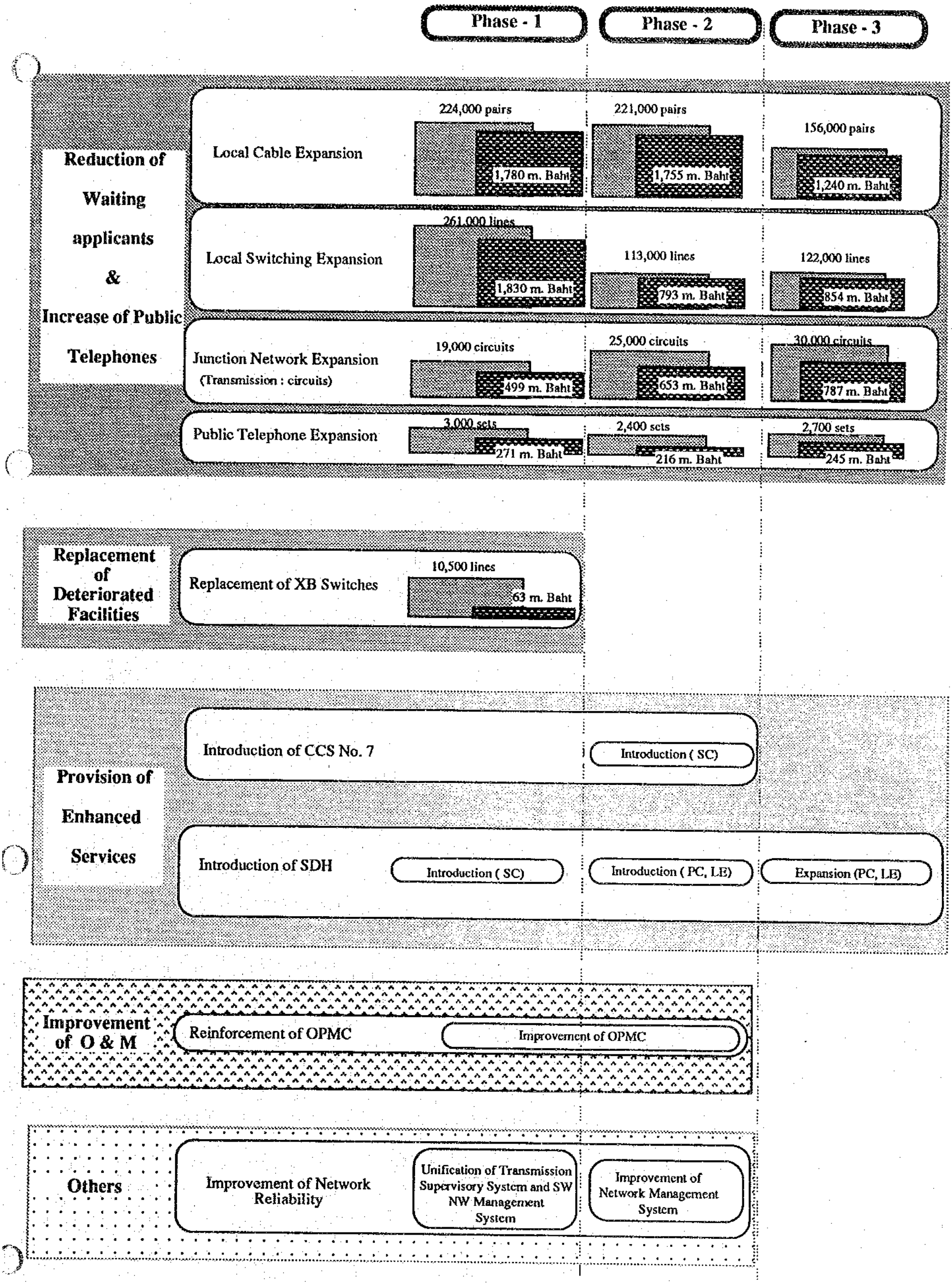


Figure 15.4.-2 Implementation Program in the Surrounding Area