The plans are classified into three priority classes by taking the following procedures:

1) Scoring the effects to improve the fault ratio,
2) Scoring the effects to improve the CCR, and
3) Scoring the improvement performance to the investment cost,

for each project.

To classify the 26 projects into the three classes: Class A "The First Priority", Class B "The Second Priority" and Class C "The Third Priority", the Study Team scores the projects and puts the priority points to each project by taking the effect and the cost of each project into consideration. Then the Study Team classifies them into the three priority classes according to the following table.

Table 4.1.1 Classification Table for Priority Order Arrangement of the Projects

Class	Weight of Effect (Improvement Ratio)	
	Fault Ratio	CCR
Class A "The First Priority"	Priority Point E: E >130	Priority Points E: E >130
Class B "The Second Priority"	Priority Point E: 130 ≥E >100	Priority Point E: 130 ≥E >105
Class A "The Third Priority"	Priority Point E: 100 ≥ E	Priority Point E: 105≥ E

The priority points are calculated according to the following manner. The detailed procedure is described in APPENDIX.

1) Priority Scoring for the Effects to Improve the Fault Ratio

   a) The priority score of the maximum points of 100 is given to the maximum improvement fault ratio project and the minimum point of zero (0) is given to the zero improvement (PCM cable system replacement).

   b) Each project which has the medium improvement between the maximum and the minimum are given the priority point in proportion to the improvement ratio.

2) Priority Scoring for the effects to Improve the CCR

The same procedure is applied to point the effect to improve the CCR of each project.

3) Improvement Performance of Service Quality per Investment Cost

The priority score of the maximum points of 100 is given to the highest improvement efficiency, i.e., the lowest cost to improve one percent fault ratio or the CCR. The projects which can be implemented without any additional cost are given the maximum evaluation point, 100.

4) Special Projects

Several projects include the effects to improve both the fault ratio and the CCR. In this case, the both evaluation points are calculated for these projects in proportion to the improvement.

4.1.3 Ranking of the Projects

Table 4.1.3 lists up the selected projects with the priority classes. Each project is explained in the section of the previous chapters as indicated in the reference. The 26 projects are classified into the three classes as follows:

- Class A: "the first priority" 10 projects,
- Class B: "the second priority" 9 projects,
- Class C: " the third priority" 7 projects.

All these proposed projects should be completely carried out within the Phase-1 period (FY 1993-FY 1997) to achieve the targets of the fault ratio and the CCR by the end of 1997. If TOT cannot carry out all the projects within the Phase-1 period, TOT should carry out them from the first priority projects by taking their effects and the cost performance into consideration.

Table 4.1.3 Ranking of the Projects

Field	Project Code	Project Name	Work Volume	Total Evaluation	Reference (Section)
Outside Plant		1) Rehabilitation of Subscriber Lines			
	OSP-1	Rearrangement of Distribution Points	(Unit: DPs) 8,250	A	2.2.3 3)
	OSP-2	Replacement of Drop Wires with Cables	(Unit: Pair-Km) 94,000	A	2.2.3 3)
	OSP-3	Renewal of Drop Wires	(Unit: Drop wire) 200,000	A	2.2.3 3)
	OSP-4	Replacement of Secondary Cables	(Unit: Pair-Km) 231,000	B	2.2.3 2)
	OSP-5	Replacement of Primary Cables	(Unit: Pairs) 343,500	C	2.2.3 2)
		2) Customer Premises			
	OSP-6	Check and Consulting for Customer Premises	(Unit: Subscriber) 187,000	A	2.2.3 5)
		3) Replacement of Public Telephones			
	OSP-7	Replacement of Public Telephone Sets	(Unit: Set) 6,158	A	2.2.3 4)
	OSP-8	Replacement of Protectors	(Unit: Protector) 17,500	B	2.2.3 4)
Switch-ing & Trans-mission	S&T-1	Replacement of Line Protectors	(Unit: Main Tel. Line) 855,066	B	2.3.2 2)
	S&T-2	Replacement of XB Switches with SPC Switches	(Unit: Line Capacity) 245,250	C	2.3.2 1)
	S&T-3	Replacement of Circuits	(Unit: Circuit) 3,154		
	S&T-4	Installation of Automatic Howling Tone Service	(Unit: Device) 239	C	3.7.3
	S&T-5	Subscriber Line Accommodation Adjustment		B	3.6.1
	S&T-6	Introduction of Record Announcement	(Unit: Device) 61	B	3.9
	S&T-7	Changing P.D. Timing		A	3.7.3
	S&T-8	Improvement of Periodic Maintenance		B	3.7.3
	S&T-9	Replacement of PCM System with FOTS	(Unit: DTI) 1,144	C	2.4.2
	S&T-10	Increasing Number of Circuit	(Unit: Circuits) 3,295	A	3.6.2
Others	OT-1	Expansion of Subscriber Lines	(Unit: Main Tel. Line) 500,000	A	3.5.1
	OT-2	Promotion of Multi-hunting-system		A	3.5.2
	OT-3	Promotion of Call-waiting Service		B	3.5.4
	OT-4	Dial Consulting Activities (User Campaign)		A	3.7.1
	OT-5	Promotion of Automatic Answer Telephone		B	3.7.2
	OT-6	Promotion of Call Transfer Service		C	3.5.4
	OT-7	Management on Operator's Answer Delay Time		C	3.7.2
	OT-8	Introduction of Information Service for Changed Number	(Unit: Switch unit) 1	B	3.7.5

4.2 Implementation Schedule

Table 4.2-1, Table 4.2-2, and Table 4.2-3 illustrate the implementation schedules for the first priority projects, the second priority projects, and the third priority projects during the next five years from FY 1993 to FY 1997 respectively.

Table 4.2-1 Implementation Schedule for the First Priority Project Group

*1 Project Name and Code		Total / Fiscal Year / Work Volume (Unit) / Cost (1,000 B)	1 1993	2 1994	3 1995	4 1996	5 1997
OSP-2	Replacement of Drop Wires with Cables						
	Total	94,000 Pair-km	1,840	1,840	30,040	30,140	30,140
		524,040 (1,000 B)	6,440	6,440	170,000	170,580	170,580
	TOT Work		Detail Investigation & Design				
		9,200 Pair-km	1,840	1,840	1,840	1,840	1,840
		32,200 (1,000 B)	6,440	6,440	6,440	6,440	6,440
	Contract Work		Basic Design and Approval	Detail Design and Contract			
		84,800 Pair-km			28,200	28,300	28,300
		491,840 (1,000 B)			163,560	164,140	164,140
OSP-1	Rearrangement of Distribution Points		Detail Investigation & Design				
			Construction				
		8,250 DPs	1,650	1,650	1,650	1,650	1,650
		12,375 (1,000 B)	2,475	2,475	2,475	2,475	2,475
OSP-6	Check and Consulting for Customer Premises		Strategy, Public Subscription (Private Company) Making Manuals and Training Implementation				
	Facility Check and Consulting	187,000 Subscribers	17,000	85,000	85,000		
	Vehicle, Equipment and Other Expenses	24,360 (1,000 B)	20,360	2,000	2,000		
OSP-3	Renewal of Drop Wires	200,000 Drop Wires	4,300	4,300	63,800	63,800	63,800
	Total	121,400 (1,000 B)	1,075	1,075	39,750	39,750	39,750
			Detail Investigation & Design				
	TOT Work	21,500 Drop Wires	4,300	4,300	4,300	4,300	4,300
		5,375 (1,000 B)	1,075	1,075	1,075	1,075	1,075
	Contract Work		Basic Design and Approval	Detail Design and Contract			
		178,500 Drop Wires			59,500	59,500	59,500
		116,025 (1,000 B)			38,675	38,675	38,675
OSP-7	Replacement of Public Telephone Sets with Good Type	Total 6,158 Sets					
	Trial Test and Telephone Set Selection	100 Sets	100				
		3,500 (1,000 B)	3,500				
	Replacement	6,058 Sets		2,000	2,050	2,008	
		201,240 (1,000 B)		70,000	71,000	60,240	
OT-1	Expansion of Subscriber Lines		Basic Design and Approval	Detail Design and Contract			
		500,000 Lines			200,000	200,000	100,000
		19,126,630 (1,000 B)			7,650,652	7,650,652	3,825,326
OT-2	Promotion of Multi-hunting-system		Make manual; Traffic Measurement, Selection of High B-Sub Busy Lines; Study on Measures; Subscriber Consulting Action; Installation; Repeat every 6 Months				
OT-4	Dial Consulting Activities (User Campaign)		Strategy, Target and Method of Campaign Implementation				
S&T-10	Increasing Number of Circuits						
	Line Control	3,295 Circuits	Traffic Measurement; Installation; Repeat every 6 Months				
	Total	55,761 (1,000B)					
	Switching		Design; Contract; Installation	1,648	1,647		
		32,418 (1,000B)		16,214	16,204		
	Transmission		Plan; Installation				
		23,343 (1,000B)		11,675	Acceptance Test 11,668		
S&T-7	Changing B.. Timing		Technical Check; Implementation				
	Sub Total (Investment Cost) * 2	20,069,306 (1,000B)	33,850	109,879	7,963,749	7,923,697	4,038,131

Note: 1. Project names are arranged in higher effect order in each field.

2. Summation of each project cost is not equal to the sub total because of the rounding off the figures.

Table 4.2-2 Implementation Schedule for the Second Priority Project Group

	*1 Project Name and Code	Total / Fiscal Year / Work Volume (Unit) / Cost (1,000 B)	1 1993	2 1994	3 1995	4 1996	5 1997
OSP-4	Replacement of Secondary Cables	231,000 Pair-km	8,700	8,700	70,500	71,500	71,600
	Total	2,006,100 (1,000 B)	48,720	48,720	629,640	639,040	639,980
			Detail Investigation & Design				
	TOT Work	43,500 Pair-km	8,700	8,700	8,700	8,700	8,700
		243,600 (1,000 B)	48,720	48,720	48,720	48,720	48,720
	Contract Work		Basic Design and Approval				
				Detail Design and Contract			
		187,500 Pair-km			61,800	62,800	62,900
		1,762,500 (1,000 B)			580,920	590,320	591,260
OSP-8	Replacement of Protectors with Good Type (Public Phon	Total 17,500 Sets					
	Trial Test and Telephone Set Selection	200 Sets	200				
		50 (1,000 B)	50				
	Replacement	17,300 Sets		8,500	8,800		
		7,650 (1,000 B)		3,750	3,900		
S&T-1	Replacement of Line Protectors		Contract				
		855,066 Lines	139,484	146,954	179,591	201,749	187,288
		312,643 (1,000 B)	51,000	53,732	65,665	73,767	68,479
S&T-8	Improvement of Periodic Maintenance		Review of Maintenance Manuals				
				Improve Periodic Maintenance			
OT-3	Promotion of Call-waiting Service		Strategy and Method of Promotion				
				Promotion Activity			
OT-8	Introduction of Information Service for Changed Numbers		Basic Design				
				Specifications			
		1 SW Unit		Contract			
		69,546 (1,000 B)			Installation 69,546		
OT-5	Promotion of Automatic Answer Telephones		Strategy and Method of Promotion				
				Promotion Activity			
S&T-6	Introduction of Record Announcement	61 Devices	Technical Check, Specifications				
		1 Device/Sw unit		Contract			
		765 (1,000 B)			Installation 765		
S&T-5	Subscriber Line Accommodation Adjustment		Selection of Object Switches, Traffic Measurement and Study on Improvement Measures				
				Implementation			
	Sub Total (Investment Cost) * 2	2,396,755 (1,000B)	99,770	106,967	768,751	712,807	708,459

Note: 1. Project names are arranged in higher effect order in each field.

2. Summation of each project cost is not equal to the sub total because of the rounding off the figures.

Table 4.2-3 Implementation Schedule for the Third Priority Project Group

	*1 Project Name and Code	Total Fiscal Year Work Volume (Unit) Cost (1,000 B)	1 1993	2 1994	3 1995	4 1996	5 1997
OSP-5	Replacement of Primary Cables		Basic Design and Approval	Detail Design and Contract			
	Contract Work	343,500 Pairs			114,500	114,500	114,500
		2,404,500 (1,000 B)			801,500	801,500	801,500
S&T-2	Replacement of XB Switches with SPC Switches		Design				
	Replacement of XB Local Switch	245,250 Lines	Contract				
		29 Unit	4	5	7	7	6
		2,248,341 (1,000 B)	508,120	470,387	458,836	433,625	377,373
S&T-3	Replacement of Circuits Total	3,154 Circuits	Plan				
		53,510 (1,000 B)	820	Installation 713	803	267	551
			13,877	12,066	13,589	4,519	9,459
				Acceptance Test			
	Replacement of XB Tandem Switch in KKM	1,505 Circuits	610	100	233	100	462
	Sub Total	25,603 (1,000 B)	10,323	1,692	3,943	1,693	7,952
	Removal of XB Tandem Switch (1 unit)	134 (1,000 B)					134
	Installation of New SPC Tandem Switch (Switching)	14,807 (1,000 B)	6,002	984	2,292	984	4,545
	(Transmission)	10,662 (1,000 B)	4,321	708	1,651	709	3,273
	Increaseing number of circuits related on replacement of XB local switch in another area	1,649 Circuits	210	613	570	167	89
	Sub Total	27,907 (1,000 B)	3,554	10,374	9,646	2,826	1,507
	Installation of New SPC Tandem Switch (Switching)	16,224 (1,000 B)	2,066	6,031	5,608	1,643	876
	(Transmission)	11,683 (1,000 B)	1,488	4,343	4,038	1,183	631
S&T-9	Replacement of PCM System with FOT	1,144 DTI (34,320 Channels)	Plan	Construction			
				Acceptance Test			
		846,999 (1,000 B)	169,400	169,400	169,400	169,400	169,400
OT-6	Promotion of Call Transfer Service		Strategy and Method of Promotion	Promotion Activity			
OT-7	Management on Operator's Answer Delay Time		Measurement Standards	Implementation			
S&T-4	Installation of Automatic Howling Tone Service		Technical Check and Specifications				
	Howler Osailator	239 unit	Contract				
	Howler Trunk	717 Trunk		Installation			
		6,117 (1,000 B)		6,117			
	Sub Total (Investment Cost) * 2	5,559,465 (1,000B)	691,397	657,970	1,443,325	1,409,044	1,357,732

Project Cost	1. First Priority Project Group	20,069,306	33,850	109,879	7,963,749	7,923,697	4,038,131
	2. Second Priority Project Group	2,396,755	99,770	106,967	768,751	712,807	708,459
	3. Third Priority Project Group	5,559,465	691,397	657,970	1,443,325	1,409,044	1,357,732
	4. Direct Cost Total	28,025,526	825,017	874,816	10,175,825	10,045,548	6,104,322
	4.1 Rehabilitation Projects	8,898,896	825,017	874,816	2,525,173	2,394,896	2,278,996
	4.2 500,000 New Telephone Line Installation * 3	19,126,630	0	0	7,650,652	7,650,652	3,825,326
	5. Contingency on Rehabilitation Project (5%) * 3	444,945	41,251	43,741	126,259	119,745	113,950
	6. Implementation Cost on Rehabili. Project (5%) * 3	444,945	41,251	43,741	126,259	119,745	113,950
	7. Sub Total Rehabilitation (4.1 + 5 + 6)	9,788,786	907,519	962,298	2,777,691	2,634,386	2,506,896
	Grand Total (4 + 5 + 6)	28,915,416 (1,000B)	907,519	962,298	10,428,343	10,285,038	6,332,222

Note: 1. Project names are arranged in higher effect order in each field.

2. Summation of each project cost is not equal to the sub total because of the rounding off the figures.

3. Cost of 500,000 New Telephone Line Installation already includes contingency and implementation cost.

4.3 Implementation Procedure

4.3.1 Effect of Priority Order

The Study Team proposes all the selected projects are to be carried out completely within the Phase-1 period. In the event that TOT cannot carry out all the project during the period, to decide which project should be selected as the top priority is important. The effects of each classified project are estimated as follows:

Table 4.3.1-1, Table 4.3.1-2, and Table 4.3.1-3 show the effects of the projects classified in the three priority groups. Table 4.3.1-4 shows the total costs and the total effects of each priority project group. These tables indicate the followings:

1) The improvement progress rate by the first priority projects is 72.7% for the fault ratio and 82.2% for the CCR.

2) When the first and the second priority projects are carried out, the improvement progress rate of the fault ratio and the CCR are estimated to become 91.9% and 97.7% respectively.

3) The projects classified in the third priority group require the large amount of costs and the long-term implementation period comparing among the other rehabilitation, replacement, and renewal projects. The Study Team, however, proposes that these projects of the third priority should be carried out completely by taking not only the short-term effects but also the long-term ones into consideration.

   The rehabilitation of the primary cables, the replacement of the XB switches with the SPC switches, and the replacement of the PCM systems with the optical fiber transmission systems are indispensable for TOT not only to improve the present service quality and to introduce the new services but also to maintain the networks and facilities in the good operational condition and to save the limited space of the existing exchange offices and the cable conduits for the future expansion.

   These three project groups require the large amount of funds and the long-term implementation periods; therefore, it is essential for TOT to map the project implementation schedules carefully from the initial stage to save costs, work loads, and times; and initiate the project implementation from the beginning of the Phase-1.

Table 4.3.1-1 Effect of the First Priority Projects

Project Code.	Project Name	Unit	Volume	Project *2 Cost (M B)	Improvement Effect (%)	
					Fault Ratio	CCR
OSP-2	Replacement of Drop Wires with Cables	pair-km	94,000	524	26.0	4.7
OSP-1	Rearrangement of Distribution Points	Dp	8,250	12	2.9	0.5
OSP-6	Checked and Consulting for Customer Premises	Subs-criber	187,000	24	10.8	21.1
OSP-3	Renewal Drop Wires	Drop Wire	200,000	121	13.7	2.5
OSP-7	Replacement of Public Telephone Sets	set	6,158	205	10.3	2.6
OT-1	Expansion of Subscriber Lines	Main Tel. Line	500,000	19,127	-	16.1
OT-2	Promotion of Multi-hunting-system	-	-	0	-	13.6
OT-4	Dial Consulting Activities	-	-	0	-	8.4
S&T-10	Increasing Number of Circuits	Circuit	3,295	56	-	7.4
S&T-7	Changing P. D. Timing	-	-	0	-	5.3
	Reduction Ratio of Test OK *1	-	-	-	9.0	-
Total *3				20,069	72.7	82.2

Note: 1. Reduction of Test OK has 12.4% share in the total improvement effect. This 12.4% effect is divided into the three priority groups in proportion to the sub total effect percentage of each group to the grand total effect except Test OK (= 100.0-12.4).

2. Project Cost here excludes the expenses for the internal resources of TOT such as staff remuneration.

3. The summation of each project cost is not equal to the total cost because of the round off.

Table 4.3.1-2 Effect of the Second Priority Projects

Project Code.	Project Name	Unit	Volume	Project *2 Cost (M B)	Improvement Effect (%)	
					Fault Ratio	CCR
OSP-4	Replacement of Secondary Cables	pair-km	231,000	2,006	11.2	2.0
OSP-8	Replacement of Protectors	Main Tel. Line	17,500	8	1.8	0.5
S&T-1	Replacement of Line Protectors	Protectors	855,066	313	3.8	-
S&T-8	Improvement of Periodic Maintenance	9	-	0	-	3.1
OT-3	Promotion of Call-waiting Service	-	-	0	-	3.1
OT-8	Introduction of Information Service for Changed Numbers	Center	1	70	-	3.1
OT-5	Promotion of Automatic Answer Telephones	-	-	0	-	1.9
S&T-5	Subscriber line Accommodation Adjustment	-	-	0	-	0.3
S&T-6	Introduction of Record Announcement	Device	61	1	-	1.5
	Reduction Ratio of Test OK *1				2.4	
Total *3				2,397	19.2	15.5

Note: 1. Reduction of Test OK has 12.4% share in the total improvement effect. This 12.4% effect is divided into the three priority groups in proportion to the sub total effect percentage of each group to the grand total effect except Test OK (= 100.0-12.4).

2. Project Cost here excludes the expenses for the internal resources of TOT such as staff remuneration.

3. The summation of each project cost is not equal to the total cost because of the round off.

Table 4.3.1-3 Effect of the Third Priority Projects

Project Code.	Project Name	Unit	Volume	Project *2 Cost (M B)	Improvement Effect (%)	
					Fault Ratio	CCR
OSP-5	Replacement of Primary Cables	pair-km	343,500	2,405	4.4	0.8
S&T-2	Replacement of XB Switches with SPC Switches	Line Capacity	245,250	2,248	2.7	
S&T-3	Replacement of Circuits	No. of Circuits	3,154	53		
S&T-9	Replacement of PCM Systems with Optical Fiber Systems	No. of DTI	1,144	847	0	-
OT-6	Promotion of Transfer Service	-	-	0	-	0.6
OT-7	Management on Operator's Answer Delay Time	-	-	0	-	0.6
S&T-4	Installation of Automatic Howling Tone Service	Device	-	6	-	0.3
	Reduction Ratio of Test OK *1	-	-		1.0	
Total				5,560	8.1	2.3

Note: 1. Reduction of Test OK has 12.4% share in the total improvement effect. This 12.4% effect is divided into the three priority groups in proportion to the sub total effect percentage of each group to the grand total effect except Test OK (= 100.0-12.4).

2. Project Cost here excludes the expenses for the internal resources of TOT such as staff remuneration.

Table 4.3.1-4 Comparison between Effects of Each Priority Group

Priority Order Group	No. of Projects	Investment Cost (MB)	Improvement Effect (%)	
			Fault Ratio	CCR
1. First Group	10	20,069	72.7	82.2
2. Second Group	9	2,397	19.2	15.5
3. Sub Total (1+2)	19	22,466	91.9	97.7
4. Third Group	7	5,560	8.1	2.3
5. Total (3+4)	26	28,026	100.0	100.0
6. Contingency and Implementation		890		
7. Grand Total (5+6)		28,916		

4.3.2 Implementation Method

In preparing the implementation of the projects, the following items are necessary to be taken into consideration.

1) Implementation Method of the Projects in the Outside Plant Section

a) Area Ranking

The characteristic of the outside plant is that the coverage area and facilities are spread widely while the switching facility covers the points. The construction, the rehabilitation, and the renewal of the outside plant facilities, therefore, takes much time, work loads, and costs. Hence, the decision of the area ranking is important for the replacement of drop wires, the rehabilitation of the secondary cables, etc. to implement the projects in the outside plant field effectively. The area ranking is given as follows:

i) Narrow Down the Area

Firstly, the high fault ratio areas are selected by a repair record analysis and by detail field investigations to narrow down the facilities to be rehabilitated.

ii) Decision of Area Ranking

Secondly, setting up the area ranking for the rehabilitation work is achieved by taking the situation of customers into consideration. The Study Team

proposes the following priority order according to the development strategy set in the Long-term Plan of the Study:

- Central Business Area,
- Rapidly Growing Suburban Area,
- Industrial Area, and
- Other Area.

Because of the social need for the public telephone, the replacement of public telephone set project, however, should be carried out according to the high fault ratio criterion not to the area ranking.

b) Combination and Synchronization of the Projects

i) Rearrangement of Drop Points

Usually the secondary cables have some spare pairs; therefore, rearrangement of the distribution points for some drop wires is possible by the installation of the new distribution points. To carry out this measure, field investigation such as the confirmation of customer locations will be required. Hence, the replacement of drop wires with cables and the drop wire renewal projects should be combined in order to avoid duplicated work and construction.

ii) Public Telephone Projects

The two projects of the public telephone, i.e., the replacement of the public telephone sets and the replacement of the protectors, are to be combined to save time and cost.

2) Implementation Method of the Projects in the Other Sections

To implement the proposed projects in the switching & transmission field and the other fields, the following procedures are proposed.

a) Office Ranking for the XB Switch Replacement

To replace the XB switches with the SPC switches, the necessary floor space for the replacement should be secured. It can be estimated that most of the exchange offices will be crowded with switches and have no additional capacity for the expansion by the end of 2007 without any measure. Hence, it is necessary to promote a planned replacement of the XB switches to secure the space for the future

expansion. All XB switches in the Study Area should be replaced with the SPC switches by FY 2000 according to the following five criteria.

i) Telephone Demand

To give the high priority for the replacement to the switching offices which will face large demand increase and the shortage of floor space.

ii) Demand for New Services

To give the high priority for the replacement to the switching offices which will have large demands for the new services.

iii) Maintenance Condition

To give the high priority for the replacement to the switching offices which have many old and frequently malfunctioning switches.

iv) Efficient O & M

It becomes possible to monitor and control all SPC switches from the 12 concentration centers. Hence, O & M can be improved after all the XB switches are replaced with the SPC switches.

v) Even Replacement Work

Which switch will be replaced in which phase is to be planned according to the above four criteria. The switches which do not fall into any of the above four criteria should be utilized as long as possible.

Since the area 1 in the BMA has high telephone demand and the new services demands, the XB switches in the area should be replaced at first. All the XB switches in the telecom. area 1 and in the Surrounding Area should be replaced in the Phase-1 and those in other areas should be replaced in the Phase-1 and the Phase-2.

Table 4.3.2 illustrates the priority order and the annual schedule of the replacement in the Phase-1.

Table 4.3.2 Priority of XB Switch Replacement

Area	Unit Name	Type	Insta-llation	Line Capacity	Replacement Year and Line Capacity					Total
					1993	1994	1995	1996	1997	
BMA (Local Switch-es)	PNC-1	C-400	1971	12,000	22,000					22,000
	PNC-2	C-400	1971	10,000						
	SRR-1	C-400	1970	10,000						
	SRR-2	C-400	1970	10,000		30,000				30,000
	SRR-3	C-400	1978	10,000						
	KKM-2	C-400	1970	10,000		10,000				10,000
	SRW-1	C-400	1976	10,000						
	SRW-2	C-400	1976	10,000	30,000					30,000
	SRW-3	C-400	1978	10,000						
	SMS-1	C-400	1980	5,800				5,800		5,800
	ASD-1	C-400	1979	10,000			10,000			10,000
	PTW-1	C-400	1980	5,384					5,384	5,384
	KGC-1	C-400	1971	13,000				13,000		13,000
	STD-1	C-400	1971	3,250			3,250			3,250
	PSP-1	C-400	1977	7,000				7,000		7,000
	HAM-1	C-400	1979	8,000					8,000	8,000
	SPK-1	ARF-102	1964	5,000		5,000				5,000
	TNB-1	C-400	1970	20,000					20,000	20,000
	PPG-1	C-400	1969	3,310		3,310				3,310
	BGT-1	C-400	1976	11,000			11,000			11,000
	BGS-1	C-400	1970	10,000				10,000		10,000
	NWW-1	C-400	1969	5,300				5,300		5,300
	DNW-1	C-400	1970	3,480					3,480	3,480
	PYT-1	C-400	1967	12,000			17,800			17,800
	PYT-2	C-400	1976	5,800						
	LKS-1	C-400	1976	6,000			6,000			6,000
	NTB-1	C-400	1979	3,300					3,300	3,300
	LTP-1	C-400	1979	5,200				5,200		5,200
	Sub Total			234,824	52,000	48,310	48,050	46,300	40,164	234,824
Provin-cial Area (Local Switch-es)	SPR-1	ARF-102	1975	1,000			1,000			1,000
	SKN-1	ARF-102	1960	2,000	2,000					2,000
	NPT-1	PC1000	1970	3,000		3,000				3,000
	BPN-1	ARF-102	1979	1,000			1,000			1,000
	WNI-1	ARF-102	1979	1,000				1,000		1,000
	PCI-1	ARF-102	1979	1,000					1,000	1,000
	AYT-1	PC1000	1960	1,426	1,426					1,426
	Sub Total			10,426	3,426	3,000	2,000	1,000	1,000	10,426
Grand Total				245,250	55,426	51,310	50,050	47,300	41,164	245,250
BMA (TDMs)	KKM T1	Remove of XB (cct)		1,505					1,505	1,505
		Installation of SPC		(1,505)	(610)	(100)	(233)	(100)	(462)	(1,505)
	Installation of SPC in another area			(1,649)	(210)	(613)	(570)	(167)	(89)	(1,649)
Total No of cct to be installed				(3,154)	(820)	(713)	(803)	(267)	(551)	(3,154)

Note : cct = circuits TDM = Tandem

According to the above mentioned criteria, the XB switches at PNC and SRW should be replaced at first.

b) Other Priority Order

The line protector should be replaced according to the fault ratio.

4.3.3 Setting up Advisory Committee and Working Groups

TOT has been making considerable efforts to provide better telecommunications services to the customers since its establishment in 1954. The present services offered by TOT in the Study Area, however, is sufficient neither in quantity nor quality.

The proposed 26 projects should be initiated as early as possible to upgrade the service quality. The implementation of the 26 projects requires the total efforts and coordination among the many departments and divisions concerned in TOT, not only the Project Office in the Engineering Bureau, but also the Maintenance and Operation Sections of the switching, the transmission, and the outside plant, the Commercial Division in Operation Bureau; and each local office to the Headquarters.

It is highly proposed and recommended for TOT to set up an advisory committee that one of top executives chairs. The role of the committee is

1) to coordinate and organize all the divisions and departments concerned,
2) to set up the targets in detail and guide all the staff for one goal,
3) to allocate their management resources,
4) to monitor the progress,
5) to find out and solve problems, obstacles, and bottlenecks for the scheduled project implementation,
6) to avoid wasting valuable work loads, funds, and time,
7) to achieve the targets as planned, and
8) to improve the service quality and provide the better quality of telecommunications services.

In order to implement the various proposed projects, several working groups are necessary to be set up. Each group is responsible for the project implementation under the authority of the advisory committee.

4.4 Investment Cost

The costs of the projects are estimated as shown in Table 4.4.

Table 4.4 Estimated Costs of the Proposed Projects

(Cost Unit: Million Baht)

Main Target	Project Code	Project Name	Work Volume		Cost
1. Improvement of fault Ratio					
	OSP-1	Rearrangement of Distribution Points	Unit: DPs	8,250	12
	OSP-2	Replacement of Drop Wires with Cables	Unit: Pair-Km	94,000	524
	OSP-3	Renewal of Drop Wires	Unit: Drop Wire	200,000	121
	OSP-4	Replacement of Secondary Cables	Unit: Pair-Km	231,000	2,006
	OSP-5	Replacement of Primary Cables	Unit: Pairs	343,500	2,405
	OSP-6	Checked and Consulting for Customer Premises	Unit: Subscriber	231,000	24
	OSP-7	Replacement of Public Telephone Sets	Unit: Set	6,158	205
	OSP-8	Replacement of Protectors	Unit: Protector	17,500	8
	S&T-1	Replacement of Line Protectors	Unit: Main Tel. Line	855,066	313
	S&T-2	Replacement of XB Switches with SPC Switches	Unit: Line Capacity	245,250	2,248
	S&T-3	Replacement of Circuits	Unit: No. of Circuit	3,154	53
	S&T-9	Replacement of PCM Systems with FOTS	Unit: No. of DTI	1,144	847
2. Improvement of CCR					
	S&T-4	Installation of Automatic Howling Tone Service	Unit: Device	239	6
	S&T-5	Subscriber Line Accommodation Adjustment			
	S&T-6	Introduction of Record Announcement	Unit: Device	61	1
	S&T-7	Changing P.D. Timing			
	S&T-8	Improvement of Periodic Maintenance			
	S&T-10	Increasing Number of Circuits	Unit: No. of Circuits	3,295	56
	OT-1	Expansion of Subscriber Lines	Unit: Main Tel. Line	500,000	19,127
	OT-2	Promotion of Multi-hunting-system			
	OT-3	Promotion of Call-waiting Services			
	OT-4	Dial Consulting Activities (User Campaign)			
	OT-5	Promotion of Automatic Answer Telephone			
	OT-6	Promotion of Call Transfer Service			
	OT-7	Management on Operator's Answer Delay Time			
	OT-8	Introduction of Information Service for Changed Number	Unit: Switch unit	1	70
Total		26 Projects			28,026

4.5 Other Measures to Upgrade the Telecommunications Service Quality

The Study Team proposes the projects to upgrade the telecommunications services quality in the previous section. There exist not only those proposed projects but also other measures which are important to maintain and improve the network and facilities to provide better quality of the telecommunications services. This section summarizes the other measures introduced and explained in Chapter 2 and Chapter 3. Table 4.5 shows the framework of the additional improvement measures.

1) The telecommunications networks and facilities are the basis of the services. Only the well maintained networks and facilities can provide the better quality of the services. Therefore, the maintenance control system is essential for the telecommunications operating corporations to maintain their networks and facilities in the operational condition.

2) Traffic management is the basis of the business operation for the telecommunications operating corporations. Traffic or calls or telecommunications in other words is the service to be provided to the customers by the operating corporations. The smooth traffic flow in the network without any congestion is the ultimate goal to be achieved.

3) The installation and construction method is one of the fundamental factors to build the networks and facilities with good quality. Two items are recommended here in this part.

4) Five measures in the outside plant field, three measures in the transmission field, and four measures in the operation and maintenance field are selected as other measures here.

Table 4.5 Recommended Main Improvement Measures

Classification	Improvement Measure Titles	Reference
1. Maintenance Management Standard	Establishment of Maintenance Control System (Improvement of the fault ratio)	2.5.3
	1) Service Control	
	Definition of Maintenance Control Value	2.4.2 2)
	2) Extraordinary Control System	2.4.2 1)
	Definition of Maintenance Control Value	
	3) Plant Control	
	a) Deteriorated Facility Control System	
	b) Peculiar Faults on the plant Control	
	Traffic Management (Improvement of the CCR)	3.8.3 1)
	1) Overall Management	
	2) Segmental Management	
2. Installation & Construction Method (includes maintenance repair system)	(Outside Plant)	
	1) Improvement of the Repair Method for Drop Wires	2.2.3 3)
	2) Improvement of the Drop Wire Installation Method	2.2.3 3)
3. Others	(Outside Plant)	
	1) Introduction of Water Penetration Monitoring System	2.2.3 2)
	2) Improvement of the Closures	2.2.3 2)
	3) Improvement of the Quality of Drop Wires	2.2.3 3)
	4) Advertisement and Campaign to the Customers	2.2.3 5)
	5) Check Customer Premises before Connection with TOT Networks	2.2.3 5)
	(Transmission)	
	6) Introduction of Tools for Channel Assignment	2.4.2 3)
	7) Introduction of Computerized Leased Line Control System	2.4.2 5)
	8) Introduction of Leased Line Remote Testing System (LLTS)	2.4.2 5)
	(O & M)	
	9) Improvement of Centralized Maintenance System	2.5.2
	10) Introduction of Computerized Customer Record System	2.5.2
	11) Establishment of Stock Management System	2.5.2
	12) Technical Skills Advancement	2.5.2

CHAPTER 5

PROJECT EVALUATION

CHAPTER 5 PROJECT EVALUATION

This chapter evaluates the Project from financial, social and economical, and technical viewpoints and describes recommendations on the Project implementation.

5.1 Financial Evaluation

Introduction

The increase of the call completion ratio (CCR) means the increase of the complete calls that brings the telephone company the increased telephone call revenue. The telephone call revenue is expected to increase also when faults decrease and repairing periods become shorter. This section estimates the effects of the Project on the call revenue and analyzes the feasibility of the Project from the financial viewpoint.

The Project is classified into two groups of main activities. One is the activities to reduce the occurrences of faults and to make repair periods shorter. The other is the activities to increase the number of complete calls, i.e., to improve the CCR.

At first, these effects on the call revenues by fault decrease and increased completed calls are estimated separately. After revenue estimation, the cost and the benefit of the Project are analyzed from the viewpoint of the financial internal rate of return (FIRR).

Assumptions

The financial evaluation of the Project in this section is based on the following assumptions at first.

1) The structure of the telephone network in the Study Area, i.e., the number of main telephone lines and line capacity, and the network configuration is considered as to be unchanged for the Project period because the Project focuses on the measures to improve the present TOT telecommunications networks in the BMA and the Surrounding Area.

2) Two million telephone lines will be installed in the next five years by the private company as another local network in the BMA. The new local network will generate additional traffic in the existing TOT network. However, the Study does not take the matters into consideration. The surveys, observations, and analyses are based on the present service quality of the existing TOT networks and the network rehabilitation projects focus on the measures to improve the present services quality.

After the estimation and analysis of the benefits and the costs for the network rehabilitation projects, the financial analysis takes into account the effects of the network expansion plan, i.e., the additional installation of the subscriber telephone lines for present high B-sub busy subscribers.

Conclusions

This section clarifies the following points as conclusions.

1) The proposed rehabilitation Project excluding the new telephone line installation plan costs 9,789 million Baht in total during the five years Project period.

2) The implementation of the Project will decrease the number of faults, which recovers the lost call revenue of 24.08 million Baht and saves the repairing work load for 175.07 million Baht in total during the five years period.

3) The implementation of the Project will increase the number of complete calls, which brings the call revenue increase of 8,152.62 million Baht in total during the five years period.

4) The IRR of the Project is estimated to be 22.61%. The IRR of the Project with 500,000 lines installation plan is estimated to be 11.28%.

5) The rehabilitation Project can be financed and carried out within TOT's own funds and internal cash generations.

5.1.1 Revenue Increase Effects by the Project to Decrease the Faults

The telephone user can not make originating calls nor receive incoming calls while their telephones are out of order. When the users find that their lines are out of order, they may abandon the call attempts. If they find telephone faults frequently and it takes longer period to get repairing service, telephone users can not rely on the telecommunications services; and this can reduce the number of completed calls and the operating revenue. the smaller the number of completed calls and the less the call revenues become.

It is expected that the Project to upgrade the operational availability of the telecommunications network contributes to decrease the lost call revenues, i.e., increase the call revenues. This

subsection estimates the call revenue increase effects by the Project to decrease the faults. The following assumptions are employed in order to make the estimation procedure simple:

1) telephone users do not make any call from other lines when their telephone lines are out of order,
2) telephone users do not make any call to the third parties when their calling parties' lines are out of order.

The annual lost call revenues (ALCR) is expressed as follows:

$$ALCR = \sum_{i=1}^{N}(FRP \times ACRd)_i$$

where

FRP: the required period (day) from the fault occurrence and repairing it per fault line,
ACRd: average call revenue per main telephone line per day,
N: the total number of faults occurred in the year.

1) The Estimation of the Decreased Faults in the BMA

The annual number of faults in FY 1997 is expected to become reduced to the half of that in FY 1992 by the Project. Under the assumption that the number of telephone lines are same during the Project period, the number of faults is estimated.

Table 5.1.1-1 indicates 1) the estimated number of the fault lines, 2) the average recovery days per fault line, and 3) the total number of fault days multiplied by fault lines in the BMA.

Table 5.1.1-1 Estimation of the Fault Period (day) in the BMA

FY	1990	1991	1992	1993	1994	1995	1996	1997
Proposed Rate of the Faults			1.00	0.94	0.90	0.77	0.66	0.58
1. Number of Faults								
BMA Total	501,972	517,040	517,040	485,557	466,184	398,375	341,464	301,506
1.1 Ordinary Tel.	384,500	399,348	399,348	375,032	360,068	307,694	263,738	232,875
1.2 PABX	43,239	43,459	43,459	40,813	39,184	33,485	28,701	25,343
1.3 Public	74,233	74,233	74,233	69,713	66,931	57,196	49,025	43,288
1.4 Ordinary + PABX (1+2)	427,739	442,807	442,807	415,845	399,252	341,179	292,439	258,218
2. Fault Recovery Days/Fault, line								
2.1 Within 1 day	90%	90%	90%	90%	90%	90%	90%	90%
2.2 More than 1 day	10%	10%	10%	10%	10%	10%	10%	10%
2.3 Average Fault Recovery Day/fault	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
3. Total Fault Day • Line								
3.1 Public Telephone	81,656	81,656	81,656	76,684	73,625	62,916	53,928	47,617
3.2 Ordinary Tel. + PABX (1+2)	470,513	487,088	487,088	457,429	439,177	375,297	321,683	284,039

2) The Estimation of the Decreased Faults in the Surrounding Area

Table 5.1.1-2 indicates 1) the estimated number of the faults, 2) the average recovery days per fault, and 3) the total number of fault days multiplied by fault lines in the Surrounding Area.

Table 5.1.1-2 Estimation of the Fault Period (day) in the Surrounding Area

FY	1990	1991	1992	1993	1994	1995	1996	1997
Decreased Rate of the Faults			1.00	0.91	0.88	0.77	0.68	0.61
1. Number of Faults								
1.1 Ayutthaya	9,696	10,681	10,681	9,760	9,387	8,225	7,260	6,492
1.2 Nakhon Phatom	8,135	8,809	8,809	8,049	7,742	6,783	5,987	5,354
1.3 Samut Sakhon	5,529	5,863	5,863	5,357	5,153	4,515	3,985	3,564
2. Fault Recovery Days/Fault, line								
2.1 Within 1 day	75%	75%	75%	78%	81%	84%	87%	90%
2.2 More than 1 day	25%	25%	25%	22%	19%	16%	13%	10%
2.3 Average Fault Day/fault	1.25	1.25	1.25	1.22	1.19	1.16	1.13	1.1
3. Total Fault Day • Line								
3.1 Ayutthaya	12,120	13,351	13,351	11,907	11,171	9,541	8,203	7,141
3.2 Nakhon Phatom	10,169	11,011	11,011	9,820	9,213	7,868	6,766	5,890
3.3 Samut Sakhon	6,911	7,329	7,329	6,536	6,132	5,237	4,503	3,920

3) Average Call Revenues per Day

a) The BMA

The following average call revenues per day and line are applied for the estimation in the BMA:

i) the Subscriber Telephone (Private + Government): 25.97 Baht per day,

ii) the Public Telephone (Local + Trunk): 83.60 Baht per day.

Table 5.1.1-3 shows the estimation procedure for the average call revenues per day and line in the BMA.

Table 5.1.1-3 Average Call Revenues per Day for the BMA

	FY 1990	Source
I. Local Calls/Main Tel. Line		
1. Annual Local Calls/Main Tel. Station	2,406	Telephone Statistical Report 1990
1.1 Subscribers (Private + Government)	1,869	ditto
1.2 Public Telephone	32,825	ditto
2. Annual Trunk Revenue/Main Tel. Station		
2.1 Subscribers (Private + Government)	2,259.85	Interim Report Annex 16-7
2.2 Public	2,408.00	ditto
3. Annual Call Revenue (Baht) per Public	30,513.00	ditto
4. Days per Year	365	
5. Average Call Charge per Day (Baht) for Subscribers (Local + Trunk)	25.97	
5.1. Local Call	19.78	
5.2 Trunk Call	6.19	
6. Average Call Charge per Day (Baht) for Public Telephone	83.60	

b) The Surrounding Area

For the Surrounding Area, the local and trunk call revenues per main telephone line are applied for the estimation. The average revenues per day and line are as follows:

i) Ayutthaya: 41.29 Baht,

ii) Nakhon Phatom: 38.72 Baht

iii) Samut Sakhon: 39.13 Baht.

Table 5.1.1-4 indicates the call revenues per main telephone line for the Surrounding Area of FY 1990 in detail.

Table 5.1.1-4 Average Call Revenue per Main Telephone Line per Day and Year for the Surrounding Area

(Unit: Baht)

	per Year (1990)	per Day
1. Ayutthaya		
1.1 Local	3,880.86	10.63
1.2 Trunk	11,191.00	30.66
1.3 Local & Trunk	15,071.86	41.29
2. Nakhon Phatom		
2.1 Local	4,628.10	12.68
2.2 Trunk	9,503.00	26.04
2.3 Local & Trunk	14,131.10	38.72
3. Samut Sakhon		
3.1 Local	3,961.50	10.85
3.2 Trunk	10,320.00	28.27
3.3 Local & Trunk	14,281.50	39.13

4) Estimation Result of the Call Revenues Increase by the Project

Table 5.1.1-5 indicates the annual lost call revenues and the recovered lost revenues estimated by the Study. 24.082 million Baht in total 5 year is the recovered or saved call revenues loss, i.e., the estimated benefit of the Project to decrease the faults.

Table 5.1.1-5 Estimated Annual Call Revenue Loss by Faults and the Recovered Revenues by the Project

(Unit: Thousand Baht)

FY	1992	1993	1994	1995	1996	1997	Total (93-97)
I. Annual Lost Call Revenue							
1. BMA	19,474	18,289	17,559	15,005	12,861	11,356	
1.1 Subscribers	12,648	11,878	11,404	9,745	8,353	7,376	
1.2 Public Telephone	6,826	6,411	6,155	5,260	4,508	3,981	
2. Surrounding Area Total (2.1+2.2+2.3)	1,264	1,128	1,058	903	777	676	
2.1 Ayutthaya	551	492	461	394	339	295	
2.2 Nakhon Phatom	426	380	357	305	262	228	
2.3 Samut Sakhon	287	256	240	205	176	153	
3. Total (1+2)	20,739	19,416	18,617	15,908	13,638	12,032	
II. Recovered Lost Revenue Estimation by Project		1,323	2,122	4,830	7,101	8,706	24,082

5) Saved Cost by the Project

The Project to decrease the faults saves not only the lost call revenues but also maintenance and repairing work load. Therefore, the manpower cost, the material cost, the costs of the vehicles for the repairing works can be saved. The Study takes the saved manpower cost of the repairing work into considerations.

Section 2.5 in Chapter 2 describes and estimates the required number of the staff for the maintenance work. Table 5.1.1-6 shows the necessary number of the maintenance staff, annual increase (decrease) number of staff, average annual wage per staff, and the saved manpower cost by the Project. For the average annual wage per staff, 8% annual increase rate is applied for the estimation based on 110,000 Baht in FY 1990.

Table 5.1.1-6 Estimated Annual Saved Manpower Costs by the Project

B. Costs Decrease Effects by Improving Faults	1992	1993	1994	1995	1996	1997	Total
1. Saved Manpower							
1.1 Necessary Number of Staff for Maintenance	2,374	2,292	2,217	2,136	2,054	1,942	
1.2 Annual Increase (Decrease) Number of Staff	0	-82	-75	-81	-82	-112	-432
1.3 Accumulated Increase (Decrease)	0	-82	-157	-238	-320	-432	
1.4 Average Accumulated Increase (Decrease)		-41	-119.5	-197.5	-279	-376	
2. Average Annual Wage per Staff (Baht) * Note	128,304	138,568	149,654	161,626	174,556	188,521	
3. Saved Manpower Cost (Staff Wages (million Baht))		5.68	17.88	31.92	48.70	70.88	175.07

Note: The figures in 1992 are estimated by the Study Team.

6) Benefits of the Project to Decrease the Faults

Table 5.1.1-7 shows the benefits of the Project to decrease the number of faults.

Table 5.1.1-7 Total Benefits to Decrease the Faults

(Unit: Million Baht)

Fiscal Year	1993	1994	1995	1996	1997	Total
I. Recovered Lost Call Revenues	1.32	2.12	4.83	7.10	8.71	24.08
II. Saved Manpower Cost	5.68	17.88	31.92	48.70	70.88	175.07
Sub Total Benefits	7.00	20.01	36.75	55.80	79.59	199.15

5.1.2 Revenue Increase Effects by Increasing Completed Calls

Implementing the activities to improve the CCR brings the increase of complete calls, which brings not only the customers satisfaction but also the call revenues increase for the TOT. This subsection applies a model to estimate the number of complete calls with the improved CCRs by the Project. Chapter 13 in the final report of the Master Plan introduces the model (13.3.6 Estimation of Additional Revenue p 13-34) to estimate the number of the total call attempts and the completed calls . The study applies the same model to calculate the number of call attempts and that of the complete calls in the BMA by the Project.

1) Calling Behavior Model: Premise and Assumption

In the case that telephone users try to make calls but the calls are incomplete at the first calling attempt, some users abandon the callings but others try to call again for the second time. When the second calling is incomplete again, some users abandon but others try to call again for the third time. The telephone users may continue to dial more than 50 times until making complete calls; however, the re-dial attempts tend to decrease according to the times of incomplete calls.

On the other hand, the complete calls generate others' calling attempts. After receiving a call from the first party, for example, the second party may call to the third parties or call back to the fist party. The first complete calls generate the second calling attempts, the second complete calls generate the third calling attempts, and so forth like the chain reaction. Hence, the increase of the complete calls for the first attempt brings a series of the increases of the calling attempts.

Figure 5.1.2 illustrates the procedure of accumulating complete and incomplete calls.

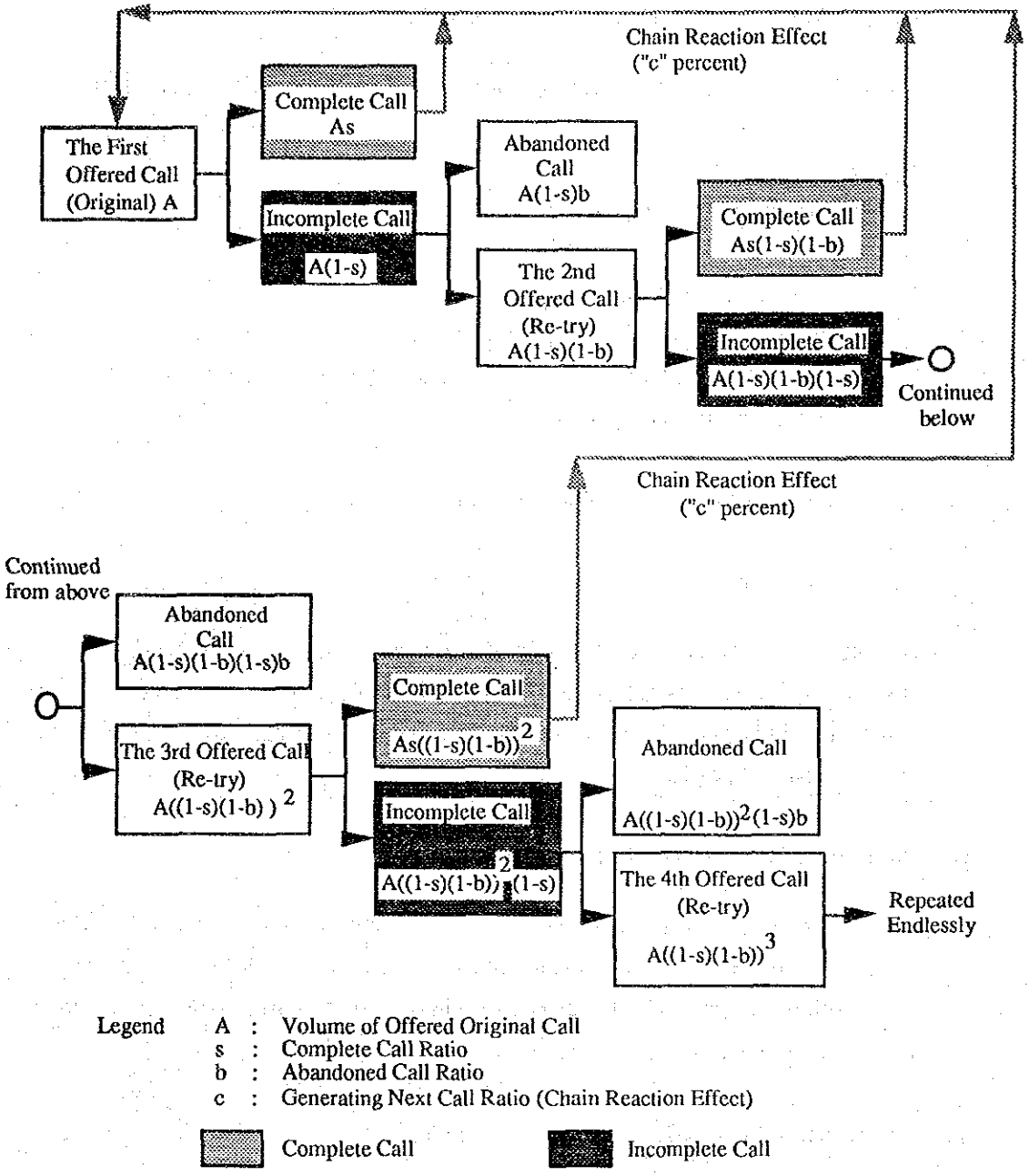

Figure 5.1.2 Call Procedure of Complete Call and Incomplete Call

The accumulated complete calls at the first chain (attempt) and the number of second calling attempts are expressed as follows:

a) Complete Calls at the First Chain:

$$[As+As(1-s)(1-b)+As\{(1-s)(1-b)\}^2+As\{(1-s)(1-b)\}^3+...+As\{(1-s)(1-b)\}^i+...]$$

b) Calling Attempts (offered calls) at the Second Chain:

$$c[As+As(1-s)(1-b)+As\{(1-s)(1-b)\}^2+As\{(1-s)(1-b)\}^3+...+As\{(1-s)(1-b)\}^i+...]$$

where

A: The number of offered original calls,

s: CCR,

b: Abandoned call ratio,

c: Generating next call ratio (Chain Reaction Effect Ratio, i.e., the ratio of the number of the second calling attempts to that of the accumulated complete calls at the first calling attempts).

The study employs the following assumptions for the model.

a) Abandoned Call Ratio: the First Assumption

The abandoned call ratio is 10% after the first call attempt, 20% after the second call attempt, and continues to step up 10% each time to become 100% after the 10 times attempts. This assumption means that no one try to re-dial after the series of 10 times incomplete calls.

b) Additional Call Generation Ratio: the Second Assumption

One complete call may generate other call attempts to send the message to the third parties or to confirm information like chain reaction. The model employs the assumption that the 10% of the complete calls generate other new calling attempts for the ten times chain reactions.

c) Adjustment of the CCR: the Third Assumption

i) The CCR is measured for the busy hour, usually during 9 o'clock and 11 o'clock in the morning for the working day. In order to estimate the annual number of the complete and the incomplete calls in total, 115% is applied for the ratio of the CCR of the busy hour to that of the all day as described in the section 3.3.2 part 4) in this report.

The CCR varies not only during 24 hours but also during a week, a month and a year. However, the study does not take these traffic variations into consideration in order to make the estimation model simple.

ii) The number of P.S.Abandon is included in the category of the incomplete calls measured in March 1992 and the target of the CCR to be achieved through implementing the projects (see Table 3.9.1-1 in 3.9.1 of Chapter 3). Most of the P.S.Abandons in the BMA are not occurred by the telephone users' calling attempts. Hence, P.S.Abandon is to be omitted from the estimation procedure of the complete calls. Table 5.1.2-1 shows the CCRs including P.S.Abandon and excluding one for both as of March 1992 and the target in FY 1997.

Table 5.1.2-1 Adjusted CCRs (%)

Items	CCR in TOT as of March 1992		Target in 1997	
	Including P.S.Abandon	Excluding P.S.Abandon	Including P.S.Abandon	Excluding P.S.Abandon
Completed Call	23.5	32.1	55.0	65.5
P.S.Abandon	26.8	Excluded	16.0	Excluded
P.D.Abandon	7.7	10.5	5.0	6.0
Congestion	5.4	7.4	2.4	2.9
B-sub Busy	24.4	33.3	13.6	16.2
Ringing Abandon	5.8	7.9	3.5	4.2
Fault	5.2	7.1	2.5	3.0
Others	1.2	1.6	2.0	2.4
Total	100	100.0	100.0	100.0

iii) The CCR in 1997 (75.30%) used for the estimation by the model is calculated by multiplying the adjusted CCR in 1997 (65.48%) by the ratio of the CCR of the all day to that of the busy hour (115%). In order to estimate the annual completed calls, the adjusted CCRs are set for each year by the straight-line method. Table 5.1.2-2 shows the average adjusted CCRs in the whole day excluding P.S.Abandon for the Project plan period.

Table 5.1.2-2 Annual Average CCR in the Whole Day excluding P.S.Abandon

FY	1992	1993	1994	1995	1996	1997
Applied CCRs	36.92%	44.60%	52.27%	59.95%	67.62%	75.30%
Annual Difference of the CCR		7.68%	7.68%	7.68%	7.68%	7.68%

d) The Number of Completed Calls at the Initial Year

In order to calculate the increased completed calls for the 5 years, it is required to set the number of completed call in the initial year, i.e., in the year of 1992. Because of the available data is as of the fiscal year of 1991, the following figures are tentatively employed as those of FY 1992.

Table 5.1.2-3 The Number of Local and Trunk Telephone Usage in the BMA

	FY 1991
Total Number of Calls	2,378,533,953
Local Service (Pulse Metered)	2,298,152,633
Domestic & International Trunk Service (Calls)	80,381,320
Domestic Trunk Service (calls)	79,488,957
International Service (calls)	892,363

Note: The period of FY 1991 is from Oct. 1, '90 to Sep. 30, '91.
Source: TOT, Telephone Statistical Report 1991

2) The Calculation Procedure of the Increased Complete Calls

Table 5.1.2-4 shows the number of 1) offered calls (original call attempts), 2) offered calls (re-try, i.e., re-dialed call attempts), 3) complete calls, 4) incomplete calls, 5) the abandoned call ratio applied, 6) abandoned calls, and 7) intended re-try calls; for each re-try time on the premise and assumption described in the previous part for the first generated calls, i.e., the first attempted calls.

The table indicates that the number of the total re-tried calls is bigger than that of the original call attempts under the CCR of 36.92%.

Table 5.1.2-4 Calculation Procedure of the Complete Calls (The First Effect)

(CCR: 36.92%)

The 1st Effect					
Calling Trial Time	1	2	10	Total	Cumulative
1. Offered Calls (Original)	2,907,371,636			2,907,371,636	2,907,371,636
2. Offered Calls (Re-try)		1,650,588,754	16,685	3,047,927,204	3,047,927,204
3. Complete Calls	1,073,384,132	609,387,446	6,160	2,198,660,535	2,198,660,535
4. Incomplete Calls	1,833,987,504	1,041,201,307	10,525	3,756,638,305	3,756,638,305
5. Abandoned Call Ratio	10%	20%	100%		
6. Abandoned Calls	183,398,750	208,240,261	10,525	708,711,101	708,711,101
7. Intended Re-try Calls	1,650,588,754	832,961,046	0	3,047,927,204	3,047,927,204

Table 5.1.2-5 shows the calculation steps of the call chain reaction for the second, the third, the eighth, and the tenth effects.

Table 5.1.2-5 Calculation Procedure of the Complete Calls (the 2nd, 3rd, 8th, and 10th Chain Effects)

(CCR: 36.92%)

The 2nd Effect					
Calling Trial Time	1	2	10	Total	Cumulative
1. Offered Calls (Original)	219,866,053			219,866,053	3,127,237,689
2. Offered Calls (Re-try)		124,823,545	1,262	230,495,379	3,278,422,583
3. Complete Calls	81,173,225	46,084,103	466	166,270,734	2,364,931,269
4. Incomplete Calls	138,692,828	78,739,443	796	284,090,698	4,040,729,004
5. Abandoned Call Ratio	10%	20%	100%		0
6. Abandoned Calls	13,869,283	15,747,889	796	53,595,320	762,306,421
7. Intended Re-try Calls	124,823,545	62,991,554	0	230,495,379	3,278,422,583
The 3rd Effect					
Calling Trial Time	1	2	10	Total	Cumulative
1. Offered Calls (Original)	16,627,073			16,627,073	3,143,864,763
2. Offered Calls (Re-try)		9,439,612	95	17,430,902	3,295,853,485
3. Complete Calls	6,138,616	3,485,048	35	12,574,000	2,377,505,268
4. Incomplete Calls	10,488,458	5,954,564	60	21,483,975	4,062,212,979
5. Abandoned Call Ratio	10%	20%	100%		0
6. Abandoned Calls	1,048,846	1,190,913	60	4,053,074	766,359,495
7. Intended Re-try Calls	9,439,612	4,763,651	0	17,430,902	3,295,853,485
The 8th Effect					
Calling Trial Time	1	2	10	Total	Cumulative
1. Offered Calls (Original)	41			41	3,145,225,028
2. Offered Calls (Re-try)		23	0	43	3,297,279,511
3. Complete Calls	15	9	0	31	2,378,533,950
4. Incomplete Calls	26	15	0	53	4,063,970,589
5. Abandoned Call Ratio	10%	20%	100%		0
6. Abandoned Calls	3	3	0	10	766,691,078
7. Intended Re-try Calls	23	12	0	43	3,297,279,511
The 10th Effect					
Calling Trial Time	1	2	10	Total	Cumulative
1. Offered Calls (Original)	0			0	3,145,225,031
2. Offered Calls (Re-try)		0	0	0	3,297,279,515
3. Complete Calls	0	0	0	0	2,378,533,953
4. Incomplete Calls	0	0	0	0	4,063,970,593
5. Abandoned Call Ratio	10%	20%	100%		
6. Abandoned Calls	0	0	0	0	766,691,078
7. Intended Re-try Calls	0	0	0	0	3,297,279,515

The table indicates that the number of the accumulated original offered calls is estimated to be 3,145 million and that of the accumulated re-tried calls is estimated to be 3,297 million to have 2,378.5 million complete calls with the CCR of 36.92%. The number of

complete calls is 2,378.5 million while that of the incomplete calls is estimated as 4,064.0 million in the year.

3) Results of the Estimation on the Completed Call Increase Effects

Table 5.1.2-6 shows the estimations of the completed calls with this simulation model.

Table 5.1.2-6 Estimation of the Increase Effects of the Completed Calls

(Unit: Million Calls)

	1992	1993	1994	1995	1996	1997
	0	1	2	3	4	5
1. Average CCR in the Whole Day excluding P.S.Abandon	36.92%	44.60%	52.27%	59.95%	67.62%	75.30%
1.1 Annual Increase of the CCR		7.68%	7.68%	7.68%	7.68%	7.68%
2. Total Offered Calls	6,442.505	5,841.033	5,314.976	4,855.215	4,453.173	4,101.046
2.1 Offered Calls (Original) Total Accumulated	3,145.225	3,167.853	3,185.189	3,198.424	3,208.504	3,216.171
2.2 Offered Calls (Re-try) Total Accumulated	3,297.280	2,673.181	2,129.787	1,656.791	1,244.669	884.876
3. Complete Calls Total Accumulated	2,378.534	2,604.811	2,778.175	2,910.523	3,011.323	3,087.990
4. Incomplete Calls Total Accumulated	4,063.971	3,236.222	2,536.802	1,944.692	1,441.849	1,013.056
5. Abandoned Calls Total Accumulated	766.691	563.041	407.015	287.901	197.181	128.180
6. Annual Increase of CCs		226.277	173.363	132.349	100.800	76.667
7. Annual Average of CCs		2,491.673	2,691.493	2,844.349	2,960.923	3,049.657
8. Net Increase of CCs	0.000	113.139	312.959	465.815	582.389	671.123

Table 5.1.2-6 indicates the following points:

a) when the CCR is 36.92 %, the number of re-try calls are larger than that of the original offered calls,
b) the number of re-try calls are remarkably decreasing according to the improvement of CCR, and
c) the number of incomplete calls are remarkably decreasing in accordance with the improvement of the CCR.

4) Estimation of the Increased Call Revenues

a) Average Call Revenue per Call

The average call revenue per main telephone line in FY 1990 is to be applied for the estimation of the increased call revenues by the projects to improve CCR. The share of the number of the trunk calls on the total calls is 2.88%. The average call revenue per trunk call is 30.89 Baht for the private and the Government subscribers in the BMA for the fiscal year of 1990

Table 5.1.2-7 Trunk Call Revenue and the Number of Trunk Calls for the Private and the Government Subscribers in the BMA for FY 1990

Trunk Revenue (Baht)	1,865,756,185
Trunk Calls	60,390,730
Trunk Revenue (Baht) /call	30.89

The average call charge per call is estimated as 3.8 Baht per call as indicated in Table 5.1.2-8.

Table 5.1.2-8 The Average Call Charge per Call

	Share of Calls	Average Call Charge/Call	Call Charge (Baht)
1. Local Call	97.12%	3	2.91
2. Trunk Call	2.88%	30.89	0.89
3. Local + Trunk Call	100.00%		3.80

b) Call Revenue Increase Effects by the Project to Improve the CCR

Table 5.1.2-9 indicates the increased call revenues by the Project to improve the CCR on the assumptions employed in the model.

Table 5.1.2-9 The Increased Call Revenues by Improving CCR

FY	1993	1994	1995	1996	1997	Sub Total (93-97)	98-
Net Increase of CCs (Million Calls)	113.139	312.959	465.815	582.389	671.123	2,145.425	709.456
Increased Call Revenue Estimates (Million Baht)	429.927	1,189.244	1,770.097	2,213.080	2,550.267	8,152.615	2,695.934

5.1.3 Project Costs

1) Rehabilitation Projects

Table 5.1.3-1 shows the summary of the Project costs during the 5 years from 1993 to 1997 excluding the costs for the new installation of main telephone lines. The following rate is applied as exchange rate of the foreign portion.

Exchange rate: 1.0 Thai Baht = 5.5 Japanese Yen

The sub total Project costs amounts 8,899 million Baht in total for five years. 65% of the Project costs are foreign portion and the rest is local portion. Classified by facility, the 30% share on the total cost is for the switching section, the 10% is for the transmission section, and 60% is for the outside plant section.

The projects are classified by three priorities in Chapter 4. The sub total costs of the first priority projects is 943 million Baht with 10.6% share on the total project costs, that of the second priority is 2,397 million Baht with 26.9% share, and the third is 5,560 million Baht with 62.5% share.

The 5% of the sub total costs is estimated as the contingency cost and the other 5% is estimated as the various project implementation costs.

In total, 9,789 million Baht is estimated for the Project to renew, rehabilitate and replace the existing TOT network facilities in the study area.

Table 5.1.3-1 Project Costs

(Unit: Total: Million Thai Baht, Foreign: Million Japanese Yen, Local: Million Thai Baht)

		Total	1	2	3	4	5
Fiscal Year		1993-1997	1993	1994	1995	1996	1997
Summary							
1. Classified by Facility							
1.1 Switching Section	30%	2,701	567	554	618	510	451
1) Foreign (M Yen)		13,597	2,842	2,784	3,129	2,568	2,275
2) Local (M B)		229	50	48	49	43	38
1.2 Transmission Section	10%	893	175	186	187	171	173
1) Foreign (M Yen)		3,698	724	775	778	706	715
2) Local (M B)		220	44	45	45	43	43
1.3 Outside Plant Section	60%	5,305	83	134	1,720	1,714	1,654
1) Foreign (M Yen)		14,679	278	637	4,706	4,693	4,366
2) Local (M B)		2,636	32	19	865	860	861
2. Classified by Expenditure							
2.1 Investment (M B)	95%	8,438	767	812	2,411	2,279	2,168
1) Foreign (M Yen)		30,257	3,558	3,902	8,254	7,562	6,981
2) Local (M B)		2,936	120	102	911	904	899
2.2 Operation & Maintenance (M B)	5%	461	58	63	114	116	111
1) Foreign (M Yen)		1,718	286	294	359	403	375
2) Local (M B)		149	6	10	48	43	43
3. Priority Order							
3.1 The First	10.6%	943	34	110	313	273	213
3.2 The Second	26.9%	2,397	100	107	769	713	708
3.3 The Third	62.5%	5,560	691	658	1,443	1,409	1,358
4. Sub Total Costs	100%	8,899	825	875	2,525	2,395	2,279
1) Foreign (M Yen)	65.3%	31,975	3,844	4,196	8,613	7,966	7,356
2) Local (M B)	34.7%	3,085	126	112	959	947	942
5. Contingency Cost	5%	445	41	44	126	120	114
6. Implementation Cost	5%	445	41	44	126	120	114
7. Grand Total Costs (4+5+6)	100%	9,789	908	962	2,778	2,634	2,507
1) Foreign (M Yen)	65%	35,172	4,229	4,615	9,474	8,763	8,091
2) Local (M B)	35%	3,394	139	123	1,055	1,041	1,036

2) Installation Cost of the Main Telephone Lines

The costs listed in Table 5.1.3-1 shows the Project costs excluding the installation costs for the additional main telephone lines, which are necessary to ease the traffic congestion for the high B-sub busy subscribers.

The amount of the necessary main telephone lines, which are required for a high B-sub busy subscriber, should be calculated by measuring the in-coming and out-going traffic of each subscriber. Therefore, it is impossible at this moment for the Study Team to estimate exactly how many main telephone lines can ease the traffic congestion for the high B-sub busy subscribers in total.

However, the additional main telephone lines are indispensable for those high B-sub busy subscribers who already use the hunting system but have frequent line-busy to improve their CCR.

The Study Team employs the following assumption:

a) The number of waiting applicants in the BMA is 1,038,886 at February 1992.
b) The half of the present waiting applicants are the existing subscribers who need additional main telephone lines to ease their traffic congestion.
c) Hence, the required number of main telephone lines for the high B-sub busy subscribers is approximately 500,000.

The tentative installation plan for the total 500,000 lines is set as follows:

Table 5.1.3-2 Tentative Installation Plan of the Main Telephone Line

(Unit: Lines)

FY	The Number of New Main Telephone Line Installed
1993	0
1994	0
1995	200,000
1996	200,000
1997	100,000
Total	500,000

The investment cost for the main telephone lines is estimated in the long-term plan. The total investment costs including the management and installation costs (20% of the investment cost) and excluding the terminal cost of the public telephone for 2,510,000

main telephone lines in the Study area for the Phase-1 (1993-1997) is estimated as 79,962 [(68,681 - 2,046) x 1.2) million Baht. Hence, the average investment cost per main telephone line is calculated as 38,253 Baht (see Vol. 1 page 16-21).

Table 5.1.3-3 Tentative Investment Costs for the Installation of the Main Telephone Line

FY	Annual Installation	Annual Investment Cost (Million Baht)
1995	200,000	7,650.65
1996	200,000	7,650.65
1997	100,000	3,825.33

5.1.4 Cost and Benefit Analysis of the Project

The main purpose of the financial analysis is to estimate the effects of the Project on the financial position in the future with and without the Project and analyze the feasibility of the Project from the financial point of view.

1) Rehabilitation Project

Table 5.1.4-1 shows the costs and the benefits of the Project only for the renewal and the rehabilitation projects, i.e., excluding the installation of new main telephone line, in terms of annual cash-flows. The internal rate of return on the Project is estimated as 22.61%.

Table 5.1.4-1 Cost and Benefit of the Project excluding the New Main Telephone Line Installation

(Unit: Million Baht)

Term	FY	Project Cost	Project Benefit			Net Balance
		Total	CCR	Fault	Total	
1	1993	907.56	429.93	7.00	436.93	-470.63
2	1994	962.34	1,189.24	20.01	1,209.25	246.91
3	1995	2,777.73	1,770.10	36.75	1,806.85	-970.88
4	1996	2,634.42	2,213.08	55.80	2,268.88	-365.54
5	1997	2,506.93	2,550.27	79.59	2,629.86	122.92
6	1998	1,928.71	2,695.93	79.59	2,775.52	846.81
7	1999	1,928.71	2,695.93	79.59	2,775.52	846.81
8	2000	1,928.71	2,695.93	79.59	2,775.52	846.81
9	2001	1,928.71	2,695.93	79.59	2,775.52	846.81
10	2002	1,928.71	2,695.93	79.59	2,775.52	846.81
FIRR						22.61%

a) The assumptions employed in this analysis are as follows:

i) The Project life is tentatively set to be the 10 years from FY 1993 to FY 2002 though the facilities which will be replaced in this Project have various durable years from 10 year to 30 year.

ii) The Project benefits from FY 1993 to FY 1997 are the estimation results in the previous part. The benefits from FY 1998 are set to be flat.

iii) The direct costs to implement the Project are taken into consideration. Tax on the increased revenues and any financial cost are not taken into account. The Costs of the Project from FY 1993 to FY 1997 are scheduled according to the Project implementation plan. On the other hand, the costs from FY 1998 to FY 2002 are set tentatively on the assumption that the average annual cost of the total Project is required from FY 1998 to maintain the telecommunications facility on the same quality level.

b) The financial analysis of the rehabilitation Project clarifies the following points:

i) If the CCR in the busy hour improves from 23.5% to 55.0% , the number of completed calls increases from 2,378.5 million to 3,088.0 million, which is approximately 30.0% up. On the other hand, the number of total offered calls becomes reduced from 6,442.5 million to 4,101.0 million, which is approximately 36.0% down. As the result, the network efficiency becomes improved.

ii) The Project benefit in FY 1997 is estimated to be 2,629.86 million Baht. Total revenue including subscription fee, local call charge, and the trunk call charge in the BMA as of FY 1991 is 9,423.05 million Baht (Source: TOT, Telephone Statistics 1991 [Billing Data]). The revenue increase rate of the Project becomes 27.9%.

iii) Improving the call completion ratio (CCR) contributes largely to the Project benefit. However, it should be noted that the rehabilitation of the network to decrease the faults is also indispensable not only to save the maintenance costs but also to increase the CCR.

iv) The call revenue increase effects by the Project are estimated using the model based on the assumptions and conditions with the limited number of variables. Therefore, the model has to be elaborated in order to be applied in the more microscopic level. However, it is sufficient to be applied for this macroscopic level of the BMA that has more than one million main telephone lines in total.

2) Rehabilitation Project and the New Installation of the Main Telephone Line

Table 5.1.4-2 shows the costs and benefits of the Project with the installation of the 500,000 new main telephone lines. The internal rate of return on the Project is estimated as 11.28%.

Table 5.1.4-2 Cost and Benefit of the Project including the Installation of the Main Telephone Line

(Unit: Million Baht)

	FY	Project Costs			Project Benefits			Net Balance	
		Rehabili.	New Install	Total	Rehabili.	New Install	Total	Annual	Accumu.
1	1993	908		908	437		437	-471	-471
2	1994	962	0	962	1,209	0	1,209	247	-224
3	1995	2,778	7,651	10,428	1,807	1,803	3,609	-6,819	-7,043
4	1996	2,634	7,651	10,285	2,269	2,874	5,142	-5,143	-12,185
5	1997	2,507	3,825	6,332	2,630	3,047	5,677	-655	-12,841
6	1998	1,929	0	1,929	2,776	2,680	5,456	3,527	-9,314
7	1999	1,929	0	1,929	2,776	2,680	5,456	3,527	-5,787
8	2000	1,929	0	1,929	2,776	2,680	5,456	3,527	-2,260
9	2001	1,929	0	1,929	2,776	2,680	5,456	3,527	1,267
10	2002	1,929	-5,355	-3,427	2,776	1,180	3,956	7,382	8,649
Total (5 years)		9,789	19,127	28,916	8,352	7,723	16,075	-12,841	
Total (10 years)		19,433	13,771	33,204	22,229	19,623	41,852	8,649	
FIRR									11.28%

a) The assumptions employed in this analysis are as follows:

i) The Project life is tentatively set to be the 10 years from FY 1993 to FY 2002. When the facilities have remaining useful life time at the end of the Project

life, non-used value is recovered. The life time of the facilities for new installation is set as 10 year though they include switches, cables, transmission, etc. whose life times are longer than 10 years.

ii) The direct costs to implement the Project are taken into consideration. The installation of the additional 500,000 main telephone lines increases the operation and maintenance costs of TOT; however, this cost increase effect is not taken into consideration. Any taxation and financial costs are not taken into consideration at this stage.

iii) The benefit of the new installation is composed of the installation fee, monthly rate, and local call and trunk call revenues. The average local and trunk call revenues per line estimated in the long-term plan are also applied in these revenues estimation. The deposit is also included but the total deposits are to be returned at the end of the Project life.

b) The financial analysis of the rehabilitation Project with the installation of the main telephone line clarifies the following points:

i) The rehabilitation Project brings the revenues increase to the TOT and the IRR is positive.

ii) The total investment cost increases approximately 1,900 million Baht during the initial three year (1995-1997) for the 500,000 lines' installation. On the other hand, this brings the revenue increases approximately as same amount as the investment costs during 8 years from FY 1995 to FY 2002.

iii) The benefits for the rehabilitation project is 22,229 million Baht while those of the new installation is 19,623 million Baht in total. Comparing the total Project benefits, there is no significant difference between the rehabilitation project and the 500,000 lines' new installation plan.

iv) Comparing the total Project costs, the costs of the rehabilitation Project is bigger than those of the new installation plan in the total 10 years. However, comparing the total costs in the initial five years, the costs of the rehabilitation Project is approximately half of the new installation plan. Therefore, the rehabilitation Project is more effective in terms of cost performance in the short-period.

5.1.5 Financing Availability

The cost and benefit analysis of the Project indicates that the Project generates the revenues increase and the IRR is positive in the both cases of the rehabilitation Project only and the rehabilitation Project with the 500,000 lines installation plan. The issues to be investigated in the next is how to finance the Project to implement.

Table 5.1.5 shows the financing simulation to implement the Project. TOT's own funds are provided to make the annual cash balances positive. The total required amount of the own fund is 12,900 million Baht for the initial five years period. The cash balance from FY 1998 becomes positive with cash generation by the Project itself. The required amount of the funds for the first year is 500 million Baht. That of the third year is 6,700 million Baht, and the forth year is 5,000 million Baht.

Table 5.1.5 Financing Assumption for the Project with 500,000 Lines Installation

(Unit: Million Baht)

FY	Cash Balance at Beginning	Own Fund	Project Operation	Cash Balance at Ending
1993	0	500	-471	29
1994	29	0	247	276
1995	276	6,700	-6,819	157
1996	157	5,000	-5,143	15
1997	15	700	-655	59
1998	59		3,527	3,586
1999	3,586		3,527	7,113
2000	7,113		3,527	10,640
2001	10,640		3,527	14,167
2002	14,167		7,382	21,549
Total		12,900	8,649	

Annual budget of TOT for the project investments was 8,042 million Baht and 9,802 million Baht in FY 1989 and FY 1990 respectively. These budgets were allocated to expand the telecommunications network to install main telephone lines. The private company named "Telecom ASIA" will invest to construct the local network and to install 2 million telephone lines in the BMA. TOT, on the other hand, will not need to invest for the expansion and installation projects except for the rural telephone project, the network rehabilitation projects, and so forth.

Therefore, TOT can allocate the sufficient budget for the rehabilitation Projects on its existing network. If the TOT's total budgets for the project investments during the next five years can be estimated as 50,000 million Baht (10,000 Million Baht X 5 years), the estimated 12,900 million Baht of its own fund in total accounts for only 25.8% of the total budgets estimation. Hence, the rehabilitation Project is feasible from the financial viewpoint.

5.1.6 Conclusion of the Financial Evaluation

This section clarifies the following points.

1) The total cost of the proposed rehabilitation Project excluding the new telephone lines installation plan is 9,789 million Baht for the five years period.

2) The implementation of the Project will decrease the number of faults, which recovers the lost call revenues for 24.08 million Baht and saves the repairing work load for 175.07 million Baht in total during the five years period.

3) The implementation of the Project will increase the number of complete calls, which brings the call revenues increase for 8,152.62 million Baht in total during the five years period.

4) The IRR of the Project is estimated as 22.61%. The IRR of the Project with 500,000 lines installation plan is estimated as 11.28%.

5) The rehabilitation Project can be financed and carried out within the TOT's own funds and the internal cash generations.

5.2 Social and Economical Evaluation

The Present Issues

The implementation of the proposed Project can solve the present issues on the telecommunications services quality in the BMA. The problems at present are described as follows:

1) From the Users Viewpoint

a) Telephone subscribers find sometimes that their telephones are out of order and try to call the TOT service claim center ("17" Center). However, their lines are always busy. Even after they succeed to claim their faults and ask TOT to repair, they sometimes have to wait more than one week for TOT to dispatch repairing teams. Some subscribers can not wait for so long that they try to repair their fault lines by themselves, which may cause another faults later.

b) Even if the users succeed to have repairing teams from TOT, the users are told that the causes of the faults are in their terminal systems or in-house wiring so that TOT staff can not do anything. TOT repairing teams go back without doing anything and the faulty telephones remain. The users still can not make any call before somebody fixes their telephone sets and/or in-house wiring.

c) Some telephone users use their telephones so often that they find it is difficult not only for their customers but also for themselves to make out-going calls from their offices and to make in-coming calls from outside. Therefore, they want to install additional telephone lines but they have to wait for approximately 4 or 5 years for a new telephone line in the BMA at present.

d) Some telephone users may continue to call changed telephone numbers because they are not informed new telephone numbers. Before they become aware that the lines are not used or the telephone numbers are changed, they may try to call many times to hear only the ringing-tone but they never hear any voice or reply signal.

e) In order to know the new telephone numbers or confirm the correct telephone numbers, the customers try to call the TOT CDAS Center for telephone directory services ("13" service) but they find again that the lines are always busy and it is difficult to get the correct telephone numbers.

f) In the area of heavy telephone traffic congestion, particularly in the Surawong Exchange area, the users often can not hear the dial-tone or they can hear the busy-tone in the morning busy hours. Secretaries and clerks ordinary continue to re-dial for about 15 minutes or even an hour to make one telephone call in the morning This also makes the traffic congestion worse. The users have to wait until the afternoon or they have to send some messengers riding motorbikes that may cause traffic congestion in the streets and air pollution in the BMA.

g) The PABX users have more than one main telephone line but hunting systems are not widely used among them. Because there are misunderstandings among TOT staff that only the PABX subscribers can use the hunting system and only 5% of the switching capacity could use the system, many subscribers are using their multi-lines without the hunting system.

2) From the Economic and Social Viewpoints

a) Because the telecommunications service quality in the BMA is in a poor level, the telephone network is not reliable to send a vast amount of information such as transferring data files among computer systems. It is better to use fast delivery services instead of telecommunications. However, delivery services require the longer time to send information, increases traffic congestion on the road network, and wastes the valuable natural resources and time.

b) The domestic communications as well as the international communications are one of the most essential business tools for the companies whose activities and markets are spread worldwide. Without reliable, speedy, easy-to-use, many, and economical telecommunications services, present business activities can not function in this information oriented world.

c) The telecommunications service quality differs so wide among the developing countries and cities. The cities and states that can provide sufficient, many, reliable, speedy, and economical telecommunications services can become telecommunications hubs or information centers in this region. If Bangkok can not provide these services, multinational business firms will not shift their operations to Bangkok and domestic large corporations may shift some parts of their Headquarters functions from Bangkok to other cities.

3) From the Viewpoints of TOT

a) Subscribers terminal sets, systems, and the in-house wiring are not the possessions of TOT. TOT is not in charge of maintenance on subscribers' facilities; therefore, when the repairing staff find some faults in customers' telephone sets and in-house wiring, the staff can not do any repair work for customers and must go back to repair other faults. Subscribers' terminals and in-house wiring cause large portion of faults claimed by subscribers. Their faults waste a large amount of the work load of the repairing teams.

b) Old and small buildings are being demolished and many new high rise buildings are now under construction in the BMA. Roads are also under construction in many places. Drop-wires and subscriber cables which hang on electric poles are often gotten detached from them and left alone without any temporary measure.

c) Heavy storms often blow out cables and wires. Trees along sidewalks sometimes damage cables. Small insects cause damages in cables. All the influences of social and natural environments are severe for the outside plant of the telecommunications networks in the BMA.

d) Most of telephone users do not wait for even three minutes before they re-dial when they get busy signals. If they can wait for three minutes to re-dial after encountering B-sub busy conditions, the possibility of call completion becomes much higher. Because users often and quickly make re-dials, the network congestion becomes worse.

e) Because of frequent faults and the low CCR, the lost telephone call revenue is so large and the investment and maintenance costs to maintain the networks in the operational condition become higher.

Conclusions

It is possible and expected for TOT to solve all the above mentioned issues by implementing the proposed rehabilitation, replacement, renewal Projects. As the results of the Project implementation, the following effects will be expected to the users, the society, and the telecommunications sector. Figure 5.2 illustrates how they will be benefited by the Project.

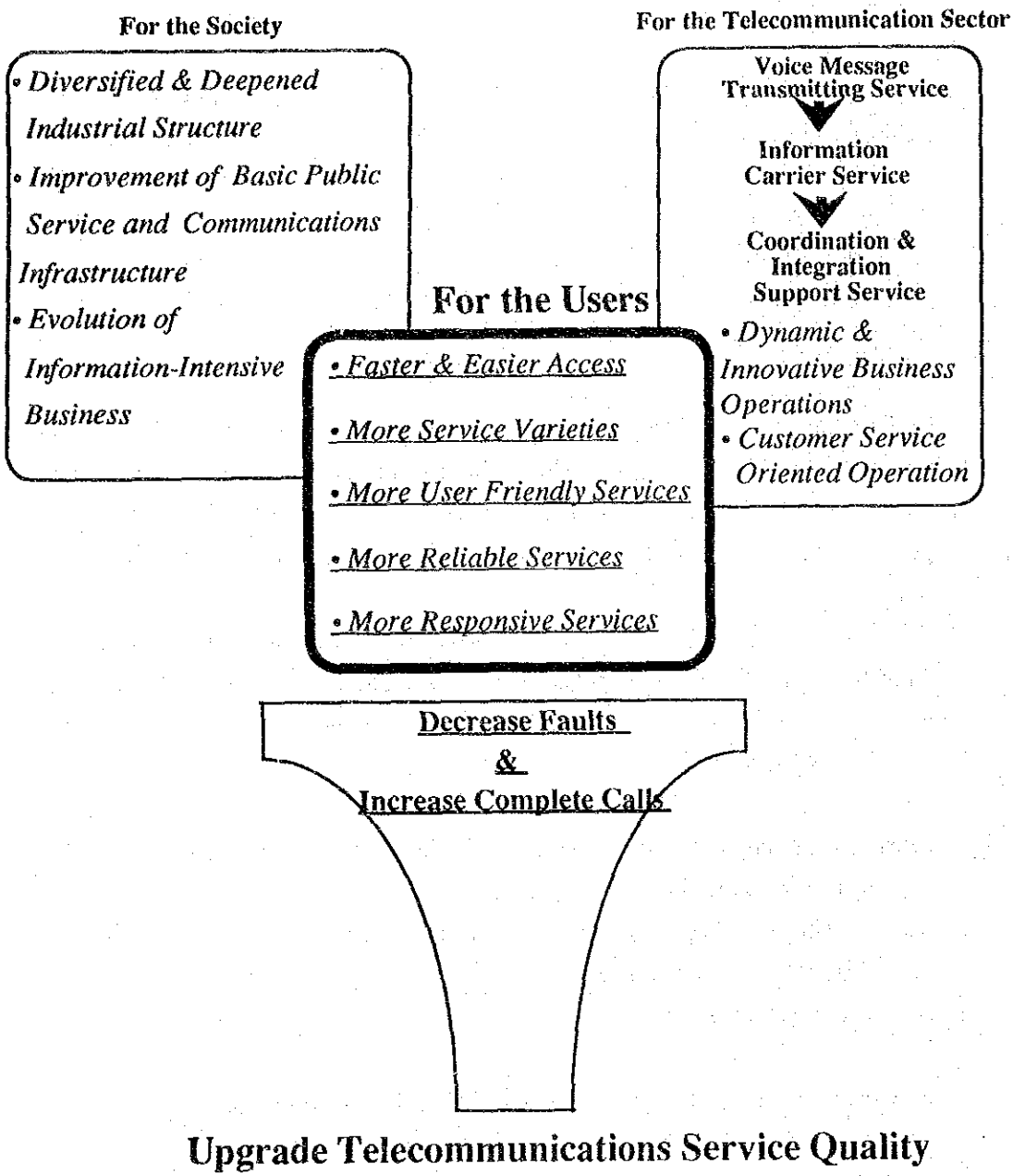

Figure 5.2 Effects of the Project

1) To the Users

As the results of the Project, users can expect:

- faster and easier access,
- more reliable services,
- more responsive services,
- more service varieties,

- more user friendly services.

Together with the network expansion and modernization, improvement and innovation in the operation and maintenance system can provide the customers with the fullest possible benefits of the services that TOT can offer. Business and residential users can enjoy not only better basic telecommunications services but also will be benefited from new intelligent services in operating business more strategically and captivating more intellectual life style.

2) To the Society

The economic growth in Thailand has been remarkable in recent years. People in Thailand expect to continue this economic growth well into the next decade. As a major infrastructure to support socioeconomic activities of people in Thailand, upgrading the telecommunications service quality is indispensable together with the expansion of the telecommunications network. The society will develop not only a sound platform of the basic infrastructure for national development and integration but also strategic infrastructure around which a new information intensive society can evolve.

3) To the Telecommunications Sector

It can be expected that modernization and expansion of the network (hardware improvement) coupled with operation and maintenance system changes (software improvement) will create an environment for dynamic and innovative business operations for TOT.

TOT can demonstrate not only how responsive and reliable it can be as the national basic telecommunications service carrier but also how innovative it can be in providing services to support strategic operations of business users and enrich the quality of life of the residential users. By meeting the needs of the customers and better serving the society, TOT can enhance its external business opportunities and enrich its internal corporate culture and strength.

Not only TOT but also the telecommunications industry as a whole may be forced into the situation in which the characteristics of the telecommunications business must be reviewed and redefined. The telecommunications business is no longer confined to the traditional voice messages transmitting service business but extends well beyond to information carrier service business. Many people expect further the telecommunications

business in the information society is expected to play a role of communications system integrators and coordination supporters on strategic alliances.

5.3 Technical Evaluation

There is no technical problem in implementing the Project to improve the call completion ratio and facility fault ratio. Since there are, however, relatively many exchange offices that do not have enough floor space for installing the SPC switches in replacing the XB switches, technical know-hows and careful planning are necessary for disconnecting and reconnecting lines and making an efficient use of the limited floor space. In rehabilitating the outside plant, technical know-hows are also needed particularly for cable replacement.

5.4 Recommendations

5.4.1 Adjustment of the Project

The proposed projects were formulated by examining several sample offices and maintenance areas because of the limited study period. When the projects are executed in the Study Area, therefore, some parts may be modified in accordance with the environment of the areas and a further study may be required by TOT itself by the reasons mentioned above. The Study Team, however, believes that these projects can be effectively carried out to upgrade the telecommunications service quality of TOT.

5.4.2 Coordination with the Seventh ESDP Expansion Project of TOT

The proposed projects are basically formulated for the existing telecommunications network facilities of TOT; however, another two million telephone lines constructed and operated by the private firm will be connected to the TOT networks by the end of 1996. Therefore, change of the TOT network condition must be taken into consideration for implementing some projects.

For example, the traffic condition in the TOT networks will be affected by the connection of the new telecommunications network. More subscriber lines and trunk circuits will be required to improve the call completion ratio at that time.

5.4.3 Manpower and Procurement

To carry out the proposed projects, a huge size of manpower for design and construction will be required during the projects implementation period. In outside plant section particularly, TOT is required to provide necessary manpower for the designing and construction work. The Study Team recommends that several projects should be carried out by the TOT employees themselves from planning and designing to implementation of the projects. To experience implementation of the projects is a good chance for the TOT employees to improve their skills and techniques.

Implementation of the proposed projects requires vast volume of equipment and materials such as cables and switches. Since the seventh ESDP expansion project of TOT has been carried by the private firm and its expansion volume amounts 3 million telephone lines, shortage of construction work is foreseeable. It is, therefore, urgent for TOT to secure the necessary procurement and start the projects implementation.

5.5 Conclusion

The proposed projects are effective and essential to upgrade the telecommunications services quality. They therefore should be implemented immediately by TOT. The effects of the proposed projects are summarized as follows:

1) Financial Viewpoints

   a) Considerable project benefit
      - Project Cost (5 year period): 28,916 million Baht
      - Project Benefit (5 year period): 16,073 million Baht
      - FIRR (10 year period): 11.27%

   b) Manpower saving effect in the maintenance work (5 year period):
      - 432 persons (175 million Baht)

2) Social and Economic Viewpoints

   a) To the users

      - Enjoying every telecommunications service when necessary.

b) To the society

- Supporting socioeconomic activities.

c) To the telecommunications sector

- Creating an environment for dynamic and innovative business operation.

APPENDICES

CHAPTER 1 INTRODUCTION

APPENDIX

MINUTES OF THE MEETINGS
ON
INCEPTION REPORT
FOR
A STUDY
ON
REGIONAL DEVELOPMENT PLAN
FOR
TELECOMMUNICATIONS NETWORK
IN
THE BANGKOK METROPOLITAN AREA
IN
THE KINGDOM OF THAILAND

The meetings were held on 19th and 22nd of July 1991 between Telephone Organization of Thailand (hereinafter referred to as "TOT") and the JICA Study Team (hereinafter referred to as "the Team") on the Inception Report (hereinafter referred to as "the Report") for a Study on Regional Development Plan for Telecommunications Network in the Bangkok Metropolitan Area in the Kingdom of Thailand (hereinafter referred to as "the Study"). The attendants of the meetings are shown in Annex-1.

1. The Team explained the Report and TOT accepted the Report.

2. Through the meetings, the following items have been agreed on between the both sides.

(1) TOT proposed to provide the Team with counterpart groups for each section and the Team accepted it.

(2) TOT explained that counterparts would be selected from Corporate Planning Office, Operation Department, Engineering Department, Human Resources Department, and Financial Department.

(3) For the purpose of mutual cooperation between TOT and the Team, and smooth execution of the Study, TOT counterpart groups and the Team members will have group meetings regularly once a week. All the counterpart members will have progress meetings regularly once a month.

(4) In the process of the Study, the Team will work in close cooperation with TOT counterparts and will make efforts to transfer technology through the meetings and discussions of the Study and the counterpart on-the-job-training in Japan.

(5) TOT requested the Team to consider new technologies such as Subscriber Optical Fiber Network, Asynchronous Transfer Mode (ATM), Synchronous Digital Hierarchy (SDH), to make the long-term plan and the Team accepted it.

(6) The Team requested TOT to provide necessary data and information in particular regarding the 7th EDP project. TOT tries to collect necessary data and information concerned the Study for the Team from the other organizations concerned.

(7) It was confirmed that JICA would accept one (1) counterpart for on-the-job-training in Japan in the Japanese fiscal year 1991 and that TOT would make necessary procedure. TOT wished to send more counterparts for on-the-job-training to Japan in the next Japanese fiscal year 1992. The Team promised to convey the wish to the Japanese organizations concerned.

Bangkok, July 22nd, 1991

Mr. Sanan PHIROMSWAD
Director of
Corporate Planning Office,
Telephone Organization of Thailand

Mr. Satoshi AKAIKE
Leader of the JICA Study Team

Mr. Osamu KOYAMA
Chairman of
Japanese Advisory Committee

ANNEX-1

ATTENDANTS LIST

July 19th, 1991

TOT

1.	Mr. Sanan PHIROMSWAD	Director of Corporate Planning Office
2.	Mr. Deacha MONGKOLRAT	Head of Corporate Planning Process Sector, Corporate Planning Office
3.	Mr. Chakree SUBPRAWONG	Counterpart Team leader, Corporate Planning Office
4.	Mr. Sawat CHAIYEN	Development Planning and Economy, Corporate Planning Office
5.	Mr. Amnuay THONGDEETARE	ditto
6.	Ms. Vilaiporn BOONYASURAKUL	ditto
7.	Miss Yupa LEEWONGCHAROEN	ditto
8.	Mr. Seree CHINTARATANA	Switching System, Corporate Planning Office
9.	Mr. Suwat NAKAPUNCHAI	ditto
10.	Ms. Jintana PRASERTSOM	Transmission System, Corporate Planning Office
11.	Capt. Akom KRACHANGMOL	ditto
12.	Mr. Kamron TEINTHONGDEE	Outside Plant and O&M, Corporate Planning Office
13.	Mr. Pichet LEEPITAKWATANA	ditto
14	Miss Atchada RUAMMAHASAP	Demand Forecast, Corporate Planning office

15.	Mr. Suwit TREJAREONWIWAT	New Services, Corporate Planning office
16.	Miss Chothip SUTHONTHUNYAKORN	ditto
17.	Miss Somsri NGOWROONGRUENG	Marketing Research, Corporate Planning office
18.	Miss Chanida SUKHAVIRAJ	Financial and Economic Analyses, Corporate Planning office
19.	Miss. Chadaporn KUNUDOM	ditto
20.	Ms. Valaikul SATTHARPHORN	Human Resources, Corporate Planning office
21.	Miss Ratree MALAISIRIRAT	ditto
22.	Ms. Kanungnid RATTANASEREEWONG	ditto

JICA Experts

23.	Mr. Toshihiro HIGUCHI	Engineering Department
24.	Mr. Masaaki KOTA	Telecommunication Network Department
25.	Mr. Sunao NANGU	Subscriber Services Department

Study Team

26.	Mr. Satoshi AKAIKE	Leader of JICA Study Team (NTTI)
27.	Mr. Katsumi MURAKAMI	Member (NTTI)
28.	Mr. Hiroshi NAKAI	ditto
29.	Mr. Hiroyuki KANO	ditto

Japanese Advisory Committee

30.	Mr. Osamu KOYAMA	Chairman (MPT)

31.	Mr. Kiyoshi KONO	Member (MPT)

JICA

32.	Mr. Noriki ASAHI	JICA Head Office

ATTENDANTS LIST

July 22nd, 1991

TOT

1.	Mr. Sanan PHIROMSWAD	Director of Corporate Planning Office
2.	Mr. Deacha MONGKOLRAT	Head of Coporate Planning Process Sector, Corporate Planning Office
3.	Mr. Chakree SUBPRAWONG	Counterpart Team leader, Corporate Planning Office
4.	Mr. Sawat CHAIYEN	Development Planning and Economy, Corporate Planning Office
5.	Mr. Seree CHINTARATANA	Switching System, Corporate Planning Office
6.	Ms. Jintana PRASERTSOM	Transmission System, Corporate Planning Office
7.	Mr. Kamron TEINTHONGDEE	Outside Plant and O&M, Corporate Planning Office
8.	Miss Atchada RUAMMAHASAP	Demand Forecast, Corporate Planning office
9.	Mr. Suwit TREJAREONWIWAT	New Services, Corporate Planning office
10.	Miss Somsri NGOWROONGRUENG	Marketing Research, Corporate Planning office

11.	Miss Chanida SUKHAVIRAJ	Financial and Economic Analyses, Corporate Planning office
12.	Ms. Valaikul SATTHARPHORN	Human Resources, Corporate Planning office

JICA Experts

13.	Mr. Toshihiro HIGUCHI	Engineering Department

Study Team

14.	Mr. Satoshi AKAIKE	Leader of JICA Study Team (NTTI)
15.	Mr. Katsumi MURAKAMI	Member (NTTI)
16.	Mr. Hiroshi NAKAI	ditto
17.	Mr. Hiroyuki KANO	ditto

Japanese Advisory Committee

18.	Mr. Osamu KOYAMA	Chairman (MPT)
19.	Mr. Kiyoshi KONO	Member (MPT)

JICA

20.	Mr. Noriki ASAHI	JICA Head Office

MINUTES OF THE MEETINGS
ON
INTERIM REPORT
FOR
A STUDY ON REGIONAL DEVELOPMENT PLAN
FOR
TELECOMMUNICATIONS NETWORK
IN
THE BANGKOK METROPOLITAN AREA
IN
THE KINGDOM OF THAILAND

The meetings were held on 20th and 21st of January 1992 between Telephone Organization of Thailand, (hereinafter referred to as "TOT") and the JICA Study Team (hereinafter referred to as "the Team") on the Interim Report (hereinafter referred to as "the Report") for a Study on Regional Development Plan for Telecommunications Network in the Bangkok Metropolitan Area in the Kingdom of Thailand (hereinafter referred to as "the Study")

The attendants of the meetings are shown in Annex.

1. Mr. Sanan PHIPOMSWAD, Director of Corporate Planing Office of TOT, expressed his gratitude to the Team members for their study, and Mr. Osamu Koyama, Chairman of Japanese Advisory Committee and Mr. Satoshi AKAIKE, Leader of the Team, appreciated the close cooperation of TOT counterparts.

2. The Team made a presentation of the Report and TOT accepted the Report.

3. Through the meetings, the followings have been agreed on between the both side.

3.1 Regarding the Report:

1) TOT pointed out that the demand forecasts for paging services and mobile telephone services should be reviewed again and the Team accepted to review the forecasts.

2) TOT and the Team confirmed that TOT will send comments and questions if any regarding the Report by the middle of February 1992 and the Team will clarify and take them into consideration in the Draft Final Report.

3) TOT pointed out that the concept of the operation right to the private firm should be changed to collaborating of work and investment with the private firm.

3.2 Regarding the Feasibility Study:

1) TOT and the Team confirmed that the title of the Feasibility Study to be conducted in the next phase of the Study is changed from "Replacement of Deteriorated Facilities" to "Implementation Plan to Upgrade the Telecommunications Services Quality".

2) TOT and the Team confirmed that the feasibility study will focus on the following objectives:
   a) Improvement of Fault Ratio,
   b) Improvement of Call Completion Ratio.

3) The Team will study the following measures which are related directly to the above mentioned objectives:
   a) Replacement of deteriorated facilities,
   b) Maintenance management standards,
   c) Installation and construction methods.

Bangkok, January 21st, 1992

Mr. Sanan Phiromswad
Director of Corporate Planning
Office,
Telephone Organization of Thailand

Mr. Satoshi Akaike
Leader of the JICA Study Team

Mr. Osamu Koyama
Chairman of
Japanese Advisory Committee

ANNEX

ATTENDANTS LIST OF THE MEETING on January 20, 1992

TOT

Name	Duty in Charge	Department
Mr Sanan Phiromswad	Director of Office of Corporate Planning TOT	Corporate Planning Office
Mr. Deacha Mongkolrat	Head of Process Sector of CPO	ditto
Mr. Apichat Indralagshana	Acting Head of Corporate Planning Policy	ditto
Mr Chakree Subprawong	Leader of the Counterpart Team of TOT	ditto
Mr Sawat Chaiyen	Development Planning, Economy	ditto
Mr. Amnuay Thongdeetare	ditto	ditto
Ms. Vilaiporn Boonyasurakul	ditto	ditto
Ms. Issra Fongsrun	ditto	ditto
Mr Suwat Nacapunchai	Switching System	ditto
Ms. Jintana Prasertsom	Transmission System	ditto
Maj. Akom Krachangmol	ditto	ditto
Mr Kamron Teinthongdee	Outside Plant and O&M	ditto
Mr. Pichet Leepitakwatana	ditto	ditto
Mr. Tinnakorn Itsrangkul Na Ayuthaya	Telecommunications Network, Traffic Forecast	ditto
Mr Somchai Vicmuktanont	ditto	ditto
Ms Archada Ruammahasap	Demand Forecast	ditto
Mr. Takbin Hengtrakul	ditto	ditto
Mr. Suwit Trecharoenviwat	New Services	ditto

Name	Duty in Charge	Department
Ms. Chothip Suthonthunyakorn	ditto	Corporate Planning Office
Mr. Prateep Thirati	Marketing Research	ditto
Ms. Someri Ngowroongrueng	ditto	ditto
Mr. Chanatip Vijakkhana	ditto	ditto
Ms. Apinya Klinfung	Marketing Research	ditto
Ms. Chanida Sukhaviraj	Financial and Economic Analysis	ditto
Ms Chadaporn Kunudom	ditto	ditto
Ms. Yupa Leewongcharoen	ditto	ditto
Ms. Valaikul Sattharphorn	Human Resources	ditto
Ms. Ratree Malasirirat	ditto	ditto
Ms. Kanungnid Rattanasereewong	ditto	ditto
Mr. Nimit Wattanutchariya	Switching System	Bureau of Engineering & Project
Mr. Prasert Manpiboon	ditto	Bureau of Operation
Mr. Charoen Wilaihong	Transmission System	Bureau of Operation
Mr. Sorrasak Sookthai	Traffic Forecast	Bureau of Engineering & Project
Ms. Wannaporn Lilahajiva	Financial	Bureau of General Affairs
Ms. Sanipong Hongspanij	Human Resources	ditto

JICA Expert

Mr. Toshihiko Higuchi	Engineering Department, TOT

Japanese Advisory Committee

Mr. Osamu Koyama	Chairman (New Service)	Senior Advisor for International Cooperation, Communications Policy Bureau. Ministry of Posts and Telecommunications (MPT)
Mr. Kiyoshi Kono	Member (Network Planning)	Assistant Director, Teleccomunications Systems Division, Telecommunications Bureau, MPT
Mr Nozomu Goda	Member (Switching System Planning)	Info-communications Development Specialist, Institute for International Cooperation, Japan International Cooperation Agency (JICA)

The JICA Study Team

Mr. Satoshi Akaike	Leader of JICA Study Team, NTT International Corporation (NTTI)
Mr. Katumi Murakami	Assistant Team Leader / Transmission System Planning (NTTI)
Mr. Kiyoshi Mushu	Network Planning (NTTI)
Mr. Hiroyuki Kano	Financial and Economic Analysis (NTTI)

JICA

Mr. Haruhiko Yoshida	JICA Head Office

ATTENDANTS LIST OF THE MEETING on January 21, 1992

TOT

Name	Duty in Charge	Department
Mr. Sanan Phiromswad	Director of Office of Corporate Planning TOT	Corporate Planning Office
Mr. Deacha Mongkolrat	Head of Process Sector of CPO	ditto
Mr. Chakree Subprawong	Leader of the Counterpart Team of TOT	ditto
Mr. Sawat Chaiyen	Development Planning, Economy	ditto
Mr. Amnuay Thongdeetare	ditto	ditto
Ms. Vilaiporn Boonyasurakul	ditto	ditto
Mr. Suwat Nacapunchai	Switching System	ditto
Ms. Jintana Prasertsom	Transmission System	ditto
Mr. Kamron Teinthongdee	Outside Plant and O&M	ditto
Mr. Pichet Leepitakwatana	ditto	ditto
Mr. Tinnakorn Itsrangkul Na Ayuthaya	Telecommunications Network, Traffic Forecast	ditto
Mr. Somuchai Vicmuktanont	ditto	ditto
Mr. Suwit Trecharoenviwat	New Services	ditto
Ms. Chothip Suthonthunyakorn	ditto	ditto
Mr. Prateep Thirati	Marketing Research	ditto
Ms. Somsri Ngowroongrueng	ditto	ditto
Mr. Chanatip Vijakkhana	ditto	ditto
Ms. Chanida Sukhaviraj	Financial and Economic Analysis	ditto
Ms. Chadaporn Kunudom	ditto	ditto
Ms. Yupa Leewongcharoen	ditto	ditto
Ms. Valaikul Sattharphorn	Human Resources	ditto

Sanan SA

Name	Duty in Charge	Department
Ms. Ratree Malasirirat	Human Resources	Corporate Planning Office
Ms. Kanungnid Rattanasereewong	ditto	ditto
Mr. Nimit Wattanutchariya	Switching System	Bureau of Engineering & Project
Mr. Prasert Manpiboon	ditto	Bureau of Operation
Mr. Thawisak Kittijarurak	Transmission System	Bureau of Engineering & Project
Mr. Sorrasak Sookthai	Traffic Forecast	ditto

JICA Expert

Mr. Toshihiko Higuchi	Engineering Department, TOT

Japanese Advisory Committee

Mr. Osamu Koyama	Chairman (New Service)	Senior Advisor for International Cooperation, Communications Policy Bureau, Ministry of Posts and Telecommunications (MPT)
Mr. Kiyoshi Kono	Member (Network Planning)	Assistant Director, Teleccomunications Systems Division, Telecommunications Bureau, MPT
Mr. Nozomu Goda	Member (Switching System Planning)	Info-communications Development Specialist, Institute for International Cooperation, Japan International Cooperation Agency (JICA)

The JICA Study Team

Mr. Satoshi Akaike	Leader of JICA Study Team, NTT International Corporation (NTTI)

Mr Katumi Murakami	Assistant Team Leader / Transmission System Planning (NTTI)
Mr. Kiyoshi Mushu	Network Planning (NTTI)
Mr Hiroyuki Kano	Financial and Economic Analysis (NTTI)

JICA

Mr. Haruhiko Yoshida	JICA Head Office

MINUTES OF THE MEETINGS
ON
DRAFT FINAL REPORT
FOR
A STUDY ON REGIONAL DEVELOPMENT PLAN
FOR
TELECOMMUNICATIONS NETWORK
IN
THE BANGKOK METROPOLITAN AREA
IN
THE KINGDOM OF THAILAND

The meetings were held on 11th, 13th and 14th of August, 1992 between Telephone Organization of Thailand (hereinafter referred to as "TOT") and the JICA Study Team (hereinafter referred to as "the Team") on the Draft Final Report (hereinafter referred to as "the Report") for a Study on Regional Development Plan for Telecommunications Network in the Bangkok Metropolitan Area in the Kingdom of Thailand (hereinafter referred to as "the Study").

The attendants of the meetings are shown in Annex.

K.S

1. Mr. Sanan PHIROMSWAD, Director of Corporate Planning Office of TOT, expressed his gratitude to the Team members for their study, and Mr. Kaoru SUZUKI, Chairman of Japanese Advisory Committee and Mr. Satoshi AKAIKE, Leader of the Team, appreciated the close cooperation of TOT counterparts.

2. The Team made a presentation of the Report and TOT accepted the Report.

3. Through the meetings, the followings have been agreed between the both sides.

1) TOT pointed out that in the measures for the faulty public telephones, it should be considered not only by way of the replacement but also by way from the viewpoint of the effective usage of the existing facility.

The Team accepted to add necessary measures for it in the Final Report.

2) TOT pointed out that the replacement of XB switches with SPC switches should be considered further from the availability of maintenance parts of XB switches in the future.

The Team replied to add necessary comments on this matter in the Final Report.

SA

K.S.

3) TOT pointed out the cost for the replacement of XB switches with SPC switches seemed to be underestimated. The Team replied to reestimate it again for the Final Report.

TOT and the Team confirmed that TOT will send comments and questions, if any, regarding the Report by 15th of September, 1992. The Team will clarify comments and questions and, if necessary, take them into consideration in the Final Report.

Bangkok 17th August, 1992

Sanan Phiromswad

Mr.Sanan PHIROMSWAD
Director of Corporate Planning Office,
Telephone Organization of Thailand.

S. Akaike

Mr.Satoshi AKAIKE
Leader of the JICA
Study Team

鈴木薫

Mr.Kaoru SUZUKI
Chairman of
Japanese Advisory Committee

SA
K. S.
Sanan

Annex

ATTENDANTS LIST OF THE MEETINGS

on August 11, 1992

Name	Duty in Charge	Department
TOT		
Mr.Deacha MONGKOLRAT	Head of Process Sector of Corporate Planning Office	(CPO)
Mr.Chakree SUBPRAWONG	Leader of the Counterpart Team of TOT	CPO
Mr.Seree CHINTARATANA	Switching System	CPO
Mr.Suwat NAKHAPHANCHAI	ditto	CPO
Ms.Jintana PRASERTSOM	Transmission System	CPO
Maj.Arkom KRACHANGMOL	ditto	CPO
Mr.Kamron TEINTHONGDEE	Outside Plant and O&M	CPO
Ms.Chothip SUTHONTHUNYAKORN	ditto	CPO
Mr.Pichet LEEPITAKWATANA	ditto	CPO
Mr.Somchai VICMUKTANON	Telecommunications Network and Traffic	CPO
Ms.Chanida SUKHAVIRAJ	Financial and Economic Analyses	CPO
Ms.Yupa LEEWONGCHAROEN	ditto	CPO
Ms.Chadaporn KUNUDOM	ditto	CPO
Ms.Atchada RUAMMAHASAP	Demand Forecast	CPO
Mr.Amnuay THONGDEETARE	Development Planning, Economy	CPO

Mr.Nimit WATTANUTCHARIYA	Switching System	Bureau of Engineering and Project
Mr.Chavalit JIARANUCHART	ditto	ditto
Mr.Charoen WILAIHONG	Transmission System	Bureau of Operation
Mr.Thawisak KITTIJARURAK	ditto	Bureau Engineering and Project
Mr.Somchai NAKPLUANG	Telecom Network and Traffic	ditto
Mr.Pattharin PATTHARASIKARIN	ditto	ditto
Mr.Sorrasak SOOKTHAI	Traffic Forecast	ditto
Mr.Amroong HEEBTAMAI	Outside Plant and O&M	Bureau of Operation
Mr.Sopchoke SOMCHAIWONG	ditto	ditto
Mr.Surasak PUTNONVIT	ditto	ditto
Mr.Subphong THANTARAWON	O&M	ditto
Mr.Sinchai KAMOLRUNGSRIPORN	Network & Traffic	ditto
Ms.Sanipong HONGSPANIJ	O&M	Bureau of General affairs
Ms.Wannaporn LILAHAJIVA	Financial and Economic Analyses	ditto

The JICA Study Team

Mr.Satoshi AKAIKE	Leader of JICA Study Team, NTT International Corporation (NTTI)
Mr.Kiyoshi MUSHU	Network Planning (NTTI)
Mr.Tomoyoshi ASO	Outside Plant Systems Planning (NTTI)
Mr.Hiroyuki KANO	Financial and Economic Analysis (NTTI)

ATTENDANTS LIST OF THE MEETINGS

on August 13, 1992

Name	Duty in Charge	Department
TOT		
Mr.Chakree SUBPRAWONG	Counterpart Team Leader	CPO
Mr.Arkom KRACHANGMOL	Transmission System	CPO
Ms.Atchada RUAMMAHASAP	Demand Forecast	CPO
Ms.Yupa LEEWONGCHAROEN	Financial and Economic	CPO
Mr.Somchai NAKPLUANG	Traffic	NCOM Center
Mr.Charoen WILAIHONG	Transmission System	BMTC
Japanese Advisory Committee		
Mr.Kaoru SUZUKI	Chairman	Senior Advisor for International Cooperation, Communications Policy Bureau, Ministry of Posts and Telecommunications (MPT)
Mr.Kiyoshi KONO	Member	Assistant Director, Telecommunication Systems Division, Telecommunications Bureau, MPT
The JICA Study Team		
Mr.Satoshi AKAIKE		Leader of JICA Study Team, NTT International Corporation (NTTI)
Mr.Kiyoshi MUSHU		Network Planning (NTTI)
Mr.Tomoyoshi ASO		Outside Plant Systems Planning (NTTI)

	Mr.Hiroyuki KANO	Financial and Economic Analysis (NTTI)
JICA		
	Mr.Motoi MURAOKA	JICA Head Office

ATTENDANTS LIST OF THE MEETINGS

on August 14, 1992

Name		Duty in Charge
TOT		
Dr.Paiboon LIMPAPHAYOM		Managing Director
Mr.Kiat SIRIBHARP		Deputy Managing Director of Bureau of General Affairs
Mr.Swat SRIKHAM		Deputy Managing Director of Bureau of Operations
Mr.Jumpone HERABAT		Deputy Managing Director of Bureau of Engineering and Project
Mr.Sanan PHIROMSWAD		Director of Corporate Planning Office
Other Executives		
Japanese Advisory Committee		
Mr.Kaoru SUZUKI	Chairman	Senior Advisor for International Cooperation, Communications Policy Bureau, Ministry of Posts and Telecommunications (MPT)
Mr.Kiyoshi KONO	Member	Assistant Director, Telecommunication Systems Division, Telecommunications Bureau, MPT

The JICA Study Team

Mr.Satoshi AKAIKE	Leader of JICA Study Team, NTT International Corporation (NTTI)
Mr.Kiyoshi MUSHU	Network Planning (NTTI)
Mr.Tomoyoshi ASO	Outside Plant Systems Planning (NTTI)
Mr.Hiroyuki KANO	Financial and Economic Analysis (NTTI)

JICA

Mr.Motoi MURAOKA	JICA Head Office

CHAPTER 2 IMPROVEMENT OF FACILITY FAULT RATIO

APPENDIX

APPENDIX

2.2 Outside Plant

2.2.1 Outline of the Outside Plant Configuration for the Local Cable Network

Figure 2.2.1-1 and Figure 2.2.1-2 show how the outside plant for a local cable network is structured in simple diagrams. An exchange area is divided into cabinet areas which serve as distribution unit areas according to the number of people who demand for access to the network. The local cables normally consist of primary cables and secondary cables. The primary cables are installed between the exchange and the cabinets as feeders, the primary cable pairs are connected to a cabinet and then connected with the secondary cable pairs. The secondary cables are wired within a cabinet area as distributors. The secondary cable pairs are connected to terminals installed on poles, walls, etc. Normally, the primary cables are laid in conduit pipes installed underground and the secondary cables are hung on poles.

A subscriber set is connected to a cable pair with a drop wire and inside wire. These wires are usually connected with a protector installed at a customer's residence.

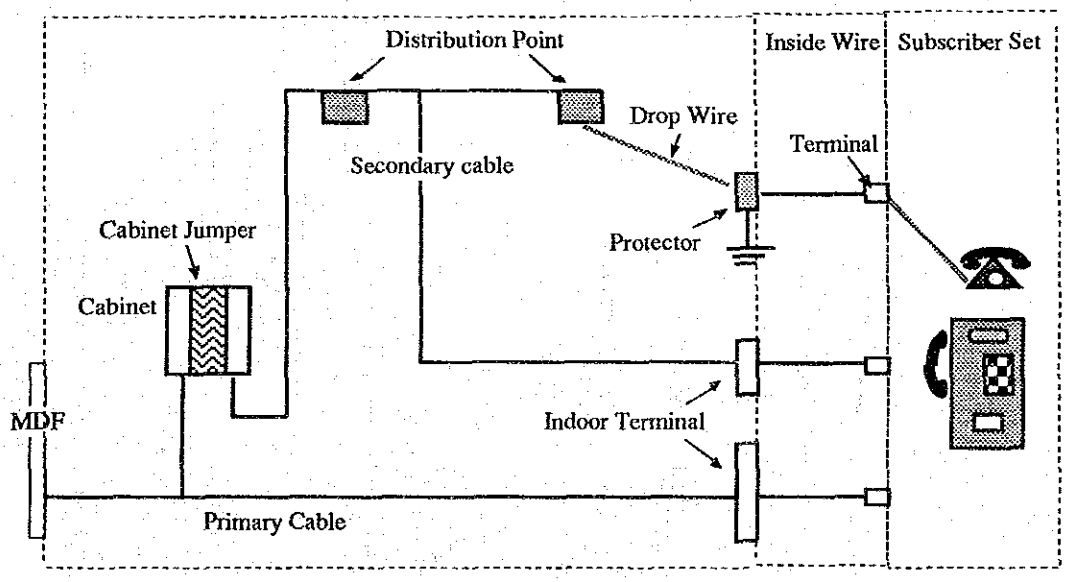

Figure 2.2.1-1 Structure of Local Cable Network of TOT (1/2)

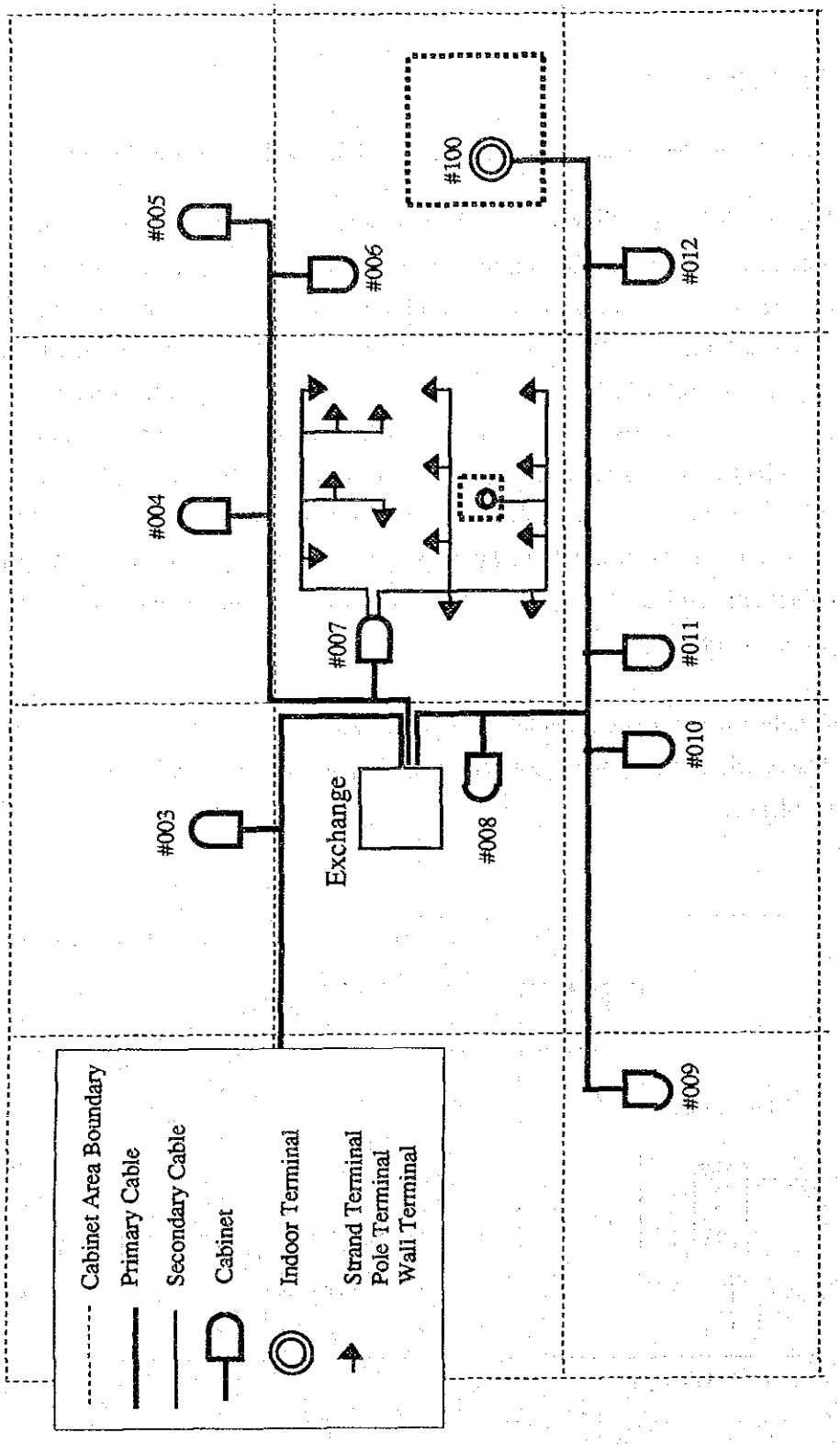

Figure 2.2.1-2 Structure of Local Cable Network of TOT (2/2)

2.2.3 Estimation of Work Volumes, Investment Costs and Effects for the Improvement Measures

Work volumes, investment costs and effects of the improvement measures are estimated by following procedures.

1) Rehabilitation of the Secondary Cables

a) Work Volume

$$Wsc = Vsc \times Psc \quad \text{(pair-km)}$$

Wsc : Work Volume of Rehabilitation for the Secondary Cables (pair-km)

Psc : Percentage of the Secondary Cables to be Rehabilitated (%)

Vsc : Amount Volume of the Existing Secondary Cables (pair-km)

$$Vsc = Vpc \times (1 - Pit) \times Rps \times Lsc$$

Vpc : Amount Volume of the Existing Primary Cables (pair)

BMA (April 1992) = 2,203,400 Pairs

Surrounding Area (Estimated) = 90,500 Pairs

Pit : $\dfrac{\text{No. of Primary Cable Pairs Connected to Indoor Terminals}}{\text{Total No. of Primary Cable Pairs}} = 0.1$

Rps : $\dfrac{\text{Number of Secondary Cable Pairs Connected to Cabinets}}{\text{Number of Primary Cable pairs Connected to Cabinets}} = 1.4$

Lsc : Average Length of the Secondary Cable Pairs (km) = 0.4

b) Investment Cost = (Work Volume) x (Unit Price)

Unit prices are estimated in due consideration of the investment cost for the 5th EDP of TOT.

Estimated Unit Price for TOT Work = 5,600 Baht / Pair-km

Estimated Unit Price for Contract Work = 9,400 Baht / Pair-km

c) Effect

For this estimation, it is assumed that the rehabilitation is carried out in order of high fault ratio area.

$$Eex1 = \{ Fsc(Psc) - (Fex1 \times Psc) \} \times Rsc$$

Eex1 : Expected Percentage Reduction of the Cable Faults

Fsc(Psc) : Percentage Share of the Secondary Cable Faults on Psc(%) of the Existing Secondary Cables. This is given by Table 2.2.3-1.

Fex1 : Expected Rate of the Secondary Cable Faults after the Rehabilitation. This is set at the average value of the faults in 30% from better side of the existing secondary cables.

$$Fex1 = \frac{\sum_{Psc=70\%}^{Psc=100\%} \text{Percent Share of the Faults}}{30} = \frac{(1 - 0.95) \times 100}{30} = 0.17$$

Rsc : Percentage Share of the Cable Faults on the Secondary Cables

$$Rsc = \frac{\text{Total No. of the Secondary Cable Faults}}{\text{Total No. of the Cable Faults}} = 0.6$$

Table 2.2.3-1 Distribution of the Repaired Secondary Cable Faults in the Krungkasem Exchange Area

Cabinet No.	No. of Repairs	No. of Pairs	Repair / 100 Pairs	Cumulative No. of Faults	Cumulative No. of Pairs
48	9	200	4.50	0.034	0.007
143	9	250	3.60	0.069	0.017
74	7	200	3.50	0.096	0.024
12	10	300	3.33	0.134	0.036
13	9	300	3.00	0.169	0.047
70	9	300	3.00	0.203	0.058
8	9	350	2.57	0.238	0.071
47	6	250	2.40	0.261	0.080
152	6	250	2.40	0.284	0.090
150	7	300	2.33	0.310	0.101
15	4	200	2.00	0.326	0.108
53	5	250	2.00	0.345	0.118
121	6	300	2.00	0.368	0.129
126	5	250	2.00	0.387	0.138
43	7	400	1.75	0.414	0.153
18	5	300	1.67	0.433	0.164
25	5	300	1.67	0.452	0.176
29	5	300	1.67	0.471	0.187
69	5	300	1.67	0.490	0.198
11	4	250	1.60	0.506	0.207
145	4	250	1.60	0.521	0.217
136	5	350	1.43	0.540	0.230
154	5	350	1.43	0.559	0.243
125	5	400	1.25	0.579	0.258
27	3	250	1.20	0.590	0.267
44	3	250	1.20	0.602	0.277
45	3	250	1.20	0.613	0.286
52	3	250	1.20	0.625	0.295
17	4	350	1.14	0.640	0.308
2	2	200	1.00	0.648	0.316
16	3	300	1.00	0.659	0.327
19	3	300	1.00	0.670	0.338
20	3	300	1.00	0.682	0.350
59	3	300	1.00	0.693	0.361
64	2	200	1.00	0.701	0.368
104	7	700	1.00	0.728	0.394
108	3	300	1.00	0.739	0.406
9	3	350	0.86	0.751	0.419
40	3	350	0.86	0.762	0.432
46	3	350	0.86	0.774	0.445
56	3	350	0.86	0.785	0.458
66	3	350	0.86	0.797	0.471
147	3	350	0.86	0.808	0.484
149	3	350	0.86	0.820	0.497
4	2	250	0.80	0.828	0.507
137	2	250	0.80	0.835	0.516
146	2	250	0.80	0.843	0.525
135	3	400	0.75	0.854	0.540
26	2	300	0.67	0.862	0.551
50	2	300	0.67	0.870	0.563
51	2	300	0.67	0.877	0.574
123	2	300	0.67	0.885	0.585
140	2	300	0.67	0.893	0.596
109	2	350	0.57	0.900	0.609
122	2	350	0.57	0.908	0.622
142	2	350	0.57	0.916	0.636
7	1	200	0.50	0.920	0.643
10	1	200	0.50	0.923	0.650
49	1	200	0.50	0.927	0.658
71	1	200	0.50	0.931	0.665
73	2	400	0.50	0.939	0.680
141	2	400	0.50	0.946	0.695
3	1	250	0.40	0.950	0.705
6	1	250	0.40	0.954	0.714
39	1	250	0.40	0.958	0.723
41	1	250	0.40	0.962	0.733
42	1	250	0.40	0.966	0.742
55	1	250	0.40	0.969	0.751
72	1	250	0.40	0.973	0.761
5	1	300	0.33	0.977	0.772
14	1	300	0.33	0.981	0.783
107	1	300	0.33	0.985	0.794
148	1	300	0.33	0.989	0.806
139	1	350	0.29	0.992	0.819
153	1	350	0.29	0.996	0.832
24	1	500	0.20	1.000	0.850
1	0	300	0.00	1.000	0.862
22	0	300	0.00	1.000	0.873
23	0	300	0.00	1.000	0.884
28	0	250	0.00	1.000	0.893
38	0	250	0.00	1.000	0.903
54	0	200	0.00	1.000	0.910
65	0	250	0.00	1.000	0.920
103	0	200	0.00	1.000	0.927
105	0	300	0.00	1.000	0.938
106	0	250	0.00	1.000	0.948
130	0	300	0.00	1.000	0.959
138	0	300	0.00	1.000	0.970
144	0	400	0.00	1.000	0.985
157	0	400	0.00	1.000	1.000
Total					
90	261	26750			

Source : Repair Records in the Krungkasem Exchange Area (1991.10 - 1992.3)

2) Rehabilitation of the Primary Cables

a) Work Volume

$$Wpc = Vpc \times Ppc \quad \text{(pairs)}$$

Wpc : Work Volume of Rehabilitation for the Primary Cables (pairs)
Ppc : Percentage of the Primary Cables to be Rehabilitated (%)
Vpc : Total Number of the Existing Primary Cable Pairs (Refer to Item 1) a))

b) Investment Cost = (Work Volume) x (Unit Price)

Unit price are estimated in due consideration of the investment cost for the 5th EDP of TOT.

Estimated Unit Price for Contract Work = 7,000 Baht / Pair

c) Effect

For this estimation, it is assumed that the rehabilitation is carried out in order of high fault ratio part.

$$Eex2 = (Fpc(Ppc) - (Fex2 \times Ppc)) \times Rpc$$

Eex2 : Expected Percentage Reduction of the Cable Faults
Fpc(Ppc) : Percentage Share of the Primary Cable Faults on Ppc(%) of the Existing Primary Cables.
This is given by Table 2.2.3-2.
Fex2 : Expected Rate of the Primary Cable Fault after the Rehabilitation.
This is set at the average value of the faults in 30% from better side of the existing primary cables.

$$Fex2 = \frac{\sum_{Ppc=70\%}^{Ppc=100\%} \% \text{ Share of the Faults}}{30} = \frac{(1 - 0.936) \times 100}{30} = 0.21$$

Rpc : Percentage Share of the Cable Faults on the Primary Cables

$$Rpc = \frac{\text{Total No. of the Primary Cable Faults}}{\text{Total No. of the Cable Faults}} = 0.4$$

Table 2.2.3-2 Distribution of the Repaired Primary Cable Faults in the Krungkasem Exchange Area

Cable No.	No. of Repairs	No. of Pairs	Repair / 100 Pairs	Cumulative No. of Faults	Cumulative No. of Pairs
6	33	1,800	1.83	0.13	0.05
3	20	1,450	1.38	0.21	0.09
1	25	2,100	1.19	0.31	0.15
4	18	1,700	1.06	0.39	0.20
13	28	2,850	0.98	0.50	0.28
2	27	2,800	0.96	0.61	0.36
14	26	3,000	0.87	0.71	0.45
11	25	3,150	0.79	0.81	0.54
8	10	1,800	0.56	0.85	0.59
12	12	2,200	0.55	0.90	0.65
10	4	900	0.44	0.92	0.68
5	6	1,750	0.34	0.94	0.73
9	3	900	0.33	0.95	0.75
17	6	3,000	0.20	0.98	0.84
16	2	1,450	0.14	0.98	0.88
7	2	1,750	0.11	0.99	0.93
18	2	1,900	0.11	1.00	0.99
19	0	500	0.00	1.00	1.00
Total					
18	249	35,000			

Source : Repair Records in the Krungkasem Exchange Area (1991.10 - 1992.3)

3) Rearrangement of the Distribution Point for the Drop Wires

a) Work Volume

$$Wdp = \frac{Nsub \times (1 - Nid) \times Rdp}{Cdp} \quad \text{(Distribution Points)}$$

Wdp : Number of Distribution Points to be installed

Nsub : Number of Subscribers

BMA (The end of 1992) = 1,212,241

Surrounding Area (The end of 1992) = 38,310

Nid : $\frac{\text{Number of Subscribers distributed from Indoor Terminals}}{\text{Nsub}} = 0.2$

Rdp : Assumed Percentage of the Drop wires which can be changed the Distribution Point by New Installation of the Terminals only = 10 %

Cdp : Average Capacity of the Distribution Points = 12 Terminals