

LEGEND

SAME AS FIG. 4.3.7 (1/6)

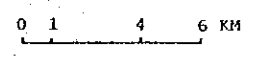


FIG. 4.3.7 (6/6)	SUBSCRIBERS COVERAGE AREA IN KAB. LAMONGAN (1999 AND 2004)
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Table 4.3.1 Junction Cable Network to be Constructed Anew (1/2)

<Repelita V>

No.	Section Name	No. of Systems (140 Mbit/s)	--- Fiber Optical Cable ---	
			No. of Cores	Length (Km)
1	Kebalen - Gresik	1 + 1 *	8	19.2
Total		No.of new sys. 1 + 1		19.2

<Repelita VI>

NO.	Section Name	No. of Systems (140 Mbit/s)	--- Fiber Optical Cable ---	
			No. of Cores	Length (Km)
1	Mergoyoso - Darmo	2 + 1	12	3.7
2	Darmo - Tandes	2 + 1	14	6.9
3	Darmo - Rungkut-I	3 + 1	12	5.9
4	Tandes - Kandangan	1 + 1	6	7.3
5	Tandes - Kalianak	1 + 1	16	7.3
6	Karang Pilang - Sepanjang	1 + 1	12	3.7
7	Karang Pilang - Bambe	1 + 1	6	10.7
8	Rungkut-I - Injoko	1 + 1	8	3.2
9	Injoko - Waru-I	1 + 1	10	3.2
10	Kebalen - Mergoyoso	1 + 1	8	4.9
11	Kebalen - Kapasan	1 + 1	12	2.6
1	Kebalen - Kapasan	1		
2	Kebalen - Tj. Perak	1		
3	Kebalen - Mergoyoso	4		
4	Kapasas - Kenjeran	1		
5	Mergoyoso - Darmo	3		(Existing FO Cable will be used.)
6	Mergoyoso - Manyar	1		
7	Darmo - Tandes	2		
8	Darmo - Rungkut-I	1		
9	Tandes - Karang Pilang	1		
10	Rungkut-I - Rungkut-II	1		
11	Rungkut-I - Injoko	2		
12	Injoko - Waru-I	1		
13	Waru-I - Waru-II	1		
14	Waru-I - Sidoarjo **	1		
1	Kebalen - Kamal	1 + 1 (34 Mbit/s)		Microwave ***
Total		No.of new sys. 15 + 11		59.4
		No.of add.sys. 21		
		Microwave 1 + 1 (34 Mbit/s)		

NOTE : * +1 -- Standby system
: ** ----- FO cable of this section will be installed during the same Repelita-V period as the trunk circuits. Under Repelita-VI, system increase will be made on this section to utilize it as the junction network.
: *** --- Existing 8 Mbit/s will be changed to 34 Mbit/s system.

Table 4.3.1 Junction Cable Network to be Constructed Anew (2/2)

<Repelita VII>

No.	Section Name	No. of Systems (140 Mbit/s)	--- Fiber Optical Cable ---	
			No. of Cores	Length (Km)
1	Kebalen - Kalianak	6 + 1	16	8.0
2	Waru-I - Sepanjang	4 + 1	12	7.0
3	Tandes - Karang Pilang	4 + 1	12	11.2
4	Mergoyoso - Manyar	2 + 1	8	6.9
5	Karang Pilang - Menganti	1 + 1	6	18.5
6	Sidoarjo - Porong	2 + 1	6	11.0
1	Kebalen - Gresik	1		
2	Kebalen - Kapasan	3		
3	Kapaslan - Kenjeran	1		
4	Kalianak - Tandes	5		
5	Tandes - Kandangan	1		
6	Tandes - Darmo	3		
7	Kebalen - Mergoyoso	1		(Existing FO Cable will be used.)
8	Mergoyoso - Darmo	2		
9	Darmo - Rungkut-I	1		
10	Rungkut-I - Injoko	1		
11	Injoko - Waru-I	2		
12	Waru-I - Sidoarjo	1		
13	Karang Pilang - Sepanjang	3		
Total		No. of new sys. 19 + 6		62.6
		No. of add. sys. 25		

Table 4.3.2 Trunk Network to be Constructed Anew

<Repelita V> --- Fiber optical system

No.	Section Name	No. of Systems (140 Mbit/s)	--- Fiber Optical Cable ---	
			No. of Cores	Length (Km)
1	Surabaya - Sidoarjo *	1 + 1	8	13.8
Total		No.of new sys. 1 + 1		13.8

NOTE : * --- New fiber optic cable will be installed between Waru-I and Sidoarjo.

<Repelita V> --- Microwave system

NO.	Route Name	No. of Systems		Remarks
		1.5 GHz 8 Mbit/s	2 GHz 34 Mbit/s	
1	Mojokerto - Jombang	1 + 1		Route standby
2	Gresik - Bangkalan	1 + 1 *		Route standby
Total		No.of new sys. 2 + 2		

NOTE : * --- Existing 8 Mbit/s will be changed to 34 Mbit/s system.

<Repelita VI> --- Microwave system

NO.	Route Name	No. of Systems		Remarks
		1.5 GHz 8 Mbit/s	2 GHz 34 Mbit/s	
1	Surabaya - Cerme	1 + 1		Set stabdby
2	Gresik - Sedayu	1 + 1		Set stabdby
3	Mojokerto - Mojosari	1 + 1		Set stabdby
4	Mojokerto - Mojoagung	1 + 1		Set stabdby
5	Mojokerto - Ploso	1 + 1		Set stabdby
6	Sepanjang - Krian		1 + 1	Route standby
7	Krian - Mojokerto		1 + 1	Route standby
8	Lamongan - Babat		1 + 1	Route standby
9	Surabaya - Sepanjang		1 + 1 *	Route standby
10	Gresik - Lamongan		1 + 1 *	Route standby
1	Surabaya - Gresik		2 + 1 **	
Total		No.of new sys. 5 + 5	5 + 5	
		No.of exp.sys. 2 + 1		

NOTE : * --- Existing 8 Mbit/s will be changed to 34 Mbit/s system.
: ** -- Existing microwave will be expanded to (2+1).

Table 4.3.3 Number of Subscribers Covered by Rural Arer Network (1/2)

<Surabaya Message Area>			
Base Station (BS) Name	Repeater Station (RS)/ Radio Subscriber Terminal (ST)	Number of Subscribers	
		End of Rep. VI	End of Rep. VII
=====			
1 CERME		120	310

	1.Wringin Anom (ST)	20	30
	2.Kesamben Kulon (ST)	0	20
	3.Kedamean (ST)	20	32
	4.Tulung (ST)	0	16
	5.Balng Panggang (ST)	20	52
	6.Ngampel (ST)	0	12
	7.Benjeng (ST)	30	60
	8.Banter (ST)	0	18
	9.Duduk Sampean (ST)	30	70

2 SEDAYU		120	348

	1.Manyar (ST)	20	58
	2.Betoto Kauman (ST)	0	34
	3.Bungah (ST)	30	50
	4.Kramat (ST)	0	8
	5.Dukun (ST)	30	70
	6.Madu Mulyorejo (ST)	0	22
	7.Wonokerto (ST)	0	14
	8.Panceng (ST)	20	54
	9.Ujung Pangkah (ST)	20	38

3 KRIAN		180	442

	1.Tarik (ST)	30	62
	2.Prambon (ST)	30	66
	3.Tulangan (ST)	30	76
	4.Wnoayu (ST)	30	74
	5.Sukodono (ST)	30	66
	6.Bakug Pringgon (ST)	0	32
	7.Krembung (ST)	30	66

4 Bangkalan		330	794

	1.Labang (ST)	30	54
	2.Kwanyar (ST)	20	54
	3.Modung (ST)	20	40
	4.Karanganyar (ST)	0	16
	5.Blega (ST)	20	56
	6.Konang (ST)	20	36
	7.Galis Daja (ST)	0	24
	8.Galis (RS)	20	50
	9.Tanah Merah (ST)	20	68
	10.Tragah (ST)	20	54
	11.Geger (ST)	20	44
	12.Kokop (ST)	20	38
	13.Tlokoh (ST)	0	6
	14.Tanjung Bumi (ST)	30	58
	15.Sepulu (ST)	30	52
	16.Bangsereh (RS)	0	0
	17.Klampis (ST)	30	72
	18.Arosbaya (ST)	30	72

Subtotal <Surabaya Message Area>		750	1,894
=====			

Table 4.3.3 Number of Subscribers Covered by Rural Arer Network (2/2)

<Mojokerto Message Area>

Base Station (BS) Name	Repeater Station (RS)/ Radio Subscriber Terminal (ST)	Number of Subscribers	
		End of Rep. VI	End of Rep. VII
1 Mojokerto		140	372
	1. Trowulan (ST)	20	44
	2. Jatirejo (ST)	20	58
	3. Rejosari (ST)	0	10
	4. Gedek (ST)	30	80
	5. Kemlagi (ST)	30	72
	6. Jetis (ST)	20	54
	7. Dawar Blandong (ST)	20	54
2 Mojosari		180	350
	1. Dlanggu (ST)	60	102
	2. Gondang (ST)	30	64
	3. Pacet (ST)	40	46
	4. Sumber Kembar (ST)	0	30
	5. Trawas (ST)	20	38
	6. Ngoro (ST)	30	70
3 Jombang		260	622
	1. Perak (ST)	50	90
	2. Gudo (ST)	30	72
	3. Diwek (ST)	50	110
	4. Ngoro (ST)	30	66
	5. Bareng (ST)	20	44
	6. Mojowarno (ST)	20	44
	7. Wonosalam (ST)	20	36
	8. Rejoso Pinggir (ST)	0	30
	9. Kesamben (ST)	20	48
	10. Kudu (ST)	20	74
	11. Jepuh Rpan (ST)	0	8
Subtotal <Mojokerto Message Area>		580	1,344

<Lamongan Message Area>

Base Station (BS) Name	Repeater Station (RS)/ Radio Subscriber Terminal (ST)	Number of Subscribers	
		End of Rep. VI	End of Rep. VII
1 Lamongan		230	684
	1. Mantup (ST)	20	48
	2. Kembabg Bahu (ST)	20	44
	3. Kelor Arum (ST)	0	16
	4. Gempol Tumloko (ST)	0	14
	5. Glagah (ST)	50	140
	6. Kali Tengah (ST)	40	98
	7. Sekaran (ST)	20	124
	8. Laren (ST)	20	46
	9. Brondong (RS)	60	82
	10. Tlogoretno (ST)	0	10
	11. Payman (ST)	0	26
	12. Tlogosadang (ST)	0	36
2 Babat		140	456
	1. Moro (ST)	40	68
	2. Sukorame (ST)	0	40
	3. Ngimbang (RS)	20	48
	4. Sambeng (ST)	20	62
	5. Sugio (RS)	20	60
	6. Sukodadi (ST)	20	96
	7. Jabung (ST)	0	12
	8. Kedungpring (ST)	20	70
Subtotal <Lamongan Message Area>		370	1,140
Total <Rural Area>		1,700	4,378

Tabel 4.3.4 Switching and Base Station Capacities for Rural Area Network

No. Local Exchange Name	Switching Capacities (LU)		No. of Subscribers Covered by Exchange		Base Station Capacities	
	Rep. VI	Rep. VII	Rep. VI	Rep. VII	Rep. VI	Rep. VII
<Surabaya Message Area>						
1. Cerme	420	1,010	300	700	120	310
2. Sedayu	150	434	30	86	120	348
3. Krian	700	1,718	520	1,276	180	442
4. Bangkalan	2,880	5,486	2,550	4,692	330	794
Total Surabaya	4,150	8,648	3,400	6,754	750	1,894
<Mojokerto Message Area>						
1. Mojokerto	7,220	10,978	7,080	10,606	140	372
2. Mojoari	800	1,244	620	894	180	350
3. Jombang	2,830	4,788	2,570	4,166	260	622
4. Mojoagung	430	878	430	878	--	--
5. Ploso	240	586	240	586	--	--
Total Mojokerto	11,520	18,474	10,940	17,130	580	1,344
<Lamongan Message Area>						
1. Lamongan	3,290	6,192	3,060	5,508	230	684
2. Babat	540	1,356	400	900	140	456
Total Lamongan	3,830	7,548	3,460	6,408	370	1,140
Total Capacities	19,500	34,670	17,800	30,292	1,700	4,378

4.4 Development Framework for Subscribers Network

4.4.1 Basic Conditions

In formulating the subscribers network development plan, the following should be taken into account:

For Surabaya Multi-Exchange Area

- (1) Suitable scope in view of the exchange capacity.
- (2) Suitable provision period for the objective area, avoiding over- or under-investment.
- (3) Suitable design to cover sharp demand increase in future (especially with respect to outside plant facilities), with due attention to city planning, i.e., new building construction plan, housing development plan, etc.
- (4) Installation of underground facilities at proper timing in view of the road development planning.

For Surrounding Areas

- (1) Provision of outside plant facilities suitable in dimensions for the quantity of telephones to be supplied.
- (2) Employment of economical facilities, e.g., aerial cable installation, joint-use of power pole, etc.

In addition to the above, close contact should be made with administrative and other organizations concerned, holding meetings periodically to discuss and exchange information with respect to utilization of road and/or private land, etc.

4.4.2 Development Target for Subscribers Network

The targets under Repelita V through Repelita VII are shown in the following:

(1) Target under Repelita V

Capacities of the existing subscribers network in the objective area are:

- Surabaya Multi-Exchange Area : 122,780 pairs
- Surrounding Areas : 15,666 pairs

Note: Number of pairs indicates total number of pairs of primary cables as of November 1989.

Perumtel is currently undertaking the improvement and development of outside plant including subscribers connections by the TELECOM III Project now being implemented with the World Bank loan assistance.

The TELECOM-III project aims at outside plant expansion corresponding to 600,000 line units expansion program to cover the whole country of Indonesia including Surabaya and surrounding areas.

Expansion programs for outside plant in Surabaya multi-exchange area and surrounding areas to be implemented under Repelita V are summarized in Table 4.4.1. Figure 4.4.1 presents configuration of outside plant in Surabaya multi-exchange area.

According to the expansion program to be implemented by the TELECOM-III Project, total capacity of subscribers network in Surabaya multi-exchange area will become more than double by the end of Repelita V. Total capacities after completion of the TELECOM III are as follows:

- Surabaya Multi-Exchange Area : 248,728 pairs
- Surrounding Areas : 25,826 pairs

(2) Targets under Repelita VI and Repelita VII

Necessary number of primary cable pairs to be required in the study area has been calculated by PERUMTEL's guideline. ("Guidelines of Local Cable Network Planning") Consequently, the number of primary cables to be required for the expansion under Repelita VI and Repelita VII is estimated to be as shown in ANNEXs 4.4.1 and 4.4.2, and summarized below.

	<u>Repelita VI</u>	<u>Repelita VII</u>
- Surabaya Multi-Exchange Area :	351,610 pairs	518,610 pairs
- Surrounding Areas :	34,827 pairs	43,341 pairs

Outside plant facilities to be required at the end of Repelita VII will be 4 times, in capacity, the existing facilities and, at the end of Repelita V, 2 times.

In order to materialize the outside plant expansion plan, establishment of design standard, strengthening of construction organization, standardization of materials to be used, and modernization of maintenance system are requisite.

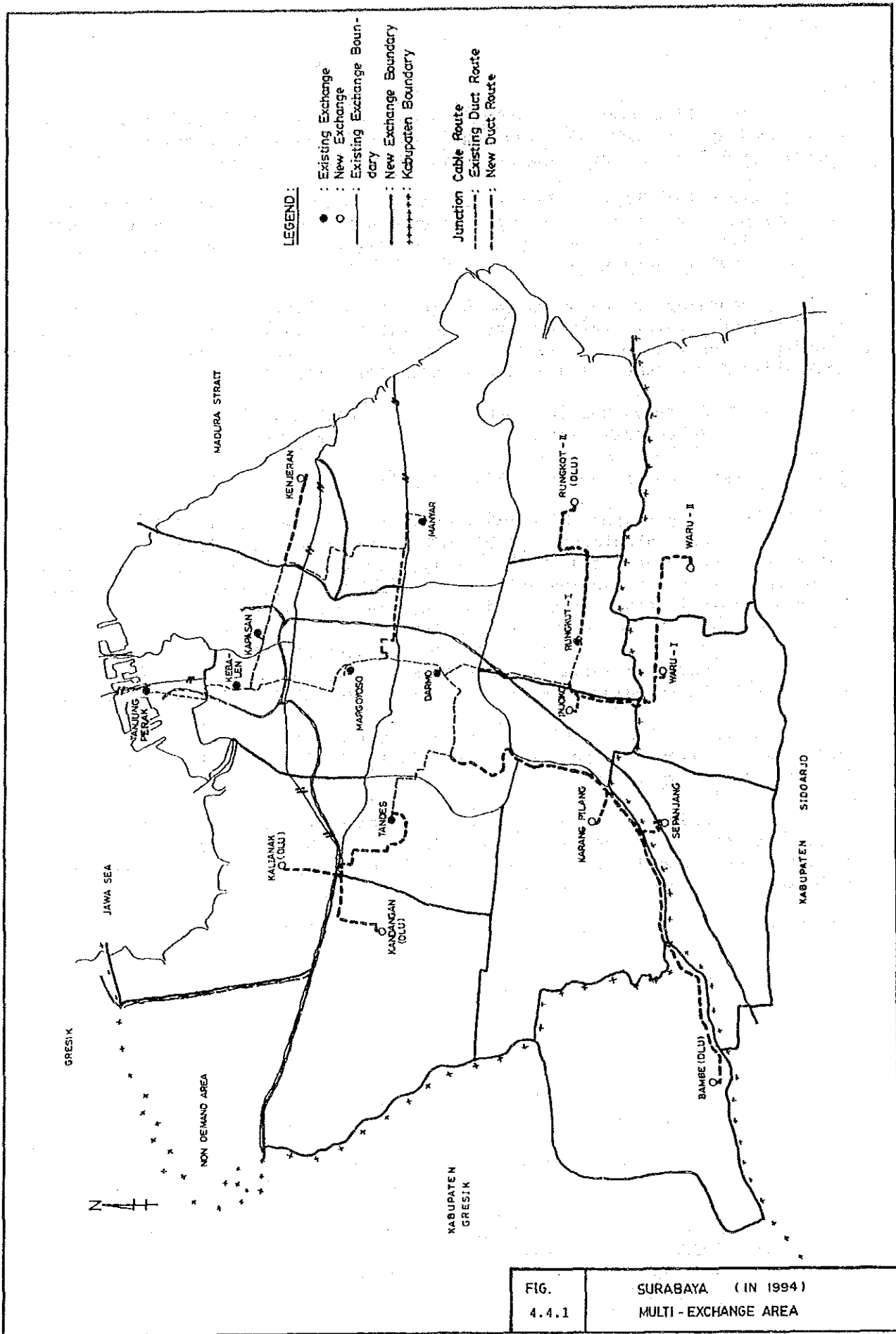


FIG. 4.4.1

SURABAYA (IN 1994)
MULTI - EXCHANGE AREA

Table 4.4.1 Subscribers Network Expansion Project during Repelita V

No.	Exchange Name	-- Termination Cable Capacities on MDF (pairs) --			Projec	Pro-	Target
		Exist	Expansion	Removed	Total	Name	gress
Surabaya Multi-Exchange Area							
1	KAPASAN	22,500	(0)	0	22,500	TEL-3	TENDER 91,92
2	KEBALEN	18,310	24,000	0	42,310	TH-1	ONGOING 07/02/90
3	TANJUNG PERAK	3,372	4,400	3,372	4,400	TH-4	90,91
4	KENJERAN	NEW	9,000	0	9,000	TEL-3	TENDER 92
5	DARMO	10,460	10,200	0	20,660	TH-1	ONGOING 11/08/90
	(NGAGEL AREA)	---	5,600	0	5,600	TH-3	CONTRACT 90
6	MERGOYOSO	26,958	---	0	26,958	C/O	---
		---	15,500	0	15,500	TEL-3	TENDER 91,92
7	MANYAR	4,300	16,800	0	21,100	TEL-3	TENDER 91,92,93
8	TANDES	21,300	0	0	21,300	TH-1	16/12/89
9	SEPANJANG	NEW	4,900	0	4,900	TEL-3	TENDER 92
		880	---	880	0	---	(OLD EX.) ---
10	KARANG PILANG	NEW	3,500	0	3,500	TEL-3	TENDER 92
11	KANDANGAN	NEW	2,400	0	3,500	TEL-3	TENDER 91
12	KALIANAK	NEW	3,700	0	3,500	TEL-3	TENDER 92
13	BAMBE	NEW	1,700	0	3,500	TEL-3	TENDER 91
14	RUNGKUT-I	14,700	3,600	300	18,000	TH-3	ONGOING 91
15	RUNGKUT-II	NEW	4,800	0	3,500	TH-3	ONGOING 91
16	INJOKO	NEW	5,600	0	3,500	TEL-3	TENDER 92
17	WARU-I	NEW	4,800	0	3,500	TEL-3	TENDER 92
18	WARU-II	NEW	6,000	0	3,500	TEL-3	TENDER 91,92
TOTAL (1)		122,780	126,500	4,552	244,728	EXP./EXIST = 1.99	
Surrounding Area							
[GRESIK]							
1	GRESIK	2,000	4,000	0	6,000	TH-2	ONGOING 09/05/90
2	CERME	100	---	---	100	---	---
3	SANGKAPURA	<SS>	---	---	---	SBK	90
[SIDOARJO]							
4	SIDOARJO	4,750	3,000	0	7,750	DESENT.	DESIGN 93
5	KRIAN	200	100	0	300	TRT	ONGOING 90
[BANGKALAN]							
6	BANGKALAN	1,400	2,300	1,400	2,300	TH-2	ONGOING 10/03/90
7	KAMAL	350	700	350	700	TH-4	90
[MOJOKERTO]							
8	MOJOKERTO	3,350	4,400	1,550	6,200	TEL-3	TENDER 91
9	MOJOSARI	400	400	400	400	TRT	ONGOING 90
10	JOMBANG	1,750	2,200	50	3,900	TEL-3	TENDER 91
11	MOJOAGUNG	210	---	---	210	---	---
12	PLOSO	140	---	---	140	---	---
[LAMONGAN]							
13	LAMONGAN	630	1,400	630	1,400	TEL-3	TENDER 91
14	BABAT	386	40	0	426	---	ONGOING 90
TOTAL (2)		15,666	18,540	4,380	29,826	EXP./EXIST = 1.90	
TOTAL (1)+(2)		138,446	145,040	8,932	274,554	EXP./EXIST = 1.98	

Note : <SS> --- Satellite communication system

Source : 1) Detailed design reports by PMC Option Services

2) Program Senpon dan Jarkab PELITA V (18-I-1990)

3) Bidding document of TELECOM III (OSP)

4.5 Development Framework for New Services

4.5.1 Data Communications Network Development

(1) Demand for Data Communications Services

Data communications services in Indonesia are provided through packet switched public data network (SKDP) and leased circuits, as well as public telephone network. Potentiality of data communications services demand in the objective area was studied, based on the market survey conducted by the Study Team and the data for existing subscribers obtained from PERUMTEL. In estimating future demand for data communications services, methodology presented in "Strategic Development Plan for Data Communications, POSTEL, 1988" is applied. The result of the demand study for data communications services provided through SKDP and leased circuit is shown in the following table:

Demand for data communications in the objective area

Year		1989	1994	1999	2004
SKDP	High Estimate	26*	208	389	727
	Low Estimate	26*	176	332	627
Leased Circuit	High Estimate	12*	84	156	289
	Low Estimate	12*	72	134	247

Note: Figures with * show the number of existing subscribers as of November 1989.

(2) SKDP Network Development

To expand SKDP network, PERUMTEL has been carrying out to install additional SKDP equipment such as NFFE, NCC and ANPs in Jakarta and major cities. During Repelita V, six (6) ANPs will be newly installed and until the end of Repelita VI, additional six (6) ANPs will be introduced in the major cities.

At present, the network configuration of SKDP is the star type with Jakarta as a center. In several important locations such as Jakarta, Surabaya and Medan, an alternative routing will be realized by the end of Repelita VI. By the end of Repelita VII, the bi-routing principle will be introduced in all the nodes as far as possible.

(3) Integration to "SPINTEL"

PERUMTEL is aiming at integration of existing systems by new data communications system named "SPINTEL (Sistem Pebyman Informasi Telekomunikasi; Telecommunications Information Service System)" in the near future. The concept of SPINTEL is shown in Figure 4.5.1.

(4) User Applications

Electronic mailbox service using SKDP has been provided by PERUMTEL since 1990. After the commencement of the service, the number of mailbox users is increasing. Considering the world trend, many national databases in many fields such as tourism, scientific, education, health, trade, industries and finance will be created in the near future by using this network. In such trend, an information business will be activated in Indonesia with popularization of those services by general public.

4.5.2 Mobile Communications

(1) Land-Mobile Telephone System

Advanced cellular system will be installed in Surabaya as a new mobile telephone system. This system will be installed and operated by private sectors. By the end of Repelita V, the service will cover not only Surabaya area but also surrounding areas along with the national and provincial roads.

(2) Future Trend of Mobile Communications

In Europe, U.S.A and Japan, digital cellular systems will be introduced in the near future. These new systems will adopt the TDMA technology with sub-microwave bands.

In CCIR, development of future mobile communications systems, so-called FPLMTS (Future Public Land Mobile Telecommunications Systems) is under study in cooperation with CCITT. FPLMTS will be established as a international standard for mobile communications.

4.5.3 Expansion of New Services Toward ISDN

(1) Expansion of Services

Existing non-voice service networks such as telex network, leased circuits and SKDP will be integrated into ISDN in the future. However, until the completion of ISDN, the following new services will be provided by the telephone network or existing basic data network like SKDP.

- Teletex

- Videotex (Information Services, Booking Services)

<Information services>

- . 108 service (local directory information),
- . Administration Information,
- . Program and Schedule of shows,
- . Schedule of flights,
- . Train and other transportation means

<Booking services>

- . Ticket booking,
- . Remote sales,
- . Telebanking

- Special services:
 - . Telemetry,
 - . Telecontrol,
 - . Telealarm
- Facsimile (CCITT Group 4)
- MHS (Message Handling System)

(2) Expansion plan

In consideration of a trend on the development of new telecommunications services in the country and the world, an expansion plan for new services by the end of Repelita VII is established as follows:

By the end of Repelita V

- Expansion of new services to potential cities.

By the end of Repelita VI

- Expansion of data communication services to all the province capitals.
- Expansion of new services to potential cities which were already provided automatic telephone facility or were possible to access to SKDP.

By the end of Repelita VII

- Expansion of data communication services to potential Kabupaten capitals.
- Expansion of new services to build narrow band ISDN in Jakarta and in potential province capitals.

4.5.4 Expansion Plan of Existing Networks

(1) Data Communications

For development of data communications, existing networks such as SKDP and leased circuits will be improved and enhanced until establishment of the common network for ISDN with sophisticated network management system. However, as the first step toward ISDN, data communications services will be integrated by the "SPINTEL" plan shown in Figure 4.5.1.

(2) Establishment of Common Network for ISDN

The implementation steps toward ISDN will vary depending on various circumstances such as demand variation, existing network quality and condition and financial capabilities, etc. In any case, however, evolution toward ISDN will be divided into the following three basic stages:

First stage

The existing analog telephone network is digitalized up to the line concentration portion through the adoption of digital switching and

transmission technologies. This will form an Integrated Digital Network (IDN) with 64 kbit/s bearer channels among users of concentrator through the switching systems.

Second stage

An ISDN interface and the common channel signaling are provided to enable the user to access to the service capabilities and/or network facilities of the ISDN.

Third stage

The ultimate ISDN is achieved in third stage. Different dedicated networks such as telephone network and data communications network are integrated into an ultimate form of an ISDN. This single network will then possess the capabilities for data switching at speeds higher than 144 kbit/s and provide video transmission switching services.

(3) Introduction of Narrow Band ISDN

In Indonesia, ISDN will be started as a field trial in Jakarta. After the trial, the service will commence in Jakarta Metropolitan Area during Repelita VII. In the objective area, ISDN using long distance subscribers service (LDS) will be available in Surabaya urban area when the ISDN service will be provided in Jakarta.

4.5.5 Future Trend of ISDN

(1) Trend of ISDN in the world

Afterward, ISDN will be considered to evolve itself by three kinds of trend. First is the evolution from narrow band network to broad band network for enabling the moving-picture communications which are the most natural tool for human understanding. Second is the evolution from dummy network to intelligent network (IN) for enabling the flexible provision to new enhanced networking services (e.g. virtual private network) which will be required by variety of users. Third is the evolution from basic backbone network to value added network (VAN) for enabling the flexible provision of new higher level services such as telecommunication processing service (e.g. protocol conversion service) and information processing service (e.g. computing and database services).

(2) B-ISDN (Broad band ISDN)

N-ISDN (Narrow band ISDN) services pave the way to new types of communication combining voice and data. However this only represents one of the first steps in the evolution of services. N-ISDN can provide sufficient bandwidth for all voice, data text and slow scan video services. The bandwidth is not, however sufficient if full motion video services are to be provided. The limited bandwidth availability of N-ISDN means that broad band distributive audio-visual services must be supported by a separate network. Since CATV (Cable Television) network using coaxial cables as transmission media is already providing broadcast video services, this trend expected to continue until the telephone companies offer the competitive video transport service to programmers or until there is subscriber demand

for switched video service. The tree topology of the CATV network is not, however, suitable for switched video of subscriber-originated video.

As optical fiber technology matures, a video switch with fiber-optic loop distribution will emerge to satisfy these requirements and the constraints of bandwidth on N-ISDN will rapidly be eroded. Therefore, B-ISDN, which is conceived within the framework of future services at higher rates, will integrate whole bunch of telecommunication services and becomes a most natural vehicle for human communications.

(3) IN (Intelligent network)

The Intelligent Network concept defines a new hierarchy of services providing intelligent nodes within the public switched telephone network. The service providing hierarchy has two levels. The lower level is Service Switching Point (SSP). It handles various basic functions such as path connection. The upper level is Service Control Point (SCP). It contains intelligence (data and program) for determining for global service sequencing. It directs the SSP in the execution of the services sequences. These two levels depend on Common Channel Signaling System No.7 (CCS7) as a communication vehicle. The information critical to execution of a service is to distribute or concentrate "intelligence" depending upon the service or featured offered.

The goal of the intelligent network is to solve the perennial problem of how to give users the services they want when they want them. As such, being the case the concept of IN has been designed to satisfy three requirements of the modern telecommunications market place. First is the ease of service introduction to permit development of a wide variety of new services. Second is the standard network interfaces that insure operability among manifold network components and allow a wide choice of suppliers. Third is the flexible network architecture that will meet service performance standards of local telephone companies and their customers.

Future trend toward ISDN in Indonesia is shown in Figure 4.5.2.

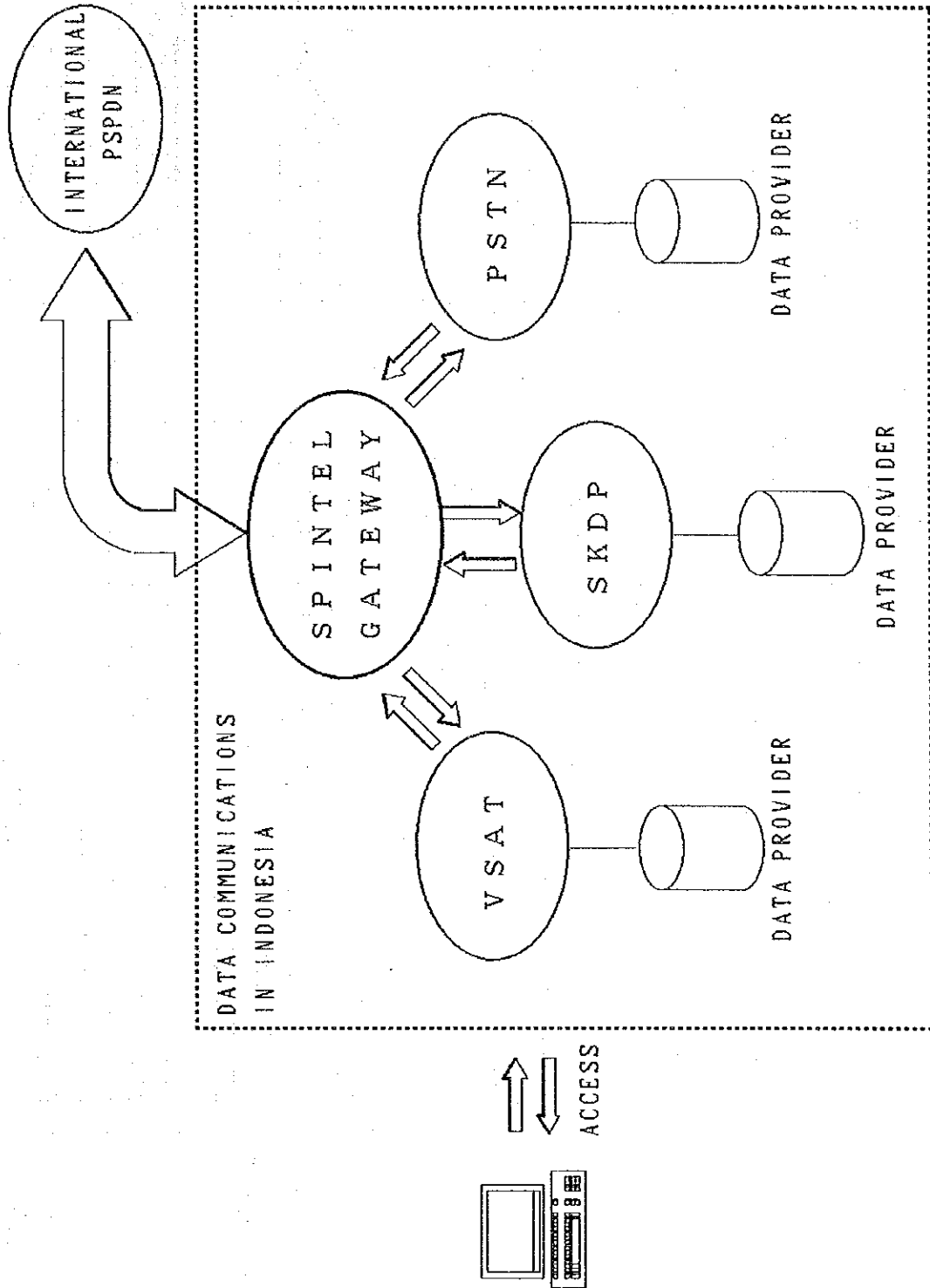
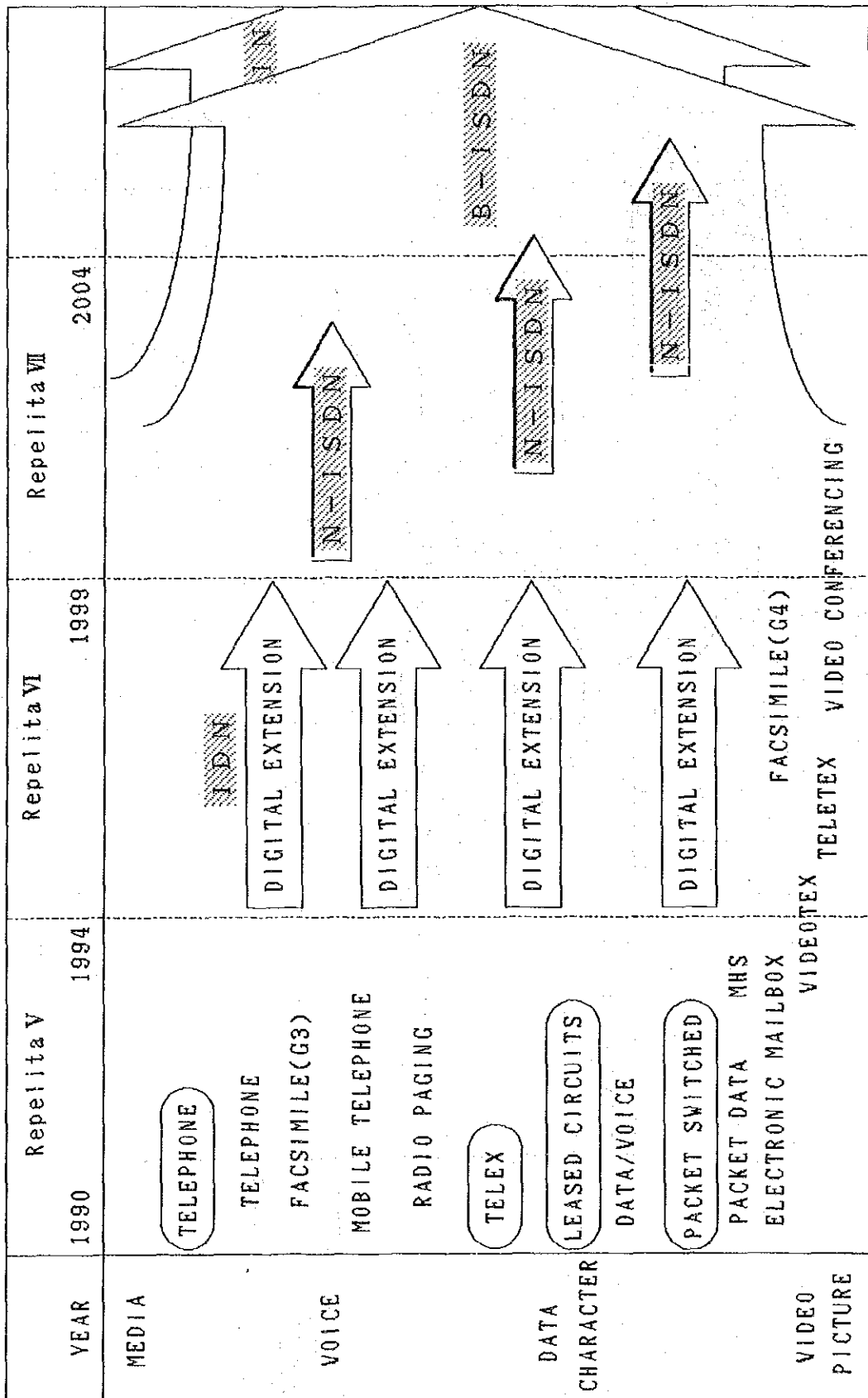


Figure 4.5.1 Concept of SPINTEL (Integrated Data Communications System)

Figure 4.5.2 Toward ISDN



4.6 Building Expansion Plan

Table 4.6.1 presents the sites and buildings of the existing facilities subject to expansion for realization of Repelita V, Repelita VI and Repelita VII targets. Land procurement for new exchange sites will need a long time and considerable efforts. Early action in this connection will be a key to success in target materialization.

Necessary land and building space to be required in the objective area have been calculated by PERUMTEL's guideline ("Guidelines of Dimensioning Rules").

Sites for Repeater Stations (RS) and Radio Subscriber Terminals (ST) of rural area network to be introduced in the outskirts of Surabaya will be selected from among Kecamatan capitals and/or premises of Desa offices except Gails (RS), Bangsereh (RS), Brondong (RS) and Ngimbang (RS).

Table 4.6.1 Building Expansion Plan after Completion of the TELECOM III Project

Exchange Name	Type of Building	Land Acquisition			--Switching--			Transmission			MDF	
		<TEL-3>	V	VI	VII	V	VI	VII	V	VI	VII	VI
Surabaya message area												
1 KAPSAN	:	:	:	:	:	New	:	Add	:	:	:	:
2 KEBALEN	:	:	:	:	:	Add	:	Add	:	:	:	:
3 TJ.PERAK	:	:	:	:	:	Add	:	Add	:	:	:	:
4 KENJERAN	:DE-3	:	:	:	:	New	:	:	:	:	:	:
5 GRESIK	:	:	:	:	:	:	:	:	:	:	:	:
6 KAMAL	:	:	:	:	:	Add	:	New	:	Add	:	:
7 DARMO	:	:	:	:	:	Add	:	New	:	:	:	:
8 MERGOYOSO	:	:	:	:	:	Add	:	Add	:	:	:	:
9 MANYAR	:Modification:	:	:	:	:	New	:	:	:	:	:	New
10 TANDES	:	:	:	:	:	:	:	New	:	:	:	:
11 SEPANJANG	:	:	:	:	:	Add	:	:	:	:	:	:
12 KARANG PILANG	:DE-3	:	:	:	:	New	:	:	:	:	:	:
13 KANDANGAN *	:DLU-TB	:	:	:	:	New	:	New	:	:	:	New
14 KALIANAK *	:DLU-TB	:	:	:	:	New	:	New	:	:	:	New
15 BAMBE	:DLU-TB	:	New	:	:	:	:	:	:	:	:	:
16 MENGANTI <VII>	:	:	:	New	:	:	:	New	:	New	:	New
17 RUNGKUT-I	:	:	:	:	:	Add	:	:	:	:	:	:
18 RUNGKUT-II *	:DLU <TH-3>	:	New	:	:	:	:	New	:	New	:	New
19 INJOKO	:DE-4	:	:	:	:	:	:	Add	:	:	:	:
20 WARU-I	:DE-4	:	:	:	:	:	:	:	:	:	:	:
21 WARU-II	:DE-4	:	New	:	:	:	:	:	:	:	:	:
22 SIDOARJO	:	:	:	:	:	:	:	:	:	:	:	:
23 PORONG <VII>	:	:	:	New	:	:	:	New	:	New	:	New

24 CERME	:	:	New	:	:	New	:	New	:	New	:	New
25 SEDAYAU <VI>	:	:	New	:	:	New	:	New	:	New	:	New
26 KRIAN	:	:	New	:	:	New	:	New	:	New	:	New
27 BANGKALAN	:	:	:	:	:	Add	:	New	:	Add	:	Add
28 GALIS (RS)	:	:	New	:	:	---	:	New	:	New	:	New
29 BANGSEREH (RS)	:<Submarine>	:	:	:	:	---	:	:	:	:	:	:

Mojokerto message area												
30 MOJOKERTO	:	:	:	:	:	Add	:	:	:	:	:	:
31 MOJOSARI	:	:	:	:	:	New	:	New	:	New	:	New
32 JOMBANG	:	:	:	:	:	Add	:	Add	:	Add	:	Add
33 MOJOAGUNG	:	:	New	:	:	New	:	New	:	New	:	New
34 PLOSO	:	:	New	:	:	New	:	New	:	New	:	New

Lamongan message area												
35 LAMONGAN	:Modification:	:	:	:	:	New	:	New	:	New	:	New
36 BABAT	:	:	New	:	:	New	:	New	:	New	:	New
37 BRONDONG (RS)	:	:	New	:	:	---	:	New	:	New	:	New
38 NGIMBANG (RS)	:<Rural>	:	:	:	:	---	:	:	:	:	:	:

Note : New ----- New land acquisition or new building
 : Add ----- Additional room with modification
 :<TEL-3> ----- TELECOM III OSP project
 :<TH-3> ----- TAHAP 3 project
 :<Submarine>-- Microwave tail link for submarine cable project
 :<Rural>----- Rural area telecommunication project (TRT)
 * DLU will be changed to STDI in Repelita VI.
 ** Other new sites for Repeater Stations (RS) and Radio Subscriber Terminals (ST) of rural area network will be selected in Kacamatan capital offices.

4.7 Financial Aspects

This Section 4 is showing a proposal for telecommunications network development plan in Surabaya city including surrounding areas, phasing with a policy of regional development and industrialization. The telecommunications network development is targetting quantitative and qualitative improvement of the telecommunications services. The quantitative improvement is to expand facility capacities and the qualitative one is to increase service categories and to improve availability of existing services responding to users' requirements. For the above, previous paragraphs are showing a development plan by network element composing the network such as exchange facility, transmission facility, subscriber network facility and so on.

The following table 4.7.1 shows a summary of network scale and financial scale by each Repelita. The investment cost excluding operation and maintenance cost were estimated on per-line unit cost basis.

FILE:PRO-SUM.MP2

Table 4.7.1 Project Summary for the Telephone Network Expansion in the Objective Area

Items	As of Jan. 1990	Repelita V (by 1994)	Repelita VI (by 1999)	Repelita VII (by 2004)
Expansion of Exchange Capacity (in line units)	-	143,496	117,392	158,170
	-	-31,280	-29,712	0
Accumulated Exchange Capacity (in line units)	84,604	196,820	284,500	442,670
Expansion of Primary Cable Pairs	-	145,040	124,919	175,514
	-	-8,932	-13,036	0
Accumulated Primary Cable Pairs	138,446	274,554	386,437	561,951
Number of New Exchange Locations by Repelita	-	9	1	2
Accumulated number of Exchange Locations	22	31	32	34
Investment Cost by Repelita (Million US\$)	-	293	235	326

Note: the above investment costs were estimated from the following assumptions:

- * US\$ 2,550 / line unit for all the cost items consisting of:
switching facility, subscribers network,
transmission system, building, land acquisition.
- * US\$ 1,990 / line unit for all the cost items excluding land acquisition.

4.8 Telecommunications Development Strategy for Industrial Estates

4.8.1 Background and Objectives

As described in Paragraph 2.3.5 in Section 2, the importance of the telecommunications development has recently been drawing wide attention in terms of its role in economic growth. In an environment in which Indonesia's economic growth is expected to accelerate, deficiency of the telecommunications facilities is often cited as a major constraint of economic growth. It is pointed out that it is necessary to secure more reliable and refined telecommunications service to the public such that more efficient business and production operations become possible.

Since Repelita I, the telecommunications development has been pushed on for accelerating the national socio-economic activities. However, most industrial estates proposed are often far from telecommunications facilities. And even if an estate could access to telecommunications facilities, it would not be reliable. In recognition of these circumstances, particular attention is paid to telecommunications development in the objective area.

4.8.2 Development Strategy for Industrial Estates

The telecommunications development for industrial estates should be planned apart from the usual development program from the viewpoint of the following.

As shown in Figure 2.3.4 in Section 2, many industrial estate projects are proposed. However, most project areas are quite far from modernized telecommunications facilities and are in typical rural areas. It means that those areas will not be able to be covered by telecommunications network coverage area to be expanded by each Repelita. Even the telephone supply plan in this master plan will not satisfied the demand for the industrial estate projects.

In reality it is possible that some of the proposed projects might not be implemented or areas for development change over time.

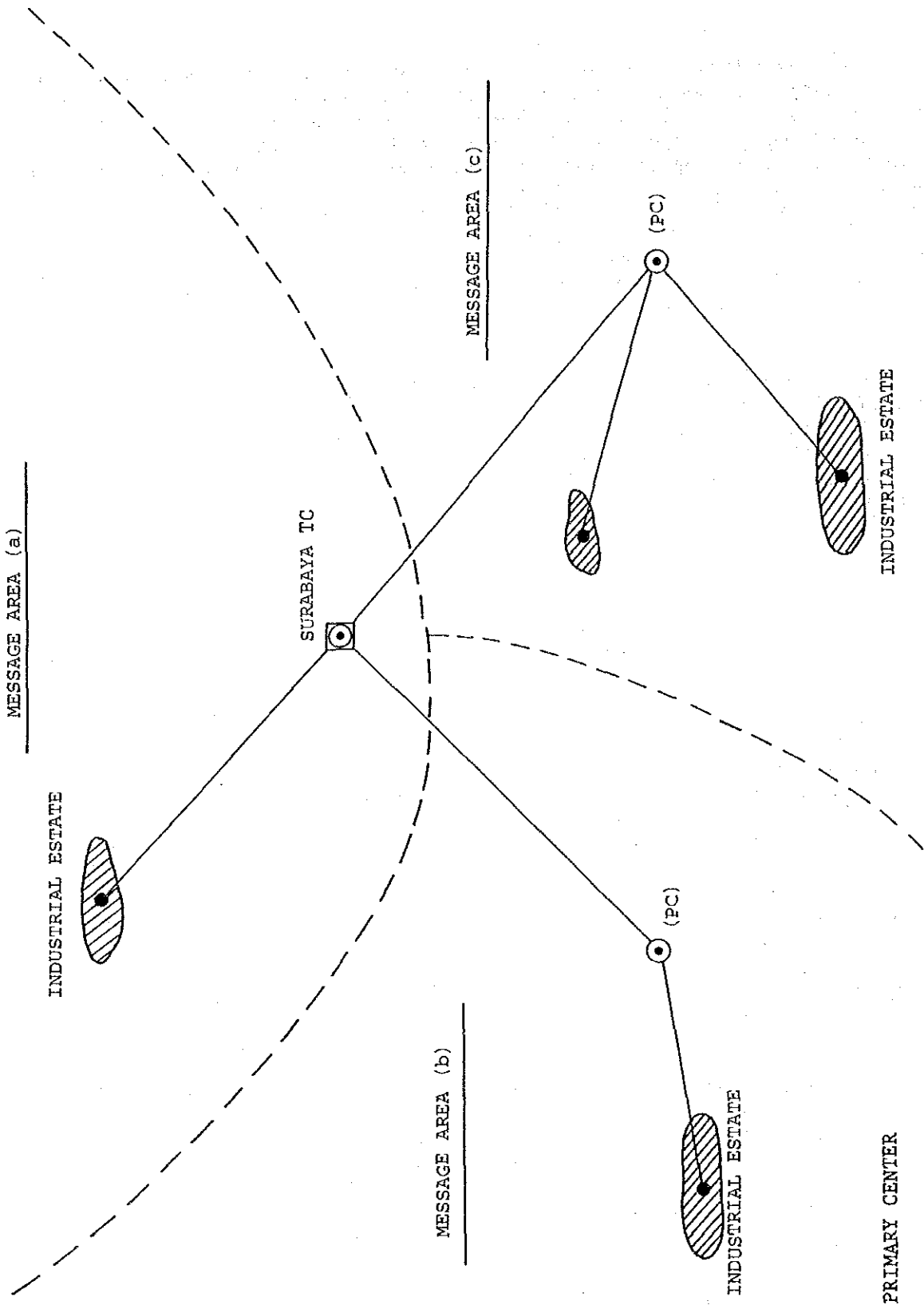
In recognition of the above circumstances, it is recommended that PERUMTEL keeps an eye on the industrial estate development trends and update the telecommunications development plans from time to time.

4.8.3 A Model Case of Development Planning for Industrial Demand

The following development policy is proposed with a model case of development planning for industrial demand:

- a) The demand in the objective industrial development area is covered by own local exchange and subscriber network coordinating with the implementation of the industrial estate development.
- b) The local exchange is connected to PERUMTEL's primary center in the same message area considering facilities transfer from private investor to PERUMTEL, when the facilities are installed by a private investor.

A model case of switching and transmission network development plan for the industrial estate projects in the objective area is shown in Figure 4.8.1 to 4.8.3. The exchange coverage areas for industrial estate projects are summarized in Table 4.8.1. In the model case, the supply volume was established on condition that two telephone lines will be supplied for a factory.



LEGEND

○ PRIMARY CENTER

● LOCAL EXCHANGE

Figure 4.8.1 A Model Case of Switching Network for Industrial Estates

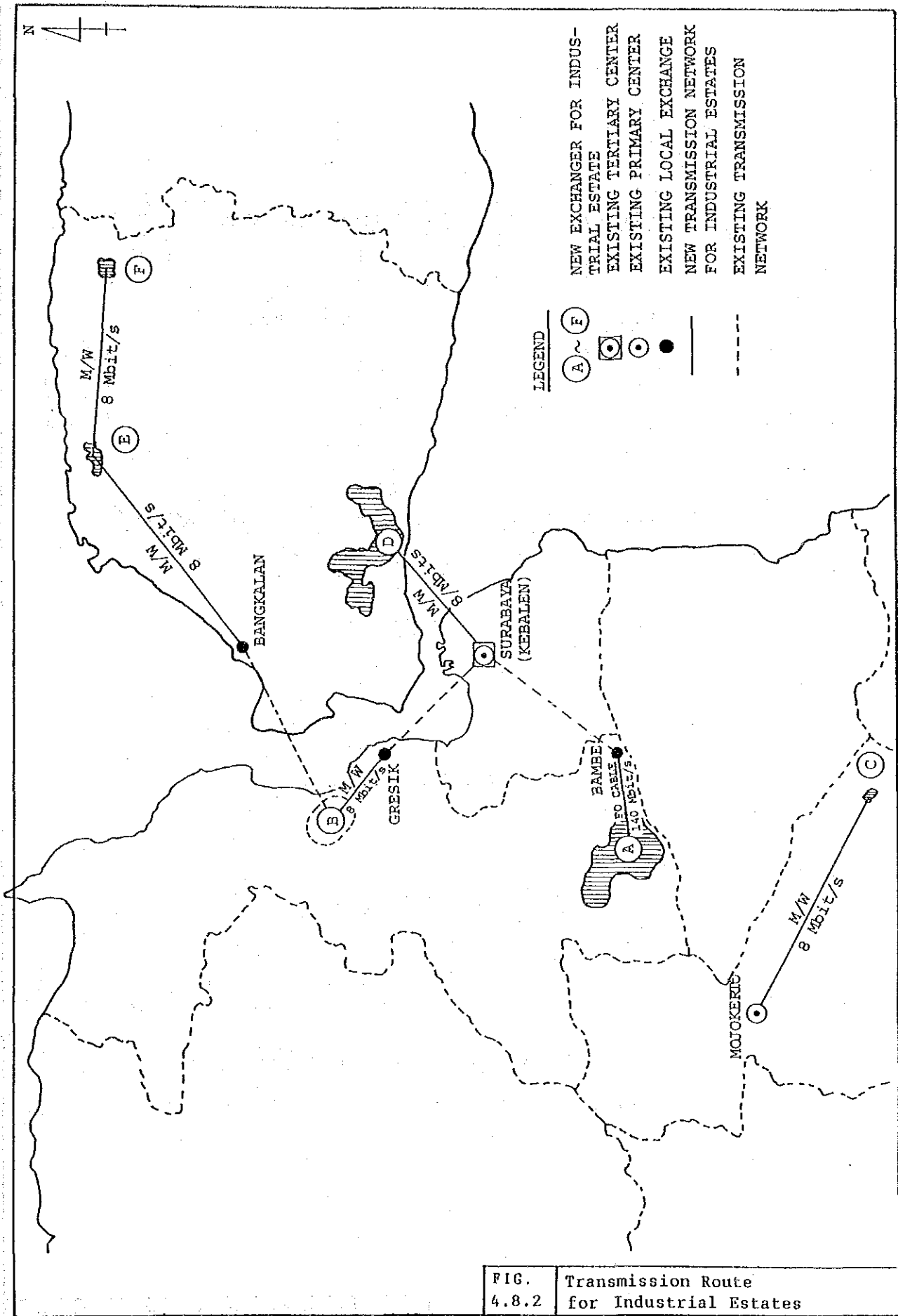
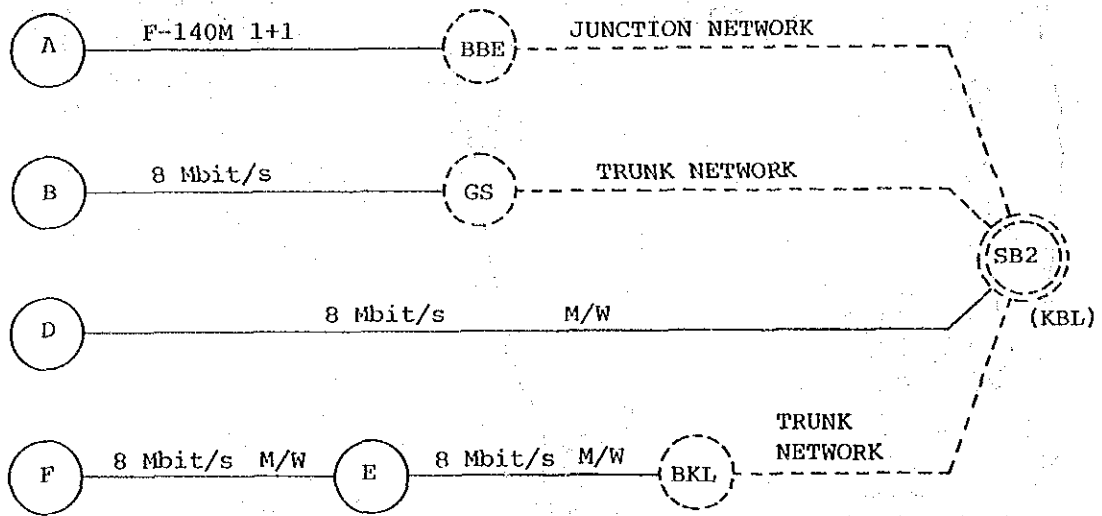
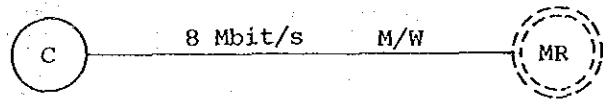


FIG. 4.8.2 Transmission Route for Industrial Estates



SURABAYA MESSAGE AREA



MOJOKERTO MESSAGE AREA

LEGEND

- (A) ~ (F) : NEW EXCHANGE FOR INDUSTRIAL ESTATES
- (---) : EXISTING LE
- (---) : EXISTING PC

FIG. 4.8.3 A Model Case of Transmission Routes for Industrial Estates

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Table 4.8.1 Exchange Coverage Areas (A to F) for Industrial Estates

No. Name of Developers	No. of factories (a)		Exchange coverage areas	Supply Volume (a)x2	
	Rep.V	Rep.VI		Rep.V	Rep.VI
1. Altap Prima I.E	120	230	230 Surabaya	240	460
2. Sarana Wisma Permai	50	90	90 multi-exchange area	100	180
3. Alindo Lighmetal .I	140	280		280	560
4. Surya Jaya Bumi Prima E.	50	90		100	180
5. Hasta Manunggal Citra Tama	50	90		100	180
6. Sier (1)	80	150		160	300
7. Darmo Santosa Raya	10	20		20	40
8. Maspion	70	140		140	280
Sub-total	570	1,090		1,140	2,180
9. Kasih Jatim	15	90	90 New exchange (A) in Kab.Gresik	30	180
9. Kasih Jatimanda	15	90		30	180
11. Alas Watu Utama	38	230		76	460
12. Prima Anom Permai	15	90		30	180
13. Sinar satelit I.E	55	330		110	660
Sub-total	138	830		276	1,660
18. Pt.Liku Telaga (3)	0	230	230 New exchange (B) in Kab.Gresik	0	460
10. Injoko	8	50	50 Cerme exchange	16	100
14. Darma Sejahtera Sakti (1)	45	90	90 New exchange (C) in Kab.Mojokerto	90	180
15. Dhipa Madura Pradana (2)	0	55	330 New exchange (D) in Kab.Bangkalan	0	660
16. Dhipa Madura Pradana	0	0	140 New exchange (E) in Kab.Bangkalan	0	280
17. Dhipa Madura Pradana	0	0	160 New exchange (F) in Kab.Bangkalan	0	320
Total	761	2,345		1,522	4,690
		2,920			5,840

SECTION 5 OPERATION AND MAINTENANCE ASPECTS

SECTION 5

OPERATION AND MAINTENANCE ASPECTS

5.1 Present Conditions

5.1.1 General

(1) Operation and Maintenance Organization in WITEL VII

Figure 5.1.1 presents the organization chart of PERUMTEL's regional headquarters WITEL VII which covers East Jawa Province.

Telephone offices in WITEL VII amount to 23, including 3 (three) regional telephone offices, 4 (four) transmission control stations and 1 (one) earth station.

Out of the 3 (three) regional telephone offices, 2 (two) offices, i.e., Southern (Selatan) and Northern (Utara) regional telephone offices, are located in Surabaya, and the third one is located in Malang which is out of the objective area. At present, there are 34 units of automatic exchanges and 100 manual exchanges. The number of subscribers is 113,447 and that of waiting applicants, 64,136 as of 1989.

(2) Number of Staff

The number of staff in whole WITEL VII totals 5,124, including 592 in WITEL VII Headquarters as of the end of March 1990. ANNEX 5.1.1 shows the number of staff by each telephone office.

The number of staff per 1,000 subscribers in WITEL VII service area is 45. That of Southern and Northern Regional Telephone Offices in Surabaya is 11 and 15, respectively, and 13.8 on an average. That of Mojokerto and Sidoarjo is 52 and 43, respectively.

According to the "Study Report on Long Term Planning for Development of Telecommunications System" prepared by JICA in 1987, the target number of staff per 1,000 subscribers in whole PERUMTEL in 2004 is 20. For reference, the ratio in Japan is 5.

(3) Service Quality

The current status of service quality in the objective area in terms of successful call ratio (SCR) is available in ANNEXes 5.1.2 and 5.1.3, and summarized in the following table:

Present SCR by exchange

Exchange	Type of switch	SCR (%)
Kebalen	STDI	59
Kebalen	EMD	41
Mergoyoso	STDI	16
Mergoyoso	EMD	24
Tj. Perak	EMD	39
Mojokerto	EMD	27
Sidoarjo	EMD	24

Note: the above data are as of 1989-90

Major items causing low ratios are shortage of trunk circuits and subscriber lines and incorrect dialling by subscribers.

To improve the low ratio, such shortage must be filled up by increasing the trunk circuits and subscriber lines, wherever urgently needed. As for incorrect dialling, a campaign to subscribers for correct dialling must be carried on. Provision of telephone instruments with abbreviated dialling and auto-redialling functions will be effective for improving the situation.

Under the TELECOM III project now under implementation, target of successful call ratio in 1993 is set at 38%.

(4) Fault Rate and Repairs

Figure 5.1.2 shows location-wise fault rates in 3 areas. The number of faults of aerial cables and underground cables accounts for more than 50% of the total, and that of house instruments, about 25%, while the faults of office equipment occupy less than 4%.

Fault rate by regional office from January to December 1989 are summarized in the following table:

<Fault rate by regional office>

Exchange	Fault rate
SB. Selatan	6.4
SB. Utara	7.1
Surrounding areas	4.0

Note: faults/month/100 tel sets

Working efficiency is evaluated by the ratio of repairs/day/person. Work efficiency in the objective area as of December 1989 is shown below:

Working efficiency by regional office

Exchange	Work Efficiency
SB. Selatan	
SB. Utara	1.3 (Average)
Surrounding areas	

Note: repairs/day/person

Necessary days for one repair work during 1989 is shown below:

Necessary days for repair by regional office

Regional office	a day	2-3 days	4-7 days	Over 7 days
SB. Selatan	25%	50%	19%	6%
SB. Utara	63%	17%	13%	7%
Surrounding area	43%	36%	15%	6%

PERUMTEL sets the following targets for the maintenance standards:

Maintenance standards

Items	Standards
Fault rate	5.0
Working efficiency	3.0
Necessary days for repair	
- within a day	70%
- within 2-3 days	20%
- within 4-7 days	10%
- over 7 days	0%

(5) Training

Training of maintenance staff is carried out in PERUMTEL Headquarters in Bandung and WITEL VII in Surabaya. The training consists of new technology training in Bandung and ordinary technical training in WITEL VII in Surabaya.

Training courses are divided into regular and non-regular courses, and each course comprises switching, outside plant, radio, transmission, and power, etc.

Outline of education and training conducted in WITEL VII is summarized as follows:

a) Training Facilities

The training facilities consist of the following:

- Class room for training
- Electric laboratory
- Job laboratory in site (exchange, transmission station, OPMC)

b) Training courses

Training items	Period	No. of trainees	No. of teachers
Regular and non-regular training	1 year	-	57
Switching training (EMD)	6 weeks	41	11
Radio and transmission training	3 weeks	-	5
Outside plant	3-6 weeks	168	29
Power	4 weeks	102	8
Traffic measurement	2 weeks	41	4
Computer	6 weeks	451	-

Note: Computer training is not carried out in the training center, but entrusted to a private company (CONCORDIA).

5.1.2 Switching System

(1) Present Conditions

Main automatic switching equipment now in use is analog switching equipment, i.e., EMD-F6A, MC-10C, and PRX-205. Digital switching system which is called STDI (Sentral Telepon Digital Indonesia), has been already introduced in some local exchanges.

(2) Organization

O/M organization in Surabaya southern and northern regional telephone offices and Mojokerto Exchange are shown in Figure 5.1.3 as an example of maintenance organization of a local exchange. Gresik and Cerme fall under Surabaya northern regional telephone office in O/M organization.

(3) Personnel

The number of maintenance personnel directly engaged in maintenance of switching system is shown in ANNEX 5.1.4 and 5.1.5. The total number of maintenance personnel for switching system in Surabaya multi-exchange area is 82 at present and 140 in the surrounding areas.

(4) Work Hour

As can be seen from ANNEX 5.1.5, the 24 hours service system is adopted in automatic exchange offices. O/M staff in each office work on three shifts system as follows:

Work hours

Category	Duration
Normal work hour	07:00 to 14:00
One person on duty	14:00 to 19:00
One person on duty	19:00 to 07:00

(5) Centralization of Complaint Desks

Complaint desks ("117") in Surabaya multi-exchange area are centralized in two centers, Darmo and Kebalen exchanges. Figure 5.1.4 shows the work flow after a subscriber complaint is received at a complaint desk.

At present, these centers are not yet computerized. Computerization of complaint desks is imperative to realize efficient services to subscribers.

5.1.3 Transmission System

(1) Organization

Figure 5.1.5 shows the operation and maintenance organization for transmission system in WITEL VII. 4 (four) transmission control stations consisting of Surabaya, Madiun, Jember and Malang supervise and control the operation and maintenance of the stations in their respective service areas. Transmission stations responsible for maintenance of transmission system in the objective area are under the control of Surabaya station.

(2) Present Conditions

Operation and maintenance of transmission network in the objective area including a part of the network in other area are controlled by Surabaya station. Transmission stations in the objective area are operated on attended and unattended basis. The attended are 8 stations with 190 staff in total as shown in the following table:

No. of staff by station

Stations	No. of staff
Surabaya	66
Gresik	2
Sidoarjo	3
Mojokerto	2
Jombang	4
Shiodoregi	2
Gayungan	8
Bawean Island	3

The following transmission systems require maintenance work:

- Coaxial cable system
- Rural radio system
- Analog and digital microwave systems

Serious problems are observed on coaxial cable systems, of which reliability is extremely low. Table 3.3.3 presents the record of failures on the coaxial cable systems.

At present, all the trunk circuits are concentrated in Kebalen station, except the analog microwave link connecting Jawa and Bali. Therefore, a failure in this station may easily develop to a serious trouble affecting the telecommunications services in the whole East Indonesia area. In the future, functions of this station should be deconcentrated. For the time being, preventive maintenance system should be established so as to protect the whole network from serious troubles.

5.1.4 Outside Plant

(1) Organization

The operation and maintenance of outside plant in Surabaya multi-exchange area are undertaken by two OPMCs (Outside Plant Maintenance Centers) located in Surabaya Utara and Selatan regional offices. The organization chart is shown in Figure 5.1.6.

(2) Present Conditions

PERUMTEL is now planning to establish 24 modernized OPMCs throughout the country for the purpose of improving outside plant maintenance services. At least 12 OPMCs are requested to be established during Repelita V as shown in the following table:

New OPMCs by location>

Locations	No.of sites
Jakarta	5
Surabaya	2
Medan	1
Ujungpandang	1
Denpasar	1
Semarang	1
Palembang	1

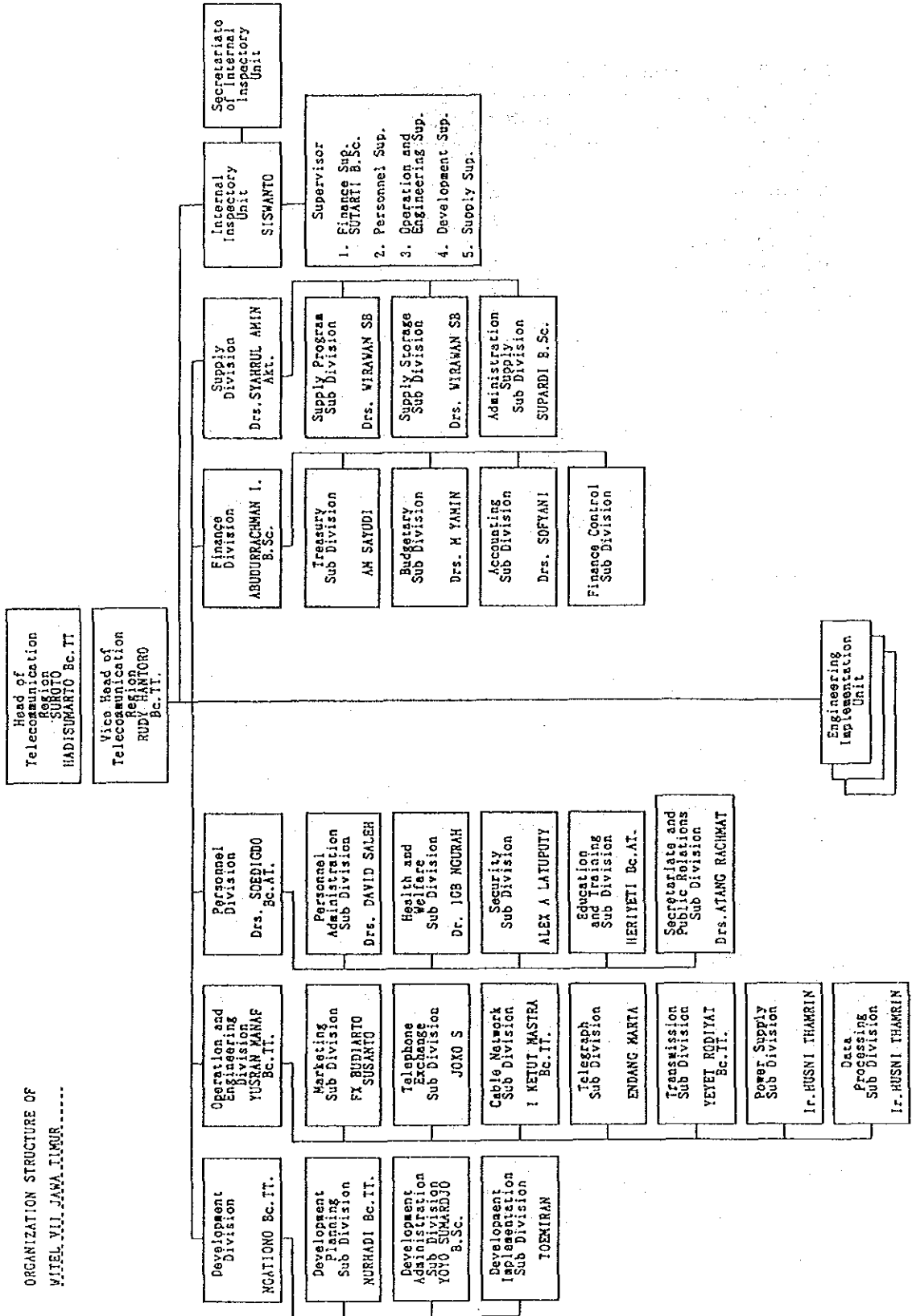
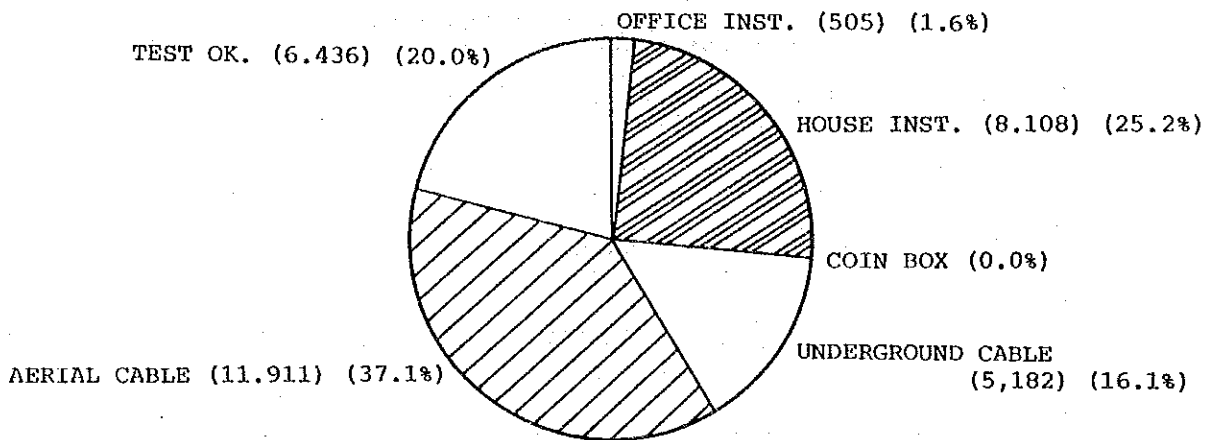
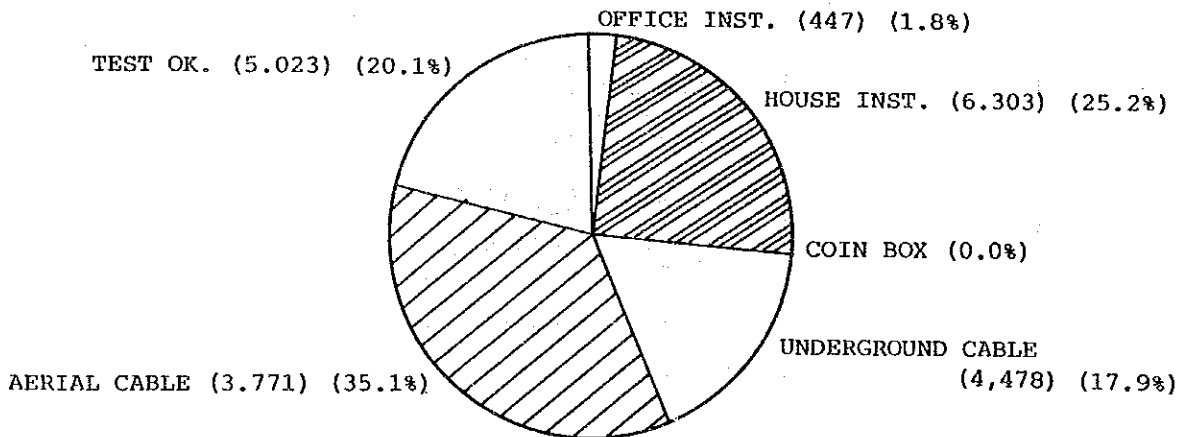


Figure 5.1.1 Organization of WITEL VII Headquarters

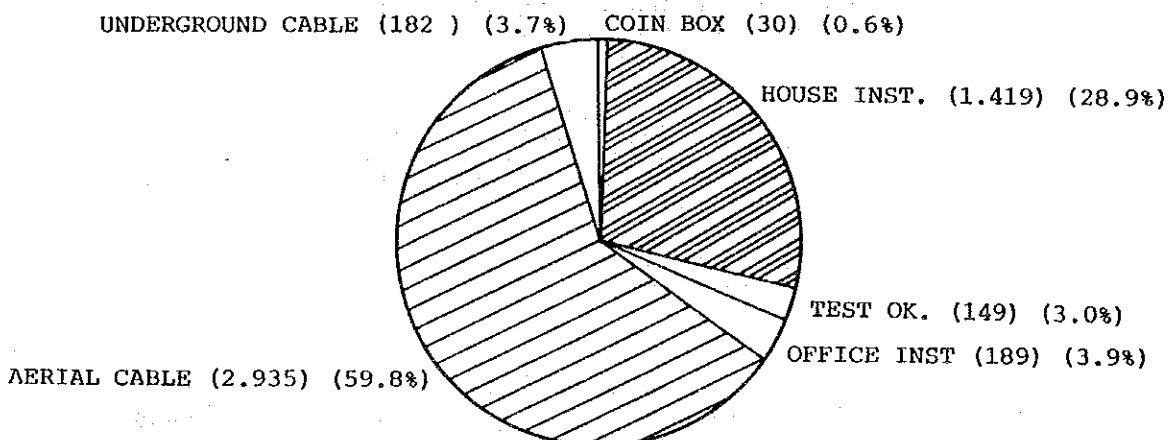
(1) SURABAYA SELATAN (DARMO, RUNGKUT, MERGOYOSO, MANYAR)
Total No. of Faults 32,142



(2) SURABAYA UTARA (KEBALEN, KAPASAN, TJ. PERAK)
Total No. of Faults 25,022



(3) SURABAYA SURROUNDING AREA
Total No. of Faults 4,904



Note: (Number of Faults) & (%) During January - December 1989

FIGURE 5.1.2 KIND OF FAULTS

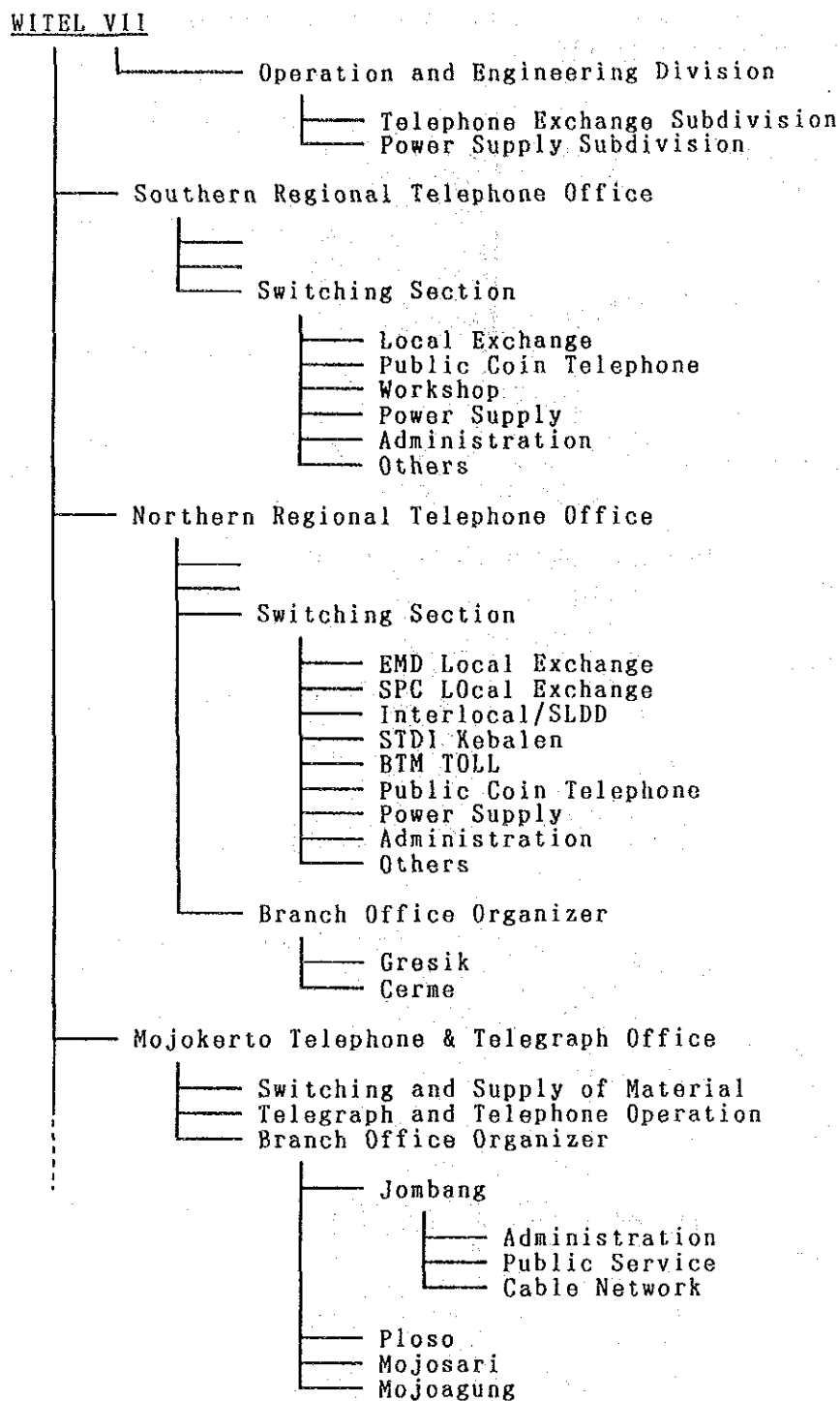


Figure 5.1.3 Organization of O/M for Telephone Exchange

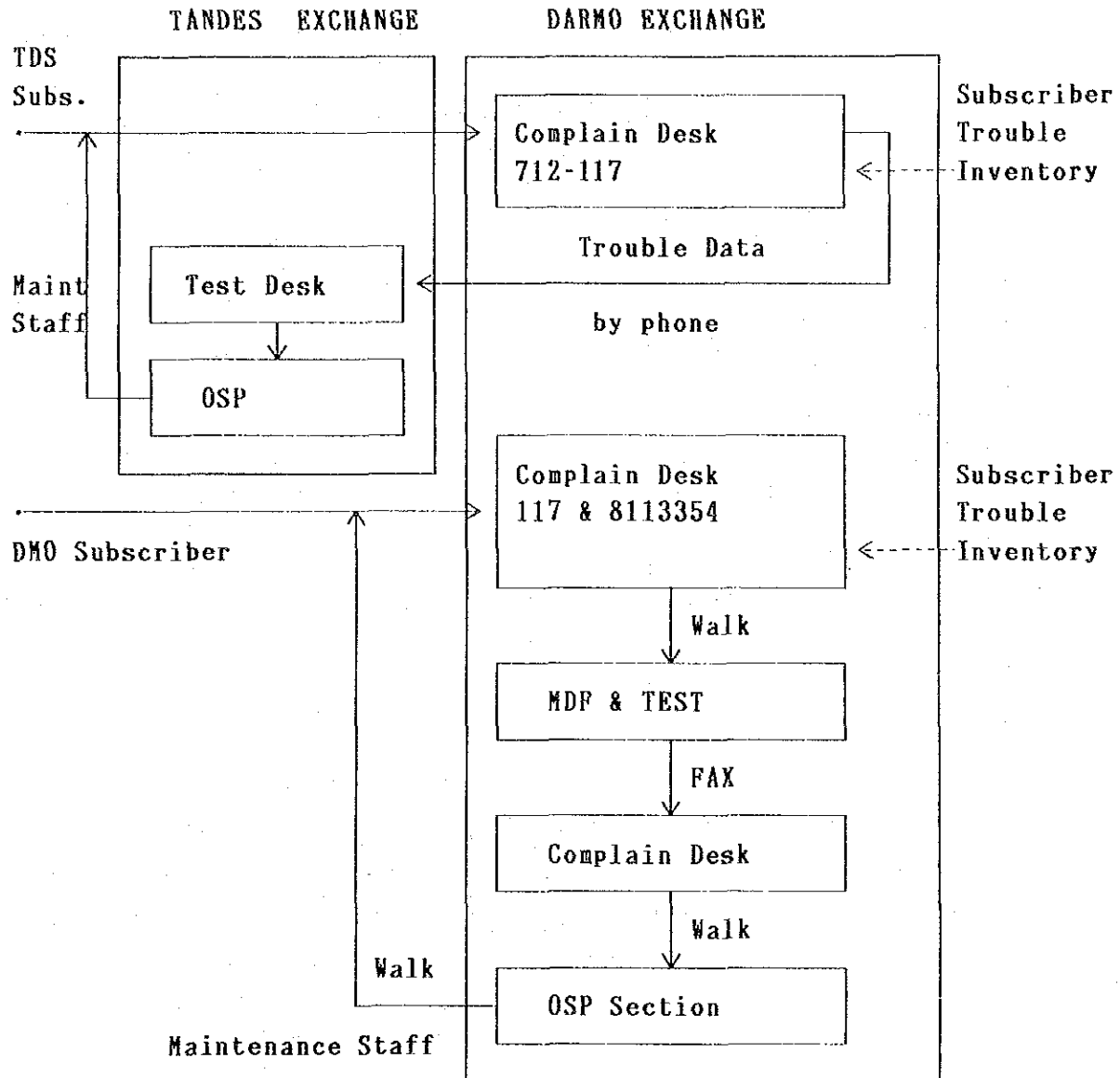


Figure 5.1.4 Centralization of Complaint Desk and Working Flow (from Tandem to DarMO)

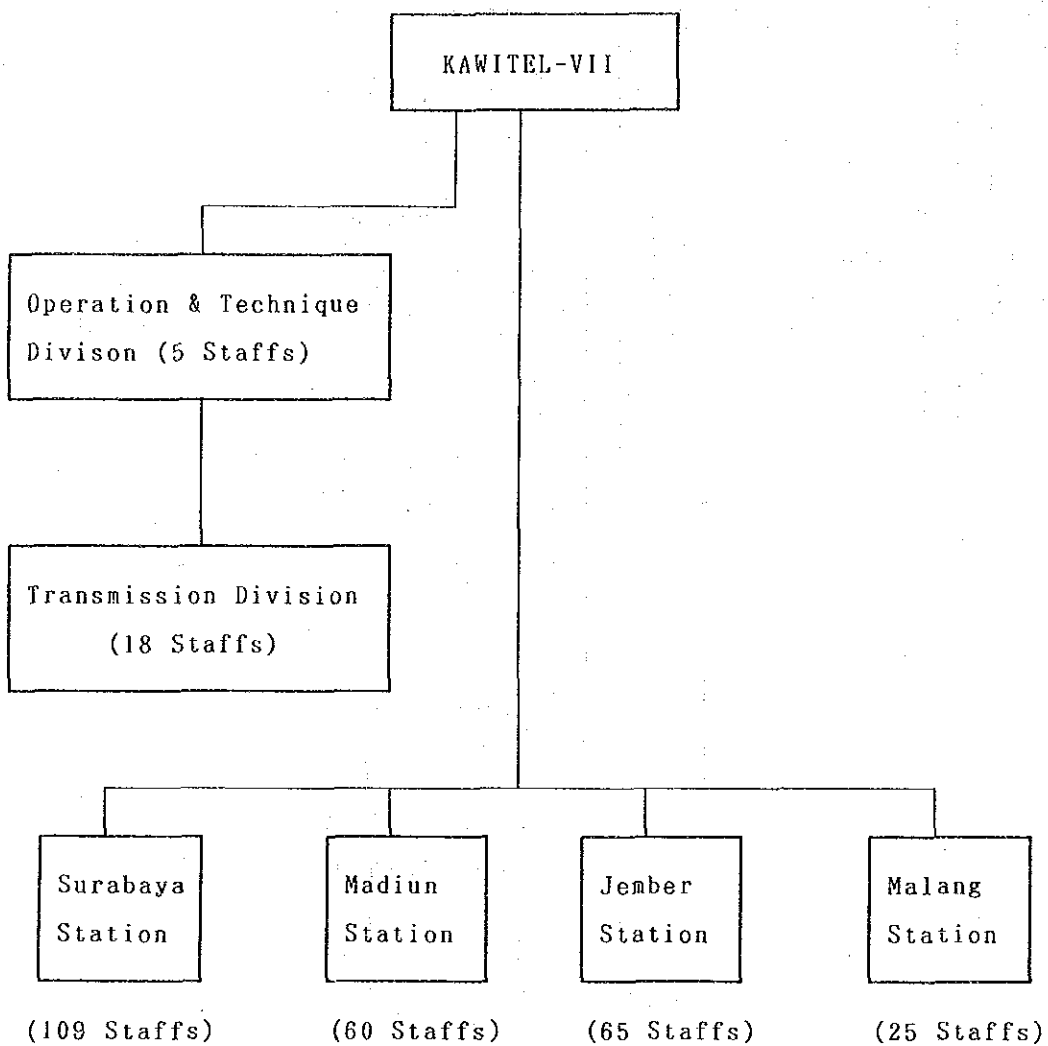
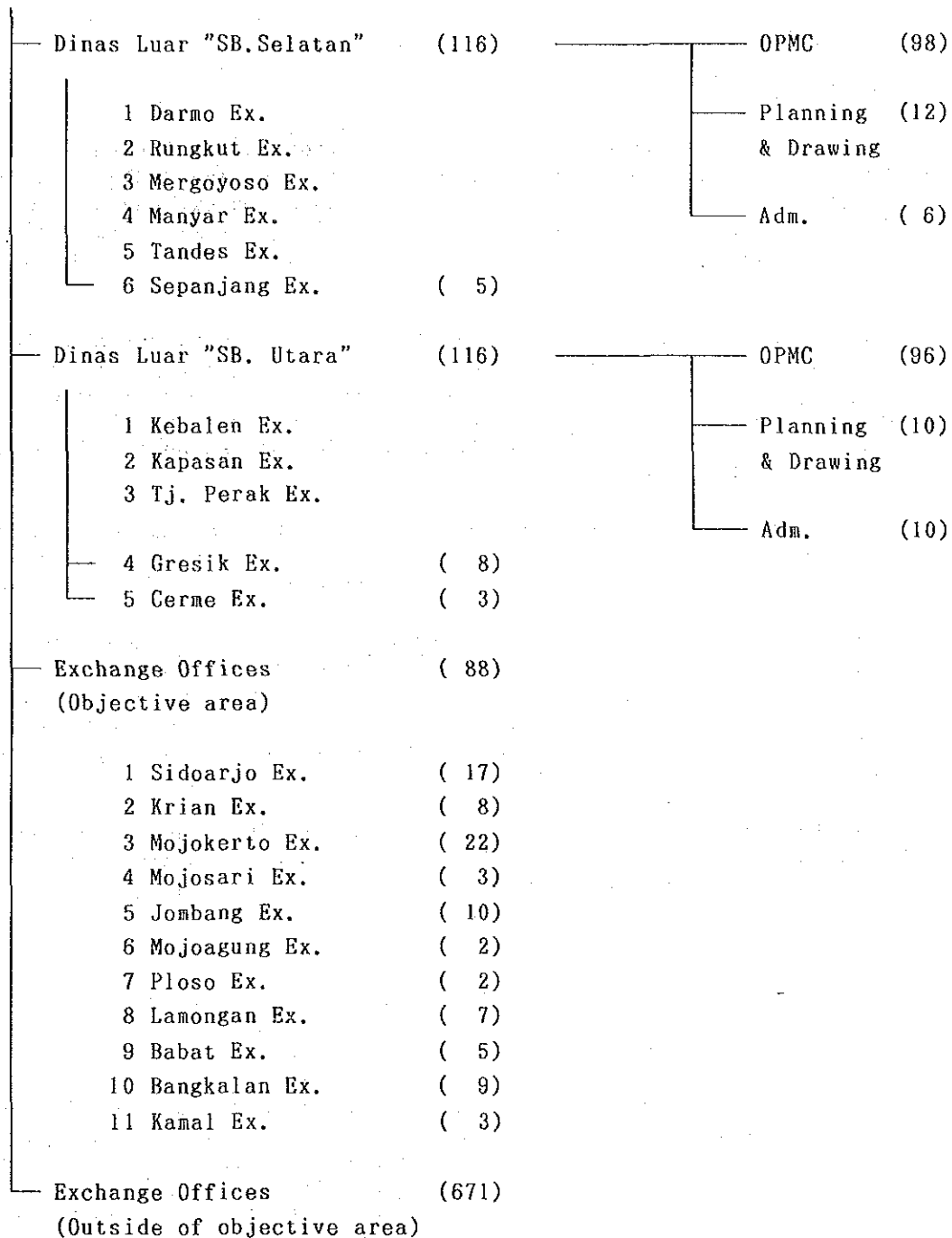


Figure 5.1.5 Organization of O/M for Transmission System

KAWITEL VII

(Total = 1,007)



Note : () --- Number of staffs
Source: Kantor Daerah Telepon
As of January 1990

Figure 5.1.6 Organization of O/M for Outside Plant

5.2 Operation and Maintenance toward 2004

5.2.1 Modernization of Operation and Maintenance

(1) Basic Idea

Operation and maintenance of outside plant facilities and complaint desks in Surabaya multi-exchange area are centralized in Surabaya Utara and Selatan regional offices located in Kebalen and Darmo exchanges. However, there is no total network management system for switching, transmission, microwave and power systems. Individual stations are taking care of them by themselves.

According as the telecommunications network expands in scale, its functions will become more and more complicated, requiring more efficient operation and maintenance. To meet this requirement, most modern maintenance support system employing high technology should be introduced where necessary, after reviewing the current maintenance and operation systems in respective fields.

Modernization of maintenance support system should be engineered, aiming at the upgrading of service to subscribers, including improvement of repair works in time and quality, and advancement of operation functions.

TMN (Telecommunication Management Network) given in CCITT Recommendation M.30 indicates the standard maintenance support system to be adopted generally. Figure 5.2.1 shows the relationship of a TMN to a telecommunication network. The figure implies the future construction of a total system inclusive of switching, transmission and outside plant. This will enable common use of various data.

Development of the maintenance support system should be promoted, step by step, based on the above idea. Maintenance support system in the objective area in 2004 should be as described in the following.

(2) Formation of System Concept

a) Operation and maintenance center (OMC) for switching system

Services can be classified into two types: the equipment oriented service and the subscriber oriented service. The former includes trouble shooting services consisting of supervision, detection, and repair of faults in switching system, etc., as well as tests, traffic data collection, billing., etc. The latter includes reception of complaints, tests, connection of new subscribers, fault repair work, etc.

In addition to the above, network management service will become necessary as SLDD networks will be developed in coming years.

In coming years, however, the network management and some of the equipment oriented and subscriber oriented services should be concentrated in a center and automatized by the computer system, through which the efficient management of the complicated network, as well as speedy shooting, can be achieved. By this

arrangement, the increase in number of maintenance personnel can be minimized.

In addition, some experts should be stationed in the center so that they can be dispatched to a site for speedy troubleshooting when it requires the expertise of specialists. The stock control of maintenance parts and materials should also be concentrated in the center.

b) OMC organization

PERUMTEL has a plan to establish the advanced management system called IMS (Integrated Management System) as shown in ANNEXES 5.2.1 and 5.2.2. The IMS will handle three main items, i.e., network management (including switching, radio & transmission and power), traffic management, and customer complaints. IMS consists of National Network Control Center in Bandung and three Regional Network Control Centers in Bandung, Jakarta, and Surabaya.

Figure 5.2.2 shows the Surabaya Regional Integrated Management System in 2004. Functions and configurations of the OMC should be as follows:

Main functions of the OMC

- Network management center
 - Alarm monitoring of exchanges
 - Remote diagnosis
 - Trunk testing
 - Traffic measurement
 - Service quality measurement
 - Charge observation
- Complaint Management Center
 - Complaint receiving
 - Subscriber line accessing and testing
 - Contact with repairmen
 - Data logging

OMC configurations

- Network Management Center

The center should be provided with wall type panel, CRT display and other terminals. The panel will indicate the network configuration and the equipment layout in each exchange, with real time information on faults and traffic congestion. It will also be able to receive, store and display various data on all switching systems composing the network. In other words, actual conditions of the whole network can be known at the center, permitting the center to take necessary actions promptly, e.g., when the traffic congestion is detected, an order is issued to

control the exchange so as to prevent further development of congestion.

It can also present the location and other information of a fault in switching system in each exchange, as well as traffic data.

- Complaint Management Center

The center should be provided with complaint desks with console and line test consoles.

- Computer Center

In case the switching systems composing the network are the products of different manufacturers, due consideration should be given, when establishing the maintenance supporting system, to the interface between different systems.

c) OMC for Transmission System

At the end of Repelita VII, transmission network will be transferred from the current analog network to the IDN. Then, the ISDN commercial service will be provided in full scale and operation and maintenance system is required to be suitable for provision of such services.

To meet the requirements for operation and maintenance of IDN, an O/M center should be established, achieving the efficient utilization of staff and automatization of works by introduction of computer system. The center will be required to have the following functions:

- Centralized supervision and control of transmission network in the objective area including the junction network, trunk network, and rural area network; the panel display system should be employed.
- Automatic recording of faults, and data compiling for statistics;
- Electronic filing of various data necessary for maintenance, operation, planning and management;
- Centralized stock control of spare parts and materials;
- Electronic filing of plant records;
- Training;

Operation and maintenance personnel should be stationed in the O/M center to be constructed in Surabaya and the sub-centers to be constructed in Mojokerto and Lamongan. For Bawean island which is far distant from the center, minimum number of maintenance personnel should be stationed. Introduction of

efficient maintenance system will realize the upgrading of operation and maintenance, without requiring the increase of the number of maintenance personnel.

d) OMC for Outside Plant Facilities

At the end of Repelita VII, outside plant in the objective area will be approx. 4 times, in scale, the existing one. How to achieve efficiency in operation and maintenance of such extensive facility is a big problem here. Presently, the advanced outside plant maintenance center (OPMC) construction plan is being materialized on a nationwide scale, and for Surabaya, establishment of 2 centers has been decided.

Main functions of the maintenance center are as follows:

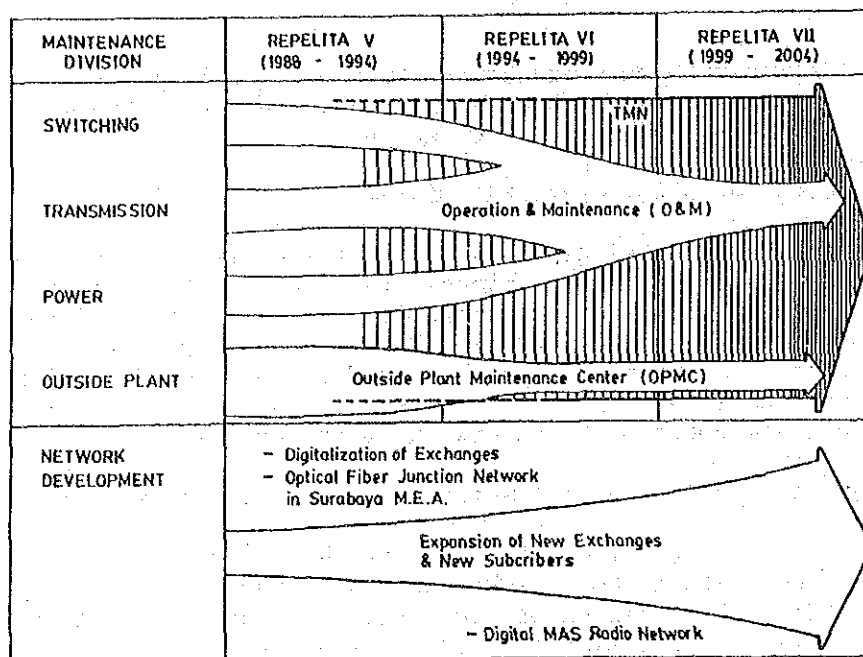
- Electronic filing of plant record;
- Computerization of subscriber's number control;
- Electronic filing of fault records, and other data necessary for planning and management;
- Computer-aided control of material stock;
- Local cable installation when small in scale;
- Training;

In addition to the above 2 centers, sub-centers should be established in Gresik, and Sidoarjo, where maintenance personnel and materials should be centralized to take care of the maintenance of the outside plants in their respective service area.

(3) Effect of Centralization

Introduction of the TMN will serve for maintenance cost reduction, service upgrading, realization of effective maintenance, efficient use of switching system, effective use of various data, efficient utilization of highly qualified experts, realization of flexible O/M control, etc.

The relationship between the effect of centralization of maintenance organizations and the network development is illustrated in the following:



5.2.2 Organization for O/M in the objective area in 2004

(1) Switching

In accordance with an increase of the number of local exchanges, the organizations for O/M should be reorganized. Then, the following items should be considered;

- An increase of the number of local exchanges from 22 to 34.
- Integration of Sidoarjo and Kamal exchanges into Surabaya multi-exchange area.
- Reorganization into four local tandem configuration.
- Balancing O&M work between southern regional telephone office northern regional telephone office.
- integration of Bangkalan exchange into Surabaya message area.
- Sangkapura is maintained by northern telephone office temporarily after an automatic exchange is installed.
- Sepanjang belongs to southern regional office for maintenance purpose, though located in Tandem tandem area.

The new organization should be as follows:

a) Surabaya multi-exchange area

Northern regional telephone office (Surabaya Utara)

- Kebalen (Complaint management center)
- Gresik
- Tj.Perak
- Kapasan
- Kenjeran
- Kamal

- Tandes
- Kalianak
- Bambe
- Karang Pilang
- Kandangan
- Menganti
- Bangkalan
- Cerme
- Sedayu

Southern regional telephone office (Surabaya Selatan)

- Mergoyoso
- Darmo (Complaint Management Center)
- Manyar
- Rungkut
- Injoko
- Waru
- Sepanjang
- Sidoarjo
- Porong
- Krian

Figure 5.2.3 shows new organization of operation and maintenance area.

b) Surrounding areas

Maintenance organization in surrounding area

Telephone & telegraph office	Local exchange
Lamongan	Lamongan Babat
Mojokerto	Mojokerto Jombang Ploso Mojosari Mojoagung

(2) Transmission

The organization of O/M for transmission division in 2004 is shown in Table 5.2.1.

(3) Outside Plant

The organization of O/M for outside plant division in 2004 and its coverage area are shown in Table 5.2.2.

5.2.3 Switching Training to be Required in 2004

The line unit capacity to be supplied by 2004 is 442,670. The number of maintenance and operating staff to be required for switching system in 2004 is estimated at about 150, based on the following conditions. The details of calculation is shown in ANNEXes 5.2.3 and 5.2.4.

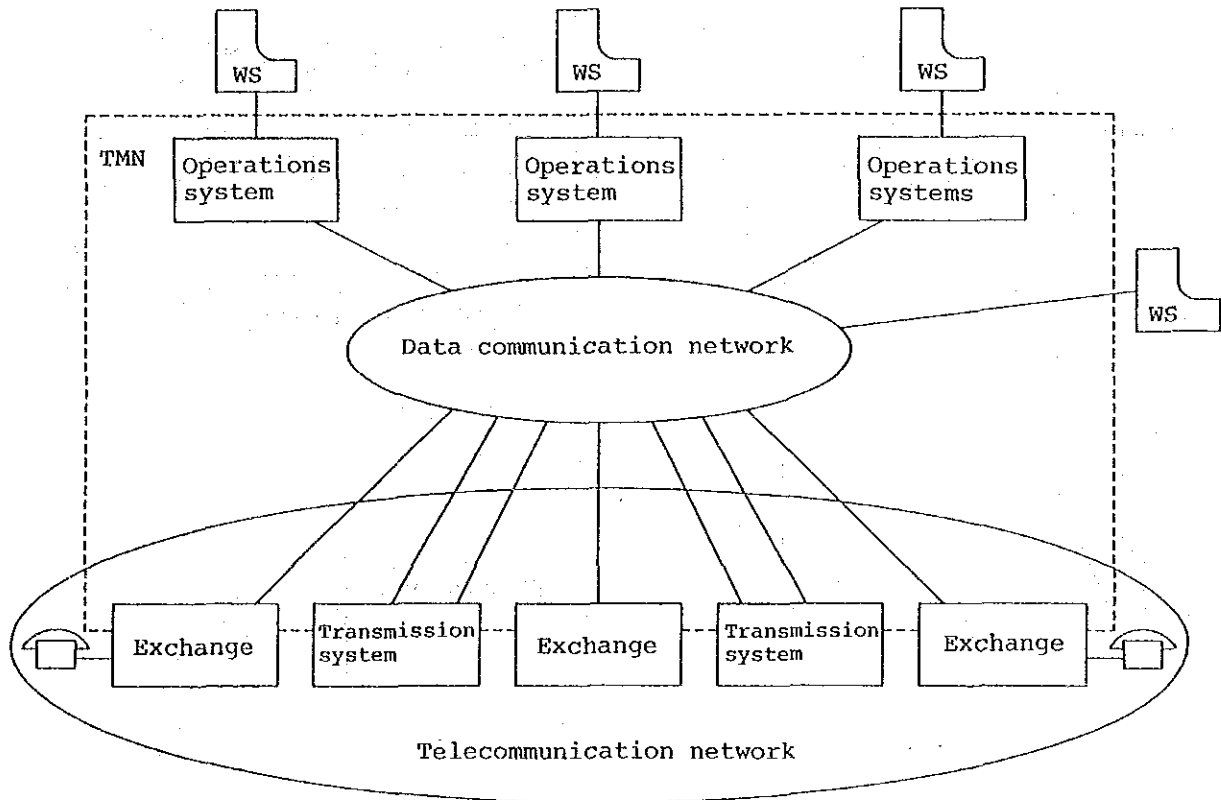
<Estimate conditions of O&M staff for switching system>

Switching capacity	No. of staff	Work Hour		
		07:00-14:00	14:00-19:00	19:00-07:00
More than 1,000 L.U	4	2	1	1
500 - 1,000 L.U.	3	2	1	
Less than 500 L.U	2	2		

The training period for the switching should be secured for one month at the least.

In addition to the above, the following training items will be required:

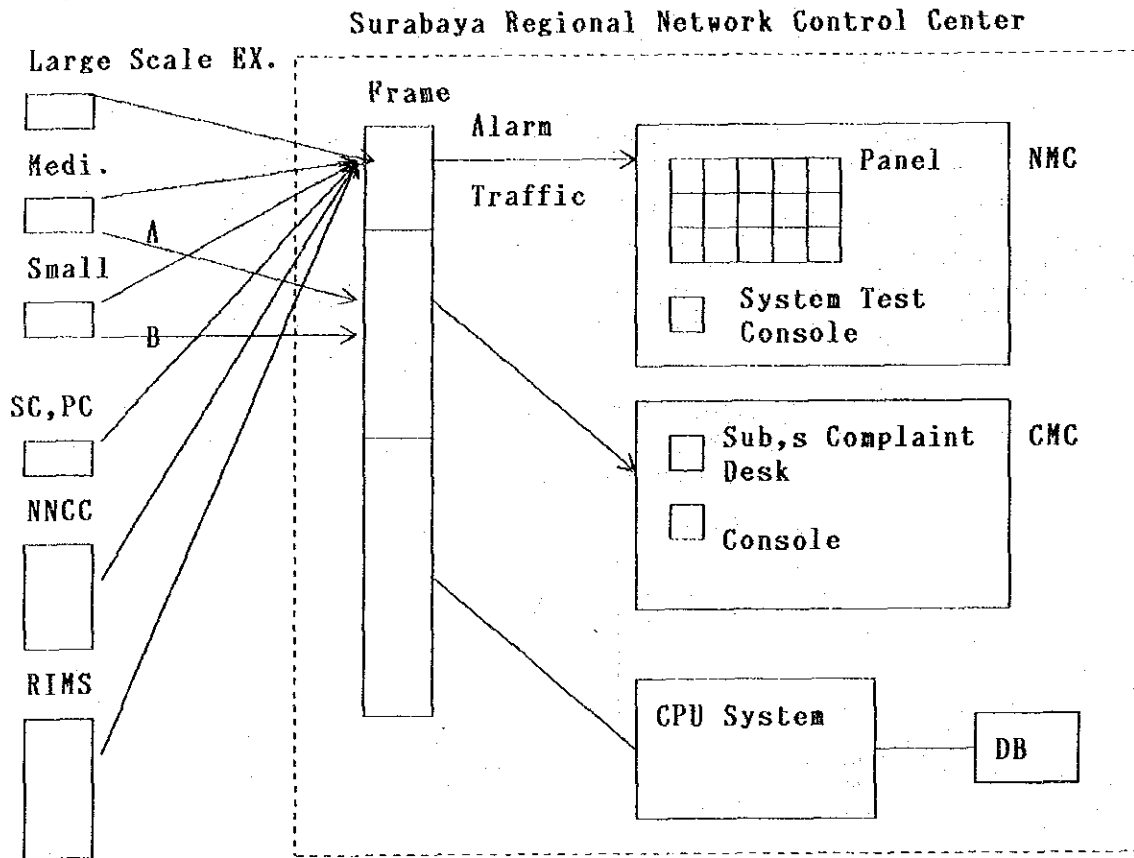
- training for instructors
- planning and design
- construction
- traffic management
- training for MDF and testing
- complaint desk
- billing staff
- others



WS: Work station

Source: CCITT Rec. M. 30 TMN (Telecommunication Management Network)

Figure 5.2.1 General Relationship of a TMN to a Telecommunication Network



Legend:

- A: Centralized at night time
- B: Centralized all the day
- NNCC: National Network Control Center (in Bandung)
- RIMS: Regional IMS (in Surabaya, Jakarta, Bandung)
- NMC: Network Management Center
- CMC: Complaint Management Center

Figure 5.2.2 Surabaya Regional Integrated Management System in 2004

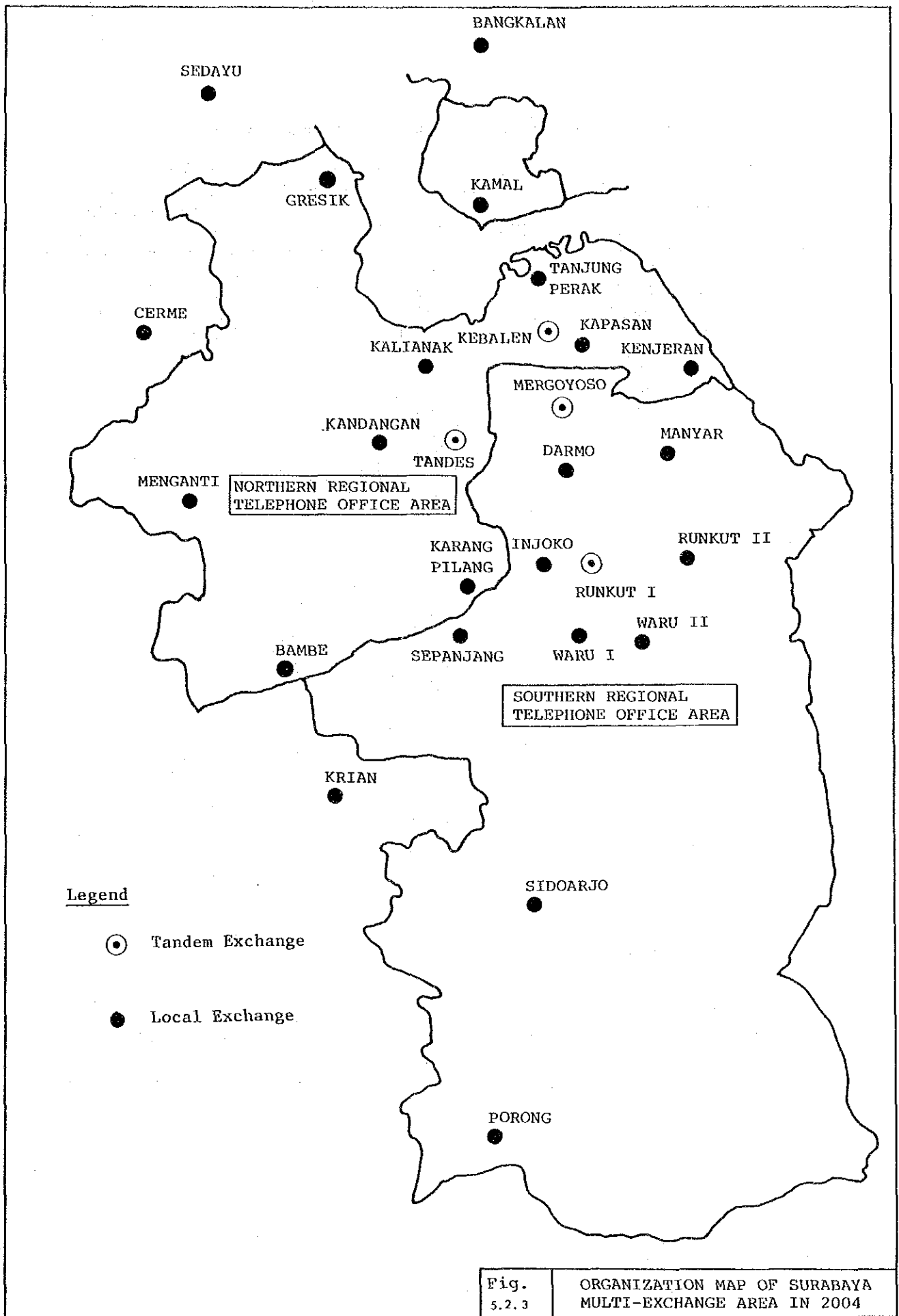


Table 5.2.1 Organization of O/M for Transmisson Division in 2004

OMC	Sub-OMC	Number of Supervised Stations					Rural Radio	
		M/W	SKSO	JUNCTION	SBK	B/S	RS/ST	
SB-II (Kebalen)	SB-II (Kebalen)	SB-II	SB-II	KBL	BWN	SDY	9	
		SB-I	MR	MGO	TBK	CME	9	
		GS	JG	TDS		KRN	7	
		BKL	KRN	RKT-I		BKL	16	
		KML		PRK				
		SDY		KJR				
		CME		KPS				
		SPJ		GS				
		KRN		MNR				
		G.BTK		KLK				
		B.BSR		DMO				
				KDN				
				PKT-II				
				IJK				
				KPL				
				MNI				
				WR-I				
		WR-II						
		SPJ						
		BBE						
		SDA						
		PR						
	Total (1)	11	4	22	2	4	41	
	Lamongan	LMG				LMG	12	
		BBT				BBT	8	
	Total (2)	2	0	0	0	2	20	
	Mojokerto	MR	MR			MR	7	
		JG	JG			JG	11	
		MJS				MJS	6	
		MOJ						
		POS						
	Total (3)	5	2	0	0	3	24	
	Total (1)+(2)+(3)	18	6	22	2	9	85	

Table 5.2.2 Organization of O/M for Outside Plant Division in 2004

OPMC	Sub-OPMC	----- Coverage Area -----	
		Exchange	Adminitration
Northern <SB.Utara> (Kebalen)	Kebalen	1. Tj.Perak 2. Kebalen 3. Kapasan 4. Kenjeran 5. Kalianak 6. Tandes 7. Kandangan 8. Karangpilang 9. Bambe 10. Manganti 11. Bangkalan 12. Kamal	Kota. Surabaya (North Side) Kab.Gresik Kab.Lamongan Kab. Bangkalan
	Gresik	1. Gresik 2. Cerme 3. Sedayu 4. Sangkapura 5. Lamongan 6. Babat	
Southern <SB.Selatan> (Darmo)	Darmo	1. Mergyoso 2. Darmo 3. Manyar 4. Injoko 5. Rungkut-I 6. Rungkut-II 7. Sepanjang 8. Waru-I 9. Waru-II	Kota. Surabaya (South Side) Kab.Sidoarjo Kab.Mojokerto Kab.Jombang
	Sidoarjo	1. Sidoarjo 2. Porong 3. Krian 4. Mojokerto 5. Mojosari 6. Jombang 7. Mojoagung 8. Ploso	

SECTION 6 SOCIO-ECONOMIC IMPACTS OF THE MASTER PLAN

SECTION 6

SOCIO-ECONOMIC IMPACTS OF THE MASTER PLAN

6.1 General

The implementation of the proposed master plan is anticipated to give a variety of impacts on socio-economy of the objective area. The anticipated impacts are identified and explained in the following part for the following aspects:

- Impacts on regional development
- Impacts in urban and industrial areas
- Impacts in rural areas

6.2 Impacts on Regional Development

The development of telecommunications systems gives impacts on the pattern of regional development, especially in the aspects of locations of economic activities and settlements. The provision of telecommunications services in the areas where no services or only limited services have been available will change the locational advantages of these areas resulting in the development of new spatial development patterns. In the objective area, northern areas in Kabupaten Gresik and Lamongan and hinterland areas of Kamal in Kabupaten Bangkalan are planned to develop as the new industrial areas as explained in Section 2. Combined with the development of other infrastructure facilities, the development of telecommunications systems in these areas will play a major role in attracting private investors to these areas in accordance with the stipulated government policies.

The telecommunications development for these planned industrial areas proposed in the objective are summarized as follows.

Item	Number of New Exchange	Number of New Repeater Station	Number of Radio Subscriber Terminal	Number of Subscriber under Rural Network	
				1990	2004
Northern Gresik	1	0	9	0	430
Northern Lamongan	0	1	5	0	210
Hinterland of Kamal	0	0	3	0	160
Total	1	2	16	0	800

Coupled with the expansion of the network as described above, the transmission systems connecting Surabaya and Lamongan, Kamal and Bangkalan shall be improved as follows.

Portion	Present	by 1999
Surabaya-Lamongan	through Bojonegoro/Madiun by open wire carrier/ microwave	through Gresik by digital transmission line
Surabaya-Kamal*	through Pamekasan by open wire carrier/radio	directly connected to Surabaya by digital transmission line
Surabaya-Bangkalan*	through Pamekasan by open wire/radio	through Gresik by digital transmission line

* It was found during the second survey in Indonesia that the new digital microwave system for these portions were installed and started operations in June (Surabaya-Kamal) and August (Surabaya-Bangkalan).

So far, communications between Surabaya and these areas have been quite inconvenient. With these improvements, on-time communication between these areas become possible greatly improving the attractiveness of the areas as investment location.

For the telecommunications sector to effectively generate positive socio-economic impacts in the aspect of regional development, planning and implementation of the telecommunications systems in the future should be based on a wider perspective incorporating:

- future prospect in regional development,
- good understanding of development trends in other sectors, and
- quick and timely response to private investors' trends.

6.3 Impacts in Urban and Industrial Areas

Surabaya and the surrounding areas in Sidoarjo and Gresik have been the center of industrial production and tertiary sector activities as well as the hub of land, air and sea transportation systems in the East Java Province. Surabaya's role as the commercial and financial center of the region will become even larger as industrialization proceeds in the surrounding areas and opportunities for international transactions increase in the coming years. As the hub of transportation, the Tanjung Perak port and the Juanda airport will handle a larger volume of cargoes and accommodate a larger number of passengers. The importance of the telecommunications sector will keep increasing as demands for better and sophisticated telecommunications services rise, particularly from business entities in the service industries such as financial agencies, trading companies, travel agencies, transportation companies, etc.

In the recognition of these circumstances, the Master Plan proposed the development of telecommunications systems for the Surabaya Multi-Exchange Area including the following components.

- the expansion of existing exchanges and transmission lines capacities through digitalization and the application of fiber optic cables
- automatization of exchanges
- establishment of new exchanges and associated transmission and subscriber lines
- the expansion of Surabaya Message Area
- the establishment of the Third International Gateway
- the expansion and introduction of new services including supplementary services for telephone and non-voice services

Through these developments, convenience of the telecommunications services will be increased in the following aspects.

- Telecommunications services become accessible to a larger number of the population. (It is estimated that the number of subscribers in the Surabaya Multi-exchange Area grows from 60,000 in 1989 to 408,000 in 2004.)
- For subscribers, telephone services become more convenient (e.g. higher call completion rate).
- For subscribers in the Surabaya Message Area, it becomes possible to make phone calls to a more distant partner at a lower cost.

These improvements in telecommunication services are expected to generate a number of positive impacts on socio-economic activities in Surabaya and the surrounding areas as summarized below.

- increased efficiency of production process (e.g. in shipping, purchase of raw materials, communications with transport companies, obtaining information on market conditions, coordinating production with other factories, adjustment of stocks, etc.)
- improved efficiency of transportation system: the complimentary role of the telecommunications sector (e.g. full loading made possible, minimization of idle time, misrouting, unnecessary trips, badly timed trips, empty return trips etc.)
- energy saving through reduced travel generation: the substituting role of the telecommunications sector (Requirements for communication could partly be met by telecommunications services in stead of trips on road leading to reduced number of trips and smaller amount of energy consumed.)
- increased business opportunities, both domestic and international, and resultant increase in production
- easier and quicker communications with partners in overseas markets or native countries enhancing efficiency in international business
- increased variety of new services made available in addition to telephone services, enabling efficient business operations

6.4 Impacts in Rural Areas

The objective area encompasses a large proportion of rural areas and the rural population accounting for the majority of the total population in the objective area. In the Master Plan, telecommunications services in rural areas are planned to be provided by rural radio telephone system. As already explained in Section 4, the criteria applied in determining the number of telephone lines in rural areas in the future are:

- the provision of minimum 20 telephone lines for each kecamatan capital by 1999, and
- the provision of minimum 2 telephone lines for each desa by 2004.

The actual number of lines to be provided was determined based on these criteria and taking into consideration the degree of urbanization of each desa. As a result, the following numbers of telephone lines are planned to be installed under the rural radio telephone system.

Number of Telephone Subscribers under Rural Radio Telephone System

Area	Number of subscribers in:		
	1990	1999	2004
Gresik	32	240	658
Bangkalan	0	330	794
Mojokerto*	392	320	722
Sidoarjo	64	180	442
Lamongan	80	370	1,140
Jombang	0	260	622
TOTAL	568	1,700	4,378

* The number drops in 1999 since Mojokerto in which 320 subscribers have been covered by the rural radio system, will be changed to local exchange.

The development and expansion of telecommunications systems in rural areas of the objective area are anticipated to improve access of the rural people to a variety of information, thus leading to upgrading living standards and increasing productivity. The following are the major socio-economic benefits of the proposed master plan in the rural areas.

Improved emergency communications:

Timely and efficient response to emergencies and natural disasters becomes possible leading to reduced costs for reconstruction, saving of human lives, reduced damages of agriculture products, etc.

Improved health services:

Health care services in the rural areas could be improved. The following are examples.

- It becomes possible for local health-care workers to consult timely with medical experts in urban areas regarding technical matters thus reducing the necessity for hospitalizing patients and spending long time for travel to obtain technical information.
- Ordering of supplies could be made quickly.

Increased productivities in agriculture and fisheries:

- Easier access to information on market conditions will work in favor of farmers and fishermen in setting prices of goods and shipping goods efficiently to a market where a commodity could be sold for higher price.
- Shipping arrangement could be better coordinated leading to reduced crop spoilage, larger shipments etc.
- Agriculture extension services could be provided to areas where extension workers are not regularly stationed through use of the telecommunications system.

Improved efficiency of commercial activities:

- Using telephone, consumers and retailers are better informed of prices of commodities in a distant market, therefore increasing choices in selecting supplier.
- Rural retailers could reduce the time to fill orders leading to increased productivity.

Transportation system and travel demand:

- Efficiency in transportation system will be improved through better arrangements of vehicles use. (supplementary role)
- Travel demand will decrease as the use of telecommunications could substitute the need for travel. (substituting role)
- Both of the benefits above shall contribute to reducing fuel consumption, desirable from the point of view of energy policy.

SECTION 7 ESSENTIAL PROJECT

SECTION 7

ESSENTIAL PROJECT

As the results of this study, "Expansion and Improvement of Regional Telecommunications Network" has been finally selected as the essential project to be materialized during the latter half of Repelita V and the former half of Repelita VI.

The implementation plan will be drawn up including the following:

- Necessity of the project implementation
- Scope of essential project
- Basic design
- Project cost estimate
- Implementation schedule
- Financial analysis and economic analysis

7.1 Selection of Essential Project

The expansion and development to be implemented as an essential project are for three kind of transmission systems in the objective area as mentioned in Section 4.3. The project has been finally selected from the following reasons:

(1) Difficulty of Smooth Procurement of Transmission Equipment

At present, switching equipment and metallic cables are procurable in Indonesia. It means that smooth project implementation for switching and outside facilities will be possible. However, advanced digital transmission equipment like fiber optic transmission system, etc. can not be procured domestically and must be imported from abroad. This has often resulted in a delay of installation of transmission systems, while other related facilities have been completed, causing the delay of the service commencement of the network as a whole.

To avoid such unfavourable situation, priority in investment should be given to the improvement of the transmission systems, so that the establishment of the well-balanced network can be achieved.

(2) Decline of Service Quality by Deteriorated Transmission System

The existing trunk network connecting the major cities in the objective area is composed of coaxial cable and open wire carrier systems. Facilities for these systems, however, are already aged 15-20 years and extremely deteriorated. Especially, the annual faulty time of the coaxial cables which are required to play an important role as the key transmission route connecting Surabaya and main cities of east Jawa province amounts to 350 hours. It is quite serious. To improve such situation, a new transmission system has to be installed urgently by this essential project.

(3) Expansion of Telecommunications Service Coverage Area

The long term regional development plan is now underway in the objective area. The extensive scale agricultural development in the southern region and the industrialization of the northern region are two major targets of this plan.

The objective area is rather densely populated, with Surabaya, the second largest city in Indonesia, as its center of activities. It is also considered as the nucleus of east Indonesia. Road and power there have already been improved considerably, but the lack of telecommunications service constitutes an obstacle in the way to regional development. At present, an average of 50,000 inhabitants are using only one open wire in common in each Kecamatan. To improve this situation, the rural area network indispensable for regional development should be constructed urgently by the essential project, including the provision of at least 20 telephones to each Kecamatan capital.

7.2 Name of Essential Project

"Expansion and Improvement of Regional Telecommunications Network"

The Project consists of the following:

- Expansion of junction network in Surabaya multi-exchange area.
- Improvement of trunk network connecting TC, PC and LE.
- Improvement of rural area network connecting subscribers in Kecamatan capitals.

The Project digest is given in ANNEX 7.1.1.

7.3 Scope of the Essential Project

7.3.1 Expansion of Junction Network

Expansion of junction network in Surabaya multi-exchange area is summarized as follows:

(1) New Transmission Sections by Fiber Optic Transmission System

- a) No. of sections: 13 sections in total
- b) Cable length : 92.4 km
- c) No. of systems : 18 (working)
(140 Mbit/s) 13 (standby)

(2) Expansion of Existing Fiber Optic Transmission Systems

- a) No. of sections: 13 in total
- b) No. of systems : 20

(3) Microwave System to be Upgraded (8 Mbit/s to 34 Mbit/s system)

- a) No. of hops: 1 (Kebalen - Kamal)

Further details are given in Figure 7.3.1 and Table 7.3.1.

7.3.2 Improvement of Trunk Network

Improvement of trunk network is summarized as follows:

(1) Installation of New Microwave Links

Type of system	No. of hops
1.5 GHz 8 Mbit/s system	5
2 GHz 34 Mbit/s system	4
Total	9

(2) Microwave Links to be Upgraded

8 Mbit/s to 34 Mbit/s system: 4 hops

Further details are given in Figures 7.3.2 and 7.3.3 and Table 7.3.2.

7.3.3 Improvement of Rural Area Network

Improvement of rural area network is summarized as follows:

Items	Numbers
Base stations	9
Radio subscriber terminal	64
Subscribers	1,700

Further details are given by Figures 7.3.2 and 7.3.3 and Table 7.3.3.

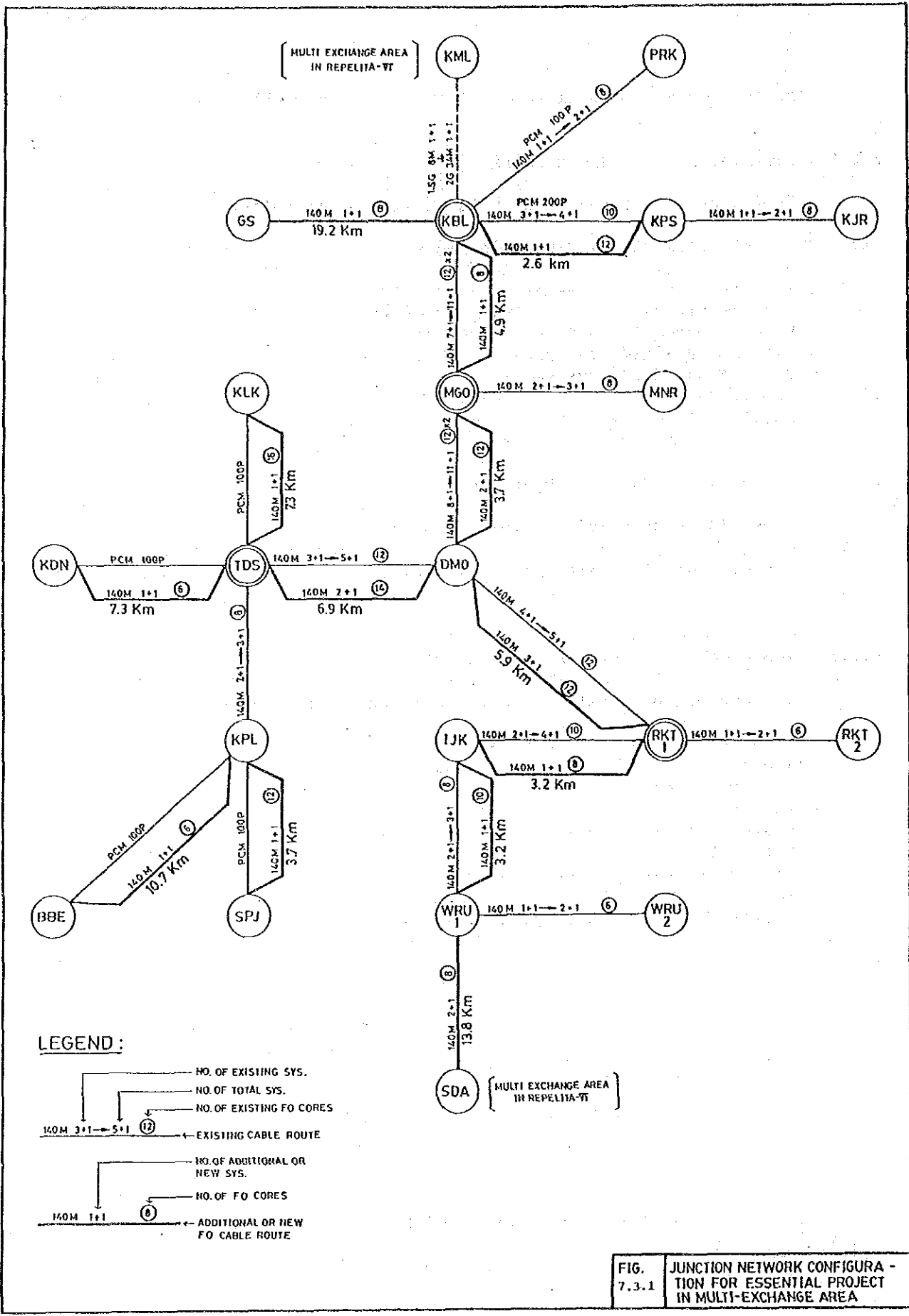
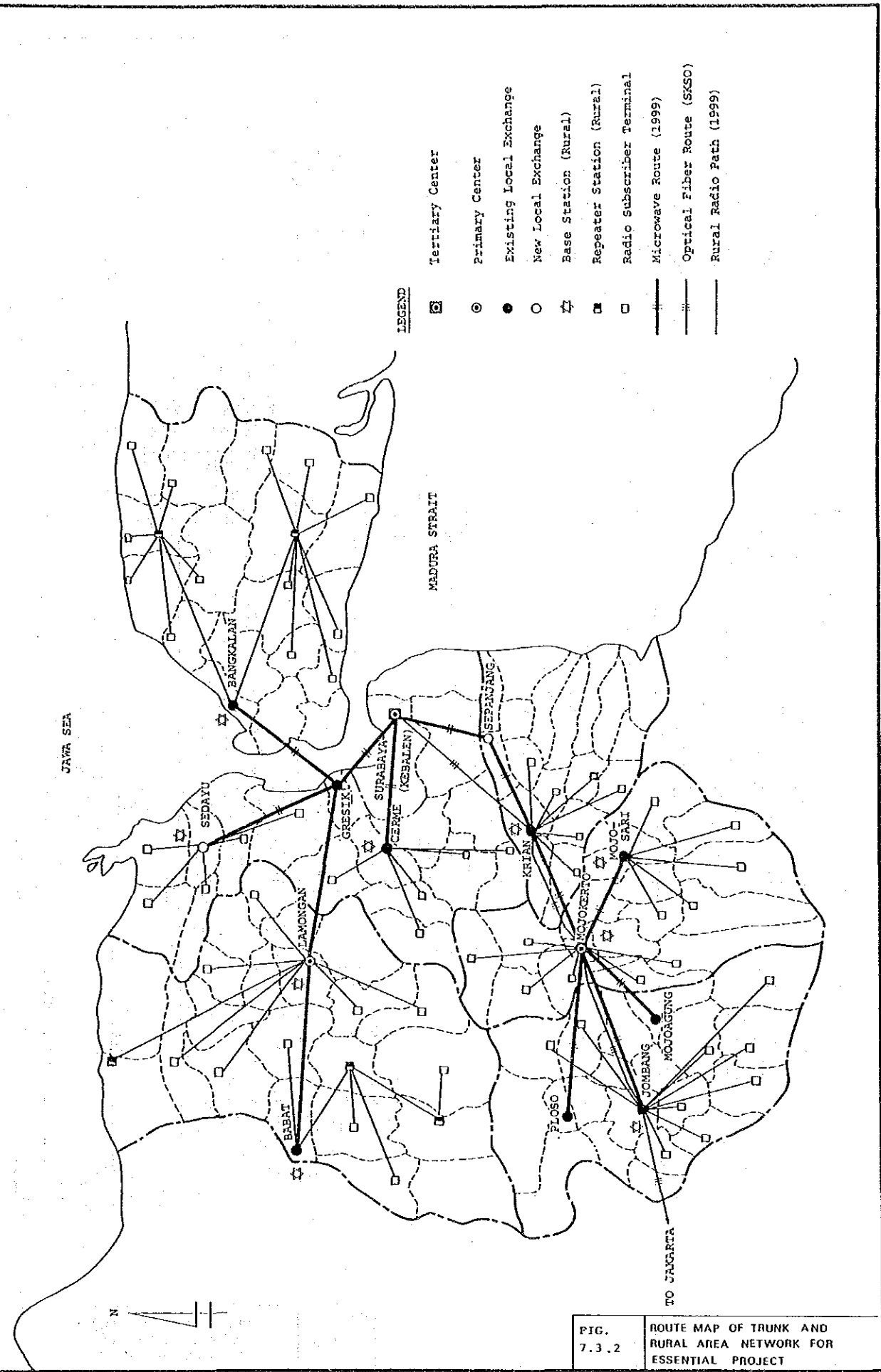


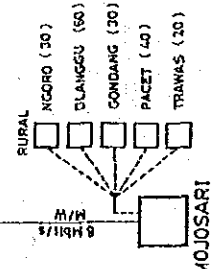
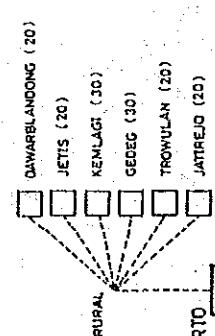
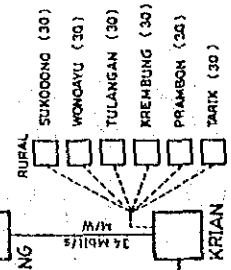
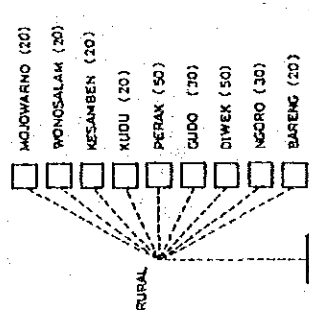
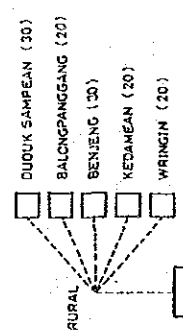
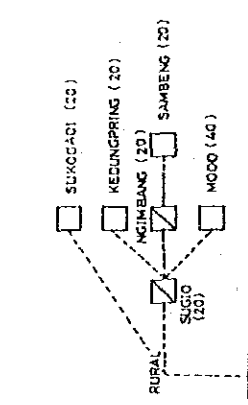
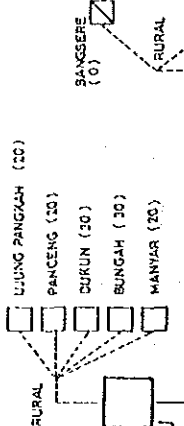
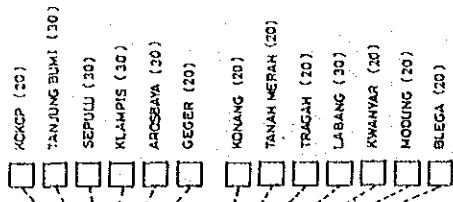
FIG. 7.3.1 JUNCTION NETWORK CONFIGURATION FOR ESSENTIAL PROJECT IN MULTI-EXCHANGE AREA



LEGEND

- Tertiary Center
- Primary Center
- Existing Local Exchange
- New Local Exchange
- ☆ Base Station (Rural)
- Repeater Station (Rural)
- Radio Subscriber Terminal
- Microwave Route (1999)
- Optical Fiber Route (SXS0)
- Rural Radio Path (1999)

FIG. 7.3.2 ROUTE MAP OF TRUNK AND RURAL AREA NETWORK FOR ESSENTIAL PROJECT



LEGEND
 ☒ : Repeater Station
 ☐ : Radio Subscriber Terminal
 (20): NO. of Subscribers.

FIG. 7.3.3

TRUNK AND RURAL AREA NETWORK CONFIGURATION FOR ESSENTIAL PROJECT

Table 7.3.1 Junction Cable Network to be Constructed Anew
under Essential Project

No.	Section Name	No. of Systems (140 Mbit/s)	--- Fiber Optical Cable ---	
			No. of Cores	Length (Km)
1	Kebalen - Gresik	1 + 1 *	8	19.2
2	Mergoyoso - Darmo	2 + 1	12	3.7
3	Darmo - Tandes	2 + 1	14	6.9
4	Darmo - Rungkut-I	3 + 1	12	5.9
5	Tandes - Kandangan	1 + 1	6	7.3
6	Tandes - Kalianak	1 + 1	16	7.3
7	Karang Pilang - Sepanjang	1 + 1	12	3.7
8	Karang Pilang - Bambe	1 + 1	6	10.7
9	Rungkut-I - Injoko	1 + 1	8	3.2
10	Injoko - Waru-I	1 + 1	10	3.2
11	Kebalen - Mergoyoso	1 + 1	8	4.9
12	Kebalen - Kapasan	1 + 1	12	2.6
13	Waru-I - Sidoarjo	2 + 1	8	13.8
1	Kebalen - Kapasan	1		
2	Kebalen - Tj. Perak	1		
3	Kebalen - Mergoyoso	4		
4	Kapasán - Kenjeran	1		
5	Mergoyoso - Darmo	3		
6	Mergoyoso - Manyar	1		(Existing FO Cable will be used.)
7	Darmo - Tandes	2		
8	Darmo - Rungkut-I	1		
9	Tandes - Karang Pilang	1		
10	Rungkut-I - Rungkut-II	1		
11	Rungkut-I - Injoko	2		
12	Injoko - Waru-I	1		
13	Waru-I - Waru-II	1		
1	Kebalen - Kamal	1 + 1 (34 Mbit/s)		Microwave **
Total		No. of new sys.	18 + 13	92.4
		No. of add. sys.	20	
		Microwave	1 + 1 (34 Mbit/s)	

NOTE : * +1 -- Standby system

: ** ---- Existing 8 Mbit/s will be changed to 34 Mbit/s system.

Table 7.3.2 Trunk Network to be Constructed Anew under Essential project

NO.	Route Name	No. of Systems		Remarks
		1.5 GHz 8 Mbit/s	2 GHz 34 Mbit/s	
1	Mojokerto - Jombang		1 + 1	Route standby
2	Gresik - Bangkalan		1 + 1 *	Route standby
3	Surabaya - Cerme	1 + 1		Set stabdby
4	Gresik - Sedayu	1 + 1		Set stabdby
5	Mojokerto - Mojosari	1 + 1		Set stabdby
6	Mojokerto - Mojoagung	1 + 1		Set stabdby
7	Mojokerto - Ploso	1 + 1		Set stabdby
8	Sepanjang - Krian		1 + 1	Route standby
9	Krian - Mojokerto		1 + 1	Route standby
10	Lamongan - Babat		1 + 1	Route standby
11	Surabaya - Sepanjang		1 + 1 *	Route standby
12	Gresik - Lamongan		1 + 1 *	Route standby

1	Surabaya - Gresik		2 + 1 **	

Total	No.of new sys.	5 + 5	7 + 7	
	No.of exp.sys.		2 + 1	

NOTE : * --- Existing 8 Mbit/s will be changed to 34 Mbit/s system.
 : ** -- Existing microwave will be expanded to (2+1).

Table 7.3.3 Rural Area Network to be constructed anew under Essential Project

No. Base Stations Name	No.of Repeater Station	No.of Radio Sub. Terminal	No. of Subscribers
1 Krian		6	180
2 Cerme		5	120
3 Sedayu		5	120
4 Bangkalan	2	13	330
5 Mojokerto		6	140
6 Mojosari		5	180
7 Jombang		9	260
8 Lamongan	1	6	230
9 Babat	2	4	140

Total	5	59	

		64	1,700

7.4 Basic Design

Basic design for the regional transmission network to be realized by the essential project is the same as that described in SECTION 4.3.2.

7.5 Project Cost Estimate

The project cost required for implementing the Essential Project is estimated as follows:

Currency portion	Amount (in million)
Foreign	M.Yen 3,570 (equivalent to M.Rp. 44,625)
Local	M.Rp. 6,373
Total Cost	M.Rp. 50,998

- Note: 1) The exchange rate as of August 1990, is used.
US\$ 1 = Rp. 1,850
Yen 1 = Rp. 12.5
- 2) The breakdown of the project cost is given in Table 7.5.1.
- 3) The cost estimate is based on price levels as of August, 1990.

The project cost is estimated based on the following preconditions:

- a) Telephone exchanges and subscriber cable networks will be constructed by other projects.
- b) Commercial power is available at radio subscriber terminals of the rural area network to be installed in each Kecamatan capital.
- c) Floor space for radio subscriber terminal equipment can be obtained in Kecamatan capital office.
- d) Equipment and installation costs of power supply system (except for engine-generator) for transmission system to be installed in telephone exchange are included in this project cost.
- e) Existing cable ducts and manholes in Surabaya multi-exchange area except for Kebalen - Gresik and Waru I - Sidoarjo, can accommodate FO cables of junction cable network.
- f) Lands and Buildings to be used for this project are shown in Table 7.5.2. Building floor layout drawings are attached in VOLUME II.

7.6 Implementation Schedule

Implementation schedule for this project is given in Table 7.6.1. The project must be implemented well coordinated with other related sub-systems such as telephone exchanges, subscriber cable network and so on.

Table 7.5.1 Project Cost

No.	Items	Costs	
		Foreign (M ¥)	Local (M Rp.)
1.	Equipment (F.O.B Price)		
1.1	Junction Cable Network	693	196
1.2	Trunk Network	543	
1.3	Rural Area Network	628	
1.4	Measuring Equipment	200	
1.5	Spare Parts	154	
	Sub-total	2,218	196
2.	Vehicles for Maintenance		340
3.	Freight and Insurance	89	
4.	Inland Transportatin		280
5.	Installation	652	2,957
6.	Training	35	
7.	One year Maintenance Assistance	33	
	Total (1 - 7)	3,027	3,773
8.	Land Acquisition		490
9.	Construction of Building		2,110
10.	Consultancy Services	240	
11.	Contingency	303	
	Project Cost	3,570	6,373

Table 7.5.2 Status of Land and Building for Essential Project
(Situation on September, 1990)

Exchange Name	Land Acquisition	Transmission	Required Room Space Rectifier	Battery	Remarks
Surabaya message area					
1 KAPSAN	0	Add	Add	0	
2 KEBALEN	0	0	Add	Add	
3 T.J. PERAK	0	0	Add	Add	
4 KENJERAN	0	0	0	0	TEL-3
5 GRESIK	0	0	0	0	
6 KAMAL	0	0	New	New	
7 DARMO	0	0	New	Add	
8 MERGOYOSO	0	Add	Add	Add	
9 MANYAR	0	0	0	0	TEL-3
10 TANDES	0	0	0	0	
11 SEPANJANG	0	0	0	0	
12 KARANG PILANG	0	0	0	0	TEL-3
13 KANDANGAN *	0	New	New	New	TEL-3
14 KALIANAK *	0	New	New	New	TEL-3
15 BAMBE	New	0	0	0	TEL-3
16 RUNGKUT-I	0	0	0	0	
17 RUNGKUT-II *	New	New	New	New	TH-3
18 INJOKO	0	0	0	0	TEL-3
19 WARU-I	0	0	0	0	TEL-3
20 WARU-II	New	0	0	0	TEL-3
21 SIDOARJO	0	0	0	0	
22 CERME	New	New	New	New	
23 SEDAYAU	New	New	New	New	
24 KRIAN	New	New	New	New	
25 BANGKALAN	0	Add	New	New	
26 GALIS (RS)	New	New	New	New	
27 BANGSEREH (RS)	0	0	0	0	Submarine
Mojokerto message area					
28 MOJOKERTO	0	0	0	0	
29 MOJOSARI	0	New	New	New	
30 JOMBANG	0	Add	Add	0	
31 MOJOAGUNG	New	New	New	New	
32 PLOSO	New	New	New	New	
Lamongan message area					
33 LAMONGAN	0	New	New	New	TEL-3
34 BABAT	New	New	New	New	
35 BRONDONG (RS)	New	New	New	New	
36 NGIMBANG (RS)	0	0	0	0	Rural (TRT)

Note : 0 ----- Enough space

: New ----- New land acquisition or New building

: Add ----- Additional room with modification

: TEL-3 ----- TELECOM III OSP project

: TH-3 ----- TAHAP 3 project

: Submarine-- Microwave tail link for submarine cable project

: Rural ----- Rural area telecommunication project

* DLU will be changed to STDI in Repelita VI.

** Other new sites for Repeater Stations (RS) and Radio Subscriber Terminals (ST) of rural area network will be selected in Kecamatan capital offices.

Table 7.6.1 Implementation Schedule of Essential Project

No. of Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Calendar Year																											
Work Items																											
Engineering service	-----																										
Approval of Tender Document	-----																										
Tender Floating	-----																										
Tender Evaluation and Negotiation	-----																										
Approval and Signing of Contract	-----																										
Manufacturing	-----																										
Installation	-----																										
Testing and Commissioning	-----																										
Land Acquisition	-----																										
Build. Construction	-----																										

7.7 Financial Analysis of Essential Project

7.7.1 Objective and Methodology

(1) Objective of Financial Analysis

A financial analysis is conducted focusing on the essential project. The objective of the financial analysis is to estimate costs and revenues to be generated by the essential project and assess its financial feasibility. The result could be referred to as a criterion in promoting the project to the implementation stage.

(2) Methodology of Financial Analysis

An overall flow of the financial analysis is presented in Figure 7.7.1. Costs and revenues to be estimated include the following:

Costs:

- investment cost of the essential project
- operation and maintenance cost of the essential project
- total development cost of all facilities required to supply telephone services to new subscribers during Repelita VI and VII

Revenues:

- revenue from pulse production
- revenue from installation fee
- revenue from monthly recurrent charge
- revenue from non-voice services

The total development costs of all facilities required to supply telephone services to new subscribers during Repelita VI and VII are estimated to calculate the contribution of the essential project in the revenues produced by the new subscribers during Repelita VI and VII.

The financial analysis is conducted based on the following assumptions:

- Both costs and revenues are estimated using 1990 constant price.
- The foreign exchange rate used is "US\$ 1 = ¥ 148 = Rp.1,850": the rate as of August 1990.
- The tariff system as of August 1990 is applied to estimating revenues.
- The project life is assumed to be 15 years from the commencement of services.
- Financial internal rate of return (FIRR) is used as the indicator for assessing financial feasibility of the essential project.

7.7.2 Cost Estimate

(1) Investment Cost of Essential Project

The investment cost of the essential project estimated in sub-section 7.5 "Project Cost Estimate" is planned to be disbursed according to the following schedule:

(in million Rupiah)

Year	Foreign	Local	Total
1992	1,650	1,545	3,195
1993	33,538	3,965	37,503
1994	5,238	863	6,101
1995	413	0	413
Total	40,839	6,373	47,212

The foreign currency portion of the investment cost estimated in Japanese yen in Section 7.5 is converted to Indonesian Rupiah applying the exchange rate of US\$ 1 = ¥ 148 = Rp.1,850; the rate as of August 1990. Contingency is excluded in the disbursement schedule above.

(2) Operation and Maintenance Cost of Essential Project

The operation and maintenance cost (OM cost) of the essential project is assumed to be 3% annually of the total investment cost. OM cost at a full operation stage is estimated to be 1,416 million Rupiah per year.

(3) Total Development Cost of All Facilities

The total development costs of all facilities required to provide telephone services to new subscribers during Repelita VI and VII, including the development cost of the essential project, are estimated as presented in sub-section 4.7. They are estimated as follows:

	(million US\$)	(million Rupiah)
Repelita VI :	235	434,750
Repelita VII:	326	603,100

The investment cost of all facilities during Repelita VI and VII in US dollar is converted to Indonesian Rupiah applying the exchange rate of US\$ 1 = Rp.1,850.

Comparing the investment costs of the essential project and the total development costs during Repelita VI and VII as presented above, the following proportions are derived as the contribution of the essential project.

Repelita VI :	10.9 % (47,212/434,750)
Repelita VII:	4.5 % (47,212/(434,750 + 603,100))

7.7.3 Revenue Estimate

(1) Revenue from Pulse Production

The pulse revenue is calculated by estimating and applying the following items according to the flow in Figure 7.7.1.

- pulse production per subscriber
- tariff rate per pulse
- revenue per subscriber
- planned number of new subscribers during Repelita VI and VII
- total revenue from pulse production during Repelita VI and VII
- total pulse revenue from SLDD calls and local calls
- proportion of the essential project
- total pulse revenue by the essential project

1) Pulse Production per Subscriber

The number of pulses produced by one subscriber is estimated based on the data obtained from WITEL VII, PERUMTEL. The data give total pulse production, the number of subscribers and pulse rates in 1989 for the Surabaya Multi-exchange area and the surrounding areas. The following pulse rates are derived as the average pulse rates per subscriber.

(pulse/subscriber/year)	
=====	
Surabaya Multi-exchange Area :	14,000
Surrounding Areas :	8,000
=====	

The financial analysis uses these pulse rates for Repelita VI and VII periods. Table 7.7.1 shows the pulse rates in the objective area.

2) Tariff Rate

Under the tariff system as of August 1990, 75 Rupiah is charged for one pulse produced by private subscriber. This rate is to be used in the financial analysis.

3) Revenue per Subscriber

By multiplying the pulse rates per subscriber and the tariff rate, the pulse revenue per subscriber is estimated as follows:

(thousand Rupiah/ subscriber/year)	
=====	
Surabaya multi-exchange area :	1,050
Surrounding areas :	600
=====	

4) Planned Number of Subscribers

The following table summarizes the existing and planned number of subscribers in the last years of Repelita IV, V, VI and VII in the objective area.

Repelita (final year)	Surabaya MEA*		Outskirts Area	
	Total	New	Total	New
IV (1989)	60,000	-	13,535	-
V (1994)	179,108	119,108	17,712	4,177
VI (1999)	265,000	85,892	19,506	1,794
VII (2004)	408,000	143,000	34,676	15,170

* Multi-Exchange Area

5) Total Pulse Revenue during Repelita VI and VII

Based on the figures given above, the total annual pulse revenue during Repelita VI and VII by new subscribers are derived as follows:

(in million Rupiah/year)

Repelita	Surabaya MEA	Outskirts Area	Total
VI (1999)	90,187	1,076	91,263
VII (2004)	240,337*	10,178*	250,515

* generated by the new subscribers added during Repelita VI and VII.

6) Total Pulse Revenue from SLDD Calls and Local Calls

To identify the contribution of the essential project in the increase of pulse revenue during Repelita VI and VII, the total pulse revenue is first allocated to a local call portion and an SLDD call portion. Since the original data on pulse production gave only the total pulse production, not categorized into local and SLDD calls, the total pulse volume was split into SLDD and local calls based on the following data.

a. Average pulses per call for SLDD and local calls

These are calculated based on average duration (in seconds) of SLDD call and local call per pulse and average holding time of SLDD calls and local calls.

b. Forecast telephone traffic by SLDD and local calls

Traffic forecast presented in Section 4 is referred to.

In terms of revenue, it was found that the total pulse revenue is split into an SLDD call portion and a local call portion in the following proportions and amounts.

(million Rupiah/year)			
Type of Call	Proportion	Repelita VI	Repelita VII
Local	25 %	22,843	62,629
SLDD	75 %	68,531	187,886
Total	100 %	91,374	250,515

The process of deriving the proportions shown above is presented in ANNEX 7.7.1 in detail.

7) Proportion of Essential Project for Local Call Revenue

The contribution of the essential project in the revenues generated during Repelita VI and VII by new subscribers is derived for the local call portion and the SLDD portion separately.

For the local call portion, the proportion of the investment cost of the essential project to the total development cost of all facilities during Repelita VI and VII are applied to estimating the local call portion of revenue that could be accrued to the essential project. The following show the result.

Local Call Revenue by Essential Project		
Repelita	Proportion (%)	(million Rp./year)
VI	10.9	2,490
VII	4.5	2,818

8) Proportion of Essential Project for SLDD Call Revenue

For the SLDD call portion, the contribution of the essential project is checked from the following two aspects.

- assessment of the proportion of SLDD revenue generated in the Study Area which the objective area deserves to receive
- allocation of contributions among the essential project and other facilities required to increase revenues during Repelita VI and VII; the same approach as that for the local call portion

Regarding the first aspect, the idea is to check the contribution of the objective area in generating the national SLDD revenue in comparison

with the national investment on all telecommunications facilities. SLDD revenues are generated by communications between parties across message area boundaries. For these communications to be realized, there should be telecommunications facilities at locations of each party. In reality, SLDD revenue goes to the message area where an SLDD call originates. In theory, it would be reasonable for both message areas to share SLDD revenue from the point of view of realizing fair allocation of SLDD revenues. This is because SLDD calls are realized using telecommunications facilities at both message areas. An appropriate way would be to allocate SLDD revenue generated in a message area in proportion to its contribution to the national telecommunications investment. The following is an example.

"If a message area invests 10% of the national telecommunications investment and generates 20% of the national SLDD revenue, it deserves to receive only 10% of the national SLDD revenue or half the SLDD revenue it actually receives under the present system. If its investment is 20% of the national telecommunications investment and it generates only 10% of the national SLDD revenue, it deserves to receive 20% of the national SLDD revenue or double the SLDD revenue it actually receives."

For the Study, the following items are checked to assess what percentage of SLDD revenue generated in the Study Area could be counted as belonging to the objective area.

- a. the share of WITEL VII in generating the total revenue of PERUMTEL in 1988: proxy for the objective area's share in the national SLDD revenue
- b. the share of WITEL VII's fixed assets value in the PERUMTEL's fixed assets value in 1988: proxy for the objective area's share in the total investment on telecommunications facilities to that of PERUMTEL

From the data obtained at WITEL VII and PERUMTEL H/Q, the following are found.

- a. the share of WITEL VII in generating the total revenue of PERUMTEL in 1988: 12.2% (Rp. 84,447 x 10⁶/Rp. 690,560 x 10⁶)
- b. the share of WITEL VII's fixed assets value in the PERUMTEL's fixed assets value in 1988: 11.8% (Rp. 190,571 x 10⁶/Rp. 1,612,641 x 10⁶)

It is judged from these figures that 100% of the SLDD revenue generated in the objective area could be counted as belonging to the objective area.

Taking into account the same proportions of the essential project to all investment costs as in the case for local call revenues: 10.9% during Repelita VI and 4.5% during Repelita VII, the following SLDD revenues are estimated to be generated by the essential project at a full operation stage.

SLDD Revenue by Essential Project

Repelita	Proportion (%)	(million Rp./year)
VI	10.9	7,470
VII	4.5	8,455

(2) Revenue from Installation Fee

Revenue from installation fee is estimated based on the installation fee as of August 1990 and planned number of new subscribers during Repelita VI and VII. Depending on the area, seven levels of installation fee are applied. Installation fees applied in the objective area are as follows:

- Surabaya Multi-exchange Area:	350,000 Rupiah
- Outside Surabaya Multi-exchange Area	
Gresik :	175,000 Rupiah
Others :	125,000 Rupiah

The number of new subscribers in these respective areas are planned as follows:

Areas	Repelita	
	VI	VII*
Surabaya Multi-exchange Area :	85,892	143,000
Outside Surabaya Multi-exchange Area		
Gresik :	520	874
Others :	1,274	14,296
Total	87,686	158,170

* the number of new subscribers added during Repelita VII only

Based on the figures above, the total revenue from installation fee is estimated as follows:

Areas	(in million Rupiah)	
	Repelita VI	Repelita VII
Surabaya Multi-exchange Area :	30,062	50,050
Outside Surabaya Multi-exchange Area		
Gresik :	91	153
Others :	159	1,787
Total	30,312	51,990

Applying the contribution of the essential project in the overall development: 10.9% during Repelita VI and 4.5% during Repelita VII, the installation fee revenue by the essential project is estimated as follows:

(million Rupiah)	
Repelita VI :	3,304
Repelita VII:	2,340

Total :	5,644

(3) Revenue from Monthly Recurrent Charge

The monthly recurrent charges as of August 1990 are 3,500 Rupiah per month for the Surabaya multi-exchange area and 2,000 Rupiah per month for the areas outside the Surabaya multi-exchange area. Multiplying these charges, the planned number of new subscribers and the contribution of the essential project, the revenue from monthly recurrent charge is derived as follows:

Items	Repelita	
	VI	VII
=====		
(Total Revenue in million Rp.)		
Surabaya Multi-exchange Area :	301	801
Outside Surabaya Multi-exchange Area :	4	34

Total :	305	835
(Contribution of Essential Project)		
Total :	10.9 %	4.5 %
(Monthly recurrent charge revenue by Essential Projection million Rp.)		
Total :	33	38
=====		

(4) Revenue from Non-voice Services

In 1989, revenues from non-voice services amounted to about 10,026 million Rupiah in WITEL VII: equivalent to about 10.4% of telephone revenue which was about 96,322 million Rupiah. Non-voice services included such services as telex, telegraph, leased circuits, radio and SKDP. General trends of non-voice services in the coming years would be a gradual substitution of telex and telegraph by facsimile and an increase of such services as leased circuits, radio and SKDP.

In the Study, it is assumed that non-voice services keep generating revenue equivalent to about 10% of telephone pulse revenue. It is estimated that 1,127 million Rupiah is annually generated at a full operation stage by non-voice services.

7.7.4 Financial Evaluation of Essential Project

Based on the costs and revenues estimated, a cash flow of the essential project is prepared as shown in Table 7.7.2 (1/2 - 2/2). From the cash flow, financial internal rate of return (FIRR) is calculated. FIRRs are calculated for a standard case and a variety of cases in which costs or revenues are assumed to exceed or fall short of those in the standard case. FIRRs are calculated for both profit before tax and profit after tax for each case. The following table presents the derived FIRRs.

Case	FIRR (%)	
	before tax	after tax
1 (standard)	14.05 %	8.41 %
2 (cost 10% up)	12.50 %	7.08 %
3 (revenue 10% down)	12.33 %	6.95 %
4 (cost 10% up and revenue 10% down)	10.83 %	5.65 %

Since the essential project serves the public objective of enhancing the telecommunications services for the public, it would be appropriate to regard the FIRRs before tax as the indicator for assessing the financial soundness of the project. The idea is to regard PERUMTEL as a part of the government rather than an entity operating solely on its own. Based on this idea, income tax to be paid by PERUMTEL to the government is regarded as a transfer payment within the government.

It is found from the FIRRs before tax that the essential project is financially sound and worth being promoted to the implementation stage. The FIRR in the standard case is calculated to be 14.05%. As a way to assess FIRR, it could be compared with lending interest rates of funds on which the project might depend for implementation. The FIRR in the standard case, 14.05%, is higher than most of lending interest rates of international financial agencies such as the World Bank (7.5 - 8.0%/year), the Asian Development Bank (6.0 - 6.5%/year) and the Overseas Economic Cooperation Fund of Japan (about 2.5%/year). This indicates that the project generates revenues at a level high enough to earn profit to repay interests of the loan from these agencies. This is also the case for the FIRRs in case 2 (12.50%), 3 (12.33%) and 4 (10.83%).

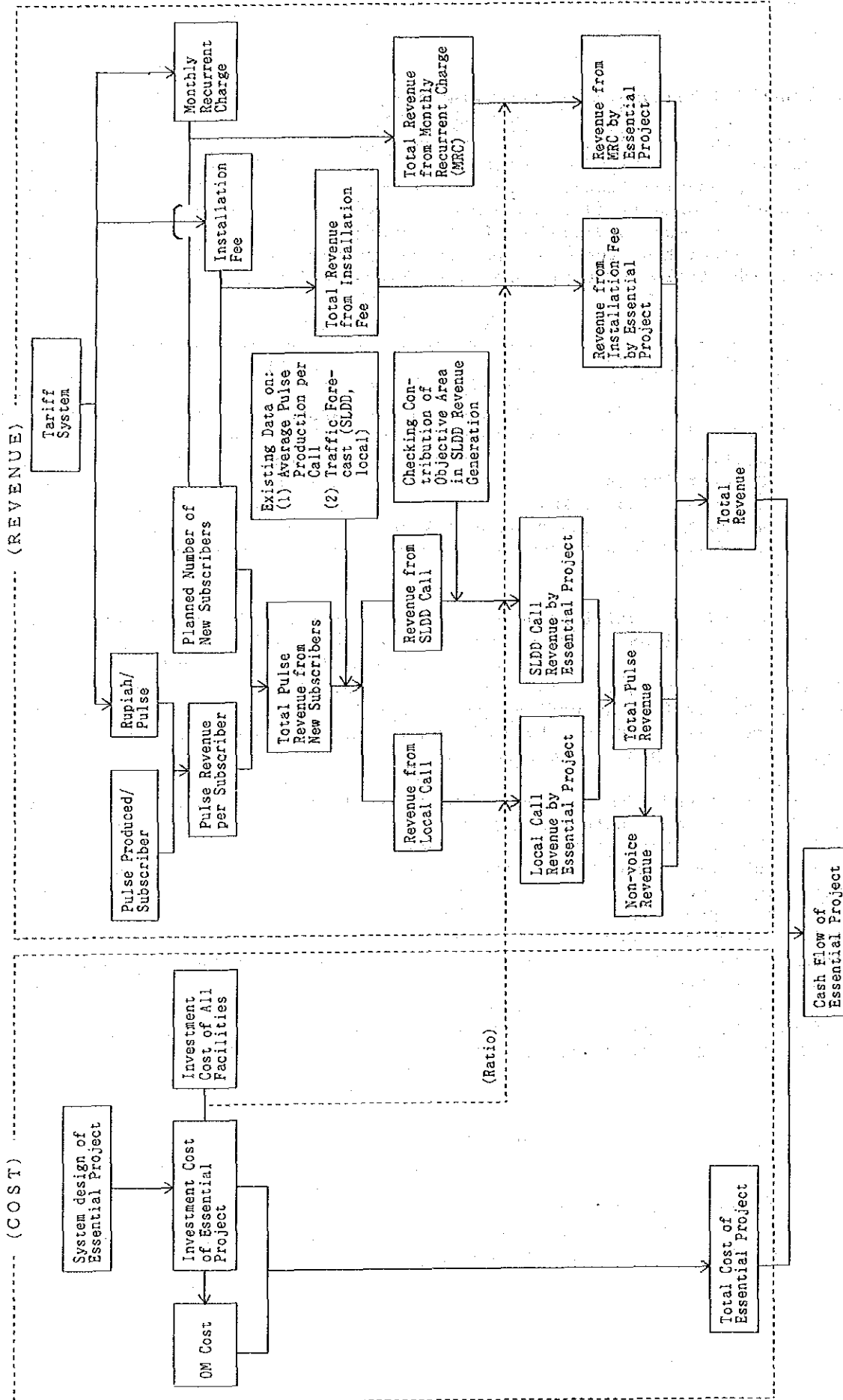


Figure 7.7.1 Flow of Financial Analysis

Table 7.7.1 Annual Pulse Production in WITEL VII in 1989

Area	Total Pulse Produced	Number of sub- scribers *	Pulse per sub- scriber
(Objective Area)			
Surabaya South	497,809,869	33,735	14,757
Surabaya North	312,197,419	24,117	12,945
Surrounding Areas	38,651,104	4,834	7,997
Sub-total	848,658,392	62,686	13,538
(Areas outside Objective Area)	308,089,871	36,135	8,526
(Witel VII)	1,156,748,263	98,820	11,706
(% distribution)			
(Objective Area)			
Surabaya South	43.0	34.1	-
Surabaya North	27.0	24.4	-
Surrounding Areas	3.3	4.9	-
Sub-total	73.4	63.4	-
(Areas outside Objective Area)	26.6	36.6	-
(Witel VII)	100.0	100.0	-

* Average of 12 months in 1989

Table 7.7.2 (1/2) Cash Flow of Essential Project : Case 1 (Standard Case)

(Unit : million rupiah)

No. Year	Investment		Cost	Revenue		Installa- Monthly tion Fee Charge	Pulse	Non- voice	Total	Profit before tax	Tax	Profit after Tax	
	FC	LC		OM	Total								
1	1,650	1,545	3,195	0	0	0	0	0	0	(3,195)	0	(3,195)	
2	33,538	3,965	37,503	0	0	0	0	0	0	(37,503)	0	(37,503)	
3	5,238	863	6,101	0	0	0	0	0	0	(6,101)	0	(6,101)	
4	413	0	413	1,416	826	826	826	249	3,573	1,744	610	1,134	
5	0	0	0	1,416	826	826	826	498	6,321	4,904	1,716	3,188	
6	0	0	0	1,416	826	826	826	747	9,068	7,651	2,678	4,973	
7	0	0	0	1,416	826	826	826	996	11,815	10,399	3,640	6,759	
8	0	0	0	1,416	468	468	468	1,022	11,747	10,331	3,616	6,715	
9	0	0	0	1,416	468	468	468	1,049	12,037	10,621	3,717	6,904	
10	0	0	0	1,416	468	468	468	1,075	12,327	10,911	3,819	7,092	
11	0	0	0	1,416	468	468	468	1,101	12,617	11,201	3,920	7,281	
12	0	0	0	1,416	468	468	468	1,127	12,906	11,490	4,021	7,468	
13	0	0	0	1,416	0	0	0	1,127	12,438	11,022	3,858	7,164	
14	0	0	0	1,416	0	0	0	1,127	12,438	11,022	3,858	7,164	
15	0	0	0	1,416	0	0	0	1,127	12,438	11,022	3,858	7,164	
16	0	0	0	1,416	0	0	0	1,127	12,438	11,022	3,858	7,164	
17	0	0	0	1,416	0	0	0	1,127	12,438	11,022	3,858	7,164	
18	0	0	0	1,416	0	0	0	1,127	12,438	11,022	3,858	7,164	
19	0	0	0	1,416	0	0	0	1,127	12,438	11,022	3,858	7,164	
20	0	0	0	1,416	0	0	0	1,127	12,438	11,022	3,858	7,164	
TOTAL	40,839	6,373	47,212	22,662	69,874	5,644	531	157,550	15,755	179,480	109,606	54,742	54,864

Note : The increase of subscribers is assumed as follows.

Repelita VI : increase by equal numbers in 4 years between 1995 and 1998 reaching 81,892 by end Repelita VI.

Repelita VII : increase by equal numbers in 5 years between 1999 and 2004 reaching 147,000 by end Repelita VII.

FIRR before tax : 14.05%
FIRR after tax : 8.41%

Table 7.7.2 (2/2) Cash Flow of Essential Project : Sensitivity Analysis

(Unit : million Rupiah)

No. Year	Case 2				Case 3				Case 4			
	Cost	Revenue	Profit before tax	Profit after tax	Cost	Revenue	Profit before tax	Profit after tax	Cost	Revenue	Profit before tax	Profit after tax
1	3,515	0	(3,515)	0	3,195	0	(3,195)	0	3,515	0	(3,515)	0
2	41,253	0	(41,253)	0	37,503	0	(37,503)	0	41,253	0	(41,253)	0
3	6,711	0	(6,711)	0	6,101	0	(6,101)	0	6,711	0	(6,711)	0
4	2,012	3,573	1,561	546	1,829	3,216	1,387	485	2,012	3,216	1,204	421
5	1,558	6,321	4,763	1,667	1,416	5,688	4,272	1,495	1,558	5,688	4,130	1,446
6	1,558	9,068	7,510	2,628	1,416	8,161	6,745	2,361	1,558	8,161	6,603	2,311
7	1,558	11,815	10,257	3,590	1,416	10,634	9,217	3,226	1,558	10,634	9,076	3,176
8	1,558	11,747	10,189	3,566	1,416	10,572	9,156	3,205	1,558	10,572	9,014	3,155
9	1,558	12,037	10,479	3,668	1,416	10,833	9,417	3,296	1,558	10,833	9,276	3,246
10	1,558	12,327	10,769	3,769	1,416	11,095	9,678	3,387	1,558	11,095	9,537	3,338
11	1,558	12,617	11,059	3,871	1,416	11,356	9,939	3,479	1,558	11,356	9,798	3,429
12	1,558	12,906	11,348	3,972	1,416	11,616	10,199	3,570	1,558	11,616	10,058	3,520
13	1,558	12,438	10,880	3,808	1,416	11,194	9,778	3,422	1,558	11,194	9,636	3,373
14	1,558	12,438	10,880	3,808	1,416	11,194	9,778	3,422	1,558	11,194	9,636	3,373
15	1,558	12,438	10,880	3,808	1,416	11,194	9,778	3,422	1,558	11,194	9,636	3,373
16	1,558	12,438	10,880	3,808	1,416	11,194	9,778	3,422	1,558	11,194	9,636	3,373
17	1,558	12,438	10,880	3,808	1,416	11,194	9,778	3,422	1,558	11,194	9,636	3,373
18	1,558	12,438	10,880	3,808	1,416	11,194	9,778	3,422	1,558	11,194	9,636	3,373
19	1,558	12,438	10,880	3,808	1,416	11,194	9,778	3,422	1,558	11,194	9,636	3,373
TOTAL	76,861	179,480	102,619	53,934	69,874	161,532	91,658	48,460	76,861	161,532	84,671	47,652

Note : (1) Condition of Sensitivity Analysis

(2) FIRR's derived

Case	Cost	Revenue	Condition	FIRR before tax	FIRR After tax
1	original	original			
2	10% up	original			
3	original	10% down			
4	10% up	10% down			
1	standard			14.05%	8.41%
2	cost 10% up			12.50%	7.08%
3	revenue 10% down			12.33%	6.95%
4	cost 10% up & revenue 10% down			10.83%	5.65%

7.8 Economic Analysis of Essential Project

(1) Objective

In this subsection, economic feasibility of the essential project is evaluated. While the financial analysis in the preceding subsection focused on the project's profitability for the government sector, the economic analysis tries to clarify the project's contribution to the national economy.

(2) Methodology

The following approach is taken for the economic analysis.

- Costs estimated for the financial analysis are converted to economic costs, as necessary, that would closely reflect the true utilization of resources.
- Revenues estimated for the financial analysis are used as benefit regarding them as representing part of consumers' willingness to pay.
- Economic internal rate of return (EIRR) is used as the indicator to evaluate the economic feasibility of the essential project.

(3) Costs

Local currency portion of the investment costs is converted to economic costs applying the conversion factor of 0.8, the rate estimated by the World Bank for the construction sector in Indonesia.

Foreign currency portion estimated for the financial analysis is applied to the economic analysis without adjustment, considering the following.

- Transfer payment such as tax are not included in the investment cost estimated for the financial analysis.
- The official exchange rate is to be used assuming it closely represents true value of the local currency and considering the importance of maintaining consistency with exchange rates used for other projects.

The investment costs for the economic analysis thus estimated are as follows:

	(million Rupiah)
Foreign currency:	40,839
Local currency :	5,098
Total :	45,937

Operation and maintenance costs are assumed to be 3% annually of the total investment cost for the economic analysis.

(4) Benefit

Revenues estimated for the financial analysis are used as the benefit to be generated by the essential project based on the concept of consumers' willingness to pay. Theoretically the revenue only partly reflects the consumers' willingness to pay. The total willingness to pay of beneficiaries could be derived by adding the real revenue and consumer surplus. The benefit here, therefore, should be regarded as the minimum level of benefit that would be generated by the essential project. Benefit at the full operation stage is estimated to be Rp. 12,438 million.

(5) Economic Internal Rate of Return (EIRR)

Economic internal rate of return (EIRR) is calculated based on the estimated costs and benefit. Table 7.7.3 shows the flow of the costs and benefit. The following are the derived EIRRs.

<u>Case</u>	<u>Condition</u>	<u>EIRR</u>
1	Standard	14.85 %
2	Cost 10% up	13.28 %
3	Benefit 10% down	13.11 %
4	Cost 10% up and benefit 10% down	11.59 %

These EIRRs should be regarded as the minimum level of EIRR of the essential project, since the benefit of the project does not include a consumer surplus portion.

Considering the following two points, the Study concludes that the essential project is economically justifiable and worth being promoted to the implementation stage.

- EIRR under the standard case is likely to be higher than 15% if consumer surplus is included in the benefit. The World Bank estimates that the opportunity cost of capital, a criterion compared with EIRR for judging the feasibility of projects, in developing countries ranges somewhere between 8 and 15%. The essential project proposed in the Study, therefore, is highly likely to generate return at a rate higher than the opportunity cost of capital.
- There are a number of intangible benefits of the essential project that are difficult to be quantified. As an integral part of the total telecommunications network development, the essential project would play an important role in generating the socio-economic impacts as described in Section 6. While some of these intangible benefits are regarded as represented by willingness to pay, there are also some impacts that are not necessarily represented by willingness to pay such as:
 - the promotion of desirable regional development pattern
 - the promotion of economic growth, and
 - the upgrading of people's living standard.

Table 7.7.3 (1/2) Flow of Costs and Benefit of Essential Project
(Standard Case : Case 1)

(Unit : million rupiah)

No. Year	Investment			Cost		Benefit	Balance
	FC	LC (1)	Total	OM	Total		
			(2)				
1 1992	1,650	1,236	2,886	0	2,886	0	(2,886)
2 1993	93,538	3,172	36,710	0	36,710	0	(36,710)
3 1994	5,238	690	5,928	0	5,928	0	(5,928)
4 1995	413	0	413	0	413	3,573	3,160
5 1996	0	0	0	1,378	1,378	6,321	4,942
6 1997	0	0	0	1,378	1,378	9,068	7,690
7 1998	0	0	0	1,378	1,378	11,815	10,437
8 1999	0	0	0	1,378	1,378	11,747	10,369
9 2000	0	0	0	1,378	1,378	12,037	10,659
10 2001	0	0	0	1,378	1,378	12,327	10,949
11 2002	0	0	0	1,378	1,378	12,617	11,239
12 2003	0	0	0	1,378	1,378	12,906	11,528
13 2004	0	0	0	1,378	1,378	12,438	11,060
14 2005	0	0	0	1,378	1,378	12,438	11,060
15 2006	0	0	0	1,378	1,378	12,438	11,060
16 2007	0	0	0	1,378	1,378	12,438	11,060
17 2008	0	0	0	1,378	1,378	12,438	11,060
18 2009	0	0	0	1,378	1,378	12,438	11,060
19 2010	0	0	0	1,378	1,378	12,438	11,060
TOTAL	40,839	5,098	45,937	20,672	66,609	179,480	112,871

Note : EIRR : 14.85%

(1) Standard conversion factor of 0.8 is applied.

(2) 3.00% annually of the total investment cost

Table 7.7.3 (2/2) Flow of Costs and Benefit of Essential Project : Sensitivity Analysis

(Unit : million Rupiah)

No. Year	Case 2		Case 3		Case 4	
	Cost	Benefit Balance	Cost	Benefit Balance	Cost	Benefit Balance
1	3,175	0	2,886	0	3,175	0
2	40,381	0	36,710	0	40,381	0
3	6,521	0	5,928	0	6,521	0
4	454	3,573	413	3,216	454	3,216
5	1,516	6,321	1,378	5,688	1,516	5,688
6	1,516	9,068	1,378	8,161	1,516	8,161
7	1,516	11,815	1,378	10,634	1,516	10,634
8	1,516	11,747	1,378	10,572	1,516	10,572
9	1,516	12,037	1,378	10,833	1,516	10,833
10	1,516	12,327	1,378	11,095	1,516	11,095
11	1,516	12,617	1,378	11,356	1,516	11,356
12	1,516	12,906	1,378	11,616	1,516	11,616
13	1,516	12,438	1,378	11,194	1,516	11,194
14	1,516	12,438	1,378	11,194	1,516	11,194
15	1,516	12,438	1,378	11,194	1,516	11,194
16	1,516	12,438	1,378	11,194	1,516	11,194
17	1,516	12,438	1,378	11,194	1,516	11,194
18	1,516	12,438	1,378	11,194	1,516	11,194
19	1,516	12,438	1,378	11,194	1,516	11,194
TOTAL	73,270	179,480	66,609	161,532	73,270	161,532
		106,210	94,923			88,262

Note : (1) Condition of Sensitivity Analysis (2) EIRRs derived

Case	Cost	Revenue	Case	Condition	EIRR
1	original	original	1	standard	14.85%
2	10% up	original	2	cost 10% up	13.28%
3	original	10% down	3	benefit 10% down	13.11%
4	10% up	10% down	4	cost 10% up & benefit 10% down	11.59%

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SECTION 1 INTRODUCTION

ANNEX 1 LIST OF PERSONS CONTRIBUTED TO THE STUDY

1. Directorate General of Posts and Telecommunications (POSTEL), Jakarta
 - Mr. Sri Slameto, Bc.TT : Deputy Director General
 - Ir. L. Woerfindarti : Director of Planning
 - Mr. Soeharsono, Bc.TT : Director of Operation
 - Mr. Tjaroso, Bc.TT : Director of Technique
 - Mr. Soedarpo, Bc.TT : Planning Division
 - Mr. Soehardi
 - Ir. Tanti D.S.

2. Department of Tourism, Posts and Telecommunications
 - Mr. M. Achmad Winarno : Director of East Java Regional Office

3. Perusahaan Umum Telekomunikasi (PERUMTEL)
 - (1) Headquarters, Bandung
 - Ir. Guntur Siregar : KA.SUBDITBINPROPEMTEL (until February 1990)
 - Ir. Taufik Akbar : KA.SUBDITBINPROPEMTEL (from February 1990)
 - Mr. Yayat Supriyatna, Bc.TT : BINPROTRATEL (until February 1990)
 - Ir. Budi Wasisto : BINPROSISTEL
 - Mr. Eman Sutarman : BINPROSENTEL
 - Ir. Remedi Perangin Angin : KA.PUSRENTEL
 - Ir. Heri Purunomo : KA.SUBDITNITEL
 - Mr. Soeprapto, Bc.TT : KA.TEKGRAP
 - Mr. Soeharyono : TEKGRAP
 - Mr. Amran, Bc.TT : KA.YANTEL
 - Mr. Darahim : YANTEL
 - Mr. Atit Kusnadi : YANTEL
 - Drs. Daud Saleh : KA.MATEL (until February 1990)
 - Mr. Monang Siregar : MATEL
 - Mr. Arman : MATEL
 - Mr. Kriana : OPERATEL
 - Ms. Nenden : OPERATEL

 - (2) Witel VII, Surabaya
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 - Mr. Suroto Hadisumarto, Bc.TT : KA.WITEL VII (from July 1990)
 - Mr. Rudy Hantoro, Bc.TT : WAKIL KA.WITEL VII
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 - Ir. Cahyana A : KA.BAGOPTEK (until February 1990)
 - Mr. Nurhadi, Bc.TT. : KA.UPLANPEM
 - Mr. Yeyet Rodiyat, Bc.TT : KA.UTEKTRA
 - Mr. Slamet Santoso : SEKPEM
 - Mr. Syailendra : PLANJAR

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Mr. Ending Djukardi Bc.TT : KA.KANDAPON
 - (4) Sidoarjo Telephone & Telegraph Office
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Ir. Ronald S. M. Sihombing : KA.KANDATPON
 - (6) Japan Telecommunications Mission (JTM), Bandung
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Mr. R. Yago : PUSRENTEL
Mr. H. Kuwata : PUSRENLITBAN
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 - (7) OPMC Project Team, Bandung
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Mr. Johan Silas (PM for GKS General Plan)
 - (2) Faculty of Industrial Technology
Department of Electrical Engineering
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Ir. Hang Suharto M.Sc
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Ir. Endroyono
Ir. Achmad Affandi
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Mr. Osamu Makino : JICA Expert
Mr. Yutaro Hasuda : JICA Coordinator

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 - Ir. Asianti Oetojo Soedjarwo
 - Ir. Poernomohadi
 - Ir. Hadi Prasetyo
 - Ir. Mustofa, CB

6. Regional Investment Coordination Board of East Java Province (BKPMJAWA TIMUR)
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 - Ir. Djokko Srihono M.Sc.
 - Mr. Bukhari

7. Statistic Office of East Java Province (Kantor Statistik Jawa Timur)
 - Sutopo Martowardoyo M.Sc. : Chief
 - Lukito Praptopriyoko M.A.

8. Land National Board of East Java Province (BPN: Badan Pertanahan Nasional)
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 - Mr. Suharno
 - Mrs. Siti Koyimah
 - Mr. Hadi Soekamto

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 - Mr. Wendy Aritenang Yazid

10. Statistic Central Bureau (BPS), Jakarta
 - Mr. Sukila

11. Dir. Gen. of Bina Marga, Ministry of Public Works, Jakarta
 - Mrs. Rento Prawati, BE

12. Regional Planning Board (Bappeda) of Kotamadya Surabaya
 - Ir. Chusen Chasbullan : Chairman
 - Mr. Poedjiono

ANNEX

SECTION 2 REGIONAL DEVELOPMENT FRAMEWORK

ANNEX 2.1 (1/4)

NUMBER OF REGISTERED POPULATION, AREA AND POPULATION DENSITY BY KECAMATAN

KABUPATEN/ KOTAMADYA	KECAMATAN	Registered Population		Growth Rate	Area (sq. km)	Pop density
		1983	1988	(%/yr) 1983-88		(1988/ sq.km)
Gresik	1 Wringinanom	40,202	43,425	1.6	62.62	693
	2 Driyorejo	40,522	45,195	2.2	51.30	881
	3 Menganti	60,754	65,308	1.5	68.69	951
	4 Kedamean	41,384	44,283	1.4	65.96	671
	5 Balongpanggang	44,718	46,644	0.8	62.96	741
	6 Benjeng	44,690	47,751	1.3	61.26	779
	7 Cerme	46,028	48,738	1.2	71.67	680
	8 Kebomas	42,529	52,155	4.2	29.73	1,754
	9 Gresik	66,110	70,688	1.3	5.24	13,490
	10 Manyar	45,399	52,442	2.9	82.86	633
	11 Duduk Sampeyan	36,122	38,343	1.2	74.47	515
	12 Bungah	43,499	47,415	1.7	80.22	591
	13 Sedayu	24,469	27,015	2.0	45.21	598
	14 Dukun	47,084	51,253	1.7	59.09	867
	15 Panceng	31,888	34,893	1.8	63.18	552
	16 Ujung Pangkah	29,468	32,841	2.2	94.82	346
	17 Sangkapura	40,147	40,830	0.3	118.79	344
	18 Tambak	24,766	25,129	0.3	78.70	319
	TOTAL	749,779	814,348	1.7	1,176.77	692
Bangkalan	19 Kamal	32,978	33,004	0.0	46.44	711
	20 Labang	26,960	26,958	0.0	35.23	765
	21 Kwanyar	34,072	33,800	-0.2	47.78	707
	22 Modung	38,265	38,226	0.0	78.89	485
	23 Blega	43,253	43,336	0.0	93.35	464
	24 Konang	32,024	32,114	0.1	79.79	402
	25 Galis	57,466	58,543	0.4	134.76	434
	26 Tanah Merah	48,933	50,220	0.5	68.58	732
	27 Tragah	22,309	22,263	0.0	39.61	562
	28 Socah	40,878	42,203	0.6	53.75	785
	29 Bangkalan	50,097	50,028	0.0	35.00	1,429
	30 Burneh	37,443	39,607	1.1	66.10	599
	31 Geger	46,742	50,875	1.7	126.80	401
	32 Kokop	38,213	41,676	1.8	125.75	331
	33 Tanjung Bumi	36,750	42,419	2.9	67.44	629
	34 Sepulu	30,881	31,276	0.3	70.34	445
35 Klampis	43,586	43,667	0.0	67.01	652	
36 Arosbaya	31,087	34,277	2.0	41.26	831	
	TOTAL	691,937	714,492	0.6	1,277.88	559

Note : Numbers given to each kecamatan correspond to Figure 2.2.1.

Source : (1) " Penduduk Jawa-Timur, Hasil Registrasi Penduduk"
1983 and 1988

(2) Area of each kecamatan are from Kantor Statistik Provinsi
Jawa Timur

ANNEX 2.1 (2/4)

NUMBER OF REGISTERED POPULATION, AREA AND POPULATION DENSITY BY KECAMATAN

KABUPATEN/ KOTAMADYA	KECAMATAN	Registered Population		Growth Rate (%/yr)	Area (sq. km)	Pop density (1988/ sq. km)
		1983	1988	1983-88		
Mojokerto (kab)	37 Jatirejo	30,861	32,279	0.9	107.62	300
	38 Gondang	30,220	32,401	1.4	98.62	329
	39 Pacet	40,800	42,754	0.9	107.98	396
	40 Trawas	20,554	22,354	1.7	58.00	385
	41 Ngoro	49,992	53,706	1.4	70.50	762
	42 Pungging	47,156	51,185	1.7	45.00	1,137
	43 Kutorejo	40,782	43,586	1.3	43.50	1,002
	44 Mojosari	50,175	54,914	1.8	28.85	1,903
	45 Dlanggu	36,937	38,820	1.0	35.82	1,084
	46 Bangsal	47,476	50,637	1.3	35.12	1,442
	47 Puri	60,405	66,224	1.9	51.65	1,282
	48 Trowulan	45,527	48,674	1.3	45.93	1,060
	49 Sooko	38,209	41,370	1.6	25.18	1,643
	50 Gedek	42,119	44,913	1.3	26.18	1,716
51 Kemlagi	43,466	46,320	1.3	42.35	1,094	
52 Jetis	54,299	55,251	0.3	53.05	1,041	
53 Dawarblandong	39,440	41,310	0.9	102.80	402	
	TOTAL	718,418	766,698	1.3	978.15	784
Mojokerto (kodya)	54 Prajurit Kulon	41,764	43,216	0.7	7.76	5,569
	55 Magersari	46,466	52,367	2.4	8.70	6,019
	TOTAL	88,230	95,583	1.6	16.46	5,807
Surabaya	56-1 Lakarsantri	34,408	48,824	7.2	34.19	1,428
	56-2 Karangpilang	82,936	102,236	4.3	25.24	4,051
	56-3 Wonocolo	93,184	106,995	2.8	16.19	6,610
	56-4 Wonokromo	173,092	172,289	-0.1	6.70	25,734
	56-5 Sawahan	208,430	213,352	0.5	7.64	27,933
	56-6 Genteng	80,844	76,332	-1.1	3.53	21,624
	56-7 Tegalsari	121,554	119,684	-0.3	4.90	24,425
	56 Surabaya Selata	794,448	839,712	1.1	98.38	8,536
	57-1 Gubeng	141,831	142,818	0.1	7.49	19,063
	57-2 Sukolilo	64,647	89,158	6.6	33.59	2,654
	57-3 Rungkut	58,519	87,527	8.4	35.71	2,451
	57-4 Kenjeran	46,978	62,591	5.9	12.50	5,008
	57-5 Tambaksari	169,229	185,569	1.9	9.09	20,408
	57-6 Simokerto	113,838	110,760	-0.5	2.66	41,670
57 Surabaya Timur	595,042	678,423	2.7	101.04	6,714	
58-1 Semampir	156,491	158,600	0.3	5.34	29,700	
58-2 Pabean Cantian	95,203	93,446	-0.4	4.43	21,118	
58-3 Krembangan	116,522	115,604	-0.2	4.58	25,230	
58-4 Bubutan	107,901	107,603	-0.1	3.45	31,162	
58-5 Tandes	116,012	150,980	5.4	32.18	4,691	
58-6 Benowo	24,852	29,472	3.5	41.04	718	
58 Surabaya Utara	616,981	655,705	1.2	91.02	7,204	
	TOTAL	2,006,471	2,173,840	1.6	290.44	7,485

Note : Numbers given to each kecamatan correspond to Figure 2.2.1.

Source : (1) " Penduduk Jawa-Timur, Hasil Registrasi Penduduk"
1983 and 1988

(2) Area of each kecamatan are from Kantor Statistik Provinsi
Jawa Timur

ANNEX 2.1 (3/4)

NUMBER OF REGISTERED POPULATION, AREA AND POPULATION DENSITY BY KECAMATAN

KABUPATEN/ KOTAMADYA	KECAMATAN	Registered Population		Growth Rate (%/yr)	Area (sq. km)	Pop density (1988/ sq. km)
		1983	1988	1983-88		
Sidoarjo	59 Sidoarjo	78,937	87,900	2.2	59.54	1,476
	60 Buduran	32,627	36,610	2.3	36.37	1,007
	61 Candi	48,129	51,166	1.2	38.05	1,345
	62 Porong	51,776	53,941	0.8	27.62	1,953
	63 Krembung	42,446	44,057	0.7	27.94	1,577
	64 Tulangan	52,533	55,812	1.2	29.34	1,902
	65 Tanggulangin	47,124	51,495	1.8	29.63	1,738
	66 Jabon	36,661	39,053	1.3	60.31	648
	67 Krian	59,111	63,964	1.6	31.74	2,015
	68 Balongbendo	42,174	44,583	1.1	30.71	1,452
	69 Wonoayu	43,868	45,954	0.9	32.86	1,398
	70 Tarik	40,764	42,592	0.9	34.72	1,227
	71 Prambon	47,381	50,935	1.5	33.19	1,535
	72 Taman	78,745	92,071	3.2	30.57	3,012
	73 Waru	54,911	79,054	7.6	26.85	2,944
	74 Gedangan	47,896	53,122	2.1	24.35	2,182
	75 Sedati	32,592	36,516	2.3	58.17	628
76 Sukodono	39,282	43,024	1.8	29.14	1,476	
	TOTAL	876,957	971,849	2.1	641.09	1,516
Lamongan	77 Bluluk	36,398	38,208	1.0	95.43	400
	78 Ngimbang	36,834	38,842	1.1	89.03	436
	79 Sambeng	43,131	44,802	0.8	144.57	310
	80 Mantup	36,524	38,480	1.0	93.07	413
	81 Kembang Bahu	39,079	40,573	0.8	63.84	636
	82 Sugio	48,352	48,947	0.2	94.43	518
	83 Kedung Pring	50,467	51,367	0.4	84.54	608
	84 Modo	41,239	43,054	0.9	77.58	555
	85 Babat	67,515	70,053	0.7	62.46	1,122
	86 Sukodadi	83,222	88,129	1.2	89.00	990
	87 Lamongan	47,327	51,029	1.5	39.65	1,287
	88 Tikung	55,151	57,140	0.7	100.38	569
	89 Deket	36,842	39,399	1.4	40.05	984
	90 Glagah	39,193	40,903	0.9	48.32	847
91 Karang Binangun	33,914	36,545	1.5	42.92	851	
92 Kali Tengah	28,889	30,607	1.2	33.45	915	
93 Turi	42,965	45,516	1.2	48.69	935	
94 Karang Geneng	38,587	40,312	0.9	36.58	1,102	
95 Sekaran	78,148	78,620	0.1	79.80	985	
96 Laren	42,390	44,796	1.1	86.07	520	
97 Brondong	47,061	49,861	1.2	70.13	711	
98 Paciran	99,778	106,997	1.4	148.91	719	
	TOTAL	1,073,006	1,124,180	0.9	1,668.90	674

Note : Numbers given to each kecamatan correspond to Figure 2.2.1.

Source : (1) " Penduduk Jawa-Timur, Hasil Registrasi Penduduk"
1983 and 1988

(2) Area of each kecamatan are from Kantor Statistik Provinsi
Jawa Timur

ANNEX 2.1 (4/4)

NUMBER OF REGISTERED POPULATION, AREA AND POPULATION DENSITY BY KECAMATAN

KABUPATEN/ KOTAMADYA	KECAMATAN	Registered Population		Growth Rate (%/yr)	Area (sq. km)	Pop density (1988/ sq. km)
		1983	1988	1983-88		
Jombang	99 Jombang	92,787	99,924	1.5	36.40	2,745
	100 Diwek	73,147	79,266	1.6	47.70	1,662
	101 Gudo	45,584	47,661	0.9	34.39	1,386
	102 Perak	39,363	42,508	1.5	29.05	1,463
	103 Tembelang	42,681	44,826	1.0	32.94	1,361
	104 Ploso	33,466	35,678	1.3	25.96	1,374
	105 Plandaan	32,984	33,668	0.4	96.79	348
	106 Kabuh	34,144	35,515	0.8	106.38	334
	107 Kudu	43,162	45,283	1.0	62.51	724
	108 Mojoagung	54,668	58,433	1.3	48.38	1,208
	109 Sumobito	60,573	64,809	1.4	47.64	1,360
	110 Kesamben	53,010	54,529	0.6	51.72	1,054
	111 Peterongan	45,197	48,720	1.5	29.47	1,653
	112 Ngoro	54,187	57,680	1.3	49.86	1,157
	113 Mojowarno	67,048	71,014	1.2	61.92	1,147
	114 Bareng	42,176	45,252	1.4	63.20	716
	115 Wonosalam	26,030	25,856	-0.1	97.78	264
	116 Bandarkedung M	36,437	39,167	1.5	32.50	1,205
	117 Megaluh	32,849	34,589	1.0	28.41	1,217
	118 Jogorogo	41,622	45,454	1.8	28.28	1,608
	TOTAL	951,115	1,009,832	1.2	1,011.27	999

Note : Numbers given to each kecamatan correspond to Figure 2.2.1.

Source : (1) " Penduduk Jawa-Timur, Hasil Registrasi Penduduk"
1983 and 988

(2) Areas of each kecamatan are from Kantor Statistik Provinsi
Jawa Timur

ANNEX 2.2
GROSS REGIONAL DOMESTIC PRODUCT BY SECTOR IN 1986 MARKET PRICE

(Unit : million Rupiahs)

S E C T O R	Gresik	Bangkalan	Kabupaten Mojokerto	Kotamadya Mojokerto	Surabaya	Sidoarjo	Lamongan	GKS	Jombang
1. Primary Sector	126,581	161,172	102,082	4,670	95,127	123,131	225,648	838,411	117,215
1.1. Agriculture (food crops)	88,935	120,013	78,048	952	7,272	44,917	166,285	506,422	77,771
1.2. Others	37,646	41,159	24,034	3,718	87,855	78,214	59,362	331,988	39,444
2. Secondary Sector	305,978	14,044	71,204	8,188	510,488	256,977	30,377	1,197,256	47,406
2.1. Mining / Quarrying	11,563	1,802	2,421	866	88	2,043	1,721	20,503	736
2.2. Large & Medium Industry	277,125	1,173	41,671	2,745	431,902	200,518	4,208	959,342	21,621
2.3. Small / Household Industries	12,220	2,355	13,845	1,902	26,186	20,455	10,974	87,937	7,927
2.4. Construction / Building	5,071	8,715	13,266	2,675	52,310	33,961	13,475	129,474	17,121
3. Tertiary Sector	197,416	85,370	145,199	52,032	2,128,982	270,011	108,822	2,987,832	180,565
3.1. Electricity/Gas/Water Supply	19,178	619	485	8,145	54,436	26,823	791	110,476	1,124
3.2. Transportation & Communication	52,313	14,907	25,529	21,958	510,332	107,250	11,594	743,883	20,628
3.3. Commerce / Service	101,751	50,723	99,338	18,160	597,438	106,376	71,202	1,044,989	133,293
3.4. Bank / Other Financial	3,221	1,121	1,678	342	152,491	3,328	1,445	163,625	3,198
3.5. Government	20,952	17,999	18,170	3,428	814,286	26,234	23,791	924,859	22,322
4. GRDP	629,975	260,587	318,485	64,890	2,734,597	650,118	364,847	5,023,499	345,185
(Percentage Structure in Each Area)									
1. Primary Sector	20.1	61.8	32.1	7.2	3.5	18.9	61.8	16.7	34.0
1.1. Agriculture (food crops)	14.1	46.1	24.5	1.5	0.3	6.9	45.6	10.1	22.5
1.2. Others	6.0	15.8	7.5	5.7	3.2	12.0	16.3	6.6	11.4
2. Secondary Sector	48.6	5.4	22.4	12.6	18.7	39.5	8.3	23.8	13.7
2.1. Mining / Quarrying	1.8	0.7	0.8	1.3	0.0	0.3	0.5	0.4	0.2
2.2. Large & Medium Industry	44.0	0.5	13.1	4.2	15.8	30.8	1.2	19.1	6.3
2.3. Small / Household Industries	1.9	0.9	4.3	2.9	1.0	3.1	3.0	1.8	2.3
2.4. Construction / Building	0.8	3.3	4.2	4.1	1.9	5.2	3.7	2.6	5.0
3. Tertiary Sector	31.3	32.8	45.6	80.2	77.9	41.5	29.8	59.5	52.3
3.1. Electricity/Gas/Water Supply	3.0	0.2	0.2	12.6	2.0	4.1	0.2	2.2	0.3
3.2. Transportation & Communication	8.3	5.7	8.0	33.8	18.7	16.5	3.2	14.8	6.0
3.3. Commerce / Service	16.2	19.5	31.2	28.0	21.8	16.4	19.5	20.8	38.6
3.4. Bank / Other Financial	0.5	0.4	0.5	0.5	5.6	0.5	0.4	3.3	0.9
3.5. Government	3.3	6.9	5.7	5.3	29.8	4.0	6.5	18.4	6.5
4. GRDP	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
(Percentage Structure in GKS)									
1. Primary Sector	15.1	19.2	12.2	0.6	11.3	14.7	26.9	100.0	-
1.1. Agriculture (food crops)	17.6	23.7	15.4	0.2	1.4	8.9	32.8	100.0	-
1.2. Others	11.3	12.4	7.2	1.1	26.5	23.6	17.9	100.0	-
2. Secondary Sector	25.6	1.2	5.9	0.7	42.6	21.5	2.5	100.0	-
2.1. Mining / Quarrying	56.4	8.8	11.8	4.2	0.4	10.0	8.4	100.0	-
2.2. Large & Medium Industry	28.9	0.1	4.3	0.3	45.0	20.9	0.4	100.0	-
2.3. Small / Household Industries	13.9	2.7	15.7	2.2	29.8	23.3	12.5	100.0	-
2.4. Construction / Building	3.9	6.7	10.2	2.1	40.4	26.2	10.4	100.0	-
3. Tertiary Sector	6.6	2.9	4.9	1.7	71.3	9.0	3.6	100.0	-
3.1. Electricity/Gas/Water Supply	17.4	0.6	0.4	7.4	49.3	24.3	0.7	100.0	-
3.2. Transportation & Communication	7.0	2.0	3.4	3.0	68.6	14.4	1.6	100.0	-
3.3. Commerce / Service	9.7	4.9	9.5	1.7	57.2	10.2	6.8	100.0	-
3.4. Bank / Other Financial	2.0	0.7	1.0	0.2	93.2	2.0	0.9	100.0	-
3.5. Government	2.3	1.9	2.0	0.4	88.0	2.8	2.6	100.0	-
4. GRDP	12.5	5.2	6.3	1.3	54.4	12.9	7.3	100.0	-

Source :
Produk Domestik Regional Bruto, 1983-1986,
Kantor Statistik Propinsi Jawa Timur

ANNEX 2.3 (1/4)

NUMBER OF URBAN AND RURAL DESA IN EACH KECAMATAN IN JOMBANG IN 1980, 1986 AND 1990

Kabupaten/ Kotamadya	Kecamatan	1980		1986		1990	
		urban	rural	urban	rural	urban	rural
GRESIK	Wringin Anom	0	16	0	16	0	16
	Driyorejo	0	16	3	13	4	12
	Menganti	0	22	0	22	0	22
	Kedamean	0	15	0	15	0	15
	Balong Panggang	0	26	0	26	1	25
	Benjeng	0	23	0	23	1	22
	Cerme	0	25	2	23	2	23
	Kebomas	7	14	12	9	13	8
	Gresik	19	3	22	0	22	0
	Manyar	1	22	2	21	4	19
	Duduk Sampeyan	1	22	1	22	1	22
	Bungah	0	22	1	21	1	21
	Sedayu	1	20	5	16	5	16
	Dukun	1	25	3	23	3	23
	Panceng	0	15	0	15	0	15
	Ujung Pangkah	0	13	0	13	0	13
	Sangkapura	1	16	2	15	2	15
	Tambak	1	12	1	12	1	12
TOTAL		32	325	55	302	65	293
BANGKALAN	Kamal	1	9	4	6	3	7
	Labang	1	12	1	12	1	12
	Kwanyar	1	15	0	16	1	15
	Modung	0	17	0	17	1	16
	Blega	1	18	0	19	0	19
	Konang	0	13	0	13	0	13
	Galis	0	22	0	22	0	22
	Tanah Merah	0	22	0	22	0	22
	Tragah	0	18	0	18	0	18
	Socha	1	10	1	10	1	10
	Bangkalan	6	7	5	8	5	8
	Burneh	0	12	0	12	0	12
	Geger	0	13	0	13	0	13
	Kokop	0	13	0	13	0	13
	Tangjungbumi	0	13	1	12	2	11
	Sepulu	1	14	1	14	1	14
	Klampis	2	20	2	20	2	20
	Arosbaya	1	17	1	17	3	15
TOTAL		15	266	16	265	24	257

Source : Biro Pusat Statistik

ANNEX 2.3 (2/4)

NUMBER OF URBAN AND RURAL DESA IN EACH KECAMATAN IN GKS AND JOMBANG IN 1980, 1986 AND 1990

Kabupaten/ Kotamadya	Kecamatan	1980		1986		1990		
		urban	rural	urban	rural	urban	rural	
MOJOKERTO (Kabupaten)	Jatirejo	0	19	1	18	1	18	
	Gondang	0	18	1	17	1	17	
	Pacet	0	20	0	20	1	19	
	Trawas	0	13	0	13	0	13	
	Ngoro	0	19	1	18	2	17	
	Pungging	0	19	0	19	0	19	
	Kutorejo	0	17	0	17	1	16	
	Mojosari	7	12	9	10	10	9	
	Dlanggu	0	16	0	16	1	15	
	Bangsals	3	20	3	20	3	20	
	Puri	0	22	1	21	2	20	
	Trowulan	0	16	0	16	1	15	
	Sooko	3	12	5	10	5	10	
	Gedek	2	12	5	9	5	9	
	Kemlagi	1	19	1	19	2	18	
	Jetis	1	15	1	15	1	15	
	Dawar Blandong	0	18	0	18	0	18	
	TOTAL		17	287	30	274	49	260
	MOJOKERTO (Kotamadya)	Prajurit Kulon	4	4	7	1	8	0
Mager Sari		8	2	8	2	10	0	
TOTAL		12	6	15	3	18	0	
SURABAYA	Karang Pilang	6	6	11	1	12	0	
	Wonocolo	8	5	13	0	13	0	
	Rungkut	2	13	11	4	12	3	
	Wonokromo	6	0	6	0	6	0	
	Tegal Sari	5	0	5	0	5	0	
	Sawahan	6	0	6	0	6	0	
	Genteng	5	0	5	0	5	0	
	Gubeng	6	0	6	0	6	0	
	Sukolilo	4	9	10	3	11	2	
	Tambaksari	6	0	6	0	6	0	
	Simokerto	5	0	5	0	5	0	
	Pabean Cantikan	5	0	5	0	5	0	
	Bubutan	5	0	5	0	5	0	
	Tandes	5	17	18	4	19	3	
	Krembangan	5	0	5	0	5	0	
	Semampir	5	0	5	0	5	0	
	Lakar Santri	0	10	1	9	3	7	
	Kenjeran	2	7	6	3	8	1	
Benowo	0	10	3	7	3	7		
TOTAL		86	77	132	31	140	23	

Source : Biro Pusat Statistik

ANNEX 2.3 (3/4)
NUMBER OF URBAN AND RURAL DESA IN EACH KECAMATAN IN GKS AND
JOMBANG IN 1980, 1986 AND 1990

Kabupaten/ Kotamadya	Kecamatan	1980		1986		1990	
		urban	rural	urban	rural	urban	rural
SIDOARJO	Tarik	0	20	1	19	3	17
	Prambon	1	19	4	16	4	16
	Kremlung	1	18	1	18	1	18
	Porong	4	15	10	9	9	10
	Jabon	0	15	2	13	2	13
	Tanggulangin	3	16	5	14	8	11
	Candi	2	22	5	19	9	15
	Sidoarjo	10	14	12	12	12	12
	Tulangan	1	21	2	20	2	20
	Wonoayu	0	23	4	19	1	22
	Krian	2	20	5	17	8	14
	Balong Bendo	1	19	2	18	2	18
	Taman	8	16	17	7	19	5
	Sukodono	0	19	0	19	4	15
	Buduran	1	14	2	13	4	11
	Gedangan	1	14	7	8	8	7
	Sedati	1	15	3	13	3	13
	Waru	4	13	14	3	14	3
TOTAL		40	313	105	248	119	234
LAMONGAN	Bluluk	0	18	0	18	0	18
	Ngimbang	0	19	0	19	0	19
	Sambeng	0	22	0	22	0	22
	Mantup	0	15	0	15	0	15
	Kambangbahu	0	18	0	18	0	18
	Sugio	0	21	0	21	0	21
	Kedungpring	0	23	0	23	0	23
	Modo	0	17	0	17	0	17
	Babat	1	22	2	21	2	21
	Sukodadi	1	36	0	37	0	37
	Lamongan	8	12	9	11	9	11
	Tikung	0	22	0	22	0	22
	Deket	0	17	0	17	1	16
	Gragah	0	30	0	30	0	30
	Karangbinangun	0	21	0	21	0	21
	Kalitengah	0	20	0	20	0	20
	Turi	0	19	0	19	0	19
	Karang Geneng	0	18	0	18	0	18
	Sekaran	2	36	2	36	2	36
	Laren	0	20	0	20	0	20
	Brondong	1	9	1	9	1	9
Paciran	6	21	1	26	5	22	
TOTAL		19	456	16	459	24	451
GRAND TOTAL OF GKS		221	1,730	369	1,582	439	1,518

Source : Biro Pusat Statistik

ANNEX 2.3 (4/4)

NUMBER OF URBAN AND RURAL DESA IN EACH KECAMATAN IN GKS AND
JOMBANG IN 1980, 1986 AND 1990

Kabupaten	Kecamatan	1980		1986		1990	
		urban	rural	urban	rural	urban	rural
JOMBANG	Perak	0	13	3	10	2	11
	Gudo	2	16	2	16	3	15
	Ngoro	1	12	1	12	4	9
	Bareng	0	13	0	13	0	13
	Wonosalam	0	9	0	9	0	9
	Mojoagung	4	14	5	13	6	12
	Mojowarno	0	19	0	19	0	19
	Diwek	1	19	4	16	6	14
	Jombang	10	10	14	6	14	6
	Peterongan	1	13	1	13	5	9
	Sumobito	1	20	1	20	1	20
	Kesamben	0	14	0	14	0	14
	Tembelang	0	15	0	15	0	15
	Ploso	2	11	2	11	2	11
	Plandaan	0	13	0	13	0	13
	Kabuh	0	16	0	16	0	16
	Kudu	0	22	0	22	3	19
	Bandar Kedung M.	0	11	0	11	0	11
	Megaluh	0	13	0	13	0	13
	Jogo Roto	0	11	0	11	0	11
	TOTAL	22	284	37	269	51	255

Source : Biro Pusat Statistik

ANNEX 2.4 NUMBER OF PMDN AND PMA BETWEEN 1968 AND 1988
BY KECAMATAN (1/2)

KABUPATEN / KOTAMADYA	KECAMATAN	NUMBER OF PROJECT			
		INDUSTRY	HOUSING	OTHERS	TOTAL
1. GRESIK	Wringinanom	2	-	-	2
	Driyorejo	35	-	1	36
	Menganti	1	-	1	2
	Kebomas	14	2	-	16
	Gresik	12	-	-	12
	Manyar	6	-	-	6
	Sedayu	1	-	-	1
	Sub total	71	2	2	75
2. BANGKALAN	Kamal	1	-	-	1
	Bangkalan	1	-	-	1
	Sub total	2	0	0	2
3. MOJOKERTO (Kabupaten)	Jatirejo	1	-	-	1
	Trawas	-	-	1	1
	Pungging	3	-	-	3
	Kutorejo	1	-	-	1
	Mojosari	1	-	-	1
	Dlanggu	1	-	-	1
	Puri	5	-	-	5
	Trowulan	1	-	-	1
	Jetis	4	-	-	4
	Sub total	17	0	1	18
4. MOJOKERTO (Kotamadya)	Magersari	1	-	-	1
5. SURABAYA	Lakarsantri	-	3	-	3
	Karangpilang	10	3	-	13
	Wonocolo	4	1	1	6
	Wonokromo	11	1	1	13
	Sawahan	2	-	-	2
	Genteng	3	-	11	14
	Tegalsari	1	-	-	1
	Gubeng	-	-	1	1
	Sukolilo	-	2	-	2
	Rungkut	61	5	3	69
	Kenjeran	4	-	-	4
	Tambaksari	2	-	-	2
	Pabean Cantian	10	-	3	13
	Krembangan	2	-	2	4
	Bubutan	11	-	2	13
	Tandes	29	1	4	34
Sub total	150	16	28	194	

Source : Daftar Proyek PMDN dan PMA di Jawa Timur
Badan Koordinasi Penanaman Modal Daerah
Propinsi Daerah Tingkat I Jawa Timur

ANNEX 2.4 NUMBER OF PMDN AND PMA BETWEEN 1968 AND 1988
BY KECAMATAN (2/2)

KABUPATEN / KOTAMADYA	KECAMATAN	NUMBER OF PROJECT			TOTAL
		INDUSTRY	HOUSING	OTHERS	
6. SIDOARJO	Sidoarjo	9	-	-	9
	Buduran	10	-	-	10
	Candi	1	1	-	2
	Tanggulangin	1	-	-	1
	Krian	3	-	-	3
	Tarik	1	-	-	1
	Taman	21	-	-	21
	Sukodono	1	-	-	1
	Waru	16	4	1	21
	Gedangan	27	-	-	27
	Sedati	-	1	1	2
	Balongsendo	1	-	-	1
	Sub total	91	6	2	99
7. LAMONGAN	Babat	1	-	-	1
	Lamongan	1	-	-	1
	Sub total	2	0	0	2
8. JOMBANG	Kabuh	1	-	-	1
	Mojoagung	1	-	-	1
	Sub total	2	0	0	2
GRAND TOTAL		336	24	33	393

Source : Daftar Proyek PMDN dan PMA di Jawa Timur
Badan Koordinasi Penanaman Modal Daerah
Propinsi Daerah Tingkat I Jawa Timur

ANNEX 2.5 (1/2)

NUMBER OF INVESTMENTS IN 1987, 1988 AND 1989 (1)

KABUPATEN / KOTAMADYA	KECAMATAN	YEAR			TOTAL
		1987	1988	1989	
GRESIK	Driyorejo	6	3	9	18
	Kebomas	4	3	6	13
	Gresik	2	0	0	2
	Manyar	0	1	2	3
	Menganti	0	1	1	2
	Panceng	0	0	1	1
	Sub total	12	8	19	39
BANGKALAN	Blega	0	0	1	1
	Bangkalan	0	0	1	1
	Tanjungbuni	0	0	2	2
	Sub total	0	0	4	4
d.MOJOKERTO	Magersari	1	3	0	4
	Prajurit Kulon	1	1	1	3
	Sub total	2	4	1	7
b.MOJOKERTO	Puri	2	1	0	3
	Jetis	1	3	1	5
	Kutorejo	0	1	0	1
	Pungging	1	1	1	3
	Mojosari	0	0	1	1
	Sooko	1	0	0	1
	Sub total	5	6	3	14
SURABAYA	Lakarsantri	1	0	2	3
	Rungkut	2	3	2	7
	Bubutan	1	0	1	2
	Tandes	5	6	5	16
	Sukolilo	3	3	3	9
	Tambaksari	1	0	0	1
	Karangpilang	4	7	3	14
	Wonocolo	0	1	1	2
	Krembangan	0	1	0	1
	Genteng	0	1	0	1
	Kenjeran	2	0	0	2
	Benowo	1	0	2	3
	Sub total	20	22	19	61

Note : Investments in this table include PMA/PMDN and non-PMA/PMDN which obtained location permit from BKPM or BPN.

Source : BKPM and BPN

ANNEX 2.5 (2/2)
 NUMBER OF INVESTMENTS IN 1987, 1988 AND 1989 (1)

KABUPATEN / KOTAMADYA	KECAMATAN	YEAR			TOTAL
		1987	1988	1989	
SIDOARJO	Waru	4	2	3	9
	Sidoarjo	1	2	2	5
	Buduran	5	2	6	13
	Gedangan	4	1	9	14
	Taman	16	8	7	31
	Candi	1	2	0	3
	Wonoayu	0	1	1	2
	Krian	1	3	2	6
	Sukodono	1	1	1	3
	Jabon	1	0	0	1
	Tanggulangin	0	0	3	3
Sub total	34	22	34	90	
LAMONGAN	Paciran	2	0	1	3
TOTAL		75	62	81	218

Note : Investments in this table include PMA/PMDN and non-PMA/PMDN which obtained location permit from BKPM or BPN.

Source : BKPM and BPN

ANNEX 2.6 Daily Traffic Volume on National and Provincial Roads in the Study Area

Road Measuring Site	Section	Category of Road	Human Movement				Freight Movement			Total	Z Distribution										
			Motorcycle	Sedan/Jeep	Small bus	bus	Subtotal	Micro-truck	Trailer			Subtotal									
Number	Site	National	Provincial	Human Movement				Freight Movement			Human Freight										
				Motorcycle	Sedan/Jeep	Small bus	bus	Subtotal	Micro-truck	Trailer		Subtotal									
008	B.008 Kartasomo - Jombang	N		2,464	1,333	1,906	1,226	6,929	1,032	1,723	633	3,408	10,337	67	33						
009	B.009 Jombang - Gemakan	N		2,889	1,419	2,458	1,251	8,017	954	1,965	550	3,469	11,486	70	30						
010	B.010 Gamakan - Mojokerto	N		3,670	2,901	4,802	1,452	14,825	2,701	4,732	689	8,122	22,947	65	35						
011	B.011 Mojokerto - Mlirip	N		3,417	1,102	2,709	1,110	7,234	1,110	3,477	128	4,715	11,949	61	39						
012	A.012 Mlirip - Krian	N		2,054	1,837	3,287	1,353	8,531	1,367	3,150	722	5,239	13,770	62	38						
013	A.013 Krian - Jaman	N		4,885	2,916	5,054	1,484	14,339	2,499	4,839	1,107	8,445	22,784	63	37						
014	A.014 Jaman - Waru	N		4,033	2,509	3,901	620	11,063	2,073	4,620	1,168	7,858	18,921	58	42						
015	A.015 Waru - Surabaya	N		15,539	6,647	14,077	1,717	37,980	4,349	7,458	1,786	12,593	50,573	75	25						
016	A.016 Waru - Sidoarjo	N		10,403	3,830	9,586	3,378	24,197	3,209	4,997	556	8,762	32,959	73	27						
017	A.017 Sidoarjo - Gempol	N		7,184	2,728	6,057	296	16,265	2,159	4,751	400	7,520	23,585	69	31						
038	C.038 Bojonegoro - Babat	P		1,499	602	1,008	346	3,455	688	737	86	1,511	4,966	70	30						
039	C.039 Babat - Pakah	P		838	573	516	366	2,293	422	992	464	1,878	4,171	55	45						
041	C.041 Gresik - Tuban	P		618	137	683	1	1,439	241	320	1	562	2,001	72	28						
041	C.341 Gresik - Tuban	P		869	48	536	2	1,455	203	156	1	360	2,011	72	28						
041	C.841 Gresik - Tuban	P		2,801	396	1,931	74	5,202	553	702	6	1,261	6,463	80	20						
042	B.042 Gresik - Lamongan	P		1,663	949	1,312	814	4,738	745	1,303	592	2,640	7,378	64	36						
043	A.043 Surabaya - Gresik	N		4,423	2,203	3,579	872	11,079	1,624	2,599	702	4,925	16,004	69	31						
044	B.044 Lamongan - Widang	N		1,543	769	1,641	607	4,560	669	1,521	556	2,746	7,306	62	38						
045	C.045 Lamongan - Gedek	P		2,603	51	1,641	1	3,202	180	497	3	680	3,882	82	18						
045	C.345 Lamongan - Gedek	P		1,575	224	537	1	2,337	256	661	0	917	3,254	72	28						
046	C.046 Babat - Ploso	P		1,610	214	1,118	38	2,980	758	1,200	0	1,964	4,944	60	40						
046	C.346 Babat - Ploso	P		829	182	555	38	1,604	365	691	2	1,058	2,662	60	40						
047	C.047 Ploso - Jombang	P		3,623	347	1,264	32	5,268	667	1,006	2	1,675	6,943	76	24						
048	C.048 Gedek - Ploso	P		1,216	181	779	0	2,176	162	1,134	0	1,296	3,472	63	37						
050	B.050 Gedek - Mojokerto	P		2,976	827	1,566	11	5,380	654	2,585	72	3,311	8,691	62	38						
051	B.051 Mojokerto - Mojosari	P		2,421	736	1,641	37	4,835	711	1,410	204	2,325	7,160	68	32						
052	C.052 Krian - Mojosari	P		1,586	326	1,364	8	3,294	335	1,833	55	2,723	5,517	60	40						
057	C.057 Legundi - Mlirip	P		2,470	464	1,726	5	3,665	515	1,581	7	2,103	5,768	64	36						
058	C.058 Legundi - Drilyorejo	P		2,575	759	1,967	26	5,327	941	1,739	155	2,835	8,162	65	35						
059	A.059 Drilyorejo - Wonokrom	P		4,859	2,224	4,054	1,365	12,502	2,470	2,396	152	5,018	17,520	71	29						
060	C.060 Krian - Legundi	P		3,773	295	1,186	17	3,118	282	1,264	8	1,554	4,672	67	33						
061	B.061 Taman - Sebanjang	P		1,724	1,724	3,256	1,136	9,889	1,603	2,805	347	4,755	14,644	68	32						
076	C.076 Jombang - Puloarjo	P		2,513	925	1,396	418	4,733	1,010	2,921	90	1,644	6,377	74	26						
081	C.081 Mojosari - Gempol	P		1,903	977	1,897	48	5,197	1,010	1,553	474	3,037	8,234	63	37						
142	C.142 Kamal - Bangkalan	P		2,058	287	2,715	78	5,138	236	524	2	762	5,900	87	13						
143	C.143 Torjun - Bangkalan	P		308	211	1,879	77	2,475	305	546	13	864	3,339	74	26						
143	C.443 Torjun - Bangkalan	P		702	260	1,283	57	2,302	288	490	0	778	3,080	75	25						
148	C.148 Bangkalan - Ketapang	P		416	37	1,061	9	1,523	142	229	1	372	1,895	80	20						
148	C.448 Bangkalan - Ketapang	P		724	41	953	6	1,724	19	333	0	352	2,076	83	17						
TOTAL										115,168	43,892	96,787	16,423	272,270	39,130	75,450	10,757	125,337	474,421	69	31

Source Data from Bina Marga based on traffic survey conducted in October, 1989

Notes (1) Road numbers and measuring sites are those used by Bina Marga. They are given here for reference.
 (2) When there are more than 1 measuring site for a portion (e.g. Gresik-Tuban), the largest number was used in the figure in the main text.