

## 6. OPERATION AND MAINTENANCE PLAN

Guidelines for operation and maintenance of facilities are described below.

### 6.1 Exchange Facility

The operation and maintenance system of VoIP, a data network to be introduced in the future, are quite different from those of existing switching networks focusing on conventional digital exchanges. The concept of the operation and maintenance is rather similar to that of existing PDN (Public Data Network).

#### 6.1.1 Maintenance Formations and Maintenance Staff

In the case of Bahir Dar, VoIP facilities are installed in the Bahir Dar Exchange (3 FTZs), Woreta Exchange and Merawi Exchange.

VoIP equipment installed in the Bahir Dar Exchange is not directly connected to subscribers, so it has a simple configuration. A monitoring unit is installed in this station to monitor operating state of unmanned facilities. Maintenance staff, therefore, needs to be placed in the station. No maintenance staff will be placed in its other VoIP sites.

On the other hand, important VoIP common facilities are installed in Addis Ababa and are capable of monitoring VoIP facilities installed in local areas. That is, the Addis Ababa Station is also considered to be important as a main control station of VoIP.

Taking the above-mentioned situation into account, both Bahir Dar Exchange and Addis Ababa Control Station shall adopt a 24-hour maintenance system and maintenance staff shall be allocated in the station. The number of maintenance staff is as follows:

Addis Ababa Control Station    Engineer: 2    Technician: 3

Category	VoIP	OSP	OFC	Total
Bahir Dar Exchange				
Telecommunication engineer	1		1	2
Assistant telecommunication engineer	3	3		6
Maintenance vehicle	1	2	1	4

#### 6.1.2 Training

In principle, equipment supplier shall train maintenance staff etc.

The contents of training are related to hardware and software. However, since most of daily maintenance and operation of IP are related to software, emphasis of the training contents is put on software.

The training is planned to continue for about three months in Ethiopia. Trainees are to take part in on-site training during the construction period from equipment installation to the beginning of operation.

## **6.2 Transmission/Radio Facilities**

### **6.2.1 Maintenance Organization**

The following systems will be introduced according to the new transmission/radio facility plan in this F/S project.

#### **(1) Bahir Dar Exchange to Woreta Exchange through Washa Indorias Rep.**

Relay transmission line, using existing 7GHz band radio system (1x4Mbps), to be connected to Woreta rural area PCO network at the Washa Indrias Repeater Station

#### **(2) Woreta area PCO network**

A PCO base station is installed in the highland area of Woreta City. The following 14 candidate sites have been selected to install PCO subscriber stations.

1. Gala Minder village area
2. Wore Meda village area
3. Arbaba WEJI village area
4. Sheleko Medhane village area
5. Anguko village area
6. Mobil Gas Exchange village area
7. Woreta ATVET village area
8. Bawabat (Road Side) village area
9. Shiga Maryam village area
10. Shena Tekele Haymanot village area
11. Hod GEBEYA village area
12. Kidiste Hana village area
13. Rice Farm Research village area
14. SEFATRA village area

#### **(3) Washa Indrias Repeater Station to Woreta Exchange**

The maintenance station for out-of-town transmission lines is currently located within the premise of the Bahir Dar Exchange, and maintenance staff for microwave radio transmission system, DRMASS, etc. are residing in the maintenance station. The existing maintenance structure of Bahir Dar Exchange serving as the core of relay transmission network shall be reinforced to cover the new facilities.

New sites (Woreta, Woreta base station, and repeater station) are to be unattended offices, in principle.

#### **(4) Merawi area PCO Network**

Merawi PCO Base Station is installed in Merawi-North repeater station. The following 13 candidate sites have been selected to install PCO subscriber stations.

1. Meshenti No.1 village area
2. Meshenti No.2 village area
3. Bachuma village area
4. INAMRT village area
5. Anbo Mask School village area
6. Anbo Mask Farmer Office village area
7. Kudimi School village area
8. Inguti school village area
9. Inguti (Road side) village area
10. Wetet ABAY village area
11. KURT BAHIR village area
12. RIM village area
13. Kurkurit village area

#### **(5) Merawi-North Repeater Station to Merawi Exchange**

The maintenance station for out-of-town transmission lines is currently located within the premise of the Bahir Dar Exchange, and maintenance staff for microwave radio transmission system, DRMASS, etc. are residing in the maintenance station. The existing maintenance structure of Bahir Dar Exchange serving as the core of relay transmission network shall be reinforced to cover the new facilities.

New sites (Merawi, Merawe North Base Station, and Inguti Rep. station) are to be unattended offices, in principle.

#### **6.2.2 Maintenance Formations and Maintenance Staff**

Maintenance staff shall always stay in the above exchange to perform maintenance according to instructions from the maintenance control station. At night, however, exchanges except for the control station may be unattended. For measuring instruments, spare parts, tools, etc. necessary for maintenance, the following procedures shall apply.

- 1) Measuring instruments to be used frequently are kept in each maintenance station and other measuring instruments are kept in the control station.
- 2) The control station performs centralized management of spare panels, spare parts, etc. Maintenance tools and consumables used constantly are provided for PCO sites or

maintenance stations.

- 3) A maintenance vehicle is provided to each of Bahir Dar exchange, Woreta exchange and Merawi exchange. Periodic inspection and periodic test of systems in the network are carried out under the initiative of the control station in cooperation with maintenance stations and PCO sites. The remote monitoring system is used to notify the control station of faults that may occur at PCO sites, and maintenance staffs at respective sites repair the equipment in principle. For faults of relay transmission lines, a maintenance team is formed mainly composed of maintenance staff of the control station, in cooperation with maintenance staff of maintenance stations, to rectify such faults, according to the instructions from the control station. In case of cable faults, however, the control station notifies the division in charge of outside plant of the faults, the division then takes necessary actions.

To make these maintenance formations, composition of maintenance staff is as follows:

a) Control Station

Chief:	0
Engineer:	2
Technician:	3
Clerical staff:	0

b) Woreta Exchange: Unattended

c) Woreta PCO

Operator:	14
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d) Merawi Exchange: Unattended

e) Merawi PCO

Operator:	13
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### **6.2.3 Training**

Introduction of new technologies to this project requires proper transfer of technology and appropriate training for staff who will be engaged in system operation and maintenance. Therefore, the following proposal is made.

Facilities and systems related to the PCO network are comprised of the following:

- 1) Point-to-point microwave radio system
- 2) Point-to-multipoint radio access system, and
- 3) Solar power supply system

Items (1) and (3) are based on existing technologies requiring neither technology transfer nor new training. However, item (2) is a new system requiring technology transfer and training necessary

for maintenance and operation.

Suppliers of equipment and systems shall provide the training. The training is divided into factory training for engineer class and domestic training performed in Ethiopia for technician class. The factory training shall be performed for a month and the domestic training (mainly on-the-job training) for a month.

### **6.3 Outside Plants (Cables and Civil works)**

Outside Plants occupy large part of telecommunications facilities. Rational and efficient operation of these facilities has great effect on the corporate management.

Different from exchange facilities, outside plant facilities are placed under severe conditions, and have many problems in terms of design, construction and maintenance.

Though faults in outside plant can automatically be detected to some extent, rectification of faults has many elements that require human power. Further, while many types of and large quantity of outside plant require various types of clerical management work, maintenance and improvement of working organization, equipment, and clerical management works lag behind other departments.

#### **6.3.1 Maintenance Level**

Maintenance level indicating maintenance service level is determined in consideration of the economical efficiency of ETC.

It is important to continue maintenance activities to prevent faults on a routine basis and to minimize repairing hours and days in the event of faults.

In particular, adjustment and maintenance of facilities are required to prevent complaints such as disconnection of calls, wrong connections or bad cross talk.

Since subscribers always expect to receive favorable maintenance services from ETC, large cost and labor are required for ETC to maintain a good maintenance level.

The following three targets are provided to improve maintenance level.

- 1) Decrease the number of faults.
- 2) Shorten repair time.
- 3) Improve maintenance management system.

#### **6.3.2 Current Situation of Facilities**

Objective stations have many ducts and buried cables exceeding their durable life span. In many areas, new and old cables exist together.

Many aerial cables and subscriber lead-in wires are being laid without adequate fixture for

suspension, and are being connected using provisional connection method without using proper materials. Most of faults are occurring in cable connection parts. Further, most cross connection cabinets and distribution boxes have no dump-proof treatment by additives at conductor fixing points of terminal blocks.

In customer premise, sheath of subscriber drop-wires and in-house cables is deteriorated. Cables are not laid using formal installation methods in many cases, and protective devices for subscribers are not mounted.

### **6.3.3 Current Situation of Maintenance**

The fault rate of local telephone network in Bahir Dar Exchange is 13.9/month per 100 telephone units. More than 90 % of all faults are due to facilities of outside Plant. Most of repairing work of them requires many hours or days, and the number of repair times per person is about 1.3 per day.

In Bahir Dar Region, since detailed management data on distribution of the number of faults per day, distribution by day of the week, average repair time and the number of open faults is limited, and has not been analyzed, the data is not fully reflected in the maintenance activities.

Though maintenance vehicles seem to be reasonably provided, parts, materials and tools necessary for repair are insufficient.

Due to inadequate repairing skill of maintenance staff and insufficient measuring tools, excessive time is required for fault localization and their rectification.

Scarce spare parts and materials prevent proper and prompt repair work and may cause recurrence of same faults as a result of long-time leaving of tentative repair state.

Insufficient formulation of facility records is causing inconveniences in planning, design, construction and maintenance.

### **6.3.4 Improvement and Modernization of Facilities**

To improve maintenance services aiming at subscribers' satisfaction is a trend of the era, and to improve and modernize facilities of outside plants and customer service management will raise economical efficiency of the corporation.

Through the examination of current status, features and problems of outside plant facilities, the following possible goals are considered for the modernization in the maintenance of outside plant facilities.

- 1) Establishment of desired construction and maintenance systems
- 2) Setup of maintenance management target
- 3) Optimum disposition of vehicles
- 4) Maintaining measuring instruments and work tools in good conditions

- 5) Preparation of appropriate maintenance materials
- 6) Formulation of facility records
- 7) Improvement of fault management (including cause analysis)
- 8) Improvement of material management
- 9) Training

To attain the above targets in an efficient and economical manner, Study Team recommend to establish a lineman center as the transit stage to OPMC in Bahir Dar Region in order to initiate centralized construction/maintenance work of outside plant facilities, and for the smooth introduction of OPMC in the near future.

### **6.3.5 Features of lineman Center**

In order to provide good services of outside plant facilities efficiently to subscribers, the formation of a lineman center for construction and maintenance of outside plant facilities is recommendable.

This lineman center will be provided with the following functions:

- 1) Initiate adequate maintenance and facility management, and grasp facility conditions.
- 2) Initiate inventory control so that materials necessary for daily operation can be available at any time.
- 3) Maintain vehicles, measuring instruments and tools in good conditions to improve operating efficiency.
- 4) Give staff members training directly related to their work to improve their skills.
- 5) Initiate correction of facility records following new installation and upgrades of facilities due to maintenance work, construction work, and new subscriber connections.

### **6.3.6 Size of Lineman Center**

The number of subscribers in Bahir Dar Region was approximately 5,080 in 2002. According to the demand estimate and the supply plan, the number of subscribers is estimated to be 15,673 in 2005, and about 33,806 in 2015.

About 20 out of 31 persons in the outside plant departments are engaged in the maintenance of subscriber lines and customer's terminals.

As shown in Table 6.3.6 the current average fault is 13.9/month per 100 subscribers.

**Table 6.3.6 The Current Average Fault (2001~2002)**

Bahir Dar Faults Data from Aug.2001 to July 2002

Date	Line fault	Cable fault	Total fault	Subscriber	Fault rate
Aug. 2001	948	170	1,118	5,030	22.23
Sep. 2001	1,210	131	1,341	5,030	26.66
Oct. 2001	805	152	957	5,040	18.99
Nov. 2001	483	61	544	5,040	10.79
Dec. 2001	453	89	542	5,050	10.73
Jan. 2002	497	58	555	5,050	10.99
Feb. 2002	371	70	441	5,060	8.72
Mar. 2002	312	131	443	5,060	8.75
Apr. 2002	320	46	366	5,070	7.22
May. 2002	352	61	413	5,070	8.15
Jun. 2002	802	211	1,013	5,080	19.94
Total	6,553	1,180	7,733	Av. 5,050	13.92

Though the number of fault repaired per repair-man is 1.3 per day, it is desired that this figure will become 2.0 in 2010 and 2.5 or more in 2015 through the training for improving repair skills by the establishment of the lineman center, and the reinforcement of mobility by adopting more vehicles. If this is achieved, the number of repairing staff engaged in subscriber lines and customer's terminals can be set from 25 to about 20 in 2010 and 30 in 2015.

The total number of indirect and management staff members required for design, materials and facility records will be about 15. The number of staff members of the lineman center is therefore estimated to be 35 in 2010 and near 45 in 2015.

### 6.3.7 Training

The equipment suppliers shall provide training to maintenance staff. The training is divided into overseas training for cultivating engineer class and domestic training in Ethiopia for cultivating technician class.

The domestic training shall be carried out by dividing trainees into two groups for subscriber optical cable and for subscriber copper loops.

Training period of both overseas training and two groups of domestic training shall be one month.



## **7. IMPLEMENTATION PLAN (PROPOSAL)**

### **7.1 Implementation Plan**

Table 7.1 shows the overall project implementation schedule.

As shown in the project implementation schedule, site feasibility study by consultants and engineering service (including specific design) will be conducted for preparing documents for bidding.

**Table 7.1 Implementation Schedule ( Bahir Dar Project)**

( cost in 1000 US\$ )

Serial month from E/N	0	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	
Year	03 /04									04 /05									05 /06								
Calendar month	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	
<b>1 Preparation stage</b>																											
Exchange of note	▲																										
Consul Agreement	▲																										
Detailed survey		—																									
Design & cost estimation		—	—																								
Preparation of Tender Doc.		—	—	—																							
Tender floating				—																							
Tender Evaluation					—																						
Contract negotiation						—																					
Approval of Contract							▲																				
<b>2 ETC's work</b>																											
Land acquisition		—	—	—																							
OSP (Woreta & Marawi)				—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Shelter ( Rep. st & PCO)				—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Commercial power for B. station																											
New subs. Connection																											
Permit from relative authority																											
Payment of road reinstatement																											
PCO telephone terminal sets																											
<b>3 Project implementation</b>																											
Construction design																											
Design Review meeting																											
Manufacturing																											
VoIP																											
OSP																											
Tr & PCO																											
Transportation upto site																											
Site implementation																											
Civil work																											
Cable work																											
VoIP																											
Transmission																											
PCO																											
Acceptance test & commissioning																											
<b>4 Issuance of ATP</b>																											

## **7.2 Implementation Policy**

### **(1) Framework of the Project Management Pays Attention on the Policy of the Decentralization.**

The key function of the “Project Management “ is to be organized in the respective “Regions”.

The functional responsibilities for the project implementation are to be divided into “Headquarters responsible” portion and “Project site responsible” portion.

Headquarters is to manage the integrated input/output of the project from the corporate level target/schedule, while the site project management is to be responsible on the procedure of the project implementation from the implementation contract up to the project hand-over to the operation and maintenance division.

#### **Headquarters is responsible on:**

- 1) Annual/ mid-term project implementation planning including the budget acquisition/ allocation
- 2) Preparation of the standard specification (General/Technical)
- 3) Tendering, tender evaluation and contract negotiation
- 4) Overall project implementation monitoring to ensure;
  - a) In-time project implementation.
  - b) Achievement of the annual (broken down to monthly) corporate targets
    - New subscriber connection
    - Network performance (call completion rate)
    - Grade of services (fault rate, fault recovery time)
  - c) Facility balance (minimize idle period of the facilities)
  - d) Network balance
  - e) Achievement of Tele-access
  - f) Sound O/M for the project output
  - g) Corporate level solution to the problems thorough the bimonthly project implementation follow-up meeting, which will be chaired by the Deputy Managing Director and be arranged by “Telecommunications Infrastructure Development Department”.

#### **The site project management (Deputy region manager will be assigned as the Project Manager) is responsible on;**

- 1) Detailed design of the project satisfying the site requirements
- 2) Review and approval on construction design, local contractor, quality of material and

equipment

- 3) Daily supervision of the project implementation and site-instructions to the contractor
- 4) Implementation of ETC's responsible works
  - a) Custom clearance
  - b) Building/Tower construction.
  - c) Commercial power supply facilitation.
  - d) Coordination with/permit from the related authorities (road, police, immigration, ETA, etc.).
  - e) Implementation of the related projects
  - f) Others
- 5) Semi-monthly reporting of the project implementation status to H.Q. (CIMIS)
- 6) Weekly follow-up meeting for the project progress, updated implementation schedule and for site problems
- 7) Witness to the progress check, site test and the acceptance test in cooperation with O/M division
- 8) Draft scheduling of new subscriber connections with customer service division
- 9) Providing solution to the site oriented problems
- 10) Receiving the technology transfer from the contractor and the consultant
- 11) Issuance of the acceptance certificate, authorization to pay and other supporting documents
- 12) Management of the project account

The consultant will mainly be involved to support the site project management and to attend the bimonthly project implementation meeting in H.Q.

The effort is to share, monitor and to advise on all the responsible work of the site project management.

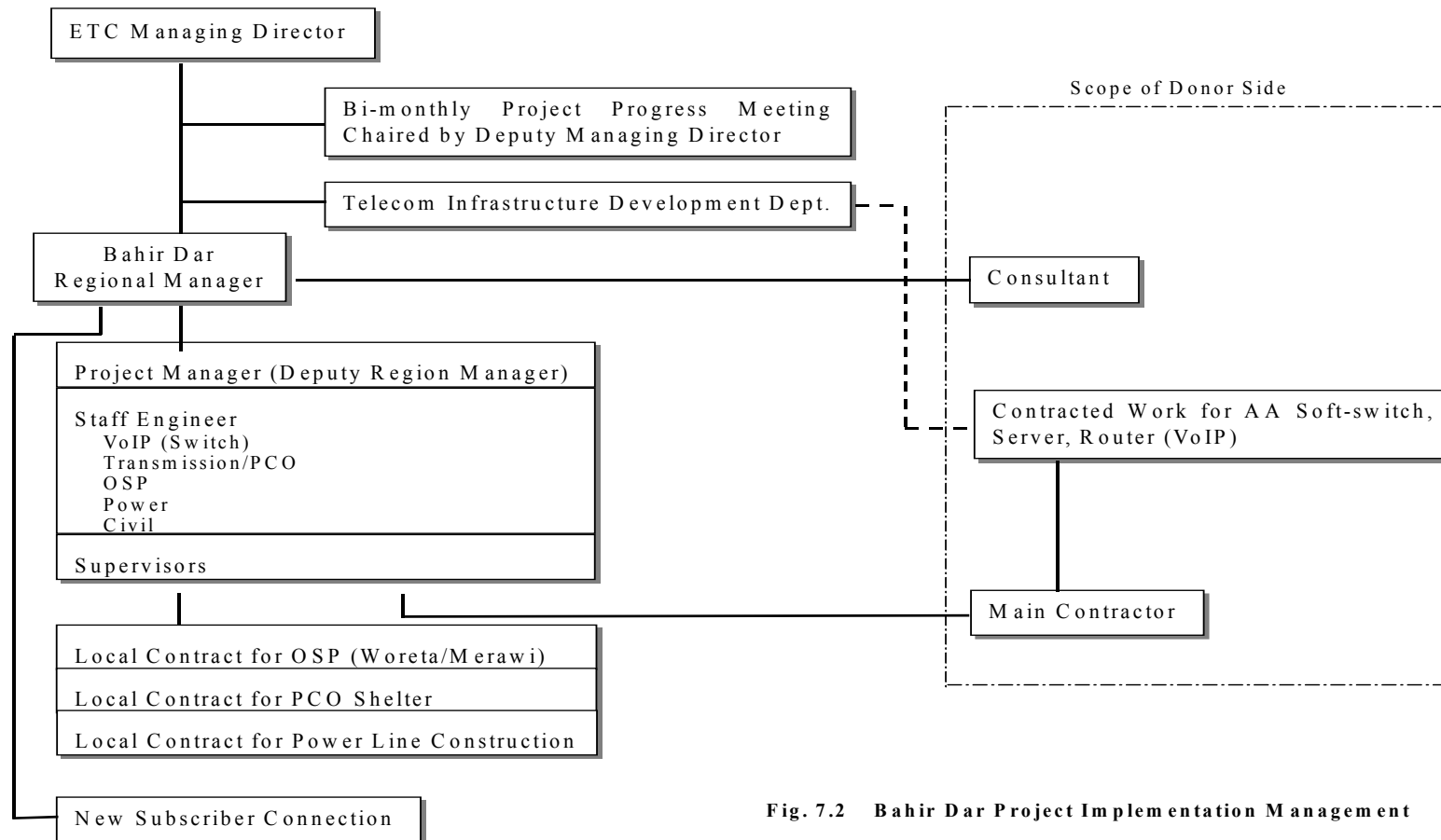


Fig. 7.2 Bahir Dar Project Implementation Management

## **(2) Consideration for the Scheduled Completion of Construction**

Since ETC is responsible for some construction, ETC and contractors shall closely contact with each other to adjust the progress of the construction and shall strictly observe the schedule of their work.

As the city administration manages the roads within the project area, the contractors must obtain permission for road excavation from the city administration through ETC. However, it is vital for them to make utmost efforts to reduce inconveniences of habitants by carrying out construction according to the plan for each region and by avoiding re-excavation in same regions or long-term interruption of construction.

## **(3) Utilization of Local Contractors**

Until recently ETC directly conducts all construction work of telephone facilities in Ethiopia. Very recently the government passed a law to license private local network contractors, which will immediately interest ETC expatriates to be involved in the business. Also, for the construction and maintenance of roads, very limited private companies exist in Ethiopia. However, there are national and private building construction companies. Therefore, foreign contractors shall use these national and private companies for subcontracting in this project.

For the construction of transmission lines, inexperienced workers should be provided by the local construction companies and given technical training by engineers of the foreign contractor so that they can join the construction work.

## **7.3 Demarcation of Scope of Work**

Responsibilities of donor country and Ethiopia for this project are as follows:

### **(1) Responsibilities of Donor Country**

- 1) Specific construction design of switching facilities, transmission/radio facilities, and outside/plant facilities
- 2) Supply of main equipment and materials
- 3) Local purchase of construction parts and materials
- 4) Installation of switching equipment
- 5) Installation of transmission/radio equipment
- 6) Construction of manholes
- 7) Extension and connection of optical cables (Installation in-duct)
- 8) Extension and connection of secondary cables, connection of cables to DP
- 9) Installation of FTZ
- 10) Installation of distribution points

- 11) Provisional restoration (dust-proofing pavement) after road excavation
- 12) As-built drawings
- 13) Testing of equipment
- 14) Delivery of maintenance materials/equipment, tools, and measuring instruments

## **(2) Responsibilities of Ethiopia**

- 1) Reservation of warehouses for storing materials and equipment of contractors
- 2) Acquisition of PCO installation sites and construction of buildings
- 3) Acquisition of permission for occupation and excavation of roads prior to civil works or aerial line facility construction
- 4) Payment of road restoration cost to the road authority after excavation of paved roads
- 5) Preparation of VoIP-related transmission channels

To efficiently proceed with this project and accomplish it as quickly as possible, project work of the donor side shall be conducted using the turnkey system through competitive bidding.

## **7.4 Supervision and Management Plans**

### **(1) Details of Supervision and Management**

In order to properly supervise and manage this project, implementation management body (shown in Figure 7.2) comprising ETC staff and consultants will be established to coordinate opinions from related departments for accomplishing this project. The supervision and management tasks for this project shall be conducted as described below.

#### 1) Tasks concerning preparation of construction contract

Site Study, creation of detailed design, preparation of bills of quantities and bidding documents, examination of qualifications of contractors, publication of bidding, evaluation of bids, selection of nominated contractor, preparation of agreements, attendance at conclusion of agreements, etc. The consultant shall share these tasks and report the results to ETC.

#### 2) Examination of documents submitted by contractors

The consultant shall examine construction drawings, samples, and other documents submitted by contractors and equipment/material manufacturers, and then advise to approve them.

#### 3) Witness inspection at plant

Prior to shipment of equipment and materials, the consultant shall conduct witness inspection at respective manufacturer's plants in donor country to verify that such equipment

and materials meet the contracted specifications. The contractor can ship equipment and materials after they are approved.

#### 4) Progress control

The consultant shall examine construction methods and procedures provided by contractor, and give necessary instructions. The consultant shall also dispatch supervisors to construction sites to check whether construction is going according to the contracted specifications and to monitor the progress of construction.

#### 5) Cooperation for payment procedures

With respect to contract amount paid during or after construction, the consultant shall examine bills submitted by contractor and extend cooperation for payment procedures.

#### 6) Acceptance

Upon completion of construction by contractor, the consultant shall observe the acceptance inspection and examine facilities by verifying them with their drawings.

### **(2) Supervision Staff Plan**

#### 1) Civil work supervision

Since the construction areas of this project contains many rocks underground, it is anticipated that ducts will be laid underground without reserving the depth specified in the specifications. Therefore, accurate supervision for construction is required.

#### 2) Overall adjustment of progress

In order to grasp overall progress constantly to strictly keep the schedule while maintaining the quality of each piece of work, the supervision and management by the consultant are focused on continuous offering of guidance and suggestions to contractors and ETC staff in charge.

#### 3) Dispatching staff

Dispatching supervisors to the installation sites constantly is essential. To adhere to the strict schedule, staff schedule shall be established including spot dispatch of supervisors and staff for inspection of materials and equipment at their plants.

### **7.5 Materials/Equipment Procurement Plan**

#### **(1) Procurement of Main Materials and Equipment**

Almost all of the main materials and equipment (exchanges, transmission/radio equipment, cables, connecting materials, and other small materials) are not manufactured in Ethiopia. They must be procured from foreign countries.



## **(2) Procurement Plan for Locally Manufactured Materials/Equipment**

1) Cements, sand, gravel, broken stones, reinforcing bars, frame-forming materials necessary for this project shall be procured in Ethiopia, because materials having the same specifications as those of ordinary materials can be obtained within the country.

2) Regarding the use of concrete poles (CP)

Concrete poles (CP) can be procured locally provided that their quality meet the specifications and their production capacity and test equipment are assured. Otherwise, they shall be procured from foreign countries.

### **7.6 Additional Tasks on the Side of Ethiopia**

In addition to the responsibilities of Ethiopia described in 7.3 (2), the following tasks are added.

- (1) Exemption from taxation for materials/equipment, customs clearing, import taxes, and durable materials procured locally
- (2) Provision of conveniences for communication means (local/out-of-town calls), construction office, fuel and light expenses, etc.
- (3) Acquisition of permission for occupation and excavation of roads
- (4) Issuance of authorization to pay certificates

Specific design, preparation of bidding documents, procurement, and supervision/management of ETC's work are conducted by the ETC's organization and project implementation management body.

## 8. PROJECT COST ESTIMATE

The total cost necessary for this project is 5.6 Mil. US\$ (Donor side expenses). According to the responsibilities of donor country and Ethiopia, expenses on the donor country and Ethiopia sides are estimated as shown below.

### 8.1 Initial Investment

The project's initial investment cost required for the construction of telecommunications networks is described in Table 8.1 "Donor side expenses".

Expenses required for executing the tasks of the ETC for this project are listed in Table 8.2 Expenditure Plan "Ethiopia side expenses"

**Table 8.1 Project Cost Estimate (Donor side expenses)** (Unit: 1,000US\$)

	SW	PCO	O.S.P.	Total
1. Construction Cost	1,554	2,232	1,151	4,937
2. Others	-	-	-	645
Total	-	-	-	5,582

**Table 8.1-1 Project Cost Estimate (Donor side expenses) Year2003** (Unit: 1,000US\$)

	SW	PCO	O.S.P.	Total
1. Construction Cost	476	644	289	1,409
2. Others	-	-	-	244
Total	-	-	-	1,653

**Table 8.1-2 Project Cost Estimate (Donor side expenses) Year2004** (Unit: US1,000\$)

	SW	PCO	O.S.P.	Total
1. Construction Cost	1,078	1,588	862	3,528
2. Others	-	-	-	401
Total	-	-	-	3,929

**Table 8.2 Expenditure Plan (Expenses of Ethiopia side)** (Unit: US1,000\$)

	S.W.	PCO	O.S.P.	Total
1. OSP (Woreta & Merawi)	-	-	625	625
2. New Subs. Connection	-	-	111	111
3. Pavement	-	-	170	170
4. Shelter for PCO	-	103	-	103
5. Tel for PCO	-	8	-	8
6. Commercial Power lead-in	-	12	-	12
Total	-	123	906	1,029

The project cost was estimated on the following conditions and assumptions.

- a) Construction work will be conducted by contractors based on the Turn-Key System, except for subscriber line connection work (between distribution point and telephone sets), according to the specific design and bidding specifications prepared under the supervision of consultant. Subscriber line connection will be directly carried out by ETC.

- b) The procurement cost of materials and equipment is estimated based on FOB prices. Therefore, marine transportation costs and insurance expenses needed for transportation to Djibouti Port (the Republic of Djibouti) and inland transportation costs and insurance expenses needed for transportation between Djibouti Port and Bahir Dar will be separately estimated. Currency exchange rate of 1US\$=120 Yen is applied.
- c) Costs occurring in Ethiopia (materials/equipment costs, domestic transportation cost, wages for locally hired construction workers, etc.) are calculated in US dollars. In this case, currency exchange rate of 1US\$=8.56 Birr is applied.
- d) Spare parts costs are calculated on conditions that they will be retained for three years.
- e) All costs are calculated using prices in 2002 and no price escalation is taken into account.
- f) It is assumed that sufficient digital transmission capacity will be provided by ETC between Bahir Dar Exchange and NSC before start of service provision of telecommunications networks to be constructed in this project.
- g) ETC conducts the following with its own fund.
  - Acquisition of lands and construction of buildings necessary for providing PCO services
  - Construction of repeater stations building
  - Reinstatement of roads
  - Local cable access network in Woreta and Merawi City
  - New subscriber connections

## **8.2 Expenditure Plan**

Expenses for each year in the early stage of the project, under the above-mentioned conditions, are shown in Table 8.2 Expenditure Plan “Ethiopia side expenses).

The expenses are classified into two; one is preparation expenses (building, land space, etc.) born by ETC for the project, and the other is required for construction of local telecommunications networks in the exchange area subject to this project (Reinstatement, new subscriber connection).

These expenses are further classified into foreign-currency expenses required for materials/equipment procured from outside countries, and local-currency expenses for materials/equipment procured in Ethiopia.

## **8.3 Operation and Maintenance Costs**

Costs required for operation and maintenance of telecommunications systems are configured with direct costs and indirect costs.

These costs are composed of labor cost, facility maintenance vehicle running cost, and

maintenance parts/materials procurement cost, and other general costs.

Table 8.3 shows the operation and maintenance costs of each fiscal year. These costs were estimated on condition that 1US\$=120.00 yen.

In addition, insurance expenses for constructed facilities are required, which account for approximately 0.1% of the total list price of all equipment and facilities constructed in the exchange areas subject to this project, according to the ETC's current insurance system.

**Table 8.3 Maintenance and Operating Cost**

(Unit: US\$1,000)

	Staff cost	General EXP	Bahir Dar
2005/06	28	42	70
2006/07	28	27	55
2007/08	28	31	59
2008/09	28	35	63
2009/10	28	39	67
2010/11	28	43	71
2011/12	28	46	74
2012/13	28	48	76
2013/14	28	49	77
2014/15	28	51	79
2015/16	28	53	81
2016/17	28	55	83
2017/18	28	55	83
2018/19	28	55	83
2019/20	28	55	83
Total	425	685	1,104

## **9. PROJECT EVALUATION**

### **9.1 Background**

This project is part of the Rural Development project, and so profitability is forecast as being low. It is planned to install PCOs at 27 locations particularly from the standpoint of tele-access improvement, and this is expected to be a strain on operation of the project. The main reason why the Rural Development project has not been implemented to date is the difficulty in recovering initial investment. In other words, it was considered that project implementation would simply put a strain on operations. This is a fact. However, the Rural Development project must be implemented in order to achieve the rollout target in the license provisions submitted to ETC from ETA.

In this situation, it is considered difficult to implement long-term loans in the Rural Development project accompanying the obligation to repay the interest and original capital. A fund-raising plan was therefore drawn up considering Foreign Grant Aid from both international organisations (Multilateral basis) and assistance between two countries (Bilateral basis), and the profitability of this was evaluated.

#### **9.1.1 Basic Assumptions for Financial Analysis**

The purpose of this analysis is to measure and assess the financial viability of the Local Network Development project in BAHIR DAR, MERAWI and WORETA area project under the following conditions and assumptions which have been discussed with ETC staff.

The financial evaluation in this chapter has not dealt with nominal change of value such as inflation and currency exchange rate fluctuation to reveal essential viability of the Project.

In the sense, Net present value and Internal rate of return are typical means as the evaluation tool under the appraisal prerequisite, for the Project.

a) Fiscal Year

1, July - 30, June

b) Project Appraisal Period

2003/04 – 2019/20 (17 years)

c) Fixed Price Base

Financial Projections have been done in 2002 constant price. In this mean, All costs shall be fixed at 2002 level. This price level, which was estimated to be the standard market price in 2002, will be adopted for all costs, such as construction costs and operating costs.

d) Exchange Rate

US\$1.00 = Birr 8.56 (August 2002)

US\$1.00 = Yen 120.0 (August 2002)

e) Long Term Loan

Current Long - Term Loan Condition

Interest rate	:	4.0%
Repayment	:	20 times over 10 years
		Fixed principal payment
Grace period	:	non

f) Foreign Grant Aid

Since Ethiopia belongs to the LLDC, bilateral aids are available to conduct through foreign grant aids. The foreign grant aids should be real grants, not to be subsidiary loans.

Duty	:	No duty, No charge
Belongings	:	ETC asset

g) Revenue Collecting Ratio

The expected collecting ratio is set as following Table 9.1-1.

**Table 9.1-1 The Expected Collecting Ratio**

<b>Year</b>	<b>Revenue Collecting Ratio</b>
2003/04 - 2005/06	90%
2006/07 - 2010/11	85%
2011/12 - 2015/16	85%
2016/17 - 2020/21	85%

h) Corporate Income Tax

30% of ETC's net taxable income.

i) Insurance

The cost for insurance was assumed to be approximately 0.1% of the book value of Equipment & Facilities costs in each project year based on the current insurance system.

j) Depreciation

Full value of all asset items is depreciated without remaining salvage value, over the estimated useful lives of these assets. Depreciation is provided as following Table 9.1-2.

**Table 9.1-2 Depreciation Method**

Items	Depreciation method
Buildings	2.5%
<i>Plant</i>	
Exchange & Switching Equipment	5.0%
Radio & Transmission Equipment, VoIP	7.0%
Cable & Subscriber Network	8.0%
Air-conditioning plant, office facilities	20%
Motor Vehicles and others	20%

k) Working Capital

The amount of Working capital is assumed to be the following for each year of operation.

Account Receivable: Sales Revenue for 2 months  
 Account Payable : Operating costs for 2 month

**9.1.2 Investment Plan**

Estimate of the gross required capital funding for the project.

**(1) Total investment cost**

The total investment cost can be summarised in Table 9.1-3.

**Table 9.1-3 Total Investment Cost**

Unit : US \$ 1,000

Items	Foreign	Local	TOTAL
<b>NODE</b>	1,414	217	1,631
<b>Transmission, PCO</b>	2,057	275	2,332
<b>OSP</b>	871	1,132	2,003
<b>Engineering Service</b>	548	97	645
<b>Total</b>	4,890	1,721	6,611

Source: Study Team

**(2) Expenditure schedule**

The total investment cost is disbursed in each project year of construction period as shown in Table 9.1-4.

**Table 9.1-4 Expenditure Schedule**

Unit: US\$ 1,000

	2003/04	2004/05	Total
Plant & Facilities	1,512	4,454	5,966
Engineering Fee	244	401	645
Pre Operation Cost	50	50	100
Initial Working Capital	0	22	22
Interest during construction	0	0	0
<b>TOTAL</b>	<b>1,806</b>	<b>4,927</b>	<b>6,733</b>
EQUITY	153	998	1,151
GRANT	1,653	3,929	5,582
LOAN	0	0	0
<b>TOTAL</b>	<b>1,806</b>	<b>4,927</b>	<b>6,733</b>

Source: Study Team

### 9.1.3 Sales Revenue Projection

This project is significant as a rural communications network construction project. The problem lies in how to predict the revenue per subscriber.

If actual past ETC data is used, the revenue structure for central Addis Ababa is heavily represented, leading to over-estimates. The data therefore cannot be used as is.

Firstly, the subscribers covered in this project are divided into three categories.

#### (1) Subscribers Installing New Access systems and Representing a Net Increase

#### (2) PCO Users

For the users in category (1), the figure for general subscribers in 2004/05 is used in the Master Plan. This is US\$ 91 per subscriber. The PCO users in category (2) cannot be identified. These users have diverse characteristics, ranging from people who use the system only once a month to people who use the system every week. In this case, the number of users was determined based on existing PCO information within the same area. The figures were set at an average of 10 people per day and Birr 2.0 per person.

Expected revenue calculated under the aforementioned conditions is shown in Table 9.1.5. The following revenues are those obtained through the operation of the telecommunication network established under the project. The revenues are deemed as the operating income of the project. Number of expected subscriber is indicated in Table 9.1-8.

**Table 9.1-5 Total Annual Revenue for the Project**

Unit: US\$

Year	Revenue
2005/06	226,980
2010/11	234,950
2015/16	263,520
2019/20	268,940

Source: Study Team



### 9.1.4 Operation and Maintenance Expenses

It is considered that the personnel required to manage this project can be covered using existing ETC staff. Necessary maintenance costs are calculated at 30% of revenue. The direct operation costs do not include interest payment and depreciation. The annual operation and maintenance (O&M) costs will be increased due to the increase of number of terminals. Estimated annual O&M cost has been calculated as following Table 9.1-6.

**Table 9.1-6 Total O&M Cost**

Unit: US\$

Year	O&M Cost
2005/06	107,000
2010/11	95,000
2015/16	93,000
2019/20	86,000

Source: Study Team

Note: Staff cost, Maintenance cost, Insurance

### 9.1.5 Financial Analysis

The purpose of the financial analysis is to measure and assess the financial viability of the priority projects under the above mentioned conditions and assumptions.

The financial soundness of the project will be assessed through the projection of the expected profit/loss and Cash flow statement, etc. The result of this financial analysis is detailed in the output sheets that are attached to the annex.

- a) Income Statement (Table 9.1-9)
- b) Cash flow Statement (Table 9.1-10)
- c) Balance Sheet (Table 9.1-11)

**Table 9.1-7 Assumption of Financing Plan**

Items	US\$ 1,000	Share %
EQUITY	1,151	17.09
Foreign Grant Aids	5,582	82.91
TOTAL	6,733	100.00

**Table 9.1-8 Number of Expected Subscribers**

Year	BAHIR DAR		MERAWI		WORETA	
	New Installation	Total Subscriber	New Installation	Total Subscriber	New Installation	Total Subscriber
2005/06	395	395	704	704	743	743
2006/07	186	581	67	771	53	796
2007/08	51	632	67	838	53	849
2008/09	50	682	67	905	53	902
2015/16	73	1,146	0	1,050	0	1,050
2020/21	0	1,250	0	1,050	0	1,050

Source: Study Team

**Table 9.1-9 Income Statement (P/L)**

PROJECT YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	UNIT: US\$1,000
	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	TOTAL
SALES REVENUE																
BAHIR DAR	32	45	49	53	57	61	66	72	77	83	89	96	97	97	97	1,070
MERAWI	58	60	65	70	75	80	81	81	81	81	81	81	81	81	81	1,139
WORETA	61	62	66	70	74	78	81	81	81	81	81	81	81	81	81	1,141
PCO	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	284
Installation Charge	66	11	6	6	6	6	5	3	3	3	3	4	0	0	0	121
NET SALES	236	185	198	211	225	238	248	253	259	264	270	278	278	278	278	3,699
OPERATING COSTS																
STAFF COST	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	425
GENERAL EXP.	42	27	31	35	39	43	46	48	49	51	53	55	55	55	55	685
INSURANCE	36	33	31	29	26	24	21	19	17	14	12	10	7	5	2	286
TOTAL	107	89	91	92	94	95	96	95	94	94	93	93	91	88	86	1,396
INTEREST (ST-LOAN)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEPRECIATION	76	76	76	76	80	60	60	60	60	60	60	60	60	60	60	978
PROFIT BEFORE TAX	54	20	32	44	51	83	92	99	105	111	118	125	128	130	133	1,325
CORPORATION TAX	16	6	10	13	15	25	28	30	31	33	35	38	38	39	40	398
PROFIT AFTER TAX	38	14	22	31	36	58	65	69	73	78	82	88	90	91	93	928

**Table 9.1-10 Cash Flow Statement**

EXPECTED PROJECT RETURN	8.88%																	UNIT: US\$1,000
PROJECT YEAR	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOTAL
	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	
<b>SOURCE OF FUND</b>																		
CASH FROM OPERATION	0	0	113	90	98	106	116	118	124	129	133	137	142	147	149	151	152	1,906
EQUITY	153	998	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,151
LONG-TERM LOAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SHORT-TERM LOAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL SOURCE OF FUND	153	998	113	90	98	106	116	118	124	129	133	137	142	147	149	151	152	3,056
<b>APPLICATION OF FUND</b>																		
PLANT AND FACILITIES(P/F)	103	926	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,029
P/F ( GRANT )	1,409	3,528	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,937
ENGINEERING SERVICE(GRANT)	244	401	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	645
PRE-OPERATION COST	50	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
WORKING CAPITAL	0	22	-6	2	2	2	2	2	1	1	1	1	1	0	0	0	0	32
INT.DURING CONSTRUCTION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUB-TOTAL	153	998	-6	2	2	2	2	2	1	1	1	1	1	0	0	0	0	1,161
REPAYMENT (ST- LOAN)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL APPLICATION OF FUND	153	998	-6	2	2	2	2	2	1	1	1	1	1	0	0	0	0	1,161
CASH SURPLUS	0	0	119	88	96	104	114	116	123	127	132	136	141	147	149	150	152	1,895
CASHFLOW	-153	-998	119	88	96	104	114	116	123	127	132	136	141	147	149	150	152	745

**Table 9.1-11 Balance Sheet**

PROJECT YEAR	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	UNIT : US\$1,000
	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	
<b>ASSETS</b>																		
CURRENT ASSETS	0	0	119	207	303	408	521	637	760	888	1,020	1,156	1,297	1,444	1,592	1,743	1,895	
FIXED ASSETS	153	1,129	1,129	1,053	978	902	826	747	687	628	568	508	449	389	330	270	211	
LESS DEPRECIATION	0	0	76	76	76	76	80	60	60	60	60	60	60	60	60	60	60	
NET FIXED ASSET	153	1,129	1,053	978	902	826	747	687	628	568	508	449	389	330	270	211	151	
ACCOUNT RECEIVABLE	0	39	31	33	35	37	40	41	42	43	44	45	46	46	46	46	46	
<b>TOTAL ASSETS</b>	<b>153</b>	<b>1,168</b>	<b>1,203</b>	<b>1,218</b>	<b>1,240</b>	<b>1,271</b>	<b>1,307</b>	<b>1,366</b>	<b>1,430</b>	<b>1,499</b>	<b>1,572</b>	<b>1,650</b>	<b>1,732</b>	<b>1,820</b>	<b>1,909</b>	<b>2,000</b>	<b>2,093</b>	
<b>LIABILITIES</b>																		
CURRENT LIABILITIES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
FIXED LIABILITY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
ACCOUNT PAYABLE	0	18	15	15	15	16	16	16	16	16	16	15	15	15	15	14	14	
<b>TOTAL LIABILITY</b>	<b>0</b>	<b>18</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>16</b>	<b>16</b>	<b>16</b>	<b>16</b>	<b>16</b>	<b>16</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>14</b>	<b>14</b>	
<b>EQUITY</b>																		
PAID-IN SHARE CAPITAL	153	1,151	1,151	1,151	1,151	1,151	1,151	1,151	1,151	1,151	1,151	1,151	1,151	1,151	1,151	1,151	1,151	
RETAINED EARNINGS	0	0	38	52	74	105	141	199	264	333	406	484	566	654	744	835	928	
SHORT TERM LOAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<b>TOTAL EQUITY</b>	<b>153</b>	<b>1,151</b>	<b>1,188</b>	<b>1,203</b>	<b>1,225</b>	<b>1,256</b>	<b>1,292</b>	<b>1,350</b>	<b>1,414</b>	<b>1,483</b>	<b>1,557</b>	<b>1,635</b>	<b>1,717</b>	<b>1,805</b>	<b>1,894</b>	<b>1,985</b>	<b>2,078</b>	
<b>LIABILITIES &amp; EQUITY</b>	<b>153</b>	<b>1,168</b>	<b>1,203</b>	<b>1,218</b>	<b>1,240</b>	<b>1,271</b>	<b>1,307</b>	<b>1,366</b>	<b>1,430</b>	<b>1,499</b>	<b>1,572</b>	<b>1,650</b>	<b>1,732</b>	<b>1,820</b>	<b>1,909</b>	<b>2,000</b>	<b>2,093</b>	

### 9.1.6 Major Financial Indicators

The major financial indicators in each operation year will be calculated. Each indicator is obtained from the following formula:

- Net Profit on Equity on Sales Revenue

$$\text{Profit before tax} / \text{Equity (Paid in share capital)}$$

- Profit Break Even Point

$$(\text{OPC} + \text{D} + \text{I}) / \text{r} \times 100$$

- Cash Break Even Point

$$((\text{OPC} + \text{D} + \text{I}) + (\text{R} - \text{D}) / (1 - \text{G}) + \text{WCI}) / \text{r} \times 100$$

where, OPC : Operating Costs

r : Sales revenue at each project year

R : Repayment of Long-term Loan

D : Depreciation

I : Interest on Long-term Loan

g : Tax rate

WCI : Working Capital Increase

**Table 9.1-12 Major Financial Index**

Items	2005/06	2010/11	2015/16	2019/20
Net profit on Equity	3.27%	5.06%	7.15%	8.07%
Profit Break Even Point	77	65	56	52
Cash Break Even Point	21	24	20	17

Source: Study Team

### 9.1.7 Sensitivity Analysis

The effects on the profitability of the projects by the changes of conditions assumed in this financial analysis have been analysed. The changes of conditions (variable factors) and their variable ranges have been assumed as follows:

a) Total Investment Cost

+20% and -20% of the fluctuation of the Total Investment Cost at the construction stage excluding Interest during construction and Initial Working Capital.

b) Sales Revenue

+20% and -20% of the fluctuation of the sales revenue in each project year.

c) O&M cost

+20% and -20% of the fluctuation of the O&M cost in each project year.

d) Grant portion

-5%, -10%, -20% of the fluctuation of the Grant portion for Initial Investment cost

The result of the sensitivity analysis is summarised in Table 9.1-13.

If the Total Investment Cost fluctuates more than  $\pm 20\%$  of the predicted value, FIRR shows fluctuations of approximately 6.3%. This will have a slight effect on the profitability of this project, but is not serious enough to affect the feasibility of implementation.

Sales revenue fluctuations will have a major effect on the profitability of the project. If the expected revenue fluctuates by  $\pm 20\%$ , FIRR will show fluctuations of 6.0%. The charge revenue for existing subscribers must be analysed to ensure suitable estimates for calculations.

If the foreign grant portion decreases and the self-financing portion increases, the FIRR calculation results will fluctuate significantly. FIRR (8.88%) will be 5.35% if the grant portion assumed decreases by 5%, 2.16% if it decreases by 10% and “not applicable” if it decreases by 20%. Support from the ETC main body will therefore be required in the form of cross subsidies.

**Table 9.1-13 The Result of the Sensitivity Analysis**

Variable factor	Variation	FIRROE (%)
Total Investment	+ 20%	5.98
	<b>Base</b>	<b>8.88</b>
	- 20%	12.29
Sales Revenue	+ 20%	11.59
	<b>Base</b>	<b>8.88</b>
	- 20%	5.52
O/M cost	+ 20%	7.13
	<b>Base</b>	<b>8.88</b>
	- 20%	10.46
Grant portion	<b>Base</b>	<b>8.88</b>
	-5%	5.35
	-10%	2.16
	-20%	n.a.

Source: Study Team

### 9.1.8 Result of Financial Analysis

The Ethiopian government is currently making progress with rural development, and Bahir Dar, Mekele, Nazareth, Awassa, and Dire Dawa are currently being focused on as development bases. Bahir Dar is a regional city with high development potential as a popular sightseeing location. The main issues in the telecommunications sector can be listed as (1) eliminating delays, (2) satisfying demand, (3) rural development, and (4) privatisation.

This project proposes installing PCOs (public call offices) as a way of strategically resolving issues (2) and (3). The population benefiting from the creation of 27 PCOs will climb to 224,000, improving tele-access to 60% in the area covered. The tele-access for the whole of Ethiopia is less than 10%.

However, PCO projects have low profitability, and while they would improve tele-access, the evaluation results confirm that implementing these will be difficult with financing schemes using normal loans.

The case in which long-term loans were used was calculated first. The conditions were the same as the assumed conditions indicated, but large losses were predicted, and it was confirmed that this would not form a calculation base. The results were the same even when the interest rate was set to 0%. In other words, the original capital could not be returned even if the budget required for operation could be covered.

**It must be concluded that, from this position, setting up this project as a base for long-term loans is difficult.**

Calculations were then performed using Foreign Grant Aid to overcome the problems of profitability surrounding this project. The cash flow is shown in Table 9.1-10.

The expected profitability and financial condition will be discussed here.

The payout period for the capital of **US\$1,151,000** required in the initial investment (Equity portion) is **9.96 years**. A cash flow of **US\$745,000** is yielded throughout the operating period, with **FIRROE at 8.88%**.

The results show that if at least the initial investment can be covered by foreign aid, operation is somehow possible. However, it must be remembered that the self-financing ratio covering the investment costs in the FIRR figures above is only 17.09%, and only the operating costs can be covered by the predicted revenue. Fund procurement using long-term loans is definitely not advisable. It is clear that the project would simply leave a negative impact on the main ETC operations. Cross subsidies will therefore be applied from the high-profit mobile phone business and urban projects in Addis Ababa.

***In the present development stage of the Ethiopian telecommunications sector, eliminating cross subsidies is one feat that is not possible.***

These results demonstrate typical evaluation results for the Rural Development Project. They show that operating costs can somehow be covered by revenue from the project alone, assuming that foreign grant aid is used for initial investment.

It must however be remembered here that a high FIRR value is calculated, since the percentage of self-financing is low at 17.09%. As shown in the sensitivity analysis, the FIRR value fluctuates greatly if the percentage of self-financing increases.

Viewing the evaluation results with this in mind, it can be evaluated that the operating costs can somehow be covered by revenue from the project, and that implementing this project will contribute to the development of the Ethiopian telecommunications sector.

***However, the government will be subject to a repayment obligation in the same way as for subsidiary loans regardless of whether foreign grant aid with bilateral support is used in this project. The use of funds raised through long-term loans is therefore not suited to this project. The project applied a long term loan will have a negative impact on the operations of***

*the ETC organization, requiring large cross subsidies from the high-profitability mobile phone and Addis Ababa projects.*

#### **9.1.9 Observation on Result of Financial Analysis (Optional Plan)**

Consider first the optional plan in which the number of PCO (Public Call Office) sites is decreased in the region in question.

The main plan proposes installing PCOs in 27 locations to boost tele-access in the region to 60%. This plan has the straightforward objective of making at least one PCO available to residents within a 5km radius of their home, and has been formulated with due respect for minimising costs, omitting all but the necessary PCO sites. The following points were taken into account in the development of this main plan.

- (1) Making maximum use of limited funds
- (2) The uneconomical nature of the PCO business in Ethiopia
- (3) Assigning top priority to improving tele-access on a national scale

It is worth revisiting here the role and distinguishing features of PCOs. PCOs are not a form of economic infrastructure targeting specific individuals or households, but rather a component of social infrastructure highly public in nature, targeting large and unspecified sections of the population. Therefore when looking at demand for PCOs, it is important to be aware that unlike demand for fixed telephone and mobile phone services, which target "units" of either individuals or households, PCOs aim to serve the region in question as such, in other words the "collective" target of all residents. Next, it is vital to remember that while users of fixed phones and mobile phones make regular and ongoing use of telephones. Meanwile, PCO users belong to a totally different category to fixed phone and mobile phone users in terms of the frequency of their telephone use, making use of telephones in fact only a few times a year or month.

The Master Plan aims to distribute around 5,000 PCOs across the whole of Ethiopia, with the aim at raising tele-access to 87%. In other words, this involves covering the entire geographical territory of Ethiopia with 5,000 PCOs.

What if under these circumstances the number of PCOs in the same region was decreased from 27 to 14.

Tele-access would not become worth even if the number of PCOs in the same region were boosted. For users, a greater number of PCOs would reduce the distance from their home to a PCO, however this would not be accompanied by any change in the number of Ethiopians with improved access to a telephone. Therefore, there would be no change in the figure for tele-access.

A look at the profitability of PCOs reveals that each can be expected to generate less than US\$1,000 in annual revenue, barely enough to cover running costs. Simply increasing the



number of PCOs of this type will increase the financial burden of operating the PCOs. Table 9.1-15 indicated a cash flow figure for 14 PCOs. The main plan of 27 PCOs has a FIRR of 8.88%, while the optional plan of 14 PCOs has a FIRR of 9.17%, indicating no major difference in cash flow between the two.

This is because a financing scheme is employed in which 90% of the required funding are covered by foreign grant aid, and because the PCOs themselves generate only minimal earnings. Even a decrease of US\$ 0.5 million in the sum invested results in no major change to the FIRROE calculated. What does change is the size of the grant by the donor country, which decreases.

*From the perspective of the donor country, if there is to be no change in the proportion of the population benefiting from the project, or any greater advantage, from the standpoint of minimising cost, setting up 14 PCOs as indicated in the optional plan would appear to be the proper course of action.*

*Under a Master Plan that aims to cover the whole of Ethiopia with 5,000 PCOs, there is no spare capacity allowing more PCOs than necessary to be installed in certain areas.*

**Table 9.1-14 Expenditure Schedule (Optional Plan)**

Unit: US\$ 1,000

	2003/04	2004/05	Total
Plant & Facilities	1,312	4,129	5,441
Engineering Fee	244	401	645
Pre Operation Cost	50	50	100
Initial Working Capital	0	21	21
Interest during construction	0	0	0
<b>TOTAL</b>	<b>1,606</b>	<b>4,601</b>	<b>6,207</b>
EQUITY	109	993	1,102
GRANT	1,497	3,608	5,105
LOAN	0	0	0
<b>TOTAL</b>	<b>1,606</b>	<b>4,601</b>	<b>6,207</b>

**Table 9.1-15 Cash Flow Statement**

EXPECTED PROJECT RETURN	9.17%																	UNIT: US\$1,000
PROJECT YEAR	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOTAL
	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	
<b>SOURCE OF FUND</b>																		
CASH FROM OPERATION	0	0	111	88	96	104	112	114	121	125	129	134	138	143	145	146	148	1,853
EQUITY	109	993	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,102
LONG-TERM LOAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SHORT-TERM LOAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL SOURCE OF FUND	109	993	111	88	96	104	112	114	121	125	129	134	138	143	145	146	148	2,955
<b>APPLICATION OF FUND</b>																		
PLANT AND FACILITIES(P/F)	59	922	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	981
P/F ( GRANT )	1,253	3,207	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,460
ENGINEERING SERVICE(GRANT)	244	401	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	645
PRE-OPERATION COST	50	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
WORKING CAPITAL	0	21	-6	2	2	2	2	1	1	1	1	1	1	0	0	0	0	31
INT.DURING CONSTRUCTION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUB-TOTAL	109	993	-6	2	2	2	2	1	1	1	1	1	1	0	0	0	0	1,112
REPAYMENT (ST- LOAN)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL APPLICATION OF FUND	109	993	-6	2	2	2	2	1	1	1	1	1	1	0	0	0	0	1,112
CASH SURPLUS	0	0	117	86	94	102	111	113	120	124	128	132	137	143	144	146	148	1,843
CASHFLOW	-109	-993	117	86	94	102	111	113	120	124	128	132	137	143	144	146	148	741

## **9.2 Economic Evaluation (Base case)**

An economic evaluation was carried out on the base case from two perspectives, that of (1) using limited funds effectively, and (2) ensuring a high level of benefit.

Telecommunication is almost universally recognised as an avenue for raising living standards and a key element of economic development. Thus telecommunication projects have an impact on individual and social welfare. As economic activity should be expanded on a national scale, telecommunications is acquiring strategic importance for growth and development. The telecommunication in Ethiopia, however, is prevented to become mature mainly due to the national treasury problems for development on large scale.

It is clear that there will be adequate demand for the telecommunication service in Ethiopia as the empirical evidence indicates that people place value on using telecommunications. In these circumstances, Government of Ethiopia has come to reconsider ways and means for the improvement of the telecommunication systems. More widely scaled services are to be provided by Ethiopian Telecommunication sector to satisfy the nation's needs. The necessity for planning new telecommunication networks is thus raised.

### **(1) Method of Economic Evaluation**

In this Economic Analysis, the economic effect expected from the performance of these projects will be assessed dealing mainly with the calculation of Economic Internal Rate of Return (EIRR) when discounting sets of economic cost and benefit streams for the project. Through elimination of the value of transfer items and application of appropriate shadow prices to the financial cost and benefit streams, the financial cash flows are transferred into economic cost and benefit streams to calculate the EIRR.

### **(2) Economic Benefit**

Economic Benefit of the project will be divided into direct and indirect benefits, which will be assessed separately.

#### **1) Direct Benefit**

The direct benefit of these projects lays its importance in the economic value. Sales revenue in economic value to be generated by the Master Plan are estimated, based on investigation results concerning historical tariff level.

One problem concerns how the difference between mobile phone and fixed phone charges should be considered. In the current charge system, mobile phone charges are three times those for fixed phones. Subscribers accept the higher charges since mobile phones have the added value of allowing calls to be made on the move. However, the spread of fixed

phones is not so advanced in developing countries, and in many cases, subscribers requiring a phone purchase a mobile phone. These subscribers simply require a means of communication, and would be happy with either a mobile or fixed phone. In this case, the cost of one call is the same for either. For fixed phones at least, the consumer surplus here arises as the cost difference with mobile phones.

## **2) Indirect Benefit**

The improvement of Telecommunication networks will contribute a great deal to the improvement of the national well-being not simply in the form of economic benefit but also in term of social benefit.

Such indirect benefits conceivable are:

For Nations:

- Greater ease in emergency access to medical institutions
- Improved emergency communication, leading to upgrading and diversification of government and private services.
- Economic effects to enhance business activities.
- Increase in employment opportunities, improvement in security, etc.

For Ethiopia Telecommunication Sector:

- Nation-wide expansion of telecommunications service.
- Improvement of telecommunications service.
- Rapid innovation in telecommunications.
- Simplification of network management.
- Creating new services.

With the combination of above effects, national economic growth is promoted.

Implementing the Master Plan involves no factors that will negatively affect Ethiopian society. The transfer of control from benefits to costs is therefore not considered.

### **(3) Economic Cost**

For the economic costs, the following items must be considered.

#### **1) Initial Investment Costs for Implementation of the Projects**

The Equipment and Facilities costs, Engineering services costs, Pre-operation costs and Initial working capital will be necessary as the initial cost for the economic value.

#### **2) Operating and Maintenance Costs**

As the operating and maintenance costs, the staff costs, general expenses and insurance charges are required. These expenses must be analysed economically considering their economic values.

#### **3) Items of Transfer**

The tax imposed on ETC is an actual expenditure for ETC. However, looking at the tax from a social perspective, it is only a transfer of cash from ETC to the government. Since it does not require resources, it will not be considered a cost.

For the same reason, the insurance to be paid to domestic companies is a transfer item and therefore is excluded from the cost.

### **(4) Economic Parameters**

The financial value projected in the Financial Analysis will be converted to the economic value using the following factors.

#### **1) Foreign Exchange Premium (FEP)**

The foreign exchange premium used was that obtained by canvassing the black market dollar rate in Addis Ababa. Under normal circumstances, the standard conversion factor is calculated from the figure for imports and exports, the FEP being the inverse of the resulting figure, however where a black market dollar rate exists, this is used for the FEP because it is deemed to reflect market prices more accurately.

#### **2) National Parameters**

The financial values of costs items presented in 'Financial Evaluation' will be divided into local and foreign currencies. Although the value of national parameter is not announced the Government of Ethiopia, the value is set up for the project with the assumption that socio-economic environment in the country will reach the average level of the African region. Then the economic values will be calculated using the value of national parameters (premium of economic value) as shown below:

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- Construction**	0.73
- Unskilled Labor**	0.50
- Working Capital*	1.00
- Foreign Exchange Premium*	1.03

\* : Estimated by study team

\*\* : These shadow price ratios were obtained in Uganda

The factor for construction is applied to all locally source equipment and services and the factor for unskilled labour is applied to all local labour.

## (5) Economic Analysis

Economic evaluation is more conceptual approach than the financial evaluation with the assumption that economic evaluation employs perspective of society while financial evaluation is based on business entity's perspective. Therefore, Economic benefit and cost are not directly related to actual monetary flow.

### 1) Determination of Economic Direct Benefit

As clear from the example of neighbouring Uganda, the recent rapid growth in mobile phone use is transforming subscriber values with regard to telephones. In many countries the number of mobile phones already exceeds that of fixed phones, and what was once one phone per household is now becoming one per person.

In Bangladesh, under similar socio-economic conditions to those Ethiopia will be experiencing in 2020, the number of mobile phones had outstripped that of fixed phones by 2002. Despite mobile calling charges three time those of fixed phones, subscriber numbers are growing. Seen in terms of a social phenomenon, this means that Bangladeshis wanted a means of communication so much they were willing to pay triple the phone charges to obtain one.

In Addis Ababa, public payphones are limited, and so there are cases of subscriber phones being lent out illegally in front of stores. The charge for these is Brr0.75 for 6 minutes. Considering these two situations, *Economic Benefit Streams 1* is calculated with charges that Ethiopians are willing to pay being the same as for mobile phones, i.e. three times that for fixed phones.

Cost fluctuations due to changes in the exchange rate were next considered. The charge system for fixed phones has remained the same since charges were revised in 1993. However, comparing the exchange rates for 2001/02 with 1996/97 shows a change of

approximately 30%. An *Economic Benefit Stream 2* is calculated with this as the consumer surplus latent within the charge system.

The total economic benefits are summarised as shown in Table 9.2-1.

**Table 9.2-1 Economic Benefit Streams**

**Unit: US\$ 1,000**

<i>Year</i>	<i>Financial Benefit Stream</i>	<i>Economic Benefit Streams 1</i>	<i>Economic Benefit Streams 2</i>
2005/06	236.10	388.90	251.38
2006/07	196.09	362.65	212.75
2007/08	204.46	382.93	222.30
2008/09	217.57	407.87	236.60
2009/10	230.83	433.04	251.05
2010/11	244.06	458.17	265.47
2015/16	272.63	515.63	296.93
2019/20	278.05	528.29	303.07

Source: Study Team

## 2) Economic Cost Streams

The total investment and O&M costs in each project year described in Table 9.2-2 for Economic Analysis. The costs are converted into the economic cost using value of national parameter (Shadow premium)

**Table 9.2-2 Economic Cost Streams**

**Unit: US\$ 1,000**

<i>Year</i>	<i>Staff Cost</i>	<i>General Expense</i>	<i>Insurance</i>	<i>Economic Cost</i>	<i>Financial Cost</i>
2005/06	25	32	-	57	107
2006/07	25	22	-	47	89
2007/08	25	25	-	50	91
2008/09	25	28	-	53	92
2009/10	25	31	-	56	94
2014/15	25	39	-	65	94
2019/20	25	42	-	68	86

Source: Study Team

### (3) Assessment of Result of Economic Analysis

EIRR during the economic life span for the Base cases are calculated using the economic benefit and costs. EIRR, the measures to assess the economic viability, are summarised as shown in Table 9.2-3 and Table 9.2-4.

**Table 9.2-3 Economic Analysis**

UNIT: US\$1,000							
	INVESTMENT (EQUITY)	O&M Cost	TOTAL COST	Benefit Stream 1	Cash Flow 1	Benefit Stream 2	Cash Flow 2
2003/04	125		125		(125)		(125)
2004/05	756		756		(756)		(756)
2005/06		57	57	389	332	251	194
2006/07		47	47	363	316	213	166
2007/08		50	50	383	333	222	172
2008/09		53	53	408	355	237	184
2009/10		56	56	433	377	251	195
2010/11		59	59	458	399	265	206
2011/12		61	61	475	414	274	213
2012/13		62	62	483	421	279	217
2013/14		64	64	494	430	285	221
2014/15		65	65	505	440	291	226
2015/16		66	66	516	450	297	231
2016/17		68	68	531	463	306	238
2017/18		68	68	528	460	303	235
2018/19		68	68	528	460	303	235
2019/20		68	68	528	460	303	235
	881	911	1,792	7,022	5,230	4,080	2,288

**Table 9.2-4 Net Present value (Discount rate 12%)**

Unit: US\$		
	Benefit Stream 1	Benefit Stream 2
Cost (C)	1,029,000	1,029,000
Benefit (B)	3,007,000	1,763,000
B – C	1,978,000	734,000
B / C	2.92	1.71
EIRROE	37.65%	20.21%

The EIRR is 37.65% or 20.21% indicates the existence of economic effects. As may be seen from the figures used to calculate this EIRR, the EIRR figure itself provides no any absolute yardstick. It is not a major element in decision-making in the sense that "if the EIRR is above 20% this should be done", and is closer to a relative value. In other words, it must be remembered that this figure does entail some risk.



The results of the economic evaluation also show that while the project is necessary for economic growth, it is a BHN type project for which profit cannot be expected. It is therefore problematic to calculate fund procurement using the long-term loan base, and it must be implemented using Foreign Grant Aid or self-financing. Implementation using self-financing would not be impossible in the present ETC-operating environment, but this would definitely become a burden. It is ideally hoped to obtain a strategic partner and at least lay down some form of operating environment in preparation for the period of competition. However, the rollout target cannot be achieved unless rural development is also carried out. This represents a major conflict. As far as can be seen from the external and internal situations surrounding ETC, the most effective solution for implementing this project is the injection of Foreign Grant Aid.

For the Ethiopian telecommunications sector, it is of primary importance that the minimum necessary telecommunications network for the country is built by actively gaining support from overseas while the government still holds a majority of the ETC capital structure, and that PCOs are expanded using foreign grant aid where possible for rural development.

### **9.3 Technical Evaluation**

#### **(1) Rural PCO**

Master plan recommends new DRCS with wide band IP network solution for PCO network in rural area. Internet and mail services are now widely deployed through the world, in which require higher speeds of transmission. World-wide tendency will certainly be to rush at developing higher speed of transmission like a Gb/s and Tb/s basis. The higher the speed in transmission, the better would be, but the investment would be limited. It is, therefore, recommended constructing a practical and feasible network and the infrastructure to telecommunication network meet the local and social needs. The new telecommunication network to be constructed must comply with the requirement of IP system, which will be applied for all telecommunication networks in future.

ETC's intention is to expand transmission lines with wide band and high-speed solutions for multimedia applications for socio-economic infrastructure of rural areas, such as remote education, remote medicine, remote medical service etc. As shown in the table below,

- 1) wide band solution is given only by the DRCS proposed,
- 2) the DRCS complies with the future IP network requirement and
- 3) installation cost and annual operation and maintenance cost will be cheaper than that of VSAT,

The terrestrial transmission system will be better solution taking a long-range view.

<b>Item</b>	<b>Proposed DRCS (Wide Band IP)</b>
Network	Wide Band IP Data Speed: 64 kb/s~256 kb/s
Telephone	VoIP (Voice over IP) Variable Voice Coding: 5,6k / 8k / 64 kb/s
Internet (e-mail, web etc.)	Wide Band IP Variable Data Speed: upto 256 kb/s
Comments	<ol style="list-style-type: none"><li>1) Voice CODEC can be selected according to the services of line. (Four (4) times as many as channels can be obtained at 8 kb/s CODEC in stead of 64 kb/s.)</li><li>2) Valuable speeds of lines such as high speed data, Internet, telephones etc. are automatically assigned.</li><li>3) High speed internet is available due to being composed of IP network.</li></ol>

## **(2) Urban Areas**

Introduction of FTZ will make possible to provide quality telecommunication services to the areas located for from the stations.

In the near future, switching equipment will be replaced to VoIP equipment over the world. Introduction of VoIP as pilot projects hiring a foreign consultant will contribute to training of engineers and technicians for future nation-wide development of the system.

## **10. RECOMMENDATIONS**

### **(1) PCO**

- a) Wide-band communication is applied for PCOs for use of IP in the future. Effective use of the communication system for distant medi-care and distant learning can be and should be encouraged in consultation with relevant authorities and related organisations to enhance these social services.
- b) For the expansion of PCOs over the country, rural electrification has to be encouraged. Co-ordination with EEPCO will be required.
- c) Since up to 15 PCOs can be established for one base station, continuous efforts to increase the coverage or beneficiaries will be required.

### **(2) VoIP**

Installation of soft-switch in Addis Ababa should be carried out by ETC in accordance with the progress of FS projects.

### **(3) OSP**

#### **(a) Optical Fiber**

Numbers of fiber cores are designed to correspond to future demands. When actual demands arise, ETC should meet the demands by efficiently utilising the installed fibers. In case ETC obtains additional information on future demands during detail design, the number of fiber cores should be reviewed.

#### **(b) New Subscriber Connection (In-house Cabling)**

At present, arrestors are not installed at demarcation points between ETC and customers. Considering release of services for installation and maintenance of customer premises equipment to the private sector, and increasing connections with computers, arrestors are to be installed to avoid current fusion from power lines and to protect from lightning. Installation of arrestors should be assured in accordance with construction manuals.

### **(4) Financial Management**

The results of financial evaluation show that if at least the initial investment can be covered by Foreign Grant Aid, operation is somehow possible. However, it must be remembered that the self-financing ratio covering the investment costs in the FIRR figures above is only 17.09%, and only the operating costs can be covered by the predicted revenue.

However, Government of Ethiopia will be subject to a repayment obligation in the same way as for subsidiary loans regardless of whether Foreign Grant Aid (Bilateral basis) is used in this project. Fund procurement using long-term loans is definitely not advisable. It is clear that the project would simply leave a negative impact on the main ETC operations.

Cross subsidies will therefore be applied from the high-profit mobile phone business and urban projects in Addis Ababa. In the present development stage of the Ethiopian telecommunications sector, eliminating cross subsidies is one feat that is not possible.