

CHAPTER 9
OPERATION AND MAINTENANCE

CHAPTER 9 OPERATION AND MAINTENANCE

9.1 Strategy and Organization

1) Important items to offer the better services

a) Trouble Clearing Side

If possible, staff should find causes of equipment trouble in advance.

The staff should protect reoccurrence of the same trouble.

The staff should recover trouble quickly.

It is very important to reduce trouble clearing time for the better customer satisfaction. For this purpose, the target of trouble clearance time shall be set. Then adequate statistic shall be edited and compared with international trends, for example by referring ITU publications, so as to know own performance.

For shortening the trouble clearance time, the installation and adequate functioning of Spare Parts Centers are indispensable..

It will be advisable to have a Central Spare Parts Center in Vientiane for storing expensive and rarely failed parts, and Provincial Spar Parts Centers attached to Provincial Operation and Maintenance Centers so as to facilitate O&M activities.

b) Traffic management side

It is important to measure the carrying traffic of equipment periodically for switching network. This action is related with knowing of adequacy of the size of equipment and this will lead to the improvement of call complete rate resulting increased revenue.

c) Action to subscriber complain

The subscriber complain to test board will be consisted of no-functioning of telephone, busy, inferior speech quality, interruption of communication and so on.

Received complain shall be immediately tested, and be classified which section among outside plant, switching and transmission be informed for trouble clearance. At this instance, complain detail and test result shall be informed not verbally but in the form of written or recorded information to the alerted section.

The concerning section shall immediately tackle to the problem, and after clearance of trouble the cause of trouble shall be reported back to the test board. The staff of test board shall record the cause of trouble as well as the time of trouble recovery. This procedure is quite important for further actions as shown below:

- Trouble rate calculation, typically number of reported troubles per subscriber per year; This figure is very often referred in international comparison for the quality of service.
- Establishment of maintenance policy based on statistical analysis of troubles.

3) Training of O&M staff

For the better performance of O&M, training shall be given the preference position in the whole organization activities.

Training facilities will be located in Vientiane as the major training site, and the provinces will have smaller size training facilities for minor training courses and on the job training.

There shall be not only courses for new technology but also courses for conventional system and equipment.

As not all manuals supplied to equipment sites can not be translated to Lao language, O&M staff should have foreign language skill such as English.

4) Organization of Operation and Maintenance

Organization of Operation and Maintenance will consist of National center, Provincial centers, and Subcenters.

The National center will be located in Vientiane, and its function will be different from other centers and it will supervise the status of international and national networks through observing traffic flow and fault in the networks. This center will cooperate with Provincial centers for lessening the traffic overload or clearing major troubles in various part of the country.

The Provincial centers in total 18 are located in each Provinces (including Vientiane Municipality). It will be also staffed with commercial staff who attend directly to the visiting customers for settling the bill, requesting new telephone subscription, attending to public telephone for international or long distance calls and so on. The Spare Parts Centers in each Province will co-locate together.

Subcenters will be allocated in the places where it takes more than half day trip by vehicle from Provincial Center to a repairing site. However Subcenters are regarded as the temporary organization until road condition is improved and travel time is shortened, and it can be expected that the necessity of having Subcenter will disappear before 2015.

9.2 Switching Network

The O&M strategy and the O&M concept for switching network have to be adapted in accordance with the network development.

At present, all exchanges (except remote exchange) are manned and controlled locally. Only in some cases the control from one site to some other sites is made possible, in general no centralized Operation and Maintenance (O&M) introduced in the telecommunications network of Lao P.D.R.

However, the implementation of the new O&M concept must be aligned with the network expansion. In addition, the transition to the Telecommunication Management Network (TMN) recommended by ITU-T must not be neglected.

The Mean Time between Failures (MTBF) for digital equipment is very high and as a consequence it has become normal proceeding to operate digital equipment regularly unattended and to send maintenance personnel to the site only in case of alarms indications.

9.2.1 Switching System Operation and Maintenance Structure

(1) O&M for Switching System

When reviewing and rearranging O&M for switching system, the future migration to the O&M Center must be borne in mind. Due to the wide variety of actions involved, and due to their different nature, a one-to-one integration of following three functions of O&M is to be considered.

These three functions explained below must be considered separately concerning their migration to the Operation and maintenance Center (OMC):

- Customer service operations
- Network Operations and management
- Maintenance of switches

Diagnostic software and fault detection hardware are included in the switching system for automatic detection of software and/or hardware faults. The built-in

fault processing program performs the following functions:

- Fault detection
- Fault analysis and diagnosis
- Fault isolation and display of diagnosis result
- System reconfiguration to restart call processing

(2) From Local O&M to Centralized O&M

Migration from Local O&M to Centralized O&M applied for digital exchanges shall be carried out according to following way:

- All exchanges to be monitored and supervised shall be connected to OMC where operation is performed during normal working hours.
- Remote Switching Units (RSU), smaller- and medium-sized digital exchanges shall be run unattended.

This O&M organization is arranged with the aim to reduce operation and maintenance staff costs and better utilization of specialized manpower. Normally, one digital exchange does not create enough work to justify full time staffing.

As far as the allocation of exchanges to OMCs is concerned, the following rules should be applied:

- All exchanges in the province where the OMC is located shall be allocated to that OMC.
- OMCs should take over monitoring and supervision of the exchanges allocated to them outside normal working hours.
- All exchanges in a province, which does not have an own OMC, shall be allocated to that OMC in an adjacent province, which has the lowest work load, in order to keep the work load as balanced as possible. A good indication for the workload in an OMC is the amount of number of switches and subscribers located in its service area.

9.2.2 OMC Arrangements for Network Operation and Management

As a long-term target, 4 Operation and Maintenance Centers (OMC) should be established in Lao P.D.R., i.e. Luangphabang, Vientiane, Khantabouli and Champasack. They should be collocated with the transit centers.

9.3 Transmission (MW/OFC/Mobile/Etc.) Network

9.3.1 Microwave Transmission Networks

The current situation of maintenance management structure in LTC has already

organized the maintenance team how to provide own facility. However, ETL is not yet a sufficient maintenance structure because it was newly established and a little number of facility.

Therefore, the required maintenance section is to be provided in Vientiane Salyom station, which includes the set up of the operation and maintenance sections, and to describe an outline of maintenance detail and procedure.

Although the detail of operation and maintenance procedure is almost the same structure with other facility, this description only provides a usual routine maintenance of how to do its activity as shown in Fig. 9.1.

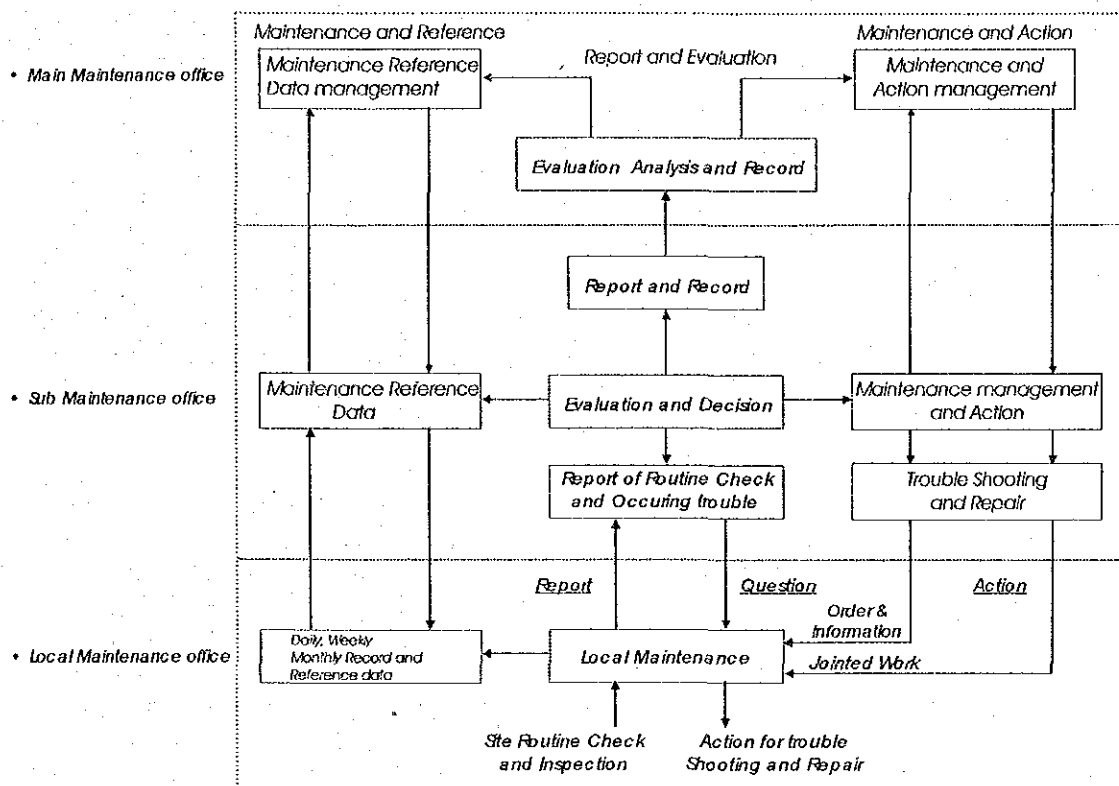


Fig. 9.1 Maintenance Management and Action Procedure

9.3.2 OFC Transmission Networks

ETL has an operation and maintenance section at the KM-21 station in the suburbs of Vientiane and conducted to the existing CSC Transmission Network and Intra-Provincial Network and etc.

However, operation and maintenance will be very important, which will be maintained for some more operation and maintenance sections and facilities

according with the expanding plan of 2002 to 2005, 2006 to 2010 and 2011 to 2015 respectively.

Therefore, the required maintenance section will propose to provide to provincial districts throughout the country, which require to set up minimum number of operation and maintenance sections and to conduct high efficient operation and maintenance works that will be required by the maintenance management and control computer network system, which is capable to get all data at site as shown in Fig. 9.2.

Further, main operation and maintenance sections should have monitor and control functions to transmission networks in the territory and will switch to back up network route in case of main trouble as shown in Fig. 9.3. Also trouble point on the transmission network will be easily detected by maintenance and control management computer system.

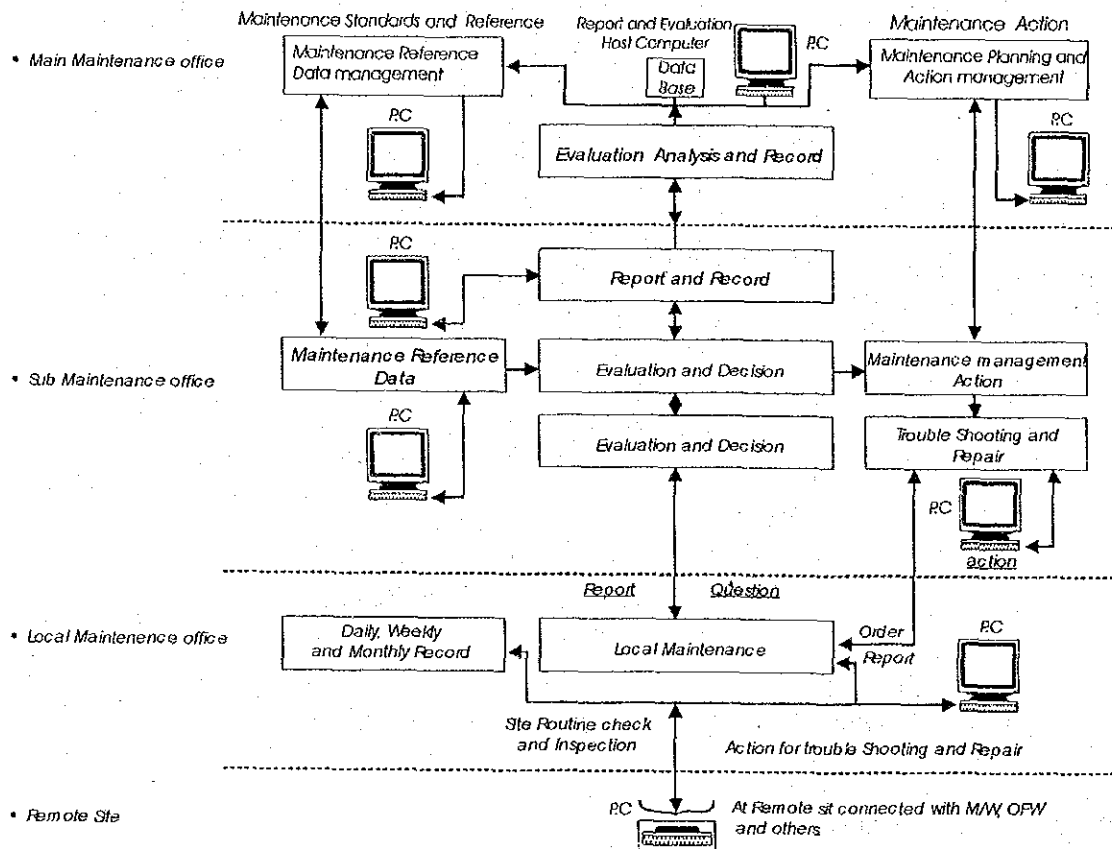


Fig. 9.2 Maintenance Management Computer Networks System

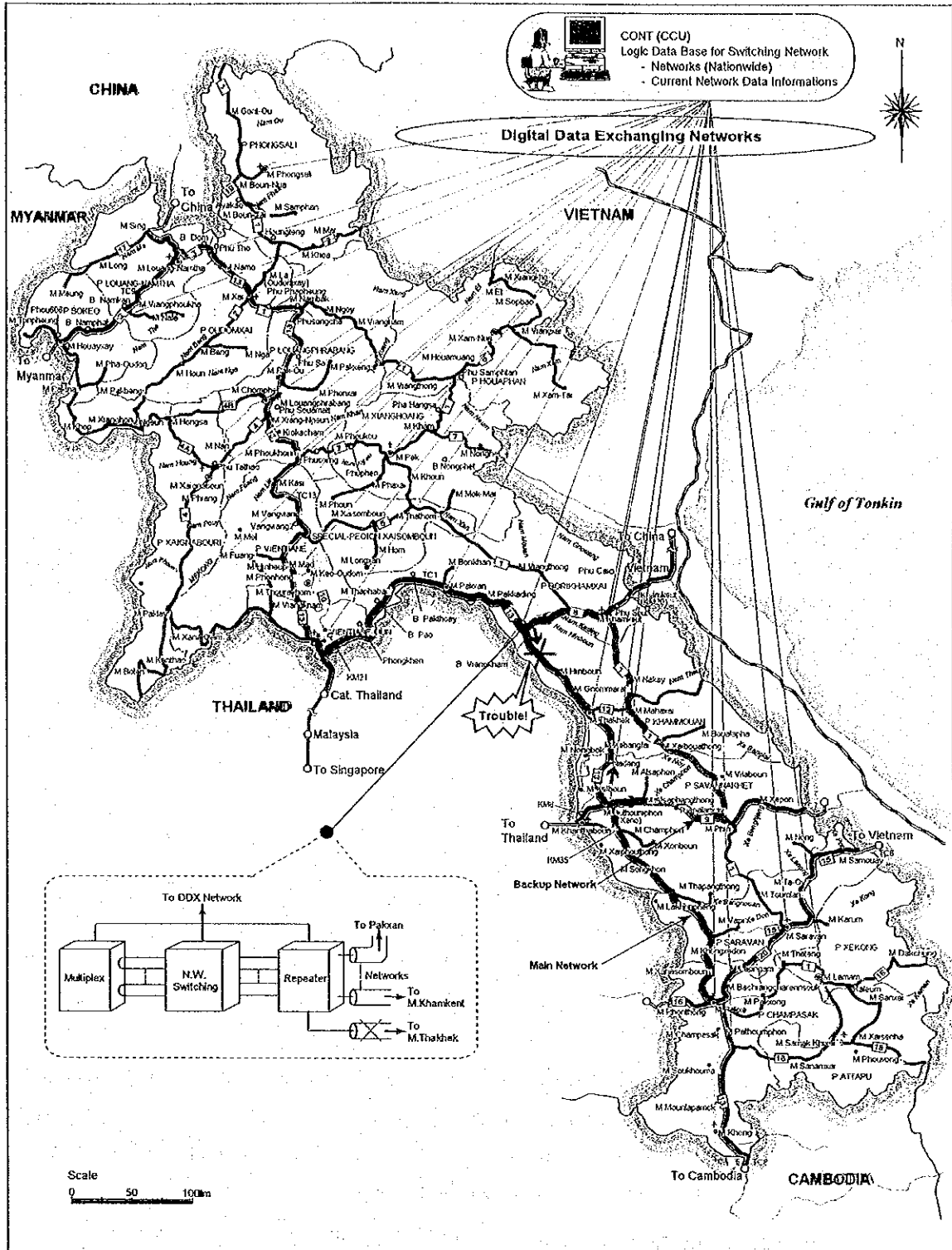


Fig. 9.3 Typical Route Switch for Main Network Trouble

9.3.3 Mobile Subscriber Telephone Network

The current situation of maintenance management structure in LTC has already organized a small maintenance team how to provide own facility. However, ETL is not yet a sufficient maintenance structure because of new establishment.

Therefore, the required maintenance section will propose to provide to provincial districts throughout the country, which require to set up minimum number of operation and maintenance sections at the least according with an expanding plan of 2002 to 2005, 2006 to 2010 and 2011 to 2015 respectively.

The detail of operation and maintenance is almost the same structure with the OFC transmission operation and maintenance, which is omitted for summarization of description.

9.3.4 Satellite Earth Transmission

The current situation of maintenance management ETL has already specified to the maintenance team how to provide own facility. Therefore, this description only provides usual routine procedures how to do it as reminders.

9.4 Outside Plant

As a whole, the maintenance activity is well carried out despite difficult situations.

9.4.1 Current Status of OSP Maintenance Activities

(1) Current operation

1. Daily fault repairing works
2. Restoration works of the damaged cables
3. Preventive Maintenance work

(2) Fault Occurrence

- 1) Because of outside facility, faults on primary cables, secondary cables and drop wires are dominant parts of trouble in telecommunications network. The causes are vehicle accident, excavator of road work, electrical short circuit, and lightning.
- 2) Major Faults in the Year 2001 are as follows;
 - Optical fiber cables were cut by excavators and auger machines - 6 times / Year, 2001.
 - The primary and secondary cables are cut by vehicle accidents - 20 times/ Year, 2001

- Electricity induction to cables and DP - 15 times / Year, 2001.
- 3) According to the information from maintenance center in Vientiane and other provincial offices, the percentage of the faults in the network portion at the drop wires is 80~90% (different by areas) .
 - 4) The existing fault ratio on subscriber network portion in Vientiane is monthly 4.92 faults per 100 subscribers (Nov.2001).
 - 5) The target criteria of the fault ratio have not been authorized.
 - 6) The target of the maximum time duration to complete repair work is not established.
 1. Recovery time exceeding three days is 87.1% of total faults in Nov. 2001.

Problem identified

- Drop wires are very close to the power line and sometimes the electricity induction damages telephone set and fuse in the MDF when two cables touch with each other. Even worse, sometimes subscriber line cards of telephone switch is damaged.
- It is observed that the long time for recovery is caused by the replacement of long portion of drop wire and complicated wiring.

9.4.2 Current status of OSP Maintenance Center

- (1) Maintenance staff are allocated in the following Centers;

- 1) Vientiane Center
- 2) Provincial Centers

Their working hour is 8 A.M. to 5 P.M.

- (2) Maintenance Tools, Testing Equipment

Fault locations are being performed by cut-and try method instead of measurement by fault locator or other testing equipment. Staff usually carries only megger (insulation resistance tester) and simple testers.

Problem identified

- Number of personnel is not enough compared with the number of faults.
- Human skills are not equal level and more training is needed.
- Shortage of proper tools causes many faults. It is observed that difficulties to provide the proper maintenance tools and test equipment are due to the financial problem.

9.5 Supporting Facilities

9.5.1 Network Management Centers

The enlargement of network and increase of complexity along with increasing importance of telecommunications services in the social and political activities requests higher reliability and survivability of the telecommunications networks.

When network expands, the rate of fault occurrence and traffic overload in some section of network because of natural disaster or special social or political events will happen more frequently.

For always keeping the health of the network, adequate network management facilities shall be implemented to international and national networks. The place having such facilities will be called as Network Management Center, and this kind of Centers for international and national networks shall be located in Vientiane.

The major functions of Centers are as follows;

- a) Network display indicating network trouble such as fault in transmission system and switching system or traffic overload.
- b) Automatic change of transmission route based on pre-installed program or manual change in the case of trouble occurrence in the transmission route.
- c) Adequate change of traffic flow within network by changing the route of connection for the case of unusual traffic increase or network trouble.
- d) Sometimes suppression of traffic becomes to be necessary. Technically various methods can be implemented.
- e) Communication or order transferring channel or facilities will be needed between Center and provincial and district O&M sites for national network management. Similar facilities will be also considered for international network.

Note: For better functioning, transmission system shall be loop configuration.

9.5.2 Telecommunication Management Network

The better management of network needs transfer of various information including present traffic information, charging information and other management related information. To facilitate such functions, ITU has been continuing the study of TMN for long years.

Lao P.D.R. shall consider the implementation of TMN in future, even though the

full configuration will not be considered.

9.5.3 OSP Maintenance Center

The almost all trouble for each subscriber occurs in outside plant including wiring inside subscriber's domicile. Therefore the maintenance of outside plant plays the important part to keep better QoS. A facility equipped with all testing, repairing, information storage as well as transporting facilities will lead to the efficient daily work for outside plant, This kind of concentrated facility is called as OSP Maintenance Center which is very successfully functioning in Indonesia. Beside above mentioned O&M organization, this kind of Center will be worth consideration.

CHAPTER 10

HUMAN RESOURCES DEVELOPMENT

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10.1 Current Situation of Human Resources in Relevant Organizations

(1) MCTPC

The major Official Tasks of telecommunication sectors in MPTPC counts 23 implemented by the telecommunication related divisions, DT and DRFM, counted only 11 staff including Directors. In terms of human resources, such two Divisions are obviously shortage in comparison with tasks both in quality and quantity.

In addition to such relatively excessive tasks, the Telecommunication Act promulgated in 2001 requests further more tasks for the Divisions. In the Act, staff is requested the expertise not only the technical aspect but also social and economic aspect as well as the basic knowledge of law and accounting. The new tasks, for example, are to study and define strategic plans for the development of telecommunications and to formulate policies, plans, programs, and projects and to obtain funding for the development of telecommunications¹. In addition, in the Act the Provincial and District officials of the CTPC are required the management and inspections in each area.

(2) ETL

ETL was established in 2000 so it posses only two years². The total number of employment counts at 126 personnel including the provincial staff.

ETL is composed of seven divisions; i.e. Administration Division, Finance & Accounting Division, Planning & Develop Division, Transmission Division, Switching Division, Customer Service Division, and Audit Division (there is no staff in 2001) and five provincial branches; Louang Prabang, Paksan, Thakhek, Savannakhek, and Champasak in 2001. Around 90 % of the total workers works in Vientiane headquarter. In the employment plan targeting 2005, the number of employers will be 536 and proportion of the province increase slightly.

(3) LTC

LTC, established in 1996, was a monopolistic telecommunication service provider until the establishment of ETL. Under the change of role as a player in the

¹ There is a Division of Planning and Budgeting in the Department but the Division is responsible for the preparation of financial information to submit Financial Department and for the conducting the budget plan.

² The ETL here is different from the former ETL, which was merged with Shinawatra to be LTC.

telecommunication market in Lao P.D.R, the number of employment is increasing slightly.

ETL is composed of 9 Department; Administration, Human Resources, Account, Finance, Corporate, Customers Services and Sales Promotion, Switching, Installation, Maintenance and Outside Plant, and Transmission & Mobile and 16 Provincial Branches.

The total number of staff counts 1,145 and 592 staff or 51% of the total work in head office in 2001. This proportion is much higher than that of ETL.

10.2 Current Situation of HRD

10.2.1 Training by LTC

The training by LTC except regarding dispatch to TCTI focuses on the short-term professional training not only in Vientiane but also in the various provinces. The training courses funded by LTC provided 24 times in 2000 of which 11 courses were technical training (average training period was 2.7 weeks) and 7 courses were management and billing system (average training period was 1 week) respectively. In total, around 300 staff participated to the courses.

In the first half year 2001, 10 courses are provided to the LTC Staff however the duration period in 2001 was shortened compared to the previous year.

10.2.2 Training provided by Training and Education Organizations

The supply of technical personnel for the telecommunication sector is carried out by TCTI under MCTPC and NUOL under MOE. TCTI aims to nurture the High Technician and Technician to mainly supply for the telecommunication sector. In parallel with such long-term training, it has been providing the short-term specialized courses aiming at upgrading the employees' skills.

NUOL is the only higher education organization in Lao P.D.R. There is a Faculty of Engineering including a Department of Mechanics, Electronics, Electric, and Architecture in NUOL relating to the telecommunication sector. NUOL, therefore, contributes to the telecommunication sector to provide the engineers.

(1) TCTI

The Telecommunication and Communication Training Institutes (TCTI) was established as the Post and Telecommunication Training Center (PTTC) initially in 1973. Since the establishment, TCTI (or PTTC) has been supplying around

80% of the senior technicians and technicians per annum to the telecommunication sector in Lao P.D.R.

The telecommunication division of TCTI has mainly the three subjects; Radio (including transmission), Switch, and Cable (Outside Plant) and 5 classes as shown in Table 10.6. As of June 2002, total number of trainees counts 172. In addition, 130 trainees are trained in the night class.

Table 10.6 Number of Trainees in TCTI in June 2002

	Radio		Telephone (Switch)		Cable
	High Technician	Technician	High Technician	Technician	Technician
1 st Year	-	23	29	-	23
2 nd Year	24	-	25	24	24
Total	24	23	54	24	47
Day Class	172				
Night Class	130				

Source: TCTI

The day-class trainees are dispatched by various organizations; 60% from LTC, 5 % from ETL, 2% from MCTPC, 8% from MOE, and other Governmental organizations.

The long-term curriculum as well as short-term courses, designed in the early 1990's in cooperation with ITU, should be revised or renewed to cope with the technological change. On the other hand, in TCTI all the courses included in the long-term and short-term curriculum didn't provide because of the several obstacles, such as shortage of training materials, equipment, instructors, and so on.

In the short-term courses, there are 4 units, namely 1) Radio Unit (9 titles), 2) Switching Unit (9 titles), 3) Management Unit (4 titles), and 4) Outside Plant (Cable) Unit (7 titles). The implementation of such titles (or courses) is not sufficient, especially the Management Unit is mostly in resting stage.

(2) NUOL

There are 10 Faculties and 11,740 students in NUOL, which is the only organization to provide the higher education in Lao P.D.R. The number of the enrolled students in each faculty is summarized as follows. Regarding to the administrative section in the telecom, Faculty of Economics & Management and that of Law & Administration might be the supplier. Since the average graduates from those faculties are around 60 and 200, the supply capacity is considered to be enough. Regarding to the technical personnel, the Faculty of Engineering & Architecture will supply engineers.

Table 10.8 Number of Enrolled Students in NUOL (2001)

Faculty		School of Foundation Students		Diploma and Bachelor (3-5Y)
		Year 1	Year 2	
1	Engineering & Architecture	1,721	1,402	3,180
2	Science			133
3	Agriculture			345
4	Forestry			537
5	Medical Science			*542
6	Education			192
7	Social Science			100
8	Philosophy			2,249
9	Economics & Management			291
10	Law & Administration			1,048
Sub-total		3,123		8,617
Total		11,740		

Note: * 3 to 6 Years

Source: NUOL

10.2.3 Overseas Training and Seminar

In Lao P.D.R., it is limited to access the up-dated technologies in the telecommunications. The telecommunication organizations, therefore, dispatch their staff for overseas in cooperation with foreign countries. In the year 2000, 27 personnel participated to the training overseas. Since the capabilities of the training institutes in Lao P.D.R. are quite limited, the participation to the overseas seminar and training are important to follow the technological change. On the other hand, the numbers of participants to them should be limited so the establishment of the efficient transfer system of the knowledge acquired at the training shall be required.

10.3 Demand and Supply of Human Resources

10.3.1 Demand of Telecommunication staff

Based on the estimates of the main lines, the required telecommunication human resources, especially technical staff, will be estimated. Since there is correlative between the teledensity and the number of main lines per telecommunication employment, the estimates are calculated to form the correlation function using the cross section data of 192 countries and region (ITU data). Since the result of partial test (extrapolation of the observed figure to the function) shows the over shooting in case of Lao P.D.R., the estimates are compensated. On the other hand, the capacity of the facilities such as switch will be satisfied around 60% of the

total demand in 2005 therefore the person engaged in the telecom sector will be reduced from the estimated figures (assessed by the microscopic approach)³.

Table 10.12 Estimates of Employment by Category

Year	Description	Technical				Finance, Accounting, Marketing & Administration			Total
		Manager	Engineers	Technician	Workers	Manager	Officers	Workers	
2005	Vientiane Municipality	72	150	365	40	71	292	40	1,030
	Provinces	90	92	407	45	68	142	26	870
	Total	162	242	772	84	139	434	67	1,900
2010	Vientiane Municipality	147	312	758	80	148	606	84	2,135
	Provinces	205	209	918	102	154	318	59	1,965
	Total	352	521	1,676	182	302	924	143	4,100
2015	Vientiane Municipality	206	430	1,047	110	205	837	115	2,950
	Provinces	307	313	1,378	154	231	479	88	2,950
	Total	513	743	2,425	264	436	1,315	204	5,900

Note: Study Team estimates.

10.3.2 Possibility to supply the required Personnel

(1) Technical Sector

Technician

TCTI, supplying the High technician and technician now, should be requested to continuously play a role to supply. Since the supply capacity of TCTI is considered, at most, as 100 technicians presuming the current situation, the supply capacity of technicians until 2005 is enough. The demand for the technicians from 2006 to 2015, on the other hand, will increase around 3 times compare to the former period so the enhancement of the TCTI is required.

Engineer

In the domestic, a supplier of the engineers will be NUOL, which will be able to supply engineers at least until the year 2005.

Manager

The managers will be nurtured by each organization through post-job training⁴.

³ The detail procedure of calculation is described in the chapter 7 in Supporting for Human Resource Development.

⁴ When the Manager will be promoted from the engineers or technicians the demand for engineers and technicians will increase.

(2) Administrative Section

The candidate officers and managers in quantity will be supplied by the existing organization such as NUOL.

10.4 Human Resources Development Plan

10.4.1 Capacity Building of MCTPC Staff

One of the most important issues for the MCTCP, especially Department of Post and Telecommunication, is to have a responsibility to implement the Telecommunication Law.

In order to carry out the responsibility, Department of Post and Telecommunication (especially Division of Telecommunication and that of Radio Frequency) is requested to increase the number of staff.

There are Department of Communication, Post, Transportation and Construction (DCPTC) in each Province to carry out the similar activities with MCTPC. In target year of 2015, the number of telephones in Provinces will be around 217,000 lines in fixed phones and 287,000 in cellular phones respectively so, from the point of view of customer protection and securing the competitiveness, the staff in provinces will be required. The strategy of enhancement of the staff in provinces is as follows:

i) Staff Distribution Plan

+ Criteria for staff assignment in Provinces: 1 staff per 10,000 lines

+ Target:

In 2005 Luangprabang (1), Khammuan (1), Savannakhet(2)

In 2010 Luangprabang (1), Khammuan (1), Savannakhet(3), and Champasak (2)

In 2015 Luangprabang (2), Vientiane (1), Khammuan (2), Savannakhet(4), and Champasak (3)

ii) Staff Nurturing Plan

+ Short-term and mid-term curriculum

+ Invitation of Candidates for transferring telecom section

+ Implementation

10.4.2 Enhancement strategy of TCTI

TCTI has an enough supply capacity until the year 2005 in quantity. From the year 2006, the demand for technical personnel will increase rapidly so the TCTI shall enhance its supply capacity. The strategy to enhance TCTI is summarized as follows:

(1) Short-term (to 2005)

- + Enhancement of existing Courses: Completely carrying out the Curriculum⁵
- + Implementation of Trainer's training abroad⁶
- + To prioritize the enhancing courses: To enhance the practical training of outside plant will be recommended (including the equipment).

(2) Mid-term (from 2006 to 2010)

- + Establishment of new training courses to correspond to the technological changes: e.g. LAN, IP
- + Installation of the training equipment⁷
- + Partially implementation of Trainer's Training in TCTI

(3) Long-term (from 2011 to 2015)

- + Fully implementation of Trainer's Training in TCTI

In addition to above the targets, TCTI shall make effort to solidify its financial bases. Currently the financial resources of TCTI are Government Subsidy and Tuition Fees and the financial bases are weak. TCTI shall make the provision of short- and mid-term training be a financial resource subject to enhance the ability of training.

10.4.3 Skill-up Training in ETL/LTC

LTC has been providing the short-term training for its employers both in Vientiane Municipality and Provinces. Regarding the training in 2001, the number of courses is almost same as previous year but the training period is declined. To expand the telephone lines and to diversify the telecom services both in Vientiane Municipality and each province will require ETL/LTC to provide more training

⁵ Please refer to the chapter 8 Proposed Curriculum in Supporting for Human Resource Development.

⁶ Regarding the trainer's Training, TCTI in cooperation with ITU dispatched its trainer to Malaysia to train the Switch (Fetex150) actually. To find the place to dispatch the trainers is required. The candidate sites will be Thailand, Vietnam, etc.

⁷ Please refer to chapter 9 Proposed Training Equipment in Supporting for Human Resource Development.

for their staff⁸. At least in the short-term, ETL/LTC will provide the practical training for the newly employed personnel. In the mid- and long-term, the skill-up training for the employment shall be required. Since the number of training courses will be increased (refer to foot note 15), out-sourcing of the training will be recommended.

Additionally the training for the administrative personnel is rather weak so the enhancement of such training will be required⁹.

⁸ In 2000, 25% of technical people except manager and worker joined to short-term training. If ETL/LTC will provide the short-term training as same level in 2000, ETL/LTC shall provide the technical training for 250 personnel in 2005, 550 personnel in 2010 and 800 personnel in 2015. In other words, the number of training courses will be 17 in 2005, 37 in 2010, and 53 in 2015 assuming the same number of attendant with in 2000. In addition, the training for administrative section will be required.

⁹ Examples of the management skill training are shown in chapter 6 Management Units (especially M3 and M4) in Supporting for Human Resource Development.

CHAPTER 11

FINANCIAL AND ECONOMIC EVALUATION

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11.1 Base Conditions

11.1.1 Capital Expenditure (CAPEX)

This chapter assesses financial and economic feasibility of the proposed investment during the period from 2004 to 2015 as discussed in Chapter 7 and in Chapter 8. The investment includes fixed phones, mobile phones, Internet¹, and the rural project from 2004 to 2015.

Two scenarios are set for the analysis. The first scenario is the case in which all the proposed investment is implemented from 2004 to 2015 (Table 11.1). The second scenario assumes implementation of all the projects from 2004 to 2010 and part of the proposed projects with the highest priority from 2011 to 2015 (Table 11.2 and Fig. 11.1).

Furthermore, the analysis is carried out in two levels in each scenario. The first level includes all the components while the second level excludes the investment on the mobile phones from the first level. The analysis on the second level is set in order to focus on the portion of the investment that is harder to receive investment from the private companies because of lower profitability.

The CAPEX in the first scenario is \$452 million (Table 11.3) while that in the second scenario is \$405 million (Table 11.4). Excluding the mobile phones, the CAPEX in the first scenario is \$293 million while that in the second scenario is \$250 million.

¹ The investment on the Internet is only for the IP network and does not include the facilities that are necessary as an internet service provider such as Web servers, proxy servers, and mail servers.

Table 11.1 First Scenario

	Base Data (Below numbers refer to the table and pages in the Main Report.)
Switch	Table 7.15, P.7-73
OSP	Table 7.15, P.7-73
Transmission	Table 7.14, P.7-67
IP	Table 7.19, P.7-92
Rural	P.8-16, P.8-17 (excluding the investment in 2003)
Mobile	Table 7.20, P.7-96

Table 11.2 Second Scenario

2004-2005	Same as 1 st Scenario
2006-2010	Same as 1 st Scenario
2011-2015	<p>All IP and rural investment plus following transmission system as well as adjacent switching, OSP, and mobile facilities:</p> <p>No. 18 M. Xaignabouri to M. Boten via M. Paklay (180 km)</p> <p>No. 19 M. Xanakham to Sylom (198 km)</p> <p>No. 20 M. Hinheup to M. Viangkham (90 km)</p> <p>No. 21 M. Paklay to Xanakham (36 km)</p> <p>No. 24 M. Xam-Nua to M. Xam-Tai (108 km)</p> <p>No. 25 M. Kham to M. Nonghet (45 km)</p> <p style="text-align: right;">(See Fig. 11.1)</p>

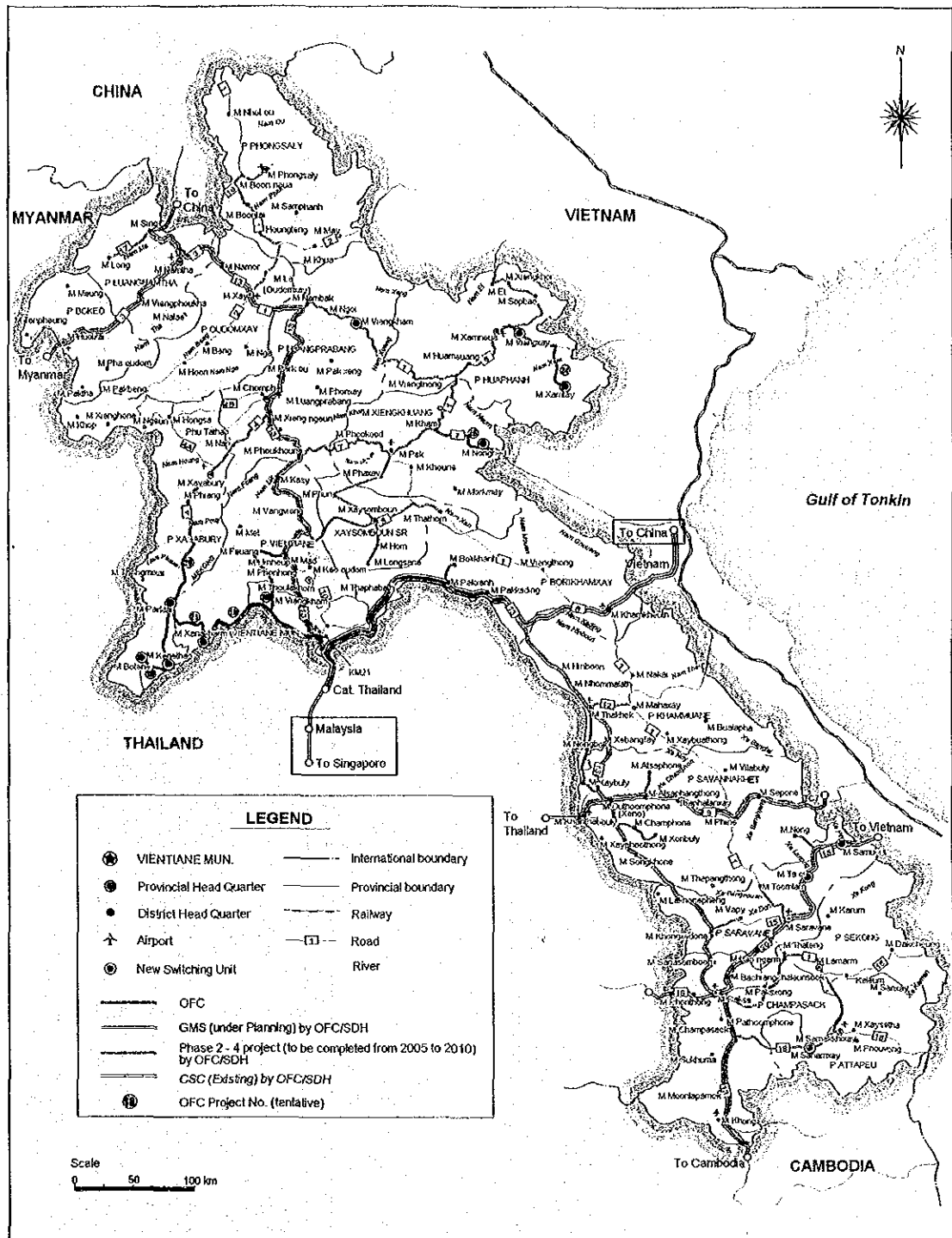


Fig. 11.1 Second Scenario (2011-2015)

Table 11.3 CAPEX (1st Scenario)

(Unit: Thousand US \$)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Swich	3,245	572	6,045	7,635	2,799	4,383	5,132	5,790	5,468	3,785	4,545	4,181	53,578
OSP	6,663	1,174	12,412	15,677	5,747	9,000	10,537	11,889	11,227	7,771	9,332	8,584	110,013
Transmission	21,735	11,490	1,839	1,839	1,839	1,839	1,839	9,690	9,690	9,690	9,690	9,690	90,870
IP	3,363	3,363	779	779	779	779	779	1,005	1,005	1,005	1,005	1,005	15,646
Rural	1,480	1,480	1,776	1,776	1,776	1,776	1,776	2,220	2,220	2,220	2,220	2,220	22,940
Subtotal	36,485	18,079	22,851	27,706	12,940	17,777	20,062	30,594	29,609	24,470	26,793	25,680	293,046
Mobile	14,580	13,851	11,664	5,103	11,664	5,832	8,748	14,580	14,580	5,103	29,160	24,057	158,922
Total	51,065	31,930	34,515	32,809	24,604	23,609	28,810	45,174	44,189	29,573	55,953	49,737	451,968

Table 11.4 CAPEX (2nd Scenario)

(Unit: Thousand US \$)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Swich	3,245	572	6,045	7,635	2,799	4,383	5,132	5,393	5,237	3,507	3,935	4,091	51,971
OSP	6,663	1,174	12,412	15,677	5,747	9,000	10,537	11,073	10,752	7,201	8,079	8,399	106,714
Transmission	21,735	11,490	1,839	1,839	1,839	1,839	1,839	1,971	1,971	1,971	1,971	1,971	52,275
IP	3,363	3,363	779	779	779	779	779	1,005	1,005	1,005	1,005	1,005	15,646
Rural	1,480	1,480	1,776	1,776	1,776	1,776	1,776	2,220	2,220	2,220	2,220	2,220	22,940
Subtotal	36,485	18,079	22,851	27,706	12,940	17,777	20,062	21,661	21,185	15,904	17,209	17,686	249,546
Mobile	14,580	13,851	11,664	5,103	11,664	5,832	8,748	14,333	14,148	4,888	27,598	22,863	155,272
Total	51,065	31,930	34,515	32,809	24,604	23,609	28,810	35,995	35,332	20,792	44,808	40,549	404,818

11.1.2 Beneficiaries

The beneficiaries of the investment are all the new telecommunication subscribers from 2004 to 2015. The number of the subscribers for the fixed phones is set at the lower value between the demand and the supply in the respective province. For the mobile phones and Internet, 100% of the demand as forecasted in Chapter 4 is assumed to be supplied by the end of each year (Table 11.5)².

Table 11.5 Number of Subscribers at the End of the Year

	Fixed Phones		Mobile Phones		Internet	
	1st Scenario	2nd Scenario	1st Scenario	2nd Scenario	Dial up	ADSL
2003	93,950		50,900		7,592	0
2004	114,801		77,460		10,559	500
2005	135,164		120,210		15,402	750
2006	144,437		141,552		18,689	824
2007	194,385		167,024		22,712	905
2008	212,537		197,535		27,647	994
2009	242,984		234,243		33,718	1,092
2010	278,199		278,615		41,209	1,200
2011	304,678	303,336	330,400	324,810	49,827	1,342
2012	335,266	333,463	392,290	380,655	60,300	1,501
2013	366,437	363,017	466,412	446,718	73,043	1,679
2014	398,846	390,798	555,376	525,629	88,570	1,878
2015	438,177	427,727	662,410	629,545	107,514	2,100

11.2 Result

11.2.1 Financial Evaluation

The aim of the financial analysis is to assess the financial feasibility of the project while Financial Internal Rate of Return (FIRR) is an indicator to estimate the level of return from the investment in the given period. Because the telecommunication service has public characteristics, cut off line of the FIRR in deciding whether to implement or not to implement the project should be decided in conjunction with the social and economic needs of the society.

The first scenario that implements all the plan results in FIRR at 19.9%. On the other hand, the first scenario that excludes mobile phone results in FIRR at 9.3%. Higher price setting and cheaper cost of the mobile phones as compared to the fixed phones caused the higher FIRR if calculated with the mobile phones.

² The fixed phones and the mobile phone subscribers include the users in the rural area.

In spite of the reduction of CAPEX by more than 10%, the second scenario does not contribute to a big leap of FIRR. FIRR with the mobile phone is estimated at 20.3% while FIRR without the mobile phone is at 10.2%. These results show that inclusion of the mobile phones in business increases the financial stability.

11.2.2 Sensitivity Analysis of FIRR

Sensitivity analysis is conducted in each scenario in response to the change in revenue, which affects change in OPEX, tax, and working capital (Fig. 11.2). It is assumed that the same ratio of the revenue is changed against the base case in each year. The amount of CAPEX is kept constant. FIRR drops to 10% when the revenue is decreased by 32% in the first and 33% in the second scenario if calculated with the mobile phones. Since the assumed number of the subscriber is almost the same as the supplied capacity in the base case, earning lower revenue than the base case may well be expected.

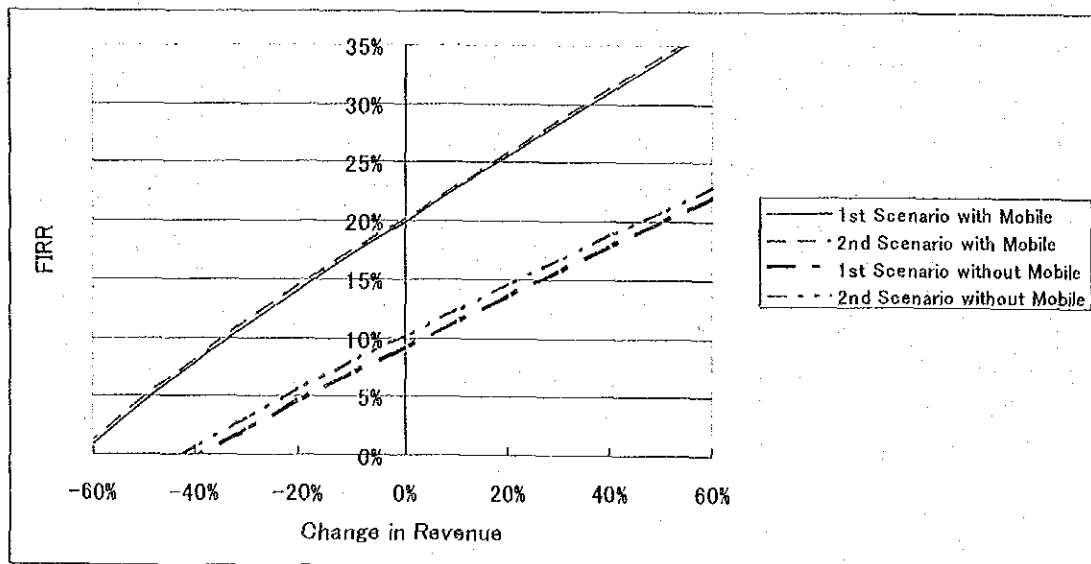


Fig. 11.2 Sensitivity Analysis of FIRR on the Change in Revenue

Secondly, the effect of the change in the number of the mobile subscribers is shown in Fig. 11.3. It is assumed that the same ratio of the subscribers is changed as compared to the base case in each year. Contrary to the analysis in Fig. 11.2, the amount of the supply is changed in accordance with the number of the subscribers. The rapid growth of the demand towards the mobile phones in recent years makes the prediction of the future demand difficult. This analysis is to check the effect of the change in the mobile subscribers on FIRR. The point at minus 100% along x-axis represents the analyses without the mobile phones in the

base case. Regardless of the number of the subscribers, investment on the mobile phone in addition to other telecommunication services is predicted to contribute to increase in FIRR.

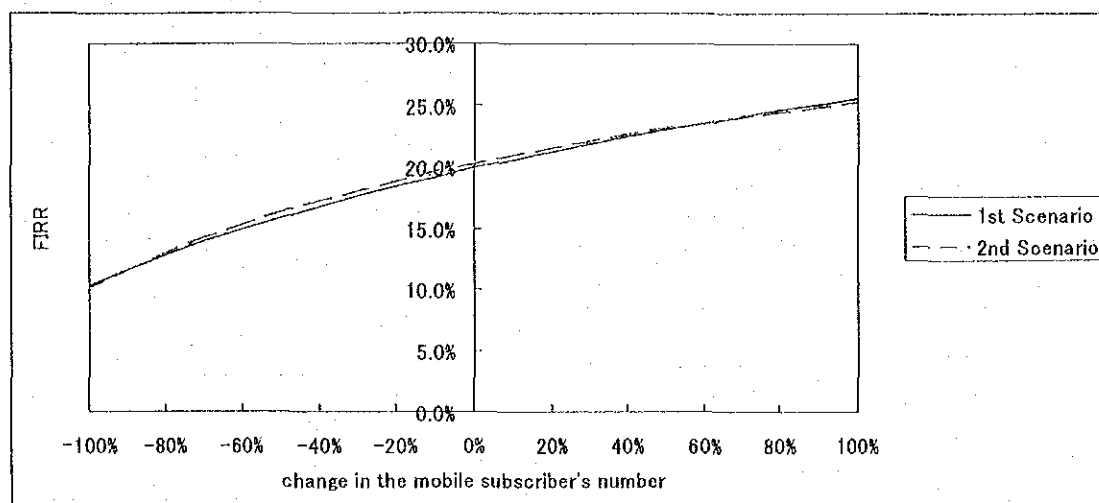


Fig. 11.3 Sensitivity Analysis of FIRR on the mobile phone subscribers

Furthermore, Table 11.6 shows the effect on FIRR by changing some major assumptions. FIRR estimated with the mobile phones shows stable result regardless of changes in the major assumptions. The most sensitive change in assumption is the monthly charge of the fixed phones. If the monthly charge stays constant at 10,000 kip, FIRR calculated without the mobile phones becomes 5.3% in the first scenario and 6.3% in the second scenario. Secondly, borrowing the long-term loan at the rate offered by the domestic bank to cover all the cash shortage results in FIRR at 6.6% in the first scenario and at 7.7% in the second scenario, which are calculated without the mobile phones. In reality, the shortage of the cash flow is likely to be covered not only by the commercial borrowing but also by earnings from without-project, ie. earnings before 2004, earnings from the Internet service, as well as foreign aid. Therefore, the total amount of interest is expected to be lower than 8.5% of the total amount of the cash shortage.

Table 11.6 Sensitivity Analysis of FIRR on the Major Assumptions

Inserted Variable	FIRR			
	with mobile phones		without mobile phones	
	1 st Scenario	2 nd Scenario	1 st Scenario	2 nd Scenario
Base Case	19.9%	20.3%	9.3%	10.2%
1) Monthly Charge of Fixed Phones				
increased to 80,000 kip by 2010	21.1%	21.5%	11.7%	12.6%
increased to 50,000 kip by 2010	Base Case			
remains constant (10,000 kip)	18.2%	18.6%	5.3%	6.3%
2) Ratio of the internet access charge shared with the internet service provider				
70% of the customer's payment	20.6%	21.0%	10.5%	11.5%
50% of the customer's payment	Base Case			
30% of the customer's payment	19.3%	19.6%	7.8%	8.8%
3) Economic life time of equipment				
IP 5 years Switching, Mobile 8 years Transmission and Rural 10 years Outside Plant 11 years	Base Case			
IP 5 years Switching, Mobile, Transmission and Rural 8 years Outside Plant 11 years	19.3%	19.9%	8.4%	9.6%
4) Loan Condition				
Interest rate 2.75% Repayment Period 8 years Grace Period 2 years (condition in Phase I)	20.9%	21.3%	10.6%	11.5%
Interest rate 5.0% Repayment Period 8 years Grace Period 2 years (borrowed from abroad)	Base Case			
Interest rate 8.5% Grace Period 1 year Repayment Period 10 years (borrowed domestically)	18.3%	18.7%	6.6%	7.7%

11.2.3 Economic Evaluation

The purpose of the economic analysis is to encourage efficient use of the national resources. Economic Internal Rate of Return (EIRR) is used to measure the return on investment, i.e. economic cost, from the viewpoint of the national resources.

Following tables show the result of EIRR calculations. Similar to FIRR, EIRR with the mobile phones shows much higher figure than that without the mobile phones, and EIRR between the first and the second scenarios do not show much difference.

The first scenario that implements all the plan results in EIRR at 35.5%. On the other hand, the first scenario that excludes mobile phone results in EIRR at 21.4%. In the second scenario, EIRR with the mobile phone is estimated at 35.8% while EIRR without the mobile phone is at 22.4%.

All results show high EIRR that certify importance of the proposed telecommunication development plan for the economic benefit of Lao P.D.R..

11.2.4 Sensitivity Analysis on EIRR

Sensitivity analysis is conducted in each scenario in response to the change in economic benefit, which affects change in OPEX (Fig. 11.4). If calculated with the mobile phones, EIRR drops to 10% when the economic benefit is decreased by 45% in the first scenario and by 46% in the second scenario. Excluding the mobile phones, EIRR drops to 10% when the economic benefit is decreased by 26% in the first scenario and 28% in the second scenario. This certifies that inclusion of the mobile phones in the development plan is beneficial not only for the financial stand point but also for the economic benefit of Lao P.D.R..

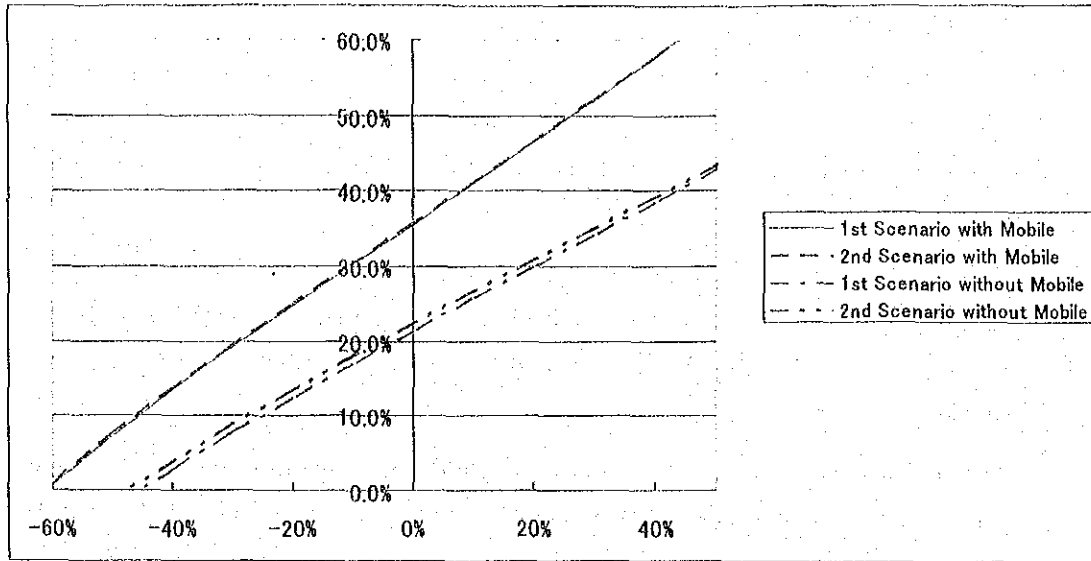


Fig. 11.4 Sensitivity Analysis of EIRR on the Change in Economic Benefit

Furthermore, Table 11.7 shows the effect on EIRR by changing the major assumptions as indicated in Table 11.6. Change in one assumption does not jeopardize the economic feasibility of the project. Especially if considered together with the mobile phones, the economic benefit of the proposed project is highly stable.

Table 11.7 Sensitivity Analysis of EIRR on the Change in Major Assumptions

Inserted Variable	EIRR			
	with mobile phones		without mobile phones	
	1 st Scenario	2 nd Scenario	1 st Scenario	2 nd Scenario
Base Case	35.5%	35.8%	21.4%	22.4%
1) Monthly Charge of Fixed Phones				
increased to 80,000 kip by 2010	36.8%	37.1%	24.1%	25.1%
increased to 50,000 kip by 2010	Base Case			
remains constant (10,000 kip)	33.6%	33.9%	17.0%	18.2%
2) Ratio of the internet access charge shared with the internet service provider				
70% of the customer's payment	36.5%	36.8%	23.1%	24.2%
50% of the customer's payment	Base Case			
30% of the customer's payment	34.6%	34.9%	19.4%	20.5%
3) Economic life time of equipment				
IP 5 years Switching, Mobile 8 years Transmission and Rural 10 years Outside Plant 11 years	Base Case			
IP 5 years Switching, Mobile, Transmission and Rural 8 years Outside Plant 11 years	34.7%	35.2%	20.5%	21.7%
4) Loan Condition				
Interest rate 2.75% Repayment Period 8 years Grace Period 2 years (condition in Phase I)	37.3%	37.6%	23.3%	24.3%
Interest rate 5.0% Repayment Period 8 years Grace Period 2 years (borrowed from abroad)	Base Case			
Interest rate 8.5% Repayment Period 10 years Grace Period 1 year (borrowed domestically)	39.5%	39.8%	25.6%	26.5%

11.2.5 Result Summary

The result of the financial and economic evaluation is summarized in the Table 11.8. Due to higher profitability of the mobile phones as explained by the price setting and lower investment cost, inclusion of the mobile phones in the business model relieves the financial constraints. With inclusion of the mobile phones, nearly three quarters of the investment is expected to be covered by earnings. On the other hand, without the mobile phones, only half of the investment is estimated to be covered by earnings unless the charges for the fixed phones are raised higher. From the economic point of view, the proposed telecommunication development is beneficial both with and without mobile phones.

Table 11.8 The Result of the Evaluation

	1 st scenario			2 nd scenario		
Assumption	All the proposed plan is to be carried out.			The lower priority projects from 2011 to 2015 are omitted from the first scenario. (Table 11.2 and Fig. 11.1)		
Targeted Subscribers	Fixed	Year	Subscribers	Fixed	Year	Subscribers
		2005	135,164		2005	Same as 1 st Scenario
		2010	278,199		2010	Same as 1 st Scenario
		2015	438,177		2015	427,727
	Mobile	2005	120,210	Mobile	2005	Same as 1 st Scenario
		2010	278,615		2010	Same as 1 st Scenario
		2015	662,410		2015	629,545
	Internet	2005	16,152	Internet	Same as Scenario 1	
		2010	42,409			
		2015	109,614			
CAPEX	Switch	\$54 million		Switch	\$52 million	
	OSP	\$110 million		OSP	\$107 million	
	Transmission	\$91 million		Transmission	\$52 million	
	IP	\$16 million		IP	\$16 million	
	Rural	\$23 million		Rural	\$23 million	
	Subtotal	\$293 million		Subtotal	\$250 million	
	Mobile	\$159 million		Mobile	\$155 million	
	Total	\$452 million		Total	\$405 million	
FIRR	with mobile phones	19.9%		with mobile phones	20.3%	
	without mobile phones	9.3%		without mobile phones	10.2%	
EIRR	with mobile phones	35.5%		with mobile phones	35.8%	
	without mobile phones	21.4%		without mobile phones	22.4%	
Estimated Required Long-term Loan	with mobile phones	\$113 million (cash shortage until 2007)		with mobile phones	\$111 million (cash shortage until 2007)	
	without mobile phones	\$131 million (cash shortage until 2011)		without mobile phones	\$113 million (cash shortage until 2010)	

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