

社会開発調査部報告書

No. 122

A MASTER PLAN STUDY  
ON TELECOMMUNICATIONS DEVELOPMENT  
IN THE KINGDOM OF THAILAND

A MASTER PLAN STUDY  
ON  
TELECOMMUNICATIONS DEVELOPMENT  
IN  
THE KINGDOM OF THAILAND

DECEMBER 1989

Dec. 1989

JICA

JAPAN INTERNATIONAL COOPERATION AGENCY

122  
78.6  
SSS

SSS
CR(5)
89-144

**A MASTER PLAN STUDY**  
**ON**  
**TELECOMMUNICATIONS DEVELOPMENT**  
**IN**  
**THE KINGDOM OF THAILAND**

JICA LIBRARY



1078936101

20362

**DECEMBER 1989**

**JAPAN INTERNATIONAL COOPERATION AGENCY**



国際協力事業団

20362

## PREFACE

In response to a request from the Government of the Kingdom of Thailand, the Government of Japan decided to conduct a study on the Master Plan of Telecommunications Development in the Kingdom of Thailand and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent to Thailand a survey team headed by Mr. Takao Iwashimizu, NTT International Corporation from October to December, 1988 and from March to June, 1989.

The team held discussions with officials concerned of the Government of Thailand, and conducted field surveys. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincerest appreciation to the officials concerned of the Government of the Kingdom of Thailand for their close cooperation extended to the team.

December, 1989



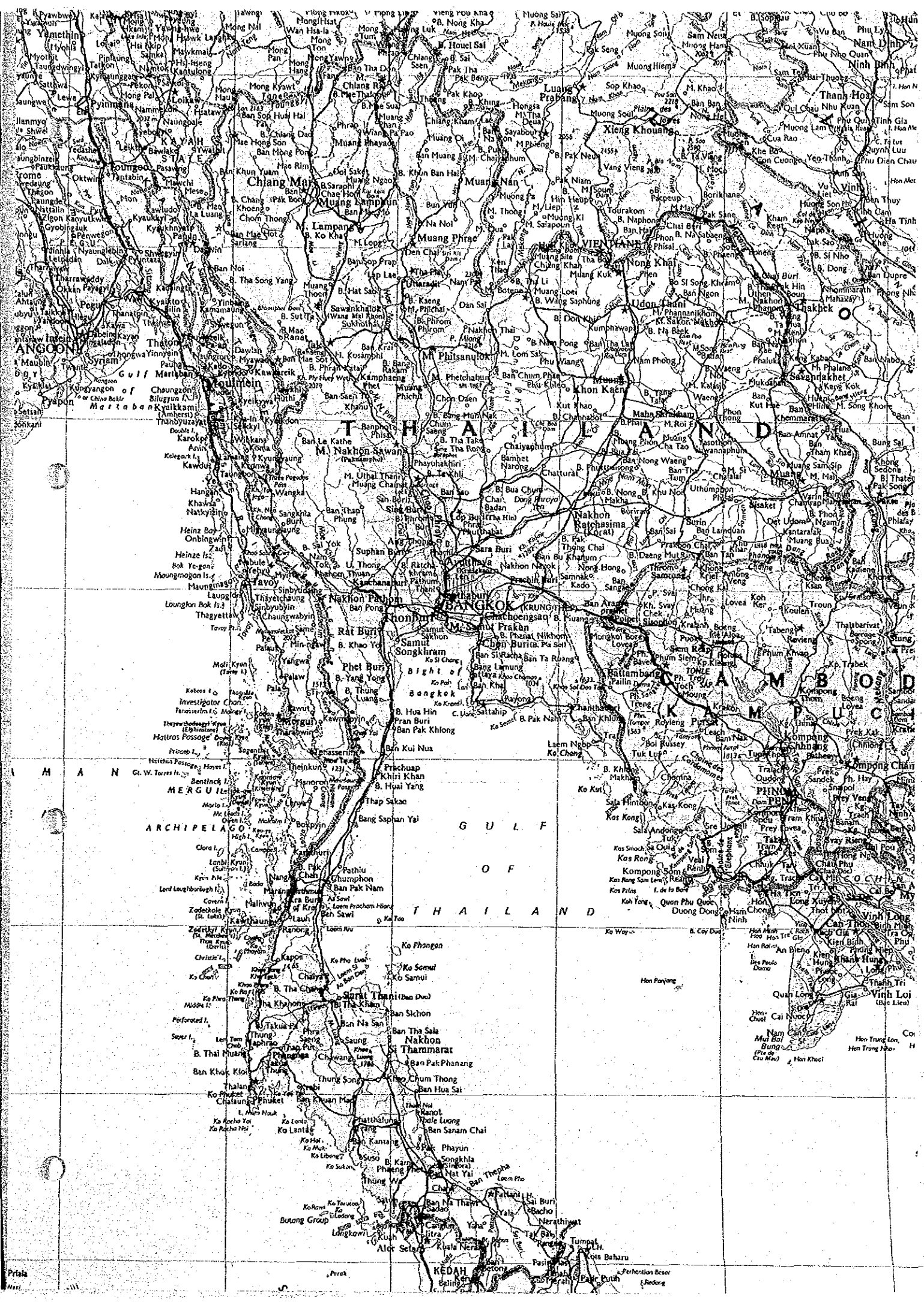
---

Kensuke Yanagiya

President

Japan International Cooperation Agency







## CONTENTS

	<u>Page</u>
CHAPTER 1. INTRODUCTION .....	1-1
1.1 Composition of the Study Report.....	1-1
1.2 Background of the Study .....	1-1
1.3 Purpose of the Study .....	1-2
1.4 Formulating Procedure of the Master Plan.....	1-2
1.5 Execution Process of the Study .....	1-4
1.6 Organization for the Study.....	1-5
1.6.1 Japanese Team Members.....	1-5
1.6.2 Thai Officers.....	1-8
CHAPTER 2. PRESENT STATE OF TELECOMMUNICATIONS IN THAILAND.....	 2-1
2.1 Past and Present Socio-Economic Situations.....	2-1
2.1.1 General Socio-economic Trend before the Sixth National Economic and Social Development Plan (1961 - 1986).....	 2-1
2.1.2 The Sixth National Economic and Social Development Plan .....	2-16
2.2 Present State of Telecommunication Services in Thailand.....	2-28
2.2.1 State of Telecommunication Services in Some Countries .....	2-28
2.2.2 Services Classified by Organizations .....	2-30
2.2.3 Services Offered by TOT .....	2-36
2.2.4 Services Offered by CAT .....	2-46
2.3 Present State of Telecommunication Facilities.....	2-57
2.3.1 Switching Facilities .....	2-57
2.3.2 Transmission Facilities .....	2-68
2.3.3 Outside Plant Facilities .....	2-80
2.3.4 Cellular Mobile Facilities.....	2-85
2.3.5 Leased Circuit Facilities .....	2-92
2.3.6 Outline of Existing Expansion Projects.....	2-93
2.3.7 Present State of Maintenance Activities.....	2-97
2.4 Existing Management Situation of the Operating Entity (TOT).....	2-109
2.5 Present Situations of Each Telecommunication Area in TOT.....	2-119
2.5.1 Criteria of the Analysis .....	2-119
2.5.2 Result of the Analyses.....	2-121



	<u>Page</u>
<b>CHAPTER 3. PROSPECTS OF SOCIO-ECONOMIC DEVELOPMENT AND THE ROLES OF TELECOMMUNICATIONS .....</b>	3-1
3.1 Prospects of Socio-Economic Development in Thailand.....	3-1
3.1.1 Industrial Outlooks and Policies.....	3-1
3.1.2 The Spatial Policies and Regional Outlooks .....	3-4
3.1.3 Socio-economic Situations of the Next 20 Years.....	3-10
3.2 Roles and Significance of Telecommunications for Socio-Economic Development in Thailand.....	3-14
3.2.1 Roles of Information in Information Society .....	3-15
3.2.2 Telecommunications Services in an Information Society and Prospects of Thailand.....	3-20
3.2.3 An Econometric Analysis of Telecommunications Investment Effects in Thailand.....	3-20
3.3 Future Trend of Telecommunication Technologies and Services .....	3-27
3.3.1 Evolution of Telecommunication Network.....	3-27
3.3.2 Technological Progress.....	3-28
3.3.3 Future Services.....	3-30
<b>CHAPTER 4. DEMAND FORECAST .....</b>	4-1
4.1 Telephone Service .....	4-1
4.1.1 Telephone Service Subscription Demand .....	4-1
4.1.2 Network Services on the Telephone Network.....	4-12
4.1.3 Terminal Connection Service to the Telephone Network.....	4-14
4.2 Mobile Communication Service.....	4-18
4.2.1 Cellular Mobile Service.....	4-19
4.2.2 Paging Service.....	4-25
4.3 Leased Circuit Service & Data Communication Service.....	4-28
4.3.1 Basic Transmission Service.....	4-28
4.3.2 Message Handling Systems (MHS) .....	4-38
4.4 Recorded Communication Service.....	4-41
4.4.1 Recorded Communication Service for Public Use.....	4-41
4.4.2 Recorded Communication Service for Private Use .....	4-44
4.4.3 Facsimile Store & Forward System.....	4-46
4.5 Video Communication Service .....	4-48
4.5.1 Videotex Service .....	4-48
4.5.2 Other Video Communication Services.....	4-53
4.6 ISDN Subscription .....	4-54

	<u>Page</u>
CHAPTER 5. OBJECTIVES AND STRATEGIES OF TELECOMMUNICATIONS DEVELOPMENT.....	5-1
5.1 Present and Future Points at Issue in TOT.....	5-1
5.1.1 Large Amounts of Waiting Applicants & Remaining Non-Telephone Communities.....	5-1
5.1.2 Insufficient Telecommunication Services .....	5-2
5.1.3 Less Reliable Telecommunication Network.....	5-2
5.1.4 Under-utilization of Telephone Traffic Data .....	5-2
5.1.5 Shortage of Management Resources.....	5-3
5.2 Long-Range Development Objectives .....	5-3
5.3 Development Strategies and Targets.....	5-3
5.3.1 Fulfillment of National Telephone Demand.....	5-4
5.3.2 Upgrade of Service Qualities .....	5-5
5.3.3 Diversification of Services .....	5-6
5.3.4 Improvement of Management.....	5-7
5.4 Strategy Formation and Execution.....	5-10
5.5 Effects Produced through Implementation of the Master Plan.....	5-11
 CHAPTER 6. TRAFFIC FORECAST.....	 6-1
6.1 Telephone Service .....	6-1
6.1.1 PC - PC Traffic Matrix Forecast .....	6-1
6.1.2 Traffic Matrix Forecast in Bangkok Multi-Exchange Area.....	6-11
6.2 Cellular Mobile Service .....	6-16
6.3 Other Services.....	6-18
6.3.1 Diversification of Services and Enhancement of Networks.....	6-21
6.3.2 Traffic Features.....	6-22
6.3.3 Traffic Measurement.....	6-24
6.3.4 Traffic Theory and Traffic Forecast.....	6-25
 CHAPTER 7. TELECOMMUNICATION NETWORK PLAN.....	 7-1
7.1 Fundamental Network Plan.....	7-1
7.1.1 Network Configuration.....	7-1
7.1.2 Numbering Plan.....	7-7
7.1.3 Signalling Plan .....	7-21
7.1.4 Network Synchronization.....	7-36
7.2 Engineering Standard.....	7-43
7.2.1 Introduction.....	7-43

	<u>Page</u>
7.2.2 Present State of Engineering Standard.....	7-43
7.2.3 Engineering Standard Plan to be Recommended.....	7-45
7.3 Introduction of ISDN.....	7-53
7.3.1 General.....	7-53
7.3.2 Introduction Plan.....	7-62
7.4 Network Management.....	7-77
7.4.1 General.....	7-77
7.4.2 Switching Management.....	7-78
7.4.3 Transmission Network Management.....	7-84
7.4.4 Local Network Management.....	7-97
7.4.5 Integrated Network Management System.....	7-100
CHAPTER 8. TELECOMMUNICATION FACILITY EXPANSION PLAN.	8-1
8.1 Expansion Plan.....	8-1
8.1.1 Expansion Objectives and Design Principles.....	8-1
8.1.2 Telephone Installation Schedule.....	8-2
8.1.3 Outline of the Expansion Plan.....	8-14
8.1.4 Local Cable and Switching Facilities.....	8-16
8.2 Switching Facilities.....	8-20
8.2.1 Expansion Plan.....	8-20
8.2.2 Economic Comparison of Installing RSU in Metropolitan Area.....	8-24
8.2.3 Replacement Plan of Analog Facility.....	8-34
8.2.4 Replacement Plan of Existing SPC.....	8-40
8.2.5 Management of Floor Plan for Exchange.....	8-42
8.2.6 Network Services.....	8-50
8.3 Transmission Facilities.....	8-53
8.3.1 General.....	8-53
8.3.2 Long Distance Transmission System.....	8-53
8.3.3 Spur Route Transmission Systems.....	8-60
8.3.4 Metropolitan Junction Transmission System.....	8-61
8.3.5 Satellite Communication System.....	8-63
8.3.6 Enhancement of Network Reliability.....	8-71
8.3.7 Diversification of Services.....	8-79
8.3.8 Replacement of Existing Analog Facilities.....	8-82
8.4 Local Cable Facilities.....	8-85
8.4.1 Expansion Plan of Local Cable.....	8-85

	<u>Page</u>
8.4.2 Public Telephone.....	8-90
8.4.3 Rehabilitation Plan of Local Cable and Wire.....	8-91
8.4.4 Digital Transmission System .....	8-93
8.4.5 Judgement of Installation Limit for Primary Cable.....	8-93
8.5 Mobile Communication Facilities .....	8-96
8.5.1 Cellular Mobile Facilities.....	8-96
8.5.2 Paging Facilities.....	8-97
8.6 Leased Circuit & Data Communication Facilities .....	8-98
8.6.1 Basic Transmission .....	8-98
8.6.2 Message Handling System.....	8-99
8.7 Other Facilities .....	8-100
8.7.1 Facsimile Store & Forward System.....	8-100
8.7.2 Videotex System .....	8-100
CHAPTER 9. FINANCIAL ANALYSIS.....	9-1
9.1 Objective and Methodology of Financial Analysis.....	9-1
9.1.1 Introduction.....	9-1
9.1.2 Identification of the Project .....	9-1
9.2 Revenue Estimation.....	9-4
9.2.1 Telephone Installation Schedule.....	9-4
9.2.2 Installation Charge and Monthly Charge .....	9-6
9.2.3 Local Call Charge .....	9-8
9.2.4 Trunk Call Revenue Estimation .....	9-18
9.2.5 Other Revenues.....	9-27
9.2.6 Deposit .....	9-27
9.2.7 Public Telephone Revenue.....	9-27
9.2.8 Total Revenue Estimation .....	9-31
9.3 Cost Estimation .....	9-35
9.3.1 Installation Cost Estimation.....	9-35
9.3.2 Working Capital.....	9-39
9.3.3 Working Cost Estimation .....	9-40
9.3.4 Tax Estimation.....	9-44
9.4 Financial Cash Flow.....	9-46
9.4.1 Financial Cash Flow without Borrowing .....	9-46
9.4.2 Financial Cash Flow with Borrowings.....	9-48
9.5 Sensitivity Analyses.....	9-52

	<u>Page</u>
CHAPTER 10. ECONOMIC ANALYSIS .....	10-1
10.1 Production Function Approach.....	10-1
10.2 Economic Evaluation of the Project.....	10-2
CHAPTER 11. FINANCIAL MANAGEMENT.....	11-1
11.1 Financial Forecasts .....	11-1
11.1.1 Case A: Pessimistic Future.....	11-3
11.1.2 Case B: Optimistic Future.....	11-9
11.1.3 Case C: Moderate Future.....	11-14
11.1.4 Revised Case C.....	11-19
11.1.5 Case D: Postponed Replacement Schedule.....	11-24
11.1.6 Case E: Tariff Increase .....	11-30
11.1.7 Debt Service of Each Case .....	11-36
11.2 Measures to Improve Financial Position .....	11-38
11.2.1 Financial Policy .....	11-38
11.2.2 Fund Management .....	11-38
11.2.3 Remittance to the Treasury.....	11-39
11.2.4 Depreciation.....	11-39
11.2.5 Tariff.....	11-41
11.2.6 Marketing and Customer Relations .....	11-42
11.2.7 Increase General Work Efficiency .....	11-43
11.3 Another Alternative Measures to Ease the Cash-flow Problems .....	11-43
CHAPTER 12. HUMAN RESOURCE MANAGEMENT.....	12-1
12.1 Human Resources .....	12-1
12.1.1 The Required Number of Staff and Human Resources Management Policy.....	12-1
12.1.2 The Number of TOT Staff in the Fiscal Year of 2007 .....	12-7
12.2 Organization .....	12-9
12.2.1 Shifting More Authority and Responsibilities to the Telecommunications Area Authorities.....	12-10
12.2.2 Introduction of Profit and Cost Center System.....	12-11
12.3 Human Development .....	12-12
12.3.1 Development of Professional Staff.....	12-12
12.3.2 Needs of Additional Training Centers .....	12-14
12.3.3 Human Resources Development Programs.....	12-16

	<u>Page</u>
12.4 Promotion and Compensation System .....	12-17
12.4.1 Promotion System .....	12-17
12.4.2 Compensation System.....	12-19
12.5 Recommendations .....	12-20
CHAPTER 13. IMPLEMENTATION OF THE MASTER PLAN.....	13-1
13.1 Guidelines for the Project Implementation.....	13-1
13.1.1 Key Points on Giving Priority Order to the Strategies.....	13-1
13.1.2 Assignment of Strategies to the Area .....	13-1
13.1.3 Project Implementation Programs in the Long Range Period.....	13-8
13.1.4 Project Implementation Programs in Phase-1.....	13-8
13.2 Guidelines for Upgrade of Service Qualities .....	13-11
13.2.1 Present Situation of Outside Plant Facilities in Thailand .....	13-12
13.2.2 On-Going Rehabilitation Project of Outside Plant in TOT .....	13-12
13.2.3 Introduction of Maintenance Control System.....	13-12
13.2.4 Control by Plant Control Value.....	13-15
13.2.5 Deteriorated Plant Control System .....	13-16
13.2.6 Recommendation for Implementation of the Improvement Plan.....	13-19
13.3 Traffic Promotion Activities .....	13-22
13.3.1 Present State of Successful Call Ratio.....	13-22
13.3.2 Objectives of Traffic Promotion Activities .....	13-23
13.3.3 Guidelines for Upgrade of Successful Call Ratio .....	13-25
13.3.4 Dial Consulting Activities as Definite Measures.....	13-25
13.3.5 Traffic Sales Activities as Definite Measures .....	13-29
13.3.6 Estimation of Additional Revenue.....	13-34
13.4 Further Preparation Studies for the Implementation .....	13-45
13.4.1 Project Management Study.....	13-45
13.4.2 Further Study for the Metropolitan Area .....	13-45

## REFERENCES

## Figure List

	<u>Page</u>
Figure 1.4 Formulating Procedure of The Master Plan .....	1-3
Figure 2.1.1-1 (1/2) GNP and Per capita GNP in Thailand at Current Market Price	2-3
Figure 2.1.1-1 (2/2) GNP and Per capita GNP in Thailand at 1972 Prices .....	2-3
Figure 2.1.1-2 Imports, Exports and Trade Balance of Thailand (1975-1987) ....	2-6
Figure 2.1.1-3 Percentage Distribution of Export Value by Economic Sectors ....	2-7
Figure 2.1.1-4 Household Income Distribution Patterns in Five Regions .....	2-12
Figure 2.1.2-1 The Main Framework of the 6th NESDP.....	2-17
Figure 2.2.3-1 Telephone Service Development .....	2-37
Figure 2.2.3-2 Concept of Line Grouping .....	2-38
Figure 2.2.4-1 Configuration of Packet Network .....	2-55
Figure 2.3.1-1 Location of LE in Metropolitan Area .....	2-62
Figure 2.3.1-2 Location of PC Level and above .....	2-63
Figure 2.3.1-3 Annual Development of Number of Exchanges .....	2-64
Figure 2.3.1-4 Annual Development of Number of Line Capacities .....	2-65
Figure 2.3.1-5 Ratio of Exchange Classified by Analog and Digital in Metropolitan Area .....	2-66
Figure 2.3.1-6 Ratio of Exchange Classified by Analog and Digital in Provincial Area .....	2-66
Figure 2.3.2-1 Constitution of Transmission System (End of 1988) .....	2-71
Figure 2.3.2-2 Long Distance Analog Transmission Layout (End of 1989) .....	2-72
Figure 2.3.2-3 Long Distance Digital Transmission Layout (End of 1992) .....	2-73
Figure 2.3.2-4 Long Distance Transmission Network (Metropolitan Area) .....	2-74
Figure 2.3.2-5 Metropolitan Junction Transmission Network Layout (End of 1992) .....	2-76
Figure 2.3.2-6 Metropolitan Junction Radio Transmission Network (End of 1988) .....	2-77
Figure 2.3.2-7 Configuration of TV Broadcasting Station (End of 1988) .....	2-78
Figure 2.3.2-8 Configuration of FM Radio Station (End of 1988).....	2-79
Figure 2.3.3-1(1) Present State of Local Cable (Number of Pairs).....	2-82
Figure 2.3.3-1(2) Present State of Local Cable (Used Ratio) .....	2-82
Figure 2.3.3-2 Used Cable Pairs .....	2-83
Figure 2.3.3-3 Configuration of Subscriber Network .....	2-81
Figure 2.3.3-4 Configuration of Rural Telecommunication System (TDMA) .....	2-84

	<u>Page</u>
Figure 2.3.4-1	Location of Radio Base Station (1/2) ..... 2-86
Figure 2.3.4-1	Location of Radio Base Station (2/2) ..... 2-87
Figure 2.3.4-2	Channel Control Procedure ..... 2-88
Figure 2.3.4-3	Common Channel Signalling for Cellular Mobile Network ..... 2-89
Figure 2.3.4-4	Numbering Plan for Cellular Mobile Network ..... 2-90
Figure 2.3.4-5	Network Configuration ..... 2-91
Figure 2.3.5-1	Major Nodes in Bangkok Metropolitan Area ..... 2-92
Figure 2.3.7-1	Maintenance Area in TOT ..... 2-100
Figure 2.3.7-2	Organization for Maintenance..... 2-101
Figure 2.3.7-3	Flow Chart of Fault Repairing..... 2-102
Figure 2.3.7-4	Number of Repair - Metropolitan Area - ..... 2-103
Figure 2.3.7-5	Number of Repair - Provincial Area - ..... 2-104
Figure 2.3.7-6	Contents of Fault - Metropolitan Area - ..... 2-105
Figure 2.3.7-7	Contents of Fault - Provincial Area - ..... 2-106
Figure 2.3.7-8	Repair Period - Metropolitan Area - ..... 2-107
Figure 2.3.7-9	Repair Period - Provincial Area - ..... 2-108
Figure 2.4-1(1/7)	Organizational Structure of Telephone Organization of Thailand... 2-112
Figure 2.4-1(2/7)	Organizational Structure of Telephone Organization of Thailand... 2-113
Figure 2.4-1(3/7)	Organizational Structure of Telephone Organization of Thailand... 2-114
Figure 2.4-1(4/7)	Organizational Structure of Telephone Organization of Thailand... 2-115
Figure 2.4-1(5/7)	Organizational Structure of Telephone Organization of Thailand... 2-116
Figure 2.4-1(6/7)	Organizational Structure of Telephone Organization of Thailand... 2-117
Figure 2.4-1(7/7)	Organizational Structure of Telephone Organization of Thailand... 2-118
Figure 2.5-1	Local Revenue ..... 2-123
Figure 2.5-2	Trunk Revenue ..... 2-123
Figure 2.5-3	Total Revenue ..... 2-124
Figure 2.5-4	Cable Capacity Margin..... 2-124
Figure 2.5-5	Switching Capacity Margin ..... 2-125
Figure 2.5-6	Fault Ratio ..... 2-125
Figure 2.5-7	Waiting Applicant ..... 2-126
Figure 2.5-8	Metropolitan Area-1 ..... 2-127
Figure 2.5-9	Metropolitan Area-2 ..... 2-127
Figure 2.5-10	Metropolitan Area-3 ..... 2-128
Figure 2.5-11	Metropolitan Area-4 ..... 2-128
Figure 2.5-12	Provincial Area-1 ..... 2-129
Figure 2.5-13	Provincial Area-2 ..... 2-129



	<u>Page</u>
Figure 2.5-14	Provincial Area-3 ..... 2-130
Figure 2.5-15	Provincial Area-4 ..... 2-130
Figure 2.5-16	Provincial Area-5 ..... 2-131
Figure 2.5-17	Provincial Area-6 ..... 2-131
Figure 2.5-18	Provincial Area-7 ..... 2-132
Figure 2.5-19	Provincial Area-8 ..... 2-132
Figure 2.5-20	Provincial Area-9 ..... 2-133
Figure 2.5-21	Present Situation in Metropolitan Areas ..... 2-134
Figure 2.5-22	Present Situation in Provincial Areas ..... 2-135
Figure 3.1.2-1	Future Development Directions in the BMR ..... 3-5
Figure 3.1.2-2	Regional Development Outlook..... 3-9
Figure 3.1.3-1	Population Projection ..... 3-13
Figure 3.1.3-2	GRP and GDP Forecast..... 3-14
Figure 3.2.1-1	Social Development Stages and the Roles of Telecommunications (1/3) ..... 3-18
Figure 3.2.1-1	Social Development Stages and the Roles of Telecommunications (2/3) ..... 3-18
Figure 3.2.1-1	Social Development Stages and the Roles of Telecommunications (3/3) ..... 3-19
Figure 3.3.1-1	Transmission of Telecommunication Network ..... 3-33
Figure 3.3.2-1	Two-layer Network Architecture ..... 3-34
Figure 3.3.3-1	Personnel Dialing Service ..... 3-35
Figure 4.1.1-1	Telephone Subscription Demand Forecast Procedure ..... 4-1
Figure 4.1.1-2	The Concept of Potential Demand ..... 4-1
Figure 4.1.1-3	Household Monthly Income Distribution Curve ..... 4-3
Figure 4.1.1-4	Result of Forecast..... 4-10
Figure 4.1.1-5	Telephone Subscription Demand and Density ..... 4-11
Figure 4.1.3-1	Facsimile Terminal Development in Japan ..... 4-16
Figure 4.2.1-1	Relations between Demand and Service ..... 4-22
Figure 4.2.2-1	Paging System Interworking with Data Network ..... 4-26
Figure 4.3.1-1	Suitable Network for Data Transmission ..... 4-30
Figure 4.3.1-2	Distribution of Demands ..... 4-31
Figure 4.3.2-1	Concept of Message Handling Systems (MHS) ..... 4-39
Figure 4.4.1-1	Operation Form of Bureau Facsimile in Japan ..... 4-42
Figure 4.5.1-1	Sectors Relating to Videotex Service ..... 4-48
Figure 4.5.1-2	Relations among Various Videotex Systems in Japan ..... 4-52

	<u>Page</u>
Figure 4.6-1	Composition of Digital Subscription ..... 4-56
Figure 4.6-2	Supposition of Price Trend and Market for Digital Terminals ..... 4-58
Figure 4.6-3	Market Segment for Tariff Level & Digital Terminal ..... 4-59
Figure 5.4	Strategy Formation and Execution ..... 5-10
Figure 5.5	Effects Producted through Implementation of Master Plan ..... 5-12
Figure 6.1.1-1	PC-PC Traffic Matrix Forecast Procedure ..... 6-1
Figure 6.1.1-2	Concept of Creating the Future PC-PC Traffic Matrix ..... 6-4
Figure 6.1.1-3	Originating Calling Rate for Automatic Exchanges of Japan in 1976 ..... 6-5
Figure 6.1.1-4	Outgoing Calling Rate for Scale of Primary Center ..... 6-6
Figure 6.1.1-5	Outgoing Calling Rate for Telephone Density of Primary Centers ..... 6-6
Figure 6.1.1-6	Estimated Total Outgoing Traffic of Primary Centers..... 6-8
Figure 6.1.1-7	Outgoing Calling Rate for Primary Centers in 1997 ..... 6-8
Figure 6.1.1-8	Outgoing Calling Rate for Primary Centers in 2002 ..... 6-9
Figure 6.1.1-9	Outgoing Calling Rate for Primary Centers in 2007 ..... 6-9
Figure 6.1.1-10	Forecasted Results of Outgoing Traffic..... 6-11
Figure 6.1.2-1	Bangkok Multi-Exchange Area Traffic Matrix Forecast Procedure ..... 6-12
Figure 6.1.2-2	Originating Calling Rate of Local Exchanges in 1987 ..... 6-13
Figure 6.1.2-3	Forecasted Results of Total Originating Traffic..... 6-15
Figure 6.3	Relations among Traffic Factors..... 6-20
Figure 7.1.1-1	Network Hierarchy ..... 7-1
Figure 7.1.1-2	Switching Locations ..... 7-3
Figure 7.1.1-3	Dispersed Tandem Exchange System ..... 7-4
Figure 7.1.1-4	Proposed Routing Plan ..... 7-5
Figure 7.1.1-5	Example of Exchange Reliability Enhancement ..... 7-6
Figure 7.1.2-1	Relation between Selection Logic and Information Signal ..... 7-14
Figure 7.1.2-2	Relation with Network and Service ..... 7-16
Figure 7.1.2-3	Classification of Services ..... 7-16
Figure 7.1.2-4	Example of Numbering Plan for using RT ..... 7-20
Figure 7.1.3-1	Location of Exchange ..... 7-23
Figure 7.1.3-2	Structure of Hierarchy Network ..... 7-25
Figure 7.1.3-3	Expansion of CCS (Phase-1) ..... 7-33
Figure 7.1.3-4	Expansion of CCS (Phase-2) ..... 7-34
Figure 7.1.3-5	Expansion of CCS (Phase-3) ..... 7-35

	<u>Page</u>
Figure 7.1.4-1	Method of Synchronization ..... 7-39
Figure 7.1.4-2	Network Synchronization Plan ( End of 1992) ..... 7-40
Figure 7.1.4-3	Long Distance Digital Synchronous Path Link (End of 1992) ..... 7-41
Figure 7.1.4-4	Configuration of Synchronous Path Link (End of 2007) ..... 7-42
Figure 7.2.2-1	Present Loss Probability Allocation ..... 7-44
Figure 7.2.2-2	Transmission Loss Allocation ..... 7-45
Figure 7.2.3-1	Proposed Loss Probability Allocation ..... 7-47
Figure 7.2.3-2	International and National HRX ..... 7-48
Figure 7.3.1-1	Basic Interface ..... 7-54
Figure 7.3.1-2	Primary Rate Access Interface ..... 7-55
Figure 7.3.1-3	ISDN Application Examples (1) ..... 7-57
Figure 7.3.1-3	ISDN Application Examples (2) ..... 7-58
Figure 7.3.1-4	High-Speed and High-Quality Transmission Service ..... 7-60
Figure 7.3.1-5	Reference Configuration for the ISDN User-Network Interfaces . 7-61
Figure 7.3.2-1	Circumstances Relating to ISDN Introduction ..... 7-65
Figure 7.3.2-2	Evolution of ISDN Services ..... 7-66
Figure 7.3.2-3	ISDN Introduction Area (End of Phase-1) ..... 7-67
Figure 7.3.2-4	ISDN Introduction Area (End of Phase-2) ..... 7-68
Figure 7.3.2-5	ISDN Introduction Area (End of Phase-3) ..... 7-69
Figure 7.3.2-6	Example for ISDN System Configuration ..... 7-70
Figure 7.3.2-7	Network Configuration ..... 7-72
Figure 7.3.2-8	Transmission Impairments of Existing Local Network ..... 7-74
Figure 7.4.2-1	Cycle of Traffic Management ..... 7-83
Figure 7.4.3-1	Transmission Supervisory System (T.S.S End of 1992) ..... 7-85
Figure 7.4.3-2	Organization of Provincial Transmission Division ..... 7-86
Figure 7.4.3-3	Organization of Maintenance Center ..... 7-87
Figure 7.4.3-4	Flow Chart of Transmission System Interruption ..... 7-88
Figure 7.4.3-5	Flow Chart of Transmission Cable in Emergency Case ..... 7-89
Figure 7.4.3-6	Flow Chart of Transmission Equipment on Fire ..... 7-90
Figure 7.4.3-7	Configuration of Working Time ..... 7-91
Figure 7.4.3-8	Transmission Network Management System (Phase-1 ~ Phase-2) 7-95
Figure 7.4.3-9	Layout of Operation Room ..... 7-96
Figure 7.4.4-1	Concept of OPMC ..... 7-99
Figure 7.4.5-1	Integrated Network Operation System (Phase-3) ..... 7-102
Figure 8.1.2-1	Estimated Number of Main Telephone Lines in the Whole Kingdom 8-3
Figure 8.1.2-2	Estimated Number of Main Telephone Lines in Metro. Area ..... 8-3

	<u>Page</u>
Figure 8.1.2-3	Estimated Number of Main Telephone Lines in Provincial Areas . 8-4
Figure 8.1.2-4	Estimated Number of Main Telephone Lines in Metro. & Prov. ... 8-4
Figure 8.1.2-5	Density of Main Telephone and Public Telephone in Japan ..... 8-5
Figure 8.1.2-6	Density of Main Telephone and Public Telephone in the World ... 8-6
Figure 8.1.2-7	Public Telephone and Main Telephone Installation Plan in Whole Kingdom ..... 8-8
Figure 8.1.2-8	Public Telephone and Main Telephone Installation Plan in Metropolitan ..... 8-8
Figure 8.1.2-9	Public Telephone and Main Telephone Installation Plan in Province ..... 8-9
Figure 8.1.2-10	Share of Public Telephone Installation Plan ..... 8-9
Figure 8.1.4-1	Comparison of Demand, Switching and Local Cable Capacity (Phase-1) ..... 8-18
Figure 8.1.4-2	Comparison of Demand, Switching and Local Cable Capacity (Phase-2) ..... 8-18
Figure 8.1.4-3	Comparison of Demand, Switching and Local Cable Capacity (Phase-3) ..... 8-19
Figure 8.2	Summary of Switching Long Term Plan ..... 8-22
Figure 8.2.1-1	Procedure of Exchange Number Estimation ..... 8-20
Figure 8.2.2-1	Economic Comparison of RSU (512L) ..... 8-32
Figure 8.2.2-2	Economic Comparison of RSU (1024L) ..... 8-32
Figure 8.2.2-3	Economic Comparison of RSU (1536L) ..... 8-33
Figure 8.2.2-4	Economic Comparison of RSU (2048L) ..... 8-33
Figure 8.2.3-1	Implementation of XB for Metropolitan Area ..... 8-38
Figure 8.2.3-2	Implementation of SPC for Metropolitan Area ..... 8-38
Figure 8.2.3-3	Implementation of XB for Provincial Area ..... 8-39
Figure 8.2.3-4	Implementation of SPC for Provincial Area ..... 8-39
Figure 8.2.4-1	State of Exchange ..... 8-41
Figure 8.2.5-1	Flow Chart of TOT's Present Procedure ..... 8-43
Figure 8.2.5-2	Flow Chart of New Procedure ..... 8-43
Figure 8.2.5-3	Demand Forecast and Outside Condition - 1 ..... 8-45
Figure 8.2.5-4	Floor Occupation Condition ..... 8-46
Figure 8.2.5-5	Demand Forecast and Outside Condition - 2 ..... 8-49
Figure 8.2.6-1	System Configuration for Non-ringing Service ..... 8-51
Figure 8.2.6-2	System Configuration for Credit Call Service ..... 8-52
Figure 8.3.1	Summary of Expansion Plan..... 8-54

	<u>Page</u>
Figure 8.3.2-1	Long Distance Digital Transmission Layout (End of 1997)..... 8-55
Figure 8.3.2-2	Long Distance Digital Transmission Layout (End of 2002)..... 8-56
Figure 8.3.2-3	Long Distance Digital Transmission Layout (End of 2007)..... 8-57
Figure 8.3.4-1	Metropolitan Junction Transmission Network Layout (End of 2007)..... 8-62
Figure 8.3.5-1	The Introduction Plan of Satellite Earth Station (End of 1997)..... 8-68
Figure 8.3.5-2	The Location Plan of Earth Station (End of 2002) ..... 8-69
Figure 8.3.5-3	The Result of 2nd Expansion Plan of Satellite Earth Station (End of 2007)..... 8-70
Figure 8.3.6-1	Transmission Switching System Concept ..... 8-73
Figure 8.3.6-2	Configuration of the Transmission Switching System ..... 8-74
Figure 8.3.6-3	Long Distance Transmission System Introduced Digital Switching System ..... 8-76
Figure 8.3.6-4	Metropolitan Junction Transmission Network ..... 8-77
Figure 8.3.7-1	Transmission Network for Diversification of Services ..... 8-80
Figure 8.3.7-2	Configuration of TV Broadcasting Network ..... 8-81
Figure 8.4	Summary of Outside Plant Expansion Plan ..... 8-86
Figure 8.4.1-1	Configuration of Intra-City Microwave Subscriber System..... 8-90
Figure 8.4.3-1	Comparison of Telephone Density and Fault Ratio in Japan ..... 8-91
Figure 8.4.3-2	Contents of Faults in Japan ..... 8-92
Figure 8.4.5-1	Flow Chart of Judgement Procedure ..... 8-94
Figure 8.6.2-1	Additional Facility for Message Handling Systems ..... 8-99
Figure 8.7.2-1	Additional Role Assignment for Videotex Service ..... 8-101
Figure 9.2.2-1	The Number of Telephones by Types ..... 9-7
Figure 9.2.3-1	Trend of Local Calls in Metro. .... 9-13
Figure 9.2.3-2	Estimated Local Calls per Telephone in Metro. (Private + Government) ..... 9-14
Figure 9.2.3-3	Trend of Local Calls in Province.(Private + Government) ..... 9-16
Figure 9.2.3-4	Estimated Local Calls per Telephone in Province. (Private + Government) ..... 9-17
Figure 9.2.4-1	Trend of the Trunk Revenue in Metro. (Private + Government) ... 9-22
Figure 9.2.4-2	Estimated Trunk Revenue per Telephone in Metro. (Private + Government) ..... 9-23
Figure 9.2.4-3	Trend of the Trunk Revenue in Province. .... 9-25
Figure 9.2.4-4	Estimated Trunk Revenue per Telephone in Province. (Private + Government) ..... 9-26

	<u>Page</u>
Figure 9.2.8-1	Total Operating Revenue Estimation ..... 9-32
Figure 9.2.8-2	Operating Revenue Estimation of the Project ..... 9-33
Figure 9.3.1-1	Foreign and Local Portion of the Total Installation Cost ..... 9-36
Figure 9.3.3-1	Operation Cost and The Number of Telephone Line Connected ... 9-42
Figure 9.3.3-2	Maintenance Cost and The Number of Telephone Line Connected 9-43
Figure 9.4.1	Net Cash Flow and Accumulated Net Cash Flow without Borrowings ..... 9-46
Figure 9.4.2-1	Net Cash Flow and Accumulated Net Cash Flow with 75% Borrowings ..... 9-51
Figure 9.4.2-2	Net Present Value with 75% Borrowings ..... 9-51
Figure 9.5-1	Net Present Values of Revenue Fluctuation Cases ..... 9-53
Figure 9.5-2	Net Present Values of Outside Plant Cost Increase Cases ..... 9-54
Figure 9.5-3	Two Cases for the Estimation of the Number of Employee ..... 9-55
Figure 9.5-4	Net Present Value of the Number of Employee Case B ..... 9-56
Figure 11.1.1-1	Estimated Revenues and Expenses of Case A ..... 11-6
Figure 11.1.1-2	Estimated Net Income before Remittance to the Treasury of Case A 11-6
Figure 11.1.1-3	Estimated Liabilities and Equities of Case A ..... 11-7
Figure 11.1.1-4	Estimated Cash Flow of Case A ..... 11-7
Figure 11.1.1-5	Estimated Cash Balance of Case A ..... 11-8
Figure 11.1.2-1	Estimated Revenues and Expenses of Case B ..... 11-11
Figure 11.1.2-2	Estimated Net Income before Remittance to the Treasury of Case B 11-11
Figure 11.1.2-3	Estimated Liabilities and Equities of Case B ..... 11-12
Figure 11.1.2-4	Estimated Cash Flow of Case B ..... 11-12
Figure 11.1.2-5	Estimated Cash Balance of Case B ..... 11-13
Figure 11.1.3-1	Estimated Revenues and Expenses of Case C ..... 11-16
Figure 11.1.3-2	Estimated Net Income before Remittance to the Treasury of Case C 11-16
Figure 11.1.3-3	Estimated Liabilities and Equities of Case C ..... 11-17
Figure 11.1.3-4	Estimated Cash Flow of Case C ..... 11-17
Figure 11.1.3-5	Estimated Cash Balance of Case C ..... 11-18
Figure 11.1.4-1	Estimated Revenues and Expenses of the Revised Case C ..... 11-21
Figure 11.1.4-2	Estimated Net Income before Remittance to the Treasury of the Revised Case C..... 11-21
Figure 11.1.4-3	Estimated Liabilities and Equities of the Revised Case C ..... 11-22
Figure 11.1.4-4	Estimated Cash Flow of the Revised Case C ..... 11-22
Figure 11.1.4-5	Estimated Cash Balance of the Revised Case C ..... 11-23
Figure 11.1.5-1	Estimated Revenues and Expenses of Case D ..... 11-27

	<u>Page</u>
Figure 11.1.5-2	Estimated Net Income before Remittance to the Treasury of Case D 11-28
Figure 11.1.5-3	Estimated Liabilities and Equities of Case D ..... 11-28
Figure 11.1.5-4	Estimated Cash Flow of Case D ..... 11-29
Figure 11.1.5-5	Estimated Cash Balance of Case D ..... 11-29
Figure 11.1.6-1	Estimated Revenues and Expenses of Case E ..... 11-33
Figure 11.1.6-2	Estimated Net Income before Remittance to the Treasury of Case E 11-33
Figure 11.1.6-3	Estimated Liabilities and Equities of Case E ..... 11-34
Figure 11.1.6-4	Estimated Cash Flow of Case E ..... 11-34
Figure 11.1.6-5	Estimated Cash Balance of Case E ..... 11-35
Figure 11.1.7-1	Debt Service of Each Case ..... 11-37
Figure 11.1.7-2	Debt Service Coverage Ratio of Each Case ..... 11-37
Figure 12.1	Present and Future Management Issues ..... 12-2
Figure 12.1.1-1	Microscopic & Macroscopic Approaches to Estimate ..... 12-3
Figure 12.1.1-2	Main Telephone Lines and Lines per Staff by Country ..... 12-6
Figure 12.1.1-3	Labor Productivity Improvement Policy ..... 12-6
Figure 12.1.2	The Estimated Number of TOT Staff in the Future ..... 12-9
Figure 12.2.1	The Outline of a Decentralization Plan ..... 12-11
Figure 12.2.2	Organizational Outline of Profit and Cost Center System ..... 12-12
Figure 12.3.1	Training Steps of Digital Switching Technician and Engineer ..... 12-14
Figure 12.3.2	Training Center Development Plan in Future ..... 12-15
Figure 12.3.3	One Example of Experience Enrichment Program ..... 12-16
Figure 12.4.1	Summary of Personnel Institution in TOT ..... 12-18
Figure 12.4.2	Example of Allowance and Objectives ..... 12-19
Figure 12.5	Recommended Projects ..... 12-20
Figure 13.1.1-1	City Plan of Metropolitan Area ..... 13-6
Figure 13.1.1-2	Exchange Office Accommodation Area in Bangkok Metropolis ... 13-7
Figure 13.2.3-1	Work Flow of Maintenance Control System ..... 13-14
Figure 13.3.1-1	Call Connection Procedure ..... 13-22
Figure 13.3.2-1	Objectives of Traffic Promotion Activity ..... 13-24
Figure 13.3.4-1	Call Restriction for Rush Call Area ..... 13-27
Figure 13.3.5-1	Method of Hunting System ..... 13-30
Figure 13.3.6-1	Call Procedure of Successful Call and Unsuccessful Call ..... 13-35
Figure 13.3.6-2	Estimated Call Relations for Direct Effect ..... 13-38
Figure 13.4.1	Master Plan Study and Further Study ..... 13-47

Table List

	<u>Page</u>
Table 1.6.1-1	Preliminary Study Team Members ..... 1-5
Table 1.6.1-2	Advisory Committee Members ..... 1-6
Table 1.6.1-3	Main Study Team Members ..... 1-7
Table 1.6.2-1	Counterparts of Corporate Planning Office, TOT ..... 1-8
Table 2.1.1-1	Trends of Main Economic Indexes ..... 2-2
Table 2.1.1-2	Gross National Product at Current Market Prices by Industrial Origin ..... 2-4
Table 2.1.1-3	Expenditures on Gross Domestic Product at Current Market Prices ..... 2-5
Table 2.1.1-4	Percentage Distribution of Export Value by Economic Sectors .... 2-7
Table 2.1.1-5	Employment Classified by Industrial Sector ..... 2-10
Table 2.1.1-6	Gross Domestic Product at Current Market Price by Region ..... 2-11
Table 2.1.1-7	Balance of Payment ..... 2-14
Table 2.1.1-8	National Government Actual Revenue & Expenditure ..... 2-15
Table 2.1.1-9	External Debt ..... 2-16
Table 2.1.2-1	Targets and Recent Results of the 6th ESDP ..... 2-20
Table 2.2.1-1	Telephone Service State in 1987 ..... 2-31
Table 2.2.1-2	Telegram Service State in 1987 ..... 2-32
Table 2.2.1-3	Telex Service State in 1987 ..... 2-33
Table 2.2.1-4	Data Transmission Service State in 1987 ..... 2-34
Table 2.2.2-1	Structure and Territory of Telecommunication Services in Aug.1989 ..... 2-35
Table 2.2.3-1	Telephone Service Development ..... 2-36
Table 2.2.3-2	Local and Trunk Service ..... 2-37
Table 2.2.3-3	Network Service Subscribers in Bangkok ..... 2-39
Table 2.2.3-4	State of PBX and PABX ..... 2-40
Table 2.2.3-5	Large Scale of PABX Subscribers ..... 2-41
Table 2.2.3-6	Facsimile Terminal Development ..... 2-41
Table 2.2.3-7	Public Telephone Service Development ..... 2-43
Table 2.2.3-8	Annual Progress of Cellular Mobile Service ..... 2-43
Table 2.2.3-9	Number of Calls & Minutes from Mobile Telephones ..... 2-44
Table 2.2.3-10	Leased Circuit Service ..... 2-44
Table 2.2.4-1	Domestic Telegram Service ..... 2-46
Table 2.2.4-2	International Telegram Service ..... 2-46



	<u>Page</u>
Table 2.2.4-3	Telex Terminals and Concentrators ..... 2-47
Table 2.2.4-4	Telex Calls and Minutes ..... 2-47
Table 2.2.4-5	Phototelegraph Service ..... 2-48
Table 2.2.4-6	Pages Handled by Bureau Facsimile Service ..... 2-48
Table 2.2.4-7	Telefax Service ..... 2-49
Table 2.2.4-8	International Telephone Service for Outgoing Call ..... 2-49
Table 2.2.4-9	Radio Telephone Service ..... 2-49
Table 2.2.4-10	Mobile Radio Telephone Service ..... 2-50
Table 2.2.4-11	Radio Paging Service etc. .... 2-52
Table 2.2.4-12	Maritime Mobile Radio Service ..... 2-53
Table 2.2.4-13	Number of Leased Circuits ..... 2-53
Table 2.2.4-14	DATTEL Service ..... 2-54
Table 2.2.4-15	IDAR Service ..... 2-54
Table 2.2.4-16	International Broadcast Transmission Service ..... 2-56
Table 2.3.1-1	Numbering Plan for Ordinary Call ..... 2-59
Table 2.3.1-2	Numbering Plan for Special Call ..... 2-60
Table 2.3.1-3	Annual Development of Number of Exchanges ..... 2-64
Table 2.3.1-4	Annual Development of Number of Line Capacities ..... 2-65
Table 2.3.1-5	Ratio of ISDN Lines ..... 2-67
Table 2.3.2-1	Existing Long Distance Transmission Network ..... 2-69
Table 2.3.2-2	Transmission Network (End of 5th project) ..... 2-70
Table 2.3.4-1	Existing Situation and Future Expansion Plan ..... 2-88
Table 2.3.4-2	Numbering System Relating to Cellular Mobile Service ..... 2-91
Table 2.3.6-1	Comparison of the ESDP and NESDP on Terms ..... 2-93
Table 2.3.6-2	Summary of 4th ESDP (1977~1987) ..... 2-95
Table 2.3.6-3	Summary of 5th ESDP (1984~1992) ..... 2-95
Table 2.3.6-4	Summary of UETP (1989~1992) ..... 2-96
Table 2.4-1	Balance Sheet ..... 2-109
Table 2.4-2	Income Statement ..... 2-110
Table 2.4-3	Statement of Retained Earnings ..... 2-110
Table 2.4-4	Statistics of Personnel Figure ..... 2-111
Table 2.5-1	Main Telephone and Revenue ..... 2-119
Table 2.5-2	Switching and Cable Capacity, and Waiting Applicant as of Feb. 1989 ..... 2-120
Table 2.5-3	Unit Value ..... 2-120
Table 2.5-4	Value of Point for Each Criterion ..... 2-121

	<u>Page</u>
Table 3.1.3-1	World Bank Projection ..... 3-12
Table 3.1.3-2	Population Projection ..... 3-13
Table 3.1.3-3	GRP and GDP Forecast ..... 3-14
Table 3.2.3-1	Sectoral Capital Stock ..... 3-24
Table 3.2.3-2	Sectoral Employment ..... 3-24
Table 3.2.3-3	Gross National Product by Industrial Origin ..... 3-25
Table 3.2.3-4	Agricultural Sector ..... 3-25
Table 3.2.3-5	Manufacturing Sector ..... 3-26
Table 3.2.3-6	Other Remaining Sectors ..... 3-26
Table 4.1.1-1	Forecasted Telephone Demand and Density ..... 4-11
Table 4.1.2-1	Network Services in Japan ..... 4-13
Table 4.1.3-1	Typical Terminals on the Telephone Network ..... 4-14
Table 4.1.3-2	Comparison between Analog PBX and LAN ..... 4-15
Table 4.1.3-3	Facsimile Terminal Development in Japan ..... 4-16
Table 4.1.3-4	Forecast of Facsimile Terminals ..... 4-17
Table 4.2-1	Mobile Communication Services ..... 4-19
Table 4.2.1-1	Comparison of Tariff Structure ..... 4-20
Table 4.2.1-2	Comparison of Traffic Structure for Call Charge ..... 4-21
Table 4.2.1-3	Mobile Telephone Service State in Some Countries ..... 4-23
Table 4.2.1-4	Forecast of Cellular Mobile Service ..... 4-25
Table 4.2.2-1	Comparison of Paging Station to Main Line in Thailand ..... 4-27
Table 4.2.2-2	Comparison of Paging Station to Main Line in Europe ..... 4-27
Table 4.2.2-3	Forecast of Paging Service ..... 4-28
Table 4.3.1-1	General Specifications for Data Transmission Use ..... 4-30
Table 4.3.1-2	On-line Circuits for Each Network in Japan ..... 4-33
Table 4.3.1-3	Share of Each Network for Data Lines in Japan ..... 4-34
Table 4.3.1-4	Forecast of Data Transmission Use ..... 4-35
Table 4.3.1-5	Forecast of Voice Transmission Use ..... 4-36
Table 4.3.1-6	Application Fields for Video Transmission Use in Japan ..... 4-37
Table 4.3.1-7	Forecast of Leased Circuits & Packet Network ..... 4-38
Table 4.3.2-1	MHS's Forecast Based on Data Lines ..... 4-40
Table 4.3.2-2	MHS's Forecast Based on Personal Computers ..... 4-40
Table 4.4.1-1	Comparison among Competitive Services in Japan ..... 4-43
Table 4.4.1-2	Forecast of Telegram & Bureau Facsimile Service ..... 4-44
Table 4.4.2-1	Forecast of Telex Service ..... 4-45
Table 4.4.3-1	Facsimile Store & Forward Service in Japan ..... 4-47

	<u>Page</u>
Table 4.4.3-2	Forecast of Facsimile Store & Forward Service ..... 4-47
Table 4.5.1-1	Number of TV Sets in Thailand ..... 4-49
Table 4.5.1-2	Comparison of Videotex Systems ..... 4-50
Table 4.5.1-3	Videotex Terminals in European Countries ..... 4-51
Table 4.5.1-4	Past Trend of CAPTAIN Service in Japan ..... 4-53
Table 4.6-1	Comparison of Tariff Level of ISDN ..... 4-54
Table 4.6-2	Price Comparison of Analog & Digital Terminal ..... 4-55
Table 4.6-3	Market Segment as Classified by Tariff Level ..... 4-57
Table 4.6-4	Estimation of ISDN Subscriptions ..... 4-60
Table 6.1.1-1	Traffic Ratio of Network Services to Basic Telephone Service .... 6-10
Table 6.2-1	Traffic Data for Cellular Mobile ..... 6-16
Table 6.2-2	Actual Traffic Data at RBS ..... 6-17
Table 6.2-3	Traffic Forecast..... 6-18
Table 6.3.1-1	Service Categorization ..... 6-22
Table 7.1.1-1	Tandem Exchange Name ..... 7-5
Table 7.1.2-1	Number Capacity ..... 7-8
Table 7.1.2-2	Study of Numbering Capacity ..... 7-10
Table 7.1.2-3	Comparison of Order ..... 7-18
Table 7.1.2-4	Comparison of Number of DN ..... 7-19
Table 7.1.3-1	Signalling Network Form ..... 7-24
Table 7.1.3-2	The Feature of Hierarchical Network Structure ..... 7-26
Table 7.1.3-3	Number of STP ..... 7-28
Table 7.1.3-4	Estimated Signalling Network ..... 7-28
Table 7.1.3-5	Comparison of Redundancy Structure of Signalling Network ..... 7-30
Table 7.2.3-1	Loss Probability (Circuit Groups) ..... 7-46
Table 7.2.3-2	Digital Switching Loss Probability ..... 7-46
Table 7.2.3-3	Post Dialling Delay ..... 7-47
Table 7.2.3-4	Error Performance Objectives for International ISDN Connections 7-48
Table 7.2.3-5	Allocation of the Degraded Minutes and Error Seconds Objectives 7-49
Table 7.2.3-6	Allocation of % Degraded Minute Intervals and Error Seconds Objectives ..... 7-49
Table 7.2.3-7	Allocation of Severely Error Seconds ..... 7-50
Table 7.3.1-1	ISDN Service Menu ..... 7-56
Table 7.3.1-2	64 kb/s Transmission Example ..... 7-59
Table 7.3.2-1	ISDN Introduction Area ..... 7-63
Table 7.3.2-2	Research and Development in the World ..... 7-75

	<u>Page</u>
Table 7.4.2-1	NCOM Main Functions ..... 7-79
Table 7.4.2-2	AOM Main Functions ..... 7-80
Table 8.1.2-1	The Demand Forecast of the Main Telephone ..... 8-2
Table 8.1.2-2	Public Telephone Installation Plan ..... 8-7
Table 8.1.2-3	Estimated Number of Main Telephone Lines by Type of Subscribers in Metropolitan ..... 8-10
Table 8.1.2-4	Estimated Number of Main Telephone Lines by Type of Subscribers in Province ..... 8-11
Table 8.1.2-5	Estimated Number of Main Telephone Lines by Type of Subscribers in Whole Kingdom ..... 8-12
Table 8.1.2-6	The Number of Installation per Year ..... 8-13
Table 8.1.3	Outline of the Expansion Plan ..... 8-17
Table 8.2.1-1	Switching Capacity to be Increased ..... 8-23
Table 8.2.1-2	Total Switching Capacity ..... 8-24
Table 8.2.2-1	RSU in Metropolitan Area ..... 8-27
Table 8.2.2-2	Economic Comparison Data of RSU (512L) ..... 8-28
Table 8.2.2-3	Economic Comparison Data of RSU (1024L) ..... 8-29
Table 8.2.2-4	Economic Comparison Data of RSU (1536L) ..... 8-30
Table 8.2.2-5	Economic Comparison Data of RSU (2048L) ..... 8-31
Table 8.2.3-1	Principle of XB Replacement Plan ..... 8-35
Table 8.2.3-2	Situation of XB ..... 8-36
Table 8.2.3-3	Implementation Plan of Replacement ..... 8-37
Table 8.2.5-1	Situation Summary ..... 8-48
Table 8.3.2-1	Long Distance Transmission Facilities Expansion Plan ..... 8-58
Table 8.3.2-2	The Installation Routes ..... 8-58
Table 8.3.2-3	The Installation Routes ..... 8-59
Table 8.3.2-4	The Installation Routes ..... 8-60
Table 8.3.3-1	Spur Route Transmission Facilities Expansion Plan ..... 8-60
Table 8.3.4-1	Metropolitan Junction Transmission Facilities Expansion Plan .... 8-61
Table 8.3.6-1	State of Looped or Duplicated Transmission Route (1/2) ..... 8-71
Table 8.3.6-1	State of Looped or Duplicated Transmission Route (2/2) ..... 8-72
Table 8.3.6-2	Feature of PCs Connected to Others with One Route ..... 8-78
Table 8.3.6-3	Alternative Routes ..... 8-78
Table 8.3.8-1	The Contents of Analog Facilities (End of 1988) ..... 8-83
Table 8.3.8-2	The Facilities Replacement Plan ..... 8-83
Table 8.3.8-3	PCM-30 Systems Replacement Plan ..... 8-84

	<u>Page</u>
Table 8.4.1-1	Total Capacity of Primary Cable ..... 8-87
Table 8.4.1-2	Number of Connected Line ..... 8-88
Table 8.4.1-3	Required Number of Primary Cable Pair ..... 8-88
Table 8.4.1-4	Expansion Volume of Primary Cables ..... 8-89
Table 8.4.2-1	Installation Plan of Public Telephone ..... 8-90
Table 8.4.3-1	Target of Fault Ratio ..... 8-93
Table 8.4.5-1	Judgement of Installation Limit for Primary Cable ..... 8-95
Table 8.5.1-1	Expansion Plan of Cellular Mobile Service ..... 8-96
Table 8.5.2-1	Expansion Plan of Paging Service ..... 8-97
Table 8.6.1-1	Expansion Plan of Leased Circuit etc. .... 8-98
Table 8.6.2-1	Development Plan for MHS etc. .... 8-100
Table 8.7.2-1	Development Plan for Videotex Service ..... 8-102
Table 9.2.1	Summary of the Installation Schedule ..... 9-5
Table 9.2.2-1	The Number of Rotary Dial and Push Button Telephone Lines .... 9-6
Table 9.2.2-2	The Share of Push Button Lines in Newly Installed Telephones .. 9-7
Table 9.2.3-1	The Classified Number of Local Telephone Usage ..... 9-9
Table 9.2.3-2	The Number of Main Telephone Stations by Type of Subscribers in Metro. .... 9-9
Table 9.2.3-3	The Number of Average Main Telephone Stations ..... 9-9
Table 9.2.3-4	The Number of Local Telephone Usages per Average Main Telephone Stations Classified by Type of Subscribers in Metro. ... 9-9
Table 9.2.3-5	The Classified Number of Local Telephone Usage ..... 9-10
Table 9.2.3-6	The Number of Main Telephone Stations by Type of Subscribers in Province. .... 9-10
Table 9.2.3-7	The Number of Average Main Telephone Stations ..... 9-10
Table 9.2.3-8	The Number of Local Telephone Usages per Average Main Telephone Stations Classified by Type of Subscribers in Province. .... 9-10
Table 9.2.3-9	The Classified Number of Local Telephone Usage ..... 9-11
Table 9.2.3-10	The Number of Main Telephone Stations by Type of Subscribers 9-11
Table 9.2.3-11	The Number of Average Main Telephone Stations ..... 9-11
Table 9.2.3-12	The Number of Local Telephone Usages per Average Main Telephone Stations Classified by Type of Subscribers in the Whole Kingdom 9-11
Table 9.2.3-13	The Number of Local Calls in Metro.(Private + Government) ..... 9-12
Table 9.2.3-14	Estimated Local Calls in Metro. (Private + Government) ..... 9-14
Table 9.2.3-15	The Number of Local Calls in Province. (Private + Government) 9-15
Table 9.2.3-16	Estimated Local Calls in Province.(Private + Government) ..... 9-17

	<u>Page</u>
Table 9.2.4-1	Tariff Table of Internal Trunk Call (as of June 1, 1989) ..... 9-18
Table 9.2.4-2	Trunk Telephone Service in Metro. .... 9-19
Table 9.2.4-3	Trunk Telephone Service in Province. .... 9-20
Table 9.2.4-4	The Trunk Revenue in Metro.(Private + Government) ..... 9-21
Table 9.2.4-5	Estimated Trunk Revenue in Metro.(Private + Government) ..... 9-23
Table 9.2.4-6	The Trunk Revenue and Telephone Lines in Province. .... 9-24
Table 9.2.4-7	Estimated Trunk Revenue in Province. .... 9-26
Table 9.2.7-1	The Revenue per Average Local Public Telephone in Metro. .... 9-27
Table 9.2.7-2	The Revenue per Average Local Public Telephone in Province .... 9-27
Table 9.2.7-3	The Revenue per Average Trunk Public Telephone in Metro. .... 9-28
Table 9.2.7-4	The Revenue per Average Trunk Public Telephone in Province. ... 9-28
Table 9.2.7-5	The Revenue from Public Telephone Service ..... 9-30
Table 9.2.8-1	Total Operating Revenue Estimation ..... 9-32
Table 9.2.8-2	Operating Revenue Estimation of the Project ..... 9-33
Table 9.2.8-3	Details of the Project Revenue Estimation ..... 9-34
Table 9.3.1-1	The Total Installation Cost ..... 9-37
Table 9.3.1-2	Annual Investment Cost ..... 9-38
Table 9.3.2-1	The Share of Current Assets to Total Revenue in TOT ..... 9-39
Table 9.3.2-2	Detail of Current Assets ..... 9-39
Table 9.3.3-1	Average Manpower Cost per Employee ..... 9-40
Table 9.3.3-2	Past Detailed Expenses of TOT ..... 9-41
Table 9.3.3-3	Past Operating Expenses of TOT ..... 9-42
Table 9.3.4	Remittance to the Treasury ..... 9-45
Table 9.4.1	The Cash Flow of the Project without Borrowings ..... 9-47
Table 9.4.2-1	Loans and Repayment Schedule ..... 9-49
Table 9.4.2-2	The Cash Flow of the Project with 75% Borrowings ..... 9-50
Table 9.5-1	The Number of Employee Estimation Cases ..... 9-55
Table 9.5-2	Summary of Financial Analyses of the Project ..... 9-57
Table 10.1-1	Agricultural Sector ..... 10-3
Table 10.1-2	Manufacturing Sector ..... 10-4
Table 10.1-3	Other Remaining Sectors ..... 10-5
Table 10.1-4	Total Incremental Output ..... 10-6
Table 10.2-1	Economic Internal Rate of Return ..... 10-7
Table 11.1-1	Conditions and Assumptions of Three Financial Cases ..... 11-1
Table 11.1-2	Conditions and Assumptions of Three Additional Financial Cases 11-3
Table 11.1.1-1	Summary of Case A ..... 11-5

	<u>Page</u>
Table 11.1.1-2	Management Indexes of Case A ..... 11-8
Table 11.1.2-1	Summary of Case B ..... 11-10
Table 11.1.2-2	Management Indexes of Case B ..... 11-13
Table 11.1.3-1	Summary of Case C ..... 11-15
Table 11.1.3-2	Management Indexes of Case C ..... 11-18
Table 11.1.4-1	Summary of the Revised Case C ..... 11-20
Table 11.1.4-2	Management Indexes of the Revised Case C ..... 11-23
Table 11.1.5-1	Original Rehabilitations and Replacements Costs for Existing Facilities ..... 11-24
Table 11.1.5-2	Postponed Rehabilitations and Replacements Costs for Existing Facilities ..... 11-24
Table 11.1.5-3	Total Project Costs of Case D ..... 11-25
Table 11.1.5-4	Summary of Case D ..... 11-26
Table 11.1.5-5	Management Indexes of Case D ..... 11-30
Table 11.1.6-1	Summary of Case E ..... 11-32
Table 11.1.6-2	Management Indexes of Case E ..... 11-35
Table 11.1.7	Debt Service Coverage Ratio of Each Case ..... 11-36
Table 11.2.4-1	Service Life of Equipment ..... 11-40
Table 11.2.4-2	Plant under Construction and Work in Progress ..... 11-41
Table 12.1.1-1	Standard Manpower Allocation Table for LS ..... 12-4
Table 12.1.1-2	The Number of Main Telephone Lines and Staff in 21 Countries . 12-5
Table 12.1.2	The Manpower Plan ..... 12-9
Table 12.3.1	Required Experts ..... 12-13
Table 12.3.2	Training Center Development Concept ..... 12-15
Table 13.1.1-1	Implementation of Master Plan ..... 13-2
Table 13.1.2-1	Selection of Implementation Area and Work ..... 13-5
Table 13.1.3-1	List of Proposed Projects in the Period ..... 13-9
Table 13.1.4-1	List of Proposed Projects in the Period ..... 13-10
Table 13.2-1	Natural and Social Influences Outside Plants Concerned ..... 13-11
Table 13.2.4-1	Plant Control Value ..... 13-16
Table 13.2.4-2	Plant Control Value by Rigid Control Distribution Area ..... 13-16
Table 13.2.5-1	Limit Value of Deteriorated Facilities (Deterioration of itself) ..... 13-17
Table 13.2.5-2	Limit Value of Deteriorated Facilities (Deterioration of the structure or the condition ) ..... 13-18
Table 13.3.1-1	Successful Call Ratio ..... 13-23
Table 13.3.3-1	Target of Successful Call Ratio ..... 13-25

	<u>Page</u>
Table 13.3.5-1 Comparison between Hunting System and Independent Lines ....	13-30
Table 13.3.6-1 Assumed Ratio of Abandoned Call .....	13-36
Table 13.3.6-2 Estimated Number of Calls .....	13-37
Table 13.3.6-3 Estimation of Successful & Unsuccessful Call (1/6) .....	13-39
Table 13.3.6-3 Estimation of Successful & Unsuccessful Call (2/6) .....	13-40
Table 13.3.6-3 Estimation of Successful & Unsuccessful Call (3/6) .....	13-41
Table 13.3.6-3 Estimation of Successful & Unsuccessful Call (4/6) .....	13-42
Table 13.3.6-3 Estimation of Successful & Unsuccessful Call (5/6) .....	13-43
Table 13.3.6-3 Estimation of Successful & Unsuccessful Call (6/6) .....	13-44



## List of Abbreviations (in alphabetical order)

ASEAN	Association of South-East Asian Nations
ATM	Automatic Teller Machine
ATM	A synchronous Transfer Mode
B-ISDN	Broadband aspects of ISDN
BMA	Bangkok Metropolitan Telecommunication Area
BMR	Bangkok Metropolitan Region
BOI	Board of Investment
BPI	Bit Per Inch
b/s	bit per second
CAT	Communications Authority of Thailand
CATV	Cable Television
CCIR	Comité Consultatif International de Radio-Communications
CCITT	Comité Consultatif International de Télégraphique et Téléphonique
CCS	Common Channel Signalling System
CDAS	Computerized Directory Assistance System
CR	Calling Rate
DN	Destination Network Code
DSU	Digital Service Unit
DTI	Digital Transmission Interface
EGAT	Electricity Generating Authority of Thailand
EIRR	Economic Internal Rate of Return
ESDP	Economic and Social Development Plan
ESP	Eastern Seaboard Development Program
FAX	Facsimile
FD	Floppy Disk
FDM	Frequency Division Multiplex
FIRR	Financial Internal Rate of Return
FY	Fiscal Year
GDP	Gross Domestic Product
GNP	Gross National Product
GPP	Gross Provincial Product
GRP	Gross Region Product
IBRD	International Bank for Reconstruction and Development
ISD	International Subscriber Dialling

ISDN	Integrated Services Digital Network
ITSC	International Transit Switching Center
ITU	International Telecommunication Union
JICA	Japan International Cooperation Agency
LAN	Local Area Network
LE	Local Exchange
MHS	Message Handling Systems
MS	Mobile Station as Cellular Mobile System
MT	Magnetic Tape
MTX	Mobile Telephone Exchange
MUX	Multiplexer
NCC	New Common Carrier
NDC	National Destination Code
NESDB	National Economic and Social Development Board
NESDP	National Economic and Social Development Plans
NIEs	Newly Industrializing Economies
NT	Network Termination
OA	Office Automation
OEFC	The Overseas Economic Cooperation Fund
OJT	On the Job Training
OM	Operation and Maintenance
P(A)BX	Private (Automatic) Branch Exchange
PC	Primary Center
PCM	Pulse Code Modulation
PRD	Public Relations Department
PSTN	Public Switched Telephone Network
QC	Quality Control
RBS	Radio Base Station as Cellular Mobile System
RS(L)U	Remote Subscriber (Local) Unit
RT	Remote Terminal
SC	Secondary Center
SEP	Signal End Point
SPC	Stored Program Control
STD	Subscriber Trunk Dialling
STP	Signal Transfer Point
TA	Terminal Adaptor
TC	Tertiary Center

TDMA	Time Division Multiple Access
TE	Terminal Equipment
TOT	Telephone Organization of Thailand
XB	Crossbar

## *CHAPTER 1*

### *INTRODUCTION*



## CHAPTER 1. INTRODUCTION

### 1.1 Composition of the Study Report

This report consists of three volumes as follows;

Volume-I:	Summary and Proposals,
Volume-II:	Main Text,
Volume-III:	Appendix.

This part is the Volume-II, Main Text, composed of main descriptions and illustrations of the study result.

### 1.2 Background of the Study

The Government of the Kingdom of Thailand has been making a considerable effort to promote telecommunication services as well as the other socio-economic activities in the country. Telephone Organization of Thailand (hereinafter referred to as "TOT"), which was established in 1954 as the state enterprise for domestic telephone service, has also been endeavoring to improve its telecommunication services and facilities.

The present situation of telephone service in this country, however, is not considered appropriate for meeting the demands from every governmental and private sector. According to the guidelines of the Sixth National Economic and Social Development Plan, which is now under way, telephone services are yet to be improved though the development of infrastructure services during the period of the Fifth Plan was quite successful. Therefore, improvement and expansion of telephone services is considered to be one of the significant targets of the Sixth National Economic and Social Development Plan.

In conformity with the Government's policy mentioned above, TOT has been proceeding with its own Economic and Social Development Project 1984-1992 (hereinafter referred to as "the ESDP 1984-1992"), with the main target of increasing 1.022 million telephone lines.

According to a macroscopic demand forecast given before, however, total telephone demand in 1992 will exceed the capacity of telephone facilities considerably. Furthermore, keeping abreast with the worldwide progress in the field, various new and diversified

telecommunication services are to be introduced to meet the demands from every sector in the country.

Therefore, it is essential to TOT that larger-scale facility expansion projects should be formulated and implemented henceforth too, to improve its telecommunication services both in quantity and in quality in order to cope with the increasing and diversified demands.

### 1.3 Purpose of the Study

The main purpose of the study is to formulate a long term telecommunication development plan (hereinafter referred to as "the Master Plan") for the period from FY 1993 to FY 2007 in Thailand.

The study includes long-range perspectives of network configuration, telecommunication facilities, maintenance and operation, tariff and finance system and the other organizational matters. The study also covers introduction and extension plan of Integrated Services Digital Network (ISDN).

### 1.4 Formulating Procedure of the Master Plan

The Master Plan is basically composed of the following 10 study items:

- 1) Prospects of Socio-Economic Conditions in the future,
- 2) Prospects of Telecommunications Sector Development and Structure, and Telecommunications Demand Forecast,
- 3) Analysis of Strength, Weakness, Opportunity and Threat for Telecommunications Entity,
- 4) Setting forth of Objectives and Strategies for Telecommunications Development,
- 5) Network Plan and Management Policies,
- 6) Facility Plan (Expansion, Rehabilitation, Replacement),
- 7) Human Resource and Organization Policies and Plan,
- 8) Financial and Economic Analyses of the Master Plan,
- 9) Financial Policies and Plan,
- 10) Guidelines for the Implementation.

Formulating procedure of the Master Plan is shown in Figure 1.4.

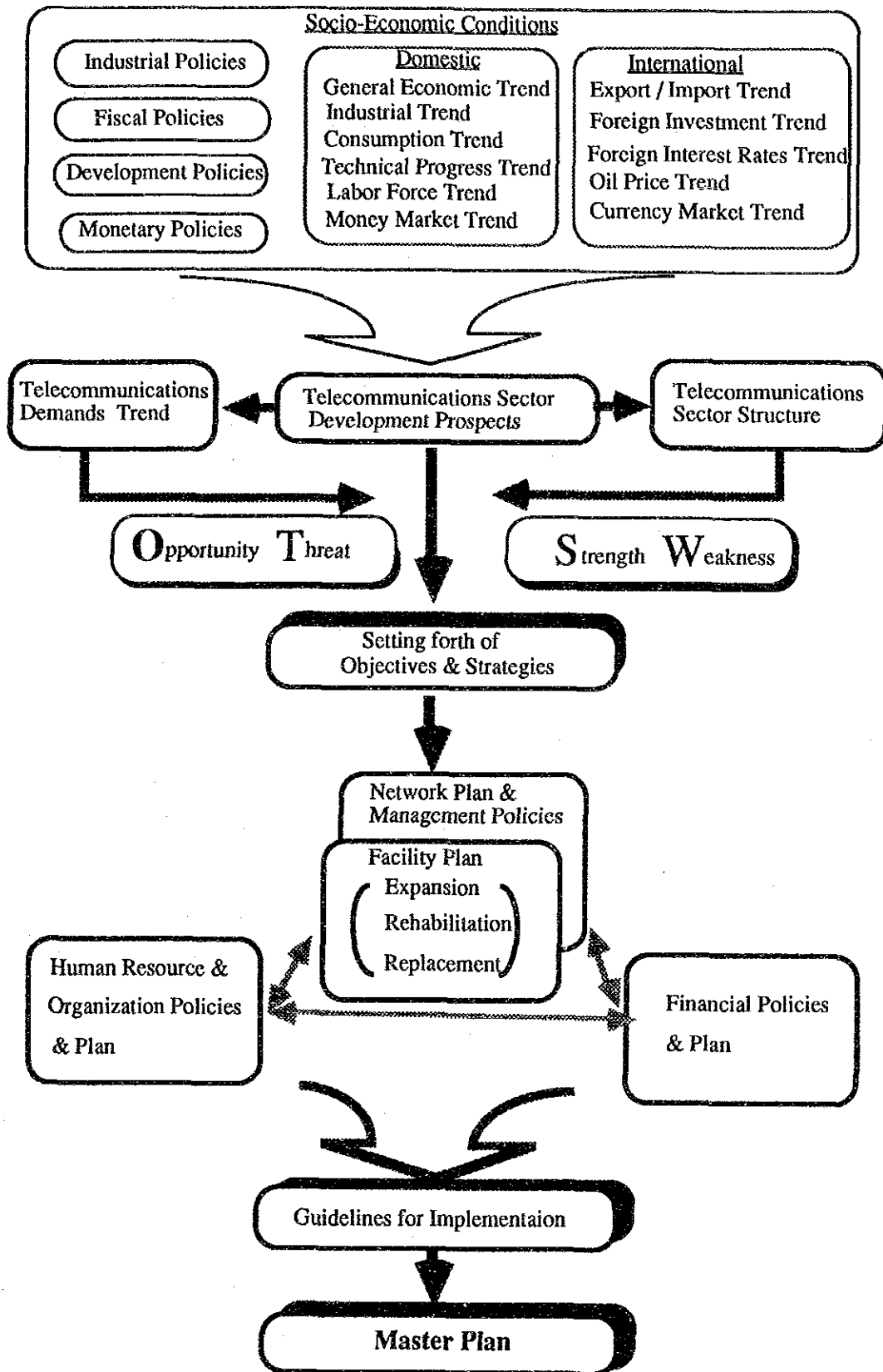


Figure 1.4 Formulating Procedure of The Master Plan



## 1.5 Execution Process of the Study

The study process is divided into seven phases as follows;

- Preparatory Work in Japan : Collection of the related materials and information,  
Preparation of Inception Report etc. Sept. 1988.
- Work in Thailand - 1 : Explanation of Inception Report, Data collection, Field  
surveys, Demand forecast, Preparation and explanation of  
Progress Report-1 Oct. - Dec. 1988.
- Work in Japan - 1 : Demand forecast, Traffic forecast, Brief study of facility  
plan, Preparation of Interim Report.  
Dec. 1988 - Feb. 1989.
- Work in Thailand - 2 : Explanation of Interim Report, Detailed study of facility plan,  
Study of tariff structure and financial plan, Study of  
management plan, Financial and economic analysis,  
Preparation and explanation of Progress Report-2  
Mar. - Jun. 1989.
- Work in Japan - 2 : Preparation of Draft Final Report. Jun. - Sept. 1989.
- Work in Thailand - 3 : Explanation and discussion of Draft Final Report.  
Oct. 1989.
- Work in Japan - 3 : Preparation of Final Report. Oct. - Nov. 1989.

1.6 Organization for the Study

1.6.1 Japanese Team Members

1) Preliminary Study Team

As shown in Table 1.6.1-1.

2) Advisory Committee

As shown in Table 1.6.1-2.

3) Main Study Team

As shown in Table 1.6.1-3.

Table 1.6.1-1 Preliminary Study Team Members  
(Contact Mission: Sept. 16 - 26, 1987. S/W Mission: June 6 - 10, 1988.)

Name	Duty in Charge	Affiliated to
Satoru ITOH*	Leader	Special Advisor, International Cooperation Division, Ministry of Posts & Telecommunications
Takao SATOH	Cooperation Policy	Member of Development Cooperation Div. Economic Cooperation Bureau, Ministry of Foreign Affairs
Takao YAMAZAKI	Transmission	Telecommunications Development Specialist, Japan International Cooperation Agency
Takahiro UENO	New Services	Member of Technology Policy Division, Communications Policy Bureau, Ministry of Posts & Telecommunications
Akira OHKUBO	Network	Trunk Communications Division, Radio Department, Telecommunication Bureau, Ministry of Posts & Telecommunications
Kin-ichi UMEYA*	Coordinator	Second Development Survey Division, Social Development Cooperation Dep. Japan International Cooperation Agency

Note: \* Members participated both of the above missions. Other members participated the Contact Mission only.

Table 1.6.1-2 Advisory Committee Members

Name	Duty in Charge	Affiliated to
Satoru ITOH* <sup>1</sup>	Chairman	Special Advisor, International Cooperation Division, Ministry of Posts & Telecommunications
Katsuharu NAKAMURA* <sup>2</sup>	Chairman	Special Advisor, International Cooperation Division, Ministry of Posts & Telecommunications
Akira OHKUBO* <sup>3</sup>	Member	Assistant to Director, Monitoring & Examination Division, Radio Dep., Ministry of Posts and Telecommunications
Kyotaro KARIMATA	Member	Senior Engineer, Telecommunication Systems Division, Telecommunications Business Dep., Telecommunications Bureau, Ministry of Posts & Telecommunications
Kin-ichi UMEYA* <sup>4</sup>	Coordinator	Second Development Survey Division, Social Development Cooperation Dep., Japan International Cooperation Agency
Kiyoshi NORITAKE* <sup>5</sup>	Coordinator	Second Development Study Division, Social Development Study Department, Japan International Cooperation Agency

Note:   \*1   Up to August 1989.                   \*2   From August 1989.  
           \*3   Up to March 1989.               \*4   Up to July 1989.  
           \*5   From July 1989.

Table 1.6.1-3 Main Study Team Members

Name	Duty in Charge	Affiliated to
Takao IWASHIMIZU	Survey Leader & Radio Transmission System Planning	Technical Advisor, Telecommunications Division, NTT International Corporation
Kanetoshi UCHINO	Assistant Survey Leader & Network Planning	Senior Manager, Telecommunications Division, NTT International Corporation
Satoru TAGAMI	Tariff and Financial Planning	Senior Manager, Telecommunications Division, NTT International Corporation
Katsumi MURAKAMI	Transmission System Planning	Senior Manager, Telecommunications Division, NTT International Corporation
Sadao KOIKE*1	Management Development Planning	Senior Manager, Telecommunications Division, NTT International Corporation
Toshiki TAMURA*2	Management Development Planning	Senior Manager, Telecommunications Division, NTT International Corporation
Akira KONAKAYAMA	Development Planning	Doctor of Economics, Professor, School of Political Science and Economics, TOKAI University
Ken-ichi WATANABE	Outside Plant System Planning	Senior Manager, Telecommunications Division, NTT International Corporation
Tsutomu KANKE	New Services	Senior Manager, Telecommunications Division, NTT International Corporation
Junji IHARA	Demand & Traffic Forecast	Manager, Telecommunications Division, NTT International Corporation
Hiroshi NAKAI	Switching System Planning	Chief, Telecommunications Division, NTT International Corporation
Hiroyuki KANO	Financial & Economic Analyses	Manager, Telecommunications Division, NTT International Corporation

Note: \*1 Up to February 1989.

\*2 From March 1989.

### 1.6.2 Thai Officers

This study work was performed in close cooperation with the executives and officers of the departments concerned in TOT. Among others, the director and the officers of Corporate Planning Office in TOT, shown in Table 1.6.2-1, continued to give the study team sincere cooperation, many arrangements and consideration as the counterparts during the study period.

Table 1.6.2-1 Counterparts of Corporate Planning Office, TOT

Name	Affiliated to
Mr. Sanan PHIROMSWAD	Director of Corporate Planning Office
Mr. Pairojn WONGCHAROEN	Head of Corporate Planning Process Sector, Corporate Planning Office
Mr. Apichat INDRALAGSHANA	Corporate Planning Office
Mr. Chakree SUBPRAWONG	Corporate Planning Office
Mr. Thawatchai VONGLUAN-NGAM	Corporate Planning Office
Mr. Seree CHINTARATANA	Corporate Planning Office
Mr. Kamron TEINTHONGDEE	Corporate Planning Office
Mr. Thusanai PIARABUTR	Corporate Planning Office
Ms. Chotip SUTHONTHUNYAKORN	Corporate Planning Office
Mr. Santasiri SIRISAKUDI	Corporate Planning Office
Mr. Tinnakorn ITSALANGKUL	Corporate Planning Office
Mr. Suwit TRECHAROENVIWAT	Corporate Planning Office
Ms. Jintana PRASERTSOM	Corporate Planning Office
Mr. Somchai VICMUKTANON	Corporate Planning Office

## **CHAPTER 2**

### **PRESENT STATES OF TELECOMMUNICATIONS**



## CHAPTER 2. PRESENT STATE OF TELECOMMUNICATIONS IN THAILAND

Section 2.1 outlines and discusses the socio-economic situations and problems during the periods of the past six National Economic and Social Development Plans (NESDP) as reference materials to analyze "Opportunities and Threats for development" discussed in Chapter 3. Sections 2.2, 2.3, 2.4, and 2.5 will analyze the present situations of telecommunications facilities, services, management of the operating entity, and telecommunications areas of Thailand to point out "Strength and Weakness" of the telecommunications sector.

### 2.1 Past and Present Socio-Economic Situations

#### 2.1.1 General Socio-economic Trend before the Sixth National Economic and Social Development Plan (1961 - 1986)

The economic performance of the recent Thai economy has been a pleasant surprise to everyone who holds great interests in Thailand. The major phenomena of the recent development are the rapid growth in manufactured exports and foreign investment boom, led by Japanese and Taiwanese firms. The Thai economy for the last couple of years has grown faster than ever. The twin deficits, the nagging macro-economic problems for many years, have started to show their improvement. The balance of payment has been significantly improved. The fiscal deficit of the government budget has been narrowed. Many people foresee that this trend will sustain over the next few decades. Thailand now is expected to lead countries following "the Asian Newly Industrializing Economies (Asian NIEs)" such as Korea, Singapore, Taiwan and Hong Kong in the near future.

Although many people were surprised by the recent performance of the Thai economy, a closer look at the Thai economy shows that Thailand has been able to maintain fairly steady growth for the last 25 years unlike unstable performances of many developing countries in the same period.

In 1958, Thailand changed its policies for industrialization and shifted the leading roles for industrialization to the private sectors from the public sector and promoted the development roles of foreign direct investment. The Thai economy steadily grew under import substitute development policies during the periods between the First and the Fourth NESDP and under an export oriented development policies afterwards.



The Thai economy steadily grew during the the periods of the First and Second NESDP (1961-1971) with 7 - 8 % of the growth rate on real GNP. The economy could still maintain 6 - 7 % of the growth rate during the periods of the Third and Fourth NESDP (1972-1981). For 20 years (1961 - 1981), real GNP and per capita GNP were quadrupled and doubled, respectively. The major reason behind this steady growth was well balanced growth of the agriculture sector through agricultural product diversification and further industrialization of the manufacturing sector.

Table 2.1.1-1 shows the trends of main economic indexes during the periods of the five NESDP.

Table 2.1.1-1 Trends of Main Economic Indexes

(Unit: %)

	The 1st ESDP	The 2nd ESDP	The 3rd ESDP	The 4th ESDP	The 5th ESDP
Annual GNP Growth Rate	8.10	7.20	6.20	7.30	4.90
Annual Agriculture Sec. Production Growth Rate	4.60	4.10	3.90	3.50	2.90
Annual Manufacturing Sec. Production Growth Rate	10.20	9.70	8.60	8.70	5.60
Annual Manufactured Export Growth Rate	8.70	4.10	14.00	20.00	7.60
Savings/GNP	26.00	20.40	24.60	22.60	18.20
Investment/GNP	25.40	24.10	23.60	26.70	22.70
Annual Inflation Rate	2.30	1.50	12.50	11.60	2.70
Trade Deficit/GNP	-	2.50	1.70	6.30	4.70
Government Deficit/GNP	0.70	2.90	2.70	3.30	3.70

Source: Compiled from NESDB data

Figure 2.1.1-1 shows the trends of GNP and per capita GNP in Thailand during the Fourth and Fifth NESDP periods (1977 - 1986).

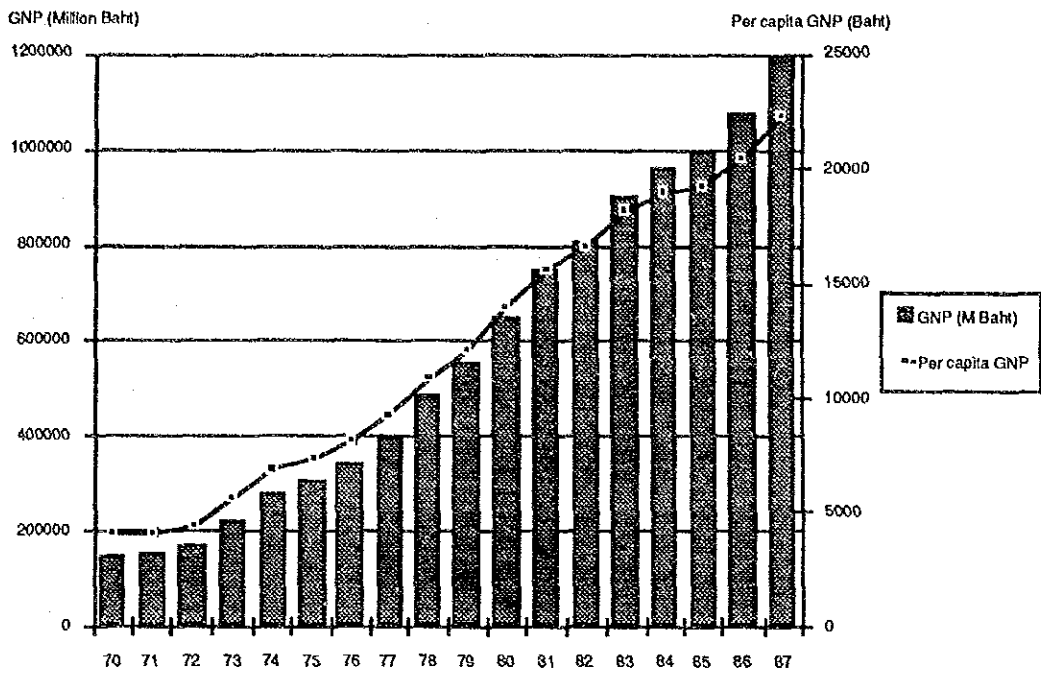
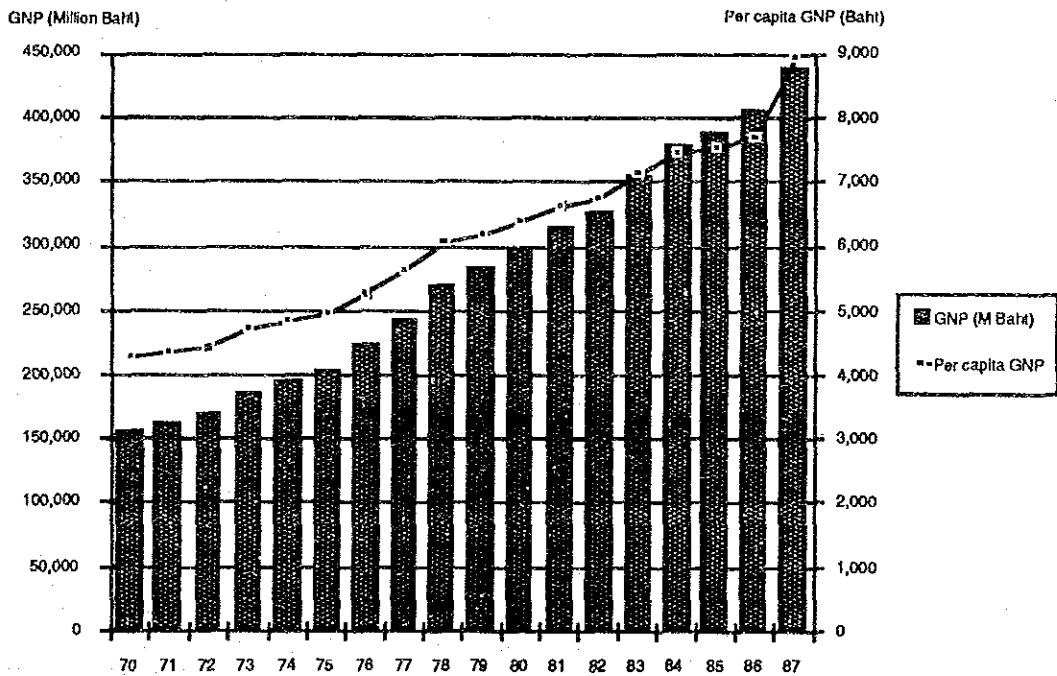


Figure 2.1.1-1 (1/2) GNP and Per capita GNP in Thailand at Current Market Price



Source: NESDB, NATIONAL INCOME OF THAILAND New Series 1970-1987, 1988

Figure 2.1.1-1 (2/2) GNP and Per capita GNP in Thailand at 1972 Prices

Table 2.1.1-2 shows how each sector contributed to the economic growth during the Fourth and the Fifth NESDP periods (1972 - 1986).

Table 2.1.1-2 Gross National Product at Current Market Prices by Industrial Origin

(Millions of Baht)

Year	1976	1981	1982	1983	1984	1985	1986
Agriculture	92,460	162,987	156,839	185,628	175,190	169,895	184,770
Mining and Quarrying	8,513	21,556	25,110	26,403	32,954	40,167	33,239
Manufacturing	68,186	169,461	176,360	194,344	218,050	224,456	253,593
Construction	15,093	38,135	41,500	47,985	56,092	56,824	56,564
Electricity and Water Supply	3,922	10,901	15,672	17,067	18,618	23,590	28,689
Transportation and Communication	20,200	45,850	55,639	60,809	69,530	78,076	86,763
Wholesale and Retail Trade	62,118	137,491	143,902	147,443	154,891	153,130	171,917
Banking, Insurance and Real Estate	8,874	22,639	26,120	31,145	34,426	35,988	37,220
Ownership of Dwellings	14,963	26,025	29,774	33,851	37,253	41,091	44,837
Public Administration and Defence	14,680	33,281	39,697	44,582	45,019	48,545	50,539
Services	37,507	91,869	109,389	120,797	131,389	142,637	151,410
Gross Domestic Product(GDP)	346,516	760,195	820,002	910,054	973,412	1,014,399	1,099,541
Plus: Net Factor Income Payment from the Rest of the World	-884	-12,035	-12,930	-6,701	-11,451	-17,597	-22,437
Gross National Product(GNP)	345,632	748,160	807,072	903,353	961,961	996,802	1,077,104

GDP Share (%)

Year	1976	1981	1982	1983	1984	1985	1986
Agriculture	26.7	21.4	19.1	20.4	18.0	16.7	16.8
Mining and Quarrying	2.5	2.8	3.1	2.9	3.4	4.0	3.0
Manufacturing	19.7	22.3	21.5	21.4	22.4	22.1	23.1
Construction	4.4	5.0	5.1	5.3	5.8	5.6	5.1
Electricity and Water Supply	1.1	1.4	1.9	1.9	1.9	2.3	2.6
Transportation and communication	5.8	6.0	6.8	6.7	7.1	7.7	7.9
Wholesale and retail trade	17.9	18.1	17.5	16.2	15.9	15.1	15.6
Banking, insurance and real estate	2.6	3.0	3.2	3.4	3.5	3.5	3.4
Ownership of dwellings	4.3	3.4	3.6	3.7	3.8	4.1	4.1
Public administration and defence	4.2	4.4	4.8	4.9	4.6	4.8	4.6
Services	10.8	12.1	13.3	13.3	13.5	14.1	13.8
Gross Domestic Product(GDP)	100.0	100.0	100.0	100.0	100.0	100.0	100.0

GDP Growth Rate (%)

Year	—	76-81	1982	1983	1984	1985	1986
Agriculture	—	12.0	-3.8	18.4	-5.6	-3.0	8.8
Mining and Quarrying	—	20.4	16.5	5.1	24.8	21.9	-17.2
Manufacturing	—	20.0	4.1	10.2	12.2	2.9	13.0
Construction	—	20.4	8.8	15.6	16.9	1.3	-0.5
Electricity and Water Supply	—	22.7	43.8	8.9	9.1	26.7	21.6
Transportation and communication	—	17.8	21.4	9.3	14.3	12.3	11.1
Wholesale and retail trade	—	17.2	4.7	2.5	5.1	-1.1	12.3
Banking, insurance and real estate	—	20.6	15.4	19.2	10.5	4.5	3.4
Ownership of dwellings	—	11.7	14.4	13.7	10.0	10.3	9.1
Public administration and defence	—	17.8	19.3	12.3	1.0	7.8	4.1
Services	—	19.6	19.1	10.4	8.8	8.6	6.2
Gross Domestic Product(GDP)	—	17.0	7.9	11.0	7.0	4.2	8.4

Source: NESDB, NATIONAL INCOME OF THAILAND New Series 1970-1987, 1988, p.18-19

The agricultural sector produced about 40% of GNP in the 1960's but produced less than 20% of GNP in the recent years, while the manufacturing sector increased its production share in GNP from 12% to more than 20% during the same period. In 1984, the manufacturing sector took over the number one position for the first time that the agricultural sector had kept.

From the GDP figures of the expenditure side, it is clear that the volume of export has been steadily increasing and that the share in GDP for the last twenty years has been also increasing every year as Table 2.1.1-3 shows.

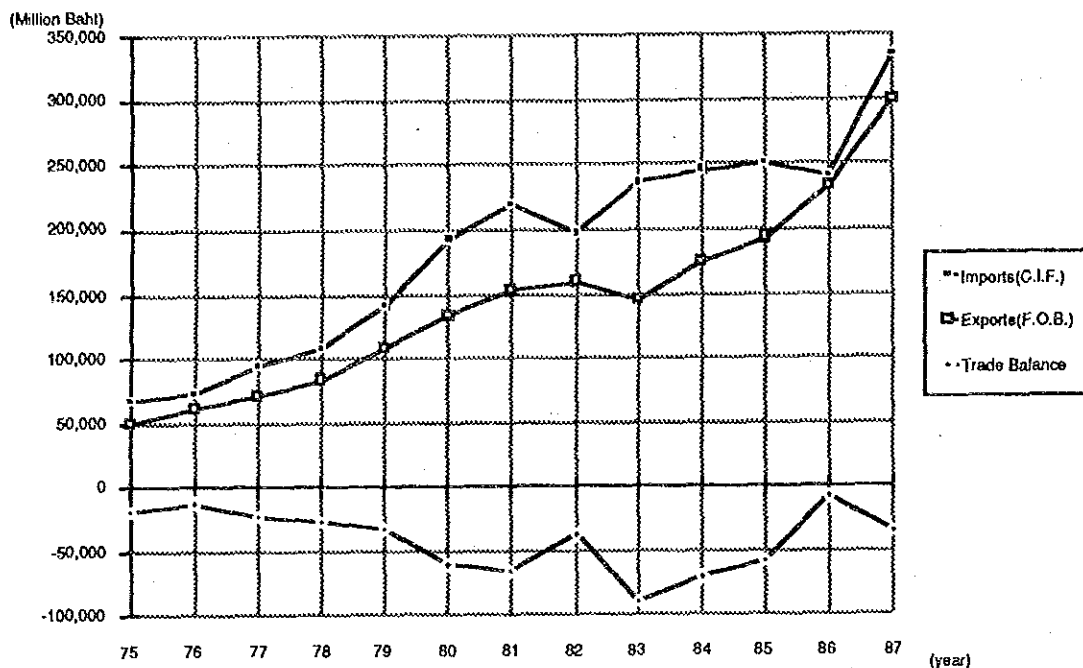
Table 2.1.1-3 Expenditures on Gross Domestic Product at Current Market Prices

(Unit: Million of Baht)

	1975	1980	1981	1982	1983	1984	1985	1986
Consumption	242.6	520.0	596.6	650.9	717.2	766.0	805.6	857.7
Private	211.3	438.6	499.6	540.7	598.6	635.9	662.7	713.1
Public	31.3	81.4	97.0	110.2	118.6	130.1	142.9	144.6
Gross fixed capital formation	69.4	165.7	188.1	192.2	218.4	238.6	240.3	237.5
Private	53.7	107.1	120.1	125.8	144.8	156.5	148.4	153.9
Public	15.7	58.6	68.0	66.4	73.6	82.1	91.9	83.6
Change in stocks	11.8	8.3	11.7	-2.6	17.6	3.9	3.7	3.8
Export of goods and services	55.7	159.7	181.3	192.9	185.2	216.4	245.3	290.2
Import of goods and services	69.7	201.2	229.0	207.3	251.2	258.6	274.1	267.1
Expenditures on GDP	309.7	652.7	748.6	826.0	887.3	966.4	1,020.7	1,122.0
Plus: Statistical discrepancy	-6.4	5.9	11.6	-6.0	22.8	7.0	-6.3	-27.4
GDP	303.3	658.5	760.2	820.0	910.1	973.4	1,014.4	1,094.7
Plus: Net factor income from abroad	0.0	-5.4	-12.0	-12.9	-6.7	-11.5	-17.6	-22.4
GNP	303.3	653.1	748.2	807.1	903.4	962.0	996.8	1,072.2

Source: NESDB

The traditional trade pattern of Thailand was to export primary agricultural commodities such as rice, maize, cassava, sugarcane and rubber and to import capital goods, industrial materials and consumption goods. As Figure 2.1.1-2 shows, the trade volume in both import and export expanded every year; however, the trade balance was continuously in red. Since the trade imbalance took its biggest deficit in 1983, the Thai government devalued the Baht and made a major policy change by stressing the new export leading growth strategy instead of the traditional import substitute strategy.



Source: National Statistical Office, Office of the Prime Minister, KEY STATISTICS OF THAILAND 1987, 1988

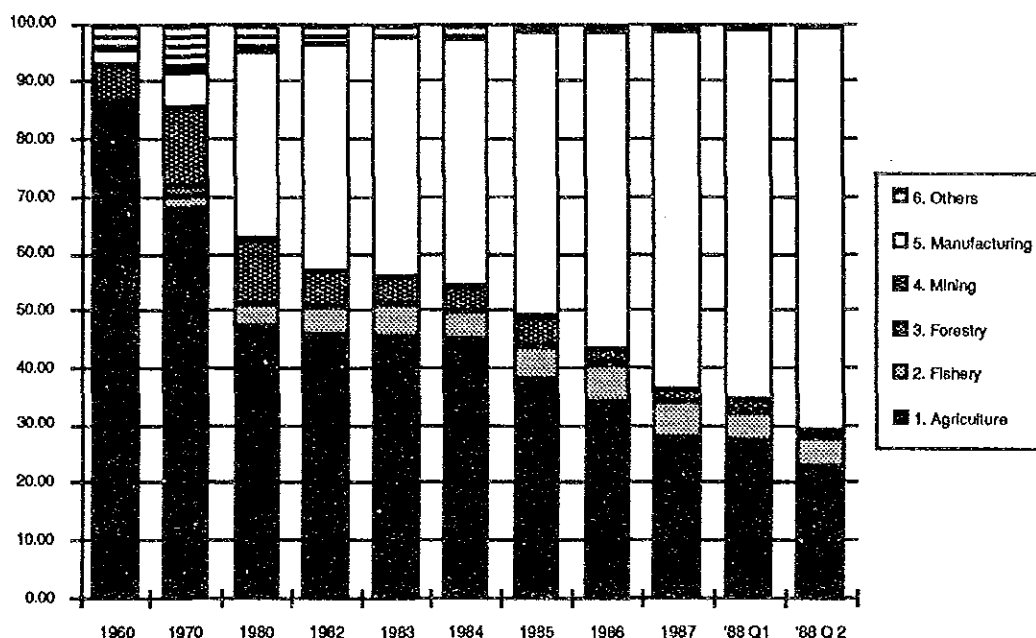
Figure 2.1.1-2 Imports, Exports and Trade Balance of Thailand (1975-1987)

Table 2.1.1-4 and Figure 2.1.1-3 show the change of the major exported commodities during the First and Fifth NESDP periods. In the 1960's, the export structure had a very skewed pattern in which agricultural commodities occupied almost 80% of the exported items, the share of rice and rubber being almost 60%. The share of the agricultural commodities went down to about 70% in 1970 and to about 50% in 1980. During these years new agricultural products such as maize, cassava, and sugarcane besides traditional commodities such as rice and rubber, became the major export items due to the agricultural product diversification promotion policy of the Thai government. The agricultural exports lost its number one position to manufactured exports in 1985 which took up almost 50% of the exported items. The textile products became the number one export item by surpassing rice in 1985.

Table 2.1.1-4 Percentage Distribution of Export Value by Economic Sectors

	1960	1970	1980	1982	1983	1984	1985	1986	1987
1. Agriculture	84.38	67.50	46.93	45.80	45.39	44.68	37.96	34.02	27.77
2. Fishery	0.41	2.49	4.16	4.78	5.62	4.96	5.48	6.36	6.06
3. Forestry	1.33	1.48	0.05	0.06	0.07	0.06	0.19	0.27	0.27
4. Mining	6.69	13.93	11.58	6.15	4.65	4.33	5.24	2.69	1.95
5. Manufacturing	2.44	6.10	32.33	39.57	41.89	43.42	49.45	55.35	62.71
6. Others	4.74	8.50	4.95	3.64	2.38	2.55	1.69	1.31	1.24
Total Exports	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Bank of Thailand, QUARTERLY BULLETIN



Source: Same as Table 2.1.1-4

Figure 2.1.1-3 Percentage Distribution of Export Value by Economic Sectors

Although consumption goods, especially non-durable consumption goods, were major import items in the 1960's, imports of raw materials and capital goods increased while the import share of non-durable consumption goods decreased and the imports of durable consumption goods increased as the policy change from the import substitute strategy to the export oriented strategy were emphasized more.

However, the change of the industrial structure caused little structural change in the labor market. The agricultural sector grew not by increase in land productivity but by

expansion of farming land and product diversification. This caused little employment structural change. More than 70% of the labor force were still employed in the agricultural sector in the 1980's.

The forest area shrunk to only 30% of the country because of expansion of farming land. Rapid expansion of the farming land and delayed efforts to maintain the forest area caused frequent floods and other environmental problems and prevented land productivity from being improved.

The growth rate of GNP went down from the previous 7% level to the 4.9% figure on the average during the Fifth NESDP period and even failed to realize the Fifth NESDP target figure of 6.6%. The reasons behind the poor performance of this period were:

- the world-wide recession,
- rise of protectionism movement among developed countries,
- unfavorable terms of trade for the Thai agricultural commodities,
- instability of international currency market,
- increased competition in international markets.

These struck the Thai agricultural and export sectors hard and caused the following vicious cycle:

- decrease of the purchasing power of Thai farmers,
- decrease in the amount of consumption,
- decrease of GNP,
- decrease in over-all demands,
- decrease in investment incentives,
- decrease in the amount of investment,
- decrease of GNP.

To get out of this vicious cycle, the Thai government started to promote the following policies:

- to strengthen the agriculture sector and export sector by increasing productivity of and by diversifying products of the agriculture sector,
- to devalue the Baht and to change the development policy from the import substitute strategy to the export oriented strategy,

- to develop more competitive manufactured exports and to promote more exports,
- to establish more regional industry bases and industrial complex through promoting small and medium size enterprises and local resources utilizing industries.

The Thai economy plunged into a sever recession and the following two major problems emerged in the early 1980's.

- Widening Gaps among Industrial Sectors and Regions (Dual Economic Structure Problem and Urban-Rural Gap Problem), Especially Urban Congestion Problems of Bangkok and Widening Gap between Bangkok and the Provincial Areas.
- Twin Deficits Problem, Increase in the Government Budget Deficit and Persisting Trade Deficit Caused by Slow Adjustment of Policy Change from the Import Substitute Strategy to the Export Oriented Strategy.

The above two problems will be discussed in more details.

1) Widening Gaps among Industrial Sectors and Regions (Dual Economic Structure Problem and Urban-Rural Gap Problem), Especially, Urban Congestion Problems of Bangkok and Widening Gap between Bangkok and the Provincial Areas.

The stagnation of the agricultural sector, mainly located in the outside of the Bangkok area and the amazing performance of the non-agricultural sectors, mainly located in the Bangkok area, widened the disparities of growth rates and income levels between the agricultural sector and the non-agricultural sector and between the Bangkok area and the other provincial areas.

Table 2.1.1-5 shows the number of employees and the percentage share for each sector during the Third, Fourth and Fifth NESDP periods. The share of the employees of the agricultural sector was more than 70% of all the employees in Thailand while the manufactured sector increased the number of employees by 1.3 millions during those years which was only 5.6% of all the employees. The manufacturing sector did not offer many job opportunities.



Table 2.1.1-5 Employment Classified by Industrial Sector

(Unit: Thousand)

Year	1971	1975	1980	1981	1982	1983	1984	1985	1986
Agriculture	13,767 78.91%	14,181 73.41%	16,779 70.79%	17,973 72.17%	17,594 68.85%	17,558 69.25%	18,453 70.22%	18,090 68.89%	18,133 67.10%
Mining	76 0.44%	72 0.37%	112 0.47%	102 0.41%	91 0.36%	98 0.39%	99 0.38%	91 0.35%	93 0.34%
Manufacturing	690 3.95%	1,407 7.28%	1,864 7.86%	1,744 7.00%	2,018 7.90%	1,842 7.27%	1,995 7.59%	2,068 7.88%	2,076 7.68%
Construction	198 1.13%	214 1.11%	451 1.90%	467 1.88%	520 2.03%	511 2.02%	535 2.04%	582 2.22%	592 2.19%
Electricity, gas, and water supply	32 0.18%	42 0.22%	62 0.26%	67 0.27%	72 0.28%	78 0.31%	80 0.30%	82 0.31%	83 0.31%
Transportation and Communication	224 1.28%	395 2.04%	473 2.00%	393 1.58%	501 1.96%	535 2.11%	519 1.97%	532 2.03%	605 2.24%
Trade and banking	1,234 7.07%	1,428 7.39%	2,001 8.44%	2,089 8.39%	2,354 9.21%	2,194 8.65%	2,223 8.46%	2,377 9.05%	2,704 10.01%
Other services	1,226 7.03%	1,578 8.17%	1,961 8.27%	2,069 8.31%	2,403 9.40%	2,537 10.01%	2,376 9.04%	2,437 9.28%	2,736 10.13%
Total	17,447 100%	19,317 100%	23,703 100%	24,904 100%	25,553 100%	25,353 100%	26,280 100%	26,259 100%	27,022 100%
Unemployment rate (%)									
Round 1 (February)	0.2	0.3	N.A.	1.4	1.6	3.9	3.8	4.1	5.1
Round 2 (August)	0.2	0.4	0.9	0.8	3.0	2.0	1.9	3.1	3.2

Source: Lamduan Pawakaranond, "Thailand's Country Paper", NESDB, May 1988.

The percentage figure of GNP of the Bangkok metropolitan Region (BMR), which consists of the Bangkok-Tonburi area and the five surrounding provinces of Samut Prakan, Samut Sakhon, Nakhon Pathom, Nonthaburi and Pathum Thani, was 29% in 1970, but went up to 46% in 1985.

Table 2.1.1-6 shows the distribution of GDP by sector and region. Also given are the population distribution, and GDP per capita. While the BMR contained about 16% of the total population, it accounted for about 46% of GDP. Per capita GDP of the BMR was about 7.3 times, 4.4 times, 4 times, and 2.8 times larger than those of the Northeast region, the North region, the South region, and the Central region, respectively. It can be safely said that the BMR alone has reached the status of an NIE.

Table 2.1.1-6 Gross Domestic Product at Current Market Price by Region

(Unit: 1985, Million of Baht)

	Whole Kingdom	Northeast	North	South	Central	Bangkok *1
Agriculture	178,533	41,721	42,302	33,462	50,221	10,827
Industry	316,697	20,611	24,295	15,367	54,694	201,730
Services	546,124	83,365	68,799	49,126	83,209	261,625
Total GDP	1,041,354	145,697	135,396	97,955	188,124	474,182
Per Capita GDP (Baht)	20,148	8,083	13,304	14,737	21,395	58,963
Population (Million)	51.684	18.025	10.177	6.647	8.793	8.042

Percent Share

	Whole Kingdom	Northeast	North	South	Central	Bangkok *1
Agriculture	100.00%	23.37%	23.69%	18.74%	28.13%	6.06%
Industry	100.00%	6.51%	7.67%	4.85%	17.27%	63.70%
Services	100.00%	15.26%	12.60%	9.00%	15.24%	47.91%
Total GDP	100.00%	13.99%	13.00%	9.41%	18.07%	45.54%
Population	100.00%	34.88%	19.69%	12.86%	17.01%	15.56%

Source: NESDB, GDP by Province, 1985

Note: \*1 Bangkok here includes the Bangkok-Tonburi area and the 5 surrounding provinces, i.e., the BMR.

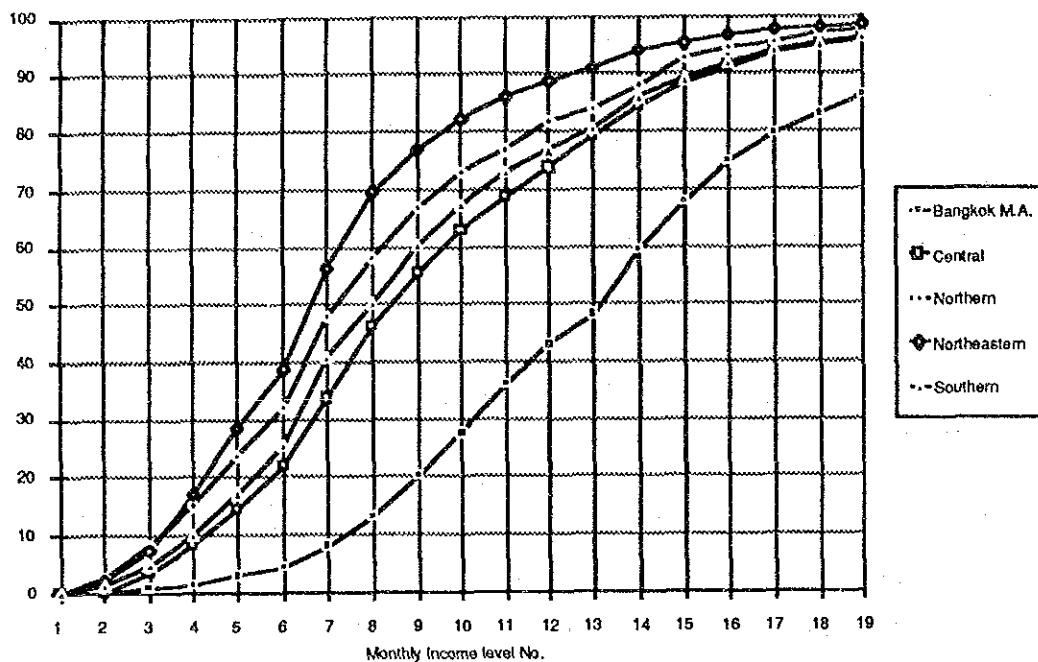
The Northeast region lags far behind the other regions. It contains about 35% of the total population while its share of GDP was only about 14%. The Central region had the next highest per capita GDP. Next came the South region and then the North region.

The share of the agricultural GDP was the highest in the Central region at about 28%. The North and Northeast regions had almost the same shares of the agricultural GDP at about 24%, while the South region had about 19%. The shares of the service GDP across region were almost the same.

For the manufacturing industry, almost two thirds of total GDP were originated from the BMR (about 64%). The Central region had the next highest share of GDP from the manufacturing industry, about 17%, the other regions all had the a share of less than 8%.

Figure 2.1.1-4 shows the monthly household income distribution patterns in the five regions. Households in the Bangkok-Tonburi area also have higher monthly income levels than those in other regions.

(%) Accumulated Percentage of Household



Level No.	Monthly Income	Bangkok M.A.	Central	Northern	Northeastern	Southern
1	250	0.1 %	0.0 %	0.1 %	0.1 %	0.2 %
2	499	0.2 %	0.2 %	2.6 %	2.4 %	1.5 %
3	749	0.7 %	3.4 %	8.3 %	7.4 %	4.8 %
4	999	1.5 %	8.4 %	15.3 %	17.2 %	10.4 %
5	1,249	2.9 %	14.6 %	23.8 %	28.7 %	17.4 %
6	1,499	4.3 %	22.0 %	32.3 %	38.8 %	25.4 %
7	1,999	8.1 %	33.7 %	47.9 %	56.3 %	40.7 %
8	2,499	13.0 %	46.2 %	57.9 %	69.6 %	50.3 %
9	2,999	20.1 %	55.6 %	67.0 %	77.0 %	60.3 %
10	3,499	27.4 %	63.1 %	73.1 %	82.5 %	67.4 %
11	3,999	36.1 %	68.9 %	76.7 %	86.2 %	73.0 %
12	4,499	42.9 %	73.8 %	81.8 %	88.7 %	76.9 %
13	4,999	48.1 %	79.3 %	84.1 %	90.9 %	80.4 %
14	5,999	59.6 %	84.4 %	88.3 %	94.0 %	86.1 %
15	6,999	68.0 %	88.6 %	92.7 %	95.4 %	89.2 %
16	7,999	74.7 %	91.2 %	94.7 %	96.8 %	92.0 %
17	8,999	79.5 %	93.7 %	95.6 %	97.7 %	94.1 %
18	9,999	83.0 %	95.0 %	97.3 %	98.0 %	95.2 %
19	10,999	86.5 %	96.0 %	97.7 %	98.4 %	96.1 %

Source: National Statistical Office, Office of the Prime Minister, THE 1986 HOUSEHOLDS SOCIO-ECONOMIC SURVEY

Figure 2.1.1-4 Household Income Distribution Patterns in Five Regions

The number of manufacturing companies excluding rice mills in Thailand was approximately 40,000 in 1983. About 74% of them are concentrated in the BMR and the Central region. Almost 90% of the companies engaged in textile, apparel, leather, printing

and press, plastic products, and machinery were concentrated in this region. According to the 1984 Industrial Statistics, all establishments in 51 industries were found in the BMR and , in 86 industries, more than 50% of the establishments were found in the BMR.

However, the concentration rates of food and beverage, fertilizer, wood products, and electric machinery ranged between 25.8% and 50%. The low concentration figures of these industries imply that food and beverage and fertilizer industries are local resource utilizing industries and that the electric machinery industry is quite labor intensive and is, therefore, located in areas where cheap and abundant labor workers are available.

Of 1,426 manufacturing companies approved by BOI between 1960 and 1986, 933 companies (65.4%) are located in the BMR. The reasons for this high industrial concentration are as follows:

- the port of Bangkok is the only port in the country which can handle a large amount of cargo,
- Bangkok is the biggest market in Thailand and other market areas are comparatively very small,
- the BMR offers the best infrastructure services,
- Bangkok offers the best urban functions and commercial and public services.

Although the benefits of being located in the BMR have been decreasing because of poor land foundation, traffic congestions, lack of industrial sites, land price inflation, and other various adverse effects of too much concentration, heavy investors still regard the BMR as the best place for investment.

The Thai government has been promoting relocation of establishments in the Bangkok-Tonburi area to other areas. Establishments, however, tend to move only within the BMR.

There are twelve industrial parks in Thailand. Only two industrial parks, one in the North region and the other in the Northeast region, are not in the BMR. Six industrial parks are located within 60 km radius of the Bangkok-Tonburi area.

2) Twin Deficits Problem, Increase in the Government Budget Deficit and Persisting Trade Deficit Caused by Slow Adjustment of Policy Change from the Import Substitute Strategy to the Export Oriented Strategy.

Both deficits had become worsened since the middle of the Fourth NESDP period. The widened savings and investment gap due to the decrease of the savings rate caused the twin deficits problem. As a result, the amount of the external debt went up with an accelerated speed and the debt service ratio also went up to about 11%, though this figure was not so high as those of South American countries and the Philippines. This problem forced the government to cut back large-scale public investment projects.

The fundamental structure of the balance of payment has been that the deficit of the trade balance was covered by the surpluses of the non-trade balance and the foreign capital inflow. This structure created a large amount of external borrowings and, as a result, a large amount of accumulated external debt. Table 2.1.1-7 shows this trend.

Table 2.1.1-7 Balance of Payment

(Unit: Million of Baht)

Year	1975	1981	1982	1983	1984	1985	1986
Merchandise Balance	-20,161	-65,782	-36,137	-89,237	-68,796	-61,672	-14,369
Nonfactor Service Balance	2,780	16,998	20,291	20,768	24,668	29,061	33,739
Factor Service Balance	3,381	-10,956	-11,495	-4,193	-9,469	-13,808	-18,769
Net Transfers	1,632	3,690	4,203	6,377	4,128	4,494	5,914
Current Account Balance	-12,368	-56,050	-23,138	-66,285	-49,469	-41,925	6,515
Net Capital Flow	7,755	55,131	38,345	34,681	58,365	51,433	11,354
Allocation of SDRs	0	488	0	0	0	0	0
Errors and Omission	1,756	2,962	-11,893	13,527	1,692	2,956	15,710
Overall Balance	-2,857	2,531	3,314	-18,077	10,588	12,464	33,579
Change in Reserves	2,857	-2,531	-3,314	18,077	-10,588	-12,464	-33,579

Source: Bank of Thailand

Table 2.1.1-8 shows the trend in Government revenue and expenditures. The government budget deficits ranged around the level of 35 billion baht a year since 1984. Revenue started to increase rapidly since the later part of 1986, following the growth in tax revenue.

Table 2.1.1-8 National Government Actual Revenue &amp; Expenditure

(Unit: Million Baht)

Year	1981	1982	1983	1984	1985	1986
Total Revenue	111,843	115,980	143,436	148,242	160,649	169,925
Taxation	100,906	105,076	129,062	136,246	144,947	154,202
-Income Taxes	22,484	24,790	27,870	31,810	35,231	34,767
-Indirect Taxes	78,422	80,286	101,192	104,436	109,716	119,435
Sales & charges	1,475	2,133	2,129	2,131	2,545	2,906
Contribution from State Enterprises	3,495	3,309	3,524	3,509	6,251	5,836
Miscellaneous	5,967	5,462	8,721	6,356	6,906	6,981
Total Expenditure	133,444	157,017	167,088	182,228	200,028	204,279
Economic Classification						
Current	105,259	125,904	137,355	154,481	166,937	173,557
Capital	28,185	31,113	29,733	27,747	33,091	30,722
Major functional Classification						
Economic Services	26,218	27,902	27,969	28,573	30,534	29,928
Social Services	37,586	47,940	50,524	55,419	58,949	60,156
Defence	25,917	31,350	31,685	36,034	43,184	41,125
General Admi. & Services	19,424	18,134	24,556	24,304	25,765	25,761
Unallocable Items	24,299	31,691	32,354	37,898	41,596	47,309
Treasury Deficit (-) or Surplus	-21,601	-41,037	-23,652	-33,986	-39,379	-34,354

Source: Bank of Thailand

Table 2.1.1-9 shows the trends of

- total external debt,
- ratio of total external debt to GDP,
- debt service ratio.

Table 2.1.1-9 External Debt

(Unit: Million of US Dollars)

Year	1975	1981	1982	1983	1984	1985	1986
Long-Term Debt	1,352.4	7,931.3	9,156.6	10,562.9	11,429.7	14,327.2	15,708.2
Amount Disbursed and Outstanding	1,352.4	7,225.7	8,454.8	9,655.7	10,638.4	13,307.0	14,720.0
Public and Publicly Guaranteed	554.5	2,883.7	3,468.3	4,280.1	4,504.0	5,844.0	7,163.0
Private Creditors	61.7	2,243.4	2,669.6	2,720.3	2,762.4	4,093.1	4,449.2
Private Nonguaranteed	736.2	2,098.6	2,316.9	2,655.3	3,372.0	3,369.9	3,107.8
Use of IMF Credit	0.0	705.6	701.8	907.2	791.3	1,020.2	988.2
Short-Term Debt Outstanding	0.0	2,878.0	3,041.0	3,305.0	3,551.0	3,200.0	2,840.0
Total External Debt Outstanding	1,352.4	10,809.3	12,197.6	13,867.9	14,980.7	17,527.2	18,548.2
Total External Debt/GDP	9.1%	31.0%	34.2%	35.0%	36.4%	46.9%	44.4%
Total Long-Term Debt Service/Exports of Goods & Services	12.0%	14.4%	16.0%	19.1%	21.5%	25.3%	25.4%

Source: Bank of Thailand

The ratio of public sector external debt to GDP increased on average by 2.5 % per year between 1981 and 1985, reaching 24.6% of GDP in 1985. In 1986, the stock of public sector external debt increased by 10.6% in baht terms because of exchange rate movements, especially appreciation of yen.

## 2.1.2 The Sixth National Economic and Social Development Plan

### 1) The Sixth National Economic and Social Development Plan

To solve the problems emerged during the period of the Fifth NESDP, the Sixth NESDP was started in 1987. This plan will continue until 1991.

The Sixth NESDP aims to direct the Thai economy and the society toward a state of higher degree of autonomy, and higher growth sustainability under uncertain and unstable world situations and to upgrade the standard of living of Thai people through utilizing scarce resources in Thailand more efficiently.

The main framework of the Sixth NESDP is shown in Figure 2.1.2-1.

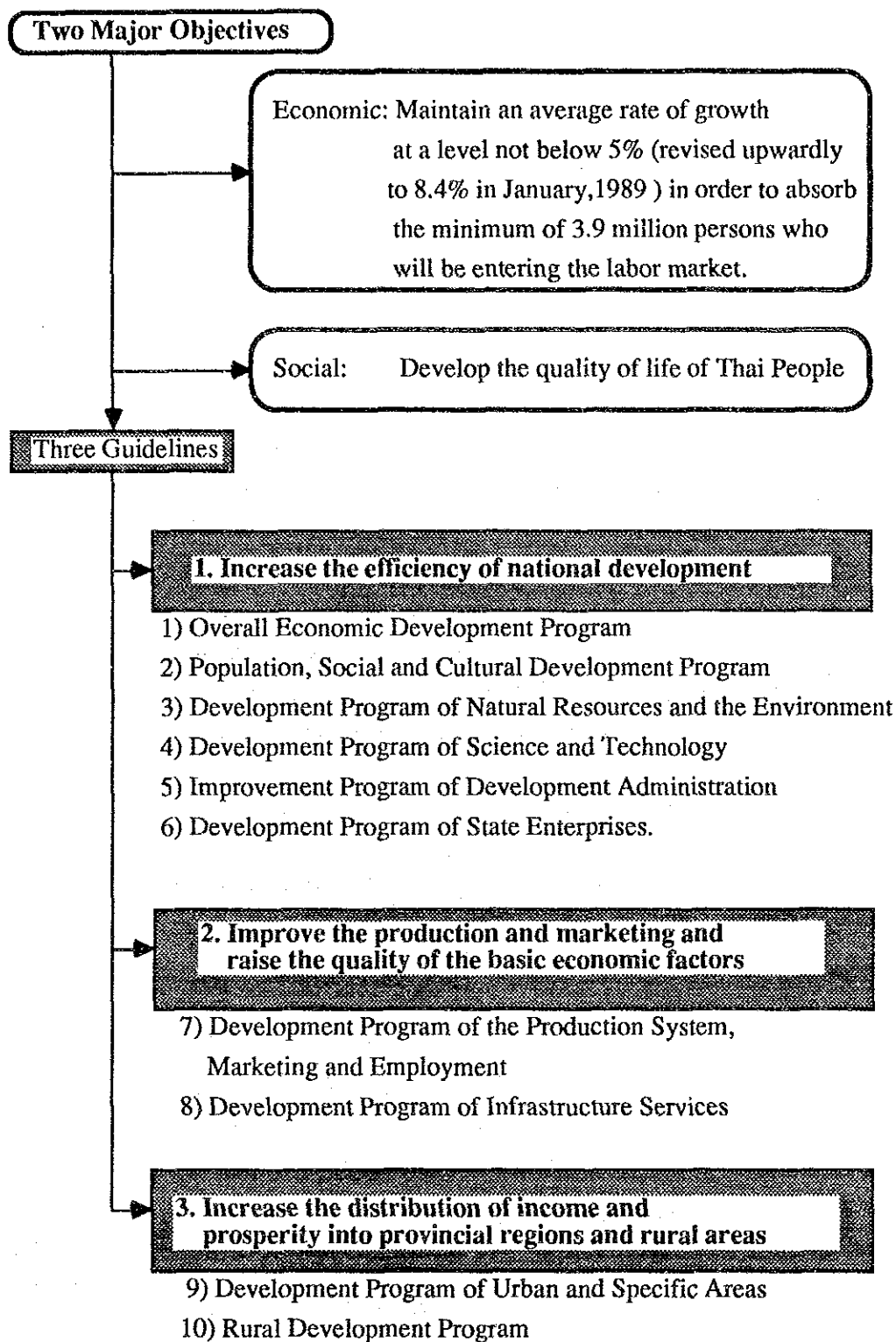


Figure 2.1.2-1 The Main Framework of the 6th NESDP



2) The Eastern Seaboard Development Program

The Eastern Seaboard Development Program (ESP) was originally planned as a first priority development program in the Fifth NESDP and is also ranked as one of the highest priority development programs in the Sixth NESDP. The ESP aims to develop heavy chemical industries which utilize natural gas produced in Gulf of Siam and labor intensive export oriented light industries and to decentralize and relocate industries which are presently concentrated in the BMR. The ESP is the first public large-scale long-term regional development project in Thailand.

The ESP will be implemented in the area called the Eastern Seaboard which covers three provinces of Chon Buri, Rayong, and Chachoengsao (3% of the country and 4% of the total population). Leam Chabang and Map Ta Phut areas are the centers of the ESP.

The Leam Chabang area is located in Chon Buri province which is southeast of and 125 km out of Bangkok and north of and 15 km out of Pattaya, an internationally famous resort city. This area will develop a commercial deep sea port which will be the number one international seaport in Thailand in place of the presently overly congested Bangkok port and also develop export-oriented labor intensive and pollution free light industries.

The Map Ta Phut area is located in Rayong province which is southeast of and 200 km out of Bangkok. The pipe line for natural gas produced in the Gulf of Siam comes out of this area. Natural gas related to heavy chemical industries will be promoted to develop currently import depending petro-chemical products in Thailand. An industrial deep seaport will be also constructed to establish this area as the national center for infant heavy chemical industries.

The ESP is also expected to spread economic influences toward the Northeast region. Once accessibility to the Northeast region from the Eastern Seaboard area is improved by development of transportation and communications infrastructure, large firms, small and medium size subcontracting firms and supporting industries of machinery parts manufacturing and assembling, light industries, and agricultural products processing industries are expected to locate along with major highways toward Nakhon Ratchasima.

3) The Recent Performance

Following a period of policy adjustment and unsteady economic performance during the first half of the 1980's, the Thai economy has been achieving an impressive record of economic expansion since 1986.

Table 2.1.2-1 shows the target, actual, and forecasted figures of major economic indexes during the Sixth NESDP period. The actual performance of the Thai economy surpassed well over the target figures in 1987 and 1988. This trend is expected to continue for the rest of the Sixth NESDP period.

Table 2.1.2-1 Targets and Recent Results of the 6th NESDP

	Target of the 6th ESDP (1987-91)	1987 (actual)	1988 (estimate)	1987-91 (forecast)
1. Real GDP Growth Rate (%)				
1.1 GDP	Over 5.0	7.1	8.3	7.0
1.2 Agriculture & Fishery	2.9	-2.5	3.0	1.9
1.3 Non Agriculture & Fishery	5.7	9.4		
1.4 Manufacturing	6.6	10.2	11.2	9.2
1.5 Mining	6.4	8.9		
1.6 Electricity & Water Supply	6.1	12.2		
1.7 Construction	5.1	7.3		
1.8 Services	5.3	9.4		
2. Real Demand Growth Rate (%)				
2.1 Consumption	4.0			
a. Private	3.7	6.4	6.9	6.7
b. Public	5.3	5.2	7.1	7.3
2.2 Gross Fixed Capital Formation	5.8			
a. Private	8.1	17.2	28.8	
b. Public	1.0	-6.5	19.0	
3. Consumer Price Increase Rate (%)	2.3	2.5	4.5	3.7
4. Balance of Payment (per year)				
4.1 External Deficit (Billion Baht)	11.8	15.0	35.5	45.4
4.2 External Deficit/GDP (%)	0.9	1.2	2.6	2.8
a. Export Value Increase Rate (%)	9.9	22.4	23.9	16.6
b. Export Volume Increase Rate (%)	7.4	14.2	16.0	11.4
c. Import Value Increase Rate (%)	9.3	33.1	26.0	19.3
d. Import Volume Increase Rate (%)	4.5	22.9	16.9	14.8
4.3 Trade Deficit (Billion Baht)	35.9	45.7	63.0	68.0
4.4 Trade Deficit/GDP (%)	2.7	3.7	4.5	4.4
a. Commodity Export (Billion Baht)	290.7	298.2	361.0	412.4
1) Export Value Increase Rate (%)	10.7	28.8	21.0	18.2
2) Export Volume Increase Rate (%)	8.1	21.8	16.0	13.7
b. Commodity Import (Billion Baht)	326.7	343.9	424.0	480.3
1) Import Value Increase Rate (%)	9.5	39.9	23.2	20.1
2) Import Volume Increase Rate (%)	4.6	31.6	16.2	16.3
5. Increase Rate of Revenue from Tourism (%)	7.4	20.6	23.2	13.0
6. Per Capita GNP (Baht)	27,783	22,850	24,700	31,200
(US Dollar)		890	980	1,200
7. Population Growth Rate (%)	1.3	1.8	1.74	1.66

Source: Japanese Chambers of Commerce, THAILAND ECONOMIC OUTLOOK (1988-1989), p.49, Jan. 1989

The most important factors that contributed to the recent economic success are the depreciation of US dollars, fall of the oil price and interest rates and the rising manufacturing costs in Japan and Asian NIEs. However, it cannot be overlooked that external factors were magnified by domestic conditions such as stable political conditions, clean bureaucracy,

promotion of foreign direct investments, well organized market conditions, domestic market size, good quality and reliable labor force, too.

First, unlike many developing countries, the Thai Government did not pursue a policy of carrying out large scale public investment projects as a driving force for industrialization. The government carefully avoided going into deep fiscal and external debts. Most of investment decisions were made by private sectors and, as a result, a production and marketing system that could flexibly respond to market opportunities was cultivated. In that system, Thai manufactures built up a sound foundation and were ready to respond to favorable opportunities vigorously.

#### 4) Constraints to Growth and Emerging Policy Issues

In order for Thailand to continue its rapid growth, the government has to promote policies to establish higher autonomy and stronger sustainability in the Thai economy. To do so, it may have to consider increasing flexibility and competitiveness and at the same time reducing some major constraints which have hindered the economic growth in the past.

The most important problem for the future economic expansion is the state of infrastructure. Almost two-thirds of the government budget for development purposes have been used to provide basic infrastructure since the First NESDP. After several years of cutbacks in public investment programs to keep the government deficits low, the present state of infrastructure is not adequate to support the recent unexpected rapid economic expansion. Bottlenecks are emerging in ports, energy, industrial water supply, transportation, and telecommunications.

Under the constraint of keeping conservative fiscal stance, the government has to strategically plan infrastructure development policies. To effectively utilize the scarce resources, the government should not only identify strategically important major infrastructure facilities, but also develop minor related facilities and integrate them into major facility network systems so that synergy effects are well exploited. To plan and implement strategies, reformation of the development administration and state enterprise system must be made.

It has been estimated that the public sector's investment may have to increase from 6.8% of GDP in 1987 to around 8% in the near future. If the government fails to improve the state of infrastructure, the cost of production will escalate, thereby stifling the growth of manufacturing industries.

At the same time, the government must maintain a sound macro-economic balance as a prerequisite condition for industrial growth. The Thai government must maintain both fiscal and trade balances in good order.

The government faces difficult tasks of achieving several conflicting objectives at the same time. The government spending will inevitably increase to develop infrastructure and to provide increased public services as income levels rise. The share of investment in GNP will also certainly increase as the capital-intensive manufacturing sector becomes a more dominant growth force in the future. Unless the private savings and the government revenue also increase in a consistent manner as private investment and public expenditures increase, the investment-savings gap and the fiscal deficit will widen. As a result, imports will exceed the exports and the external debt problem will become serious to disrupt economic expansion. Increase in government expenditures will also be a major cause of inflation.

Therefore, while the Thai Government has to maintain a basically conservative fiscal stance not to produce inflationary pressure, it must continue its efforts to develop infrastructure, to raise the operating efficiency of the state enterprises, to increase its tax revenue to improve fiscal conditions by reforming the taxation system, to promote financial liberalization to increase private savings and to efficiently utilize foreign capital, to simplify import tariff, to reduce corporate tax rates, to create export incentives, to legislate local contents regulations on usage of Thai made parts and intermediate materials, to develop human resources and to improve compensation systems for workers.

Under the existence of a wide investment-savings gap, reformation of the financial sector is essential to promote private savings and business activities through efficient utilization of foreign capital funds. Continuous and stable supply of both short-term and long-term capital funds must be secured to promote the growth of the export oriented manufactures, small and medium size firms and the agriculture sector. Reformation of the financial sector must be made as well as tax and salary systems reformations to promote private savings. Reformation of the financial sector must be carried out on the following points:

- restructuring of the financial system by establishing financial intermediaries for long-term capital funds,
- review of interest rate system,
- expansion of availability of medium-long term credits,

- coordination of business activities of commercial banks and the central bank policies.

Vitalization and expansion of the stock market is also a major issue in the financial sector reformation. More stocks of private and public corporations with excellent business records are expected to be issued and to be made public. Institutional investors are expected to play more active roles in the stock market. Laws and regulations on fair trade of stocks are expected to be reviewed and implemented.

People are the most important key ingredient for development even with well designed industrial, financial, and infrastructure policies. The supply of skilled labor and professionals, especially engineers, will be in serious shortage in a few years and the supply of unskilled labor will be also in shortage in several years as the trend of the present economic growth continues. Labor shortage will not only stifle economic growth but also increase labor price and cause inflation.

To improve the quality of human resources, improvement of the education system is essential. To improve the over-all quality of the labor force, upgrading and expansion of secondary education is needed. For skilled and professional workers, more emphasis on science and engineering education should be made.

It is also urgently needed to reform salary and compensation systems to improve people's standard of living, to increase labor productivity, and to create savings incentives as well as development of human resources.

To transform the industrial structure of Thailand from the agriculture dominant, simple, and fragile structure to more industrialized, sophisticated, and self-sustainable structure, the following strategies are needed to be vigorously implemented.

- To increase technological capabilities of the Thai manufactures through public efforts on research and development, encouraging people to take science and engineering education, and technical transfers.
- To develop a wide range of efficient and reliable subcontractors and supporting industries which can supply Thai-made parts and intermediate materials for export orienting foreign and domestic firms.
- To develop rural industries which can spread the benefits of economic development to rural areas and to expand the size of the domestic market.

- To develop industries with comparative advantages in international industrial specialization and with competitive advantages in international markets.
- To develop desirable industries for the socio-economic development of Thailand.

5) Summary of Socio-Economic Issues

The major socio-economic trends and issues are summarized as follows:

a) Economic development of Thailand started in the later part of the 1960's and reached a nation-wide and sector-wide development phase in the 1970's. Production expansion in the agricultural sector led the development at first, and then gradual and rapid industrialization followed in the 1970's. The manufacturing sector took over the leading role of development in the 1980's.

b) However, the change of the industrial structure caused little structural change in the labor market. The agricultural sector grew not by increase in land productivity but by expansion of farming land and product diversification. This caused little employment structural change. More than 70% of the labor force were still employed in the agricultural sector in the 1980's.

c) The forest area shrunk to only 30% of the country because of expansion of farming land. Rapid expansion of the farming land and delayed efforts to maintain the forest area caused frequent floods and other environment problems and prevented land productivity from being improved.

d) Export items were primarily agricultural products in the 1960's and the 1970's. Thailand exported mainly just rice and rubber in the 1960's but succeeded in diversifying the export products such as maize, cassava, sugar cane, and pineapples. Thailand started to export more and more manufactured products in the late 1970's. Manufactured exports shared more than 50% of all exports in 1985. Major manufactured exports are textile and apparel, canned and processed food, light manufactured products such as jewelries and integrated circuits.

e) Although consumption goods, especially non-durable consumption goods, were major import items in the 1960's, imports of raw materials and capital goods increased while the import share of non-durable consumption goods increased as the policy change from the import substitute strategy to export oriented strategy was emphasized more.

f) In the early 80's, imbalances of three macro-economic factors, i.e., investment and savings, government revenue and expenditure, and import and export, became serious. The Thai government took a conservative fiscal position in order to restrain the speed of development. As a result, in 1984, the Thai economy experienced a severe recession. Although the accumulation of external debt was avoided, advancement of industrialization was slowed down due to decrease of both public and private investment. The development strategies in Thailand has been formulated to promote further industrialization within a given level of external debt ceiling since then.

g) After the Plaza Agreement in September 1985, several favorable external conditions such as depreciation of US dollars, fall of oil price and interest rates, and rising manufacturing costs in Japan and the Asian NIEs emerged and helped the Thai manufactured exports. The trade imbalance has been improved and the fiscal deficit has been narrowed.

h) Thailand seems to have been going through major economic structural changes. The recent trend in the surge of manufactured exports and the stagnation of the traditional agricultural sector pictures the manufacturing sector as the present major force behind the future economic development. The recent economic success has created an impression that Thailand may be on the verge to be the fifth Asian Newly Industrializing Economy.

i) Industrialization in Thailand started for the purpose of import substitution of consumption goods in the 1960's. This created a mass concentration of industries in infrastructure rich and consumer concentrated Bangkok as a market of mass consumption. As a result, disparities of growth rates and income levels among regions and sectors became serious problems.

j) These disparities will widen more in the future because the the traditional agricultural sector located in the outside of the BMR is and will be in stagnation and the economically successful non-agricultural sectors are mainly located in the BMR although the government has been trying to relocate factories in Bangkok to provincial areas.

k) To solve the problems emerged during the Fifth NESDP period, the Sixth NESDP was started in 1987. The Eastern Seaboard Development Program is one of the highest priority development project. The effort to develop the Eastern Seaboard indicates a strategy of development of the surrounding areas of the BMR and decentralization of industries.



l) There are already several industrial parks in Thailand. Most of them are, however, located in the BMR. There are several plans for development of industrial parks in the provincial areas.

m) The most important problem for the future economic expansion is the state of infrastructure. After several years of cutbacks in public investment programs, the present state of infrastructure is not adequate to support the recent unexpected rapid economic expansion caused by increased manufactured exports and direct foreign investments. Bottlenecks are emerging in ports, energy, industrial water supply, transportation, and telecommunications.

n) The Thai economy faces many problems such as rise of protectionism in developed countries, low labor workers employment capability of the manufacturing sector, shortage of skilled workers, professionals, and engineers.

o) Advancement of industrialization may be halted because of entry barriers into markets of developed countries.

p) The overall labor supply situation in Thailand appears to be quickly heading toward a shortage, especially for skilled workers and professionals, perhaps within several years if the current pattern of economic growth continues. Labor shortage will not only stifle economic growth but also increase labor price and cause inflation.

q) In order for Thailand to continue its rapid growth, the government has to promote policies to establish higher autonomy and stronger sustainability in the Thai economy. To do so, it may have to consider increasing flexibility and competitiveness and at the same time reducing some major constraints which have hindered the economic growth in the past. The following are some urgently necessary policies:

- To increase technological capabilities of the Thai manufactures through public efforts on research and development, encouraging people to take science and engineering education, and technical transfer.
- To develop a wide range of efficient and reliable subcontractors and supporting industries which can supply Thai-made parts and intermediate materials for export orienting foreign and domestic firms.
- To develop rural industries which can spread the benefits of economic development to rural areas and to expand the size of the domestic market.

- To develop industries with comparative advantages in international industrial specialization and with competitive advantages in international markets.
- To develop desirable industries for the socio-economic development of Thailand.
- To develop infrastructure, to raise the operating efficiency and the quality of services of the state enterprises under the constraint of keeping conservative fiscal stance not to create inflationary pressure.
- To review the tax system to increase the tax revenue and improve the fiscal condition.
- To promote financial liberalization to increase private savings and to efficiently utilize foreign capital.
- To simplify import tariff, to reduce corporate tax rates, to create export incentives, to legislate local contents regulations on usage of Thai made parts and intermediate materials.
- To develop human resources and to improve compensation systems for workers.