

THE STUDY
ON
THE CHILEAN STATE RAILWAYS
MODERNIZATION PROJECT
IN
THE REPUBLIC OF CHILE
FINAL REPORT

MAY 1981

UNEP INTERNATIONAL COOPERATION
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MAY 1983

**JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)**

国際協力事業団	
受入 月日 84.9.27	704
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PREFACE


In response to the request of the Government of the Republic of Chile, the Government of Japan decided to conduct a study on the Project to modernize the Chilean State Railways and entrusted the study to the Japan International Cooperation Agency (JICA). The JICA sent to Chile a study team headed by Mr. Kazuya Nakanishi, Executive Director of the Japan Railway Technical Service from July to August and from November to December, 1982 under the guidance of the Supervisory Committee chaired by Mr. Shoshi Hashimoto, Director of the General Affairs Division, Railway Supervision Bureau of the Ministry of Transport.

The team held discussions with the officials concerned of the Government of Chile on the Project and conducted a field survey in Chile. Subsequently, further studies were made in Japan and the present report has been prepared.

I hope that this report will serve for development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of Chile for their close cooperation extended to the team.

May, 1983

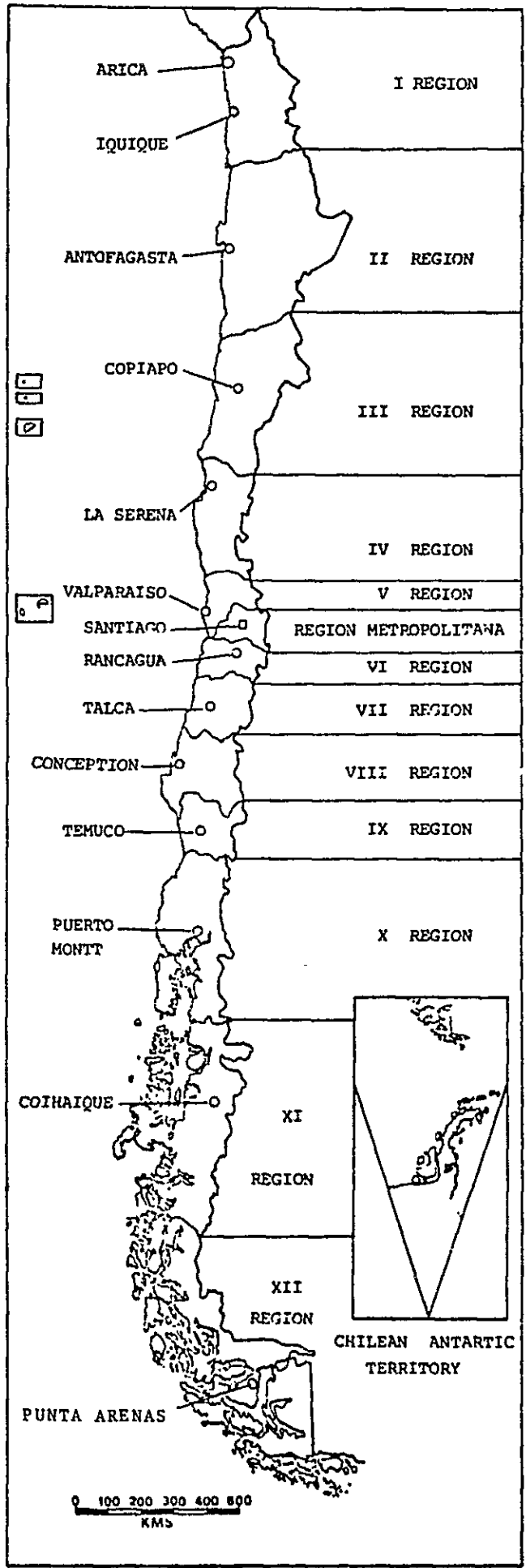


Keisuke Arita

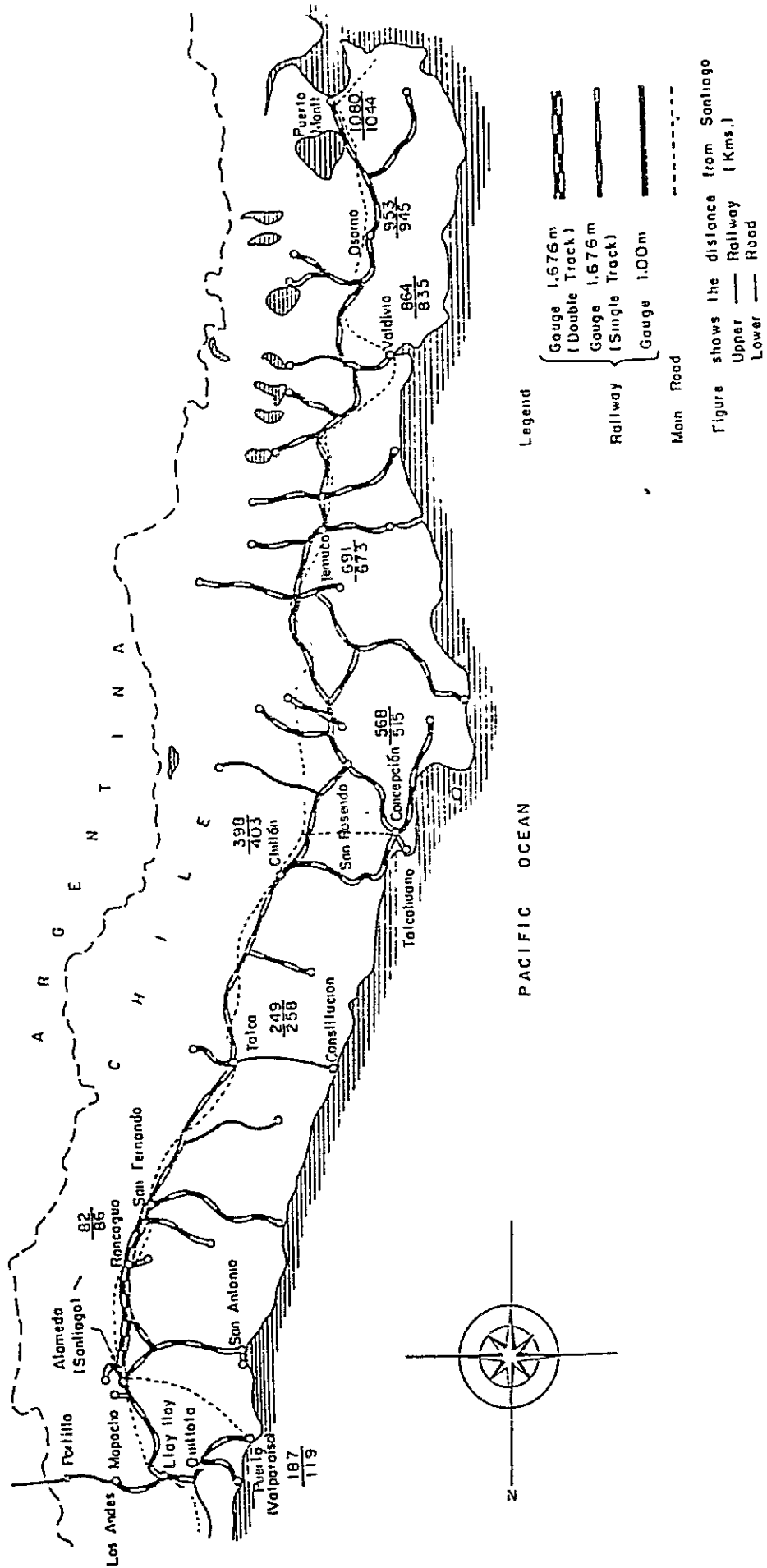
President

Japan International Cooperation Agency

MAP OF CHILE



CHILEAN STATE RAILWAY SOUTHERN RAILWAY NETWORK



CONTENTS

	Page
I. OUTLINE	I-1
I.1 PREFACE	I-1
I.1.1 Background of the Study	I-1
I.1.2 Objects of the Study	I-2
I.1.3 Study Objectives	I-2
I.2 INTRODUCTION	I-2
I.2.1 Outline	I-2
I.2.2 Outline of Concrete Proposals	I-4
I.2.2.1 Freight	I-4
I.2.2.2 Passenger	I-12
I.2.2.3 Telecommunications equipment	I-18
II. PROJECT 1 (IMPROVEMENT OF FREIGHT CAR CONTROL AND INFORMATION SYSTEM)	II-1
II.1 GENERAL ASPECT OF THE STUDY	II-1
II.1.1 Objective of the Study	II-1
II.1.2 Methods of the Study	II-1
II.1.3 Results of the Study	II-2
II.2 FREIGHT TRANSPORTATION OF THE SOUTHERN RAILWAY OF THE CHILEAN STATE RAILWAYS	II-6
II.2.1 General Situation of Freight Transportation	II-6
II.2.2 Performance in Freight Transportation	II-9
II.2.3 Current Situation of Freight Transportation	II-10

II.3	FACTORS FOR EFFECTIVE OPERATION	II-12
II.3.1	Objective	II-12
II.3.2	Concrete Factors	II-12
II.4	FREIGHT CAR CONTROL SYSTEM	II-15
II.4.1	Organization of Operation Control of Freight Cars.	II-15
II.4.1.1	Location of the Central Command Office (PCC)....	II-15
II.4.1.2	Organization of the Central Command Office	II-16
II.4.1.3	Jurisdiction and personnel of the Traffic Control Centers	II-18
II.4.1.4	Requirement to be a dispatcher	II-18
II.4.2	Freight Transportation Planning	II-21
II.4.2.1	Current situation	II-21
II.4.2.2	Need for a transportation plan	II-21
II.4.3	Information, Services for Control and Operation of Cars	II-22
II.4.3.1	Types of cars and systems of operation	II-22
II.4.3.2	Forms and reports used in control of car operations	II-25
II.4.3.3	Operation control service	II-29
II.4.4	Service of Freight Car Control Office	II-33
II.4.4.1	Current situation of freight car control office	II-33
II.4.4.2	Necessity of computerization	II-37
II.4.5	Systems of Transportation by Freight Trains	II-38
II.4.5.1	Classification of freight trains	II-38
II.4.5.2	Composition of freight trains	II-40
II.4.5.3	Personnel of train crew	II-42
II.4.6	Current Situation in Loading-Unloading and Equipment Installed at Stations	II-43
II.4.6.1	Equipment installed	II-43
II.4.6.2	Current situation of loading and unloading by type of freight	II-44

II.5	CURRENT SITUATION OF CAR MOVEMENTS	II-48
II.5.1	Summary of Studies Concerning Car Movements	II-48
II.5.2	Results of the Investigation	II-50
II.5.2.1	Number of cars investigated	II-50
II.5.2.2	Travel time of one cycle rotation of a car	II-50
II.5.2.3	Loading and unloading time	II-52
II.5.2.4	Inspection of investigated cars	II-53
II.5.3	Rotation of Cars (Loaded, empty)	II-54
II.5.3.1	On the rotation of cars	II-54
II.5.3.2	Concept of "One rotation"	II-54
II.5.3.3	Rotation of cars by situation (loaded or empty)	II-56
II.5.3.4	One cycle rotation of car by type	II-58
II.5.3.5	Rotation by specific type of freight	II-60
II.5.4	The Time for Loading and Unloading	II-60
II.5.4.1	Loading and unloading time by type of car	II-61
II.5.4.2	Loading and unloading time by type of freight ..	II-62
II.5.5	Assumption of the Operational Performance Based on the Investigation on Current Car Movement	II-62
II.5.5.1	Assumption for the transportation time	II-62
II.5.5.2	Assumption for the detention time	II-63
II.5.5.3	Time for one rotation of cars (operational performance)	II-63
II.5.6	Future Tasks	II-64
II.6	CONTROL OF FREIGHT CAR MAINTENANCE	II-79
II.6.1	Current Situation for Inspection and Repair of Cars	II-79
II.6.2	Current Situation as to Disabled Cars	II-82
II.6.3	Current Situation of Operational Accidents	II-84
II.6.4	Abolition and Manufacturing of Freight Cars	II-85
II.7	PROPOSAL FOR IMPROVEMENT	II-87
II.7.1	Organization of Traffic Control Center	II-87
II.7.2	Freight Transportation Planning	II-87

II.7.2.1	Plan for arrangement of transportation capacity	II-87
II.7.2.2	Program of transportation execution plan	II-88
II.7.3	Forms and Reports Required for Freight Car	
	Operational Control	II-89
II.7.3.1	Acquirement of accuracy of information	II-91
II.7.3.2	Forms and reports which are kept at stations ...	II-91
II.7.3.3	Forms relative to car control services	II-95
II.7.4	Computerization of Freight Car Control	II-98
II.7.4.1	Premised conditions	II-98
II.7.4.2	System plan	II-98
II.7.4.3	Improvement of informations	II-98
II.7.4.4	Software	II-99
II.7.4.5	Hardware	II-107
II.7.4.6	Procedure of constructing computer system	II-110
II.7.4.7	System construction cost	II-114
II.7.5	Characteristic of Goods Flow and New Traffic System	II-116
II.7.6	Maintenance of Freight Car	II-119
II.7.6.1	Improvement of inspection system	II-119
II.7.6.2	Prevention of disabled cars	II-131
II.7.6.3	Execution of scrapping cars	II-133
III.	PROJECT 2-1 (IMPROVEMENT OF COMMERCIAL MANAGEMENT OF THE FREIGHT TRANSPORT)	III-1
III.1	GENERAL ASPECT OF THE STUDY	III-1
III.1.1	Objective of the Study	III-1
III.1.2	Methods of the Study	III-1
III.1.3	Results of the Study	III-2
III.2	PRESENT SITUATION AND PROBLEMS OF FREIGHT OPERATION OF THE SOUTHERN RAILWAY	III-6

III.2.1	Freight Transportation in Chile	III- 6
III.2.2	Results of Freight Operation on the Southern Railway	III-10
III.2.3	Problems in Southern Railway Freight Operation ...	III-13
III.3	PRECONDITIONS FOR DETERMINATION OF THE COMMERCIAL POLICY MEASURES	III-14
III.3.1	Preparation of the Organization for the Market Survey	III- 14
III.3.2	Strengthening of the Sales System	III-18
III.3.2.1	Strict control of the income targets	III-18
III.3.2.2	Reinforcement of the sales activity	III-22
III.3.3	Establishment of Railway Consignors Organizations.....	III-28
III.4	PROPOSALS OF CONCRETE MEASURES FOR THE IMPROVEMENT OF FREIGHT OPERATION	III-30
III.4.1	Promotion of Individual Contracts	III-30
III.4.2	Promotion of Intermodal Transportation	III-32
III.4.3	Promotion of Sales by Utilizing Forward- ing Agents	III-36
III.4.4	Preparation of Freight Cars Suitable for Each Type of Commodity	III-38
III.4.5	Review of the Tariff System	III-39
III.5	ADVERTISING AND PUBLIC RELATIONS ACTIVITIES	III-50
III.6	RELATED ACTIVITIES	III-51
IV.	PROJECT 2-2 (MEASURES FOR THE COMMERCIAL POLICY OF THE PASSENGER TRANSPORT)	IV-1
IV.1	GENERAL ASPECT OF THE STUDY	IV-1
IV.1.1	Objective of the Study	IV-1
IV.1.2	Methods of the Study	IV-1
IV.1.3	Results of the Study	IV-2

IV.2	GENERAL DESCRIPTION OF THE PASSENGER SERVICE ON THE SOUTHERN RAILWAY	IV-6
IV.2.1	Characteristics of the Passenger Service	IV-6
IV.2.2	Importance of the Railways in the Zone of the Southern Railway	IV-7
IV.2.3	Description of the Main Sections of the Service	IV-12
IV.2.4	Passenger Fare System	IV-16
IV.2.4.1	Basic fare system	IV-16
IV.2.4.2	Fare discount system	IV-18
IV.3	PRECONDITIONS FOR THE ANALYSIS OF THE COMMERCIAL POLICY MEASURES	IV-19
IV.3.1	Conditioning of the Basic System for Sales	IV-20
IV.3.2	Improvement of the Rolling Stock	IV-21
IV.4	MEASURES TO INCREASE THE INCOME	IV-22
IV.4.1	Present Situation of the Measures to Increase the Income	IV-22
IV.4.2	Introduction of the Control of the Income Goals ..	IV-23
IV.4.2.1	Organization and functions	IV-23
IV.4.2.2	Method to establish the amount of the income goals	IV-26
IV.4.3	Various Measures to Increase the Income	IV-26
IV.4.3.1	Criteria to determine the measures to increase the income	IV-26
IV.4.3.2	To attract regular users	IV-27
IV.4.3.3	Consolidation of the relationships with external enterprises	IV-30
IV.4.3.4	Use of travel agencies	IV-37
IV.4.3.5	Efficient use of the railway installations	IV-43
IV.4.3.6	Preventing passengers from stealing rides (Travel without purchasing a ticket)	IV-45

IV.5	IMPROVEMENT OF THE PASSENGER RESERVATION SYSTEM	IV-48
IV.5.1	Existing Seat Reservation System	IV-48
IV.5.1.1	Sales organization of reserved seats	IV-48
IV.5.1.2	Method of selling reserved seats	IV-50
IV.5.2	Development of the New System	IV-66
IV.5.2.1	Assumption for the system design	IV-66
IV.5.2.2	Planning the new system	IV-67
IV.5.2.3	Recommendation	IV-87
IV.6	MARKETING RESEARCH	IV-87
IV.6.1	Organization of Structure for the Marketing Research	IV-87
IV.6.1.1	Need for organization of the structure	IV-87
IV.6.1.2	Definition of the organization in charge	IV-88
IV.6.2	Data to be Prepared	IV-88
IV.7	INVESTIGATION THROUGH QUESTIONNAIRES	IV-89
IV.7.1	Purpose of the Investigations	IV-89
IV.7.2	Content of the Investigations	IV-91
IV.7.3	Matters to be Taken into Consideration during Study of the Results of the Investigations	IV-91
IV.7.4	Execution of the Survey	IV-92
IV.7.4.1	Dates of the survey and trains surveyed	IV-92
IV.7.4.2	Passengers surveyed	IV-93
IV.7.4.3	Method of survey	IV-94
IV.7.4.4	Contents of the questionnaire	IV-94
IV.7.4.5	Questionnaire	IV-96
IV.7.4.6	General description of the results of the survey	IV-96
IV.7.4.7	Opinions on the results of the survey	IV-122
IV.7.4.8	Results of the analysis of the survey	IV-125
IV.8	PUBLICITY ACTIVITIES	IV-128
IV.8.1	Publicity	IV-128
IV.8.2	Advertisements	IV-129

V.	TELECOMMUNICATION EQUIPMENT	V-1
V.1	GENERAL ASPECT	V-1
V.2	GENERAL DESCRIPTION OF THE INSTALLATIONS	V-2
V.2.1	Equipment of Transmission	V-2
V.2.1.1	Aerial wire	V-2
V.2.1.2	Wave carrier of telephone system	V-2
V.2.1.3	Radio communication system	V-3
V.2.2	Equipment of Exchanger	V-5
V.2.2.1	Telephone exchanger (central exchanger)	V-5
V.2.2.2	Central telex exchanger	V-6
V.2.3	Installations of Telephones	V-6
V.2.3.1	Dispatcher telephone	V-7
V.2.3.2	Magnetic type intercommunication telephone	V-7
V.2.4	Telex	V-7
V.2.5	Electric Power Supply Equipment	V-10
V.2.6	Other Installations of Telecommunication	V-10
V.2.6.1	Equipment of amplifier	V-10
V.2.6.2	Interphones	V-10
V.3	ADMINISTRATION SYSTEM	V-10
V.3.1	Organization	V-10
V.3.2	Maintenance of Installations	V-11
V.4	PROBLEMS AND COUNTERMEASURES FOR IMPROVEMENT OF INSTALLATION	V-14
V.4.1	Transmission Equipment	V-14
V.4.1.1	Problems	V-14
V.4.1.2	Countermeasures of improvement	V-14
V.4.1.3	Improvement measures of communication transmission system	V-15
V.4.1.4	Utilization of public circuit line	V-27
V.4.2	Dispatcher Telephone	V-28
V.4.2.1	Problems	V-28

V.4.2.2	Improvement measures	V-29
V.4.2.3	Improvement of dispatching telephone	V-29
V.5	ORGANIZATION AND PROBLEMS OF SUPERVISING SYSTEM	V-32
V.5.1	Organization	V-32
V.5.2	Maintenance Planning	V-32

REFERENCE MATERIALS

1.	SCHEDULE OF OVERALL STUDY	VI-1
2.	COMPOSITION OF STUDY TEAM	VI-2
3.	THE CURRENT STATE OF THE CHILEAN ECONOMY	VI-3
4.	PROPOSED PROJECT EVALUATION	VI-29

ATTACHMENTS

1.	Investigation Card for Cars in Transit	VII-1
2.	Investigation Card for Detained Cars	VII-1
3.	Investigation Card of Actual Rolling Stock Movements	VII-2
4.	Questionnaire Form on the Use of Trains for the Transportation of Freight	VII-3
5.	Questionnaire Form on the Use of Passenger Trains	VII-11
6.	Goods Flow in Southern Railway	VII-13
7.	OD Table of Passengers in Southern Railway	VII-14

LIST OF TABLES

II. PROJECT 1 (IMPROVEMENT OF FREIGHT CAR CONTROL AND INFORMATION SYSTEM)	Page
Table II.2.1	Volume of Transportation Load (Principal freight goods) II-7
Table II.2.2	Tonnage Transported by Type of Freight II-8
Table II.2.3	Proportion of Primary and Secondary Products II-9
Table II.2.4	Figures Indicating Freight Transport Per- formance II-11
Table II.4.1	Personnel of the Traffic Control Centers and Type of Work II-19
Table II.4.2	The Number of Existing Freight Cars by Type II-23
Table II.4.3	Results of Bogie Exchanging of Dual-gauge Cars in Junction Stations II-24
Table II.4.4	List of Forms and Reports II-26-28
Table II.4.5	Necessary Items for Freight Car Control II-34
Table II.4.6	Equipment Installed II-43
Table II.4.7	Loading and Unloading at the Principal Stations II-44
Table II.4.8	Loading and Unloading by Type of Freight II-46-47
Table II.5.1	Number of Cars Investigated II-50
Table II.5.2	Percentage of Execution of the Investigation of Circulation of Cars II-51
Table II.5.3	Cars with Investigation Completed II-51
Table II.5.4	Cars with Incompleted Investigation, Classified by Cause II-52
Table II.5.5	Cars for Which the Loading and Unloading Time is Confirmed II-53
Table II.5.6	Cars Investigated on the Execution of Inspection II-53
Table II.5.7	Rotation of Cars (Average by situation of loaded or empty) II-56

Table II.5.8	Rotation of Cars by Type (Loaded, average)	II-65
Table II.5.9	Rotation of Cars by Type (Empty, average)	II-66
Table II.5.10	Rotation of Cars by Type (Loaded and empty, average)	II-67
Table II.5.11	Rotation by Type of Freight (Average)	II-68
Table II.5.12	Detention Time of Cars (By situation loaded or empty, average)	II-69
Table II.5.13	Detention Time of Cars by Type (Loaded, average)	II-70
Table II.5.14	Detention Time of Cars by Type (Empty, average)	II-71
Table II.5.15	Detention Time of Cars by Type (Loaded and empty, average)	II-72
Table II.5.16	Detention Time by Type of Freight (Average)	II-73
Table II.5.17	Loading and Unloading Time by Type of Freight Cars (Average/car)	II-74
Table II.5.18	Loading and Unloading Time by Type of Freight (Average/car)	II-75~76
Table II.5.19	Days of Detention of Empty Cars Which Did not Finish Being Investigated Due to not Yet Having Left the Station at the End of the Investigation	II-77
Table II.5.20	Detained Cars by Type	II-78
Table II.5.21	Detained Cars (Only in cessation of use)	II-78
Table II.5.22	Cars in Transit by Type	II-79
Table II.6.1	Disabled Cars by Type of Failures	II-83
Table II.6.2	Number of Train Operational Accidents	II-84
Table II.6.3	Comparison of Train Operation Accidents	II-85
Table II.7.1	Goals for Transportation Volume and Income by Railway Division	II-90
Table II.7.2	Program for Distribution and Utilization of Cars	II-90
Table II.7.3	Report of Existing Freight Cars as of 8:00	II-93
Table II.7.4	Arrival and Departure of Cars	II-94

Table II.7.5	Movements of Cars between Central and South Divisions	II-97
Table II.7.6	Balance between Requested and Available Freight Cars	II-97
Table II.7.7	Prospects for Demand and Supply of Cars	II-97
Table II.7.8	File Access Key	II-102
Table II.7.9	Parameter and Capacity Estimated	II-106
Table II.7.10	Capacity of File	II-107
Table II.7.11	Output Information and Output Condition	II-115
Table II.7.12	Transition of Number of Stations and Traffic Volume	II-118
Table II.7.13	Method of Inspection (Standard) of Principal Parts by Cycle of Inspection	II-125-130
Table II.7.14	Comparison of Number of Car Inspection	II-133

III. PROJECT 2-1 (IMPROVEMENT OF COMMERCIAL MANAGEMENT OF THE FREIGHT TRANSPORT)

Table III.2.1	Breakdown of the Main Foreign Trade Commodities	III-8
Table III.2.2	Traffic by Various Means of Transportation	III-8
Table III.2.3	Trend in the Traffic by Main Commodities and by Various Means of Transportation (1980/1973)	III-9
Table III.2.4	Freight Traffic on the Southern Railway	III-11
Table III.2.5	Results of Freight Operation on the Southern Railway	III-12
Table III.2.6	Evolution of the Transport Volume by Product on the Southern Railway	III-12
Table III.2.7	Reasons for Selecting the Means of Transportation	III-14
Table III.3.1	Scheme of the System of Origin-based Income	III-21
Table III.4.1	Commodities with Average Transportation Distance exceeding 500 km	III-32

Table III.4.2	Situation Produces Due to Delays in Payments (Deferred payments) for Service of Freight with Current Accounts	III-47
IV. PROJECT 2-2 (MEASURES FOR THE COMMERCIAL POLICY OF THE PASSENGER TRANSPORT)		
Table IV.1.1	Evolution of the Passengers Transported of the Chilean State Railways	IV-4
Table IV.2.1	Summary of the Passenger Services on the Southern Railway of the Chilean State Railways..	IV-8
Table IV.2.2	Annual Transition of Passengers Transported by Train, Bus, and Airplane in the Commercial Zone of the Southern Railway	IV-10
Table IV.2.3	Annual Transition of Passengers Transported by Train, Bus, and Airplane in the Main Sections	IV-11
Table IV.2.4	Energy Consumption for the Different Means of Transport in Japan, in 1978	IV-16
Table IV.2.5	Formulas for the Calculation of Passenger Fares According to the Distance Covered	IV-17
Table IV.4.1	Distribution of the Functions for the Control on Income, within the Passenger Service Scheme	IV-25
Table IV.4.2	Rate of Commissions for the Travel Agencies in Japan	IV-41
Table IV.4.3	Rate of Commissions for the Travel Agencies in Various Countries	IV-42
Table IV.4.4	Annual Evolution of the Volume of Sales by the Travel Agencies of the Japanese National Railways	IV-43
Table IV.5.1	Trains with Reserved Seats and Quantity of Seats	IV-53
Table IV.5.2	Assignment of Reserved Seats (For downward trains)	IV-56
Table IV.5.3	Assignment of Reserved Seats (For upward trains)	IV-57

Table IV.5.4	Assignment for Each Type of Reserved Seats for 1023 and 1024 Fast Trains	IV-58
Table IV.5.5	Assignment for Each Type of Reserved Seats for 9 and 10 Express Trains	IV-59
Table IV.5.6	Assignment for Each Type of Reserved Seats for 7 and 8 Express Trains	IV-60
Table IV.5.7	Assignment for Each Type of Reserved Seats for 1005 and 1006 Fast Trains	IV-61
Table IV.5.8	Assignment for Each Type of Reserved Seats for 1007 and 1008 Fast Trains	IV-62
Table IV.5.9	Assignment for Each Type of Reserved Seats for 1009 and 1010 Fast Trains	IV-63
Table IV.5.10	Assignment for Each Type of Reserved Seats for 1003 and 1004 Fast Trains	IV-64
Table IV.5.11	Assignment for Each Type of Reserved Seats for 1025 and 1026 Fast Trains	IV-65
Table IV.7.1	Passengers Surveyed According to Train and Class	IV-93
Table IV.7.2	Number of Passengers Surveyed According to Sex and Age	IV-96
Table IV.7.3	Number of Passengers Surveyed According to Age and Occupation	IV-97
Table IV.7.4	Number of Passengers Surveyed According to Age and Their Place of Residence	IV-98
Table IV.7.5	Travel Distances According to Objective of Travel	IV-100
Table IV.7.6	Objective of Trip According to Occupation, Sex and Age	IV-102
Table IV.7.7	Objective of Trip According to Class of Coach ...	IV-103
Table IV.7.8	Number of Passengers Forming Travel Groups According to Objective of Trip	IV-104
Table IV.7.9	Number of Days of Travel	IV-108
Table IV.7.10	Time of Deciding the Trip According to Class of Coach	IV-108
Table IV.7.11	Time of Reserving Reserved Seat	IV-109

Table IV.7.12	Time of Deciding Trip and Time of Reserving Reserved Seat	IV-110
Table IV.7.13	Means of Transport to be Used for the Return Trip or Used for the Outward Trip	IV-111
Table IV.7.14	Means of Transport to be Used for the Return Trip or Used for the Outward Trip According to Distance of Trip and Objective of Trip	IV-112
Table IV.7.15	Opinions on the Services Offered Inside the Train	IV-118
Table IV.7.16	Sections with Large Passenger Movement in Order of Importance	IV-126

V. TELECOMMUNICATION EQUIPMENT

Table V.2.1	Location of Telephone Exchanger	V-5
Table V.2.2	Disposition of Teletypewriters	V-8
Table V.3.1	Inspection Period of Major Installments of Telecommunication Equipment	V-11
Table V.4.1	Comparison of Various Plans	V-27

VI. REFERENCE MATERIALS

Table VI.1.1	Schedule of Overall Study	VI-1
Table VI.2.1	Composition of Study Team	VI-2
Table VI.3.1	Main Economic Indicators (1)	VI-4
Table VI.3.2	Main Economic Indicators (2)	VI-5
Table VI.3.3	Trends in Import Duty Rates	VI-8
Table VI.3.4	Movements in Foreign Exchange	VI-9
Table VI.3.5	Flow of Foreign Capital into Chile (Based on approvals for investment)	VI-11
Table VI.3.6	Basic Social and Economic Data about Chile	VI-12
Table VI.3.7	Index Related to Industrialization	VI-13
Table VI.3.8	Constituent Percentages of Exports and Imports according to Region	VI-14

Table VI.3.9	Balance of Payments of Chile	VI-15
Table VI.3.10	Chile's Economic Growth Potential by Sector	VI-17
Table VI.3.11	GDP by Principal Sectors	VI-20
Table VI.3.12	Chile's Copper Production	VI-21
Table VI.3.13	Estimates of Chile's Major Economic Indicators	VI-23
Table VI.3.14	Goals by Sector for the 6-year Social and Economic Development Plan	VI-25
Table VI.3.15	Chile's Power Generation Development Projects ...	VI-25
Table VI.3.16	Infrastructure Facilities	VI-26~28
Table VI.4.1	Cost of Computerization of Freight Car Control	VI-33
Table VI.4.2	Cost of Reestablishment of the San Eugenio Plant	VI-35
Table VI.4.3	Increase in Personnel Necessary to Undertake Repairs at San Eugenio Plant	VI-36
Table VI.4.4	Cost of Seat Reservation System	VI-38
Table VI.4.5	Calculation of Internal Rate of Return (Computerization of freight car control)	VI-43
Table VI.4.6	Calculation of Internal Rate of Return (Reestablishment of the San Eugenio Plant)	VI-44
Table VI.4.7	Calculation of Internal Rate of Return (Computerization of the sales of reserved seat ticket)	VI-45

LIST OF FIGURES

II. PROJECT 1 (IMPROVEMENT OF FREIGHT CAR CONTROL AND INFORMATION SYSTEM)	Page
Fig.II.3.1	Principal Factors in Effective Operations II-13
Fig.II.4.1	Organization Chart of the Southern Railway II-16
Fig.II.4.2	Organization of Control Centers and Information Flow II-17
Fig.II.4.3	Jurisdiction of Each Traffic Control Center II-20
Fig.II.4.4	Actual Freight Car Control System and the Computerization of the Service of Freight Car Control Office II-36
Fig.II.4.5	Number of Freight Trains on Each Line II-39
Fig.II.5.1	Concept of One Cycle Rotation of Freight Cars ... II-55
Fig.II.6.1	Repairs (R2, R3) Accomplished II-80
Fig.II.6.2	Number of Cases of Disabled Cars II-83
Fig.II.7.1	Composition of Data Base II-102
Fig.II.7.2	System Composition of Traffic Control II-108
Fig.II.7.3	Composition of Dispatcher System (Short term plan) II-112
Fig.II.7.4	System Composition of Traffic Control Centers of Intermediate Term II-113
Fig.II.7.5	Principal Freight Flow between Major Stations ... II-117
III. PROJECT 2-1 (IMPROVEMENT OF COMMERCIAL MANAGEMENT OF THE FREIGHT TRANSPORT)	
Fig.III.3.1	Bolck Diagram of the Freight Transportation Sales System III-24
Fig.III.3.2	Report on the Sales Activities of the Southern Railway III-25
Fig.III.4.1	Piggy-back System Which is Envisaged for Development by JNR III-35

IV. PROJECT 2-2 (MEASURES FOR THE COMMERCIAL POLITY OF THE PASSENGER
TRANSPORT)

Fig.IV.2.1	Participation of the Each Means of Passenger Transport in Japan, in 1979	IV-15
Fig.IV.2.2	Train and Bus Fares	IV-17
Fig.IV.4.1	The Future Organization for the Control of Income within the Passenger Service Scheme	IV-24
Fig.IV.4.2	Map of the Circuit for the Hakone Free Ticket ...	IV-36
Fig.IV.5.1	Sales Organization of Reserved Seats	IV-49
Fig.IV.5.2	Diagram for Seats Assignment	IV-51
Fig.IV.5.3	Flow of Tasks Related to the Diagram of Assignment of Reserved Seats	IV-52
Fig.IV.5.4	Composition of the System in the First Alternative	IV-68
Fig.IV.5.5	Model of Microcomputer for Reservation Center in the First Alternative.....	IV-71
Fig.IV.5.6	System Plan for Reservation Center, Subcenters and Stations with Assignment in the First Alternative	IV-72
Fig.IV.5.7	System Schematic of the First Alternative	IV-73
Fig.IV.5.8	Composition of the System in the Second Alternative	IV-75
Fig.IV.5.9	Model of Installation for Reservation Center in the Second Alternative	IV-79
Fig.IV.5.10	System Plan for Reservation Center, Subcenters and Stations in Each Region in the Second Alternative	IV-80
Fig.IV.5.11	System Schematic of the Second Alternative	IV-81
Fig.IV.5.12	Composition of the System in the Third Alternative	IV-83
Fig.IV.5.13	System Schematic of the Third Alternative	IV-86
Fig.IV.7.1	Travelling Distance of the Passengers Surveyed	IV-99
Fig.IV.7.2	Average Travelling Distance According to Class of Coach	IV-99

Fig.IV.7.3	Objective of Trip of the Passengers Surveyed	IV-101
Fig.IV.7.4	Reasons for Travelling by Railway According to Travel Distance	IV-106
Fig.IV.7.5	Reasons for Travelling by Railway According to the Type of Train	IV-107
Fig.IV.7.6	Reasons for Travelling by Railway According to Class	IV-107
Fig.IV.7.7	Impressions on Exterior and Interior Appearances According to Train	IV-115
Fig.IV.7.8	Impressions on Exterior and Interior Appearances According to Class of Coach	IV-116
Fig.IV.7.9	Annual Frequency of Trips	IV-117

V. TELECOMMUNICATION EQUIPMENT

Fig.V.2.1	Outline of Equipment of Dispatcher Telephone	V-9
Fig.V.3.1	Organization of Supervising Telecommunication Equipment	V-12
Fig.V.3.2	Organization of Telecommunication Section	V-13
Fig.V.4.1	The Method of Using Open Wire for Carrier Circuit	V-20
Fig.V.4.2	The Method of Using Cable for Carrier Circuit ..	V-22
Fig.V.4.3	The Method of Using Multiple Radio System for Long Distance Circuit	V-23
Fig.V.4.4	Example of Circuit Construction Among Stations (UHF Radio System)	V-25

I. OUTLINE



I. OUTLINE

I.1 PREFACE

I.1.1 Background of the Study

The general geographic conditions of Chile with its narrow land extending from north to south, combined with state policy, has made the Chilean State Railways the dominant means of transportation.

However, the operational results of the State Railways have been worsening up to the present, along with the preference for buses and trucks resulting from the development of road networks. To cope with this situation, extensive rationalization including abolishment of service has been made under the government's basic policy of free competition.

The principal themes thus chosen have been (1) the improvement of freight car control and the information system, and (2) the improvement of commercial management of freight and passenger transport. The Chilean government made a request to the Japanese government for cooperation in May 1981. Japan dispatched a preliminary government mission to the site and discussions were held regarding the basic policy of the study. As a result of this, the Scope of Work was concluded on March 25, 1982.

For the execution of this study, the Japan International Cooperation Agency dispatched to Chile in July 1982 a study team headed by Kazuya Nakanishi of the Japan Railway Technical Service, and the survey started. In order to supervise this study, a steering committee was established. The committee is headed by Shoshi Hashimoto, Director of the General Affairs Division in the Railway Supervision Bureau of the Ministry of Transport. This study was undertaken from July 1982 to May 1983.

I.1.2 Objects of the Study

(1) Study object items

- a. Improvement of freight car control and the information system
- b. Proposals for improvement of commercial management

(2) Study object line

Southern Railway of the Chilean State Railways

The structure of the Chilean State Railways has been divided into three, the Arica Line, the Northern Railway and the Southern Railway. The extending of the technical cooperation, however, is limited to the Southern Railway which provides 90% of the total revenue and undertakes diverse transportation.

I.1.3 Study Objectives

Project 1 "Improvements of freight car control and the information system" aims propose the raising of efficiency of freight car operation and improving of the transportation system. The proposal for improvement of information about the positioning of rolling stock is also aimed at.

The objective of Project 2, "Proposals for improvement of commercial management", is to propose concrete measures for the establishment of business foundations which will enable the railway to fully display its capabilities in the competition with other modes of transport.

I.2 INTRODUCTION

I.2.1 Outline

The Chilean State Railways has the longest history of 130 years among railways in South America and currently has a total track length of 8,000 km. The Railways has activated movement of people

and goods throughout the long, narrow country and reinforce the development of backward regions. It has made large contribution to the development of Chile's industrial economy by acting as an important means of transportation in the export of minerals and lumber.

Up until the construction of the Pan American Highway, which traverses the country, and other arterial roads, the Railways was the dominant means of transport which constituted the transportation network.

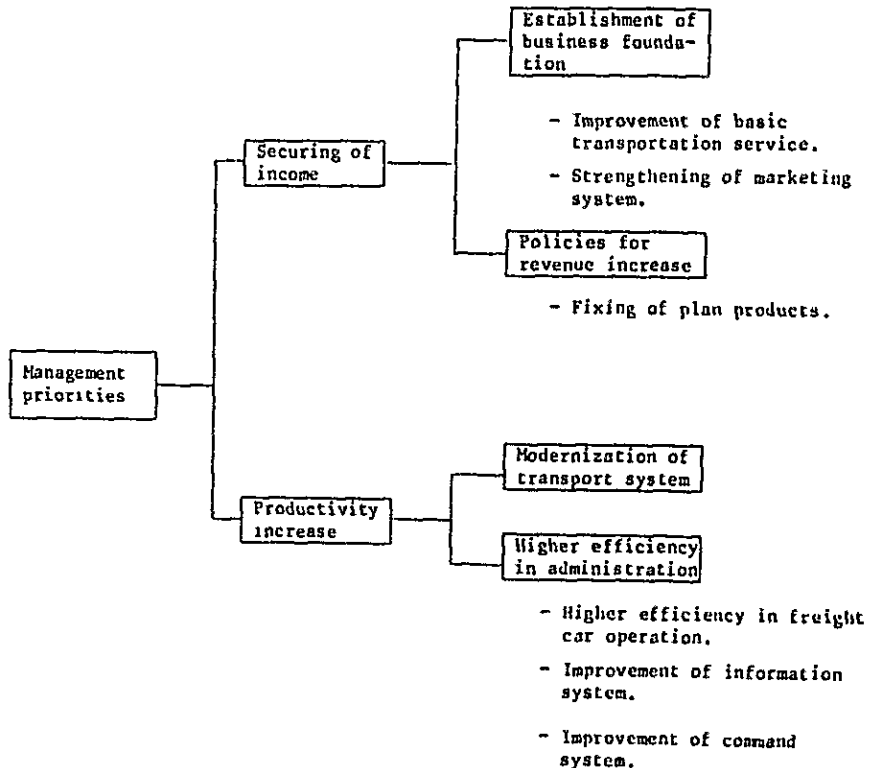
Under policies of free competition which have nurtured initiatives by the private sector, however, the development of roads has brought a drastic upswing in trucks, buses and passenger automobiles together with the development of planes. This has caused a deterioration of the business conditions of the State Railways in recent years, and resulted in large scale drops in the number of passengers and in the amount of freight. A thorough improvement of efficiency in the management of the State Railways has become an urgent matter in order that it can cope with the abolishment of the government assistance and compete satisfactorily in the severe domestic transportation area.

Since 1974, wide-ranging rationalization has been promoted, including the abolition of service, under the government's policy of a self-supporting financial system and free competition. In February 1982, the structure of the Railways was divided into three, the Arica Line, the Northern Railway and the Southern Railway. The profitability of each Line was made clear, and changes are being made so as to promote policies that are appropriate to the market structure.

An evaluation of the current state of the Chilean State Railways indicates that thorough rationalizations, including reduction of the scale of business, has been undertaken. It is considered that such reduction and cost saving have reached their limit. The present business scale is the minimum one necessary for the maintenance of current transportation services. Accordingly, emphasis must be put, in future, on the management by which the railway can fully display its abilities in the severe free competitive market in the new age.

To these ends, most important factors are the establishment of a solid business foundation for the main trunk lines to secure income, and promotion of drastic new management policies for further revenue increase.

Nextly important are the corresponding modernization of the transportation services and the raising of efficiency in the business operation. (See the following chart.)



I.2.2 Outline of Concrete Proposals

I.2.2.1 Freight

(1) Establishment of business foundation

*Rearrangements should be carried out centered around large volume, fixed-pattern transportation, with a system linking principal centers as the basic transportation service.

The total freight traffic on the Southern Railway of the Chilean State Railways is 4 ~ 4.5 million tons per year. One part of this is a mutual flow of goods centered on between the port regions and the inland. Another part is the shuttling of freight principally between the major industrial factories.

Both of these flows are suitable to relatively large volume, fixed pattern transportation.

The principal commodities to the port regions are lumber, pulp and copper, and to the inland, barley, wheat, maize, shipping containers and so on. To the principal industrial factories go chip, materials for pulp, pulp, steel, oil, coal, cement, fertilizers etc. These main items account for 70% of the total.

It is considered that in the long term, concentration of the role of freight transport on the area of large volume, fixed pattern transport is indeed the best way to fully utilize the scale merit which is a characteristic of the railway.

According to our study, 81% of the freight on the Southern Railway is handled between 48 stations. This fact fits in well with the transport system connecting key stations.

Accordingly, based on the past experience, integration of freight handling stations should be further promoted for the time being. It is desirable that, in future, freight stations be concentrated on those which will become business centers.

Under this situation, small volume, dispersed-type freight that is sent to and from absorbed stations will be carried to end from the key stations by truck. At the same time, policies should be advanced in respects of charges and regulations in order to raise the business accumulation effect at the key stations through traffic volume increase.

In future, at the stage when the freight handling has totally been concentrated on the key stations, it will be possible to fix the trains linking these key stations, and the service will be improved by such measures as the shortening of transport time. This is also effective in promotion of cooperative through transport with trucks.

By concentrating on the business center stations and organizing the means of transportation between centers, the strong points of both railway and road transportation will be optimized, and their respective shortcomings supplemented. For the railways, efficient transportation will become possible through reduction in transportation costs.

In deciding the concrete key stations, judgement should be made taking into consideration the current state of the yearly flow of goods as well as the flow of newly developed goods.

In addition, it is desirable that trains be operated between the key stations on appropriate diagrams.

(2) Strengthening of marketing system

*An income goal management system should be introduced in order to strengthen the marketing setup.

At present, the method of collection of freight charges in the Chilean State Railways is divided half and half between payment on consignment and payment on arrival according to the commercial practice of the consignor. This system, however, makes it difficult to accurately gauge the efforts by staff to increase sales, and weakens the will to increase revenue on the origin station side. Accordingly, the norm on revenues at origin side should be established, whether in the case of direct selling or selling through a forwarder. Thorough income control should be made then for objective evaluation. At the same time, an award method should be applied to organs which achieved the aimed amount.

Although there are organs for the sales of goods, they are composed of an extremely small number of staff. Such organs should be expanded to systems including the stations, and the organization and division of duties be clarified, and the collection and transmission of information should be thoroughly promoted and speeded up. In addition, an award system for employees can be studied in order to increase the will of the staff to promote sales. Since the current freight charge system is very complicated, it should be simplified such measure as the abolition of the class system. Improvement should be made, through its flexible application, for smooth sales activities.

(3) Strengthening of marketing research system

*A marketing research system should be established in order to grasp the movements in customer demands. A proposal is made regarding the establishment of railway consignors groups.

Marketing research should be the foundations on which all policies are built. It is essential to business and transportation planning in the State Railways. Two matters are absolutely necessary for this. First is the constant availability of basic statistics from departments within the State Railways. The other is the continuous maintenance of ties with other transport organs and related government ministries and departments so that necessary materials can be obtained at any time.

At present there is no department responsible for these type of duties, and this system should be set up at an early date.

Furthermore, for the future, in order to have a firm grasp of the trend of traffic demands through direct contact with railway users, railways consignors groups should be established.

(4) Measures for increasing income

*The following points are proposed as concrete measures for increasing income.

- 1) Promotion of individual contracts with major consignors.
- 2) Expansion of the transportation of marine containers.

1) Promotion of individual contract with major consignors

The present level of individual contracts with major consignors exceeds 60% of income. While this is a considerable achievement, it should be promoted further. The following points are proposed as improvements to those ends.

- a) It would be desirable to implement measures such as changing the discount rate when contracts are renewed on the basis of the level of transportation of each consignor.
 - b) The present procedure is acceptable for large volume, fixed pattern transportation. In the case of large volume, spot transportation, however, discount should be applied after a fixed level of freight transportation is reached. That is, the so-called "Freight Contract with Discount according to Tons Carried" system should be newly established.
- 2) Expansion of the transportation of marine containers

The transportation of shipping containers will generally continue to increase in future and this should be further promoted. For that reason the following two points are proposed.

The first point concerns the fittings for securing marine containers on rolling stock. Improvements are essential in the present system of tying down with wires, which presents problems for efficient loading.

The second proposal concerns the use of the system for freight charges by individual container. The current system of leasing one whole car gives rise to cases where there is only one container per car, and this is extremely inconvenient for both parties. Therefore, if this were changed to the system of charging for freight per container, the State Railways could load containers from multiple consignors on a car, and the inconvenience for both the consignor and the State Railways in respect of tariffs would be eliminated.

(5) Organization of transportation foundation

*At the same time as transport execution plans are devised and the number of freight car is optimized, the modernization of freight car maintenance and the improved effectiveness of freight car control offices should be promoted.

When the yearly budget is compiled for the Southern Railway of the Chilean State Railways, plans are drawn up for the yearly amount of goods transportation and income. No plans are made, however, to attain this income goal.

Two concrete plans need to be devised if the goods transportation goals are to be met. One plan is how to improve transportation as a commercial product. The other is a transportation plan for linking the transport capacity to the transport demand.

For the past ten years, the Chilean State Railways have had an excess of capacity. The most needed measure at present is the optimization of the number of freight car in possession. This is because, judging from the present circumstances, it will be difficult to put the current excess of transportation capacity to effective use, by developing the demand for transport and the expansion of the amount of transport.

Although there are stipulated standards for preventative maintenance for freight car they are not being observed.

"Ex-post-facto" maintenance is being practised, whereby repairs are carried out after some fault has occurred.

The reason for this is that maintenance costs are being saved, but there are also problems with the maintenance standards. We would like to propose a new system for inspection, including the type and frequency of inspection.

Because the yards where major repairs of freight car are undertaken are unevenly distributed to the southern management area, the distance over which cars for repair have to return is long, and for this reason, there are many cars which can not be operated at present.

Our proposal is that the facilities and functions in the Patio depot be transferred to the San Eugenio plant. This measure requires the least investment for the prevention and reduction of instances in which cars become immobile.

The freight car control office records on control cards the daily movement and condition of each car for all freight car attached to the Southern Railway of the Chilean State Railways. The operating conditions of one car for 365 days are on one card. Reports about the condition of freight car is conveyed from stations and train crew to the command center.

Only two employees are filling in the cards based on this information. There are also problems such as the insufficiency of the data.

Thus, as computerization is considered as one means of improving these procedures, a proposal is made regarding the gradual introduction of computers.

At first, computers are to be installed in three command centers, and a command system be introduced. The second step is linking of the three command centers through telecommunications lines. The third, long-term step is the undertaking of large volume, integrated processing with data base machines.

Note: Further detailed study is needed regarding the introduction of computers, their economic effectiveness, a maintenance system and the decision about the system's applicable scope.

(6) Higher efficiency of freight car operation

*In order to improve the efficiency of freight car operation, improvement must be made in the freight car control system, including the command system.

Information necessary to the control of freight car operation, right from the gauging of transportation demands up to the completion of transportation, must be assembled systematically, accurately and promptly gathered and dispersed.

As an organization for the control of freight car operation, the central command center is located at the headquarters of the Southern Railway. This center undertakes control of all positioning of freight car on the whole Southern Railway.

As regional organizations, there are three command centers situated at Alameda, Concepción and Valdivia.

The Concepción command center is attached to the South Superintendence Office, and is in charge of the area under control of the office. The Valdivia command center is attached to the Valdivia control section and is in charge of the area under control of the section. The Alameda command center, however, is similar to the central command center.

It is a special type organization as it is attached to the Southern Railway headquarters and is in charge of the area under control of the central control office. On this point, it is desirable that the Alameda command center is separated from the Southern Railway headquarters and attached to the central control office.

The duties of the command centers are to carry out the efficient positioning of freight car on the basis, primarily, of transportation demands, and then of data reported from stations. There are problems, however, requiring improvement in the transmission of information, such as the defective form of report paper. These information systems should improved in order to establish a system for the control of freight car operation.

I.2.2.2 Passenger

(1) Establishment of business foundation

*Rearrangements should be made for a fundamental service of transportation on the long-distance trunk lines and between the cities.

The distance between Santiago and the southern extremity of Puerto Montt by rail is 1,080 km. The railway runs parallel to a major trunk highway (Pan American Highway) almost this whole distance, so that competition over the whole sector is with buses.

Buses have a 3/4 share, and the railways a 1/4 share in the Southern Railway region. Since these figures include data on areas that the railway does not serve, it is only natural that the bus share is higher.

However, in view of the conditions of the roads, the maximum distance over which buses are used is considered as 300 km.

About 7 ~ 8 hours are necessary for a bus journey of 400 ~ 500 km, while this distance can be covered in 4 ~ 5 hours by train.

Intercity transport by train is under favorable conditions from the point of view of safety, time required and comfort. Therefore, in future, transport around the cities should be left to buses, and the emphasis of the railway business should be put on the intercity transport.

Even at present, on certain section, the railways has sufficient superiority. However, in these cases, the service should be improved by shortening the travelling time with higher operating speeds, and by improving the rolling stock equipment. (This improvement of rolling stock is considered as the precondition to all measures.)

The next point is frequency (convenience), where buses are in a superior position. Consideration should be given to the effective time zones and the composition of trains while grasping the movements in demand, and the number of trains operated should be gradually increased. On the other hand, coordinated transportation with buses should be strengthened in those areas like Chillán which have in the background of stations have a high demand for railway. At present, other modes of transport should not be considered as merely competing organs. However, positive collaboration and cooperation should be pursued and organic links be made with their respective characteristics. Policies should be undertaken to heighten the efficiency of the modes of transport as a whole.

(2) Strengthening of marketing system

*It is urgent that the fundamental system for marketing (income goal control system) be organized.

The current situation of the Chilean State Railways leaves room for improvement in the organization which produces

merchandise and which sells that merchandise. In particular, the set up has been influenced by the reduction of personnel and is in an extremely weakened state.

The marketing goals for lower level organizations, such as by region, line, station and so on, are unclear. Nor is there a stable checking structure for this. Thus, before the execution of all other measures, this marketing system must be strengthened.

Income goals are only attained when all employees work as one functional unit. Accordingly, the organization and division of duties must be clarified and made to be functionally efficient. For that purpose each organ must be given detailed goals, and at the same time, a reward system should be introduced.

(3) Organization of marketing research system

*A marketing research system should be organized in order to grasp the movement in passenger demands.

Passenger business necessarily requires that variations in the flow of persons be detected early; the same is true for the flow of goods. Suitable business activities must be developed at the appropriate time. To achieve this, all economic trends must be accurately grasped. At the same time, movements in other modes of transport, information about tourist sites and so on must be constantly gathered. A system should be organized that provides a transportation service which fulfills passenger needs, that develops new products and actively engages in activities to attract passengers.

At present, the Southern Railway of the Chilean State Railways does not have a division to handle these duties, but they are handled by designated persons when the needs arise.

This has resulted in a shortage of information materials and a procedure which lacks continuity and is unsystematic. It is imperative that a continuous grasp be made of the various data which become the foundation of marketing research. Moreover, these data should be available at any time.

Supply of needed external information materials should be secured by maintaining close contact with other modes of transport and related government ministries and departments. The sections in charge of these contacts should be clearly designated.

(4) Measures for increasing income

*The following points are proposed as measures for increasing income in the passenger business.

- 1) Expansion of stable customers
- 2) Strengthening of ties with external enterprises
- 3) Utilization of travel agents

1) Expansion of stable customers

The results of surveys indicate that of the passengers using the Chilean State Railways on week days, 52% are on business. The future policies most likely to be effective will to focus on these business passengers.

For the time being, two methods can be considered for this: (a) expansion of contract groups, (b) inducement of students on school excursions.

(a) Expansion of contract groups

There are 9 groups which currently have contract with the Chilean State Railways, including the Boy Scouts Association and the Chamber of Commerce. In future, these groups should be expanded to official groups, economic groups, work groups, labor groups, consumers groups, artistic and cultural groups and regional

groups. Efforts should be made to develop and attract passengers.

(b) Inducement of students on school excursions

School excursions are planned fairly beforehand, and since they are considered as a school activity, week-days are often used, enabling the railway to conduct well-planned transport. Accordingly, these excursions are an extremely effective means of increasing passengers in light traffic seasons.

2) Strengthening of ties with external enterprise

Seats should be guaranteed on the train, the connection with trains or other modes of transport should be efficient, the hotel at the destination should be secured in advance. In order to achieve these aims, not only the sales of train tickets but also the setting up and sales of integrated ticket should be promoted by strengthening of ties with other modes of transport, hotel enterprises and so on.

3) Utilization of travel agents

At present, passenger tickets of the Chilean State Railways are only available at passenger stations and seven information and sales offices in the major cities. Travel agents are not being utilized at all.

However, their sales networks and abilities of sales planning and attracting passengers are considerable. The positive utilization of these agents would be extremely effective for the Chilean State Railways.

(5) Improvements in seat reservation system

*The seat reservation system should be improved and computerized

Currently, the Chilean State Railways has a reservations system for 3,560 seats on 16 trains. Reservations for seats can be made, and their tickets can be purchased at seven service centers and surrounding stations. That system relies almost completely on manual work for its processing, since it uses a registration system that uses the half of the ticket which is torn off. While this system is rather primitive, it is considered sufficient for the volume of transportation at present. However, as long as this system is used, there will be difficulty in increasing the number of trains, expanding the selling points and lengthening the selling period for promotion of positive sales activities.

The introduction of computers will improve and simplify the task of making reservation and selling reserved seat tickets. If, further, automatic printing and issuing machines for passenger tickets are installed at ticket windows, the tasks at the windows and the follow-up business processing will be simplified, considerably reducing the required time. With computer control of the reservation situation, it also becomes possible to provide proper replies to inquiries about the situation of sales and reservation. Prompt action, based on accurate data, can also be taken in such matters as the preparation of extra trains in response to the trends of passenger demands. Passenger services are thereby improved.

There are three proposals made regarding the computer. Of those, Proposal 3 (On-line, real-time method) is an effective, ideal system in the long-term view. However, in consideration of the financial situation and the condition of telecommunication circuits in the Chilean State Railways, Proposal 2 (the "office computer processing method"), is considered feasible because it is not greatly affected by the condition of telecommunication circuits and can be expanded by stages.

(Note) Further detailed investigations into such matters as economic effectiveness are necessary for the introduction of computers.

I.2.2.3 Telecommunications equipment

*Thoroughgoing measures, including replacement, are necessary for telecommunications equipment such as transmission devices and command telephones which are in general old and deteriorated. The contents of the future planning for telecommunications equipment are, in themselves, the important factors in deciding the level of modernization of the information system.

There are problems in the operating rate of the transmission equipment and in the quality of lines. This is due to the uncovered aerial lines which are installed along almost all railway lines.

The operating rate has a low stability, with troubles occurring every day. The quality of the lines is, in general, bad. The levels of understanding and clarity are low.

The command telephones are a direct link for contact between the command centers and each station. They are used in such jobs as train operation and placement of rolling stock. As more than 100 years has passed since they were manufactured, they are extremely deteriorated and their communication quality is poor.

Since the command telephones are the telecommunications equipment which serve as the means of transmitting basic information about transportation, they must have high reliability and quality, and at the same time, be easy to operate.

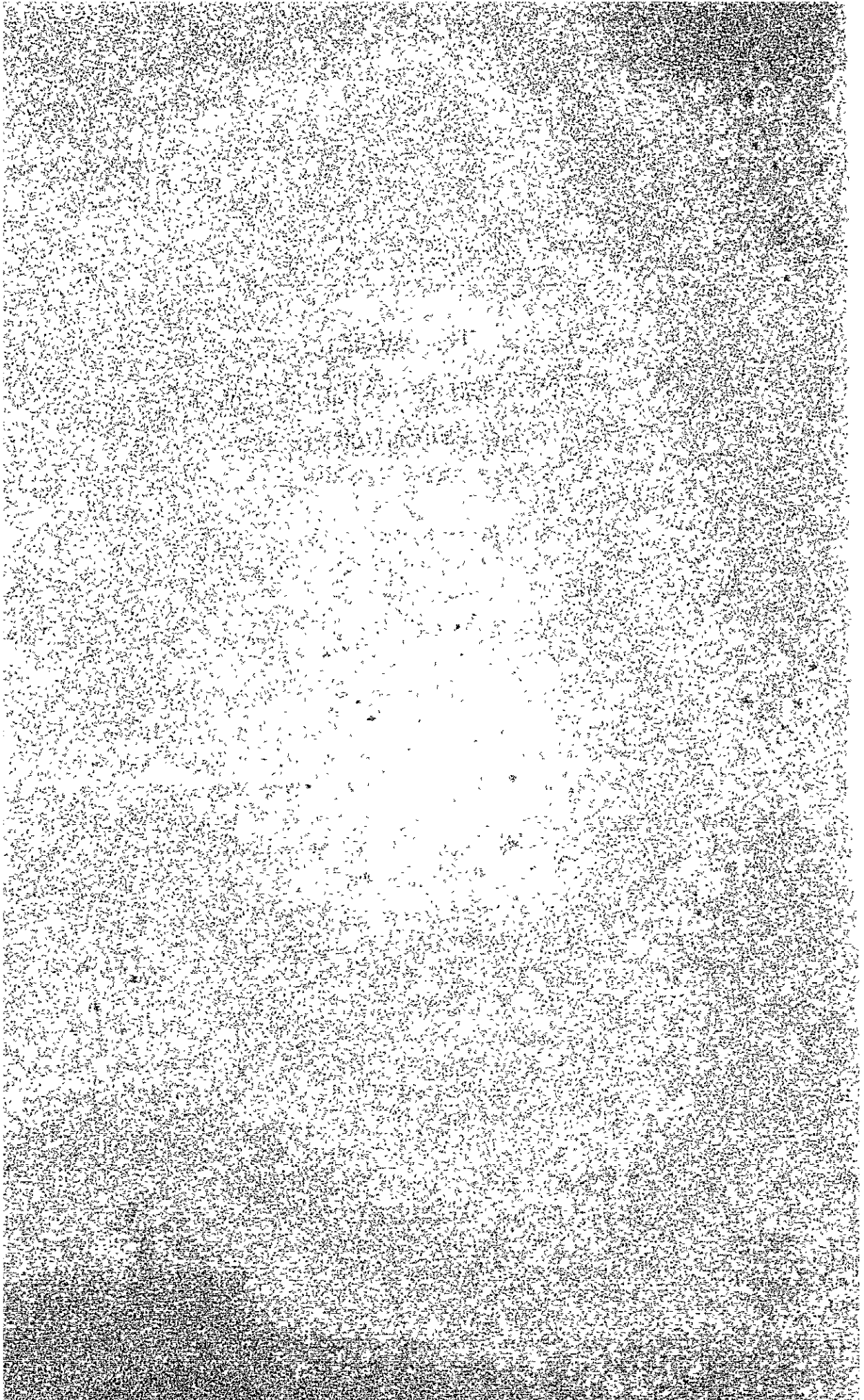
Therefore, in order to carry out accurate command transmission and data gathering, the introduction of new equipment is desirable.

The contents of the future planning for telecommunications equipment are, in themselves, the important factors in deciding the level of modernization of the information system.

At the time of the establishment of the rolling stock operation control and the passenger information systems, it must be clearly understood that the operating level of those systems will be determined by the contents of improvement of the telecommunications equipment.

The proposals for these improvements are general and require large amount of capital investment. Therefore, for their introduction a separate feasibility study must be carried out in order to investigate whether these improvements can be implemented both technically and profitably.

II. PROJECT 1
(IMPROVEMENT OF FREIGHT CAR CONTROL
AND INFORMATION SYSTEM)



II. PROJECT I (IMPROVEMENT OF FREIGHT CAR CONTROL AND INFORMATION SYSTEM)

II.1 GENERAL ASPECT OF THE STUDY

II.1.1 Objective of the Study

Our study team has executed on-site surveys in 1982 to prepare concrete proposals for the improvement of freight car control system to realize effective rotation of freight cars in the Southern Railway, introduction of effective information system and improvement of telecommunication equipment, etc.

II.1.2 Methods of the Study

- (1) Studies have been carried out on actual freight car movements with the purpose of preparing basic data for the effective freight car operation and understanding actual one cycle freight car rotation and necessitated transportation hours, by using investigation card, etc. at the major three stations at Laja, San Rosendo and Talcahuano on all 636 cars which existed on investigated days by a method of pursuit of each freight car movement.
- (2) The studies on freight car control system, freight car maintenance and on-site survey of telecommunication equipments have been performed mainly through hearing from counterparts of the Chilean State Railways.

Major survey items on actual situations are as follows:

- Organization of freight car operation control system,
- Freight transportation planning,
- Informations concerning freight car operations and their transmission,
- Freight car dispatching business,
- Freight car transportation system,
- Major freight flow in the Southern Railway Lines,

- Inspection and repair works of freight cars,
- Accidents of train operation,
- Telecommunication equipments,
- Maintenance system of telecommunication equipments.

II.1.3 Results of the Study

(1) Rotation time

The results of investigation of freight car movement indicate a fact that the detention time is very long among one cycle of car rotation.

Furthermore the long detention time is not a result from loading and unloading time, but from waiting for loading. This phenomenon is remarkable in the case of tankcars and cars which carry harmful chemicals.

But these results were acquired from the investigation at the above mentioned three stations. In future, it's necessary execute the same investigation on all stations for the calculation of appropriate car rotation time of one cycle and to determine necessary number of freight cars for commercial use.

(2) Organization of freight car operation control

Central command office of the Southern Railway supervises all freight cars distribution services on all the Southern Railway lines.

As regional Organizations, Traffic Control Centers are in Alameda, Concepcion, and Valdivia.

Among these, Concepcion Traffic Control Center is under the jurisdiction of the South Division to supervise a part of the Division and Valdivia traffic control center is under the Valdivia Operation service department, supervising the area concerned.

But the Alameda traffic control center is under the jurisdiction of the Southern Railway like Central command office and controls directly the stations of Central Division.

It's desirable to transfer the organization of Alameda Traffic Control Center from the Southern Railway to Central Division.

(3) Planning

With respect to the freight transportation, Southern Railway of the Chilean State Railways prepare annual freight transportation volume and incomes at the stage of formation of the budget of fiscal year. But the transportation plan to achieve the goal of income to be gained.

As of concrete planning for achievement of freight transportation goal, it is important to establish an execution plan of transportation capacity as a commodity of transportation, by considering the capacity of transportation commodity and the traffic demand.

(4) Information and report

The information which is necessary for operation control of freight cars should be systematized from the familiarity with the demand to the completion of transportation and must be transferred precisely and rapidly, by gathering them effectively.

As results of investigations on the forms and reports for the control of freight car operation, the papers of reports are not prepared completely, partly because of the deficit of capital but the solution of this problem is very important.

According to the rapid rationalization of personnel in recent years, it is important to educate personnel more widely to avoid the decrement of faculties and to compensate the lack of personnel.

The other important problem is kind and contents of informations. It is necessary to revise some information and reports from the above view point.

(5) Proposal of a format of arrangement

With respect to the dispatching service, Central Command Office and Concepción traffic control center were investigated. For the improvement of car distribution service an arrangement list might be recommended to compare and check the daily freight car distribution work more efficiently and more precisely.

(6) Computerization of freight car control work

With respect to the business of Freight Car Control Office all the freight cars of the Southern Railway are recorded by using cards in which the daily movements of freight cars and conditions for the 365 days are recorded. The reports, from stations or train crew to the dispatchers in traffic control centers, are noted by two personnel members on the cards. But there exist many problems as the lack of data, etc.

For that sake the computerization of these works might be very effective.

At the first stage in three Traffic Control Centers will be deposited computerized dispatcher systems. In the medium second stage three Traffic Control Centers will be connected by telecommunication line and in third stage wide jobs will be manipulated by using data base machine massively and systematically.

The introduction of this computer system will be realized according to the above mentioned three stages. For deciding the introduction, the feasibility of these projects should be checked more precisely from the technical, political and economical viewpoints.

(7) Centralization of freight service stations

The flow of major freight on Southern Railway lines of the Chilean State Railways has been investigated on the data of 1981 partially (March, July and December; 12 weeks; 84 days).

From that, the freight flow is characterized by about 720,000 tons between 48 stations. This transportation volume might be equivalent to 81% of the total freight transport of all the Southern Railway. Among them the 3 port-area stations (Ventanas, Pto. Aduana and Barrancas) are remarkable and the dispatch freight goods volume is 245,000 tons and arrival freight is 227,000 tons.

Their ratios are dispatching 34% and arrival 32% and the values are remarkably high.

By considering this situation of freight transportation of the Southern Railway, the role of freight transport can be found in the massive and regular form of freight transport.

As a short term project, the concentration of freight handling stations should be continued and in future 48 stations should be connected to each other by direct operation trains after the completion of concentration to the 48 strategic stations for the rationalization and for the improvement of transportation service.

(8) Maintenance of freight cars

With respect to the inspection and repair of freight cars, the maintenance system is a " ex-post-facto " method, although the inspection standard is existing, to repair failed cars after detention by some accidents without regarding the standard.

This phenomenon is caused mainly by the decrease of finance of maintenance. The maintenance standard has a problem to be solved by new inspection system: which types and intervals of inspections should be considered for the solution.

With respect to the repair work, the workshops of great reparation exist only in South Division and the dead head operation of repair cars is long-distanced, causing many freight cars to be incapable of operation.

For the improvement of these situation, a part of faculty of Patio depot will be proposed to be transfered to San Eugenio workshop as a countermeasure with little investment.

(9) Decreasement of freight cars

With respect to the manufacturing and abolition of freight cars, newly manufactured cars were last put into service in 1973 and the abolition of cars is not executed regularly, although many deteriorated cars and cars incapable for use are existing. From now on it is necessary to retain a reasonable number of cars for the demand of transportation, and to achieve a decrease of inspection and maintenance cost.

II.2 FREIGHT TRANSPORTATION OF THE SOUTHERN RAILWAY OF THE CHILEAN STATE RAILWAYS

II.2.1 General Situation of Freight Transportation

- (1) These years, the Southern Railway have transported from 4 to 4.5 million tons of freight per year, which is to say 1,000 to 1,200 million ton-kilometers.

The volume transported varies according to the year.

Especially in the year 1981 it shows a reduction by 780,000 tons, which is 16.7% with respect to the preceeding year, reflecting the economic recession. (See Table II.2.1)

Table II.2.1 Volume of Transportation Load
(Principal freight goods)

Year	Tonnage (1000 tons)	Variation (%)	Ton-km in (1000's)	Variation (%)	Average distance (Km)	Variation (%)
1977	4,516.5	- 6.6	1,216,158	- 5.6	269	1.1
1978	4,375.1	- 3.1	1,081,379	-11.1	247	- 8.2
1979	4,487.5	2.6	1,092,140	0.1	243	- 1.6
1980	4,679.2	4.3	1,150,395	5.3	245	0.8
1981	3,898.5	-16.7	1,038,791	- 9.7	266	8.6

- (2) With respect to volume by freight type, 10 principal products occupy 73% ~ 78% of the total volume transported, as indicated in Table II.2.2.

Specifically, they are: imported wheat which is sent from the port zones of Concepción to San Antonio, in the interior of the country; lumber from the southern interior to the port zone of Concepción for export; coal; saltpeter; cement; steel; and fertilizer for domestic consumption.

Classifying the freight into two general categories, between primary and secondary products, it is observed that the primary products have decreased in importance with respect to the secondary ones as is indicated in Table II.2.3.

Table II.2.2 Tonnage Transported by Type of Freight
(1,000 tons)

Freight	Year						Variation %
	1977	1978	1979	1980	1981		
Wheat	539.1	635.9	510.3	615.8	664.8	8.0	
Lumber and parts	1,023.3	1,223.1	1,305.0	1,318.1	725.5	-45.0	
Copper minerals	144.1	143.3	155.6	194.2	175.2	- 9.8	
Salt peter	161.3	161.2	138.2	121.6	60.8	-50.0	
Coal and charcoal	511.6	357.6	384.5	361.5	211.1	-41.6	
Cement	115.3	65.3	77.9	99.2	145.6	46.8	
Copper in bars	264.3	239.2	266.6	236.6	251.5	6.3	
Steel	161.3	209.7	214.5	281.7	243.3	-13.6	
Cellulose	229.9	311.7	-	318.4	279.9	-12.1	
Fertilizer	140.0	87.1	122.1	124.3	99.3	-20.1	
	(73)	(78)		(78)	(73)		
Total of principal products	3,290.2	3,434.1	-	3,671.4	2,857.0	-22.2	
Total volume transported	4,516.5	4,375.1	4,487.5	4,679.2	3,898.5	-16.7	

NOTE: The figures in parentheses indicate the percentage of principal products in the Total volume transported.

Table II.2.3 Proportion of Primary and Secondary Products

		(1000 tons)				
Year	1977	1978	1979	1980	1981	
Products						
Primary products	-	(68) 2,956.6	-	(65) 3,027.1	(62) 2,400.2	
Secondary products	-	(32) 1,418.5	-	(35) 1,652.1	(38) 1,498.3	
Total	4,516.5	(100) 4,375.1	4,487.5	(100) 4,679.2	(100) 3,898.5	

Note: (1) Primary products are agricultural products, forest products except for cellulose, livestock, sea products, minerals such as copper, saltpeter, coal, charcoal, etc.

The other products are understood as secondary products.

(2) Figures in parentheses indicate percentage composition.

II.2.2 Performance in Freight Transportation

In Table II.2.4 there are figures which indicate the performance in freight transportation, accompanied by those of several countries as a reference.

(1) The operating performance has been obtained by dividing the number of cars occupied on daily average by all of those registered in the Southern Railway at the end of the year (cars in cessation and those which are under repair are also included). The Southern Railway shows a figure of 5.8% which translates into the rotation of a car being delayed by approx. 17 days, which is to say, from the departure from the originating station until the departure from the station investigated. The operating performance factors will be discussed later.

- (2) The ton-kilometers refer to the volume occupied per car, a figure which varies according to the operating performance and tonnage transported per car on the average.
- (3) The tonnage transported per km has been obtained by dividing the ton-kilometers by the train kilometers. It is evident that the hauling capacity of the locomotives and the degree of mechanization of the loading play an important role in this.

II.2.3 Current Situation of Freight Transportation

- (1) In freight transportation by the Southern Railway, the supply (transportation capacity, which is to say equipment and infrastructure) has always exceeded demand. That is, there is a lack of balance between supply and demand, apart from naturally having to have a certain reserve of equipment to be able to handle any demand which might arise.
- (2) In the actual car control operation which is executed under these conditions, the designation of depot stations for surplus cars in order to prevent the surplus cars from interfering with those which are in service should be more important than the improvement of the efficiency of the operation.
- (3) Two alternatives are considered for achieving an equilibrium between supply and demand for cars. The first consists of the effective utilization of the transportation capacity of available freight cars. For this, a positive foundation for commercial policy will be established in order to develop the demand and increase the volume transported. Thus, not only will income be assured, but profit will be produced as well.

The other involves a reduction in equipment of cars in accordance with the demand when no great increase in it is expected, in consideration of the current or medium-term situation. This measure will economize on unnecessary expenses, contributing to the improvement of the situation for the commercial balance.

Table II.2.4 Figures Indicating Freight Transport Performance

Item	Country	Chile (Southern Railway) 1980	West Germany 1979	France 1979	Brazil 1979	Norway 1979	Japan 1979
	Tons transported (in thousands)		4,937	338,089	232,395	63,025	33,495
Ton-km transported (in thousands)		1,201,836	67,213,313	71,876,000	28,063,230	3,085,022	42,284,287
Mean distance transported (km)		243.4	198.8	309.3	445.3	92.1	310.0
Length of commercial track (km)		4,829	28,565	34,444	22,772	4,239	21,322
Number of cars	State railway	7,349	280,334	171,250	43,172	8,632	99,686
	Private railway	0	49,199	81,207	3,139	391	19,634
	Total	7,349	329,533	252,457	46,311	9,023	119,320
Cars occupied		(423) 154,832	(42,358) 15,460,831	(21,002) 7,665,883	(3,206) 1,170,119	(2,377) 867,798	(17,219) 6,302,154
Kilometers of freight trains (in thousands)		2,881	205,301	213,607	38,001	11,286	152,154
Car-km (in 1000 km)	Loaded	36,538	4,060,883	3,372,000	479,719	182,946	2,522,787
	Empty	-	2,269,410	1,750,000	381,823	88,892	918,495
	Total	-	6,330,293	5,122,000	761,442	271,838	3,441,282
	Percentage of empty car-km $\frac{\text{Empty car km}}{\text{car km}}$	-	35.8	34.2	50.1	32.7	26.7
Tonnage carried per car		31.9	21.9	30.3	53.9	38.6	21.6
Rotation performance (%)		5.8	12.9	8.3	6.9	26.3	14.4
Tonnage transported per car		672	1,026	921	1,361	3,712	1,143
Ton-km transported per car		163,537	203,965	284,706	605,973	341,906	354,377
Ton-km transported per train		417	327	336	738	273	278
Personnel occupied		10,998	336,923	258,904	94,959	18,138	420,815

Note: (1) Volume transported includes internal services

(2) Data on commercial track and number of cars as of the end of the year.

(3) Cars occupied include those which arrive loaded and dispatched on other lines. figures in parentheses indicate daily average.

(4) Car operating performance = $\frac{\text{Cars occupied (daily average)}}{\text{Total cars}}$

(5) Tons transported per car = $\frac{\text{Tonnage transported}}{\text{Total cars}}$

(6) Ton-km transported per car = $\frac{\text{Ton-km transported}}{\text{total cars}}$

(7) No data available.

(8) Ton-km transported per train = $\frac{\text{Ton-km transported}}{\text{Train km.}}$

(9) Personnel occupied includes EFE NORTE.

- (4) In recent years, the Chilean State Railways has done everything possible to halt investment in equipment, carrying the rationalization forward in an accelerated fashion.

From the operational point of view, nevertheless, this accelerated rationalization gave rise to a lack of the number of personnel, and above all that of experts with much experience. This, together with the lack of forms for reports as a result of not having resources available, makes the collection of exact information on car operation impossible.

II.3 FACTORS FOR EFFECTIVE OPERATION

In car operation it is necessary to make them work as effectively and efficiently as possible. From this point of view, the factors for effective operation of cars will be analyzed in Fig. II.3.1.

II.3.1 Objective

An increase in income is expected if operation of cars is accomplished efficiently, so long as there is demand for transportation with the possibility of attracting it. This is because in this case the improvement in operational efficiency will bring with it more efficient use of the cars in order to satisfy a new demand. On the other hand, a reduction in expenses is expected if the volume transported is fixed; in this case maintenance expenses can be reduced for those of inefficient cars which are eliminated due to reduction in the number of cars as a consequence of the improvement in efficiency.

II.3.2 Concrete Factors

The constituent factors in effective car operation are summarized briefly in the following chapter.

- Cycle time for rotation
- Operational system
- Control system
- Fluctuation of demand

(1) The cycle time for rotation is divided into the transportation time, the detention time and the time for review and repair. The reduction of any of these times leads to improvement in efficiency.

1) Transportation time is the time required to arrive at the destination station from its origin.

This time, in turn, is composed of the travel time and the time waiting in transit at intermediate stations.

The travel time is related with the speed of the train and the distance to be transported. The transit time depends on the frequency of trains at the transit stations.

2) The detention time is that required from arrival at the destination station until the departure therefrom, being composed of the time spent waiting for unloading, unloading time, time waiting for loading, loading time and time spent waiting for departure.

Cutting down this detention time is the most important point in the rotation time.

3) The time for inspection is that which is required for inspection properly speaking, and the inspection time is consisted of the times of waiting for repair, repair and waiting for the departure from workshop.

(2) With respect to travel pattern for the cars, there exist two systems; that is, unlimited or common operation and area determined operation according to the nature of the freight. In other words, this depends on whether the freight is distributed in small lots or is concentrated over a given stretch. In any case, it will be convenient to adopt a system for reducing the distance travelled while the car is empty.

- (3) The control system consists of giving a series of instructions from the Central Command Post to stations distributed over the Divisions. The proper functioning of its organization, equipment, information and management systems would permit satisfying demand adequately, bringing an effective operation.
- (4) The fluctuation of demand is a passive factor. In any case, it is obvious that the degree of activity of the cars depends on this factor.

II.4 FREIGHT CAR CONTROL SYSTEM

II.4.1 Organization of Operation Control of Freight Cars

II.4.1.1 Location of the Central Command Office (PCC)

- (1) The Central Command Office of the Southern Railway depends on the Traffic Manager, performing tasks of control and coordination of the distribution of cars with the Central and South Divisions (see Fig. II.4.1).

Also, it performs the operations of distribution and control of the cars directly with stations which are under the jurisdiction of the Central Division. Therefore the Central Division does not have its own traffic control center.

- (2) With respect to local organizations, South Division and Valdivia Operation Service, which is under the jurisdiction of the former, have their traffic control center.
- (3) The traffic control center of the South Division is under the direct command of the Superintendent, controlling the distribution and use of the cars in contact with stations under the jurisdiction of Concepcion and Temuco Operation Services. Also, it is in coordination with the Traffic Control Center of the Valdivia Operation Service.

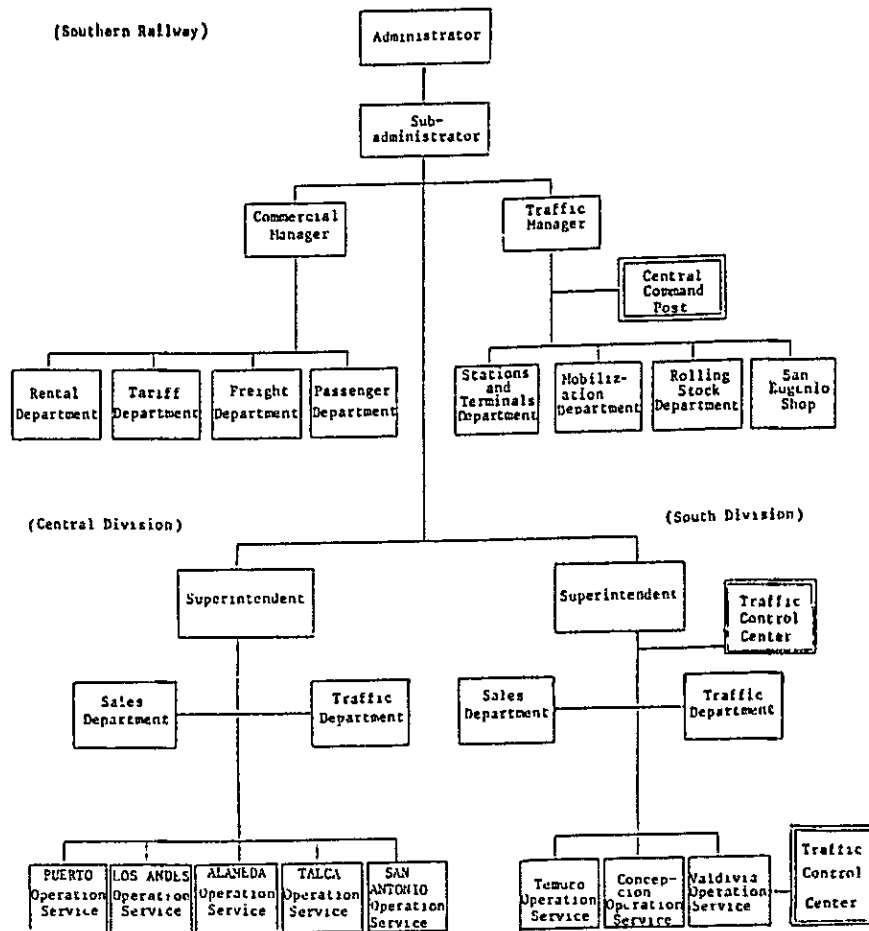


Fig. II.4.1 Organization Chart of the Southern Railway

- (4) The Traffic Control Center is installed in the Valdivia Operation Service for reasons of the communication equipment. Its integration with the South Division will be difficult until substantial improvement thereof has been obtained.

II.4.1.2 Organization of the Central Command Office

The Central Command Office is under the traffic manager and its function is to coordinate and control the distribution of equipment over the entire Southern Railway system.

All informations from and to the stations concerning cars are handled in this Traffic Control Office.

The Traffic Control Centers are installed at three places: one located at Alameda, another located at Concepción, and the last located at Valdivia.

Around each center, there exists an organization called Freight Transport Office which is responsible for performing locally the control over the daily situation and location of freight cars, and to this office each freight car section is subordinate. (From now on, including car section, they are called "freight car dispatcher")

The organization of each control center and information flow are shown in Fig. II.4.2.

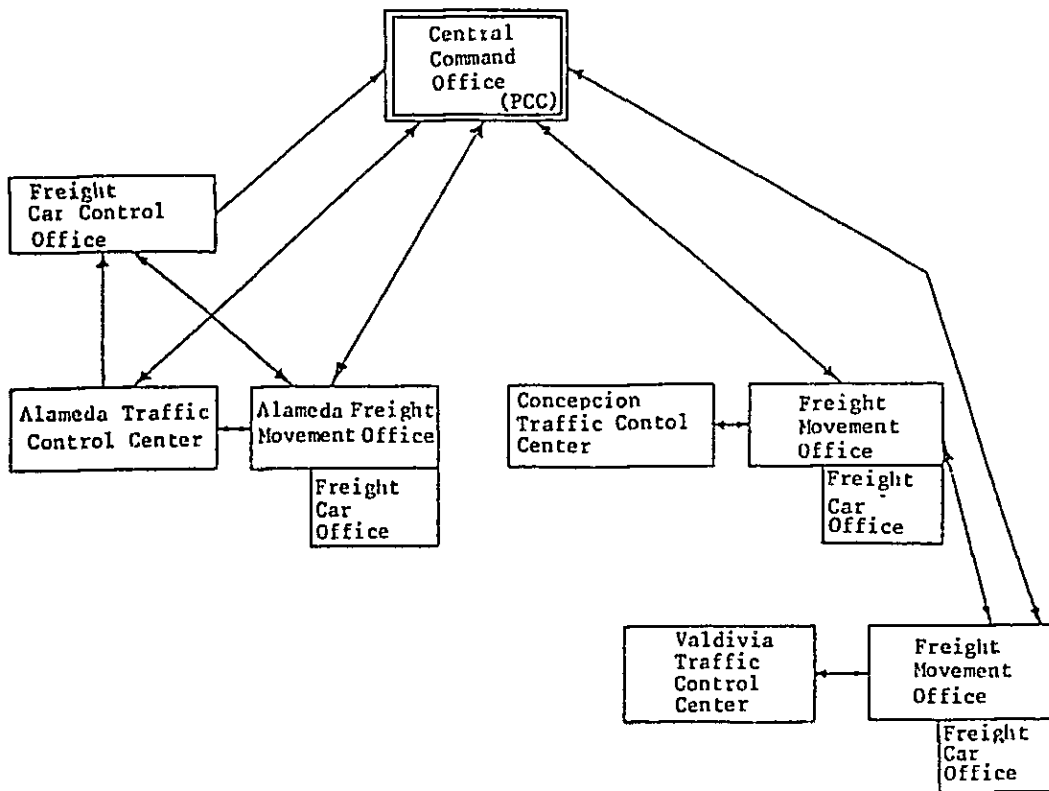


Fig. II.4.2 Organization of Control Centers and Information Flow

The central command office, Alameda control center, its freight car dispatcher, and Freight Car Control Office are subordinate to the Southern Railway.

II.4.1.3 Jurisdiction and personnel of the Traffic Control Centers

The jurisdiction of each CCT is indicated in Fig. II.4.3 and Table II.4.1. With respect to the CCT's, the Southern Railway region is divided into 12 sectors handled by 17 officials in three eight-hour shifts.

As freight car dispatchers, 8 persons work on day time shift, and at the Freight Car Control Office 2 persons work on day time shift.

One official in charge of the central command office works to coordinate the work of these offices on day time shift.

II.4.1.4 Requirement to be a dispatcher

In order to cover the posts of Chiefs of the Central Control Office, Traffic Control Center, and Freight Transport Office, personnel with great experience at section chief level are appointed, while for the traffic controller posts those with experience at the level equivalent to the station masters are selected.

In any case, when designating the personnel for these jobs, backgrounds in training courses taken by the applicant are considered together with his history of services, in consideration of the importance of these posts.

These considerations should be appreciated because of the importance of the dispatchers business.

Table II.4.1 Personnel of the Traffic Control Centers and Type of Work

Place	Traffic control center						Freight Movement and Freight Car Office				Freight Movement Control Office		
	Number of sectors	Personnel			Shift	Total	Personnel		Shift	Total	Personnel	Shift	
		Chief	Assistant to chief	Traffic controllers			Chief	Controller					
Alameda	5	1	1	5	7	3	1	2	3	2	Daily	2	Daily
Concepción	5	1	1	5	7	3	1	2	3	-	Daily	-	-
Valdivia	2	1	-	2	3	3	1	1	2	-	Daily	-	-
Total	12	3	2	12	17	-	3	5	8	2	-	2	-

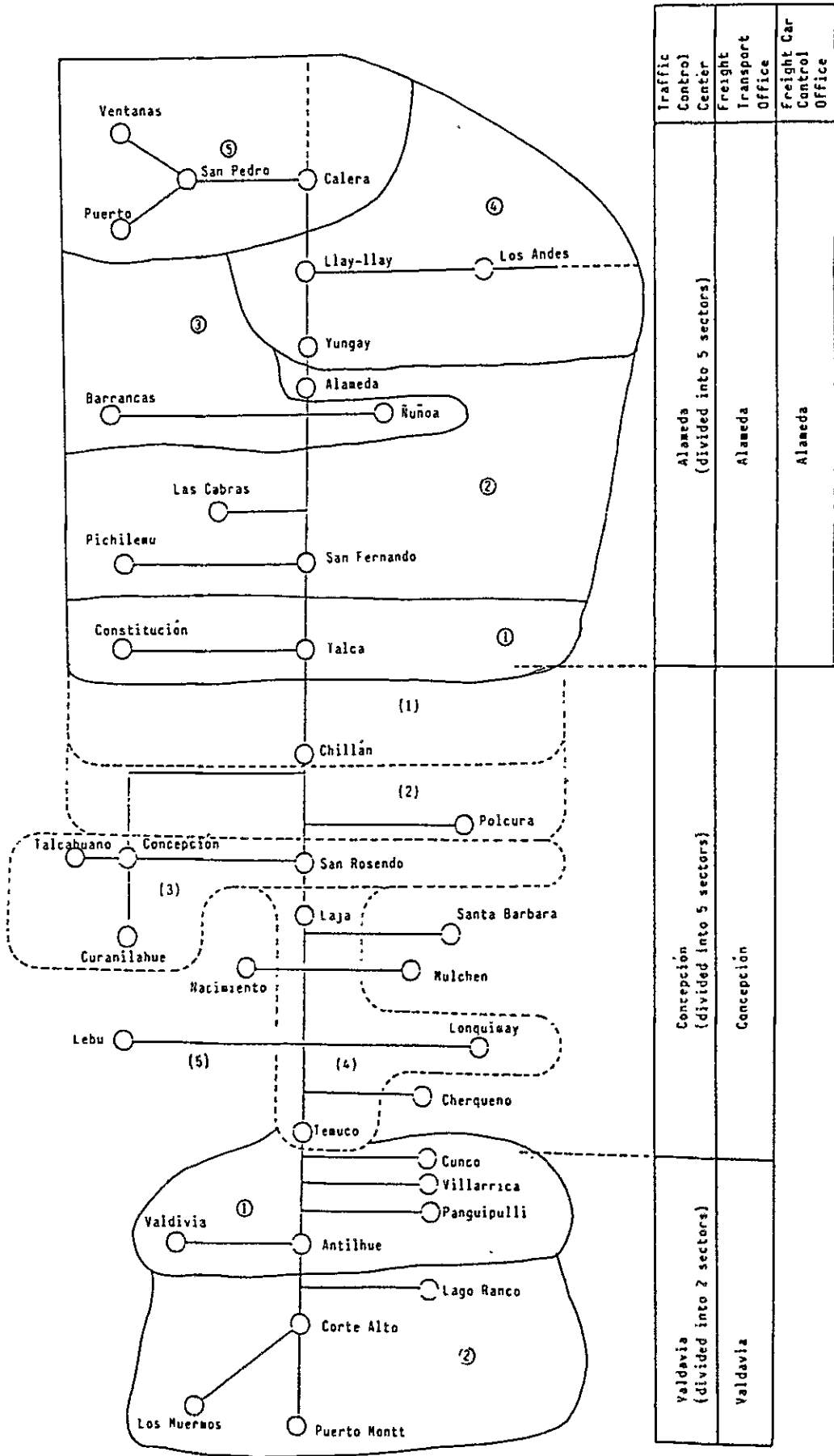


Fig. II.4.3 Jurisdiction of Each Traffic Control Center