II.4.2 Freight Transportation Planning

II.4.2.1 Current situation

The concept of freight transportation planning involves the preparation of a schedule of transport capacity of trains and cars based on preset goals for volume to be transported and income to be obtained.

These goals are shceduled analyzaing the factors such as the economic prospects for the respective year, supply and demand for transportation of speciffic types fo freight, situation of principal customers, etc.

For example, the volume to be transported is calculated based on the following data:

- Estimated production or importation per customer
- Current production or importation per customer
- Production figures per item based on the statistics of international trade and industry.

With respect to the income goals, the scheduling is done by setting the tariff per ton-kilometer in relation to the scheduled volume to be transported, also considering the variations of the CPI.

In this manner, the annual transportation goal is planned. Currently, nevertheless, a transportation plan is not established based on this goal. A weekly schedule is made of the demand arising from principal customers, in accordance with which the transportation is carried out.

II.4.2.2 Need for a transportation plan

In the world of business in general, while the company goes on growing and its organization becomes more complicated, there is a need to plan production, sales, inventory control, etc., in order to rationalize the administration.

A transportation plan occupies the greatest part of the production and sales of the Southern Railway, whose product is translated into transportation. Therefore, a rational plan together with execution in a precise manner plays an important role in the railway transportation service.

(1) The production plan considers the maintenance and improvement of the car equipment in order to accomplish the established annual goal, which is to say: manufacturing of cars, repairs, adaptation of car equipment, etc. As a consequence, improvement of the transportation capacity itself follows.

(2) Sales plan: this consists of selling the products in the most effective manner in the market in which they move, according to supply and demand. In this case, the products would be trains and cars. That is, a plan of execution is involved.

II.4.3 Information, Services for Control and Operation of Cars

The current situation concerning information and car control services and their operation will be analized. The countermeasures will be explained in the following.

II.4.3.1 Types of cars and systems of operation

(1) The cars are classified into three types in accordance with their gauges. On the greatest part of the Southern Railway, the cars with a gauge of 1,676 mm and dual gauge cars are used, although on some sectors 1,000 mm gauge cars are also used.

The number of existing cars by type as of May 1982, including the cars of the Northern Railway, is indicated in Table II.4.2.

(2) Table II.4.2 indicates that the proportion of cars under repair reaches 26%. Above all, attention is called to the

high proportion of covered cars for transportation of general articles, grating cars for livestock, and refrigerator cars for frozen food like meat.

(3) The dual-gauge cars are those whose bogies may be changed in accordance with the width of the track. The change is performed at the junction stations between the 1,676 mm and 1,000 mm gauges, lifting the chassis from below by jacks or lifting the car with an electric hoist. Table II.4.3 indicates the junction stations, with information concerning the bogie changes performed.

Table II.4.2 The Number of Existing Freight Cars by Type

Type of car		Existing	Available	Detained (under repair)	
Box cars		2,658	1,703	(35.9)	955
Gratings		453	228	(49.7)	225
Gondola cars		1,462	1,070	(26.8)	392
Flatcars		1,389	1,149	(17.3)	240
Hopper cars		1,086	916	(15.7)	170
Tank cars		249	211	(15.3)	38
Transporters		17	16	(5.9)	1
Refrigerated cars		55	34	(38.2)	21
Cabooses		147	109	(25.9)	38
Total of commercial cars		7,516	5,436	(27.7)	2,080
Cars for internal service		889	766	(13.8)	123
Total		8,405	6,202	(26.2)	2,203
Number of cars by type of gauge	1,676 mm	4,979	3,239	(34.9)	1,740
	1,000 mm	1,347	1,173	(12.9)	174
	Dual gauge	2,079	1,790	(13.9)	289

Table II.4.3 Results of Bogie Exchanging of Dual-gauge Cars in Junction Stations

Station	Year 1980	Year 1981	Note
Calera	1,457	1,740	North and South transfer
Los Andes	2,567	1,902	Transference to Argentine
Talca	1,131	1,201	Transfer branches between Talca and Constitucion
Monte Aguila	311	608	Transfer branches between Monte Aguila and Polcura
Total	5,466	5,451	

(4) The dual-gauge cars do not have any restriction in their travel throughout the country, while single-gauge cars of 1,676 mm and 1,000 mm have their use limited to the gauge corresponding to them.

(5) In addition to operation by type of cars, there is operation by form of transportation and also by the particular type of equipment installed in the cars. Operation by form of transportation consists of sending a large volume of freight in a fixed form. That is, the system consists of providing cars in advance destined exclusively to daily transport of a more or less fixed volume freight with a single destination. The exclusive use of cars by given customers will be advantageous not only for the customers but also for Railways in the sense of maintaining a fixed clientele, improving operational efficiency and facilitating the prompt removal of empty cars.

Here are some examples:

Cement Calera to Maipu
Lumber for export Colico to Talcahuano
Lumber for cellulose from the interior to Laja

In specific operations, the structural particulars of cars restrict the type of freight to be transported, thus limiting the area of operation. In the majority of cases, these cars are distributed to specific customers.

Example: Tank cars for chemical products or petroleum at the station of Talcahuano. Above all in the case of the tank cars, a very careful scheduling of transportation is indispensable, since it is very difficult to adapt them for other types of freight, when there are too many cars due to a reduction in the demand.

II.4.3.2 Forms and reports used in control of car operations

(1) The current situation and some problems concerning this item are enumerated in Table II.4.4.

In the list of forms indicated, revisions have been made to T.50, T.56 and T.430 which are used at the stations, and to their contents and records, having arrived at the conclusion that the 48 stations investigated whose freight movement exceeded 30,000 tons in 1980 all have these documents available.

(2) In order to obtain an adequate and efficient use of the cars it is necessary to be familiar with the current position and condition of cars and the prospects for the future.

The basic point is that in the forms used for control of cars, a series of information is considered which go from the awareness of the demand until it is served, a fact which should be systematically organized. That is, the revision of the forms was done with respect to the following points of view:

1)	Familiarity with the demand	Request for cars on the part of the customer
2)	Knowledge of the car situation	Existing car situation at the station and their movement

Table II.4.4 List of Forms and Reports (1)

Place where prepared	Form	Name	Summary	Contents	Purpose	Suggestions
Station		Situation of cars at eight o'clock	Daily report on situation of cars by type at 8 o'clock	(By type) Box cars, grating cars, flatcars, gondola cars, hopper cars, refrigerator cars, tank cars. (By situation) loading, unloading, loaded in transit, empty in transit, available.	To adjust imbalances in distribution in accordance with supply demand.	1. There is no uniformity of forms between Central and South Divisions, so not all necessary information is being collected. 2. The stations are not provided with forms in a complete manner.
	T.150	Station car request book.	Book for recording the requests for cars on the part of customers, in addition to the final results of the process.	Customers, contents of request (date of receipt, desired loading date, type of cars, tonnage, destination station, consignee), signature of the customer, handling of request (date of loading, type of cars, number of cars, notice number).	To record the transportation contract with the customer.	1. It will be convenient to prepare a column for noting the communication of handling the request from the CCT, which could be done in the remarks column.
	T.56	Record of arriving and departing car, at	Book for recording the arrival and departure of cars.	No. and type of cars, originating station, data of arrival, train No., dates and times for entering the siding and leaving it, date of departure (dispatch), train No.	For controling operation of cars at stations from arrival until departure with investigation of the time of detention, efficiency and calculation of excess detention (layover).	1. It would be convenient to give more attention to the time of detention of the cars in order to improve efficiency.
	T.430	Statistics book. Results of movement of passengers, car and freight.	Monthly record of the flow of freight arriving and departing, car and passengers	Tonnage by type of freight arriving and departing, passengers, and income.	Monthly and annual statistics for stations.	

Table II.4.4 List of Forms and Reports (2)

Place where prepared	Form	Name	Summary	Contents	Purpose	Suggestions
PPC or CCT		Number of cars at 8 o'clock	Data to give the situation of cars throughout South JR, Railways, compiled at the PCC based on the "situation of cars at 8 o'clock" which is reported from stations to each CCT.		To determine the situation of availability of cars, and as a data base for giving orders to return empty cars, hasten loading and unloading, etc.	1.Different forms are being used at Alameda and the South. Those from the South are more appropriate for determining the situation of cars with greater precision.
		Weekly demand estimate and record for important customers.	To determine weekly demand and estimates (from important customers) and to revise the daily results. There are approx. 32 customers (10 from Central and 22 from the South.)	Name of customer, type of freight, type of cars, origin and destination stations, weekly demand tonnage, results of tonnage dispatched daily.	To determine the tendency of transportation for the most important customers and the car availability situation	
	T.83	Distribution of freight car. Weekly results of dispatched freight.	Each Division summarizes the results of weekly transportation, based on information from stations.	Current results of employment of cars by type, number of cars and tonnage by type of freight, income.	For analysis of the weekly results and comparing them with those of the same period in the preceding year.	1.Data from stations for filling out T.83 are reported by telegram after summing the daily information data. But the stations are not provided with this form.
	T.210 A	Cars dispatched at South Railways.	Computation of data on Central and South through T83.		For tracking the weekly results in EFE SUR and comparing them with the same period in the preceding year.	
		Port report (Valparaiso, San Antonio)	Record of movements of ships in these ports	Tonnage of cars solicited to handle ships carrying wheat, distribution carried out on the preceding day, tonnage dispatched tonnage to be dispatched.	In order to determine the situation for transportation of imported wheat, verifying that it is handled efficiently.	

Table II.4.4 List of Forms and Reports (3)

Place where prepared	Form	Name	Summary	Contents	Purpose	Suggestions
	T.124	Book of requests for cars	Requests for cars from stations, summarized at the CCT	No. of receipt, type of cars, date of receipt, date desired for loading, destination station, type of freight, handling of request.	Basic data for adequate distribution of freight car.	1. At CCT Concepci6n more complete control is exercised which covers all the stations divided into 5 records, but in exchange, this system is not applied at Alameda.
Conductor	T.75	Bulletin of the conductor of the train	Form in which reports are noted for each car coupled into the freight train, clarifying which cars are left and which are taken on at stations where it stops.	Origin and destination stations, No., type and weight of each car, variation of the train at stations where it stops.	In order to maintain the control of the composition of the train in question after receiving the respective data by telephone. Also to control final location of each car at the Freight Car Control Office which will be discussed later.	1. There is no information on all the trains due to the lack of forms. Lack of precision due to the reduction of personnel whose quality has consequently deteriorated. In any case, the system does not function as expected.
Freight car control office		Record of control of cars	The daily movement of cars is obtained through T.75, transferring the information to a card prepared for each car.	A card has space for 365 days.	In order to control and locate each car.	1. Deficiencies in fundamental data (only at CCT Alameda) 2. Low level of precision of data.

3)	Knowledge of the transportation carried out	Cars distributed, tonnage trasnsported, income
4)	Evaluation of the order	Based on the above information the preparation of the evaluation material, to adjust the balance of freight car supply within the boundaries
5)	Order	Based on this evaluation material, send the order regarding the empty, redirected carriages, etc.

II.4.3.3 Operation control service

(1) The PCC supervises the Central and South Divisions, performing the general control over assignment of freight cars in the Southern Railway. The principal functions consist of:

- Adjusting the distribution of cars among the Freight Transport Offices (Alameda, Concepcion and Valdivia)
- Coordinating the availability of cars for handling the transportation of imported bulk freight.
- Putting together the actual results of transportation for the week.
- Providing for the replacement of faulty locomotives and preparing for their entry into service or the shop, as the case may be.
- Designating stations for locating car depots.

(2) The business of freight car dispatchers is:

Gathering informations,

Analysis of informations,

Arrangement of orders for balancing car supply and demand, based on the data prepared.

In Chilean State Railways, according to the situation of telecommunication equipments, the dispatching telephone which connects directly stations and dispatchers is equipped only to the desk of traffic controllers in CCT.

Thus, a large part of the information necessary for the control of cars is collected through traffic dispatchers in the CCT. Therefore, the CCT is responsible for collecting various types of information concerning cars and transferring it to the Freight Transport and Freight Car Control Offices (T.75), which in turn will control the itineraries of the trains.

Given the volume of work, the personnel staff in this system is quite rational. Despite this there is a certain difficulty to a minor degree with respect to the rapid transmission of information, since the desks are separated. The services responsible for the control of cars perform the following operations:

1) Receiving from the CCT a report concerning the "Situation of cars at 8 o'clock" collected from the stations.

2) Ordering the corresponding data for the Central Division, in order to later add the reports from Concepcion and Valdivia with the purpose of determining the number and situation of all the cars in Southern Railway.

3) Receiving telephoned telegrams for requests for cars from stations and noting them in the Record of Requests for Car Equipment in order to be handled. Also preparing distribution of cars for handling important customers, in accordance with the weekly schedule.

4) Determination of the distribution and ordering it based on:

   - Situation of cars at 8 o'clock
   - List of requests for cars by station
   - Weekly estimation of demand for important customers and results.

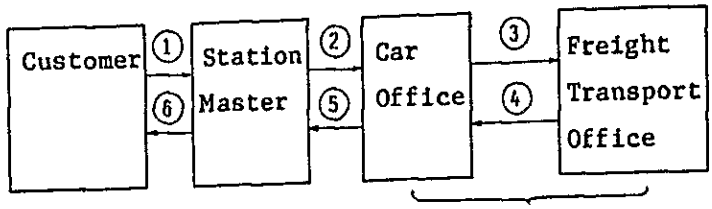
   In any case, the concrete criterion is based on the availability of cars in accordance with the demand.

5) With respect to the order to return empty cars, the destinations are almost fixed. That is, orders are given to the Alameda yard to send them to stations under the jurisdiction of the South Division (principally Concepcion and Osorno), and the principal stations in the sector under the jurisdiction of the Central Division. On the other hand, empty cars are not always concentrated at Alameda. For example, hopper cars are deposited at Barrancas and boxcars at Calera, Alameda and Baron.

6) With respect to the instructions for the transfer of empty cars to return to the South Operating Division, they are given by telex to the offices of Freight Transport, and the instructions to the stations under the jurisdiction of the Central Operating Division are given by means of the traffic controllers through telephoned telegrams, employing the selector network.

7) When the demands are concentrated on a certain type of cars these are assigned taking into account the frequency of utilization of the equipment on the part of the customer.

8) The process from the request for car equipment until it is attended to will be diagrammed in the following manner:



(Dispatcher of Freight cars)

① Having received the request from the customer, the data are noted in the "Freight Car Request Book", recording the signature of the customer.

② The Station Master communicates by telephone (selector) with the CCT, so that the request arrives, or else by telegram addressed to the Freight Car Office or Freight Transport Office, in which it is recorded in Book T.124 "Freight Cars Solicited".

③④⑤ The Freight Transport Office determines the distribution, informing the Station Master by telegram about the type of car and the number of the train.

⑥ The Station Master in turn notifies the customer of the type of cars assigned, the loading date, etc. After loading has been completed, the Station Master notes the loading date and te ticket number on form T.50.

A series of operations is thus executed relative to the distribution of cars. As can be seen, the Station Master is not authorized to make cars available at will, including those in the depot, without an order from the Freight Transport Office. In this sense, the system is firmly established.

II.4.4 Service of Freight Car Control Office

II.4.4.1 Current situation of freight car control office

(1) Actuality

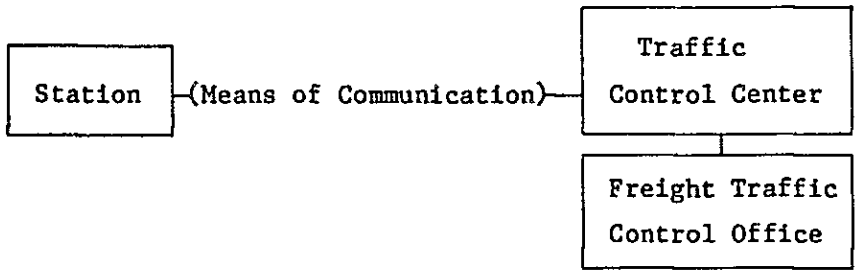
The comprehension of the freight car distribution are being prepared every day by the report of freight cars from each station at 8 o'clock and by the report of train conductors on form T.75.

Upon the base of these reports dispatchers of freight cars are grasping actual situation to execute the planning of car distribution service.

Individual freight car pursuit system is being aimed at.

1) Information transmission flow

Fundamental flow of information is shown in the following figure.



The means most frequently used is the dispatching telephone. Other are telex and public telephones, but the places in which these are installed are limited.

2) Form T.75

This is a daily report of operation of freight train in which appears any change of train formation by conductor of train and despatcher of traffic control center in the same form according to the report of stations related to the train operation.

The records of control center are innovated by actual train operation.

This report from is very important as a primitive data for the freight car control, because in this report there are included detailed informations on the train operation which are innovated according to the proceeding of train. Table II.4.5 shows items extracted from the form T.75, which are important for the freight car control.

3) Actual freight car control system

Fig. II.4.4 shows the way of processing of dis-patchers, work based on the report of form T.75. The train X3 shown in the figure as a example runs all areasof Traffic Control Centres of the Southern Railway from departure to a destination. According to the proceeding for train, the results of train operation are reported to each traffic control center.

Table II.4.5 Necessary Items for Freight Car Control

Informations	Item
Informations concerning train	Number of train Train-Km Name of departure station Departure day (year, month, day, hour, minuite) Name of arriving station Arriving day (month, day, hour, minuite)
Informations concerning locomotives	Type and number of locomotive Operation section of locomotive Station of coupling and discoupling of freight cars
Informations concerning freight cars	Type and number of freight cars Name of station where the freight car is coupled Day of coupling (day, hour) Name of loading goods Weight of loading goods Gross weight Leaving sation Arriving station Discoupling station Day of discoupling (Day, hour)
Record of train operation	Stopped station Hour of arriving (hour, minuite) Hour of departure (hour, minuite)

Station master send the report and dispatcher of traffic control center receives and describes the informations.

The dispatcher notes the report on the form T.75. The numbers ①∿③ in the figure show the order of writing in. When the train passed his own supervising area, the form T.75 will be duplicated to be sent to the freight car control office.

At freight car control office, each reserved card of each freight car will be selected and necessary informations will be entered on the card.

This ledger book of freight car control office consists of two parts: characteristic part, in which are shown the type, number, weight of freight car, etc.; and data parts, in which there are noted the position, loaded or empty, etc. for one year. The cards are prepared for all freight cars. For that sake, the condition of freight cars can be grasped by researching the contents of the ledger book, but when we want to check by manual work, we shall be confronted with the following problems.

(Besides, by using freight car control board, the positions and situation of freight cars are grasped in manual method.)

(2) Problems in the actual system

1) Precision of data

The registered book of freight car control is prepared using resulted data and estimated data. For that sake, the actual condition is not reflected completely.

By using Fig. II.4.4, real situation will be explained as follows:

At the time of departure of train from the station, the formation of train is reported to CCT (Traffic Control Center) as shown in ①.

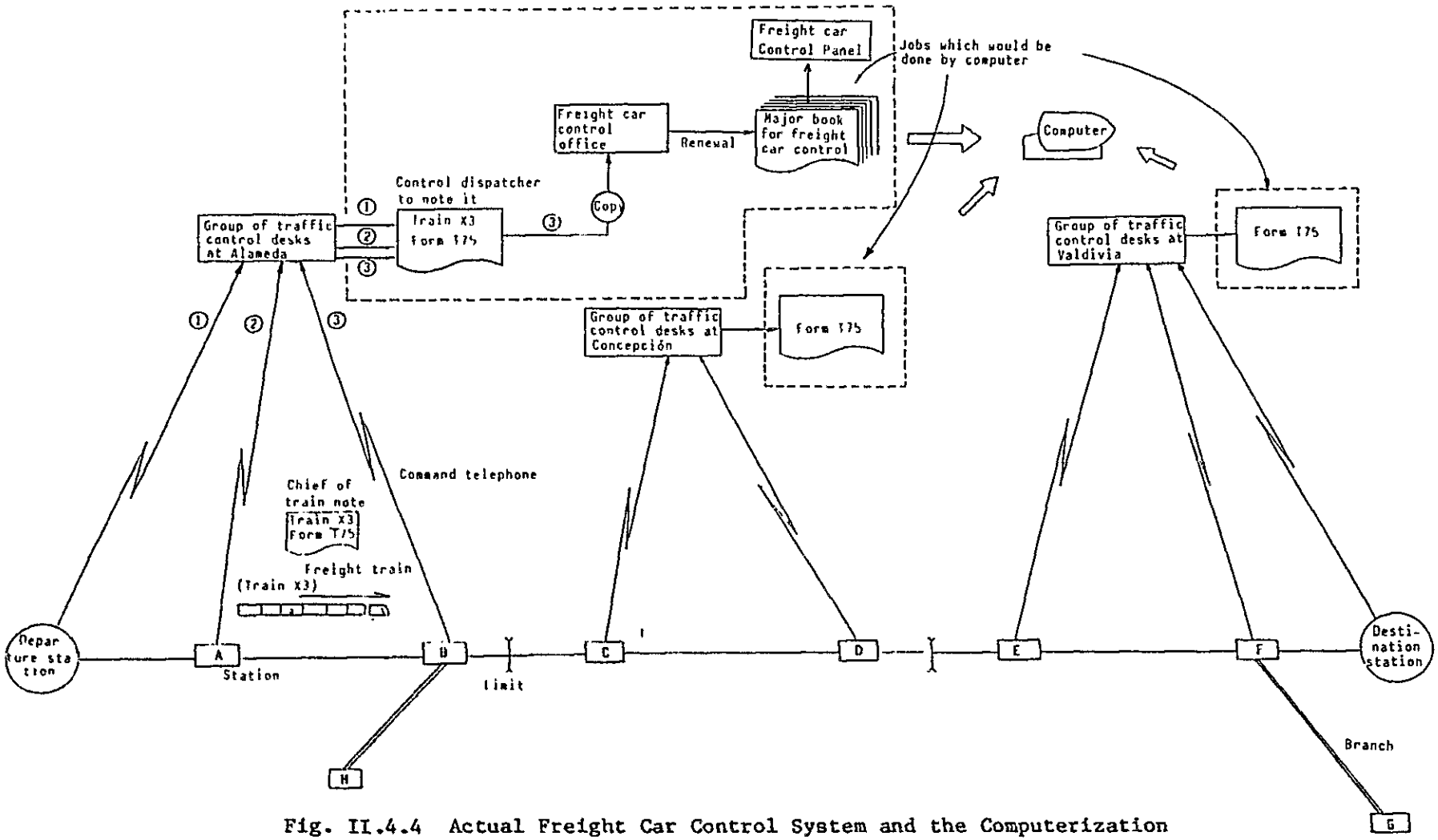


Fig. II.4.4 Actual Freight Car Control System and the Computerization of the Service of Freight Car Control Office

In this train are included such freight cars which will move inside the control area of Alameda CCT and other freight cars destined for stations in the control areas of Concepción or Valdivia.

If the arriving stations are A or B, the movements of freight cars are traced precisely by the reports of ② or③. But concerning to freight cars bounded for other areas (not including A or B), the work of innovation of arriving stations, etc. will be done mechanically by the information of freight car movement noted in the form T.75, inspite of any change after the report③. This procedure will cause sometimes errors in the information by T.75.

2) Lack of data

In the control area of freight transport offices of Concepcion and Valdivia, reports are done using T.75, but the individual control of freight cars are not executed there.

For that sake, while the freight cars circulate in the areas of Concepción and Valdivia, their histories are not recorded in the ledger book of freight car control.

3) Low grade of availability of data

The data noted in the book of freight car control are deposited only in the cabinet and not utilized effectively, although the data are very useful for the pursuit of freight car movement.

II.4.4.2 Necessity of computerization

Actual freight car control system is based on individual freight car pursuit system by using the report of form T.75. By knowing the position (station and train) and the situation (loaded, empty, cessant of use or repair, etc.), the efficiency of car rotation will raise. The concrete measures are freight car

control board and freight car ledger book. Although there are above mentioned problems, the aims are not yet achieved.

The goal might be achieved utilizing the data in the form T.75, but for that sake it is necessary to reform the data elements for the object of decision. For example, the procedure work is necessary to classify the data and show the total of each items as type of train, by stations, by condition, by type of freight cars, etc.

Furthermore the results of the classification should be given rapidly and precisely, and the indication should be ordered for execution.

For the improvement of abovementioned works, it is necessary to adopt computer system.

For the precise analysis of computer system design and evaluation, the execution of a feasibility study should be done, but the merit of introducing the system in daily work will improve evidently rapidity and preciseness.

II.4.5 Systems of Transportation by Freight Trains

II.4.5.1 Classification of freight trains

(1) Freight trains are classified as express, direct, etc., accord-ing to the type they serve. There are sectors in which the so-called mixed train has been put into service; this involves freight cars which are coupled to a passenger train. There are 26 trains in this category.

Freight trains are broken down by type as follows:

Express (X)	4
Direct (Z)	13
Ordinary	36
Extraordinary	18
Total	71

Freight trains by sector are indicated in Fig. II.4.5.

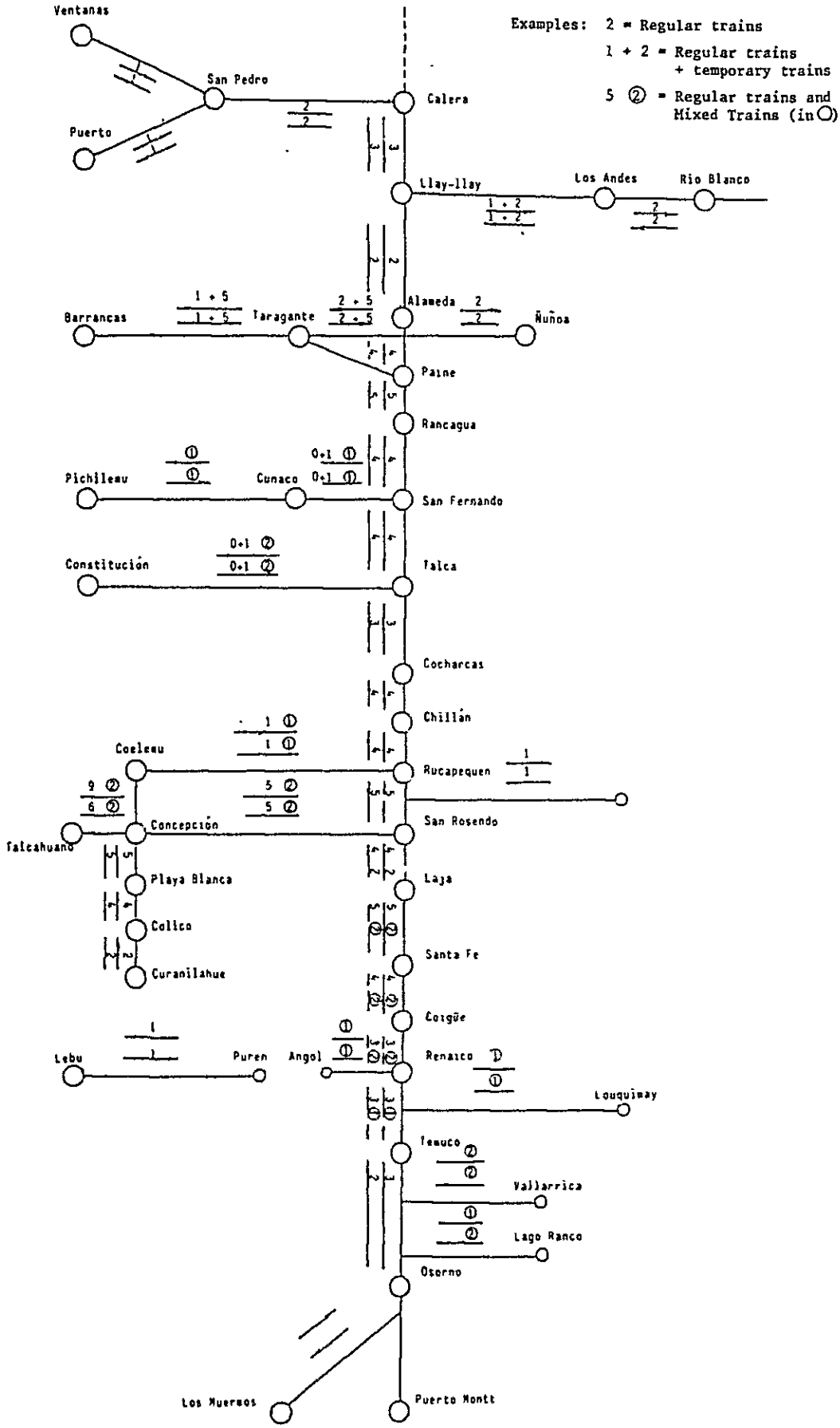


Fig. II.4.5 Number of Freight Trains on Each Line

(2) The express freight train is composed of cars with roller bearings, operating at a speed of 60 km/hr between Alameda - Chillán and at 50 km/hr from Chillán to the South.

The maximum speed is limited to 50 km/hr with the exception of express trains.

(3) Freight car trains have no determined diagram with time table except for a part of freight trains like rapid express train.

CCT adopts the system of recording and arranging the train runs (itinerary) on an open timetable. Above all, the operation of freight trains varies considerably day by day, affected by the productive situation in the major industries and the movements of ships.

II.4.5.2 Composition of freight trains

(1) The Alameda yard has an automatic hump for classifying the cars which make up the freight trains. This yard serves as a base for distribution of the freight which is concentrated by arriving from the different regions which extend to the north or to the south of Santiago, serving at the same time as a transit station for the cars which move between these regions. The hump has retarders which govern the speed of movement of the cars toward the receiving line tracks. The retarders are operated from a control tower with high efficiency.

Apart from this yard which is the only one which has a classifier hump, there are flat yards at Llay Llay, San Rosendo, Laja, Concepcion, Barrancas and Talcahuano which are considered the main ones in the Southern Railway.

(2) With respect to the order of priority in the transportation of freight, there is no special provision. But customarily priority is given to animals, milk and perishable products in general.

(3) With respect to the limitations for making up a train, there are restrictions due to characteristics of the route of the track and the speed, those related to the length of the train, and those of traction tonnage. Considering what has been indicated, the type X train is equipped with cars having roller bearings, while other types of trains have no restrictions. A train can haul up to 40 cars on the Alameda - San Rosendo section. In case of double traction, nevertheless, a composition of up to 50 cars is permitted with prior authorization from the traffic manager.

The tonnage of the trains depends on the power of the locomotive. For important trains such as X and Z, a type 32 electric locomotive is assigned, although the type of locomotive for other trains is not fixed, depending upon the type which is available.

The restriction on tonnage to be pulled on the Alameda to San Rosendo section is:

Type 32 electric locomotive	1,500 tons
Type 30 electric locomotive	1,100 tons

The tonnage of a freight train is obtained by weighing the cars on scales installed at the principal stations (14). The tonnage of trains from stations which do not have scales is obtained from the recorded weight (tare plus freight tonnage).

(4) Restriction of the concentration of trains will not be justified, given the scanty train service.

(5) For the composition of a train, the instructions are imparted from the freight transport office of the CCT, and from it to the yard chief. The instructions cover the details of loaded and empty cars, destination station, locomotive and personnel, stations at which it must drop off or

pick up equipment, etc. The conductor of the train will be informed of the characteristics of the equipment which will make up his train, and will organize and classify the corresponding documentation, becoming fully familiar with the stations at which he will pick up or drop off equipment.

(6) The yard chief, once he has received the instruction, passes them to the assistant chief who controls the yard crew to make up trains.

One party of train composition service is consisted of 3 or 4 men. (1 yardman and 2 or 3 switchmen.)

II.4.5.3 Personnel of train crew

The composition of train crew is descrided hereafter.

Occupation	Number of persons	Belonging	Contents of buseness
Chief of train	1	Station master	Person responsible of train, arriving to office before 45 min. and inspecting the condition of freight cars (Possibility of use, seal, condition of loading etc.). Recording the T.75.
Assistant conductor	1	Station master	Assistant and proxy of Chief of Train
Switchman	2	Station master	Shunting operation in intermediate stations
Driver	1	Master of Locomotive depot	Operate the train
Assitant to driver	1	Master of Locomotive depot	Assitant to driver

Currently it is difficult to keep the station staffed with personnel for a train due to the shortage of personnel caused by rationalization. Therefore, conductors are sometimes replaced by substitutes without long experience.

The 2 switchmen are responsible for engaging and disengaging the cars and they operate the switches with manual control at the intermediate stations. A mobile dispatch system is involved, extremely rational with respect to the employment of personnel.

II.4.6 Current Situation in Loading-Unloading and Equipment Installed at Stations

II.4.6.1 Equipment installed

The investigation concerning the situation as to equipment installed for loading and unloading belonging to the Southern Railway was carried out at the 48 stations which had handled more than 30,000 tons of loading and unloading per year (1980 statistics), with the following results:

Table II.4.6 Equipment Installed

Station	Type of machinery					Total
	Austin Western	Hystre	Drott	Toyo Umpanki	Galion	
Baron	1					1
Yungay		1	1			2
Los Andes	1					1
Alameda	1	2		1	2	6
Talca	1		1			2
Ñuñoa			1			1
Concepción	1					1
Total	5	3	3	1	2	14

A great part of the loading and unloading operations is done with the customers' equipment since the Southern Railway has very little.

II.4.6.2 Current situation of loading and unloading by type of freight

(1) Actual situation observed in the on-site investigation

The current situation of loading and unloading at the principal stations is summarized in Table II.4.7. As it will be mention after, the operations are mechanized in an almost complete way with the exception of Talcahuano where the employment of manual means was observed.

This fact coincides more or less with the results of the investigation on current car movements, and leaves little to call attention to, with respect to loading and unloading.

Table II.4.7 Loading and Unloading at the Principal Stations

Station	Operations	Freight	Car Type	Customer	Means and time occupied
Laja	Loading	Paper, Cellulose	PC, PCF	CMPC	By crane-forklift, in 15-30 min./machine
	Unloading	Lumber	PC, TTC	CMPC	By large (fixed) crane-forklift in 10-30 min./machine.
Coronel	Loading	Coal, Charcoal	TE	ENACAR	By automatic shovels in 30 min./ machine
Carampangue	Loading	Cellulose	PC	Forestal Arauco	By crane-forklift in approx. 15 min./machine.
Colico	Loading	Lumber	PC		By crane-forklift in approx. 20 min./machine
Talcahuano	Loading	Chemical products, chlorine, chlorate, soda	EE, EC	Petro-quimica	By mechanical pump in 30-60 min./machine
	Loading	Cement in sacks	BC	Cemento Bio-Bio	By conveyor belt with two operators in 40-60 min./ machine.
Lirquen	Unloading	Lumber	PC	Celulosa Arauco	By crane-forklift in approx. 15-20 min./machine.
Barrancas	Loading	Imported Wheat	ETE	SAAM	By large electric hoist in 5-10 min./machine. Daily capacity of about 100 cars.

(2) Loading and unloading by type of freight

In this respect, that which was studied on-site was added to the results of the investigation of current car movements, since the time for loading and unloading must be established based on reality. In Table II.4.8 the current situation for loading and unloading is indicated by type of freight.

The loading and unloading at Laja and Talcahuano are carried out on the CMPC sidings and at other industrial plants, by almost totally mechanized means. The time occupied is 40 minutes in unloading and 54 minutes in loading, figures which do not present problems. With respect to some types of freight which take a relatively long time, this has been mentioned in II.5.4 'The Time for Loading and Unloading'.

It is known that the investigation concerning the actual loading and unloading situation plays an important role in future modernization of the system.

From the point of view of the time occupied, at least, the mechanized operations are accomplished efficiently. Therefore, in view of the current situation of freight transportation, Southern Railway seems to have the need to positively modernize in this sense, although this could be required in the sense of mechanizing, standardizing and unifying the system, while the flow of freight continues to diversify and intensify.

Some points which are emphasized in transportation are:

a) Primary products constitute the principal type of freight, transported in bulk.

b) Transportation is directly to ports and industries. There is little secondary transportation.

c) Machinery for loading and unloading belongs mainly to customers who seek the most convenient means on their own account.

Table II.4.8 Loading and Unloading by Type of Freight

Unloading								
Freight (code)		Number of cars investigated	Quantity of freight treated (Kg)	Packing	Means	Per car		
						Quantity treated (Kg)	Time for unloading (min.)	Personnel occupied
Forestal products	Sleepers (20)	1	24,600	Bulk	Manual	26,400	360	3
	Pressed wood (22)	2	65,000	Packets with bands	Crane-forklift	32,500	150	1
	Sawn lumber (22)	4	124,420	Packets with bands	Crane-forklift	31,105	38	1
	Lumber in pieces (23)	3	96,300	Bulk	Conveyor belt	32,100	87	1
	Wood for cellulose (24)	99	2,573,800	No packaging	Large crane-forklift	25,998	24	3
	Wood for other uses (26)	29	819,000	No packaging	Large crane-forklift	28,241	33	1
	Cellulose (28)	39	1,118,700	Bales	Crane-forklift	28,685	33	1
	Subtotal	177	4,823,620			27,252	32	2
Mineral products	Coal (30)	4	196,200	Bulk	Hopper	49,050	60	2
	Charcoal (51)	16	774,500	Bulk	Hopper	48,406	60	2
	Subtotal	20	970,700			48,535	60	2
Prepared food	Seafood (71)	1	8,000	Bags	Manual	8,000	300	3
Industrial products	Chlorate (82)	2	61,200	Tank	Mechanical lamp	30,600	360	1
	Paper (88)	8	239,800	Rolls	Crane-forklift	29,975	38	1
	Empty drums (89)	1	1,100	Drum	Manual	1,100	120	2
	Empty containers (89)	1	5,000	Containers	Crane-forklift	5,000	60	1
	IBM paper (90)	4	126,100	Rolls	Crane-forklift	31,525	30	1
	IBM paper (90)	1	30,500	Rolls	Crane-forklift	30,500	30	1
	Subtotal	17	461,700			27,276	79	1
Total		215	6,266,020			29,144	40	2

Loading								
Freight (code)		Number of cars investigated	Quantity of freight treated (Kg)	Packing	Means	Per car		
						Quantity treated (Kg)	Time for unloading (min.)	Personnel occupied
Forestal products	Sawn lumber (22)	4	111,500	Packets with bands	Crane-forklift	28,875	38	1
	Cellulose (28)	25	712,500	Bales	Crane-forklift	28,500	30	2
	Cellulose (28)	10	310,300	Rolls	Crane-forklift	31,030	30	2
	Subtotal	39	1,134,300			29,085	31	2
Mineral products	Coal (52)	10	298,200	Bags	Crane-forklift	29,820	102	1
	Gasoline (56)	6	201,200	Tank	Mechanical pump	33,533	80	1
	Paraffin (57)	1	40,100	Tank	Mechanical pump	40,100	60	1
	Petroleum (58)	7	288,720	Tank	Mechanical pump	41,246	73	1
	Cement (59)	4	120,000	Sacks	Conveyor belt	30,000	60	4
	Steel (65)	1	22,600	Packets with bands	Crane-forklift	22,600	30	1
	Steel (65)	4	112,600	Parcel with bands	Crane-forklift	28,150	68	1
	Steel (65)	2	56,300	Rolls	Crane-forklift	28,150	60	2
	Steel (65)	1	30,000	Pieces with bands	Crane-forklift	30,000	120	1
	Rolled steel (65)	2	59,200	Parcel with bands	Crane-forklift	29,600	90	1
	Steel plate (65)	3	79,500	Parcel with bands	Crane-forklift	26,500	60	2
	Subtotal	41	1,308,420			31,913	78	1
Industrial products	Chloride (80)	2	60,000	Tank	Mechanical pump	30,000	60	1
	Chlorate (82)	3	91,000	Tank	Mechanical pump	30,333	60	1
	IBM paper (90)	7	212,800	Rolls	Crane-forklift	30,400	30	2
	IBM paper (90)	2	61,000	Rolls	Crane-forklift	30,500	30	2
	Caustic soda (91)	8	247,200	Tank	Mechanical pump	30,900	60	1
	Subtotal	22	672,000			30,505	48	1
Interval services	Steel pipe for construction (92)	1	12,000	No packaging	Crane-forklift	12,000	60	1
Total		103	3,126,720			30,357	54	2

d) The investigation on current car movements does not establish much loss in the time for loading and unloading.

Therefore, it seems improbable the Southern Railway will have a basis for carrying out a substantial investment in these matters. Nevertheless, it will be necessary to continue thinking about modernization, preferably at strategic stations. Among other things, the strengthening of loading and unloading yards might have first priority.

II.5 CURRENT SITUATION OF CAR MOVEMENTS

II.5.1 Summary of Studies Concerning Car Movements

(1) Objectives

Studies have been accomplished on car movements with the purpose of preparing basic data for the improvement of the system and an effective application of it, knowing the reality of transportation in cars from the functional point of view.

(2) Stations investigated and their periods

Laja	From August 4 (Wednesday) to August 6 (Friday)
San Rosendo	From August 5 (Thursday) to August 7 (Saturday)
Talcahuano	From August 6 (Friday) to August 8 (Sunday)

(3) Cars investigated

All the cars which are at each station at eight o'clock in the morning on the first day of the investigation and those which arrive on the same day (cars in transit included)

(4) Contents of investigation

1) Common items

a) Type and number of freight cars

b) Inspection of freight cars investigated:

Type of inspection, Date of inspection, Place of inspection executed

2) Cars in transit

Time they remained

3) Detained cars

Date of detained, and its reason

4) Other cars

a) Arrival and departure

Origin and destination stations

b) Freight

Specifics, actual weight, tariff calculation, weight, quantity, packing

c) Loading and unloading

Means, number of machines used, number of workers

d) The total travel time from the departure from the origin station until departure from the station under investigation, including transportation and detention time

(5) Method of investigation

The existence of cars was verified on the first day at each station with the collaboration of four inspectors, and then the movement of cars was checked with the collaboration of the station chiefs.

(6) Classification of cars investigated and relative investigation cards issued

(Classification)	(Investigation Card)
1) Cars in transit	ATTACHMENT 1 (for cars in transit)
2) Detained cars	ATTACHMENT 2 (for detained cars)
3) Other cars	ATTACHMENT 3 (for the investigation of movement of cars)

II.5.2 Results of the Investigation

II.5.2.1 Number of cars investigated

With the collaboration of 4 inspectors with high qualifications from the Southern Railway, the investigation was performed at the stations at Laja, San Rosendo and Talcahuano on 636 cars which are shown as follows:

Table II.5.1 Number of Cars Investigated

Station	Situation of cars			Total
	In transit	Detained	Others	
Laja		7	151	158
San Rosendo	5	111	13	129
Talcahuano		121	228	349
Total	5	239	392	636

II.5.2.2 Travel time of one cycle rotation of a car

The total travel time is counted from the departure from the origin station until the departure from the station under investigation.

The circulation of cars was investigated at said stations on 392 cars, preparing cards for each car.

Cars in transit and detained cars were excluded.

Due to the limited time of three days assigned for each station, only 267 cars were able to be investigated, with the investigation of the rest remaining incomplete. (Percentage of execution 68%.)

Table II.5.2 Percentage of Execution of the Investigation on Circulation of Cars

Station	Circulation of Cars			
	Cars to be investigated	Cars investigated	Pending cars	Percentage of execution %
Laja	151	140	11	93
San Rosendo	13	0	13	0
Talcahuano	228	127	101	56
Total	392	267	125	68

The cars investigated are classified by situation, in the following manner:

Arrived and departed loaded: 6 at Talcahuano
Arrived loaded and left empty: 167
Arrived empty, left loaded: 94

Table II.5.3 Cars with Investigation Completed

Station	Arrived and left loaded	Arrived loaded, left empty	Arrived empty, left loaded	Total
Laja	0	99	41	140
Talcahuano	6	68	53	127
Total	6	167	94	267

Of the 125 cars with inconclusive information, 100 were not investigated since they had not yet left the station at the end of the investigation.

Table II.5.4 Cars with Incompleted Investigation, Classified by Cause

Causes	Laja	San Rosendo	Talca-huano	Total
Had not yet left the station at the investigation	8 (7)	13 (13)	79 (33)	100 (53)
Destination station was changed after the arrival in the study	0	0	17 (17)	17 (17)
Arrived empty at the station for investigation and again left empty	0	0	3	3
Items poorly annotated or erased	3	0	2 (2)	5 (2)
TOTAL	11 (7)	13 (13)	101 (52)	125 (72)

Note: Figures in () indicated those which arrived loaded.

II.5.2.3 Loading and unloading time

Of the cars which accomplished one rotation, 173 unloaded and 100 loaded. (6 arrived and departed loaded.)

With respect to the cars with inconclusive investigation, 72 arrived loaded, of which 54 came to be unloaded before the end of the investigation. On 42 of these, the unloading time is available. Three of them arrived empty and finished loading. In total, the unloading time is confirmed on 215 cars, and 103 cars have background information on the loading time.

Table II.5.5 Cars for Which the Loading and Unloading Time is Confirmed

Situation	Station	Unloaded cars	Loaded cars	Note
Cars which accomplished the rotation	Laja	99	41	
	Talcahuano	74	59	6 arrived and left loaded
	Subtotal	173	100	
Cars which did not complete rotation, but for which the load-unload time is confirmed	Laja	6	3	
	San Rosendo	1	-	
	Talcahuano	35	-	
	Subtotal	42	3	
Note:	Laja	105	44	
	San Rosendo	1	0	
	Talcahuano	109	59	
	Total	215	103	

II.5.2.4 Inspection of investigated cars

Of the 636 cars subject to investigation, 582 cars finished the investigation, with the rest being incompleted. (Percentage of execution 92%.)

Table II.5.6 Cars Investigated on the Execution of Inspection

Station	Cars to be investigated	Cars investigated	Cars incompleted	Execution %
Laja	158	145	13	92
San Rosendo	129	126	3	98
Talcahuano	349	311	38	89
Total	636	582	54	92

II.5.3 Rotation of Cars (Loaded, empty)

II.5.3.1 On the rotation of cars

When hereinafter discussing the results of the investigation on current car movement, it should be understood that the "rotation" refers to those cars which completed it at the three stations within the period of investigation, not including that of the other cars with incomplete investigation.

For this reason, it is very probable that the actual time which is required for completing a rotation is more than that indicated in our data.

The execution of an investigation concerning movements of all the cars and their average rotation from the point of view of the whole company requires an accumulation of various situations and conditions concerning transportation. For this purpose, it will be more convenient to adopt our original method for all the stations.

In this sense, our data is distorted in relation to the various conditions of transportation, and do not reflect the general situation of rotations in the Southern Railway, although it reflects something of the reality.

In any case, it is considered convenient to mention some problematical points, based on the above explanation.

II.5.3.2 Concept of "One rotation"

The concept of rotation of the cars which is analyzed in this investigation is summarized into two cases:

(1) Arrival loaded. In this case, the rotation refers to the time elapsing from the departure from the origin station until the departure, loaded or empty, from the station which is under investigation.

(2) Empty arrival. The time is calculated from the departure from the origin station until the departure, loaded, from the station under investigation.

This concept is expressed in Fig. II.5.1.

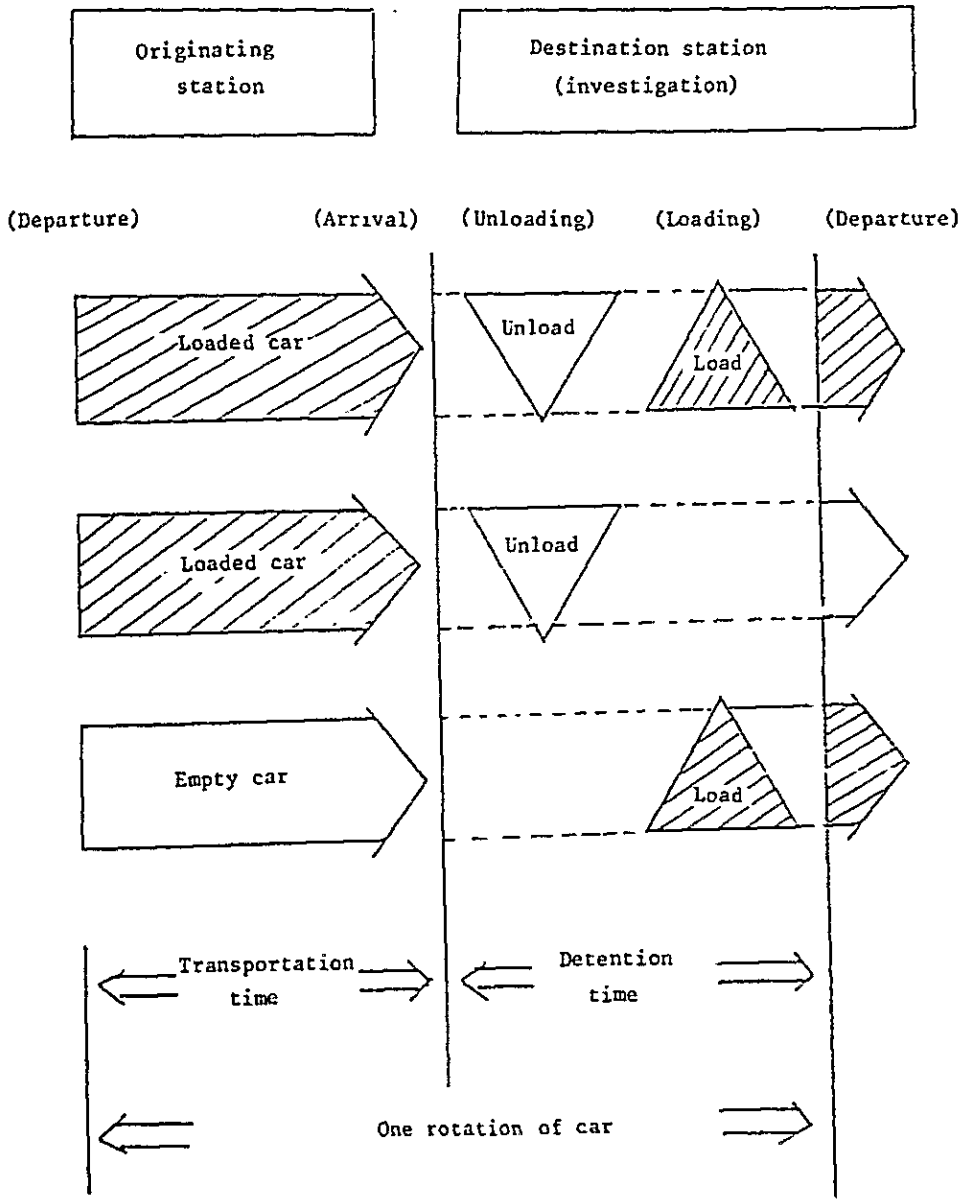


Fig. II.5.1 Concept of One Cycle Rotation of Freight Cars

II.5.3.3 Rotation of cars by situation (loaded or empty)

(1) Times for transportation and for detention

The results of the investigation on rotation of cars by situation (loaded or empty) are indicated in Table II.5.7.

Table II.5.7 Rotation of Cars
(Average by situation of loaded or empty)

Station	Situation	Number of Cars	Trans-portation Distance (km)	Rotation		
				Trans-portation Time (min.)	Detention Time (min.)	Total (min.)
Laja	Loaded	99	67	684 (24.9)	2,060 (75.1)	2,745 (100)
	Empty	41	101	1,552 (23.8)	4,976 (76.2)	6,528 (100)
	Total	140	77	939 (24.4)	2,914 (75.6)	3,853 (100)
Talca-huano	Loaded	74	103	1,748 (30.3)	4,019 (69.7)	5,768 (100)
	Empty	53	206	1,363 (10.7)	11,361 (89.3)	12,724 (100)
	Total	127	146	1,587 (18.3)	7,083 (81.7)	8,671 (100)
Total	Loaded	173	82	1,139 (28.2)	2,898 (71.8)	4,038 (100)
	Empty	94	160	1,445 (14.4)	8,576 (85.6)	10,022 (100)
	Total	267	110	1,247 (20.3)	4,897 (79.7)	6,144 (100)

Note: The Figures in ( ) show the percentage of each item in one rotation of freight car, by time.

The average time for which a rotation is delayed is 6,144 minutes (approx. 4.3 days). When breaking down this time into transportation and detention, they become 1,247 min. (0.9 days) and 4,897 min. (3.4 days), respectively.

Attention is called to the fact that the detention time is very long with respect to transportation time.

In comparison with the transportation time, the time for detention is 3.1 and 4.5 times as long at Laja and Talcahuano, respectively. Overall, the detention time for empty cars at Talcahuano is quite long.

On the other hand, the transportation time gives a relatively small figure due to the short distance, which averages 110 km. In all cases, there is the impression that the transportation time is even longer for the short distance. However, from the view point of rotation, the transportation time is not so great a problem as the time of detention.

Consequently, it will be necessary to establish a system which leads to improvement of the rotation of freight cars by knowing the problems and analyzing the detention time especially the time of empty cars.

(2) Analysis of the detention time in a rotation

As stated above, that the detention time has a large weight in the rotation. The summary of the detention time is as shown in Table II.5.12.

Both at Laja and Talcahuano, a greater time is taken up in waiting for operations, with the time which corresponds to loading and unloading being relatively small.

Note: "One cycle of the loaded car" means the one cycle rotation of the loaded car which arrives to the investigation station, and "One cycle of the empty car" means that of empty car which arrives to the investigation station. They are classified according to the situation when they arrive to the investigation station.

II.5.3.4 One cycle rotation of car by type

(1) Loaded cars

The time for transportation and that for detention in a rotation by type of car is indicated in Tables II.5.8 - 10.

With respect to loaded cars, the average distance for transportation is 82 km. The transportation time and the detention time are 1,139 minutes (0.8 days) and 2,898 minutes (2.0 days), respectively.

Therefore, the total time of rotation is 4,038 minutes (2.8 days), a figure which demonstrates a relatively good situation.

With respect to the transportation time by type of car, the flatcars (PE) occupy 5,021 minutes (approx. 3.5 days), in accordance with the data based on the transportation of lumber between Colico and Talcahuano. This was caused by the fact of having included the case of one car which for some reason occupied a considerable time (approx. 11 days) in transit at Concepción.

If this case is not considered, the difference in time between this and other types would not be notable.

On the other hand, the gondola car (CC) remained detained for considerable time. Two of them arrived from Cholguan with sawn lumber. According to Table II.5.13, they employed an enormous time in waiting for operations after having arrived at Talcahuano. The delay could have been caused by waiting for embarkation. In any case, it is a notably excessive detention.

The box cars (BC) have 6,728 minutes (approx. 4.7 days) of detention. The fact that they remain for a long time at the depot awaiting departure after unloading will reflect the low demand for this type of car. Despite this, the operation of other types does not present particular problems, so

that from the general viewpoint the rotation of loaded cars is considered relatively efficient.

(2) Empty cars

With respect to the time for transportation and for detention, the following figures are given:

Average transportation distance	160 km	
Transportation time	1,445 min.	(1.0 day)
Detention time	8,576 min.	(6.0 days)
Total in the rotation	10,022 min.	(7.0 days)

The empty cars are characterized by the long detention. The case is given for a tank car (unmarked) whose total detention time is very long with respect to the transportation time, which, as in the preceding case of loaded cars, should be considered even more exceptional. From the point of view of evaluation of time of transportation in relation to transportation distance, the time of transportation, either in loaded or empty cars, does not present a very grave problem, given the current conditions.

With respect to the detention time, on the other hand, the time for the box car (BC) and tank car (EE) is incomparably large with respect to other types.

Types of freight which are indicated in this report correspond to the cement from Talcahuano to Pilahueque (in BC), petroleum, gasoline, etc., from Talcahuano to Temuco and other destinations (in EE).

As can be seen in Table II.5.14, both types have much waiting time from the arrival empty until arriving at the siding to unload.

With respect to cars of other types such as gondola cars (CE), flatcars (PC), tank cars (EC), etc., the time of detention is far from being short even though it is not so long as the two types of cars mentioned above. In any case, much time is occupied in waiting for operations, loading and unloading.

II.5.3.5 Rotation by specific type of freight

The transportation and detention time by specific type of freight in one rotation is given in Table II.5.11 and Table II.5.16.

This rotation which is linked with that of the loaded cars is strictly related to the rotation by type of cars. That is, the commodities which arrive at stations under investigation have large peculiarities according to the stations, and the kinds of cars are clearly defined. From this, a glance at the rotation by type of cars permits a presumption as to the type of freight which is being transported.

With respect to the rotation time according to the kind of freight, the lumber has the longest time, including the time of detained cars for ship loading.

Cars for the carrying of sleeper wait a long time in detention, which come from Curacautin to Laja.

Note: The investigated cars for the survey of rotation time by specific freight are loaded cars which arrived to the investigated stations.

II.5.4 The Time for Loading and Unloading

The investigation concerning the time for loading and unloading was carried out as one component of the item "One rotation of cars" within the investigation of the current movements of cars, in order to clarify the current situation of the time for loading and unloading in relation to the time of detention.

While this constitutes a very important factor from the point of view of rotation of cars, the investigation shows that the time which corresponds to loading and unloading with that of detention, is about 1% of detention time, considering the percentage, the time for loading and unloading is not so great.

The above-mentioned time for loading and unloading, nevertheless, refers to average loading and unloading time per car from the point of view of rotation of investigated cars, not being concerned with the average time of those effectively carried out. Therefore, the time occupied by operation (loading and unloading) will be analyzed below by type of car.

In summary, there are 215 for unloading and 103 for loading with respect to the cars effectively investigated in the 3 stations. (See Table II.5.5.)

II.5.4.1 Loading and unloading time by type of car

Table II.5.17 indicates the loading and unloading time by type of freight car.

As indicated in the Table, the time occupied in loading and unloading is 40 and 54 minutes, respectively. This figure is no particular problem. Considering the result of the investigation by type of car, overall the loading time is quite level, leaving little to be indicated. The unloading time, on the other and, is much shorter than the total loading time, and the time varies a little according to the type of car.

For example, the unloading of flatcars whose principal type of freight is lumber is accomplished in 29 minutes on the average. Overall at the C.M.P.C. siding, Laja unloads with high efficiency and rapidity, thanks to the use of large cranes-forklifts.

The habitual freight transported in BC and EC cars are sleepers for Laja and flour for San Rosendo. In both cases, the unloading is done by manual means.

II.5.4.2 Loading and unloading time by type of freight

The loading and unloading time by type of freight is summarized in Table II.5.18, in strict relation to the preceding classification by type of car. Viewed by type of freight, in the majority the time for loading and unloading is balanced with the exception of the sleepers, flour and chlorate which exceed 300 minutes.

These types of freight do not provide much material for analysis in consideration of the fact that they occupy extremely limited equipment and that sleepers and flour were unloaded by hand. On the other hand, the unloading of lumber is very short, being delayed an average of only 30 minutes per car. This is due to the large cranes-forklifts which permit carrying out the unloading with high efficiency as was indicated previously. In summary, it can be said that in general the tasks of loading and unloading are being accomplished very efficiently with respect to the time occupied in these operations.

II.5.5 Assumption of the Operational Performance Based on the Investigation on Current Car Movement

The operational performance of cars based on the current movement investigated is shown as follows.

II.5.5.1 Assumption for the transportation time

(1) Figures taken from the investigation

Situation	Cars investigated	Transp. distance	Transp. time	Speed
Loaded	173	82 km	1,139 min.	4.3 km/hr
Empty	94	160 km	1,445 min.	6.7 km/hr
Total	267	110 km	1,247 min.	5.2 km/hr

(2) Assuming the transportation time in the case of the distance transported of 243.4 km on the average (1980 result) based on (1), we obtain the following:

1) Loaded 243.4 km ÷ 4.3 km/hr = 56.6 hours

2) Empty 243.4 km ÷ 6.7 km/hr = 36.3 hours
(since the distance is the same as for loaded cars)

3) Transportation time
56.6 hrs + 36.3 hrs = 92.9 hrs, or about 93 hours.

II.5.5.2 Assumption for the detention time

(1) Figure taken from the investigation

Situation	Cars investigated	Detention time	Remarks
Loaded	173	2,898 min.	6 arrived and departed loaded, 167 arrived loaded and departed empty
Empty	94	8,576 min.	94 arrived empty and departed loaded
Total	267	4,897 min.	

Of the 267 cars, only six arrived and departed loaded, involving in their majority one way transportation. Of this, there is the figure of approximately 81 hours as the time of detention, to which 24 hours are added due to having fallen on a holiday even though the investigation was performed on one day of the week. Thus, the final figure comes to be 105 hours.

II.5.5.3 Time for one rotation of cars (operational performance)

93 hours + 105 hours = 198 hours
24 hours ÷ 198 hours = 12.1, or approximately 12 (%)

II.5.6 Future Tasks

Through this chapter, an analysis has been made of the rotation of cars based on the results of the investigation concerning current car movements. The greatest problem with cars resides in the prolongation, for reasons separate from that of the time occupied in loading and unloading. A great part of the detention time is caused by waiting to be loaded after having been unloaded. This tendency is particularly notable in the BC and EE cars, although something similar is observed in the CE, PC and EC cars. Also, these examples are reflected the in cars with unifinished investigation on rotation or without results.

Of these incompleted cars, 99 cars were empty. The detention time in the investigated sations of 99 cars are indicated in Table II.5.19. Among the cars which do not operate more than 10 days, there are plenty of covered cars (BC), hopper cars (TE), and tank cars (EC).

It is extremely important to clarify the reasons which gave rise to these results: Whether it is due to reduced demand or to other factors temporal (seasonal) and partial (regional), etc. This fact, in relation to the results of the study on detained cars, leads us to conclude that at least the demand for BC, TE, EE and EC cars is low, with an unbalance existing between the size of the demand and the equipment park. This situation of the reduced demand is not only on these three types, but, as indicated in the results of each investigation, reflects the fact that there are surplus cars for the existing demand. Thus, henceforth, a greater-demand must consequently be stressed, together with a review of the situation of the park. For this, it is necessary to press for determination of the precise number of freight cars to attend to the size of the demand. It is possible to reduce expenses caused by the surplus equipment, adapting the cars to the real situation.

Table II.5.8 Rotation of Cars by Type (Loaded, average)

Type		Number of Cars	Trans-portation Distance (km)	Rotation		
				Trans-portation Time (min.)	Detention Time (min.)	Total (min.)
Box cars	BC	1	184	1240 (15.6)	6728 (84.4)	7968 (100)
Gondola cars	CC	2	152	1530 (6.9)	20610 (93.1)	22140 (100)
Flatcars	PC	121	79	1040 (25.9)	2973 (74.1)	4013 (100)
	PCF	4	114	2889 (44.8)	3555 (55.2)	6444 (100)
	PE	6	92	5061 (73.3)	1846 (26.7)	6907 (100)
	TTC	37	81	656 (27.5)	1727 (72.5)	2383 (100)
	Sub-total	168	81	1143 (30.0)	2672 (70.0)	3815 (100)
Tank cars	EC	2	86	382 (14.4)	2276 (85.6)	2658 (100)
Total		173	82	1139 (28.2)	2898 (71.8)	4038 (100)

Note: The Figures in ( ) show the percentage of each item in one rotation of freight car, by time.

Table II.5.9 Rotation of Cars by Type (Empty, average)

Type		Number of Cars	Trans-portation Distance (km)	Rotation		
				Trans-portation time (min.)	Detention time (min.)	Total (min.)
Box cars	BC	4	66	161 (0.4)	37384 (99.6)	37544 (100)
Gondola cars	CC	18	347	1549 (32.5)	3210 (67.5)	4759 (100)
	CE	1	13	10 (0.2)	5220 (99.8)	5230 (100)
	Q	2	48	109 (4.8)	2145 (95.2)	2254 (100)
	Sub-total	21	303	1338 (29.5)	3204 (70.5)	4543 (100)
Flatcars	PC	40	102	1583 (23.9)	5053 (76.1)	6635 (100)
	PCF	2	328	1512 (34.6)	2862 (65.4)	4373 (100)
	Sub-total	42	112	1580 (24.2)	4949 (75.8)	6528 (100)
Tank cars	No code	1	245	8100 (80.8)	1920 (19.2)	10020 (100)
	EC	16	86	1589 (17.1)	7683 (82.9)	9272 (100)
	EE	10	211	724 (2.7)	25665 (97.3)	26389 (100)
	Sub-total	27	138	1510 (9.7)	14129 (90.7)	15639 (100)
Total		94	160	1445 (14.4)	8576 (85.6)	10022 (100)

Note: The Figures in ( ) show the percentage of each item in one rotation of freight car, by time.

Table II.5.10 Rotation of Cars by Type (Loaded and empty, average)

Type		No. of Cars	Transportation Distance (km)	Rotation		
				Transp. time (min.)	Detention time (min.)	Total (min.)
Box cars	BC	5	89	376 (1.2)	31253 (98.8)	31629 (100)
Gondola cars	CC	20	327	1547 (23.8)	4590 (76.2)	6497 (100)
	CE	1	13	10 (0.2)	5220 (99.8)	5230 (100)
	Q	2	48	109 (4.8)	2145 (95.2)	2254 (100)
	Sub-total	23	289	1355 (22.3)	4718 (77.7)	6073 (100)
Flatcars	PC	161	85	1175 (25.2)	3490 (74.8)	4665 (100)
	PCF	6	185	2430 (42.2)	3324 (57.8)	5754 (100)
	PE	6	92	5061 (73.3)	1846 (26.7)	6907 (100)
	TTC	37	81	656 (38.0)	1727 (62.0)	2383 (100)
	Sub-total	210	87	1230 (28.2)	3127 (71.8)	4358 (100)
Tank cars	No code	1	245	8100 (80.8)	1920 (19.2)	10020 (100)
	EC	18	86	1455 (17.0)	7082 (83.0)	8537 (100)
	EE	10	211	724 (2.7)	25665 (97.3)	26389 (100)
	Sub-total	29	135	1432 (9.7)	13312 (90.3)	14744 (100)
Total		267	110	1247 (20.3)	4897 (79.7)	6144 (100)

Note: The Figures in ( ) show the percentage of each item in one rotation of freight car, by time.

Table II.5.11 Rotation by Type of Freight (Average)

Type of freight (code)		No. of Cars	Trans-portation Distance (km)	Rotation		
				Trans-portation time (min.)	Detention time (min.)	Total (min.)
Forestal products	Sleepers (20)	1	184	1240 (15.6)	6728 (84.4)	7968 (100)
	Finished lumber (22)	6	152	4297 (24.7)	13086 (75.3)	17382 (100)
	Lumber for cellulose (24)	96	65	685 (25.4)	2007 (74.6)	2692 (100)
	Lumber for other uses (26)	29	104	2372 (60.7)	1535 (39.3)	3905 (100)
	Cellulose (28)	31	85	944 (15.5)	5166 (84.5)	6109 (100)
	Subtotal	163	80	1170 (28.3)	2960 (71.7)	4131 (100)
Industrial products	Chlorate (82)	2	86	382 (14.4)	2276 (85.6)	2658 (100)
	Paper (88)	8	130	695 (28.0)	1788 (72.0)	2483 (100)
	Subtotal	10	121	632 (25.1)	1885 (74.9)	2518 (100)
Total		173	82	1139 (28.2)	2898 (71.8)	4038 (100)

Note: The Freight of low columns in ( ) show the composition ratios of each item to each detention time as of 100.

Table II.5.12 Detention Time of Cars (By situation loaded or empty, average)

Station	Situation	Number of Cars	Detention Time							
			Waiting to enter the siding	Unloading		Intermediate departure from siding	Loading		Left from the siding and awaiting departure	Total
				Waiting	Unloading		Waiting	Loading		
Laja	Loaded	99	213 (10.3)	397 (19.3)	34 (1.7)	-	-	-	1,416 (68.7)	2,060 (100)
	Empty	41	304 (6.1)	-	-	-	4,120 (82.8)	30 (0.6)	521 (10.5)	4,976 (100)
	Total	140	240 (8.2)	281 (9.6)	24 (0.8)	-	1.207 (41.4)	9 (0.3)	1,154 (39.6)	2,914 (100)
Talcahuano	Loaded	74	1,248 (31.1)	743 (18.5)	37 (0.9)	293 (7.3)	126 (3.1)	4 (0.1)	1,569 (39.0)	4,019 (100)
	Empty	53	8,851 (77.9)				1,747 (15.4)	74 (0.7)	689 (6.1)	11,361 (100)
	Total	127	4,421 (62.4)	433 (6.1)	21 (0.3)	171 (2.4)	803 (11.3)	33 (0.5)	1,202 (17.0)	7,083 (100)
Total	Loaded	173	656 (22.6)	545 (18.8)	35 (1.2)	125 (4.3)	54 (1.9)	2 (0.1)	1,481 (51.1)	2,898 (100)
	Empty	94	5,123 (59.7)	-	-	-	2,782 (32.4)	55 (0.6)	616 (7.2)	8,576 (100)
	Total	267	2,228 (45,5)	353 (7.2)	23 (0.5)	81 (1.7)	1,014 (20.7)	20	1,177 (24.0)	4,897 (100)

Note: The Freight of low columns in ( ) show the composition ratios of each item to each detention time as of 100.

Table II.5.13 Detention Time of Cars by Type (Loaded, average)

(Unit: minutes)

Types		Number of cars	Detention time							
			Waiting to enter the siding	Unloading		Intermediate movement from siding	Loading		Left the siding and awaiting departure	Total
				Waiting	Unloading		Waiting	Loading		
Box cars	BC	1	1,565 (23.3)	120 (1.8)	360 (5.4)	-	-	-	4,683 (69.6)	6,728 (100)
Gondola cars	CC	2	14,160 (68.7)	-	150 (0.7)	210 (1.0)	4,560 (22.1)	60 (0.3)	1,470 (7.1)	20,610 (100)
Flatcars	PC	121	561 (18.9)	598 (20.1)	30 (1.0)	173 (5.8)	1 (0)	1 (0)	1,610 (54.2)	2,973 (100)
	PCF	4	1,800 (50.6)	473 (13.3)	38 (1.1)	83 (2.3)	30 (0.8)	8 (0.2)	1,125 (31.6)	3,555 (100)
	PE	6	156 (8.4)	715 (38.7)	30 (1.6)	-	-	-	945 (51.2)	1,846 (100)
	TTC	37	185 (10.7)	405 (23.4)	23 (1.3)	-	-	-	1,114 (64.5)	1,727 (100)
	Sub-total	168	493 (18.5)	556 (20.8)	28 (1.0)	127 (4.8)	1 (0)	1 (0)	1,466 (54.9)	2,672 (100)
Tank cars	EC	2	363 (15.9)	330 (14.5)	360 (15.8)	-	-	-	1,223 (53.7)	2,276 (100)
Total		173	656 (22.6)	545 (18.8)	35 (1.2)	125 (4.3)	54 (1.9)	2 (0,1)	1,481 (51.1)	2,898 (100)

Note: The Freight of low columns in ( ) show the composition ratios of each item to each detention time as of 100.

Table II.5.14 Detention Time of Cars by Type (Empty, average)

(Unit: minutes)

Types		Number of cars	Detention time							
			Waiting to enter the siding	Unlonding		Intermediate movement from siding	Loading		Left the siding and awaiting departure	Total
				Waiting	Unloading		Waiting	Loading		
Box cars	BC	4	35,444 (94.8)	-	-	-	750 (2.0)	60 (0.2)	1,130 (3.0)	37,384 (100)
Gondola cars	CC	18	545 (17.0)	-	-	-	1,620 (50.5)	85 (2.6)	960 (29.9)	3,210 (100)
	CE	1	540 (10.3)	—	-	-	3,480 (66.7)	60 (1.1)	1,140 (21.8)	5,220 (100)
	Q	2	405 (18.9)	-	-	-	1,410 (65.7)	120 (5.6)	210 (9.8)	2,145 (100)
	Sub-total	21	531 (16.6)	-	-	-	1,689 (52.7)	87 (2.7)	897 (28.0)	3,204 (100)
Flatcars	PC	40	311 (6.1)	-	-	-	4,182 (82.8)	30 (0.6)	531 (10.5)	5,053 (100)
	PCF	2	330 (11.5)	-	-	-	1,020 (35.6)	30 (1.0)	1,482 (51.8)	2,862 (100)
	Sub-total	42	311 (6.3)	-	-	-	4,031 (81.5)	30 (0.6)	576 (11.6)	4,949 (100)
Tank cars	No code	1	1,200 (62.5)	-	-	-	60 (3.1)	120 (6.3)	540 (28.1)	1,920 (100)
	EC	16	4,639 (60.4)	-	-	-	2,636 (34.3)	64 (0.8)	343 (4.5)	7,683 (100)
	EE	10	24.012 (93.6)	-	-	-	1,152 (4.5)	69 (0.3)	432 (1.7)	25,665 (100)
	Sub-total	27	11,687 (82.7)	-	-	-	1,191 (14.1)	68 (0.5)	383 (2.7)	14,129 (100)
Total		94	5,123 (59.7)				2,782 (32.4)	55 (0.6)	616 (7.2)	8,576 (100)

Note: The Freight of low columns in ( ) show the composition ratios of each item to each detention time as of 100.

Table II.5.15 Detention Time of Cars by Type (Loaded and empty, average)

(Unit: minutes)

Types		Number of cars	Detention time							
			Waiting to enter the siding	Unloading		Intermediate movement from siding	Loading		Left the siding and awaiting departure	Total
				Waiting	Unloading		Waiting	Loading		
Box cars	BC	5	28,668 (91.7)	24 (0.1)	72 (0.2)	-	600 (1.9)	48 (0.2)	1,841 (5.9)	31,253 (100)
Gondola cars	CC	20	1,907 (38.5)	-	15 (0.3)	21 (0.4)	1,914 (38.7)	83 (1.7)	1,011 (20.4)	4,950 (100)
	CE	1	540 (10.3)	-	-	-	3,840 (66.7)	60 (1.1)	1,140 (21.8)	5,220 (100)
	Q	2	405 (18.9)	-	-	-	1,410 (65.7)	120 (5.6)	210 (9.8)	2,145 (100)
	Sub-total	23	1,717 (36.4)	-	13 (0.3)	18 (0.4)	1,938 (41.1)	85 (1.8)	947 (20.1)	4,718 (100)
Flatcars	PC	161	499 (14.3)	449 (12.9)	22 (0.6)	130 (3.7)	1,040 (29.8)	8 (0.2)	1,342 (38.5)	3,490 (100)
	PCF	6	1,310 (39.4)	315 (9.5)	25 (0.8)	55 (1.7)	360 (10.8)	15 (0.5)	1,244 (37.4)	3,324 (100)
	PE	6	156 (8.4)	715 (38.7)	30 (1.6)	-	-	-	945 (51.2)	1,846 (100)
	TTC	37	185 (10.7)	405 (23.5)	23 (1.3)	-	-	-	1,114 (64.5)	1,727 (100)
	Sub-total	210	457 (14.6)	445 (14.2)	23 (0.7)	101 (3.2)	807 (25.8)	7 (0.2)	1,288 (41.2)	3,127 (100)
Tank cars	No Code	1	1,200 (62.5)	-	-	-	60 (3.1)	120 (6.3)	540 (28.1)	1,920 (100)
	EC	18	4,164 (58.8)	37 (0.5)	40 (0.6)	-	2,343 (33.1)	57 (0.8)	441 (6.2)	7,082 (100)
	EE	10	24,012 (93.6)	-	-	-	1,152 (4.5)	69 (0.3)	432 (1.7)	25,665 (100)
	Sub-total	29	10,906 (81.9)	23 (0.2)	25 (0.2)	-	1,854 (13.9)	63 (0.5)	441 (3.3)	13,312 (100)
Total		267	2,228 (45.5)	353 (7.2)	23 (0.5)	81 (1.7)	1,014 (20.7)	20 (0.4)	1,177 (24.0)	4,897 (100)

Note: The Freight of low columns in ( ) show the composition ratios of each item to each detention time as of 100.

Table II.5.16 Dentention Time by Type of Freight (Average)

(Unit: minutes)

Type of freight (Code)		Number of cars	Detention time							
			Waiting to enter the siding	Unloading		Intermediate movement from siding	Loading		Left the siding and awaiting departure	Total
				Waiting	Unloading		Waiting	Loading		
Forest products	Sleepers (20)	1	1,565 (23.3)	120 (1.8)	360 (5.4)	-	-	-	4,683 (69.6)	6,728 (100)
	Finished lumber (pressed lumber) (22)	6	6,963 (53.2)	30 (0.2)	75 (0.6)	3,615 (27.6)	1,555 (11.9)	45 (0.3)	803 (6.1)	13,086 (100)
	Lumber for cellulose (24)	96	196 (9.7)	401 (20.0)	24 (1.2)	-	-	-	1,386 (69.1)	2,007 (100)
	Lumber for other uses (26)	29	183 (11.9)	378 (24.6)	33 (2.2)	-	-	-	940 (61.3)	1,535 (100)
	Cellulose (28)	31	1,302 (25.2)	1,395 (27.0)	33 (0.6)	-	-	-	2,435 (47.1)	5,166 (100)
	Subtotal	163	661 (22.3)	571 (19.3)	31 (1.0)	133 (4.5)	57 (1.9)	2 (0.1)	1,505 (50.8)	2,960 (100)
Manufactured products	Hydrochloric acid (82)	2	363 (15.9)	330 (14.5)	360 (15.8)	-	-	-	1,223 (53.7)	2,276 (100)
	Paper (85)	8	615 (34.4)	71 (4.0)	38 (2.1)	-	-	-	1,064 (59.5)	1,788 (100)
	Subtotal	10	565 (30.0)	123 (6.5)	102 (5.4)	-	-	-	1,096 (58.1)	1,885 (100)
Total		173	656 (22.6)	545 (18.8)	35 (1.2)	125 (4.3)	54 (1.9)	2 (0.1)	1,481 (51.1)	2,898 (100)

Note: The Freight of low columns in ( ) show the composition ratios of each item to each detention time as of 100.

Table II.5.17 Loading and Unloading Time by Type of Freight Cars

(Average/car)

Type		Number of cars	Unloading		Loading		
			Average/Car		No. of cars Loaded	Average/car	
			Q'ty	Unloading Time (Min.)		Q'ty (Kg)	Loading Time (Min.)
Box cars	B C	3	11,883	260	4	30,000	60
Gondola cars	C C	2	32,500	150	20	28,835	83
	C E				1	12,000	60
	Q				2	29,550	120
	Sub-total	2	32,500	150	23	28,165	85
Flatcars	P C	134	27,022	30	45	29,364	31
	P C F	6	29,550	35	4	27,325	30
	P E	6	30,000	30			
	T T C	39	27,156	23			
	Sub-total	185	27,229	29	49	29,198	31
Hopper cars	T E	23	46,391	63			
Tank cars	No code				1	30,400	120
	E C	2	30,600	360	16	30,506	64
	E E				10	40,972	69
	Sub-total	2	30,600	360	27	34,379	68
Total		215	29,144	40	103	30,357	54

Table II.5.18 Loading and unloading Time by Type of Freight

(Average/car)

Type of freight	(Code)	Unloading			Loading		
		Number of cars	Average/Car		Number of cars	Average/Car	
			Q'ty (Kg)	Unloading time (min.)		Q'ty (kg)	Loading time (min.)
Forestal products	Sleepers (20)	1	26,400	360			
	Sawn lumber (22)	6	31,570	75	4	27,875	38
	Chips (23)	3	32,100	87			
	Lumber for pulp (24)	99	25,998	24			
	Lumber for other uses (26)	29	28,241	33			
	Cellulose (28)	39	28,635	33	35	29,223	30
	Subtotal	177	27,252	32	39	29,085	31
Mineral products	Coal (50)	4	49,050	60			
	Charcoal (51)	16	48,405	60			
	Lime and limestone (52)				10	29,820	102
	Gasoline (56)				6	33,533	80
	Paraffin oil (57)				1	40,100	60
	Petroleum (58)				7	41,246	73

	Cement (59)				4	30,000	60
	Finished steel (65)				13	27,708	69
	Subtotal	20	48,535	60	41	31,913	78
Manufactured food products	Flour (71)	1	8,000	300			
Industrial products	Chlorine (80)				2	30,000	60
	Chlorate (82)	2	30,600	360	3	30,333	60
	Paper (88)	8	29,975	38			
	Empty containers (89)	2	3,050	90			
	IBM Paper (90)	5	31,320	30	9	30,422	30
	Caustic soda (91)				8	30,900	60
	Subtotal	17	27,276	79	22	30,545	48
Internal service	Iron pipe for construction (92)				1	12,000	60
Total		215	29,144	40	103	30,357	54

Table II.5.19 Days of Dentention of Empty Cars Which Did not Finish Being Investigated Due to Not Yet Having Left the Station at the End of the Investigation

Days of detention at the station investigated since becoming empty		Station				Cars by type and days of detention										
		Laja	San Rosendo	Talca-huano	Total	Box cars	Grat-ings	Condola cars		Flatcars			Hopper cars	Tank cars		
						BC	K	CC	Q	PC	PCF	TIC	TE	-	EC	EE
Days	91 ∿			2	2									1	1	
	61 ∿ 90			2	2								1		1	
	31 ∿ 60		11	5	16	9	2						3		2	
	21 ∿ 30															
	11 ∿ 20			4	4										4	
	6 ∿ 10	7		5	12							2	5	2	1	2
	1 ∿ 5	1	1	61	63	1		11	1	12	5		20	5	1	7
		8	12	79	99	10	2	11	1	12	5	2	29	8	10	9

Table II.5.20 Detained Cars by Type

Station	Type of cars									
	Box cars	Gondola cars			Flatcars		Hopper cars	Tank cars		Total
	BC	CC	CE	Q	PC	TTC	TE	EC	EE	
Laja					(2) 2	(5) 5				(7) 7
San Rosendo	(2) 39	(1) 6		1	(2) 3	(2) 7	55			(7) 111
Talcahuano	15	22	5				21	(5) 39	(1) 19	(6) 121
Total	(2) 54	(1) 28	5	1	(4) 5	(7) 12	76	(5) 39	(1) 19	(20) 239

Note: Datained cars for repair are shown in ( ).

Table II.5.21 Detained Cars (Only in cessation of use)

Type		Number of cars	Days of detention per stage					
			1-10	11-20	21-30	31-60	61-90	More than 90 days
Box cars	B C	52	14	24	5	9		
Gondola cars	C C	27	23	1	1	2		
	C E	5	5					
	Q	1	1					
	Subtotal	33	29	1	1	2		
Flatcars	P C	1	1					
	T T C	5	5					
	Subtotal	6	6					
Hopper cars	T E	76	57	15	1	3		
Tank cars	E C	34	17	2	3	1	1	10
	E E	18	2	1	2	1	1	11
	Subtotal	52	19	3	5	2	2	21
Total		219	125	43	12	16	2	21

Table II.5.22 Cars in Transit by Type

San Rosendo Station

Type \ Item		Number of cars	Transit time (min.)	Transit time per car (min.)	Note
Box cars	BC	2	4,200	2,100	
Flatcars	PC	2	6,600	3,300	
Hopper cars	TE	1	1,440	1,440	
Total		5	12,240	2,448	

II.6 CONTROL OF FREIGHT CAR MAINTENANCE

For operational control of freight cars, it is most important to keep them in a normal condition and to put them into service according to established rules.

To schedule the utilization of cars in such unstable condition confronting with accident possibility anytime is highly dangerous.

It would appear that there is no relationship between control of maintenance and of operations. However, in actuality, this is not the case.

Taking notice of the fact that railroad accidents must not occur other than through force majeure, leads to a stricter control of cars.

Some problems related to car maintenance are as follows:

II.6.1 Current Situation for Inspection and Repair of Cars

With respect to inspection and repair of cars, the truth is that there is a great difference between what is actually practiced and what is established in the maintenance regulations. For example, in the years 1978 and 1979, repairs R2 and R3 were not accomplished, nor were R3 repairs done in 1980 and 1981.

While the considerable increase in R2 repairs since 1980 shows greater repair activity in shops and workshops, these figures do not amount to more than one-third of those programmed (calculated) in accordance with the cycle established in the Maintenance Regulations.

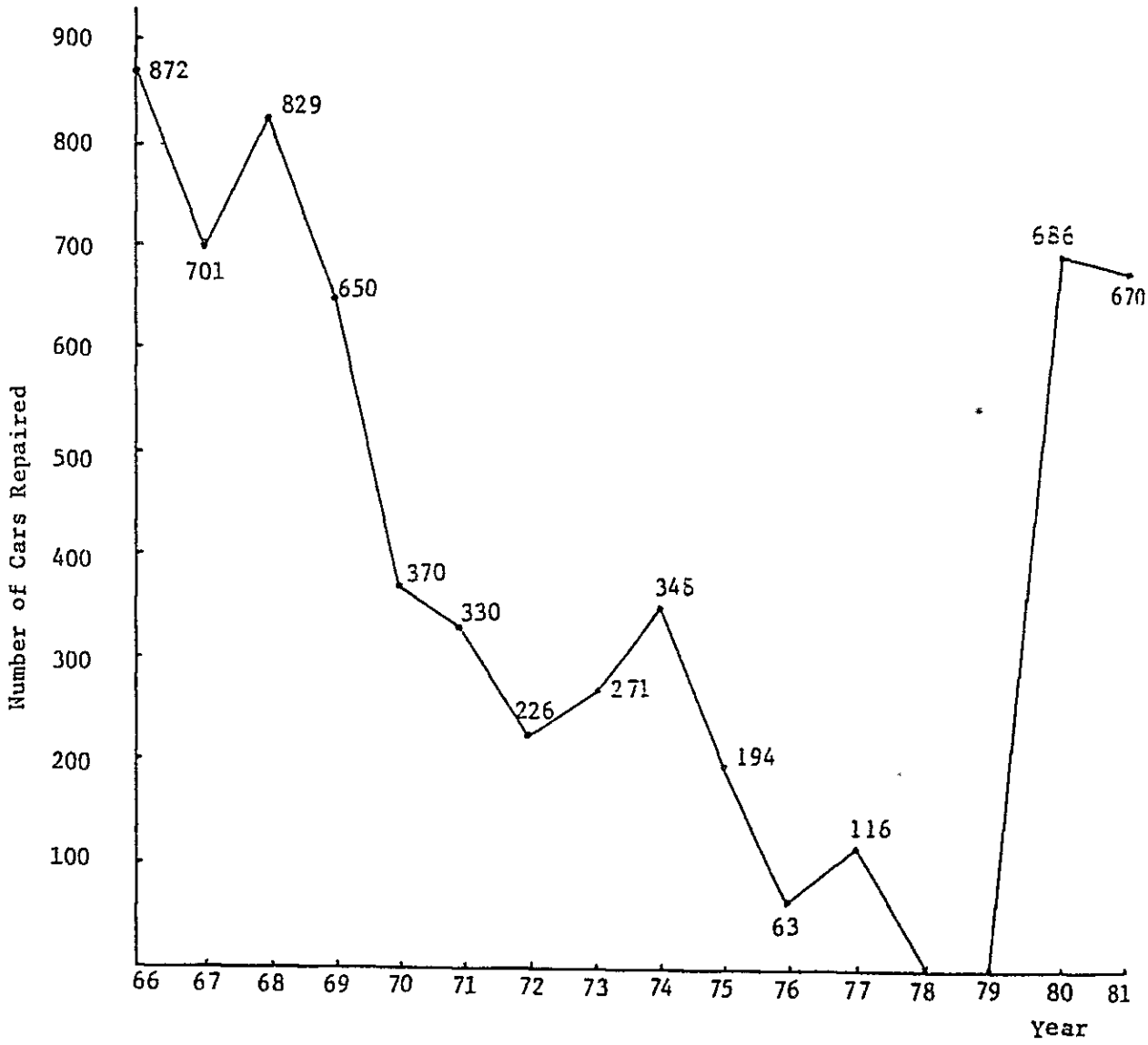


Fig. II.6.1 Repairs (R2, R3) Accomplished

In this manner, the cycle established in the maintenance regulations is not currently applied. Instead of it, the "ex-post-facto" system is adopted. That is, repairs are done after the detention of freight cars by failures or accidents and are classified at levels RP, R1, R2 and R3 according to their quality.

In car maintenance, it is not desirable for only the "ex-post-facto" system to be practiced without respecting the established cycle.

It is probable that this situation is due primarily to the reduction of expenses, even though the regulation itself contains problems.

That is, the current regulation apparently adopts the system of preventive maintenance (periodic review in accordance with a predetermined cycle). But actually, it has more of an "ex-post-facto" nature. In addition, there is a rule which permits modifying the cycle established in the regulation by means of a prior agreement, which easily converts the system of the established cycle into the "ex-post-facto" system, when the compliance with the cycle becomes difficult because of expense reductions.

While the reduction of expenses may be a modifying factor in the repair system, it must not be directly related to the modification of the established cycle.

Apart from the advantages and disadvantages of both systems, which will be discussed later, here we enumerate some negative results which occur in case only the "ex-post-facto" system should continue to be adopted:

(1) Preoccupation with the need for an enormous investment at a given time if numerous cars are disabled for operation at the same time due to failure to repair worn-out equipment, or fear of partial paralysis of transportation.

(2) The advanced state of wear of the equipment presupposes a frequency of serious accidents, due to deterioration alone.

The roller bearing system is adopted in 65% of the total freight cars.

In this respect, there is a program of adaptation of the bearing system. This also says that the same program is very positive in the sense of improving capacity, saving energy, preventing accidents, etc.

If this program fails to have an appropriate cycle, carefully calculated based on the distance travelled, overheating can occur which, in turn, causes a series of accidents, such as derailments and overturning because of breakage of axles, fire in tanks, etc. In this case, it is presumed that an exhorbitant amount of money must be invested in repairs of other cars equipped with the same system.

(3) The "ex-post-facto" maintenance system has no problems when the cars are new since repair expenses are small. As the equipment wears out, nevertheless, the "ex-post-facto" system is not always more economical than the other.

II.6.2 Current Situation as to Disabled Cars

Disabled cars (those out of service) constitute one of the biggest problems in car maintenance. As indicated in the Table below, these cars are increasing each year. As for the causes, the majority refer to the deterioration of cars.

In summary, the installed capacity for repairs is not adequate to handle the growing number of disabled cars.

Since the increase in these cars was recorded immediately after the years 1978 and 1979, in which R2 and R3 repairs were suspended, the improvement of repair capability will be the most rapid solution.

The location of repair shops also presents problems. That is, while the South Division has the Concepcion and Temuco shops which are able to perform major repairs, the Central Division has none.

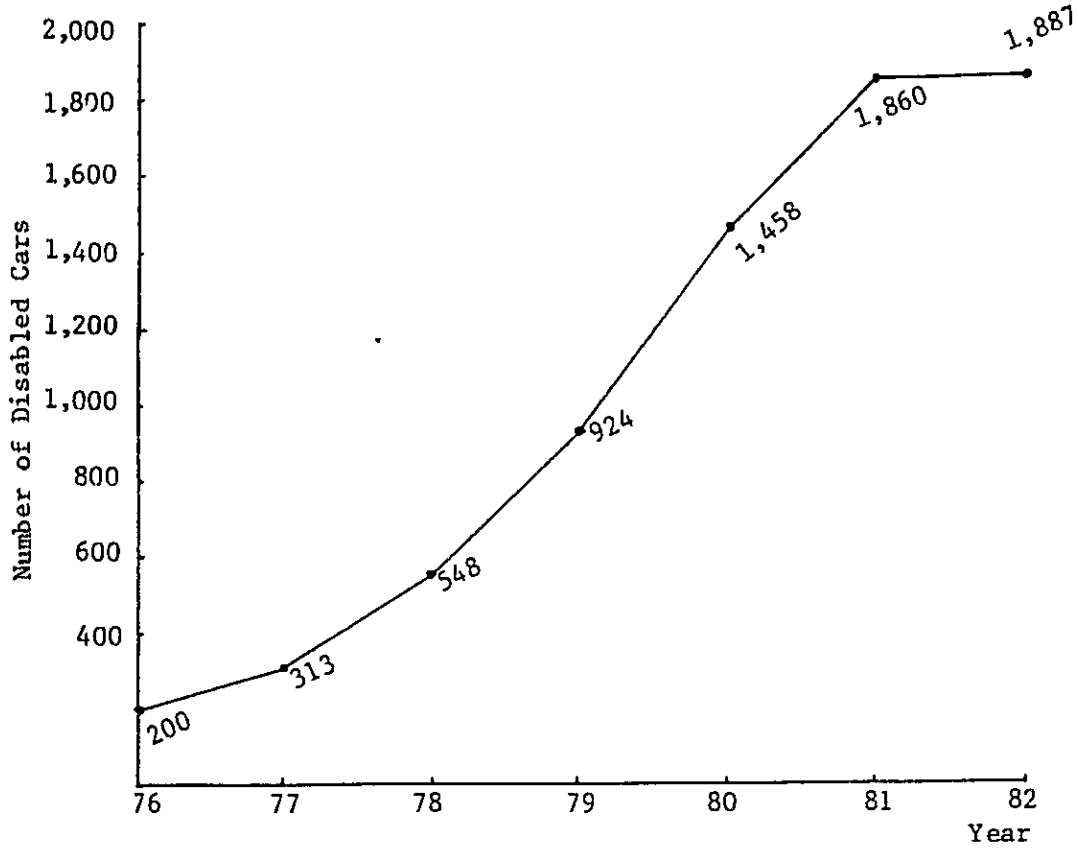


Fig. II.6.2 Number of Cases of Disabled Cars

Table II.6.1 Disabled Cars by Type of Failures

Failures	Number
Deterioration of entire cars by wear	700 units
Bogie failures	900 units
Door and floor failures	190 units
Brake failures	97 units
Total	1,887 units

There is thus a need to send faulty cars from the central jurisdiction to the southern repair facilities 600 km. away, making the execution of repairs very difficult, with the result that many cars fall in the disabled category, remaining at the depot.

The reasons for this type of car vary; they include human errors in switching and in loading-unloading, predominant with respect to accidents caused by deterioration of cars. The absence of repair shops in the Central Division, where relatively large yards are present, constitutes another factor.

II.6.3 Current Situation of Operational Accidents

It is obvious that the prevention of operational accidents is the greatest goal of transportation services.

In the same way, the prevention of deterioration of cars, the Southern Railway property, has much economic significance.

Thus, as explained earlier, the improvement of the repair capability leads to a reduction of disabled cars. Fundamentally, however, it involves even more the prevention of increase of accidents than an improvement of the repair capability.

The number of operational accidents occurred is shown in Table II.6.2.

Table II.6.2 Number of Train Operational Accidents

Type of accident		North	South				Total 1980	Total 1981
			Zone I-II	Zone III	Zone IV	Sub-total		
Train collisions	On tracks	0	2	4	0	6	6	4
	In yards	0	0	2	1	3	3	8
	Subtotal	0	2	6	1	9	9	12
Train derailments	On tracks	36	11	45	14	70	106	92
	In yards	0	4	13	10	27	27	27
	Subtotal	36	15	58	24	97	133	119
Accidents at grade crossings	Humans	0	2	0	0	2	2	0
	Collisions with vehicles, etc.	8	140	23	23	186	194	86
	Subtotal	8	142	23	23	188	196	86
Total 1980		44	159	87	48	294	338	
Total 1981		44	120	36	17	173		217

Only counting derailments on tracks, 106 occurred in 1980, and adding other cases due to accidents at grade crossings, a very high number of deteriorating cars is presumed. Under these circumstances, it is necessary to conduct some very effective preventive measures.

The essential item in car maintenance consists of preventing deterioration before they are repaired, since this is translated into savings of repair costs and a greater confidence placed by the public in the Southern Railway that it will preserve their lives and property.

Thus, accident prevention measures, together with training of personnel, must be carried out at all costs.

The number of train operation accidents can not be compared with each other between the Southern Railway and JNR, according to the different definition and method of statistics. But for the ording to the reference sake, only the number of train operation accidents concerning train collision and derailments in 1980 is shown for comparison's sake in Table II.6.3.

Table II.6.3 Comparison of Train Operation Accidents

	FC Sur	JNR
Train collision	9	2
Derailment	133	33

II.6.4 Abolition and Manufacturing of Freight Cars

For the execution of rational maintenance of cars, new cars with maintenance-free equipment should be put into service by abolishing deteriorated or inadequate cars incessantly. The scale of freight cars should meet the traffic demand appropriately. In the Chilean State Railways, abolition of freight cars are not executed according to the following reasons:

1) Without the cost of dismantling,

2) Reuse of parts of cars,

3) Difficulty of abolition of assets because of the procedure.

In the results, the old aged box cars are operated actually, and the number is counted as 202 which is surplus for the traffic demand probably.

By base of assumption, according to the formulas shown in II.7.2.1 necessary number of freight cars might be calculated as follows:

$$X = \frac{4,937,000 \text{ tons}}{365 \text{ days}} = 13,500 \text{ tons/day}$$

-------- From the efficiency index of freight transport

Y = 31.9 tons -------- From above-mentioned material

Z = 0.12 -------- Assumption from the investigation data at the 3 stations

P = 1.2 -------- Assumption rate

$$A = \frac{13,500 \text{ tons} \times 1.2}{31.9 \text{ tons/car}} : 0.12 = \text{approximately } 4,300 \text{ cars}$$

Of the actual 7,349 freight cars, necessary cars are calculated as of 4,300 cars and about 3,000 cars are supposed unnecessary.

Among the 3,000 cars, disabled cars 1,800 awaiting for repairs are included. There exist may cars to be evidently abolished.

But the 3,000 cars are calculated by formula in general way, and the cars calculated can not be determined to be abolished. They sould be considered as a base of concept that plenty of unnecessary cars existing are to be abolished.

The newly manufactured cars are 201 covered cars with capacity of 30 tons in 1973 in recent years, after that no cars have been manufactured.

II.7 PROPOSAL FOR IMPROVEMENT

II.7.1 Organization of Traffic Control Center

Central command office (PCC) which is deposited in the Southern Railway is subordinated to director of traffic department and controls the two Railway Divisions (South and Central Divisions) on the car distribution business and executes directly the dispatching car jobs to the stations under jurisdiction of Central Division. That is, PCC are covering the part of the work which ordinally would correspond to the Central Division.

It is assumed that the central command office PCC might act the role of planning and regulation principally, while freight car dispatchers of Divisions execute the practical car distribution work connected directly with subordinated stations as a daily work.

Therefore, it is advisable to separate the dispatching business of Central Command Office and transfer it to the new Traffic Control Center under jurisdiction of Central Division, by transferring the personnel of PCC. The new Traffic Control Center might be a form of Alameda CCT which absorbe the dispatching faculty of PCC.

II.7.2 Freight Transportation Planning

The necessity of planning of freight transportation is mentioned in the article II.4.2.

Therefore, the methodology of planning of transportation capacity and the execution plan will be mentioned in the following.

II.7.2.1 Plan for arrangement of transportation capacity

The improvement of the freight transportation equipment requires much money and time. Given the need for responding to demand for transportation based on the calculation of the flow of merchandise which is very complicated, it is evident that it is necessary to perform and effective investment in accordance with guidance from macro-analysis.

Speaking of the car improvement plan, the Southern railway transport capacity has exceeded demand for more than ten years, as was explained previously. Thus, there are always surplus cars, with many of them in suspension of use. Therefore, it is necessary to mathematically establish the number of cars needed to handle the current and medium-term demand forecasts.

In practice, it will be impossible to make a precise calculation because the demand is too complicated and is subject to wide variation, in accordance with the transportation situation.

In any case, the figure of necessary freight cars can be obtained approximately in the following manner:

$$A = \frac{X \times P}{Y} \div Z$$

where:

A: Number of cars required

X: Tonnage transported per day, on the average

P: Busyness coefficient

Y: Tonnage carried per car

Z: Operational efficiency

Of these 4 factors, the most important is the efficiency of operation, which is composed of various factors. Therefore, it is difficult to calculate the efficiency itself and it must be estimated based on figures obtained in the past, current rotation of cars, etc.

II.7.2.2 Program of transportation execution plan

This program has two objectives: that is, executing transportation service without delay utilizing capacity which is adequate for the demand, and planning an effective operation of the capacity. The program should be monthly and weekly. Since the Southern Railway adopts the weekly system, the monthly one is reduced in importance. From the point of view of each program, nevertheless, the monthly program has greater reason to exist. Thus, in case of adoption of a system in which the volume of

transportation and the quantity of programmed income are divided as a quantity assigned between Divisions (preferably between operation services) with each Superintendent being responsible for fulfillment of his quota, there will be a need to perform the distribution of the transportation capacity on a monthly basis, in order to attain the assigned values.

The quota in this case refers to all the cars which, naturally, must be linked with the programmed volume of transportation for the Division.

The types of programs and their contents are summarized in the following manner:

(1) Goals for transportation volume and income by Division;tonnage of transportation, number of cars distributed, tonnage carried per car on the average, efficiency of operation, income.

(2) Programs for distribution and utilization of cars

Cars distributed by type and those utilized per day on the average.

These programs will be prepared by the Railway Divisions, which will submit them for consideration by the General Manager of the Southern Railway for approval or modification. The contents in detail are indicated in Tables II.7.1 and II.7.2.

II.7.3 Forms and Reports Required for Freight Car Operational Control

For the smooth and efficient execution of freight car operation, it is necessary to acquire necessary informations precisely and rapidly and to transfer orders.

As results of on-site survey, the actuality and problems are mentioned in the article II.4.3. From the view points of above mentioned, some proposals are indicated as follows on the partial modification and new forms for car control.

Table II.7.1 Goals for Transportation Volume and Income by Railway Division

Division	Transportation tonnage		Average tonnage carried per car (B)	Average daily number of cars utilized ($C=\frac{A}{B}$)	Cars distributed					Operational efficiency ($\frac{C}{D}$ x 100)	Income goals
	Monthly	Daily average (A)			Cars unloading and those available	Other	Subtotal	Traveling	Total (D)		
Central											
South											
Total											

Table II.7.2 Program for Distribution and Utilization of Cars (Breakdown of D)

Division	Situation of cars	Box cars		Gratings		Flatcars				Gondola cars				Hopper cars			Refrigerated cars	Tank cars		EXTR	Total
		CTES	BITR	K	RC	PC CTES	PCT	PC ARM	PE	Q CC CTES	CC FI	PQ	CE	TE	ETE	TETC TME	FC	EE	EC		
Central	Existing																				
	Utilized																				
South	Existing																				
	Utilized																				
Total	Existing																				
	Utilized																				

II.7.3.1 Acquirement of accuracy of information

The major quantity of information is acquired from each station and through regular method they are totalized, arranged, and used for judgement in the management sections.

Therefore, the information prepared in each station should not be prepared incompletely or incorrectly for the achievement of the purpose.

That is, however the form of report may be complete, if there is incorrect information or missing necessary information, the total judgement might be mistaken and the decrease of efficiency of freight car rotation might be induced.

For that sake, it is necessary to prepare precise information urgently and to make complete delivery system of informations. Deficiency of various report papers, which might be caused by economic condition of Chilean State Railways, should be solved at the same time.

It is important to regulate concretely for the solution of above mentioned problems and to have a system of transference of precise information by education of personnel, etc.

By consolidation of the above mentioned proposals, considerable improvement of business can be achieved.

II.7.3.2 Forms and reports which are kept at stations

As mentioned above, the forms and reports should include necessary information for the freight car operation to carry out efficiently the car distribution and circulation of freight cars. With respect to the progress of rationalization of the Southern Railway, informations should be restricted to the minimum level of necessary information volume.

From this view point, the report "Report on car situation as of eight o'clock" and the form "Record of arriving and departing cars" will be recommended to be improved as follows respectively.

(1) The "Reports on car situation as of eight o'clock" which are sent daily from the stations will be modified as indicated in Table II.7.3.

1) In "Bulletin of existing cars at eight o'clock", in addition to the number of cars requested (grouped into three categories: for the day, for the following day, for the subsequent day until two days later), information will be given on the number of cars arriving and departing on the preceding day (by situation) and transportation carried out on the preceding day with its corresponding tonnage carried and income.

2) The hour of the report and the breakdown by type of cars are not modified.

3) In cars existing at eight o'clock, all cars are included, except those which are travelling. That is, Cars existing at eight o'clock = Cars existing - those in circulation.

4) By "cars solicited" is meant the demand for the following day or the subsequent day until two days later, based upon which the distribution order is given.

5) With the car having arrived and departed, the difference between the car which arrived loaded and departed loaded is established, balancing the deficit with empty cars. The return of the empty cars is thus assured.

At the same time the reasons for the requests for empty car equipment are verified.

6) The degree of compliance with the transportation and income goals is controlled daily by "Transportation carried out".

(2) The T.56 book, "Record of arriving and departing cars" will be modified in conformity with table II.7.4.

Table II.7.3 Report of Existing Freight Cars as of 8:00

Item	Situation		Box cars		Crating cars		Flatcars				Gondola cars				Hopper cars			Refrigerator cars	Tank cars		EXTR	Total
			CTES	BITR	K	RC	PC CTES	PCT	PC ARM	PE	Q CC CTES	CC FI	PQ	CE	TE	ETE	TETC TME	FC	EE	EC		
Number of cars	Being loaded (1)																					
	Being unloaded (1)																					
	Available (2)																					
	At depot (3)																					
	Transit (4)	Loaded																				
		Empty																				
	Under repair																					
	Total																					
Solicited	Today																					
	Tomorrow																					
	The day after tomorrow																					
Arrival and departure (yesterday) (5)	Arrived	Loaded																				
		Empty																				
	Departed	Loaded																				
		Empty																				
Results of transportation (yesterday)	Tons dispatched																					
	Income from transportation																					

Note: (1) Being loaded and unloaded: Including cars which are awaiting both operations.

(2) Available: Empty cars which are available.

(3) At depot: Cars with depot order.

(4) Cars in transit: Cars ready to leave

(5) Arriving and departing cars: These are subdivided into ( ) cars with distribution and cars with orders to be dispatched to the South.

Table II.7.4 Arrival and Departure of Cars

Type and number of cars	Loaded or empty	Originating station	Arrival at station				Arrival at the siding				Departed from the siding			At the siding	Departure from the station					Hours of detention	Note
			No. of train	Month	Day	Time	Name of siding	Day	Time	Loaded or empty	Day	Time	Loaded or empty	Hours standing there	Month	Day	Time	No. of train	Loaded or empty		

Note: (1) If period of less than 30 minutes is disregarded. 30 minutes or over is calculated up to the nearest hour.

(2) Regarding detention time, this is the average detention time for all the departed freight cars in the station for that day.

Situation of the equipment	Number of cars	Total hours of detention	Average hours of detention
Arrival and departure of loaded cars			
Arrived empty and departed full			
Arrived loaded and departed empty			
Others			
Total			

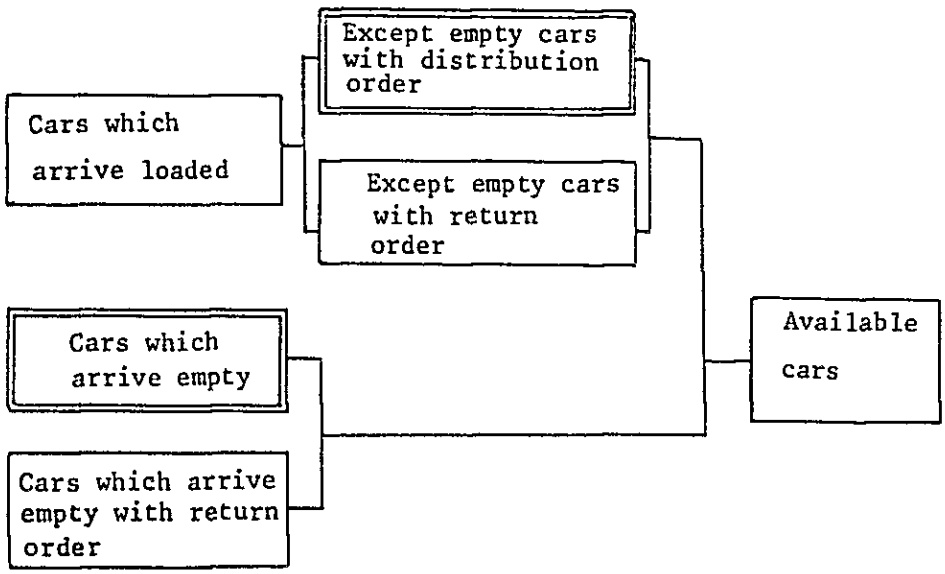
1) Objective of "Record of Arriving and Departing Cars" is to clarify the proceeding of fregiht cars from arrival to departure for check of detention time, efficiency of car rotation, calculation of tariff of detention time etc. and should be an aim to create a complete control book of cards in each station. For that sake the results of each cars should be clarified and checked preparing the volumes of arriving and departure time and detention of each car.

2) The time of detention will be calculated for each one of the cars dispatched (loaded and empty) on that day in order to reduce the time of detention and to improve the efficiency in comparison with the normal detention time.

II.7.3.3 Forms relative to car control services

For the precise judgement of car dispatchers and improvement of efficiency of execution of business, a new form relative to car control in which are included necessary informations for the distribution work, is proposed.

(1) When discussing the distribution of cars, this refers to empty cars, which is diagrammed in the following way:



As can be seen, the available cars are those which arrive loaded, those which arrive empty and those which arrive empty with a return order. Especially with respect to those which arrive loaded with freight, those unloaded with a distribution order or return order are not considered as beingavailable. Therefore, empty cars which arrived empty remain available for a distribution order.

(2) The criteria for deciding the type of instruction concerning the use of the empty cars, in the case of the PCC, are first of all the balance in the schedules of the Divisions and second, regulation of the distribution to respond to the variation in demand. Then, the remaining adjustment weighs against a great fluctuation in demand.

On the other hand, the Divisions are occupied with the manner of handling demand with cars which come assigned from the PCC, above all in consideration of the balance between supply and demand which is the basis of the transportation program for important customers.

(3) In Tables II.7.5, II.7.6 and II.7.7, the basic forms for determining an order are explained

In Table II.7.5, the number of cars entering and departing by type between the Central and South Divisions is shown. This constitutes an important datum for controlling the empty cars and preventing unbalanced distribution by type.

Table II.7.6 is for calculating the deficit and/or excess between the available freight cars and that which is needed with the purpose of giving better utilization to the empty cars.

Table II.7.7 refers to planned shortage and/or excess between supply and demand which permits providing the time necessary for execution of an adequate distribution.

Table II.7.5 Movements of Cars between Central and South Divisions

Division	Situation of cars	Boxcars		Gratings		Flatcars				Gondola Cars				Hopper cars			Refrigerated cars	Tanks cars		EXTR	Total
		CTES	BITR	K	RC	PC CTES	PCT	PC ARM	PE	Q CC CTES	CC FI	PQ	CE	TE	ETE	TETC TME	FC	EE	EC		
Central	Loaded																				
	Empty																				
	Total																				
South	Loaded																				
	Empty																				
	Total																				
Total	Loaded																				
	Empty																				
	Total																				

Table II.7.6 Balance between Requested and Available Freight Cars

Item			Types of cars are the same as those of Table II.7.5.
Available cars	Report as of 8:00	Being unloaded	
		Available	
		Total	
	T.75	Arrived	
		Total (A)	
Requested for today		(B)	
Difference between cars available and those requested		(A) - (B)	

Table II.7.7 Prospects for Demand and Supply of Cars

Item		Types of cars are the same as those of Table II.7.5.
Available cars	Difference according to Table II.7.6	
	Cars which will arrive according to T.75	
	Total	
Requested for tomorrow		
Difference between cars available and those requested		

The sources of information for preparing the forms indicated above are: "The bulletin of existing equipment at 8 o'clock" and T.75, Bulletin of the conductor. The latter will be discussed later on. In any case, these operations will be carried out easily through the computerization of the Freight Car Control Office.

II.7.4 Computerization of Freight Car Control

The reports based on T.75 should be utilized positively for the freight car control, because the data are very effective for understanding the actual train operation in real time.

If the aforementioned problems are solved, actual condition of freight car movement can be monitored precisely.

As one improving measure, the works inside of plotted frame in Fig. II.4.4 will be studied for computerization.

II.7.4.1 Premised conditions

The most important thing.for computerization is the acquirement of source of infomation. Namely it is the most important premise to have all informations of train operation by T.75.

II.7.4.2 System plan

Each computer system will be deposited in each traffic control center (CCT) where the input of the data of T.75 will be done directly at the table of dispatcher of Alameda, Concepcion, and Valdivia.

Matching data of three systems will be executed periodically according to necessity. This execution depends on the faculty of the communication line.

II.7.4.3 Improvement of informations

(1) Preciseness will be raised up, because data are innovated always by actual result information.

(2) Perfectness

Blank part will be vanished by combination of three areas data of Alameda, Concepción, and Valdivia.

(3) Activity data

The ledger book of freight car control will be transferred to electronic register system which will facilitate the easy and rapid reference of necessary data.

By preparing program, data analysis can be made from various angles.

(4) Rationalization

The preparation work of ledger book for freight car control will be rationalized.

II.7.4.4 Software

By entering the information of T.75 as a original data, the computer system works researching various files and picks up necessary information. For that sake, always the contents of informations inside files are reflecting precisely the real estate of freigth car rotation, and can be obtained precisely and in short time such necessary data as information of position and condition of freight cars for the planning of freight car distribution, the results of freight car operation, and other various useful informations. In the following will be mentioned the principle of procedure of computer system.

(1) Input of the T.75 form

In the Southern Railway, the actual state of freight car rotation is reported by T.75 form and it is not necessary to prepare a new resource of information. If the small train operation is reported, the preciseness of informations can be elevated.

(2) Necessary data files for freight car control are shown as follows:

1) File of freight car

In this file there will be recorded characteristic data and variable data of all freight cars of Chilean State Railways.

Characteristic data are:

- Type and number of freight car
- Gauge
- Type of bogie
- Manufacturing company
- Date of manufacturing (year, month, day)
- Weight of freight car
- Weight of freight goods
  and
- Other characteristics data of freight car.

Variable data of freight cars are:

- Actual position and condition
- Record of inspection
- Pointer of related file, etc.

They are innovated up to date by the input of T.75 form.

2) File of freight goods

In this file there are noted departure station, arriving station, commodity, weight, etc.

They are innovated by the input of T.75 form.

3) Train file

In this file there will be noted the number of freight trains, departure station, stopping station, arriving station, departure and arrival time, works of coupling

and uncoupling, and other necessary information concering train operation.

By the input of T.75 from, the contents of this file are refreshed to initial condition and by proceeding of train, they are innovated to up to date condition.

4) File of station

In this file there will be recorded characteristic data and variable data of freight service station.

Characteristic data are position of station by kilometers, name of line, etc. Variable data are pointer of related files, etc.

5) Relation of file subordination

The relation among files is constructed by theoretical relation of subordination.

The connection and release of the relation among files are done only by manipulation of pointer.

The principle of data base composition is shown in Fig. II.7.1.

A record is a unit of some information group. They are accessed by their own record number. The number of a record is confronted with every outer information one by one.

From that reason they are called "keys" to express their connection.

The information used as keys is shown in Table II.7.8.

The creation of keys is made by a function.

(3) Processing system

The procedure of data processing will be explained in Fig. II.4.4.

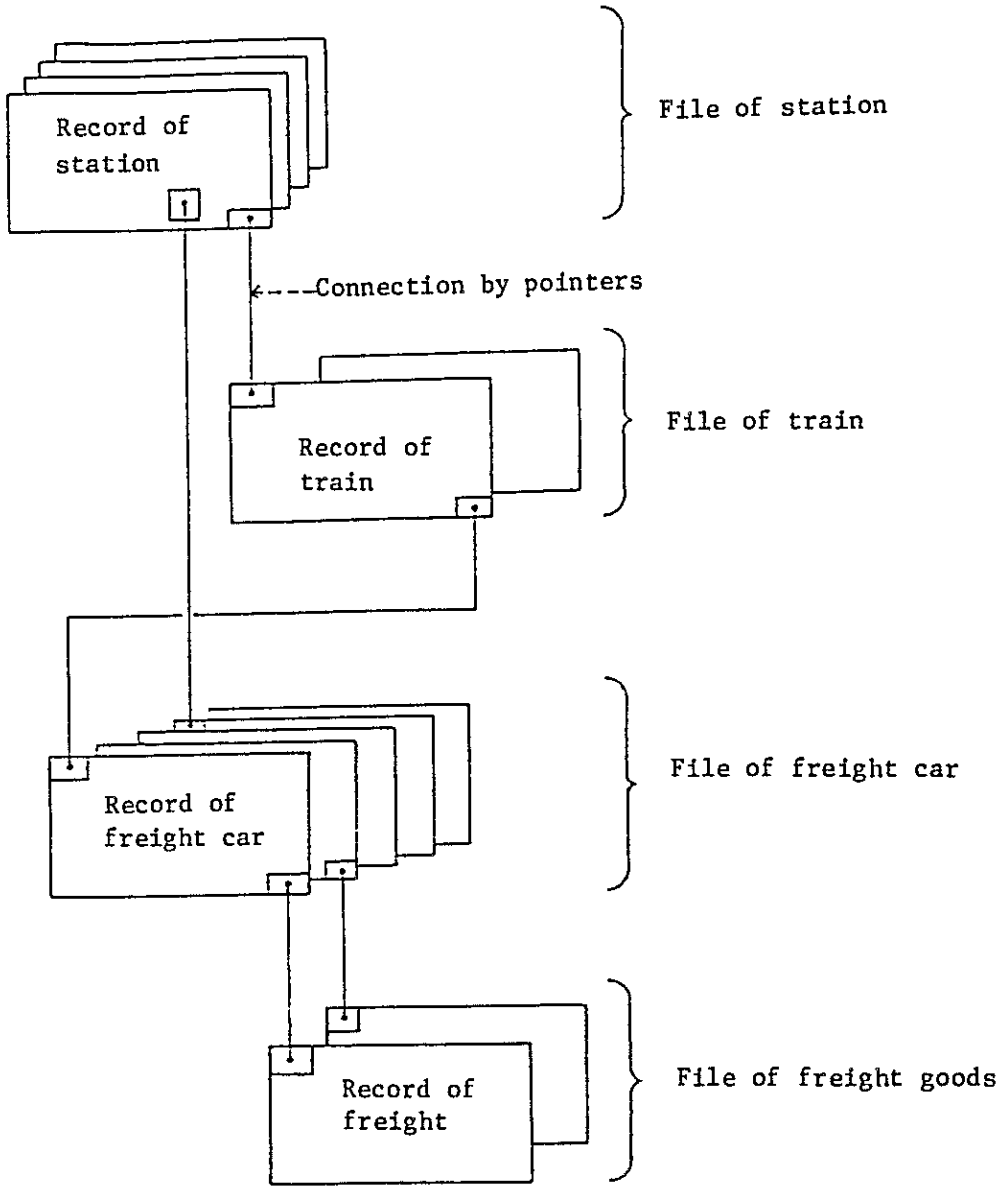


Fig. II.7.1 Composition of Data Base

Table II.7.8 File Access Key

Name of file	Key
Station file	Code of station
Train file	Departure day Number of train
Freight car file	Type of freight car Number of freight car
Freight goods file	Type and number of freight car

When the formation of train X3 is determined at departure station, the first information concerning to the train is reported to the dispatcher of train operation control center.

By the date and number of train, train record is created and by the input of station code of departure station, the X3 train record is connected with station record.

By continuing the input works of the type and number of freight cars in the train formation, freight car records are connected with train record. (Procedure by the input ① of Fig. II.4.4).

By the input of name of freight at the same time, the freight record is connected with freight car record. When the train starts and arrives at A station, the train manipulation work like coupling and uncoupling might be executed.

These working results are reported to train dispatcher of traffic control center.

By input of such information, the contents of files of this system are innovated.

By the input of ② in the Figure, the train record which was connected to the departure station of the train will be transfered to the connection with A station, and the code of freight car a will be connected with the X3 train record.

When uncoupling work is done, the record of the uncoupled freight car is disconnected from train record and is exchanged to the connection with A statin. At every time to receive reports from stations, same procedure of data processing are executed and train record will be erased by receiving the report of the destination station.

(4) Output information from system

The information to be gained from system are shown in the following.

Output information can be classified into two groups. They are real information by resulted data and anticipated information which will be gained from some procedure of esti mation based on the resulted data. The former data will be used for the understanding the present situation, and the latter is used to back up data of planning.

Actual information is as follows:

1) Inforomation of present car situation

These is information of present freight cars in stations and in trains. Once it is put into computer system as freight car information, the freight car records are connected to station record or to train record. These conditions are kept in same, until new input will be supplied from outside. The type, number, and codition of related freigth cars can be obtained from the system by indicating station or train.

2) Search for freight car

By inputting the type and number of the aimed freight cars, the place of the car is informed.

3) Back up data of car distribution

By execution of estimated calculation, the expected data based on the resulted data can be output. Because the system can output the future estimated information after some hours of actual time, the system can act as a effective means of efficient planning of freight car distribution.

4) Data of freight car inspection

By adding the information of car inspection (type of inspection, execution dag name of workshop, etc.) to freight car record, understanding of the next inspection and seizing time of freight car can be done easily.

By this system, the total running kilometers can be calculated and the execution of maintenance work based on the running kilometers might be realized.

5) Information concerning the freight car movements.

Access to the records in freight car file can be made through a table, named "key table", in which a pair of type and number of freight car corresponds to each record number one by one. In this table, quantity of key numbers will be increased at every time when new freight car information is input (i.e. freight car is used.). For that sake, the name of freight cars and frequencies utilized can be seized easily for some period. The cars which are not memorized in the system are the ones which are not used for that period.

6) Administrative information

From the records of commodity, loading weight, departure station, arrival station, etc. can be output the results of each freight goods flow, income, cost, etc. By doing estimated calculation, expectative income can be prepared as a output from the system easily.

(5) Design of computer system

1) Construction of system

Informations of the form T.75 sent by dispatching telephone are processed by dispatchers.

A premise for the system construction is the file marging of three traffic control offices in Alameda, Concepción, and Valdivia, which will be done periodically as shown in Fig. II.4.4.

2) Premise parameter and estimated capacity of system design is shown in Table II.7.9.

Table II.7.9 Parameter and Capacity Estimated

Parameter	Capacity
Number of freight cars used in one day	500 cars per day
Number of trains per day	60 trains/day/traffic control office
Number of freight cars coupled to one train	50 cars/train
Number of freight service stations	400 stations
Number of freight cars of Chilean State Railways	6,000 cars

3) Formation of the system

The formation of the system is classified into two parts of processing system of input data of T.75 and preparation system of output informations. The former is a replacing system of the hand writing works and the latter is a generating system of various informations acquired from the form T.75.

4) File capacity

Capacity of each file which constructs the aforementioned data base is shown in the Table II.7.10. The estimated capacity of necessary files is shown in the Table by unit of one day.

Table II.7.10 Capacity of File

Name of file	Capacity
Station file	32 byte/record x 400 stations = 12.8 K Byte
Train file	256 Byte/record x to trains = 12.8 K Byte
Freight car file	32 Byte/record x 6,000 cars = 192 K Byte
Freight file	32 Byte/record x 500 cars = 16 K Byte
Total	234 K Byte

Actually data bases for the various outputs and for keeping informations during some determined period, etc. are necessary.

Access to auxiliary memory device is generally executed by sector units. For that sake the unit is 128 or 256 Bytes.

By considering these situations, the file capacity used for the back up system to the freight car distribution service might be 3 MB.

II.7.4.5 Hardware

(1) System construction

By considering actual telecommunication equipments as a means of data transmission of the input data of T.75, the system will be constructed as shown in Fig. II.7.2.

In each traffic control center (CCT) there will be deposited the files for keeping information of T.75, and each files will be connected directly or sent by telecommunication line to the central command office (PCC) in Alameda.

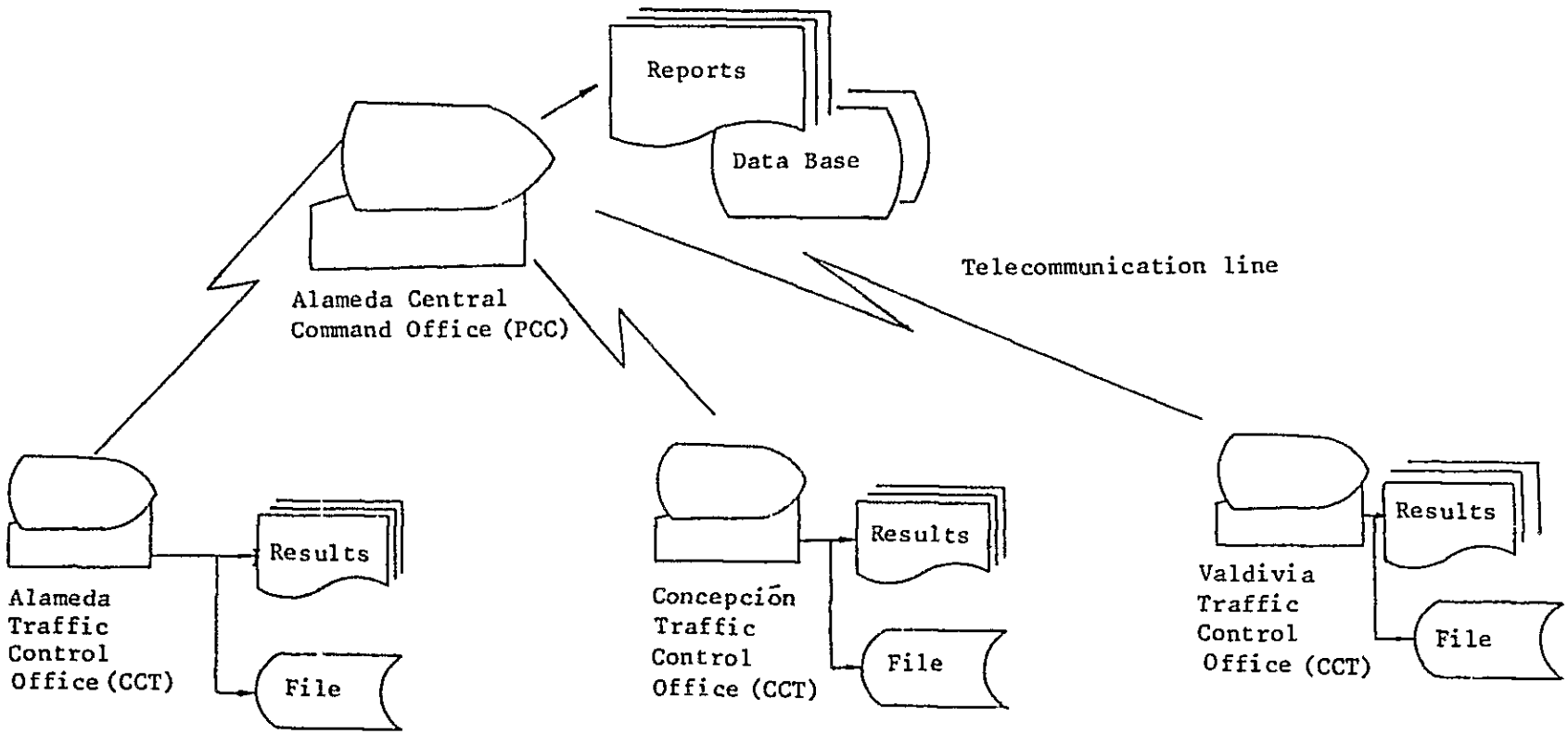


Fig. II.7.2 System Composition of Traffic Control

(2) Condition of hardware

1) Alameda central command office (PCC)

This system should be equipped with the faculty of data base system.

2) Each traffic control center (CCT)

This system is used as data entry system, and at least should be equipped with the faculties of file maintenance and telecommunication control.

3) Telecommunication control device

It is necessary for the commanding office (CCT) in Concepción and Valdivia to send the contents of files to Alameda central command office (PCC) at determined hours every day.

The data will be sent through telecommunication line. The Chilean State Railways has not efficient private communication line and the public line might be used for that purpose.

The cheapest and easiest method is a sound coupler, using telephone line.

In this case, if file capacity is 256 KB and transfer velocity be 300 baud, 2 hours are necessary for the transmission of the contents of a file.

If a line of 4,800 baud is used for the transmission, 7 minutes might be sufficient for the transference.

Which kind of transfer system might be selected depends on the type of operation.

(3) Man-Machine system

The conditions of Hardware of Control system were mentioned before. In this case, it is important to pay attention for the easy and errorless data entry.

There are many types of data entry methods. Most popular one is to input data through key board, but this method has a defect of too many key touches. Nowadays various simple input devices like page type, sheet reader, etc.

It is necessary to select adequate method for the execution of business to elevate the efficiency.

(4) Data base system

To construct data base is a labouring work which will demand plenty of work and time.

In this system direct rapid answer is not demanded, and it's more suitable to select computer machine which has general data base system.

Because the construction cost of introduction is incomparably cheaper than that of the cost of cultivation of special data base system.

II.7.4.6 Procedure of constructing computer system

The constitution of the completed system is shown in Fig. II.7.2. From this total system the aforementioned effects can be deduced as output, and the results will be very great. But for realizing this system in short time, plenty of investments will be required and, in practical operation, difficult problems will be caused.

For that sake, the build up method of construct the system by ascertaining the faculty and manipulation technique in each stage can be recommended and might be desirable.

(1) Short term plan

This is the period of construction of dispatching system. The items of the form T.75 which will be input into computer system should be determined, and the way of input should be checked completely.

From the view point that the purpose of the system should be a support for improving the efficiency of freight car rotation, the items should be selected for realizing this aim.

Names of stations, name of the freight goods should be expressed by own codes for facilitating the manipulation of input. In next stage, should be determined the items of output informations.

Because this computer system is a data entry system, such a complicated calculation like anticipation by referring to great capacity files and the work of great processing inside calculator should be avoided and output should be prepared on the base of the resulted data.

The way of system operation is explained in the following.

Dispatcher of central control office will input the contents using the key board when the receives reports concerning the form T.75. When commands are input and then the items to be introduced are expressed on the screen of CRT (Cathode Ray Tube). The dispatcher will input necessary data according to the indication of computer.

The actual situation of freight cars in each station and in the trains can be monitored by inputting command. Once a day, related information necessary for freight car control is extracted from the files of computer systems in Concepción and Valdivia and is written into floppy disk or magnetic tapes. This information in magnetic medium will be sent to the central control office in Alameda to be merged into the central files.

The total movement of freight cars before two days on the Southern Railway lines will be grasped completely in central control office of Alameda (PCC). By continuing these procedures every day, daily informations will be accumulated inside the computer system, and various resulted tables will be prepared for reference, besides the actual freight car control ledger book.

Microprocessor computer system will be adopted as hardware. Floppy disk is cheap and easy to use as a auxiliary memory, but velocity of access and reliability are low.

From the cause of security, the purpose of the floppy disk should be limited to the transport of files, etc. Recently the price of fixed disk is becoming very low and can be applied economically. The memory capacity is relatively large of 3 ∿ 30 MB, and access speed is also high.

Several fixed disk with the capacity of 30 MB will be attached to the system of Alameda central control office for the data procedure.

The composition of hardware of each dispatcher's office (CCT) is shown in Fig. II.7.3.

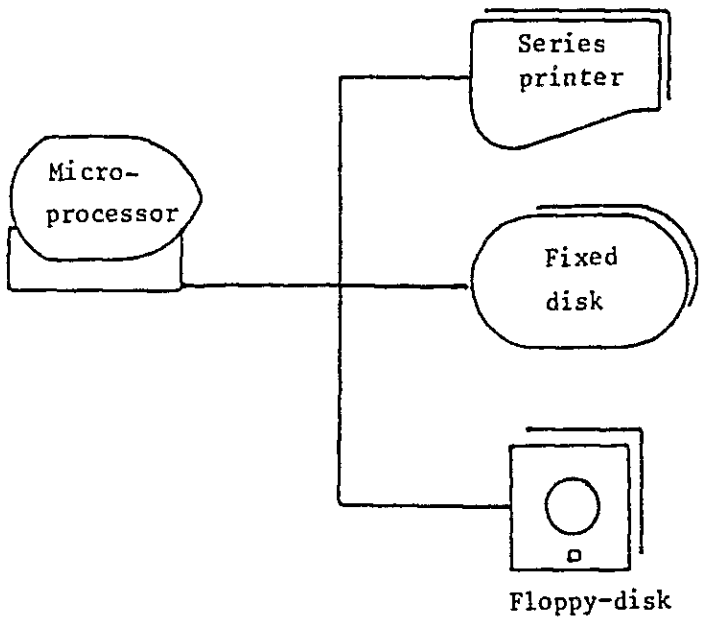


Fig. II.7.3 Composition of Dispatcher System (Short term plan)

(2) Intermediate term plan

This is the stage of joining each control center using communication line. The period or time interval for renovation of fundamental files in central command office will be shortened. By utilizing inactive hours of system operation, this system can be operated like a real time system. By using this processing system, the central command office can recognize actual situation precisely and send more appropriate orders.

The system composition of the intermediate term is shown in Fig. II.7.4.

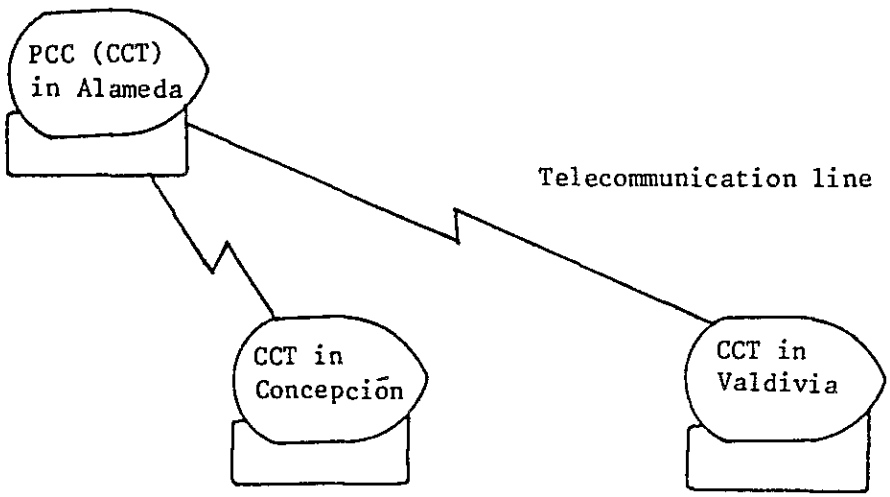


Fig. II.7.4 System Composition of Traffic Control Centers of Intermediate Term

(3) Long term plan

Total system of long term plan is shown in Fig. II.7.2.

In this third stage, plenty of data and informations will be treated by data base machine systematically. If such information concerning locomotive and driver is added, operations of locomotives and drivers can be controlled by this system.

That means that the grade of information procedure will be improved fundamentally.

(4) Output of each system and its restrictive conditions

The output information and restriction of contents of output in short term, intermediate term and long term system are shown in Table II.7.11.

(5) Important figures for the introduction of the system

When the system comes to the stage of operation, we will be confronted with maintenance problem. Hardware might be maintained by the support group of the manufacturing company.

Serious problems might be produced on Software. Various problems like control of programs, changing faculty, accidents, etc. will arise. Especially the change of specification will be required more and more according to the progress of utilization of the computer system in daily work.

In view of these needs, specialist groups should be formed and educated.

II.7.4.7 System construction cost

For the estimation of construction cost, precise system design is necessary. Following data are shown approximately.

Term	System scale	Approximate value (thousands of US$)		
		Hardware	Software	Total
Short	Total equipment of dispatcher system (3 units)	81.5	327 (20k step)	408.5
Intermediate	Addition of telecommunication control device	8	8	16
Long	Introduction of data base machine	4,000	5,000 (200k step)	9,000

Note: US$ 1 = ¥ 245

Table II.7.11 Output Information and Output Condition

Term	System	OUTPUT INFORMATION FROM SYSTEM						
		Actual information of cars	Search of cars	Back up data for car distribution	Car inspection data	Car operation data	Administration data	Restrictive condition
Short term	Dispatcher system	○	○	△ (without anticipation)	X	○	X	Time lag of 2-3 days exists from actual situation
Intermediate term	To connect each dispatcher system by communication line	○	○	△ (without anticipation)	X	○	X	Time lag for data transference exists
Long term	Total system with data base machine in central command office	◎	◎	◎	◎	◎	◎	By on line system can be obtained necessary data immediately at any time

Note: ◎ = can be gained rapidly and precisely

○ = possible with restrictive condition

△ = possible but except the contents inside of ( )

X = not included.

II.7.5 Characteristic of Goods Flow and New Traffic System

The transportation of freight of the Chilean State Railways is characterized by two traffic patterns:

The first is a massive transportation which can be seen between port zones and inland areas.

The second is a traffic flow from and to major manufacturing companies.

They have adequate condition for massive and fixed form transportation system.

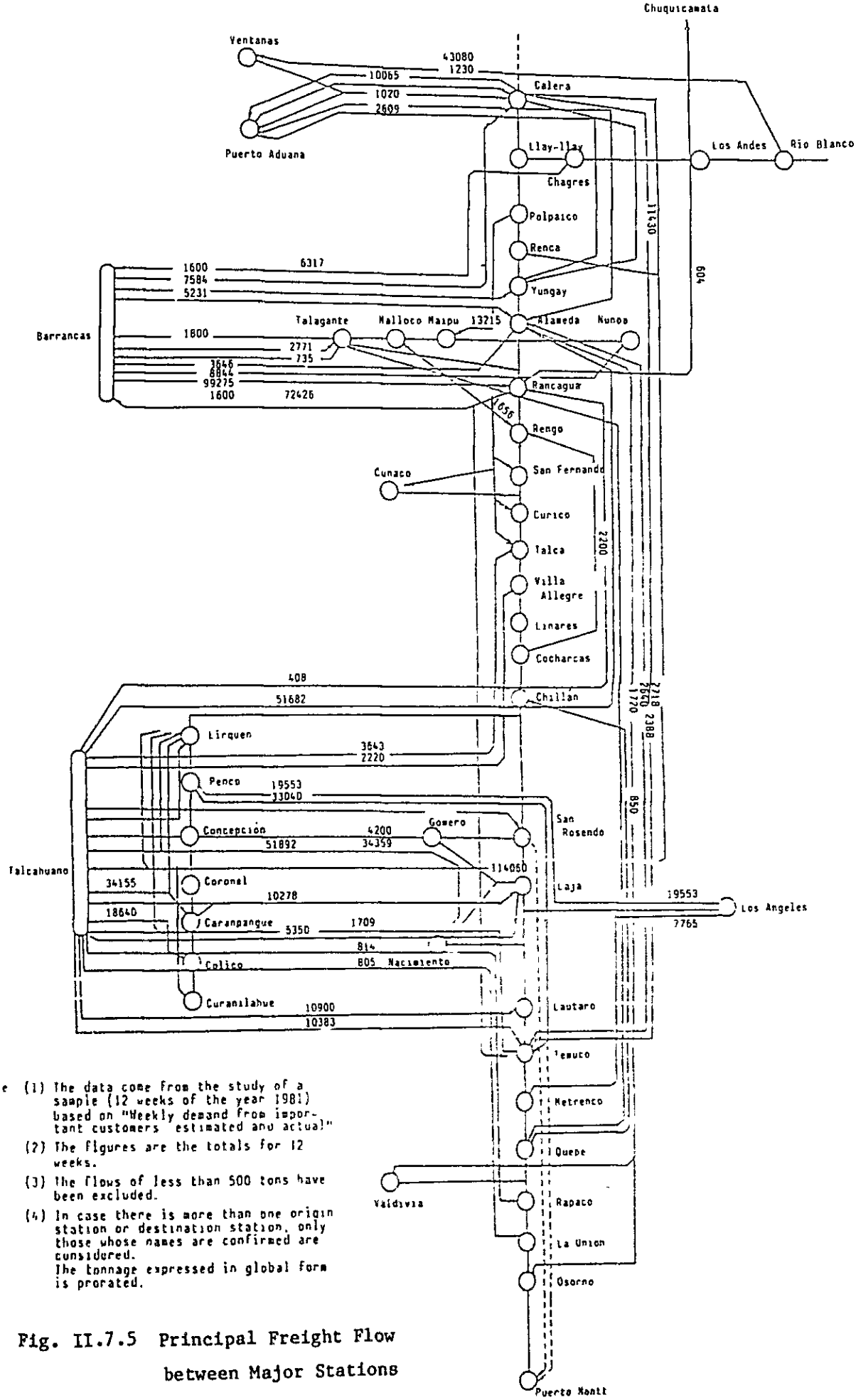
Main products transported to port areas are lumber, pulp and copper. Barley, wheat and maize are transported to inland areas. To and from major manufacturers are transported lumber for cellulose, cut lumber, pulp, steel products, petroleum, coal, cement, fertilizer, etc.

According to the data of the "Weekly demand from principal customers: estimated and actual", which the Southern Railway is utilizing daily in its car operation, it can be seen that the flow of products in one part of the year 1981 (March, July and December; 12 weeks; 84 days) was approximately 750,000 tons. (See ATTACHMENT 6).

It is assumed that the volume transported amounts to 84% of the total flow of the Southern Railway.

These figures of traffic flow are indicated in Fig. II.7.5. Excluding the products flow with relatively minor movements and those which have two or more stations as origin and destination, the traffic flow between 48 stations is about 720,000 tons. Among the stations above mentioned, 3 ports areas (Stations are Ventanas, Valparaíso, Barrancas, and Talcahuano) have traffic flow as follows;

- Depart from port areas = 245,000 tons
- Arrive to port areas = 227,000 tons
- Thier weights are 34% and 32% respectively.



Note (1) The data come from the study of a sample (12 weeks of the year 1981) based on "Weekly demand from important customers estimated and actual"

(2) The figures are the totals for 12 weeks.

(3) The flows of less than 500 tons have been excluded.

(4) In case there is more than one origin station or destination station, only those whose names are confirmed are considered.
The tonnage expressed in global form is prorated.

Fig. II.7.5 Principal Freight Flow between Major Stations

The above figure shows fairly high values.

In the light of this situation, the best route toward better utilization according to the "economies of scale", such a particular attribute of railways, is to give a new orientation to the long term role of freight transportation, concentrating on the transport in massive and fixed form.

In Chilean State Railways, many minor stations have been abolished of the freight handling services (including passenger service stations) but the freight handling volume is increasing. This phenomenon should be paid attention to.

For that sake, the concentration of freight handling stations should be continued by this experience and results for a while and in future should be realized the transportation by strategic stations like 48 stations mentioned.

Table II.7.12 Transition of Number of Stations and Traffic Volume

Year	Number of Station		Tonnage of Transportation	
	Station	1975 year= 100	Volume (Ton)	1975 = 100
1975	452	100	3,989,272	100
1976	457	101	4,788,769	120
1977	457	101	4,516,461	113
1978	396	88	4,375,068	110
1979	367	81	4,487,501	112
1980	305	67	4,679,237	117

Note: The above figures show the commercial freight transportation only.

In case transportation is limited to these 48 strategic stations, it is necessary to establish measures to handle the less dispersed flow which occurs at other stations, together with trucks which will be responsible for carrying it to the strategic stations.

At the same time, measures of tariff and regulations (see Project 2-1, article III.4.5) should be promoted to raise up the effect of accumulation to secure traffic volume.

In future, when the service stations are concentrated to strategic points, trains can be prepared among these stations to shorten the travel hours and to be able to serve more effectively.

The concentration to the strategic stations is a measure to attract the strong points and reject week points of railway and road transportations, resulting in rationalization of railways and lower cost.

The survey in this time was executed on limited materials and by sampling method. For that sake, the execution plan of actuality should be prepared according to the annual flow in more precise and new traffic flow which will be cultivated newly, by determing the strategic stations and planning trains between them.

II.7.6 Maintenance of Freight Car

II.7.6.1 Improvement of inspection system

(1) In general, the ways of maintenance (preservation of faculty) of rolling stock, ships and automobiles is classified as follows:

- Performing inspection or repair of the parts in which occurs deterioration or wears at any time when it is necessary.
  ----- ex-post-facto maintenance system

- Performing inspection or repair in accordance with an established interval.
  ----- Preventive maintenance system.

Each system has its own advantage and disadvantage as follows.

1) Ex-post-facto maintenance system

This refers to repairs which are accomplished on the faulty parts after the failures occurs, when it is possible to stop the function of the machine.

Therefore, spare automatic switching apparatus is needed when greater safety is involved.

This system is adopted in fixed installations in electric power plants, substations, etc., where, in case of an accident, the spare equipment functions automatically while the cause of the accident is investigated and countermeasures are taken.

It is impossible to install spare equipment in railway cars in anticipation of every kind of accident. While it is partially installed, no great effect will be expected, although enormous investments have to be carried out.

Therefore, the ex-post-facto system is not recommended for railway, given the possibility that, on many occasions, traffic will be suspended for a long time. Also, there is the danger that the same accident may cause another very serious one, causing damage to passengers and freight.

2) Preventive system

This is method of maintenance in which periodic inspections are carried out, repairing the deteriorating parts promptly. In this way, perfect functioning is guaranteed until the next inspection. The period is determined based on the frequency of accidents as well as experience in the past.

This system is capable of giving rise to a misunderstanding that greater frequency is translated into an improvement in the level of maintenance. On the other hand, inspections and arrangements which are applied to all parts indiscriminately result in useless parts. As was explained above, it is not necessary to be inclined to one of these systems. Instead, it will be desirable

to establish a method which absorbs the merits of both systems.

Many countries have adopted the preventive system, since the ex-post-facto system is not desirable for a railway which has no spare equipment installed on its cars. The maintenance systems in these countries adopt the characteristics of both systems, in accordance with the type of periodic inspection.

Based on what has been stated until now, henceforth we are going to propose a new system of inspection which does not fall completely into the character of an ex-post-facto system.

(2) Summary of the proposals

These proposals involve the periodic revision of the maintenance regulations in effect, with other inspection remaining as they are now.

The proposals cover:

1) Type of review

Current	Proposed
R3 and R2	Complete revision (A)
R1 and RP	Provisional revision (B)

The 4 current types are summarized as 2 types. The difference between RP and R1 is not clearly stated in the actual system.

2) Inspection cycle

Current		Proposed	
Type	Cycle	Type	Cycle
R3	12 years	A	4 years
R2	4 years		
R1	2 years	B	1 year
RP	1 year		

3) Establishment of inspection

Type	Establishment	Type	Establishment
R3 R2	Main repair shop	A	Main repair shop
R1 RP	Main repair shop, depot Depot	B	Depot

Note: In case of accident, inspection B will be carried out at the nearest place, including a main repair shop.

4) Parts to be inspected and their methods

This topic is discussed in Table II.7.13. With respect to roller bearings, it is desirable that each time a inspection A is accomplished a detailed study be performed, with disassembly if necessary based on actual data on km. travelled.

5) Indication of inspection

Currently, the type car, the data and the place of inspection are recorded as an indication of inspection.

Thus the responsibility for the inspection is clear, but a plan for the next review is not indicated.

In this proposal, the indication of the first inspection A is installed on one side of the equipment as can be seen in Example in which the next inspection B are programmed underneath the first.

Each time a review B is accomplished, the data is acratched out (which appears lower down), noting the place of review at the side.

Example 1

Approx. 40 cm

A	20-11-82	CO-M
A	20-11-86	
B	20-11-85	
B	20-11-84	
B	20-11-83	

Approx. 30 cm

Indicating that the inspection A was done at Conception Shop on Nov. 20, 1982.

Example 2

A	20-11-82	CO-M
A	20-11-86	
A	20-11-85	
B	20-11-84	
B	20-11-83	P-T

Indicating that the inspection B was done at the depot at Baron on Nov. 20, 1984 for the second time.

Example 3

A	20-11-82	CO-M
A	20-11-86	
B	20-11-85	
B	20-11-84	BR-T
B	20-11-83	P-T

Indicating that the inspection B was done at the depot at Baron on Nov. 20, 1983 for the second time.

It will be convenient to establish in advance the abbreviations for each execution place of inspection.

(3) Application of the new system of inspection

1) Cars whose inspection period has expired (the one appearing at the bottom of indication) should not be used for any reason.

Even when it is difficult to execute the review within the established cycles due to the lack of funds, etc., the inspection period must be complied with in any case, at the cost of the quality of the inspection.

2) When a car is put into service, it should be confirmed that it is not overdue, proceeding with its return to a nearby inspection establishment in case the period has expired.

The same procedure will be taken naturally when a repairman or anyone finds an overdue car in the yard.

3) In case of difficulty with the return, a request will be made to send repair personnel to the repair shop or depot which is closest. These personnel shall execute the inspection in conformity with type B, and after filling out the indication in the established manner will put it into service.

This provision will not be applied to the A inspection.

4) The indication of inspections must be handled exclusively by repair personnel at main repair shops or depots.

Table II.7.13 Method of Inspection (Standard) of Principal Parts by Cycle of Inspection

(1)

Inspection type	Inspection cycle	Parts to be inspected									
		Bogies									
		Axles				Bearing and lubrication					
		Stub axle	Wheel center	Rim	Shape of rim	Bearing boxes	Axle box cover	Lubri-cator	Bearing metal	Dust guard	Roller bearing
A	4 years	△	△	□	□	△	△	×	×	×	◬
B	1 year	○	○	○	○	○	○	⊙	○	○	○

Note : The following codes will be indicated in the corresponding parts.

- ○ Superficial inspection
- ⊙ Superficial inspection and lubrication
- △ Inspection through disassembly
- ◬ Inspection through disassembly and lubrication
- □ Inspection with measurement
- S Inspection of functioning
- × Replacement
- • Lubrication

(2)

Type of inspection	Inspection cycle	Parts to be inspected										
		Bogies							Coupling apparatus			
		Shock absorbers		Bogie frame					Coupling			
		Spring	Spring seats	Cross members	Lateral wear plates	Cup beam	Center cup	Lateral support	Head of coupling	Catcher and bolt	Actuating lever	Safety pin
A	4 years	△	△	○	○	△	△	□	×	×	△	×
B	1 year	○	○	○	○	○	○	○	○	○	○	○

(3)

Type of inspection	Inspection cycle	Parts to be inspected									
		Coupling apparatus			Braking apparatus						
		Shock absorber system			Basic brake						
		Shock absorber	Shock absorber limiter	Wedge	Shoe	Shoe adjuster	Valve	Reser-voir	Cylinder	Piston and packing	Brake lines
A	4 years	△	△	△	×	△	×	○	◬	◬	○
B	1 year	○	○	○	○	○	S	○	○	S	○

(4)

Type of inspection	Inspection cycle	Parts to be inspected									
		Brake apparatus						Body			
		Basic brake			Hand brake			Door			
		Automatic adjuster	Hose	Brake rods and their guide	Brake stem	Chain	Wedge of toothed wheel	Door	Door wheel	Door rail	
A	4 years	△	×	△	△	△	△	○	S	○	
B	1 year	○	○	○	○	○	○	○	○	○	

(5)

Type of inspection	Inspection interval	Parts to be inspected								
		Body								
		Door			Body structure					
		Door lock	Safety apparatus	Apparatus for avoiding rain	Roof	Side and front plates	Boxcar door	Door receiver	Paint	Description
A	4 years	S	○	○	○	○	○	△	×	×
B	1 year	○	○	○	○	○	○	○	○	○

(6)

Type of inspection	Inspection interval	Parts to be inspected			
		Body			
		Inside of the body			
		Floor	Ceiling	Wood floor	
T	4 years	○	○	○	
0	1 year	○	○	○	

II.7.6.2 Prevention of disabled cars

(1) Movement of the repair depot

The Alameda Yard is the largest one in the Southern Railway. There are many cars. It also assembles and breaks up the largest number of trains in comparison with the other yards. Therefore, cases frequently occur in which deterioration occurs in cars due to human error. In this sense, the existence of a shop at the yard is very convenient.

With respect to the status of installations, nevertheless, there are no sheds or pit lines or air tubes for tests of brakes. In addition, this is accompanied by a poor contition in which the repair trackes cross a siding of a nearby coldstorage plant, with the result that any entry of cars to the plant on the siding obliges movement of some cars under repair.

That is, a condition which is extremely difficult for the execution of major repairs exists.

This is why it will be most desirable that major repairs are performed in this yard, in the sense of making the quality of maintenance uniform among the Divisions as well as preventing the use of cars which are in poor condition.

In order to achieve the above, the best thing would be to improve the yard with the purpose of transforming it into a repair station at the level of a main repair shop. However, it is necessary to take into account that this will require an enormous investment.

As one solution to these problems, it is suggested that the current shop in the yard be closed and a new one installed in the main shop at San Eugenio which is located about 3 km. away.

Fortunately there are installations for major repairs at San Eugenio, and therefore it is not necessary to make an enormous investment.

With respect to personnel, half of the current staff of the yard (15 persons) could be moved to San Eugenio, where about eight more could be brought from other sites with the purpose of being in a condition to do major repairs. The other half of the yard would remain there in order to be dedicated to the usual tasks.

This would naturally contribute to good results by preventing the occurrence of disabled cars. With respect to administrative responsibility, it will correspond to the chief of the shop at San Eugenio insofar as installations are concened, with responsibility for operational matters, as now, falling to the chief of the yard. This measure will avoid drastic organizational modifications, giving greater facility for maintenance services. Also, problems of cars wearing out in such a manner that they require rapid attention will be solved.

(2) Prevention measures of train operation accidents

These measures should be carried out as soon as possible. When the cars and the installations are causes of accidents, an enormous investment must be made, and it is not easy to put such measures into practice. However, there are measures which do not require investments, and according to the causes they will be carried out easily.

The main and fundamental one is to investigate and to clarify the causes of accidents.

One of the causes which is difficult to explain is derailment along the tracks.

In this respect, one or more factors which are indicated below constitute the cause :

° Defective cars

° Anomalies on the rails or those above them.

° Anomalies in the traffic conditions

° Defects or loading conditions poorly performed.

Based on this point of view, the suggested solution is to create a team of investigators which is specialized in each area.

II.7.6.3 Execution of scrapping cars

With respect to the causes of actual ex-post-facto maintenance work in the freight car mintenance, there is a concept that the inspection according to the determined cycle will demand unne cessary cost for surplus cars, due to the excess cars surpassing traffic demand.

The most important goal of modernization of car maintenance work is how to preserve appropriate number of freight cars in the lowest cost in the most reasonable way.

For reference, calculation results of annual inspection car number, based on the actual car number and calculated necessary car number, are shown in Table II.7.14.

II.7.14 Comparison of Number of Car Inspection

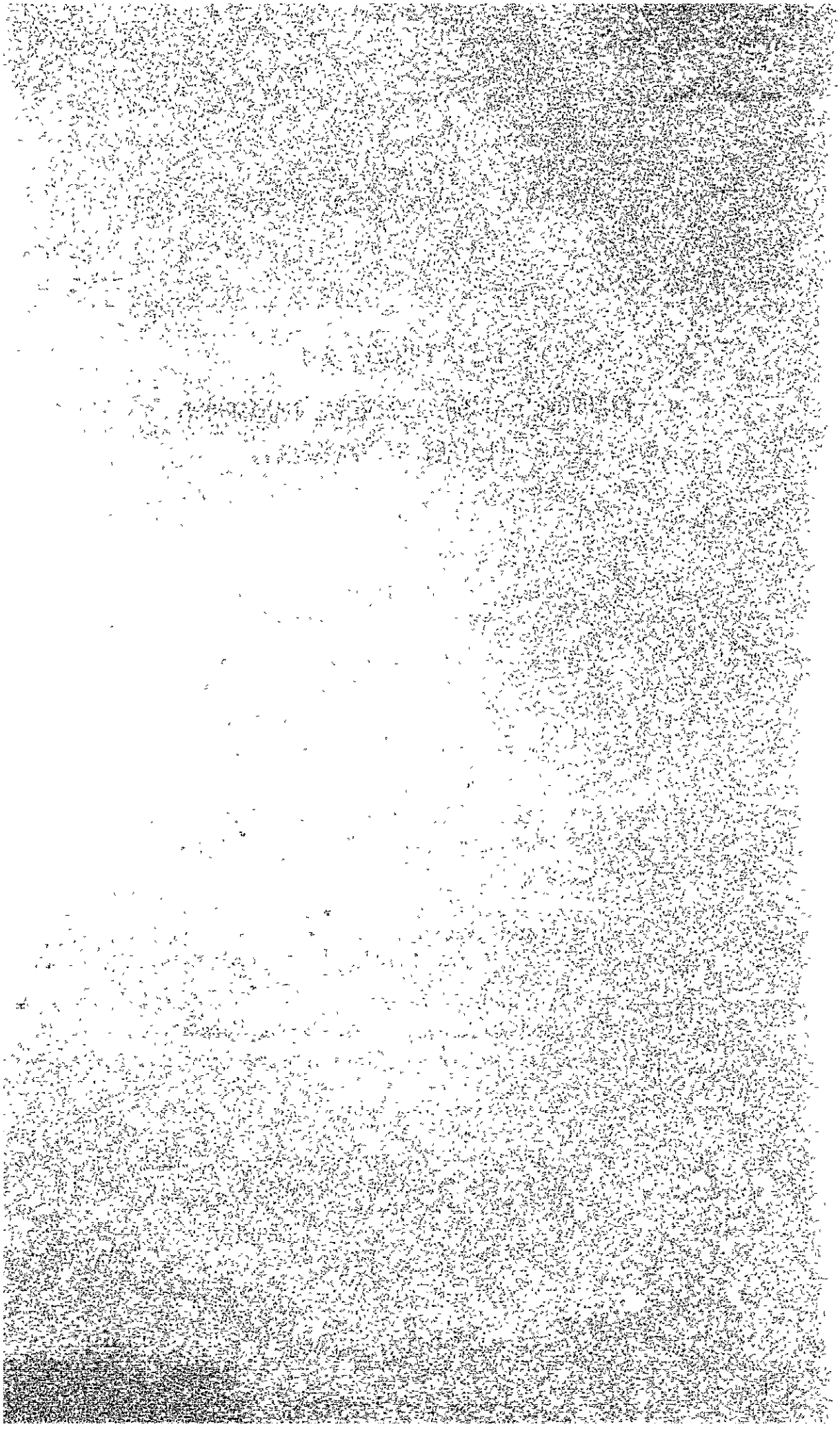
	General inspection(A)	Inspection(B)
Actual car number (7,349)	1,840 cars	5,510 cars
Estimated necessary car number (4,300)	1,075 cars	3,225 cars

From the results above mentioned, the scrapping of freight cars should be accelerated, but the contents of traffic demand are very complicated. For that sake, which cars and what numbers should be abolished must be determined.

Although freight cars are national properties and should not be scrapped easily, it is important to properly regulate the scale of cars to the traffic demand by scrapping unnecessary cars and namufacturing necessary cars according to the natural selection.

III. PROJECT 2-1

(IMPROVEMENT OF COMMERCIAL MANAGEMENT OF THE FREIGHT TRANSPORT)



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

III.1 GENERAL ASPECT OF THE STUDY

III.1.1 Objective of the Study

This study group performed investigations of the present situation of the Chilean State Railways and its freight transportation market in two periods, from July to August and from November to December, 1982. The purpose was to make concrete recommendations for the establishment of the foundation of the commercial policy measures which will enable the Chilean State Railways to develop its functions adequately in competition with other means of transportation and to promote active commercial activities.

III.1.2 Methods of the Study

For the purpose of clarifying the present situation and the problems of freight transport, surveys were made by obtaining opinions of the counterpart members of the Chilean State Railways concerning the subjects indicated hereunder. Concerning the tendencies of consignors and the present situation of their use of the railway and their opinions on the Chilean State Railways, surveys by questionnaire and interview were conducted. Moreover, for the purpose of grasping the actual situation of other means of transportation, field trips were made.

(1) Outlook concerning the general aspect of the freight operations and the execution plans related to the freight operations
(2) System of the freight operations and tariff system
(3) Market survey
(4) Sales system
(5) Various measures for increasing income
(6) Advertising and public relations activities

III.1.3 Results of the Study

Further to the investigations performed according to the indicated aims, it is considered that regarding the operations of the Chilean State Railways in general, drastic scale reductions have been made, including reduction of the work force, and the simplification and cost reduction have reached their limits.

However, for the Chilean State Railways to be able to perform their functions adequately in the severe market of free competition in the new era, it is necessary for the freight transportation function of the future to be centralized on mass transportation of fixed pattern linking major key stations. This would be most appropriate for utilizing the scale merit which characterizes the railway.

For this purpose it is necessary to structure primarily attractive transportation service and organize a system which permits total marketing of this service. The concrete recommendations on this viewpoint are summarized as follows:

(1) Preconditions for determination of the commercial policy measures

1) Setting up of the organization for the market survey

At the present time there is no standing department which performs surveys of the market, and the Freight Section deals with the task when the need arises. On account of this, it is not possible to obtain real-time and consistent statistical data and other information, and therefore, it is difficult to determine the commercial policy measures to meet the trends of the other means of transportation and the demand for transportation.

Consequently it is necessary to establish a structure which will take charge of the market surveys and set up a system which at any time can provide the needed information.

2) Strengthening of the sales system

a) Strict control of the income targets

The control of the freight income is not based on the income from the origin station. Consequently, at the present time it is not possible to establish the income targets by station or line.

Therefore it is necessary the introduction of the origin station concept, which allows to develop a control system of income target, within the measures for the organization of sales framework.

b) Restructuring of the sales activity

Whilst there is an organization for freight sales system, it operates with a very limited number of personnel.

Therefore, to activate this structure efficiently it is necessary to take measures for fostering the sales spirit of the employees together with the organization of the sales system which includes the station, the definition of responsibility, expediting of the collection of information, and establishment of an efficient system for transmission of information.

3) Establishment of railway consignors organizations

To be able to grasp exactly the tendencies of the demands of the consignors it is necessary, for the future, to establish organizations of consignors which enable the railway to make direct contact with its users.

(2) Proposals of concrete measures for improvement of the freight operation

1) Promotion of individual contracts

Individual contracts with the consignors of large volume presently cover more than 60% in terms of the income, a fairly large amount. However, this type of contracting should be further promoted, and improvement is necessary in the following aspects.

a) Putting into practice the measures which include modifications of the discount rates based on the records of the loads sent by the consignors at the time when the contracts are renewed.

b) There would be no problems with the present system in the case of transportation of large volume of fixed forms; however, in the case of the large volume spot transport, it would be necessary to establish a new system consisting of a "commercial discount with contractual freight tonnage" permitting application of discounts after designated volume of freight has been consigned.

2) Promotion of integrated transportation

It is very advantageous for increasing the efficiency of railway transportation to adopt the method of integrated transportation which combines the functional advantages of the railway and the truck. This will be realized by setting up a coordinated transportation system with the truck enterprises that carry approximately 80% of all freight. For these purposes it is necessary to develop new demand by promotion of the system of marine containers tainers and the rail-truck (piggy-back) method between the truck and the distribution enterprises which have the capacity to collect the loads.

3) Promotion of sales through utilization of forwarding agents

At the present time, almost no sales are conducted through forwarding agents. It is necessary therefore to foster forwarders by cooperation with truck enterprises. For that purpose, it is needed to adopt the system of mixed load unit car trains which perform transportation of small volume and less-than-car load by collecting them into a car unit.

4) Preparation of freight cars suitable for each type of commodity

The cars which are in use are generally old and their maintenance is insufficient. Complaints are often voiced, therefore, by consignors.

Particularly deficient is the development of new cars and the remodelling for adaptation to the large volume fixed pattern loads such as cellulose, meat, liquid fuels, coal, and cement.

In order to handle these large volume of freight for long periods in stable manner, it is necessary to prepare cars to meet the requirements of the customers.

5) Revision of the tariff system

The present tariffs for the car-load freight comprise 4 classes according to weight under complicated and diversified system. It is necessary, therefore, to abolish the system of tariff classification applied to general car-load freight for unification of the basic tariffs and simplification of the method of calculating the freight charges.

Moreover, for loads, such as large volume fixed pattern commodities, by which it is possible for the railway to

diplay its characteristics which is particularly suitable for the transportation of large volumes and fixed forms, it is necessary to consider measures for inducement and establish tariffs according to the forms of transportation.

(3) Advertising and public relations activities

Advertising and public relations of the freight operation is being conducted in very restricted forms. For the future it is necessary to promote active advertising activities when the various measures mentioned before are put into practice.

(4) Related activities

At the present time the installations within the station yards are being leased to persons who have no connection with the railway transportation, and policies and plans of use of these facilities are not clear.

For the future, therefore, their use should be planned so as to serve for securing constant freight traffic.

III.2 PRESENT SITUATION AND PROBLEMS OF FREIGHT OPERATION OF THE SOUTHERN RAILWAY

III.2.1 Freight Transportation in Chile

(1) Foreign trade and freight transportation in Chile

The freight transportation in Chile as seen by the main commodities of foreign trade is as follows. In export, copper, wood, paper and pulp account for approximately 60% of the export total, which amounts to US$ 4,820 million, and especially, the share of copper is about 50%.

In import, fuel, mineral products, machinery and tools, and transportation equipment account for approximately 50% of the total of US$ 5,820 million in which the proportion of secondary products represented by machinery and tools, transportation equipment and industrial chemicals is substantial.

When the abovementioned aspects are generally observed, the freight flows can be divided into major groups. In the case of export, the main flow is the traffic of large volume fixed pattern commodities carried by trains and trucks from areas of production to main ports. In the case of import, the flow is roughly devided into two types. One is by such commodities as fuel and agricultural products transported from the ports to the industrial zones or the stock points in large volume fixed pattern. The other is mainly by secondary products carried by marine containers to the main consumption areas. (Table III.2.1)

(2) Traffic by various means of transportation

When the traffic volume of each means of transportation are observed, it can be seen that railway transportation's share has dropped from 14% to 11% during the period of 5 years, whilst truck transportation's share increased from 75% to 78%, which shows that there has been a shift in the transportation market from the railway to truck.

Table III.2.1 Breakdown of the Main Foreign Trade Commodities
(Units in millions of dollars)

Exportation			Importation		
Commodities	Amount	%	Commodities	Amount	%
Copper	2,200	46	Fuel & Minerals	1,010	17
Wood, paper, pulp	580	12	Machinery, tools	1,090	19
Metallurgical products	280	6	Transportation equipment	1,020	18
Molybdenum	230	5	Industrial chemicals	440	8
Agricultural products	240	5	Agricultural products	430	7
Fish meal	230	5	Fibers and textile products	340	6
Iron	160	3	Foodstuffs	460	8
Others	900	18	Others	1,030	17
Total	4,820	100	TOTAL	5,820	100

Table III.2.2 Traffic by Various Means of Transportation
(Units in 1,000 tons)

Year	Railway	Truck	Ship	Pipeline	Total
1973	5,195 (14)	27,832 (75)	1,128 (2)	3,175 (9)	37,330 (100)
1978	4,375 (11)	29,344 (78)	772 (2)	3,264 (9)	37,775 (100)
1978/ 1973	84%	105%	69%	103%	101%

Source: Inecon

(3) Traffic by commodities and by various means of transportation

When the trend in traffic by commodities and by various means of transportation is observed, it can be seen that it is a characteristic of the Chilean State Railways that heavy and voluminous loads such as cellulose, iron materials, copper bars, and rough timber for which the merits of the railway can be displayed, accounts for a major part.

However, for commodities of similar characteristics such as wheat, coal, cement, copper ore, and fuel, trucks and ships are making significant inroads.

Table III.2.3 Trend in the Traffic by Main Commodities and by Various Means of Transportation (1980/1973)

Type / Commodity	Production and import			Volume transported by each means of transportation			
	National production	Imports	Total	Total	Chilean State Railways (Southern Railway)	Truck	Ship
	%	%	%	%	%	%	%
Wheat	55	186	87	87	66 (67)	101	-
Cellulose	255	-	255	255	216 (216)	295	-
Coal and * dust coal	80	-	80	80	76 (75)	43	140
Cement	115	3	113	113	31 (34)	138	-
Copper ore*	93	-	93	93	61 (71)	222	-
Fetilizers (except saltpeter)	57	57	57	57	27 (28)	?	?
Iron ores*	84	82	84	84	100 (100)	73	-
Fuels *	100	15	98	98	74 (34)	135	35
Copper * bars	140	-	140	140	170 (158)	72	-
Wood	87	-	87	87	104 (104)	?	?

Note: The data of the products marked * are those of 1973 ∿ 1978.

III.2.2 Results of Freight Operation on the Southern Railway

The magnitude of freight operation on the Southern Railway of the Chilean State Railways in 1980 is as itemized in Table III.2.4.

According to the results of the freight operation in the year, the tonnage transported was 4,700,000, the ton-kilometers were, 1,200 million, and the income was 1,900 millions of pesos.

The flow of the loads is divided into two types. One is the both-direction movement between port zones and interior of the country. The other is the flow mainly by commodities to and from major factories. Both flows fit fairly large volume fixed pattern transport.

The main commodities transported to the port zones are wood, pulp, copper, etc., whilst those going to the interior of the country are barley, wheat, maize, marine container cargoes, etc. The commodities transported to the industrial centers consist of the materials for paper pulp, wood chips, pulp, irons and steels, oil, coal, cement, fertilizer, etc., which accounted for 75% of the total. When the trend of traffic during the 7 years between the years 1973 and 1980 is observed it is noted that there was a decline of 12% in the tonnage, a decline of 25% in the tonne-kilometers and a 16% drop in income. (Table III.2.5)

With regard to the tonnage, the 70% share for agricultural and mining products in 1973 was reduced to 50% in 1980, resulting in a reduction of 30% against 1973. Therefore, total traffic decreased by 12% in spite of the increase in the transportation of forestry products.

With regard to the ton-kilometers, there was a reduction of 25% on account of the reduction in the mean transportation distance and tonnage transported. This was due to the increase in short-distance loads and the reduction in the long-distance loads, as can be seen in Table III.2.6. The income decreased by 16% due to the decline in the ton-kilometers by 25% in spite of the 13% increase in the tariff rates.

Table III.2.4 Freight Traffic on the Southern Railway

(Year: 1980)

Freight working kilometers (km)		4,829
Freight train kilometers (km)		2,881
Number of freight handling stations		305
Number of freight cars	Box cars	2,394
	Cage cars	438
	Gondola cars	1,070
	Flat cars	1,295
	Hopper cars	994
	Tank cars	211
	Refriperator cars	56
	Others	891
	Total	7,349
Tonnage transported (1,000 tons)		4,679
Ton-kilometers (millions of ton-kilometers)		1,150
Income (millions of pesos)		1,856

With regard to the ton-kilometers, there was a reduction of 25% on account of the reduction in the mean transportation distance and tonnage transported. This was due to the increase in short-distance loads and the reduction in the long-distance loads, as can be seen in Table III.2.6. The income decreased by 16% due to the decline in the ton-kilometers by 25% in spite of the 13% increase in the tariff rates.

The increase in the tariff rates were substantially below the growth in the consumer price index (by 4.3 times) on account of the severe competition with the other means of transportation.

Table III.2.5 Results of Freight Operation on the Southern Railway

Item \ Year	1973	1980	'80/'73
Tons transported (1,000 tons)	5,311	4,679	88
Ton-kms. transported (1 million ton-kms.)	1,537	1,150	75
Tariff (1 million pesos)	2,198	1,856	84
Average mileage (km)	289	245	85
Rate per ton-km (peso) (CPI at December, 1978 = 100)	1,430 (0.3715)	1,614 (161.26)	113 (434)

Table III.2.6 Evoluation of the Transport Volume by Product on the Southern Railway

Product \ Year	1973 (1,000 tons)	1980 (1,000 tons)	'80/73 (1,000 tons)	Average transport distance (1980) (km)
Agricultural	1,329	883	66	231
Forestal	755	1,648	218	159
Livestock	118	58	49	773
Marine	83	49	59	109
Foodstuff	456	163	36	236
Manufactured products	282	284	100	235
Mineral	2,170	1,595	73	333
Total	5,194	4,679	90	245

III.2.3 Problems in Southern Railway Freight Operation

The general aspect of freight operation on the Southern Railway has been so far described. However, the problems lie principally in how to resist the advance of the truck, and put the emphasis of freight service on the areas, such as large volume fixed pattern transport, where the inherent characteristics of the railway can be displayed, in order to secure income and promote sales activities.

Concerning these points, the following can be mentioned as problems in the freight operation on the South Line of the Chilean State Railways:

(1) Reduction of sales capacity on account of the strict rationalization measures (reduction of the work force and the sales organization, reduction of the facilities for performance of market surveys)

(2) Deficiency in the transportation service to meet the needs of the consignors, who want stable railway transportation through provision of suitable freight cars for competition with trucks, and establishment of train timetables which have high reliability.

When the results of investigations by questionnare made by this Mission are summarized, the points which must be specially mentioned for the solution of these problems are that although the consignors use the railway for bulk loads transport of long distances with low tariff rates, they do not select trains because of the transportation time delays, the lack of precision concerning the date of arrival, the impossibility of door-to-door service and the lack of security (Table III.2.7).

Table III.2.7 Reasons for Selecting the Means of Transportation (28 replies received from the 55 consignor's consulted)

(Number of replies)

Transportation means / Reason for the choice	Southern Railway	Truck	Ship
Transportation time	2	17	1
Punctuality	2	17	1
Movement flexibility	2	21	
Transportation distance	16	7	3
Transportation cost (Rates)	21	11	5
Packing		6	
Safety	4	13	
Transportation volume	20	3	5
Others	2	8	1

For the railway to be able to survive as a means of transportation which is preferred by consignors, it is necessary that these points be taken into account and attention be paid to promotion of the following measures:

1) Bulk and fixed pattern transportation between major key stations

2) Integrated through transportation incorporating the advantages of the railway and truck

III.3 PRECONDITIONS FOR DETERMINATION OF THE COMMERCIAL POLICY MEASURES

III.3.1 Preparation of the Organization for the Market Survey

At the present time the Chilean State Railways does not have a department which performs surveys of the market, and the Freight Section deals with the task when the need arises.

(1) Need for the market survey

The market survey should become the basis for all measures, and it is indispensable for drawing up commercial and transport plans of the Chilean State Railways. Consequently, it is important to set up a system which can provide at any time the internal basic statistical data. At the same time, continuous and close contact should be made with the other means of transportation and official bodies concerned, so that informative data may be available upon the need.

(2) Collection of materials for the survey

(a) Collection of the internal basic data of the Chilean State Railways

(b) Collection of indices related to the economy

a) Population (Distribution, composition by age, etc.)

b) Labor statistics (Working population, composition by age, etc.)

c) Statistics concerning the income of inhabitants

d) Statistics concerning wholesale prices and consumer prices

e) Statistics of mining production (Production, shipments and stocks according to industries, including data by zones)

f) Statistics on the exportation and importation of the main products

g) National plan for socioeconomic development

h) Investigation of the trend in the production of the various companies related to the railways

(c) Investigation of the trend in the various means of transportation

a) Investigation of the level of the services (number of trucks, number of ships, ratio of paved roads, transportation times, tariffs, etc.)

b) Comparative investigation of the traffic volume (Main commodities according to zones, etc.)

c) Comparative investigation of the consumption of energy

(d) Grasping of the needs of consignors

Investigation by questionnaire (see the reference) and direct grasping of the needs of the users through organizations of the railway consignors

(3) Establishment of the organization for investigation of the market

It is necessary for the time being to establish an organization which can arrange the above-stated data in organic form, adequately grasp the present situation, and can reflect it into the commercial policies.

(Reference) Survey by questionnaire

Concerning the investigations by questinnaire, explanation is made of the method adopted by this Mission in July 1982.

1) Objective of the investigations

The investigations performed had the purpose of grasping the present situation of use of the railway in the market, the reasons for selection of the various means of transportation, the opinions of users concerning railway tariffs, concerning improvement of the freight operation

system, transportation equipment, and the installations for handling freight, opinions concerning the sales activities of the Chilean State Railways, etc., so that they can be reflected in the future commercial policy measures for freight operation.

2) Method of the investigations

The investigations were performed with the cooperation of the personnel in charge of freight operation of the Southern Railway. Questionnaires were distributed to the selected major consignors.

3) Contents of the investigations

a) Present situation of the use of the railway

b) Motives for selection of the various means of transportation

c) Opinions of users concerning the railway tariffs

d) Opinions of consignors concerning the increase of tariff rates

e) Opinions for improvement of the procedures for the dispatching of loads by railway and improvement of other systems of the commercial operations

f) Opinions concerning the use of industrial siding

g) Opinions concerning the railway cars, the cars for private use and the containers for private use

h) Opinions for improvement of the installations for handling the freight

i) Opinions concerning the sales activities of the railway

j) Opinions concerning the method of paying the freight tariffs

k) Other opinions and suggestions concerning the transportation of freight by railways

4) Date of performance of the investigations:

July 30 to August 20, 1982

5) Parties to whom the investigation questionnaires were sent:

55 parties

6) Answers received to the questionnaires:

Of the 55 questionnaires sent to the consignors, 28 answers were received, representing 51% of the consignors consulted.

7) Form of the investigation by questionnaire

(See ATTACHEMENT 4)

III.3.2 Strengthening of the Sales System

III.3.2.1 Strict control of the income targets

At the present time the method for collecting the freight charges is divided into freight paid at the station of origin and freight payable at the destination, according to the procedure adopted by the consignors, the proportions being 50% for each case. The income belongs to the stations of origin when the charge is paid at the origin and belongs to the stations of destination when paid at the destination. Consequently, even when the load is induced by the station of origin, the income is computed at the station of destination when the freight is paid at the destination.

The problems under this system are the following:

1) It is difficult to make a correct evaluation of the freight collected at the station of origin.

2) It is difficult to plan and analyze the income according to the sending out volume of the freight.

In the case 1) above, if the income collected at the origing were paid at the destination, the sales efforts of the officials at the station of origin and the managerial sectos who collect the freight (approaching the consignors - performing the negotiations - signing the contract - arrangements for preparation of the cars, etc.) would not be evaluated at all, even when their efforts were considerably large. Therefore, the will of the clerks at the origin station to increase income would decline.

Consequently it is necessary to adopt a system which would permit provisional accounting as income of the station of origin, and open the way for evaluation with an objective criterion. (See reference of the system of income of the station of origin).

In case 2) it is considered that the present conditions are adequate because the income based on cost calculation is distributed to the stations of origin and destination in proportion to the route length. However, from the viewpoint of commercial policy, the income of the station of origin and the tonnage sent out do not correspond if the system of the origin-based income is not adopted, and it is difficult to make the analyses of the income of the previous year, and to raw up sales and income plans for the current and following years.

In view of the present difficulties, it is considered necessary to develop a system which will permit the precise determination of the expected income and the planned expenditure which is compatible with the income, by fixing income targets for each station, each line and each superintendent department or division, by standards based on the income of the station of origin, strict control of the income and an objective evaluation. (Table III.3.1)

(Reference) Conceptual scheme of the origin-based income system

PRESENT SYSTEM

	(Station A)	(Station B)
Payment at origin (Income at origin	100$. 10 ton)	(0$. 0 ton)
Payment at destination (Income at destination	500$. 0 ton)	(0$. 50 ton)
TOTAL	600$. 10 ton)	0$. 50 ton

SYSTEM OF ORIGIN-BASED INCOME

100$. 10 ton	500$. 50 ton

Under the present system, the result of Station A is 600$ and 10 ton. While for Station B, income is not rendered because payment is made at destination, staying in 0$. 50 ton.

If the system is changed to the origin-based one, the result for Station A would be 100$ and 10 ton, while for Station B it would be 500$ and 50 ton. In this case, the income at origin station and tonnage sent out correspond with each other.

Table III.3.1 Scheme of the System of Origin-based Income

(unit: Pesos)

Type of system		Income of origin		Income at destination (real income)	Total income
		Real income	Hypothetic income (paid at destination station)		
Actual	January	100	(500)	400	500
	February	500	-	200	700
	March	400	(100)	100	500
	Total	1,000	(600)	700	1,700
Modified	January	100	500	(400)	600
	February	500	-	(200)	500
	March	400	100	(100)	500
	Total	1,000	600	(700)	1,600
Modified		1,000		700	1,700

Matters which must be taken into consideration for adoption of the system of origin-based income.

a) After closure of the income in cash and the income of origin, it is necessary to perform the tasks of transfer of the income of the destination to the computation of the income of origin both in the stations and in the administrative departments.

b) When the checks are made of the income in cash and the income of origin, it is necessary to define the respective responsibilities of each department.

Income in cash: This will be controlled under the responsibility of the Accounting Department.