A result of calculation is shown in Table 2.4.5.

Table 2.4.5 The Number of Rolling Stock to be Acquired

	As of 1986	Necessary Number 2005-06	Overaged Number 2005-06	No. to be Acquired 2005-06
EL	29(BG)	414	0	385
DEL	568(BG)	396	243	71
SL	258(BG)	0	258	0
WAGON	34,200(BG)	67,600	12,400	45,800
(No. of Equivalent to Bogie)		(33,800)	(6,200)	(22,900)
Carriage	2,480(BG)	3,000	1,050	1,570

Source: JICA Study Team

2.4.2 Investment Target

The list of projects and cost estimation for the Master Plan by the year 2005-06 is shown in Table 2.4.6. Total investment costs for the Master Plan is estimated at Rs.76.7 billion out of which the investment for the major ground facilities is estimated at Rs.26.3 billion, and for the rolling stock at Rs.43.4 billion, and for minor projects and miscellaneous items at Rs.7.0 billion.

Further details are shown in Appendix 4.

Fig. 2.4.1 Automatic Block Signalling (Master Plan)

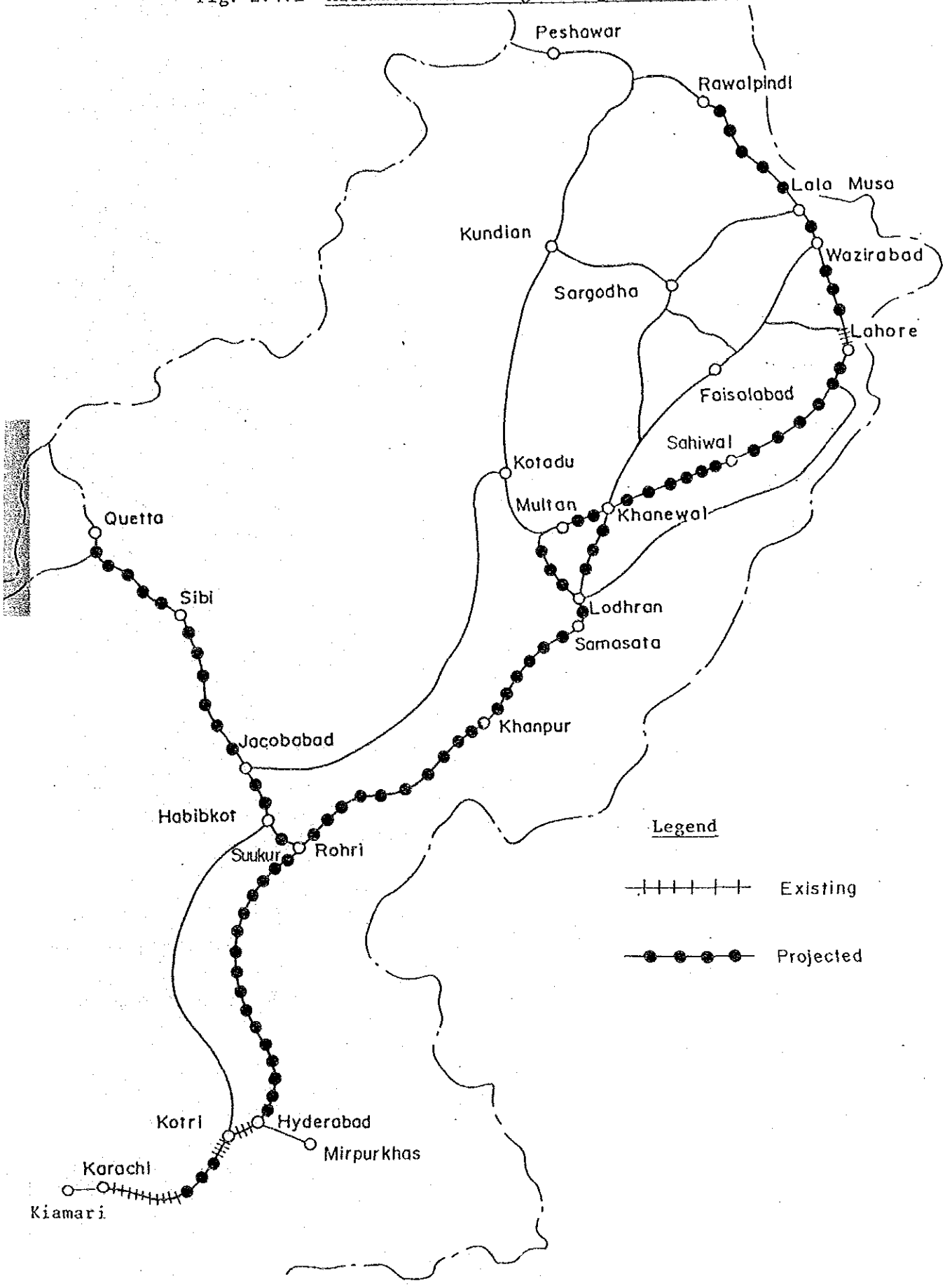


Fig. 2.4.2 Tokenless Block Signalling & Color Light Signal (Master Plan)

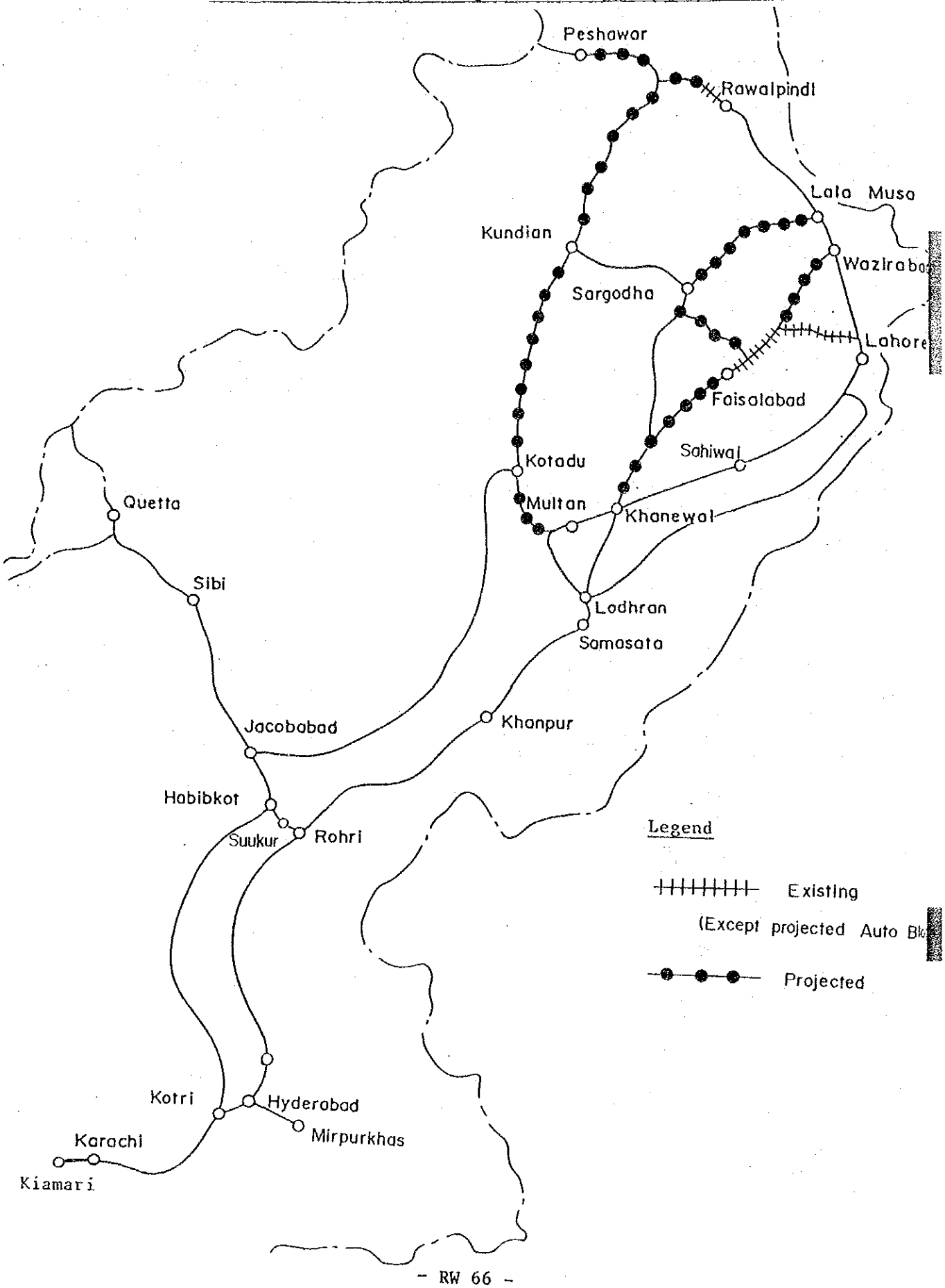


Fig. 2.4.3 Electronic/Relay Interlocking (Master Plan)

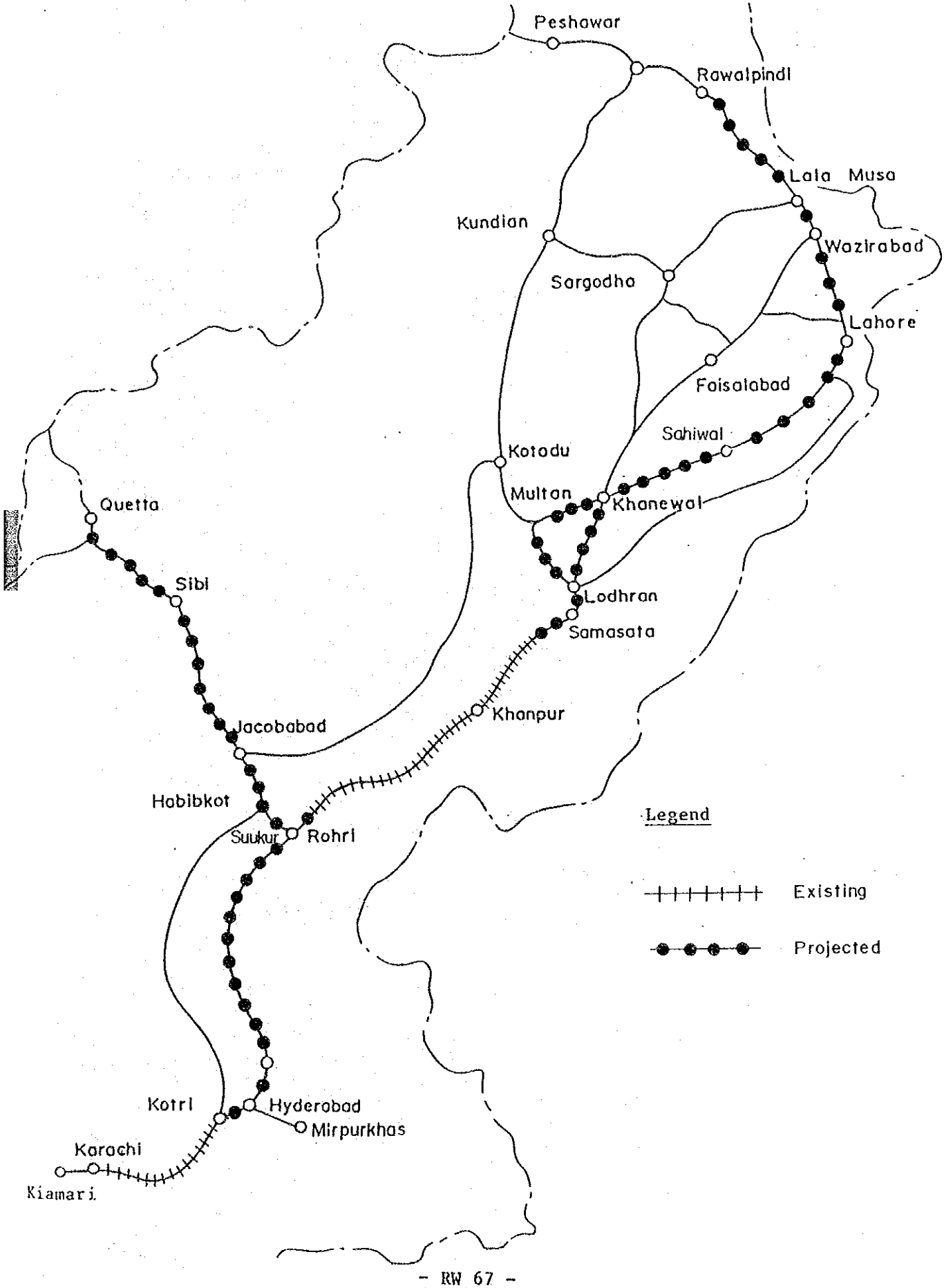


Fig. 2.4.4 Track Doubling (Master Plan)

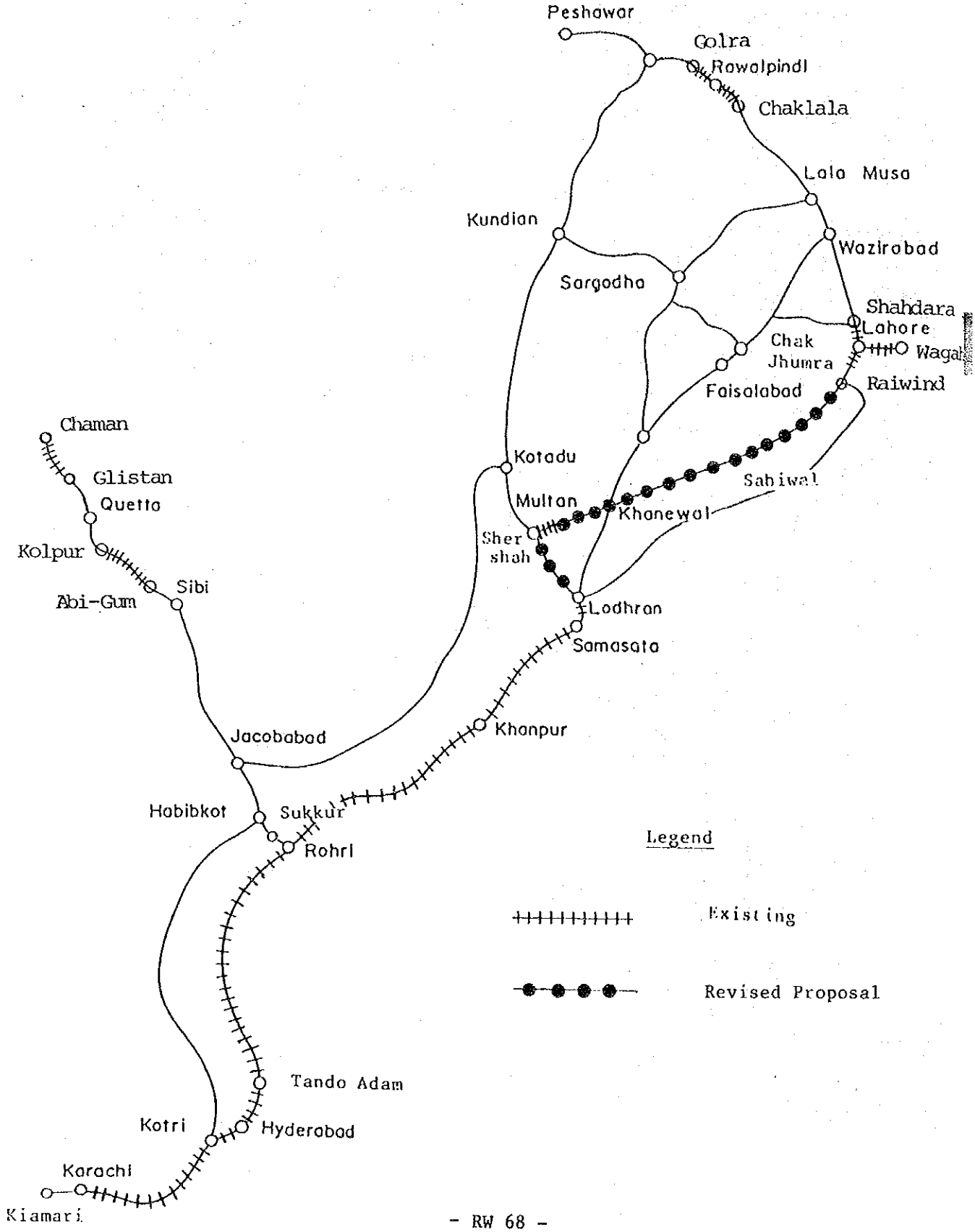


Fig. 2.4.5 Electrification (Master Plan)

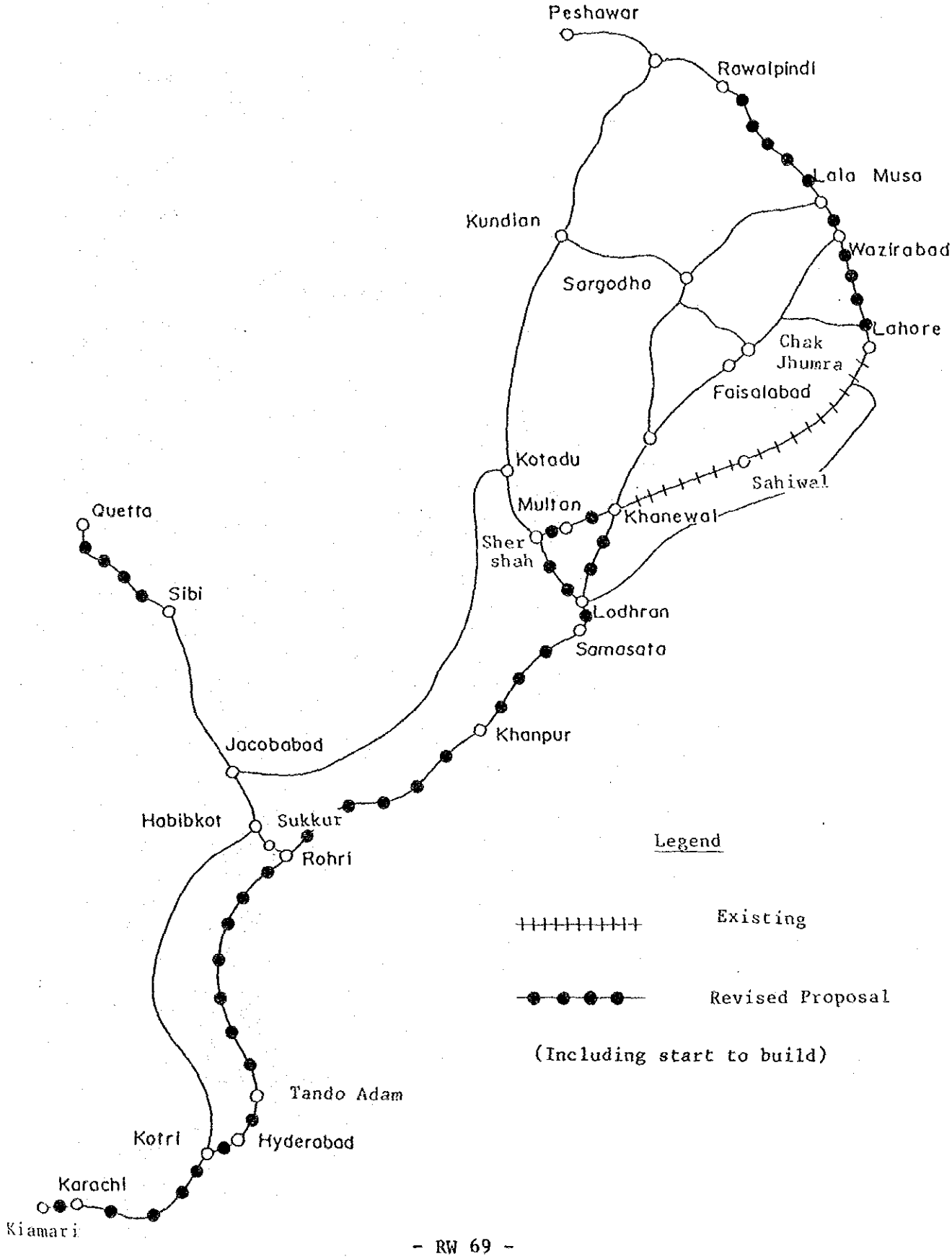


FIG. 2.4.6 Dry Port (Master Plan)

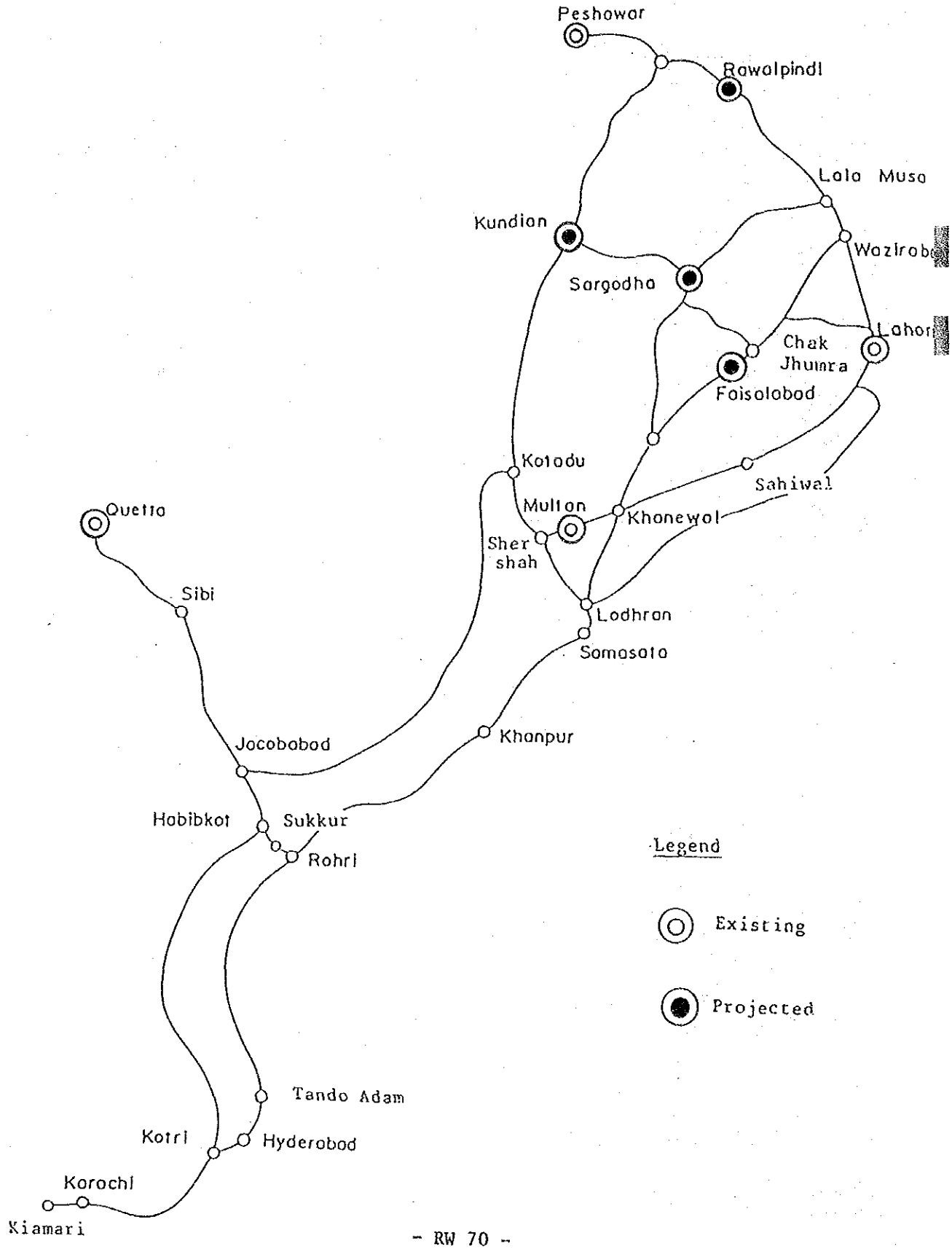


Fig. 2.4.7 Centralized Traffic Control System (Master Plan)

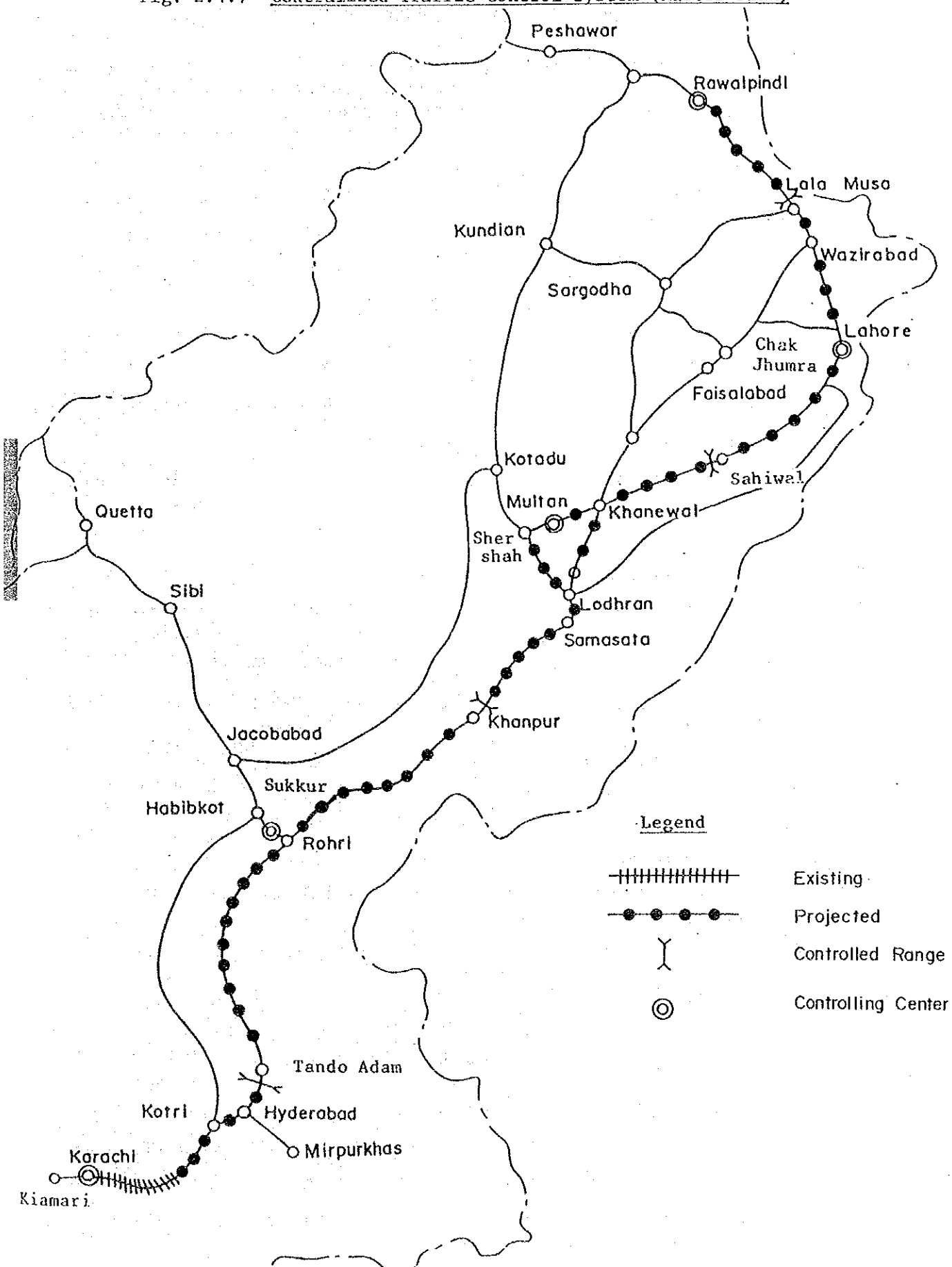


Table 2.4.6 Summary of Proposed Projects for Master Plan

No.	Projects	Estimated Cost (Rs. million)		Remarks
1.	Track Renewal	7,600		
	"Primary A Sections"		1,390	
	"Primary B Sections"		3,090	
	"Secondary Sections"		3,120	
2.	Track Doubling	2,130		
	Lohdran - Sher Shah		290	
	Multan - Khanewal		200	
	Khanewal- Raiwind		1,650 (670)	(Electrification)
3.	Automatic Block Signaling	1,010		
	Karachi - Rawalpindi		810	Excluding existing Section
	Rohri - Quetta		200	
4.	Electric/Relay Interlocking	1,550		
	Karachi - Rawalpindi		1,210	Excluding existing Section
	Rohri - Quetta		340	
5.	Tokenless Block Signalling and Color Light Signal	680		
	Khanewal - Faisalabad		110	
	Sanglahill - Wazilabad		70	
	Chakjhumra - Sargodha		60	
	Sargoda - Lalamusa		90	
	Attock City - Kundian		100	
	Kundian - Shershah		170	
	Taxila - Peshawar		80	
6.	Centeralized Traffic Control System	400		
7.	Information System & Communication Network	2,360		
	Seat Reservation System		400	
	Freight Information System		400	
	Communication Net Work		1,560	
	(Karachi - Rawalpindi)		1,560	

(Cont'd)

No.	Projects	Estimated Cost (Rs. million)		Remarks
8.	Electrification 1/	6,890		
	Sibi - Quetta		660	
	Samasata - Khanewal		1,110	
	Kiamari - Samasata		4,940	
	Lahore - Rawalpindi		180	(Partial Provision)
9.	Improvement of Freight Terminals	1,700		
10.	Improvement of Moghal-pura Workshop	500		
11.	Locomotive Factory	1,520		
12.	Purchase of Electric Locomotives	14,630		
13.	Purchase of Diesel Electric Locomotives	2,590		
14.	Re-condition Diesel Electric Locomotives	7,340		
15.	Replacement of Coaches	3,920		
16.	Purchase of Wagons	14,890		
17.	Misc. and Minor Projects 2/	6,970		
	Total	76,680		

Note 1/ The conditions for estimation of cost for electrification are:

1) Including installations needed for electrification such as overhead equipment, feeder equipment, power supply equipment, and bases for locomotives.
2) Excluding electric locomotives, signalling and telecommunication equipment and other minor items, which are contained in each item.
3) Excluding power transmission lines, which are to be installed by power suppliers.
4) Employing single transformer system at substation, not double system.
5) Including customs duties and other taxes.

2/ This item is considered as 10% of major projects.

Source: JICA Study Team

CHAPTER 3 THE SEVENTH FIVE YEAR PLAN (1988/89 - 1992/93)

3.1 Planning Targets for the 7th Five Year Plan

Railway transport in Pakistan is in a situation where Pakistan Railways had lost its monopolistic share in land transport and is facing stiff competition especially from road transport.

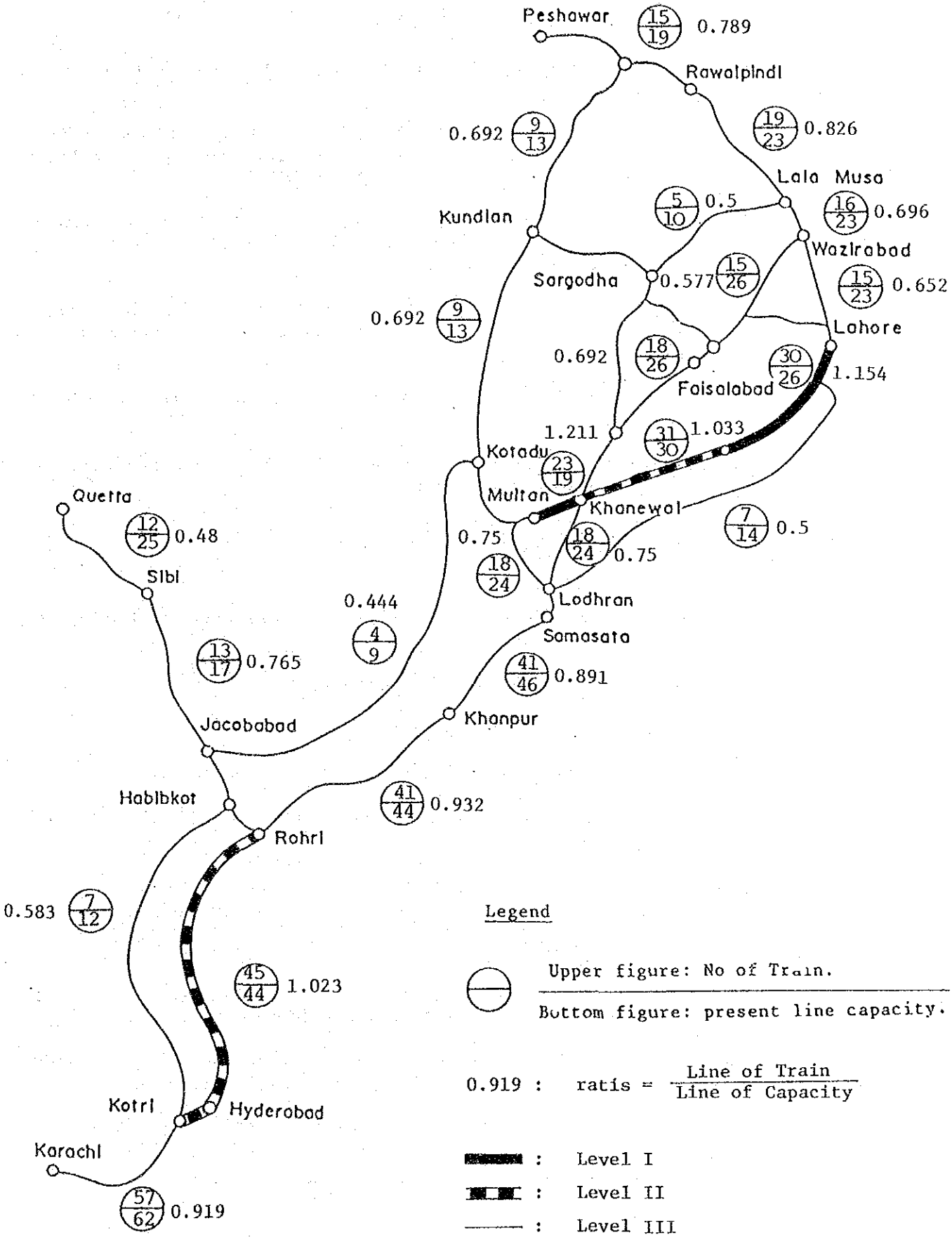
However, in accordance with the strategic traffic demand forecast based on the relative traffic costs, freight transport by railways is more beneficial than by road transport in longer distance traffic. Moreover the demand of long distance passengers by railway is also forecasted to increase in the future (See Section 2.1). That is, freight traffic in 1992/93 is forecasted at 12,294 million ton-kms and passenger traffic at 18,797 million passenger-kms. They are 1.48 times that of 1985/86 for freight and 1.19 times that for passenger. The estimated number of trains in the year 1992/93 is shown in Fig. 3.1.1. For example, the number of the trains, both passenger and freight, between Karachi and Lodhran is forecasted at 41 to 57 trains per day per way.

The capacity of the existing facilities has little room considering the result of the past maximum performance. But if the railways should not do anything about the present situation, they could not retain the traffic and even survive.

The Government is desirous of inducing long distance freight traffic to railway transport from the viewpoint of the national economy. On the other hand, the railways are expected to enhance not only the quantity but also the quality of services for customers (passengers and consignors) such as speed-up, frequency, on-time performance, train operation at convenient times, improvement of coach accommodations and provision of information to customers (e.g., seat reservation systems and freight information systems).

Keeping the above in view, the Five Year should be considered an integral part of the Master Plan, as a foothold for recovering the past traffic and for developing railway transport.

Fig.3.1.1 Total No. of Trains Required by the Year (1992-93)



Legend

Upper figure: No of Train.

Bottom figure: present line capacity.

0.919 : ratis = Line of Train / Line of Capacity

: Level I

: Level II

: Level III

3.2 Basic Elements for Selection of the Projects

3.2.1 Strategies for Selection of the Projects

For railway planning, the following items are considered as fundamental strategies.

1) For the enhancement of overall functions of the railway system, replacements for grade-up of the over-aged facilities in the trunk lines should be given priority.

2) Investments should be focused on the trunk routes, particularly the national corridor and east-west route, which are anticipated to show traffic increase.

3) Under the competitive situation with other transport modes, the provision of helpful information to customers is effective.

4) The utilization of the existing rolling stock should be improved.

5) To take advantage of Lahore Dry Port, liaison among railways, ports and shippers is important.

6) Electrification is useful from the view-point of reducing energy consumption.

In selecting projects for the Five Year Plan the following were considered:

1) Adoption of the fundamental strategies.

2) Completion of on-going projects.

3) Resolving bottle-necks in accordance with exigencies.

4) Harmony with the draft plans drawn up by the relevant organizations.

3.2.2 Priority for Selection of the Projects

(1) Ground Facilities

1) Track Doubling, Signalling and Electrification

These projects have the effect of increasing line capacity. Correlation among them can be described as follows.

There are two ways to increase the railway traffic capacity;

- to carry more volumes per train
- to increase the number of trains operated per day

As to the former, it is considered to operate long trains by higher powered locomotives or electric multiple-unit trains with traction dispersed among the cars.

In this case, it is necessary to improve the platforms and effective length of stations. However, it is not useful for high frequency service and operation of trains during customers' preferred periods.

As to the letter, one method is to increase the number and length of passing tracks or loops. In this case, it does not take much time to construct them and does not cost much, so immediate effects on line capacity can be obtained. But it might induce reduction in service in some trains with detaining time.

Otherwise, the methods to lessen the period of exclusive track occupation are to improve block signalling systems and speed-up of train operation (sometimes including improvement of rolling stock, shape of lines and tracks, etc.). The method of substantial improvement of line capacity is to doube track.

On the other hand, degrees of criticalness in line capacity can be indicated by the ratio of traffic demand in the number of trains to line capacity. Calculated ratios for the year 1992-93 are shown in Fig. 3.1.1. Ratios more than 1.0 show critical sections in line capacity. The more the ratio, the more the criticalness in line capacity. So, priority levels can be given in accordance with ratios as follows:

$\text{Ratio} = \frac{\text{Traffic Demand in No. of Trains}}{\text{Line Capacity}}$	Priority Level
$1.1 \leqq R$	Level I
$1.0 \leqq R < 1.1$	Level II
$R < 1.0$	Level III

The following sections with higher investment priority can be seen in Fig. 3.1.1 from criticalness in line capacity.

Level I	1 Multan - Khanewal	(49 km)
	2 Sahiwal - Lahore	(166 km)
Level II	3 Khanewal - Sahiwal	(119 km)
	4 Kotri - Rohri	(307 km)
Level III	5 Other sections	

For other sections of Level III, priority can be given in the same way, which can be read in Fig. 3.1.1.

However, the following should be dept in mind for final decision.

a) For the existing double-tracked sections, if the capacity is not enough, automatic block signalling or electrification are effective.

b) For the existing electrified sections, if the capacity of the sections is not enough, track-doubling is effective.

c) For the sections to be electrified and or to be double-tracked, improvement of signalling systems will make the facilities more efficient from the viewpoint of the effectiveness of concentrated investment.

d) For the major trunk lines, where traffic volume has almost reached the full capacity, improvement of the signalling system is useful.

e) The merit of greater utilization of locomotives is an important element in deciding priority of investment. (starting the electrification project in the Seventh Five Year Plan in the section between Samasata and Khanewal is recommended mainly for utilization of EL and future traffic demand in 2005/06)

Rankings A, B and C are given in the lists of projects and cost estimations in Appendix 4. The meaning of each ranking is as follows:

A: to be completed in the Seventh Five Year Plan
B: to start construction in the Seventh Five Year Plan
C: to be postponed beyond the Seventh Five Year Plan

As to track doubling, signalling and electrification, the sections of Levels I & II are proposed as ranking A and some sections with the elements above-mentioned as ranking B.

2) Track Renewal

The sections of overaged tracks to be renewed by the year by 2005-06 are listed in Table 2.4.4. A classification of tracks such as primary A, primary B and secondary is defined as follows:

Classification of Track	Maximum Permissible Speed KM/h	Assessed Daily Tonnage Calculated as per U.I.C. Formula	Weight of Rail per Meter	Track Structure		
				Number of Sleepers per KM		Ballast Cushion (cm)
				On Straight	On Curve	
Primary A	Above 100	60000 & above.	60 kg	1640	1640	30 cm
		Below 60000.	50 kg	1640	1640	30 cm
Primary B	Above 80 and upto 100	60000 & above.	60 kg	1562	1562	25 cm
		28000 to 60000.	50 kg	1562	1562	25 cm
		Below 28000.	45 kg	1562	1562	25 cm
Secondary	Above 70 & Upto 80	28000 & above.	50 kg.	(N+4)	(N+5)	20 cm
		Below 28000.	45 kg. Less	(N+4)	(N+5)	20 cm
Tertiary	- omitted -					

The major sections for classification of track are as follows.

Classification of Track	Section
Primary A	Karachi - Lalamusa
Primary B	Lalamusa - Pershawar
	Khanewal - Faisalabad - Wazirabad
	Chakjhumra - Sargodha - Lalamusa
	Sanglahill - Shahdarabagh
	Shershah - Kundian - Daudkhel
	Rohri - Sibi

Priority of investment on track renewal can be given by classification of track grades generally. Moreover, density of the future numbers of trains per day is to be kept in view. Priority can be given in accordance with the density shown in Fig. 3.1.1.

For example, the following sections with density of more than 10 trains per way per day have higher priority.

1. Karachi - Lalamusa (1,482 km)
2. Lalamusa - Peshawar (330 km)
3. Khanewal - Faisalabad - Wazirabad (324 km)
4. Rohri - Sibi (244 km)

In the Seventh Year Plan, the sections of "primary A & B" and some "secondary" sections shown in Table 3.3.1 have been included in ranking A.

3) Computer Systems

Priority for investment on this item mostly depends on whether the railway has the intention to improve the service for its customers in view of the competition with other transport modes.

In the Seventh Five Year Plan, computer system projects are included in rank A.

4) Thrownforward Projects such as Locomotive Factory

Thrownforward Projects should be given higher priority in investment as rank A.

(2) Rolling Stock

Necessary number of rolling stock is nearly in proportion to future traffic demand.

Therefore, priority of investment on rolling stock depends on the future increase of traffic demand.

For the actual numbers of rolling stock to be acquired newly, the over-aged numbers of rolling stock are to be kept in view. Distribution of locomotives by age is shown below. Method of estimation of the number of rolling stock can be seen in Section 2.4.1.6 and Appendix 3. In the Seventh Five Year Plan, the calculated number of rolling stock in such a way is proposed as rank A.

Distribution of Locomotives by Age

December, 1986

Age	Electric	Diesel	Steam
			Broad guage
1	2	3	-
1-5	-	74	-
6-10	-	97	-
11-15	29	94	-
16-20	-	63	-
21-25	-	21	-
26-30	-	154	-
31-35	-	5	-
36-40	-	-	-
41-45	-	-	63
46-50	-	-	-
51-55	-	-	-
56-60	-	-	5
61-65	-	-	25
66-70	-	-	77
71-75	-	-	73
76-80	-	-	9
81-85	-	-	6
Total:	29	508 1/	258

Note 1/: As of 1987, the total number is 568 with additional 60 DELs acquired newly.

3.3 Proposed Projects

3.3.1 Proposed Projects for the 7th Five Year Plan

As the result of consideration in 3.1 and 3.2, it is desirable to place emphasis on the following projects in the 7th Five Year Plan.

1) Improvement of the train-operation systems in the trunk lines
2) Expansion of container transport
3) Expansion of highspeed freight trains
4) Expansion of highspeed passenger trains
5) Provision of information for customers
6) Improvement of basic transport facilities

(1) Improvement of the Train-Operation Systems

Improvement of signalling systems between Karachi and Lahore should advanced. The overall projects are so numerous that the following ideas may be practical.

Even though the section between Karachi and Lodhran has the highest density in the railways, only 9% of the section has automatic block signalling. In the 7th Five Year Plan, it is desirable to complete the following sections (Fig. 3.3.1).

Automatic block signalling:	Pipri	- Meting
	Hyderabad	- Rohri

The sections where track doubling or electrification are projected should also be completed to take advantage of the greater effect of concentrated modernization.

Automatic block signalling:	Multan	- Khanewal
	Sahiwal	- Lahore

In the same way, electronic or relay interlocking systems are recommended for the following sections (Fig. 3.3.2).

Electronic/Relay Interlocking :	Padidan	- Hingoro Road
	Multan	- Khanewal
	Sahiwal	- Raiwind

(2) Expansion of Container Transport

In general, current intermodal systems relevant to railways are:

1) Moving highway goods transport vehicles on railway wagons commonly described as piggyback or trailer-on-flat-car;

2) Moving International Standards Organization (I.S.O) containers on railway wagons -- commonly referred to as container on flat car;

3) Moving non-standard domestic containers on railway.

Pakistan Railways has already introduced the international movement of I.S.O. Containers between the port of Karachi and the Lahore Dry Port. The construction of Lahore Dry Port is virtually complete.

Containerization appeared as a means to speed-up the movement and to reduce the costs of transport. This enables the railway to compete with the highway carriers in providing door-to-door transportation.

The present situation from Karachi to Lahore Dry Port is as follows:

- o Average two trains per week per way.
- o Average 33 bogie wagons per train (Equivalent to 66 four-wheeled wagons)
- o Approximately 32 hrs running time from Karachi to LDP
- o Approximately 200 wagons to handle I.S.O. 20-ft and 40-ft containers.
- o Bill of landings can be issued at the LDP from October 1987.

Pakistan Railways would have to make a serious attempt to make the import and export shippers use railway containers. There could be a demand for empty containers to move export rice and cotton to Karachi from the areas around Multan/Khanewal.

Keeping the advantage of containerization in view, the following methods are recommended:

- o Average 1.5 trains per day per way
- o Improvement of the average speed of train operation
- o Improvement of freight terminals at Multan and Khanewal
- o These container trains should not be allowed to be yarded.

(3) Expansion of High-speed Freight Trains

By the year 1992-93 most of the freight traffic volume is expected to be carried by high-speed freight trains.

From July 1987, Pakistan Railways commenced operating trains at the maximum speed of 90 km/h with the hauling capacity of 2,000 ton per train, which travel in 30 hours between Karachi and Lahore.

In the 7th Five Year Plan, expansion of the operation along the following sections, as well as, the number of high-speed trains is desired.

- o Karachi - Lahore - Peshawar
- o Karachi - Khanewal - Faisalabad - Sargodha
- o Rohri - Sibi

(4) Expansion of High-speed Passenger Trains and Improvement of Their Accommodations

From August 1987, Pakistan Railways commenced operation of passenger trains at the maximum speed of 120 km/h between Karachi and Lodhran. The trains make a round trip per day with running time of 15.5 hours per way, hauling 15 coaches. In the next Five Year Plan the following sections for operating high speed trains are desired.

- o Karachi - Lahore - Rawalpindi
- o Karachi - Khanewal - Faisalabad - Sargodha
- o Karachi - Habibkot - Sibi

An improvement in train accommodations is strongly desired such as more air-conditioned cars, including second class.

(5) Provision of Information to Customers

Under the competitive situation especially with road transport, improvement of the quality of service for customers (passengers and consigners) is essential. Some of the counter-measures for customers can be achieved by computer systems.

For instance, one is the introduction of seat reservation system and the other is freight information system (or wagon control system). Fortunately, telecommunication networks are being installed along the following sections (Fig. 3.3.3).

a) Rawalpindi - Lahore - Faisalabad - Khanewal - Lodhran
(both via loop and chord) - Sukkur - Karachi.

b) Wazirabad - Sangla Hill

c) Shershah - Jacobabad - Habibkot - Sukkur

d) Habibkot - Dadu - Kotri

The radio capacity is 960 channels for 7 GHZ Radio, and 36 channels for 1.5 GHZ Radio. Sections a) and b) mentioned above are being operated. Sections c) and d) are scheduled to be operated by December 1987.

By taking advantage of these telecommunication networks, seat reservation system and freight information system (or wagon control system) can function effectively. Freight information system is useful not only for customers but also for Pakistan Railways for effective utilization of wagons.

In order to reap the full benefits of these systems, extension of communication networks of SHF is proposed for the following sections:

a) From Khanewal to Lahore Via Sahiwal
b) From Rawalpindi to Peshawar.

(6) Improvements of Basic Facilities for Transport

Basic facilities must be improved in accordance with expansions of container transport, high-speed freight trains and high-speed passenger trains.

Considering speed-up of trains, improvement of utilization of rolling stock and overall improvement of facilities, the following projects should be implemented (Fig. 3.3.4 and Fig. 3.3.5).

- o Track Doubling : Multan - Khanewal
  : Sahiwal - Raiwind (Partial Provision)
- o Electrification: Samasata - Khanewal (Partial Provision)
- o Locomotive Factory: Risalpur
- o Track Renewal : Rail 2,680 km, Sleeper 2,430 km
  Detailed sections are shown in Table 3.3.1.

Table 3.3.1 Sections of Tracks to be Renewed by 1992-93

Primary "A" Section	LENGTH IN KM	
	RAIL	SLEEPER
Karachi - Tando Adam	103	103
Kiamari - Karachi City	-	8.07
Tando Adam - Khanpur	220	220
Khanpur - Sahiwal (cord & loop)	120	120
Sahiwal - Lalamusa	27	27
Moghalpura - Lahore Cantt	3.49	3.65
Total	473.49	481.72

Primary "B" Section	LENGTH IN KM	
	RAIL	SLEEPER
Rohri - Sibi (ROH-QTA)	59.83	147.46
Khanewal - Shorkot Cantt (KWL-WED)	-	46.66
Shar shah - Kundian (SSH-ATCY)	203.79	132.82
Chak Jumra - Shahinabad (CKJ-LLM)	138.40	143.70
Shorkot - Wazirabad (KWL-WZD)	246.61	259.45
Shahinabad - Sanglahill (KWL-WZD)	85.25	55.34
Lalamusa - Peshawar Cantt (KHI-PSc)	90.59	123.07
Lalamusa - Kundian (CKJ-LLM)	131.85	230.90
Shahinabad - Malakwal (CKJ-LLM)	92.51	16.66
Kundian - Attock City (SSH-ATCY)	165.97	88.24
Total	1214.8	1244.3

"Secondary" Sections	LENGTH IN KM	
	RAIL	SLEEPER
Kotri - Dadu (KOT-HBKJ)	65.44	16.09
Habib Kot - Dadu (KOT-HBKJ)	116.83	84.51
Jacobabad-Kashmore (JCD-KZLC)	119.86	89.02
Lodhran - Pakpattan (LON-KUS)	101.30	90.36
Shorekot Cantt - Qila Shei - Khupura (SKO-QSP)	54.0	50.0
Pakpattan - Kasur (LON-KUS)	135.42	86.23
Sibi - Quetta (ROH-QTA)	162.40	62.02
Shorkot - Shahinabad (SKO-SHND)	80.70	77.75
Shadara - Narowal (SDR-NWL)	70.15	66.73
Total	906.1	622.71

"Secondary" Section	LENGTH IN KM	
	RAIL	SLEEPER
Malik Colony - Malir Cantt	8.09	4.47
Karachi - Korangi	5.95	1.77
Hyderabad - Mirpur Khas	65.69	66.87
Daudkhel - Mari Indus	9.71	7.71
Total	89.44	80.82

o Rolling stock : As shown in Table 3.3.2. Unit Prices of EL and DEL are assumed at 37.4 and 36.4 in Rs. million respectively.

Table 3.3.2 The Number of Rolling Stocks Necessary & to be Acquired by the Year 1992-93

	Necessary Number	Number to be Acquired Newly
EL	42	13
DEL	605	42
SL	63	0
Wagon	40,200	7,300
(No. Equivalent to Bogie)	(20,100)	(3,650)
Carriage	2,260	110

Source: JICA Study Team

(7) Miscellaneous and Price Contingency

The following items are included in the miscellaneous items:

- o Plant and Machinery for Sheds
- o Depots and Workshops
- o Modernization of Freight Wagons for Higher Speed
- o Electrical Works
- o Research Institute
- o Bridge Renewal
- o Level Crossing Equipment
- o Extension of Loops or Sidings at Stations
- o Road Overbridge
- o Investment for Minor Branch Lines
- o Office Facilities
- o Others

The cost for the miscellaneous and price contingency is assumed as 10% of the total cost of the major projects.

3.3.2 Cost Estimation

The list of projects and cost estimation for the 7th Five Year Plan by the year 1992/93 is shown in Table 3.3.3.

Total investment cost for the 7th Five Year Plan is estimated at Rs.18.5 billion of which the investment for the major ground facilities is estimated at Rs.10.4 billion, that for the rolling stock at Rs.6.4 billion, and that for minor projects and miscellaneous at Rs.1.7 billion.

Further Details are shown in Appendix 4.

Fig. 3.3.1 Automatic Block Signalling (1992-93)

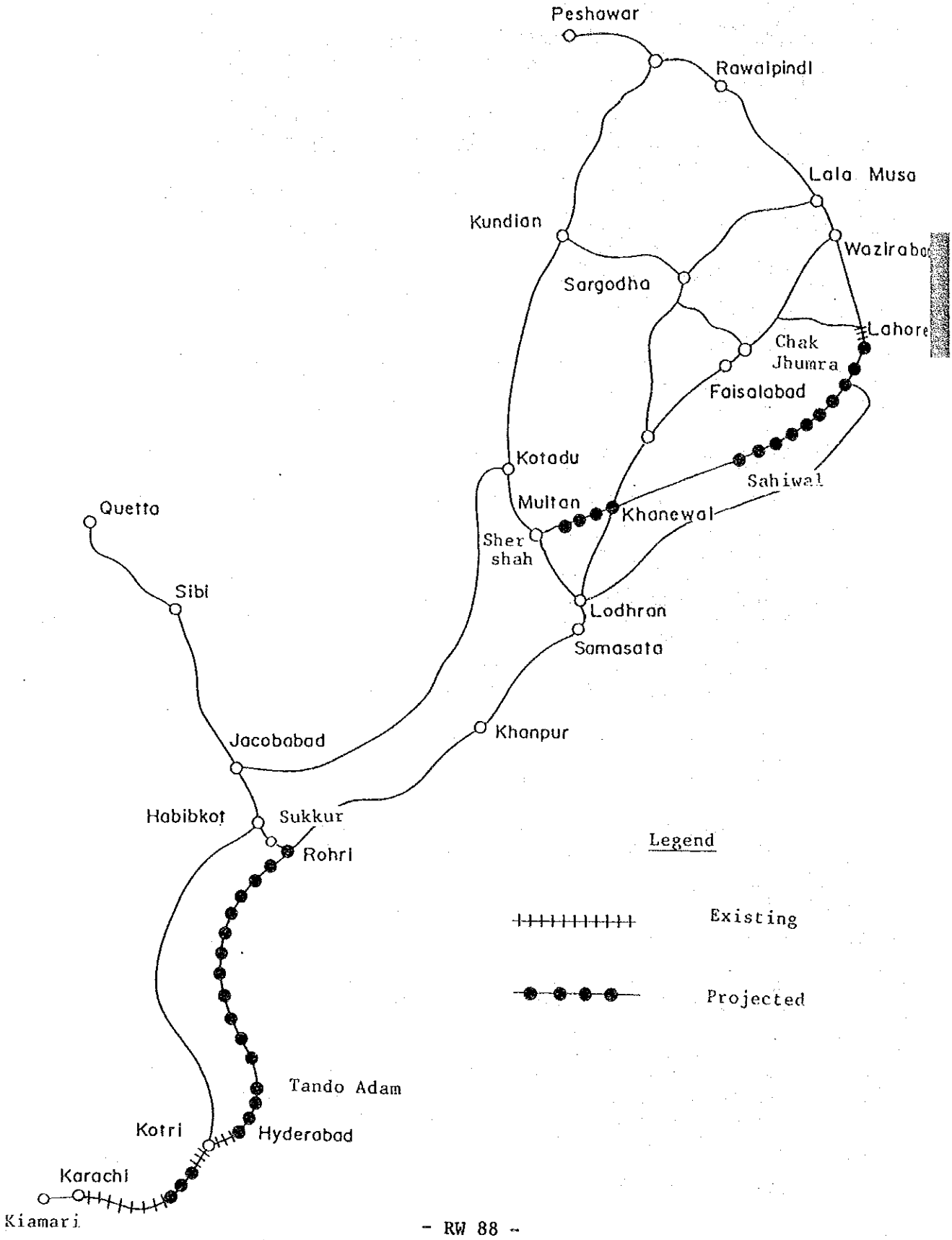


Fig. 3.3.2 Electronic/Relay Interlocking (1992-93)

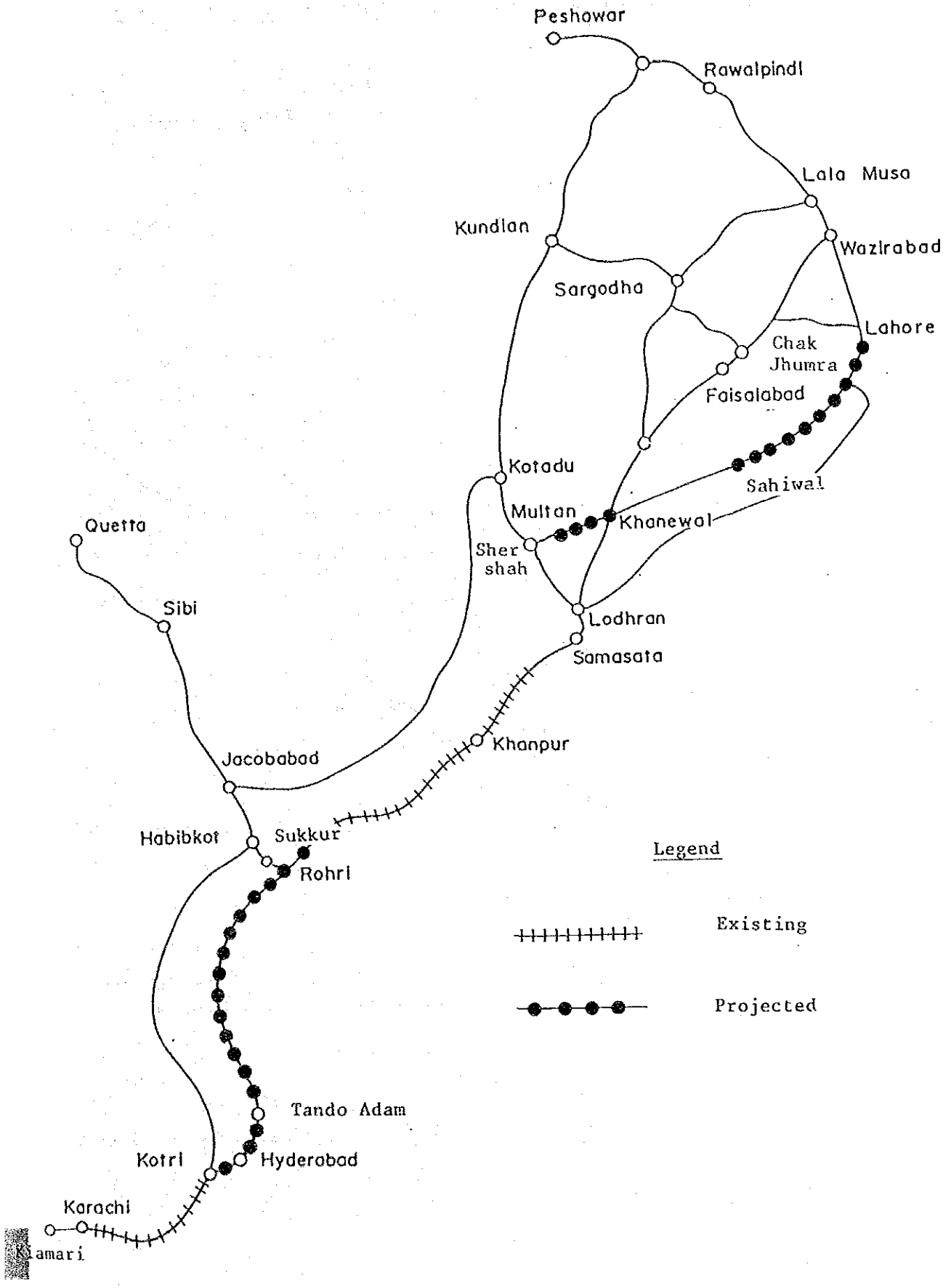


Fig.3.3.3 Communications Network & Company System (1992-93)

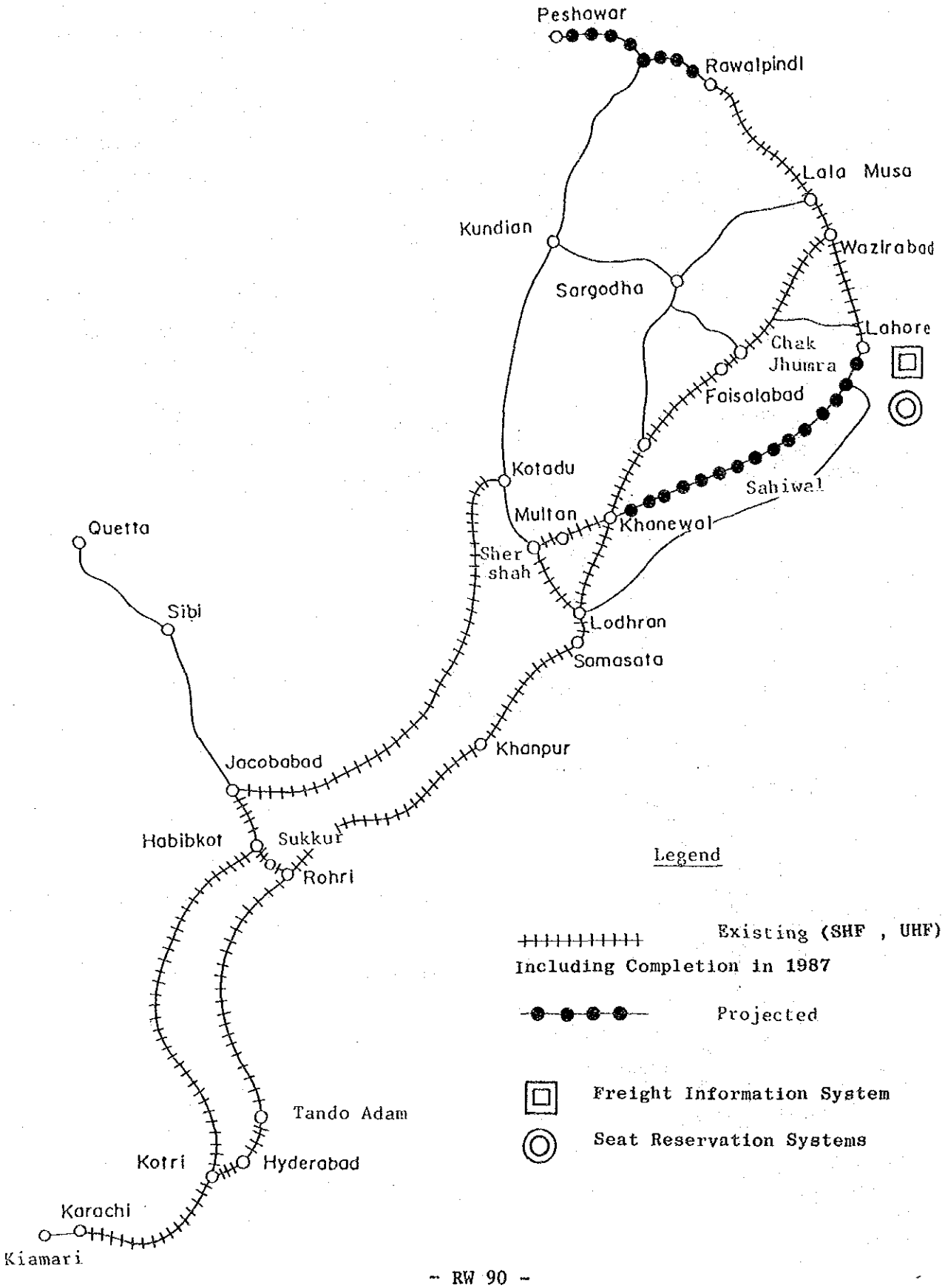


Fig. 3.3.4 Track Doubling (1992-93)

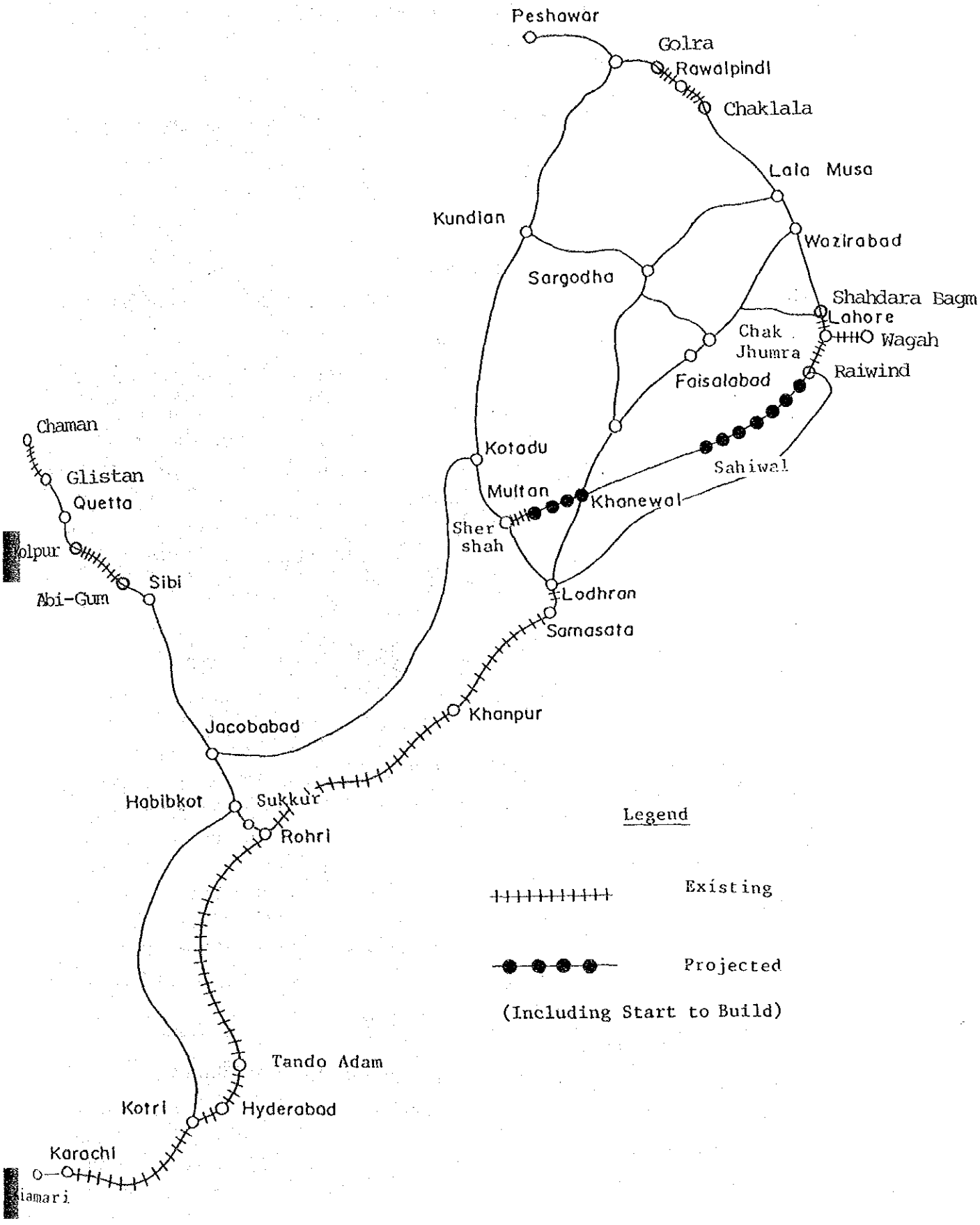


Fig. 3.3.5 Electrification (1992-93)

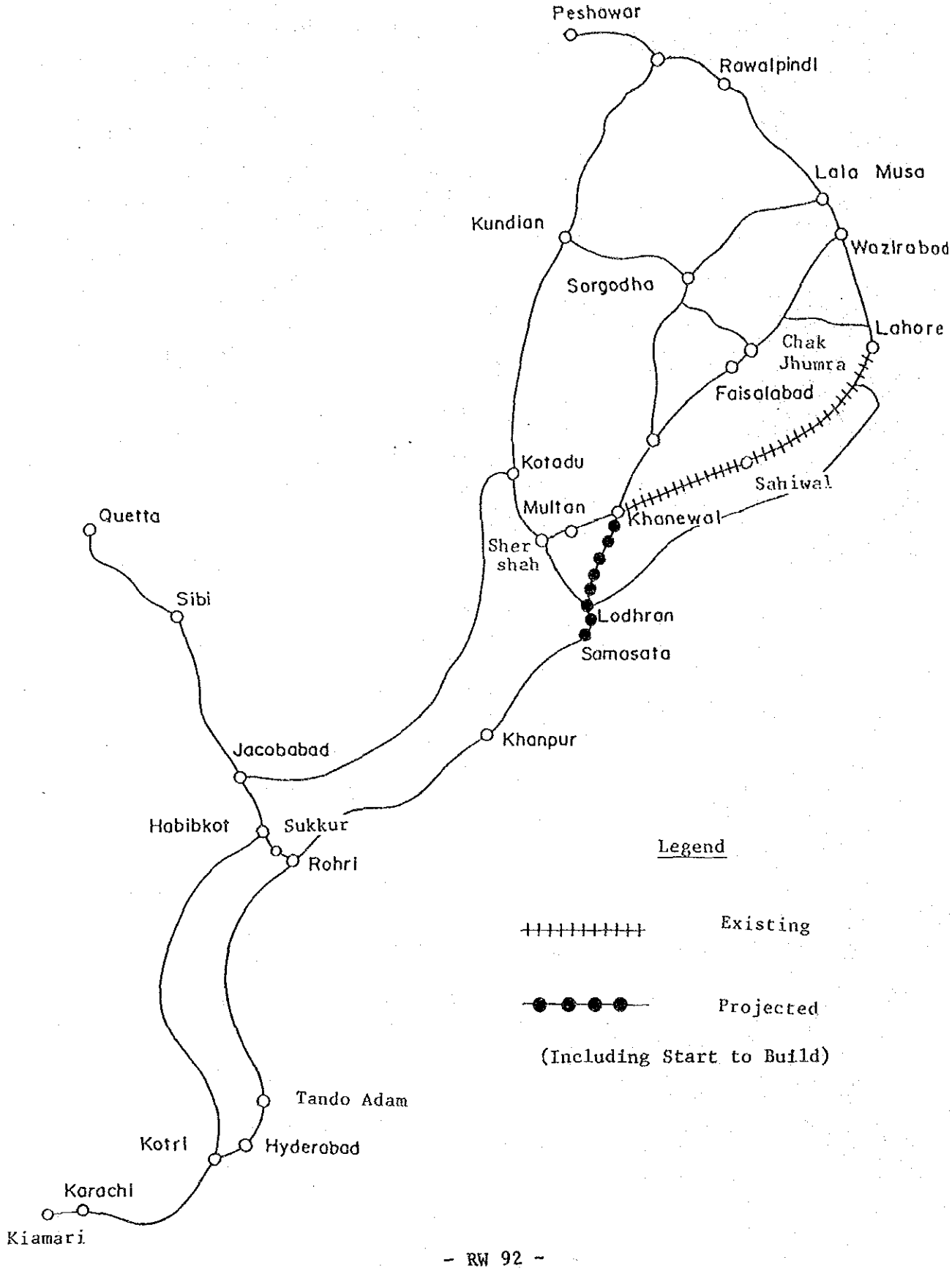


Table 3.3.3 Summary of Proposals for Seventh Five Year Plan

No.	Projects	Estimated Cost (Rs. million)		Remarks
1.	Track Renewal	6,570		
	"Primary A Sections"		1,390	
	"Primary B Sections"		3,090	
	"Secondary Sections"		2,090	
2.	Track Doubling	260		
	Multan - Khanewal		200	
	Khanewal - Raiwind		60	Partial provision
3.	Automatic Block Signalling	260		
	Karachi - Rawalpindi		260	Exclude existing Section
4.	Electric/Relay Interlocking	440		
	Karachi - Rawalpindi		440	Exclude existing
5.	Tokenless Block Signalling & Color Light Signal	120		
	Khanewal - Faisalabad		50	
	Chakjhumra - Sargodha		30	
	Taxila - Peshawar		40	
6.	Information System & Communication Network	1,100		
	Seat Reservation System		400	
	Freight Information System		400	
	Communication Network (Karachi - Rawalpindi)		300	
7.	Electrification	90		
	Samasata - Khanewal		90	Partial provision
8.	Locomotive Factory	1,520		
9.	Purchase of Electric Locomotives	490		
10.	Purchase of Diesel Electric Locomotives	1,530		
11.	Re-condition Diesel Electric Locomotives	1,750		
12.	Replacement of Coaches	280		
13.	Purchase of Wagon	2,370		
14.	Misc. and Minor Projects*	1,680		
	Total	18,460		

Note: * This item is considered as 10% of the total cost of other projects.
Source: JICA Study Team

3.4 Preliminary Evaluation

(1) Electrification

In the Master Plan the following sections are proposed for electrification. The status of the sections is as shown below.

- o Samasata - Khanewal (Chord & Loop)
- o Lahore - Rawalpindi
- o Kiamari - Samasata
- o Sibi - Quetta

1) Samasata - Khanewal (Chord & Loop)

These sections are 245 km long with a double-tracked section of 28 km, chord route of single track of 91 km and loop route of single track of 135 km.

The status of the traffic on these sections is as follows.

Table 3.4.1 The Status of the Traffic (Samasata - Khanewal)

(Unit: Average number of trains per way per day)

Section	Line Capacity	Resultant Traffic 1985-86			Estimated Traffic 1992-93			Estimated Traffic 2005-06		
		Pass.	Goods	Total	Pass.	Goods	Total	Pass.	Goods	Total
1. Samasata - Lodhran	44	22	12	34	24	14	38	31	31	62
2. Lodhran - Khanewal (Chord)	24	6	7	13	9	9	18	11	18	29
3. Lodhran - Multan	24	13	15	18	13	5	18	18	15	33
4. Multan - Khanewal	19	20	3	23	20	3	23	24	6	30

Source: JICA Study Team

The features on these sections are as follows:

(a) There is no tunnel section so the cost of repairs for tunnels is unnecessary.

(b) Being adjacent to the already - electrified section, the utilization of rolling stock is effective with the section to the Base Samasata electrified.

(c) Electrification of these sections has been investigated.

2) Lahore - Rawalpindi

These sections are 290 km long with a double-tracked section of 13 km and a single-tracked of 277 km. There is not so much traffic demand on these section as on the section between Karachi - Lahore. But they have relatively higher traffic demand in the Pakistan Railways.

Particularly the section between Lalamura and Chaklala has a steep gradient of 10/1000 and makes the best use of the line capacity as shown in Table 3.3.3. The status of the traffic on the sections is as follows.

Table 3.4.2 The Status of the Traffic (Lahore - Rawalpindi)

(Unit: Average number of trains per way per day)

Section	Line Capacity	Resultant Traffic 1985-86			Estimated Traffic 1992-93			Estimated Traffic 2005-06		
		Pass.	Goods	Total	Pass.	Goods	Total	Pass.	Goods	Total
1. Lalamusa - Mandra	23	11	4	15	13	6	19	15	12	27
2. Mandra - Chaklala	23	10	4	14	12	6	18	14	11	25
3. Chaklala - Rawalpindi	53	10	4	14	12	6	18	14	11	25

Source: JICA Study Team

The features on these sections are as follows:

(a) The sections include 5 tunnels of 0.65 km in total.

(b) They include steep gradient sections so that electrification is useful to increase line capacity.

3) Kiamari - Samasata

These sections are 815 km long with all the sections double-tracked. Even though they have the highest density in Pakistan Railways, the proportion of automatic block signalling system is only 25% in station. A block system with only one train permissible between two stations is adopted in most sections so that full advantage of track-doubling is not taken.

The status of the traffic on the section is as follows.

Table 3.4.3 The Status of the Traffic (Kiamari - Samasata)

(Unit: Average number of trains per way per day)

Section	Line Capacity	Resultant Traffic 1985-86			Estimated Traffic 1992-93			Estimated Traffic 2005-06		
		Pass.	Goods	Total	Pass.	Goods	Total	Pass.	Goods	Total
1. Karachi-Hyderabad	62	34	9	43	43	14	57	51	32	83
2. Hyderabad - Rohri	44	19	12	31	31	14	45	39	37	76
3. Rohri - Samasata	44	18	12	30	26	15	41	34	33	67

Source: JICA Study Team

The features on these sections are as follows:

(a) These are the highest density sections.

(b) There is no tunnel section so that the cost of repairs for tunnels is unnecessary.

(c) It seems that much time will be taken to provide the sections with necessary electrical power.

4) Sibi - Quetta

These sections are 141 km long with the section between Abigum and Kolpur (38 km) double-tracked and the rest (103 km) single. They have 20 tunnels which are 3.6 km long in total. The double-tracked section between Abigum and Kolpur has the most steepest gradient of 1/25.

Due to such a steep gradient, the following particular operations are conducted:

(a) The hauling capacity from Sibi to Kolpur (for upgrade) is limited to 500 tons due to the capacity of 500 tons from Abigum to Kolpur with 2 engines for reducing detaining time and easy shunting.

(b) In the same way, for down-grade, several empty wagons have to be coupled to ensure necessary brake force.

Example: Loaded wagons (7) + Empty Wagons (5) + Brake Van (1) = 13 in total (Loaded tonnage: 238 tons)

(c) Most freight trains are uncoupled or coupled at Abigum and Kolpur. Accordingly, additional time is required there.

(d) Speed of the trains from Sibi to Kolpur is 15 km/h on the average.

The status of the traffic on the section is as follows.

Table 3.4.4 The Status of the Traffic (Sibi - Quetta)

(Unit: Average number of trains per way per day)

Section	Line Capacity	Resultant Traffic 1985-86			Estimated Traffic 1992-93			Estimated Traffic 2005-06		
		Pass.	Goods	Total	Pass.	Goods	Total	Pass.	Goods	Total
Sibi - Quetta	25	6	4	10	6	6	12	7	27	34

Source: JICA Study Team

The features on these sections are as follows:

(a) The sections include 20 tunnels of 3.7 km in total length so that the cost of repairing them will be required.

(b) They include steep gradient sections so that electrification is useful to dissolve the bottlenecks.

If finance should be available, all the projects could be implemented at the same time. Keeping in view a certain frame of the 7th Five Year Plan as well as the utilization of rolling stock, power supply and the traffic demand in 2005/06, the section between Samasata and Khanewal should be electrified at first.

(2) Track Doubling

It is proposed in the 7th Five Year Plan to double the track at the section between Multan and Khanewal, and between Sahiwal and Raiwind. These sections are selected out of the those proposed for doubling in the Master Plan.

Number of trains in 1992-93 is expected to increase over the present number in accordance with the growth in future traffic volume based on demand forecast. If these sections are not doubled in the near future, decline in service level will become unavoidable.

Details of the effect of track doubling is described in the Interim Report. Summary is given below.

1) The transport capacity can be greatly increased.
2) The train speed can be greatly raised.
3) Flexible traffic service can be offered.
4) Restoration of normal traffic schedule from delay is easy.
5) Railway maintenance is easier.

Due to the doubling of these sections, main line of Pakistan Railways from Karachi to Lahore will be doubled by about 85% in length.

Also, supposing that the track is doubled between Lahore and Shershah, and Khanewal and Sahiwal, it will be possible to raise the transport capacity greatly on the main line between Karachi and Lahore.

(3) Signalling

The primary purpose of the signalling system is to secure safe operation of trains and the secondly to enhance the efficiency of train operations.

So in the sections where high speed operation or high density operation is to be seen, modernization of the signalling system is indispensable.

In case of double tracks with one block between two stations, the capacity of 2 tracks is only twice that of single ones. But in case of doubled tracks with multiple blocks between two stations, the capacity per track can be increased by about 1.5 times the single track.

An example of models is shown in Fig. 3.4.5 and Fig. 3.4.6.

In the upper figure, the section contains two trains per track between two stations and in the lower approximately three trains per track. 3 divided by 2 makes 1.5. The practical number of blocks between two stations depends on the length between two stations, the maximum operating speed, braking distance, etc.

As explained above, automatic block signalling is effective in high speed sections or high-density sections. The double-tracked non-automatic sections, the electrified non-automatic sections and the sections to be double-tracked or electrified in the 7th Five Year Plan are shown below.

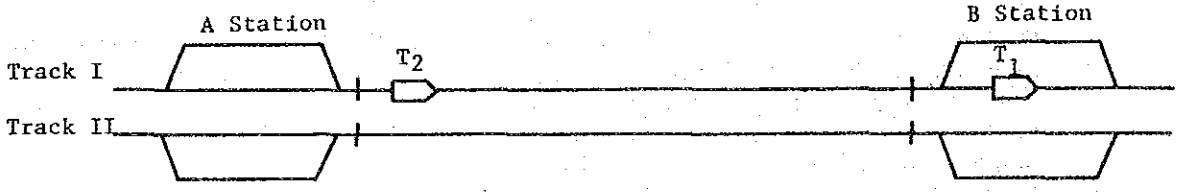


Fig. 3.4.1 Track Doubling with One Block between Two Stations

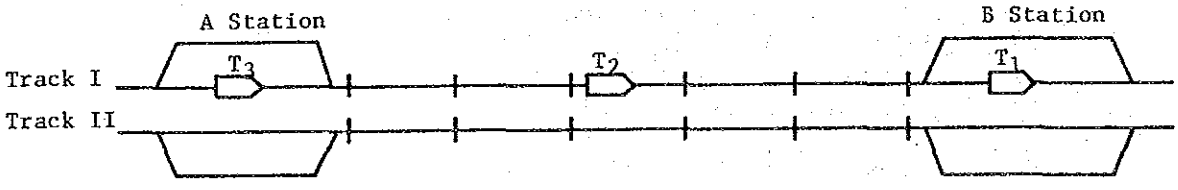


Fig. 3.4.2 Track Doubling with Five Blocks between Two Stations

Track Doubling	a)	Pipri	-	Meting
	b)	Hyderabad	-	Lodhran
	c)	Shershah	-	Multan
	d)	Multan	-	Khanewal (Proposed)
	e)	Sahiwal	-	Raiwind (Proposed)
	f)	Raiwind	-	Shahdara Bagh
	g)	Chaklala	-	Golra Sharif
	h)	Abigum	-	Kolpur
	i)	Gilista	-	Chaman
	j)	Lahore	-	Chaman
Electrification	a)	Khanewal	-	Lahore
	b)	Samasata	-	Khanewal (Proposed).

Out of them, in the following sections are given priority in terms of high density or concentrated investment.

a) Pipri - Meting
b) Hyderabad - Rohri
c) Multan - Khanewal
d) Sahiwal - Raiwind

3.5 Economic Evaluation

3.5.1 Methodology

In order to assess the economic viability of the proposed project, a preliminary benefit/cost analysis was prepared. The benefit attributable to the proposed projects can be calculated based on the assumption that if no investment is made in railway transport to cope with the increasing railway traffic demand, the increased demand has to be carried by other means of transport incurring additional cost to the mode. For the preliminary evaluation, road was selected as the alternative mode and the calculated benefits are:

a) Vehicle operation cost (VOC) on road additionally incurred by the increased railway traffic demand that would have to shift to road transport.

b) Additional road construction cost incurred by the increased railway traffic demand that would have to shift to road transport. The cost of the proposed projects was divided into the following categories:

- o Investment
  - Track Renewal
  - Signalling
  - D.E.L. Engine
  - E.L. Coach/Wagon
  - Electrification/Workshop/ Freight Terminal
  - Track Doubling
- o Maintenance and Repairs
- o Operating Cost

The economic benefit and cost calculated were formed into a year-by-year data stream using interpolation techniques based on the 1985-86, 1992-93 and 2005-06 calculated values. Then a benefit/cost ratio was calculated.

3.5.2 Benefits

(1) VOC Savings

The VOC savings were calculated as a difference in total VOC of the following two cases:

a) Traffic assignment of OD Tables of road traffic and increased railway traffic (converted to vehicles) on to the road network improved by the road projects proposed in the road planning section of this report.

b) Traffic assignment of usual road OD Tables on to the same road network as above.

In other words, the additional VOC incurred by the increased railway traffic on the improved "with network" was calculated as one of the possible benefits of the proposed railway projects.

(1992-93)		
Road + Railway	61,097	(Million Rs)
Road	53,498	(Million Rs)
Savings	7,599	(Million Rs)
(2005-06)		
Road + Railway	99,504	(Million Rs)
Road	64,352	(Million Rs)
Savings	35,152	(Million Rs)

(2) Savings in Road Construction Cost

This was calculated in a similar manner as VOC; the additional road construction cost incurred by the possible increase in road traffic if the increased railway traffic is shifted to road was taken as a saving. In the last year of evaluation, the residual values were subtracted from the construction cost since road construction has a project life of 20 years.

During the Seventh Five Year Plan Period this cost was calculated at Rs 8,537 million and for the remaining Master Plan period (1992-93/2005-06) at Rs 222 million in economic prices.

3.5.3 Cost

The cost of the proposed railway projects were estimated in financial prices as shown in Table 3.5.1.

The project life of each investment cost is as follows:

Track Renewal	20 Years
Signalling	20
D.E.L. Engine	18
E.L. Coach/Wagon	35
Electrification/Workshop/Freight Terminal	30
Track Doubling	60

The maintenance/repair cost and operating cost were estimated as a difference of "With" case and "Do-Nothing" case. The conversion factor from financial cost to economic cost is 0.8574 (same as the 1983 NTPS).

Table 3.5.1 Financial Cost Stream of Proposed Railway Projects

(million Rs.)

Year	Investment Cost										
	Track Renewal	Signalling	D.E.L Engine	E.L Coach/Wagon	Electrification/ Workshop/ Freight Terminal	Track Doubling	Total	Maint. and Repair	Operating Cost	Others	Total
1988-89	1,605	273	292	530	310	40	3,050	1,825	1,830	305	7,010
1989-90	1,165	324	803	644	310	52	3,298	1,875	1,841	330	7,344
1990-91	1,313	445	803	720	310	52	3,643	1,925	1,852	364	7,784
1991-92	1,093	435	803	720	310	52	3,413	1,975	1,863	341	7,592
1992-93	1,390	445	584	526	370	60	3,375	2,025	1,875	338	7,613
1993-94	519	313	511	2,330	743	88	4,504	2,075	1,912	407	8,898
1994-95	518	313	511	2,330	743	89	4,504	2,125	1,948	407	8,984
1995-96	0	313	511	2,330	743	89	3,986	2,175	1,984	407	8,552
1996-97	0	313	511	2,331	743	89	3,987	2,225	2,021	407	8,640
1997-98	0	313	511	2,331	743	89	3,987	2,275	2,057	407	8,726
1998-99	0	313	512	2,331	743	95	3,994	2,325	2,094	407	8,820
1999-00	0	313	512	2,331	743	95	3,994	2,375	2,130	407	8,906
2000-01	0	313	512	2,331	743	95	3,994	2,425	2,167	407	8,993
2001-02	0	313	512	2,331	743	95	3,994	2,475	2,203	407	9,079
2002-03	0	313	512	2,331	743	96	3,995	2,525	2,240	407	9,167
2003-04	0	314	512	2,331	743	96	3,996	2,575	2,276	407	9,254
2004-05	0	314	512	2,331	743	96	3,996	2,625	2,312	408	9,341
2005-06	0	314	512	2,331	743	96	3,996	2,675	2,349	408	9,428

Source: JICA Study Team

3.5.4 Benefit/Cost Analysis

Using the benefit and cost calculated above, a benefit/cost analysis was prepared. Firstly, the Master Plan up to the year 2005-06 was calculated as shown in Table 3.5.2.

Table 3.5.2 Economic Evaluation of Railway Projects upto 2005-06

(million Rs.)

Total Year	Discounted Benefit	Total Benefit	Discounted Cost	Cost
1988-89	3,227	2,297	6,010	4,278
1989-90	4,747	3,017	6,297	4,002
1990-91	6,266	3,556	6,674	3,787
1991-92	7,786	3,945	6,509	3,298
1992-93	9,306	4,210	6,527	2,953
1993-94	8,566	3,460	7,629	3,081
1994-95	9,635	3,474	7,703	2,778
1995-96	10,838	3,490	7,332	2,361
1996-97	12,191	3,505	7,408	2,130
1997-98	13,713	3,520	7,482	1,920
1998-99	15,426	3,535	7,562	1,733
1999-00	17,353	3,551	7,636	1,562
2000-01	19,520	3,566	7,711	1,409
2001-02	21,959	3,582	7,784	1,270
2002-03	24,703	3,598	7,860	1,145
2003-04	27,789	3,614	7,934	1,032
2004-05	31,262	3,630	8,009	930
2005-06	32,881	3,409	-32,341	-3,353
Total	277,168	62,956	91,728	36,315

B/C Ratio at a Discount Rate of 12 %/year: 1.78
Internal Rate of Return: 39.90 %/year

Source: JICA Study Team

The B/C ratio was calculated at 1.78 for the entire project package of the Master Plan. Due to the large benefit resulting from the VOC savings, the railway projects proposed here have been proved to be highly feasible economically.

Secondly, the project package proposed for the Seventh Five Year Plan period was evaluated independently as shown in Table 3.5.3.

Table 3.5.3 Economic Evaluation of Railway Projects upto 1992-93

(million Rs.)

Year	Total Benefit	Discounted Benefit	Total Cost	Discounted Cost
1988-89	3,227	2,297	6,010	4,278
1989-90	4,747	3,017	6,297	4,002
1990-91	6,266	3,556	6,674	3,787
1991-92	7,786	3,945	6,509	3,298
1992-93	1,626	735	-6,597	-2,984
Total	23,65113,549	18,894	12,381	

B/C Ratio at a Discount Rate of 12 %/year: 1.09
Internal Rate of Return: 22.71 %/year

Source: JICA Study Team

The benefit/cost ratio arrived at 1.09, and the internal rate of return at 22.71%.

3.5.5 Summary

Judging from the above results, the projects proposed for the Master Plan are considered to be very sound. Although the calculated benefit/cost ratio as well as the internal rate of return is not so high for the projects proposed for the Seventh FYP, this may be justified. This is because these projects are essential to achieve the Master Plan targets in which all the proposed projects show a high economic viabililty as the economic feasibility can be raised if more traffic is allocated to the railway as described in Chapter 4 and Chapter 6 of TRANSPORT DEMAND FORECAST, PART II.

The controversial point will be more on the financial aspects rather than the economic viability. Assuming that the current fare/freight rate remains unchanged, the investment necessasry for the proposed projects will totally depend on the subsidy from the Government or on foreign aids. This might be considered to be possible due to the high economic feasibililty. However, the management of railway operation must be further improved by PR's own effort prior to the proposed investment. These efforts include:

- Curtailment of cost by reducing the number of employees, by abolishing unnecessary branch lines, etc.

- Conduct of strategic marketing to absorb more long-distane transport demand.

- Improvement of the levels of service, for instance, issuance of TBL at dry ports.

- Restructuring the current fare/freight rate system.

The Government is also requested to assist PR to carry more goods generated by the public sector and to rationalize its fare and freight rate structure so that PR can compete with roads.

3.6 Policy Options

3.6.1 Unremunerative Local Lines

(1) If local residents strongly want to keep up the operation of unremunerative local lines as a public utility, one solution is to have the lines managed and operated by third sectors, with the support of both private and local government funds.

(2) If there are roads along with the unremunerative lines, transport by buses of private companies or third sectors is a method of ensuring public traffic and eliminating unremunerative local railway lines.

3.6.2 Tax, Rate and Fare

(1) Price and tax concessions not available to Railways should not be provided to competing modes of transport such as NLC.

(2) Railways should be exempted from payment of tax and duties particularly on sleepers manufactured at the railway factories and ballast as these put the railways in relatively disadvantageous position.

(3) A flexible policy for rates and fares should be followed whereby freight rates could be varied not only according to type of commodity but according to direction. Where railway wagons run empty, rates can be reduced to attract traffic.

3.6.3 Privatization Versus Public Service

3-1 If it is not practical for the railway to be operated as a commercial enterprise and it has to function as a public utility organization, and accordingly, if it has no freedom and authority to close and open lines, charge rates and fares on commercial principles, hire and discharge staff according to requirement, accord priority to trains, and determine routes and stoppages, the Government should meet the deficits and provide reasonable funds for replacement, renewal of assets and future development.

Keeping in view the changed circumstances surrounding the railways, if the railways and the Government will choose their future course of privatization, "Restructuring of the Japanese National Railways" may be most practical and useful information for them. So, Restructuring of JNR is summarized as the following.

3-2 Restructuring of the Japanese National Railways - Process Leading to Privatization and Division -

(1) Financial Situation in the JNR Era

The Japanese National Railways (JNR) transported 19 million passengers and 0.19 million tons of freight per day in 1985, and although its share of the total national traffic volume had decreased considerably compared with earlier years, the JNR continued to play important roles in those fields where railways can utilize their inherent advantages.

However, operating revenue in 1985, about ¥3.55 trillion, was much less than operating expense of about ¥5.57 trillion. The substantial deficit before government grants-in-aid was about ¥2.4 trillion, which is actually a deficit of about ¥6.3 billion per day.

Repeated borrowings to make up for the deficits had accumulated to ¥23.561 trillion at the end of fiscal 1985. In the budget of that year, JNR incurred another debt of ¥2.6 trillion, but had to pay back ¥2.4 trillion for past borrowings and interest, a situation from which it was not possible to recover.

If this had been ignored for the next two or three years, JNR would lack the ability to repay not only the interest but also the principal, and ultimately its train operation and other activities would be seriously hindered.

(2) Basic Policies Concerning JNR Restructuring

The Ad Hoc Commission on Administrative Reform was established by the Prime Minister in March 1981, and in July 1982 it submitted its "Third Report on Administrative Reform." This report made recommendations for the restructuring of JNR by privatization and division so as to restore the railway finances which had been going through this critical phase. The JNR Reform Commission was then set up as an investigative body in 1983. After deliberating for more than two years, the Commission submitted its "Opinions on the Restructuring of JNR - For the Development of the Railways's Future".

These Opinions pointed out that the basic causes for the deterioration of JNR's finances were the public corporation system itself and JNR operation as a centralized nationwide business, and that a thorough restructuring by its privatization and division was the only cure.

The Opinions identified four problems of the public corporation system:

1) The system is constituted so that it can not escape outside interference, because the government is heavily involved with it.

2) Because of the lack of management independence, its management responsibilities are not clear.

3) Labor-management relations become abnormal.

4) Because of limitations on the scope of business, it is difficult to carry out varied and dynamic business activities.

Problems of centralized nationwide business operation stated in the Opinions were the following four points:

1) The enormous size of the organization exceeds the limits of control and management of an enterprise.

2) Centralized nationwide operation makes it difficult to provide services that properly match the actual conditions of different regions.

3) Because of the unreasonable interdependent relations incurred among regions and among business sectors, an efficient and activated business operation is difficult to achieve.

4) There is no will to compete.

The 107th Extraordinary Session of the Diet passed eight bills related to JNR restructuring on November 28, 1986 in accordance with the Opinions. The basic idea was to restore sound finances by the drastic restructuring role as the central means of transportation in the future, as expected by the nation as a whole.

(3) Main Points of JNR Restructuring

The main points of JNR restructuring based on the Opinions can be summarized by the following three points.

1) Privatization and Division of JNR Business

The JNR has been restructured to eliminate its management dependence on the Government and to become several independent private companies with their own definite responsibilities. JNR was divided into six passenger railway companies, one freight railway company, a telecommunications company, an information systems company, a technical research institute (an incorporated foundation), and a Shinkansen property corporation. This was one done to enhance the effects of privatization and to provide transportation services accurately reflecting local characteristics and trends in demand.

2) Securing a Sound Financial Basis

Financial solvency is an essential condition for any enterprise. JNR restructuring included the following basic measures to establish a sound financial basis for the new enterprises.

a) JNR long-term liabilities to be taken on by the new companies have been limited to an extent that will not harm their solvency. In particular, the three passenger railway companies located in Hokkaido, Shikoku, and Kyushu, whose financial conditions are difficult, did not assume any of the burden of those liabilities. The remaining liabilities are to be disposed of by the JNR Accounts Settlement Corporation through the sale of land which is not now required for business purposes and the disposition of stock holdings; liabilities still remaining are to be borne by the people at large.

b) The total number of personnel for the new companies was set at 215,000. Measures for new employment for personnel who lose their jobs as a result have been taken with the support of the national government, local communities, and industry in general, and thus reemployment opportunities have been secured by the nation as a whole.

c) The JNR Accounts Settlement Corporation, which is responsible for remaining JNR affairs, has been assigned the responsibility for additional expenses for pensions, which have been a great burden for JNR management. Through this measure, the new companies will only be responsible for their own appropriate contributions.

d) Three passenger railway companies located in Hokkaido, Shikoku, and Kyushu will suffer operating deficits even after these measures are taken. Therefore, Financial Stabilization Funds amounting to a total of ¥1.3 trillion were to be established to pay these losses with the gains from the fund operation.

3) Enlargement of Scope of Business

Traditional legal limitations of the scope of business have been abolished and the companies may engage in a wide range of business activities other than railway business, subject to the approval of the Minister for Transport. The companies will be able to engage in diversified activities to fully meet the needs of the people in each locality, in close coordination with all interests involved.

(4) Determination of Assets and Liabilities

The assets and liabilities to be allocated to each of the new enterprises were ultimately set in accordance with the Business Takeover Implementation Plan prepared by JNR under the direction of the Minister for Transport, based on decisions about the amount of existing assets by the Evaluation Investigation Committee in the Ministry of Transport.

1) Assets

The concepts of the division of assets among the new enterprises are as follows:

a) Passenger railway, freight railway and other companies

The minimum amounts of land and other assets necessary for business operation are to be taken over by the companies concerned. The assets for non-railway business operation, such as railway station building sites being leased or having been selected for leasing, which are difficult to sell or inappropriate for sale are to be taken over. In this case, the successor company in principle shall be the passenger railway company or the freight railway company whose business operation is related to these assets.

b) Shinkansen Property Corporation

Facilities for Shinkansen operation, excluding rolling stock, are to be taken over by the Shinkansen Property Corporation.

c) JNR Accounts Settlement Corporation

Lands other than that allocated to new enterprises and shares of stock held by JNR as investments are to be held by the JNR Accounts Settlement Corporation.

2) Liabilities

The concepts for sharing responsibility for liabilities among the new enterprises are as follows:

a) Passenger Railway, Freight Railway and Other Companies

The three passenger railway companies in Honshu - the East Japan Railway Company, Central Japan Railway Company, and West Japan Railway Company, and the Japan Freight Railway Company are to take over JNR long-term liabilities to the extent that they can operate their business with maximum efficiency, maintain the balance between revenues and expenses for the present, and can continue sound and smooth operations in the future. In addition, they are to share the burden of capital expenditures for railway facilities constructed by the Japan Railway Construction Public Corporation (JRCC) for the portions related to their operations.

b) Shinkansen Property Corporation

The JNR long-term liabilities equivalent to the book value of the Shinkansen railway facilities (Tokaido, Sanyo, and Tohoku) are to be taken over by the Shinkansen Property Corporation. Liabilities of the JRCC related to the construction of the Joetsu Shinkansen are also to be taken over by the Shinkansen Property Corporation.

c) JNR Accounts Settlement Corporation

JNR Long-term liabilities other than those taken over or shared by the passenger and freight railway companies and the Shinkansen Property Corporation are to be taken over and disposed of by the JNR Accounts Settlement Corporation.

(5) Financial Prospects of New Enterprises

The financial prospects of the new enterprises have been tentatively calculated by the Government on the premise that the previously mentioned measures will be fully implemented, and, based on the latest economic trends, that overall operations will be as efficient as private railway companies.

As a result, each of the new enterprises has been predicted to be profitable, as a trend beginning in fiscal 1987. Expected ordinary profits of the passenger railway companies in 1987 are ¥1.0 billion for Hokkaido, ¥16.6 billion for East Japan, ¥9.8 billion for Central Japan, ¥7.8 billion for West Japan, ¥0.5 billion for Shikoku, and ¥1.2 billion for Kyushu.

(6) JNR Restructuring into New Companies

1) JNR Restructuring Promotion Setup

In order to achieve success in the preparation for JNR restructuring, which could not be delayed, comprehensive nationwide arrangements to implement the restructuring were made by the Cabinet, the Ministry of Transport and of course JNR itself.

After the JNR Reform Commission submitted the Opinions on July 26, 1985, the Government decided at a Cabinet meeting on July 30 to fully implement the Opinions. The Government established the JNR Restructuring Cabinet Ministers Conference, and on August 7 it also organized a Surplus Personnel Reemployment Measures Headquarters in the Cabinet, to set and enforce government policy under close mutual cooperation.

On July 31, the JNR Restructuring Promotion Headquarters was set up in the Ministry of Transport, and on August 1, a joint Liaison & Coordination Committee of the Ministry and JNR was established to work toward achievement of these government policies.

In order that the entire organization could work toward accomplishment of the restructuring, JNR took action from its own standpoint by setting up the Surplus Personnel Measures Committee on June 1 and the Restructuring Implementation Promotion Committee on July 4, 1985, so that a smooth start could be ensured for the new companies. In addition, 22 project teams were set up on July 30 under the Restructuring Implementation Promotion Headquarters and started a specific preparatory work.

The 107th Extraordinary Session of the Diet, convened in September 1986, set up a Special Committee Concerning JNR Restructuring in each House of the Diet because of the developing situation and the vital importance of JNR restructuring, and intensive discussions began on this subject.

The Committees discussed a wide range of problems, such as the necessity and principles of JNR restructuring, the prospects for revenues and expenses of the new companies, employment problems, the disposal of long-term liabilities, problems involving the sale of JNR land, passenger fares and freight rates, local line problems, pension problems, and the advantages and disadvantages of JNR division. The necessity and importance of JNR restructuring were recognized and national understanding and support were secured through these discussions.

2) Process of Shift to New Companies

a) Appointment of Establishment Committee

After approval of the related bills, Establishment Committee Members for each of the new companies were appointed from among the representatives of central and regional governments, the business world, and JNR by Minister for Transport to prepare for the transition. Committee members were appointed for each of the eight companies -- six passenger railway companies, the freight railway company, and the Shinkansen property corporation -- to allow them to make necessary decisions for the establishment of the new companies.

The Establishment Committee members for each enterprise accomplished functions related to the establishment of a new company, such as preparing the articles of incorporation, allocating the stock, scheduling the inaugural general meeting, and taking other actions necessary for each new company to commence its activities smoothly.

The Committee members also solicited applications from all JNR personnel for the respective, new companies. In particular, the Establishment Committee Members for each company decided on the personnel employment standards and working conditions and presented them through JNR to JNR personnel. When each JNR employees' wishes had been determined, JNR collated the Committee members' employment standards, prepared a list of names of candidates for employment by each enterprise, and presented it to the Establishment Committee members. The Committee members selected the names of persons to be employed by each enterprise from the name list and notified selected individuals of their employment.

For the Railway Telecommunications Company, Railway Information Systems Company, and Railways Technical Research Institute, which will be described in the following

paragraph, invitations for applications and decisions about employment were made by the boards of these organization rather than by Establishment Committee members.

b) Establishment of Other Companies

The Railway Telecommunications Company and Railway Information Systems Company, which were to be established in the current restructuring as separate entities from the passenger and freight railway companies, were established with their capital provided 100% by JNR and designated by the Minister of Transport as JNR successor enterprises on December 9, 1986. Both companies then applied for and received licenses and took other necessary steps for inaugurating business, and commenced full-scale operation on April 1, 1987.

The Railway Technical Research Institute was also established as an incorporated foundation with JNR capital on December 10, 1986 and was designated by the Minister for Transport as a JNR successor organization. The Institute took over JNR's important technical research and development activities and also commenced full-scale operation on April 1, 1987.

c) Evaluation of Assets Taken Over by New Enterprises

The assets to be taken over by the new enterprises were selected according to the Business Takeover Plan. The value of the assets to be acquired by each enterprise was determined by the Evaluation Council temporarily set up in the Ministry of Transport. The council was composed of five specialists in this field and the members of the Establishment Committees (board members for the Railway Telecommunications Company, etc.).

d) Selection of Assets Taken Over by JNR Accounts Settlement Corporation

The Assets Utilization Council was set up temporarily in the Ministry of Transport, under a government ordinance, to discuss the extent of land and other assets to be transferred to the JNR Accounts Settlement Corporation as part of JNR restructuring. This Assets Utilization Council determined the basic concepts for JNR land classification.

e) Preparation of Business Takeover Plan

The Business Takeover Plan was prepared to define the scope of the JNR activities, assets, liabilities, rights and duties to be assumed by the new passenger railway companies, the freight railway company, the Shinkansen Property Corporation, and the other organizations. Specifically, the Cabinet adopted the "Basic Plan Concerning the Assumption of JNR Activities, Rights and Duties, etc.," and, based on this, the Minister for Transport directed JNR to prepare its implementation plan, which it did in detail. This Takeover

Implementation Plan was approved by the Minister for Transport on March 13, 1987 and became the firm plan for the transition. The documents of the plan amount to a massive 8,000 pages, including the text and supplementary volumes.

f) Preparations for New Companies

Following Diet passage of the related bills for JNR restructuring, JNR started work on the transition to the new companies in order to implement the preparation accomplished to this point by the project teams. On November 28, 1986 JNR set up the Transfer Promotion Committee under the Executive Vice-President. This Committee included Establishment Preparation Teams for each passenger company and the freight Company, the Shinkansen Property Corporation, and the JNR Accounts Settlement Corporation Establishment Preparation Team, so as to provide the new companies with the necessary organization. Centering on these teams, JNR also made final coordination and adjustments to the organization of the new companies and rules and regulations to enable a smooth transition to the new companies.

g) Corporate Symbol for New Companies

JNR selected a corporate identification symbol for the new companies as one of the strategies for establishing corporate identity, to assist the new companies to win customer favor and goodwill.

(7) New JR Group

The JNR was reborn as 12 corporate bodies on April 1, 1987. All of these new companies and organizations, which form the Japan Railways Group (JR Group), are determined to play the roles entrusted to them, so that they can continue to earn the understanding and support of the nation's people in the future.

3.6.4 Efficiency of Railways in Comparison with Some Countries

For information, efficiency of railways in comparison with some countries is shown in Table 3.6.5.

Table 3.6.1 Efficiency of Railways in Comparison with Some Countries

SUBJECT	UNIT	PAKISTAN	INDIA	IRAN	WEST GERMANY	* JAPAN (JNR)
Route - Km	Km	8,775	61,850	4,567	27,628	20,789
Electrified - Km	Km	285	6,603	146	11,396	9,109
Electrified Ratio	%	3.2	10.7	3.2	41.2	43.8
Double-Tracked Ratio	%	11.8	21.6	----	42.0	27.8
Automatic - Block Signalized Ratio	%	0.8	2.8	---	---	68.6
No. of Locomotives	PER Km	0.10	0.16	0.12	0.20	0.14
No. of Passenger cars	PER Km	0.33	0.67	0.22	0.56	1.13
No. of Wagons	PER Km	4.0	5.8	2.6	9.2	1.9
Traffic Volume (Passenger)	PASS.- Km	16.8×10^9	227×10^9	5.7×10^9	51.2×10^9	142.0×10^9
	PASS./DAY.Km	5.2×10^3	10.0×10^3	3.4×10^3	5.1×10^3	18.7×10^3
Traffic Volume (Goods)	TON - Km	8.2×10^9	173×10^9	6.8×10^9	68.2×10^9	21.6×10^9
	TON / DAY.Km	2.6×10^3	7.7×10^3	4.1×10^3	6.8×10^3	2.8×10^3
Max.Train Speed	Km / h	105	130	120	200	120** (240)
Max.Tractive Force	TON	2,000	1,300	----	----	1,850

Source: JARTS " Railway in the world 1987 " Data as of 1985
: JNR , Year book 1986

* Excluding " Shinkansen "
** Shinkansen

APPENDIX FOR

RAILWAY PLANNING

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RAILWAY PLANNING

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Appendix 1. Table and Figures for Present Condition and Problems

App. Table 1-1 Number of Station by Signalling Type

Classification	Number of Stations		Total	Remarks
	Main Lines	Branch Lines		
Standard I	40	453	493	
Standard II		21	21	
Standard III	94		94	
Standard III (with main lines track circuited)	122		122	
Standard III (with passenger yeards track circuited)	15		15	
Relay interlocking	62		62	
Total	333	474	807	

Source: P.R.

App. Table 1-2 Route Kilometers by Block Signalling Type

Classification	Route Kilometer		Total	Remarks
	Main Lines	Branch Lines		
Token block instrument (single line)	233	1335	1568	
Tokenless block instrument (single line) Siemans	661		1087	
Tokenless block instrument (single line) 'U' style	225			
Tokenless block instrument (single line) 'N' style	201			
Block instrument (Double line) 'V' style	46			
Block instrument (Double line) TYER's	798		980	
Block instrument (Double line) CARSEN	37			
Automatic Block system	62			
CTC system	37			
Total	2300	1335	3635	

Source: P.R.

App. Table 1-3 Pakistan Railways: Number of Locomotives

Year	Broad-Gauge. Steam. (No.)	Diesel. (No.)	Electric. (No.)	Metre-Gauge. Steam. (No.)	Narrow-Gauge. Steam. (No.)	Total (No.)
1976-77	404	468	29	36	41	978
1977-78	404	468	29	36	41	978
1978-79	411	462	29	36	41	979
1979-80	411	486	29	36	41	1,003
1980-81	381	474	29	35	41	960
1981-82	380	488	29	31	35	963
1982-83	380	504	29	31	35	979
1983-84	356	492	29	31	35	943
1984-85	339	482	29	31	35	916
1985-86	278	512	29	25	35	879

Source: P.R. Year Book, 1985-86

App. Table 1-4 Pakistan Railways: Number of Coaching Vehicles

Year	Broad Gauge. Passenger carriages (No.)	Broad Gauge. Other coaching vehicles (No.)	Metre-Gauge. Passenger carriages (No.)	Metre-Gauge. Other coaching vehicles (No.)	Narrow-Gauge. Passenger carriages (No.)	Narrow-Gauge. Other coaching vehicles (No.)	Total Passenger carriages (No.)	Total Other coaching vehicles (No.)
1976-77	1,860	740	114	30	112	46	2,086	816
1977-78	1,911	730	110	30	112	46	2,133	806
1978-79	1,921	715	107	30	110	43	2,138	788
1979-80	2,011	706	101	30	110	43	2,222	779
1980-81	2,061	691	97	30	110	43	2,268	764
1981-82	2,116	655	97	30	110	47	2,323	732
1982-83	2,161	614	97	30	107	41	2,365	685
1983-84	2,201	538	97	30	107	41	2,405	609
1984-85	2,293	538	87	18	107	35	2,487	591
1985-86	2,515	457	87	18	120	31	2,722	506

Source: P.R. Year Book, 1985-86

App. Table 1-5 Pakistan Railways: Number of Wagons

Year	Broad-Gauge. (No.)	Metre-Gauge. (No.)	Narrow-Gauge. (No.)	Total. (No.)
1976-77	35,143	1,013	564	36,720
1977-78	34,846	999	561	36,406
1978-79	34,757	989	530	36,276
1979-80	34,725	989	521	36,235
1980-81	34,740	989	519	36,248
1981-82	34,793	989	431	36,213
1982-83	34,810	754	426	35,990
1983-84	34,613	743	426	35,782
1984-85	34,261	654	426	35,341
1985-86	34,184	654	399	35,237

Source: P.R. Year Book, 1985-86

App. Table 1-6 Passengers Classified, 1979-85

(Number of thousands)

Years	Air-conditioned Class				First Class				Second Class		Total
	Sleeper		Sitter		Sleeper		Sitter				
	No.	%	No.	%	No.	%	No.	%	No.	%	No.
1979-80	96	0.07	115	0.08	286	0.20	4,316	3.00	138,861	96.65	143,674
1980-81	95	0.08	160	0.13	362	0.29	3,406	2.77	118,979	96.73	123,002
1981-82	102	0.09	173	0.14	508	0.42	3,220	2.69	115,825	96.66	119,828
1982-83	108	0.09	207	0.17	557	0.45	3,381	2.76	118,457	96.53	122,710
1983-84	80	0.07	163	0.15	608	0.57	2,837	2.65	103,423	96.56	107,111
1984-85	74	0.08	125	0.13	609	0.64	2,414	2.55	91,479	96.60	94,701
1985-86*	78	0.09	120	0.15	621	0.75	2,049	2.47	80,060	96.52	82,928

Source: P.R. Year Book, 1985-86

* Provisional

App. Table 1-7 Freight Traffic by Main Commodities, 1980-81 to 1985-86

Name of Commodity.	1980-81			1981-82			1982-83			1983-84			1984-85			1985-86		
	Tonnes (000)	Tonne Kms (Million)	Average lead Kms.	Tonnes (000)	Tonne Kms (Million).	Average lead Kms.	Tonnes (000)	Tonne Kms (Million).	Average lead Kms.	Tonnes (000)	Tonne Kms (Million)	Average lead Kms.	Tonnes (000)	Tonne Kms (Million)	Average lead Kms.	Tonnes (000)	Tonne Kms (Million)	Average lead Kms.
Wheat.	805	583.1	721	718	593.9	828	726	702.1	967	625	555.4	888	640	702.3	1097	1424	1663.3	1168
Rice and Paddy.	539	529.4	982	589	619.3	1034	658	680.6	1035	540	536.0	992	613	604.9	987	733	717.8	980
Other grains.	10	10.4	991	23	25.5	1087	15	13.4	877	19	18.0	957	9	7.8	879	7	5.3	804
Sugar and Sugar Cane.	171	143.9	842	73	57.4	786	75	51.3	684	115	111.9	973	155	168.8	1090	47	50.3	1063
Timber & Firewood.	434	172.7	398	307	123.7	419	256	104.4	408	190	80.3	423	108	54.0	500	63	26.1	413
Coal & Coke.	361	432.6	1199	328	397.2	1211	294	353.3	1201	400	479.6	1198	297	363.6	1221	324	397.4	1227
P.O.L.	1561	1675.5	1073	1874	1033.2	552	1979	1119.9	566	1825	1211.0	664	1869	1194.8	639	1876	1148.7	612
Cement.	784	561.4	716	904	799.1	884	761	705.9	928	878	834.4	950	819	754.5	922	703	648.6	924
Fertilizers.	1081	875.5	810	506	308.6	610	567	391.4	690	623	415.3	666	471	328.0	697	734	447.4	610
Iron and steel.	34	42.0	1235	40	45.1	1159	50	56.1	1122	90	108.1	1201	92	108.7	1185	269	314.9	1170
Other commodities.	2546	2000.0	706	2683	2073.9	773	2807	2173.0	774	2776	2215.5	798	2771	2106.5	760	2883	2112.8	734
Total Revenue Earnings.	8330	7026.5	844	5053	5034.9	755	8188	6351.4	776	8081	6565.5	812	7844	6393.9	815	9063	7532.6	832
P.R.Freight.	3041	891.2	307	3395	981.9	299	3648	972.0	266	2672	819.4	307	2676	809.0	312	2742	737.2	276
Total.	11371	7917.7	705	11446	7066.4	624	11836	7323.4	619	10753	7384.9	687	10520	7202.9	690	11805	8269.8	705
Other coaching freight.	823	884.0	786	1030	1377.1	773	1675	1296.6	774	2121	1692.4	798	1679	1276.1	760	2197	1613.1	734
Grand Total.	12194	8801.7	722	13276	8443.5	636	13511	8620.0	638	12874	9077.3	705	12199	8479.0	695	14002	9882.9	706

Source: P.R.

App. Table 1-8 Pakistan Railways: Trains Run

Year	No. of Passenger Trains	No. of Freight Trains	Total No. of Kms covered by Passenger and Mixed Train (Thousands)	Total No. of Kms covered by Freight Trains (Thousands)	Average No. of Wagons per Train	
					Diesel	Electric
1976-77	164,258	63,101	34,478	11,504	54.2	61.1
1977-78	166,624	67,106	35,650	13,183	55.3	59.6
1978-79	166,731	62,206	35,409	13,995	55.8	59.0
1979-80	163,618	62,634	35,578	13,517	54.1	58.7
1980-81	164,150	62,434	36,006	12,952	53.1	57.2
1981-82	161,340	62,734	35,349	11,480	52.9	58.2
1982-83	158,980	64,419	34,662	12,338	53.8	57.9
1983-84	159,245	61,043	34,807	11,840	54.7	61.0
1984-85	156,406	57,839	35,689	11,708	57.2	61.6
1985-86	150,194	57,337	35,553	12,453	57.2	61.1

Source: P.R. Year Book, 1985-86

App. Table 1-9 Sixth Five Year Plan Budget Allocation and Expenditure and Prospect

Sl. No.	Summary of Project	Sixth Five Year Plan Allocation (1983-88) On the basis of 10000.000 million	On the basis of 7033,411 million	Total utilization upto 30-6-86	Likely Expenditure next 2 year	Total estimated Expdt. upto 30-6-88	Percentage column 6/3(a)%	Percentage column 6/3(b)%
1.	2	3(a)	3(b)	4	5	6	7	8
1.	Procurement and rehabilitation of locomotives.	3583.532	3015.712	1678.956	1231.518	2910.474	85.54%	96.5%
2.	Procurement of Traction Motors (250 No.)		155.000	-	155.000	155.000		100%
3.	Other coaching vehicles including A.C. Coaches.	1726.405	864.847	614.892	335.100	949.992	55%	109.84%
4.	Hopper Trucks/ Bogie oil tanks.	183.635	62.465	61.383	0.001	61.384	33.5%	98%
5.	Bridge & Civil Energy Works.	190.866	109.375	69.752	44.500	114.252	59.85%	104%
6.	Telecommunication and signalling	321.611	197.426	54.155	103.825	157.980	49.1%	80%
7.	Plant & Machinery for workshop Depots including structural works.	122.133	114.236	92.842	34.000	126.848	103.86%	111%
8.	Line capacity and Terminal facilities	242.988	43.978	10.281	53.076	63.357	26%	115%
9.	Dry Port Peshawar		11.085					
10.	11th Railway Project	938.697	628.406	471.238	175.000	646.238	68.84%	102.8%
11.	Locomotive factory	700.000	536.870	64.146	300.450	364.596	52.08%	67.91%
12.	Track Rehabilitation	1500.000	984.292	849.956	282.897	1132.853	75.5%	115.09%
13.	Electric Traction	50.120	-	-	-	-	-	-
14.	Braking System	60.000	2.780	3.278	-	3.278	5.4%	117.9%
15.	Stores inventory	85.000	241.753	241.753	-	241.753	284%	100%
16.	Peshawar Division		10.500	-	10.500	10.500		100%
17.	Railway Board Colony	295.013	0.001	-	10.001	10.001	25.5%	-
18.	Other Minor Projects		54.785	24.731	30.174	54.905		100.2%
	Total:	10000.000	7033.411	4237.369	2766.042	7003.411	70%	99.57%

Source: The Middle Plan Review of the 6th Five Year Plan (1983-88) and P.R.

App. Table 1-10 Pakistan Railways: Traffic Operation Revenue and Expenditure

(Rs. million)

Year	Operating Revenue	Operating Expenditure	Operating Ratio	Traffic (millions) Passenger Kms	Ton Kms'
1976-77	1,748	1,463	83.7	13,199	7,857
1977-78	2,213	1,635	73.9	15,375	8,557
1978-79	2,274	1,855	81.6	16,713	9,375
1979-80	2,709	2,273	83.9	17,316	8,598
1980-81	2,942	2,491	84.7	16,387	7,918
1981-82	3,044	2,848	93.5	16,502	7,067
1982-83	3,395	3,308	97.4	18,031	7,323
1983-84	3,680	3,604	97.9	18,287	7,385
1984-85	3,681	3,868	105.1	17,807	7,203
1985-86	4,368	4,002	91.6	16,850	8,270

Source: P.R. Year Book, 1985-86

App. Table 1-11 Pakistan Railways: Operating Expenditures'

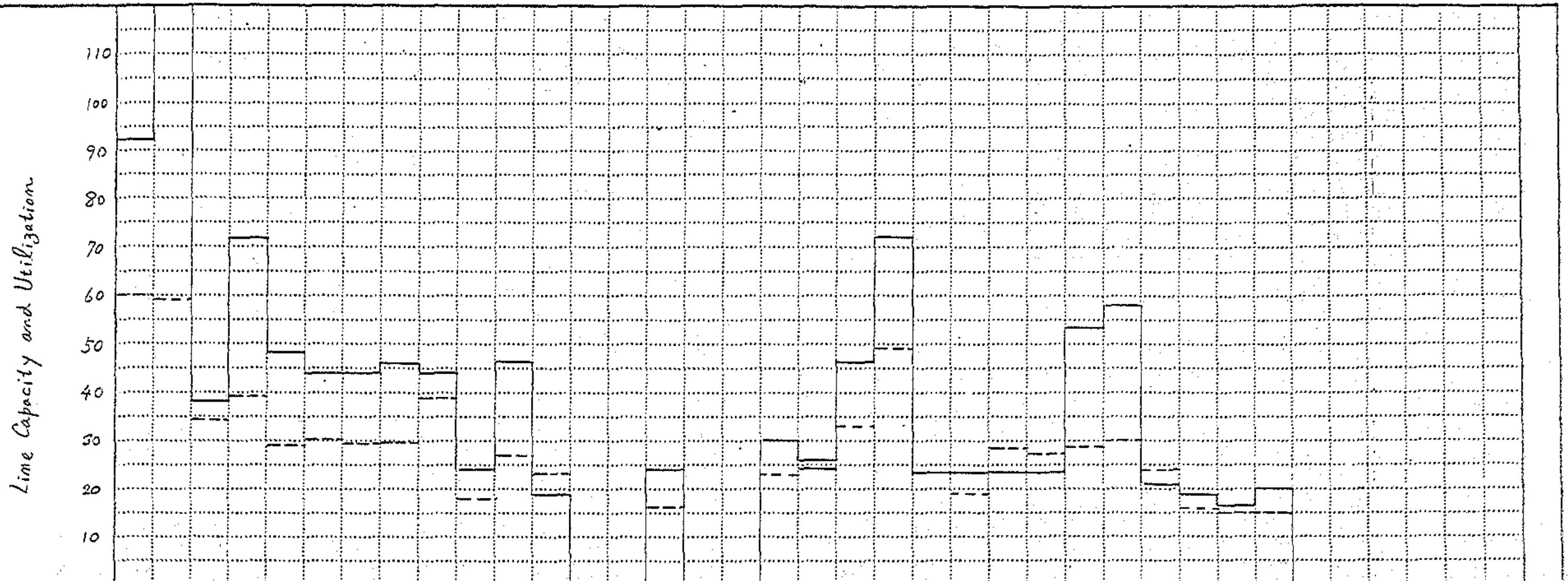
(Rs. million)

Year	Repairs' and Maintenance	Fuel Costs	Staff Costs	Administration Costs	Other Costs	Total Operating Expenses'
1976-77	661.5	342.3	200.4	181.1	77.4	1,462.7
1977-78	683.0	376.3	250.4	238.6	86.9	1,635.2
1978-79	807.3	457.0	241.4	246.1	103.1	1,854.9
1979-80	900.3	678.7	279.5	289.3	125.5	2,273.3
1980-81	955.0	816.7	280.5	312.6	126.0	2,490.8
1981-82	1,181.0	870.6	331.1	322.9	141.9	2,847.6
1982-83	1,349.9	996.3	369.2	409.8	182.7	3,307.9
1983-84	1,393.7	1,079.5	460.4	483.5	186.7	3,603.8
1984-85	1,627.3	1,098.5	463.1	483.9	195.4	3,868.2
1985-86	1,675.2	1,106.6	503.4	517.6	198.7	4,001.5

Source: P.R. Year Book, 1985-86

App. Table 1-12 Line Capacity and Utilization (1)

(UP)



		KYC	KC	BQM	KOT	HDR	TDM	ROH	KPR	SMA	LON	SSH	MUL	KWL		LON	KWL		KWL	SWAL	RND	LHR	SDR	WZD	LLM	MNA	CKL	RWP	GLRS	TXLC	ATCY	NOP	PSC
Distance (Km)	From KMR	2.92	8.62	42.06	173.71	192.28	276.17	420.21	692.42	837.20	847.13	910.23	928.07	974.9		843.13	934.07		934.01	1052.24	1199.17	1211.13	1226.17	1312.33	1351.54	1462.70	1502.21	1509.23	1521.24	1534.21	1581.14	1626.04	1627.45
	Between	3.70	37.44	131.65	8.57	57.87	200.09	212.21	136.11	11.83	62.10	5.46	58.-			90.9			118.22	126.77	40.14	6.84	92.76	72.63	116.34	34.71	4.62	14.01	17.97	49.88	47.77	38.59		
Utilization	Passenger	34	44	19	25	17	15	14	14.5	21.5	12.-	20	16			4.5			12.5	15	23	38	14	14	14	15	15	18	14	10	9	10		
	Goods	8	12	12	10.8	11	12	12	12.9	15.6	3.9	6.-	5.8			11.-			8.6	7.-	8.-	8.-	8.-	4.-	11.-	9.-	7.-	[illegible]	7	4	5	4		
	L/Engine	18	3	3	3.-	1	3.2	3.2	1.5	1.5	1.-	1.3	1.3			1.2			1.7	2.-	2.-	3.-	1	1	3	3	6	3	3	2	1	1		
	Total	60	59	34	38.8	29	30.2	29.2	29.5	38.8	19.9	27.3	23.1			16.7			23.8	24	33	49	23	19	28	27	28	30	24	16	15	15		
Line Capacity		92	126	38	72	48	44	44	46	44	24	46	19			24			30	26	46	72	23	23	23	23	53	58	21	19	17	20		

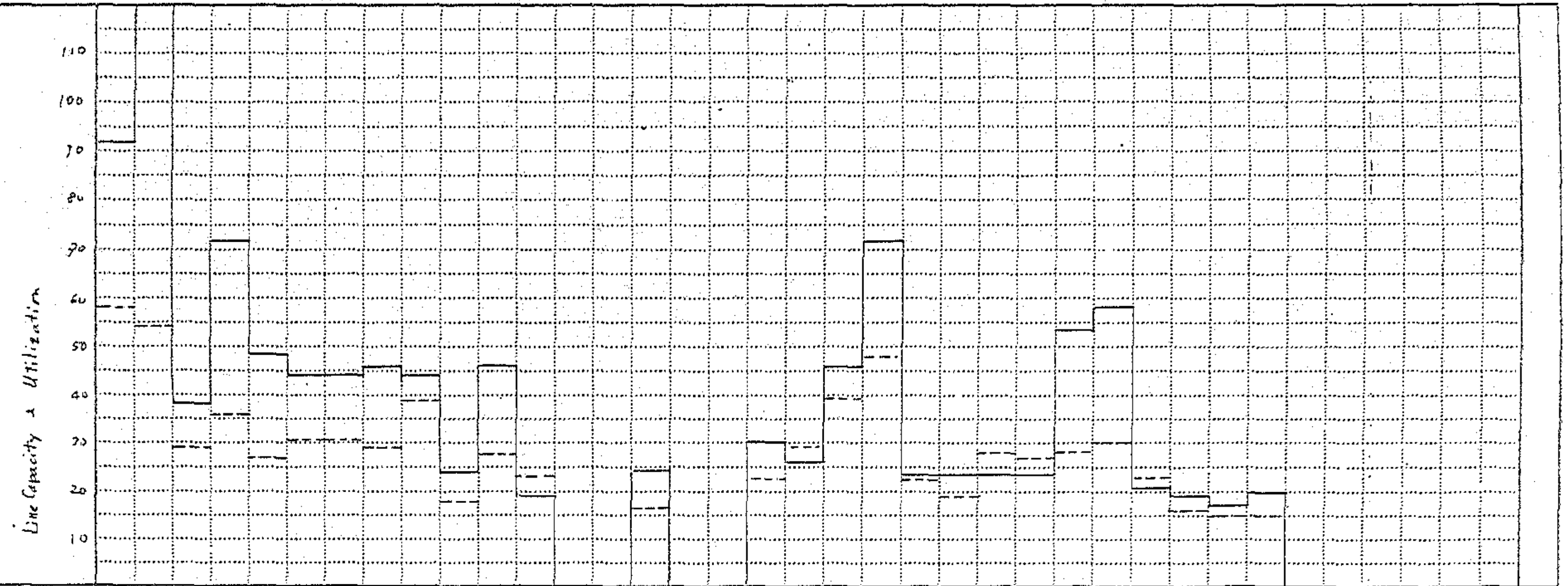
Station	
KYC	KARACHI CITY
KC	KARACHI CANT.
BQM	BIN QASIM
KOT	KOTRI Jn.
HDR	HYDERABAD Jn.
TDM	TAND ADAM Jn.
ROH	ROHRI Jn.
KPR	KHANPUR
SMA	SAMASATA Jn.
LON	LODHRAN Jn.
SSH	SHER SHAB Jn.
MUL	MULTAN CANT.
KWL	KHANEWAL Jn.
LON	LODHRAN Jn.
KWL	KHANEWAL
KWL	KHANEWAL
SWAL	SAHIWAL
RND	RAIWIND Jn.
LHR	LAHORE Jn.
SDR	SHAHDARA BAGH Jn.
WZD	WAZIRABAD Jn.
LLM	LALA MUSA Jn.
MNA	HANDRA Jn.
CKL	CHAKLALA
RWP	RAWALPINDI
GLRS	GOLRA SHARIF Jn.
TXLC	TAXILA CANT Jn.
ATCY	ATTOCK CITY Jn.
NOP	NOWSHERA Jn.
PSC	PESHAWAR CANT.

LOOP (SHER SHAB Jn. – MULTAN CANT. – KHANEWAL Jn.)

CHORD (LODHRAN Jn. – KHANEWAL)

App. Table 1-12 Line Capacity and Utilization (2)

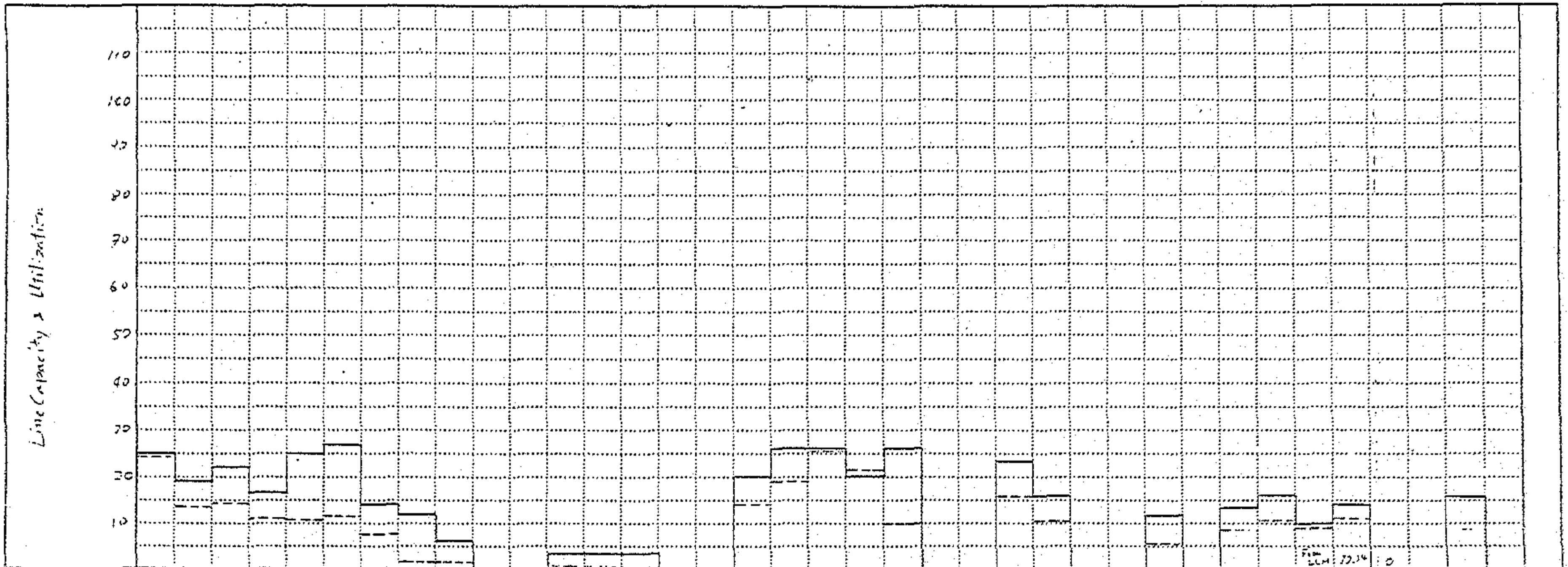
(DOWN)



Station	Code	Distance (Km) From KMR	Distance (Km) Between	Utilization Passenger	Utilization Goods	Utilization L/Engine	Utilization Total	Line capacity
KARACHI CITY	KYC	4.92	3.70	24	2	21	58	92
KARACHI CANT	KC	8.62	23.44	44	2	2	54	126
BIN QASIM	BQM	32.06	101.65	19	3	3	29	30
KOTRI Jn.	KOT	133.71	8.57	25	2	3	36	72
HYDERABAD Jn.	HDR	142.28	57.27	17	9	1	27	48
TANDO ADAM Jn.	TDM	276.17	244.04	15	12	2.6	30.6	44
ROHRI Jn.	ROH	480.21	212.21	14	13	2.6	30.6	44
KHAN PUR	KPR	692.02	134.88	14.5	12.8	1.6	29.3	46
SAHASATA Jn.	SMA	827.70	15.82	21.5	15.7	1.5	38.7	44
LODHRAN Jn.	LON	843.13	67.10	13	7.8	2.9	17.7	24
SHER SHAB Jn.	SSH	910.23	9.46	20	6	1.5	27.5	46
MULTAN CANT.	MUL	919.69	50.-	16	5.7	1.3	23.-	19
KHANEWAL Jn.	KWL	929.69						
LODHRAN Jn.	LON	843.13	90.9	8.5	10.3	1.1	16.6	24
KHANEWAL	KWL	934.03						
KANEWAL	XWL	934.17	118.37	12.5	8.5	1.6	22.6	30
SAHIWAL	SWAL	1052.80	126.37	15	10	4	29	26
RAIWIND Jn.	RND	1179.19	40.14	23	12	4	39	66
LAHORE Jn.	LHR	1219.33	6.84	30	7.-	3.-	40	72
SHAHDARA BAGH Jn.	SDR	1226.17	92.76	14	6	2	22	23
WAZIRABAD Jn.	WZD	1318.93	32.60	14	4	1	19	23
LALA MUSA Jn.	LLM	1351.56	111.19	14	11	3	28	23
MANDRA Jn.	MNA	1462.75	34.71	15	9	3	27	23
CHAK LALA	CKL	1497.21	4.62	15	7	6	28	53
RAWALPINDI	RWP	1502.83	14.01	13	2	3	30	58
GOLR SHARIF Jn.	GLRS	1521.84	13.17	14	6	3	23	21
TAXILA CANT Jn.	TXLC	1578.61	64.88	10	4	2	16	19
ATTOCK CITY	ATCY	1584.49	48.77	9	5	1	15	13
NOWSHERA	NSR	1672.46	32.11	10	4	1	15	20
PESHAWAR CANT	PSC	1622.45						

App. Table 1-12 Line Capacity and Utilization (3)

(UP)



Station	ROH	SUK	HBKT	JCD	SIBI	ABG	KLR	QTA	GTN	CMN
Station name	ROHRI Jn.	SUKKUR	HABIB KOT Jn.	JACOBABAD Jn.	SIBI Jn.	ABIGUM	KOLPUR	QUETTA	GULISTAN	CHAMAN
Distance (Km) From KCH		4.3	52.65	27.77	247.54	306.15	247.32	334.47	366.79	426.12
Distance (Km) Between	43	48.15	25.12	155.22	62.11	33.17	38.17	81.92	60.14	
Utilization Passenger	12	7	8	5	4	4	4.1	1	1	
Utilization Goods	5	3	3	3	6.5	6.7	3.2	0.5	0.5	
Utilization L/Engine	2.1	3.4	2.1	2.0	0.3	0.9	0.2	0.3	0.2	
Utilization Total	26.1	17.4	14.1	11.-	10.8	11.2	7.5	1.8	1.8	
Line Capacity	25	19	22	17	25	27	14	12	6	

Station	SZD	AHW	DLH	TFT
Station name	SPEZAND	AHMEDWAL	DALBANDIN	KOHI-TAFTAN
Distance (Km) From	SPB	164.56	318.58	613.15
Distance (Km) Between	154.56	164.02	204.57	
Utilization Passenger	0.3	0.3	0.3	
Utilization Goods	0.5	0.5	0.5	
Utilization L/Engine	—	—	—	
Utilization Total	0.8	0.8	0.8	
Line Capacity	3	3	3	

Station	KWL	SKCC	FSLD	CKJ	SLL	WZD
Station name	KHANEWAL	SHORKOT CANTT Jn.	FAISALABAD	CHAK JHUMRA	SANGLA HILL Jn.	WAZIRABAD Jn.
Distance (Km) From	KWL	125.51	132.33	104.10	513.91	324.02
Distance (Km) Between	67.51	107.02	19.17	20.81	110.11	
Utilization Passenger	9	14	21	12	8	
Utilization Goods	4.1	7.5	7.2	2.4	1.-	
Utilization L/Engine	0.8	1.-	1.2	1.-	1.-	
Utilization Total	13.8	14.5	25.5	21.4	10.-	
Line Capacity	20	26	26	20	26	

Station	SDR	QSP	SLL
Station name	[illegible]	QILA SHEIKHUPURA	SANGLA HILL Jn.
Distance (Km) From	SDR	35.76	40.54
Distance (Km) Between	35.54	53.98	
Utilization Passenger	15	10	
Utilization Goods	1	6.3	
Utilization L/Engine	—	—	
Utilization Total	16	10.3	
Line Capacity	23	16	

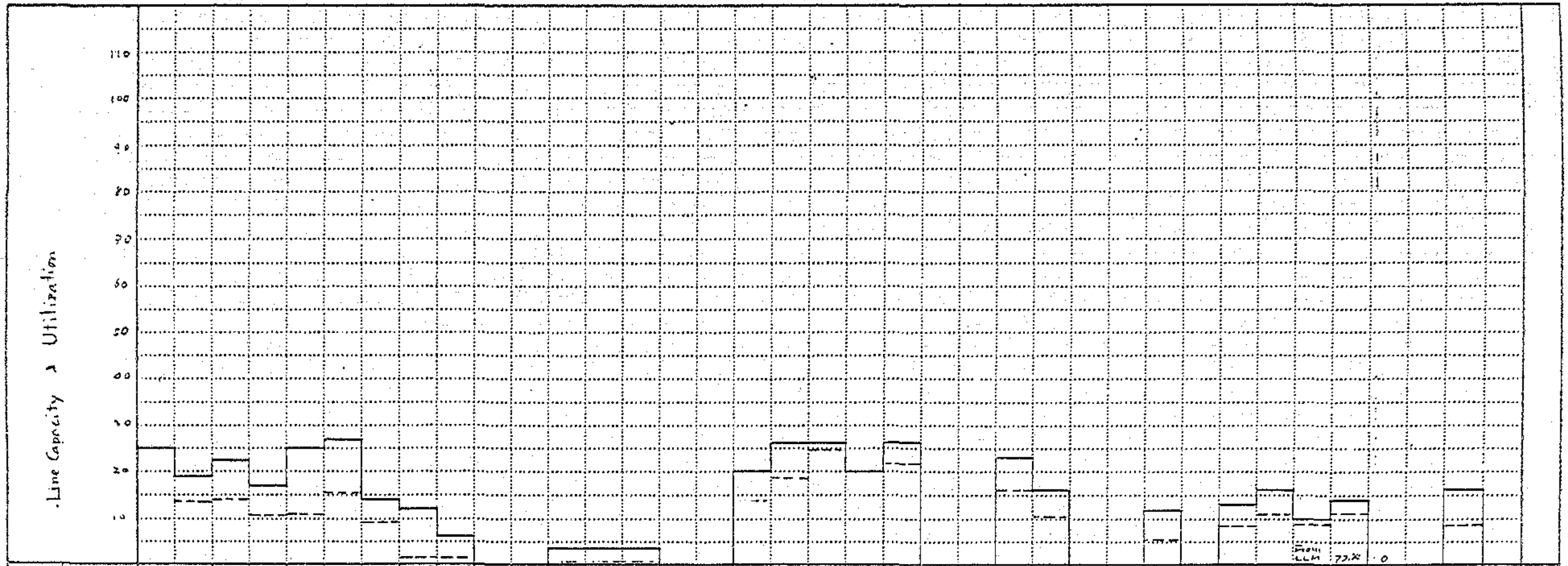
Station	QSP	SKCC
Station name	QILA SHEIKHUPURA	SHORKOT Jn.
Distance (Km) From	SKOC 220.16	0
Distance (Km) Between	220.16	
Utilization Passenger	5	
Utilization Goods	0.4	
Utilization L/Engine	0.2	
Utilization Total	5.6	
Line Capacity	12	

Station	SKOC	SHHD	SRO	MKW	LLM
Station name	SHORKOT Jn.	SHAHINABAD Jn.	SARGODHA Jn.	MALAKWAL Jn.	LALAMUSA Jn.
Distance (Km) From	0	106.44	116.85	240.51	From LLM 72.34 : 0
Distance (Km) Between	106.44	14.61	24.58	72.34	
Utilization Passenger	6.-	10.-	7.-	8.-	
Utilization Goods	1.9	1.-	1.-	2.-	
Utilization L/Engine	0.5	—	1.-	1.-	
Utilization Total	8.4	11.-	9.-	11.-	
Line Capacity	13	16	10	14	

Station	SHNS	CKJ
Station name	SHAHINABAD Jn.	CHAK JHUMRA
Distance (Km) From	From CKJ	62.13
Distance (Km) Between		62.13
Utilization Passenger		7.-
Utilization Goods		1.-
Utilization L/Engine		0.5
Utilization Total		8.5
Line Capacity		16

App. Table 1-12 Line Capacity and Utilization (4)

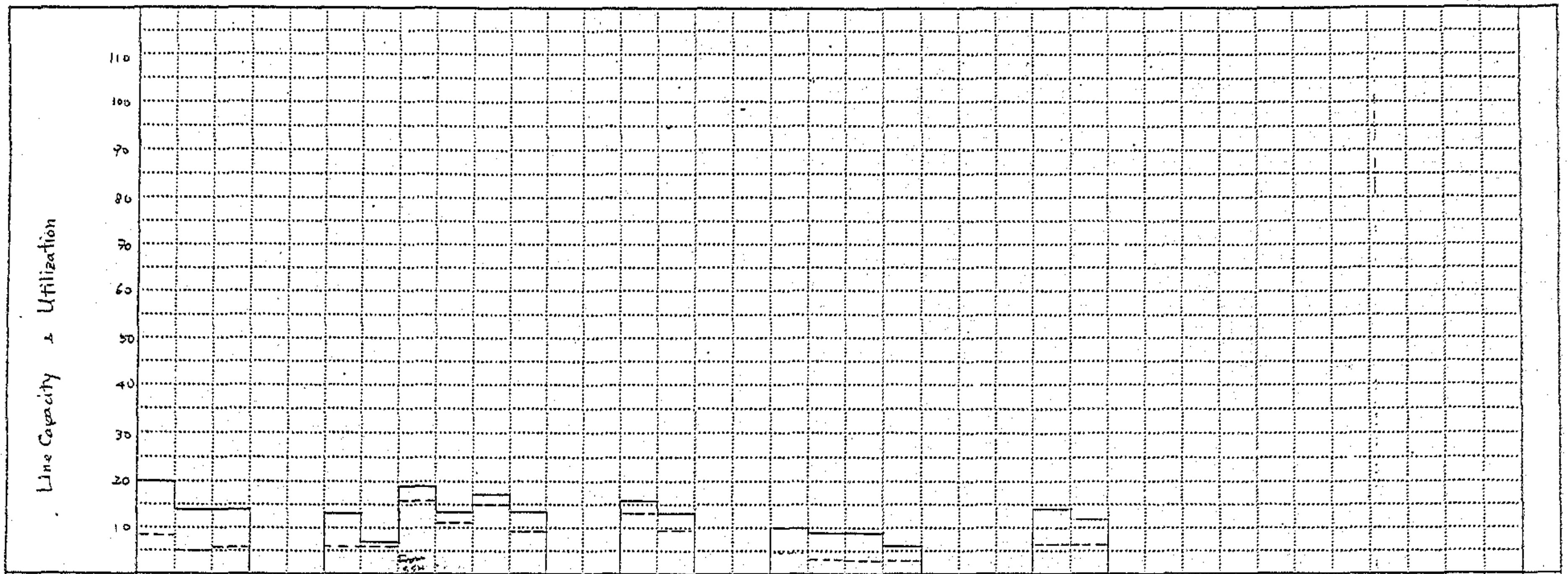
(DOWN)



Station	Code	Distance: From ROH	Distance: Between	Utilization: Passenger	Utilization: Goods	Utilization: L/Engine	Utilization: Total	Line Capacity
ROHRI Jn.	ROH		4.3	12	6	7.1	25.1	25
SUKKUR	SUK	4.3	08.25	7	3	2.4	12.4	19
HABIB KOT Jn.	HBKJ	52.65	75.12	8	3	3	14.-	22
JACOBABAD Jn.	JCD	97.77	155.77	5	3	3	11	17
SIBI Jn.	SIBI	253.54	47.11	4	2.5	0.3	11.8	25
ABI GUM	ABG	306.65	33.17	4	9	7.8	12.3	27
KOLPUR	KLR	343.82	38.17	4.1	2.7	0.2	9.-	14
QUETTA	QTA	404.47	81.72	1	0.5	0.2	1.8	12
GULISTAN	GTN	466.29	60.14	1	0.5	0.3	1.8	6
CHAMAN	CHN	526.53						
		From						
SPEZAND	SZD	SPZ	154.56	0.3	0.5	–	0.8	3
AHMEDWAL	AHW	154.56	160.02	0.2	0.5	–	0.8	3
DALBANDIN	DLH	318.48	224.77	0.3	0.5	–	0.8	3
KOHI-TAFTAN	TFT	408.17						
		From						
KHANEWAL	KWL	KWL	63.51	2	4	0.7	13.7	20
SHORKOT CANT Jn.	SYOC	63.51	107.42	14	2.2	1	18.2	26
FAISALABAD	FSLD	150.93	19.17	21	2.7	1.2	24.9	26
CHAK JHUMRA	CKJ	189.10	24.41	18	2	1.8	21.8	20
SANGLA HILL Jn.	SLL	213.71	110.11	8	1	1	10.-	26
WAZIRABAD Jn.	WZD	324.02						
		From						
SHAHDADA BASTI Jn.	SDR	SDR	33.54	15	1	–	16	23
QILA SHEIKHUPURA Jn.	QSP	33.36	57.78	10	0.4	–	10.4	16
SANGLA HILL Jn.	SLL	91.59						
		From QSP						
QILA SHEIKHUPURA Jn.	QSP	220.16	220.16	5	0.3	0.3	6.6	12
SHORKOT Jn.	SKOC	0						
SHORKOT Jn.	SKOC	0	146.40	6	2	0.4	8.4	13
SHAHINABAD Jn.	SHND	146.44	14.61	12	1	–	11	16
SARGODA Jn.	SRQ	161.05	211.24	7	1	1	9	10
MALAKWAL Jn.	MKW	260.27	77.34	8	3	1	11	14
LALAMUSA Jn.	LLM	From LLM 77.34	0					
		From CKJ						
SHAHINABAD Jn.	SHND	68.12	68.12	7	1.9	0.5	9.4	11
CHAK JHUMRA	CKJ	0						

App. Table 1-12 Line Capacity and Utilization (5)

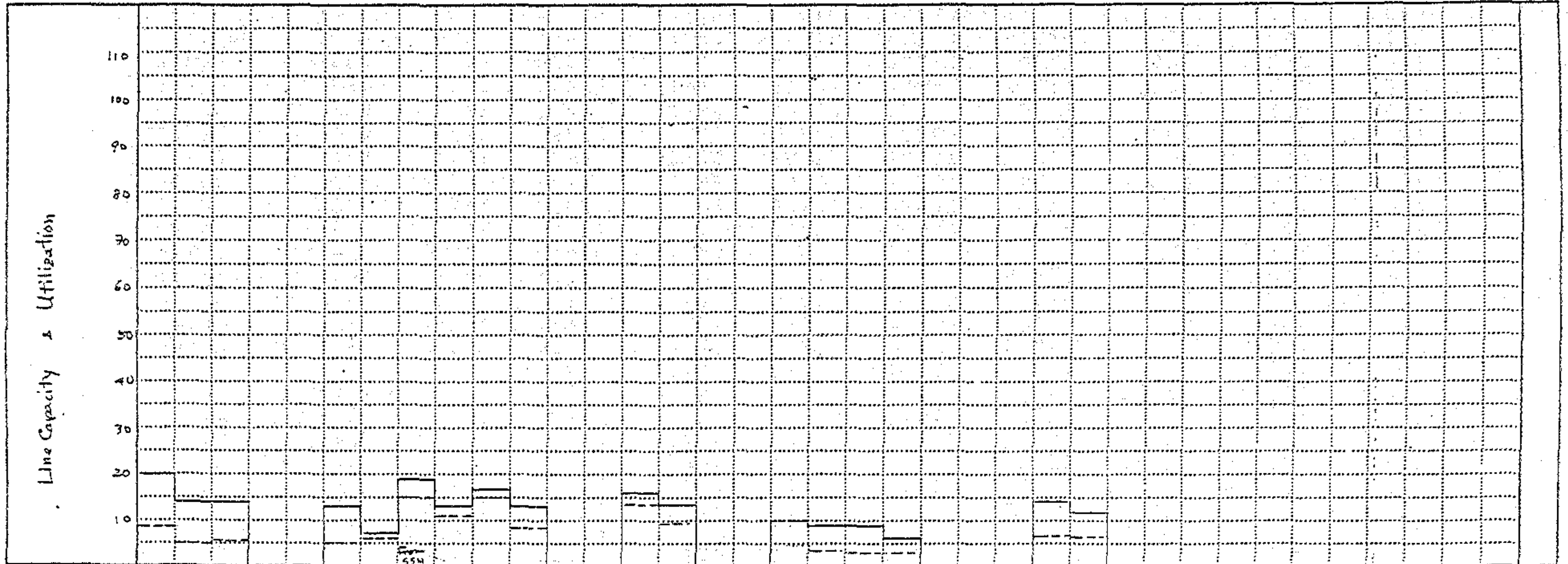
(UP)



Station / Section	Distance (Km) From LON	Distance (Km) Between	Utilization Passenger	Utilization Goods	Utilization L/Engine	Utilization Total	Line Capacity
RND RAIWIND – KUS	369.97	26.61	8	–	–	8	20
KUS KASUR Jn. – PPX	343.36	139.72	5	–	–	5	14
PPX PAKPATTAN – LON	203.64	202.19	4	1.3	0.4	5.7	14
LON LODHRAN	0						
SRQ SARGODHA Jn. – KHB		44.42	3	2	1	6	13
KHB KHUSHAB – KDA		81.49	3	2	1	6	7
KDA KUNDIAN Jn. – DKL	302.09	68.74	9	6	1	16	19
DKL DAUD KHEL Jn. – JAD	361.05	88.12	6	4	1	11	13
JAD JAUD Jn. – BOS	479.21	26.50	9	5	1	15	17
BOS BASAL Jn. – ATCY	466.77	31.03	4	4	1	9	13
ATCY ATTOCK CITY	496.80						
(From SSH)							
SSH SHER SHAH Jn. – ADK		21.75	7	4.9	1.1	13	16
ADK KOTADU – KOA	91.75	270.24	5	3.2	1.3	9.5	13
KOA KUNDIAN	202.09						
(From JCD)							
ADK KOTADU Jn. – OGK	407.57	77.56	3	1.5	0.3	4.8	10
OGK DERA GHAZI KHAN – KZL	409.99	226.11	2	1	0.1	3.1	9
KZL KASHMOR – JCD	123.24	123.99	3	–	–	3	9
JCD JACOBABAD – LOK	0	135.12	3	–	–	3	6
LOK LARKANA Jn.	135.12						
(From KOT)							
HBKJ HABIBKOT Jn. – DDU	296.08	165.53	5	1	0.5	6.5	14
DDU DADU – KOT	140.55	140.55	5	1	–	6	12
KOT KOTRI	0						

App. Table 1-12 Line Capacity and Utilization (6)

(DOWN)



Distance (Km)	From LON	369.97	343.76	207.64	0				702.09	751.05	839.37	865.77	896.40	From SSH		71.75	292.09	From JCD	427.57	409.97	123.94	0	135.12	From KOT		746.08	180.55	0
	Between	26.61	137.32	202.14			44.42	83.44	48.96	88.32	26.59	31.03			21.75	270.74			77.56	226.11	123.97	135.12				165.57	180.55	
Utilization	Passenger	2	5	4			3	3	9	6	9	4			7	5			2	2	2	3				5	4	
	Goods	—	—	1.4			1	2	5	4	5	3			6.9	7.2			1.4	1	—	—				1	1	
	L/Engine	—	—	0.5			1	1	1	1	1	1			1.3	1.4			2.5	2.2	—	—				2.6	—	
	Total	8	6	5.9			5	6	15	11	15	8			15.2	9.6			6.9	7.2	7	7				13	[illegible]	
Line Capacity		20	14	14			13	7	19	13	17	13			16	13			10	9	9	6				14	12	

RND	KUS	PPX	LON		SRQ	KHB	KOA	DKL	JAD	GOS	ATCY		SSH	ADK	KOA		ADK	DGK	KSL	JCD	LRK			HBKJ	DDU	KOT
RAIWIND	KASUR Jn.	PAKPATTAN	LODHRAN		SARGODHA Jn.	KHUSHAB	KUNDIAN Jn.	DAUD KHEI Jn.	JAUD Jn.	BASAL Jn.	ATTOCK CITY		SHER SHAH Jn.	KOTADU	KUNDIAN		KOTADU Jn.	DERA GHAZI KHAN	KASHMOR	JACOBABAD	LARKANA Jn.			HABIBKOT Jn.	DADU	KOTRI

App. Table 1-13 Financial Performance of PR Passenger Trains as of 1985-86 - Mail & Express

Train No.	Kms Covered	No. of Pass.	Ested Earnings (Rs)	Terminal Cost (Rs)	Other Direct Cost (Rs)	Total Direct Cost (Rs)	Indirect Cost (Rs)	Total Cost (Rs)	Ested Ave. Travel Distance (kms)	Ested Pass-kms (000)
1/2	3442	3531	353326	7062	168649	175711	61147	236858	1329	4692
3/4	1720	2706	137880	5412	87538	92950	32347	125297	637	1725
5/6	3362	3007	284384	6014	166141	172155	59910	232065	1252	3763
7/8	3098	3131	419840	6262	152412	158674	55219	213893	1549	4850
9/10	2690	3234	225615	6468	137548	144016	50118	194134	902	2918
11/12	3346	3678	248715	7356	166397	173753	60466	234219	872	3208
13/14	3442	4645	344631	9290	174537	183827	63972	247799	965	4481
15/16	2518	4981	323218	9962	131165	141127	49112	190239	834	4153
17/18	2512	2185	132963	4370	130909	135279	47077	182356	777	1697
21/22	2294	3200	140969	6400	115581	121981	42449	164430	540	1729
23/24	2918	3628	249772	7256	141008	148264	51596	199860	889	3227
31/32	690	1625	29348	3250	33416	36666	12760	49426	213	346
33/34	1136	1641	56073	3282	56449	59731	20786	80517	413	677
37/38	284	1320	13091	2640	13644	16284	5667	21951	111	147
39/40	490	1196	19187	2392	24906	27298	9500	36798	188	224
41/42	284	1580	16074	3160	13280	16440	5721	22161	115	181
43/44	284	1276	12727	2552	13644	16196	5636	21832	112	143
45/46	1432	2512	64624	5024	67483	72507	25232	97739	308	773
49/50	432	985	10103	1970	21657	23627	8222	31849	116	114
51/52	1146	1775	69383	3550	56875	60425	21028	81453	474	841
53/54	834	1254	26373	2508	40478	42986	14959	57945	250	313
55/56	442	1458	16673	2916	21927	24843	8645	33488	130	190
57/58	880	1351	25551	2702	39840	42542	14805	57347	223	302
59/60	288	931	8309	1862	14439	16301	5673	21974	99	92
61/62	296	1148	7424	2296	15871	18167	6322	24489	69	79
63/64	298	750	6238	1500	14084	15584	5423	21007	92	69
69/70	956	2178	92425	4356	49414	53770	18712	72482	478	1041
71/72	580	936	33532	1870	27487	29357	10216	39573	290	271
73/74	580	970	35973	1940	27487	29427	10241	39668	290	281
101/102	3074	6884	361002	13768	148270	162038	56389	218427	658	4533
105/106	2428	2211	362792	4422	108616	113038	39337	152375	1214	2684
207/208	50	629	2155	1258	6184	7442	2590	10032	25	16

Train No.	Earning /pass-km (Rs)	Total Cost /pass-km (Rs)	Total Economic Cost /pass-km (Rs)	Direct Cost /pass-km (Rs)	Direct Economic Cost /pass-km (Rs)	Terminal Cost /pass. (Rs)	Earning less Total Cost /pass-km (Rs)	Earning less Direct Cost /pass-km (Rs)
1/2	0.075	0.050	0.043	0.037	0.032	2.000	0.025	0.038
3/4	0.080	0.073	0.062	0.054	0.046	2.000	0.007	0.026
5/6	0.076	0.062	0.053	0.046	0.039	2.000	0.014	0.030
7/8	0.087	0.044	0.038	0.033	0.028	2.000	0.042	0.054
9/10	0.077	0.067	0.057	0.049	0.042	2.000	0.011	0.028
11/12	0.078	0.073	0.063	0.054	0.046	2.000	0.005	0.023
13/14	0.077	0.055	0.047	0.041	0.035	2.000	0.022	0.036
15/16	0.078	0.046	0.039	0.034	0.029	2.000	0.032	0.044
17/18	0.078	0.107	0.092	0.080	0.068	2.000	-0.029	-0.001
21/22	0.082	0.095	0.082	0.071	0.060	2.000	-0.014	0.011
23/24	0.077	0.062	0.053	0.046	0.039	2.000	0.015	0.031
31/32	0.085	0.143	0.123	0.106	0.091	2.000	-0.058	-0.021
33/34	0.083	0.119	0.102	0.088	0.076	2.000	-0.036	-0.005
37/38	0.089	0.149	0.128	0.111	0.095	2.000	-0.060	-0.022
39/40	0.086	0.164	0.141	0.122	0.104	2.000	-0.079	-0.036
41/42	0.089	0.122	0.105	0.091	0.078	2.000	-0.034	-0.002
43/44	0.089	0.153	0.131	0.113	0.097	2.000	-0.064	-0.024
45/46	0.084	0.126	0.108	0.094	0.080	2.000	-0.043	-0.010
49/50	0.089	0.280	0.240	0.207	0.178	2.000	-0.191	-0.119
51/52	0.082	0.097	0.083	0.072	0.062	2.000	-0.014	0.011
53/54	0.084	0.185	0.159	0.137	0.118	2.000	-0.101	-0.053
55/56	0.088	0.176	0.151	0.131	0.112	2.000	-0.089	-0.043
57/58	0.085	0.190	0.163	0.141	0.121	2.000	-0.105	-0.056
59/60	0.090	0.238	0.204	0.177	0.151	2.000	-0.148	-0.087
61/62	0.094	0.311	0.267	0.231	0.198	2.000	-0.217	-0.136
63/64	0.091	0.306	0.262	0.227	0.195	2.000	-0.215	-0.136
69/70	0.089	0.070	0.060	0.052	0.044	2.000	0.019	0.037
71/72	0.124	0.146	0.125	0.108	0.093	1.998	-0.022	0.015
73/74	0.128	0.141	0.121	0.105	0.090	2.000	-0.013	0.023
101/102	0.080	0.048	0.041	0.036	0.031	2.000	0.031	0.044
105/106	0.135	0.057	0.049	0.042	0.036	2.000	0.078	0.093
207/208	0.137	0.638	0.547	0.473	0.406	2.000	-0.501	-0.336

App. Table 1-14 Financial Performance of PR Passenger Trains as of 1985-86 - Ordinary

Train No.	Kms Covered	No. of Pass.	Ested Earnings (Rs)	Terminal Cost (Rs)	Other Direct Cost (Rs)	Total Direct Cost (Rs)	Indirect Cost (Rs)	Total Cost (Rs)	Ested Ave. Travel Distance (kms)	Ested Pass-kms (000)
153/154	614	2237	8652	4474	29565	34039	11846	45885	39	88
155/156	760	2819	10903	5638	36270	41908	14584	56492	39	111
157/158	798	3038	11750	6076	39846	45922	15981	61903	39	120
159/160	760	3477	13446	6954	36270	43224	15042	58266	39	137
161/162	614	3117	12054	6234	36990	43224	15002	58226	39	123
171/172	1004	2402	9288	4804	49309	54113	18831	72944	39	94
173/174	916	2230	8627	4460	52502	56962	19823	76785	39	88
175/176	764	6918	26756	13836	38321	52157	18151	70308	39	272
177/178	1030	2427	9385	4854	52425	57279	19947	77226	39	95
181/182	974	5793	22403	11586	49299	60885	21188	82073	39	228
183/184	880	5542	21433	11084	53057	64141	22321	86462	39	218
185/186	880	3128	12099	6256	52433	58689	20424	79113	39	123
189/190	752	2596	10041	5192	45376	50568	17598	68166	39	102
191/192	1246	5263	20354	10526	76844	87370	30405	117775	39	207
193/194	460	1465	5668	2930	27217	30147	10491	40638	39	58
195/196	468	1660	6420	3320	21926	25246	8786	34032	39	65
201/202	630	1674	6473	3348	36381	39729	13824	53553	39	66
203/204	334	975	3770	1950	20424	22374	7786	30160	39	38
205/206	630	2669	10322	5338	36381	41719	14518	56237	39	105
209/210	216	536	2074	1072	11092	12164	4233	16397	39	21
211/212	926	2698	10435	5396	45743	51139	17796	68935	39	106
215/216	512	3311	12804	6622	33218	39840	13864	53704	39	130
217/218	562	3364	13009	6728	33261	39989	13916	53905	39	132
219/220	882	6197	23968	12394	46109	58503	20359	78862	39	244
221/222	628	3035	11740	6070	30974	37044	12891	49935	39	119
223/224	358	1113	4307	2226	23356	25582	8903	34485	39	44
227/228	176	244	943	488	10269	10757	3743	14500	39	10
251/252	200	435	1685	870	10426	11296	3931	15227	39	17
253/254	200	619	2395	1238	10426	11664	4059	15723	39	24
255/256	200	420	1626	840	10426	11266	3921	15187	39	17
263/264	152	490	1839	980	10286	11266	3921	15187	38	19
265/266	152	625	2414	1250	7805	9055	3151	12206	39	25
265/266	152	625	2414	1250	7805	9055	3151	12206	39	25

267/268	152	738	2536	1476	7805	9281	3230	12511	35	26
269/270	152	556	2070	1112	7805	8917	3103	12020	38	21
271/272	152	639	2166	1278	7805	9083	3161	12244	34	22
273/274	338	600	2320	1200	17343	18543	6453	24996	39	24
275/276	152	548	2101	1096	7805	8901	3098	11999	39	21
281/282	402	154	594	308	25728	26036	9061	35097	39	6
291/292	142	143	555	286	8279	8565	2981	11546	39	6
295/296	168	241	931	482	8247	8729	3038	11767	39	9
297/298	168	315	1219	630	9251	9881	3439	13320	39	12
299/300	272	833	3220	1666	13915	15581	5422	21003	39	33
301/302	272	863	3335	1726	13915	15641	5443	21084	39	34
303/304	272	866	3351	1732	13915	15647	5445	21092	39	34
305/306	244	1005	3889	2010	12815	14825	5159	19984	39	40
307/308	70	47	165	94	4294	4388	1527	5915	35	2
309/310	70	28	102	56	4294	4350	1514	5864	35	1
311/312	244	1590	6150	3180	15026	18206	6336	24542	39	63
321/322	230	455	1418	910	12707	13617	4739	18356	32	14
323/324	238	491	1900	982	14235	15217	5296	20513	39	19
325/326	182	551	2130	1102	9566	10668	3712	14380	39	22
327/328	366	595	2298	1190	20875	22065	7679	29744	39	23
329/330	366	723	2795	1446	21291	22737	7912	30649	39	28
331/332	216	214	826	428	13782	14210	4945	19155	39	8
333/334	204	465	1797	930	12557	13487	4693	18180	39	18
335/336	204	179	691	358	12557	12915	4494	17409	39	7
337/338	148	228	598	456	9123	9579	3333	12912	27	6
339/340	148	228	654	456	9123	9579	3333	12912	29	7
341/342	594	1368	5291	2736	36858	39594	13779	53373	39	54
343/344	330	269	1041	538	18726	19264	6704	25968	39	11
345/346	110	767	2246	1534	7352	8886	3093	11979	30	23
347/348	464	1107	4280	2214	25950	28164	9801	37965	39	44
349/350	100	269	805	538	6903	7441	2590	10031	30	8
351/352	260	2217	8574	4434	14573	19007	6614	25621	39	87
353/354	260	2418	9351	4836	14573	19409	6754	26163	39	95
355/356	522	2062	7976	4124	25206	29330	10207	39537	39	81
357/358	200	1149	4444	2298	11934	14232	4953	19185	39	45
359/360	286	1430	5531	2860	14622	17482	6084	23566	39	56
363/364	284	1868	7224	3736	14531	18267	6357	24624	39	73
365/366	284	1700	6576	3400	14531	17931	6240	24171	39	67
367/368	522	3418	13220	6836	26610	33446	11639	45085	39	134
369/370	522	2925	11312	5850	26220	32070	11160	43230	39	115
371/372	522	1664	6437	3328	27156	30484	10608	41092	39	65
373/374	382	1927	7453	3854	20565	24419	8498	32917	39	76
375/376	278	1415	5473	2830	15173	18003	6265	24268	39	56

377/378	278	1427	5521	2854	15173	18027	6273	24300	39	56
379/380	172	698	2702	1396	8803	10199	3549	13748	39	27
381/382	172	1501	5805	3002	10912	13914	4842	18756	39	59
383/384	172	1347	5209	2694	9820	12514	4355	16869	39	53
385/386	172	1242	4802	2484	10912	13396	4662	18058	39	49
387/388	172	874	3381	1748	9508	11256	3917	15173	39	34
389/390	106	594	1751	1188	5844	7032	2447	9479	30	18
391/392	316	1023	3956	2046	13817	15863	5520	21383	39	40
395/396	210	1201	4473	2402	14409	16811	5850	22661	38	46
397/398	86	384	1036	768	5989	6757	2351	9108	27	11
399/400	86	219	571	438	5989	6427	2237	8664	27	6
401/402	124	754	2572	1508	6650	8158	2839	10997	35	26
403/404	124	719	2449	1438	6650	8088	2815	10903	35	25
405/406	416	1888	7302	3776	21050	24826	8639	33465	39	74
407/408	136	1185	4363	2370	8803	11173	3888	15061	37	44
409/410	136	822	2977	1644	7188	8832	3074	11906	37	30
411/412	136	455	1665	910	8803	9713	3380	13093	37	17
413/414	216	1044	4038	2088	13439	15527	5403	20930	39	41
415/416	216	814	3146	1628	13673	15301	5325	20626	39	32
417/418	310	1474	5702	2948	18506	21454	7466	28920	39	58
421/422	310	1564	6048	3128	18064	21192	7375	28567	39	62
423/424	310	1817	7026	3634	15697	19331	6727	26058	39	71
425/426	310	1729	6686	3458	18064	21522	7490	29012	39	68
427/428	522	4155	16069	8310	26609	34919	12152	47071	39	163
431/432	108	419	1595	838	6092	6930	2412	9342	39	16
451/452	230	180	211	360	11564	11924	4150	16074	12	2
453/454	296	1023	3956	2046	18376	20422	7107	27529	39	40
455/456	336	963	3722	1926	20532	22458	7815	30273	39	38
457/458	192	1266	4896	2532	12379	14911	5189	20100	39	50
459/460	192	600	2319	1200	12379	13579	4725	18304	39	24
461/462	58	43	127	86	3907	3993	1390	5383	29	1
463/464	58	36	105	72	3382	3454	1202	4656	29	1
467/468	230	221	622	442	11564	12006	4178	16184	29	6
469/470	48	702	1786	1404	3368	4772	1661	6433	24	17
471/472	48	597	1488	1194	3368	4562	1588	6150	24	14
475/476	104	168	478	336	5912	6248	2174	8422	29	5
477/478	132	124	357	248	8676	8924	3106	12030	29	4
479/480	104	30	105	60	7166	7226	2515	9741	36	1
481/482	86	63	155	126	5884	6010	2091	8101	25	2
485/486	1270	1408	54453	2816	101884	104700	36436	141136	497	700
487/488	286	1421	5495	2842	18850	21692	7549	29241	39	56
489/490	263	1141	4415	2282	13356	15638	5442	21080	39	45
501/502	196	1211	4684	2422	9723	12145	4226	16371	39	48
503/504	196	552	2133	1104	9723	10827	3768	14595	39	22
505/506	88	858	2133	1716	4883	6599	2296	8895	25	22

Train No.	Earning /pass-km (Rs)	Total Cost /pass-km (Rs)	Total Economic Cost /pass-km (Rs)	Direct Cost /pass-km (Rs)	Direct Economic Cost /pass-km (Rs)	Terminal Cost /pass. (Rs)	Earning less Total Cost /pass-km (Rs)	Earning less Direct Cost /pass-km (Rs)
153/154	0.098	0.521	0.447	0.387	0.332	2.000	-0.423	-0.288
155/156	0.098	0.509	0.437	0.378	0.324	2.000	-0.411	-0.280
157/158	0.098	0.518	0.444	0.384	0.329	2.000	-0.420	-0.286
159/160	0.098	0.426	0.365	0.316	0.271	2.000	-0.328	-0.218
161/162	0.098	0.475	0.407	0.352	0.302	2.000	-0.377	-0.254
171/172	0.098	0.772	0.662	0.573	0.491	2.000	-0.674	-0.474
173/174	0.098	0.875	0.750	0.649	0.556	2.000	-0.777	-0.551
175/176	0.098	0.258	0.221	0.192	0.164	2.000	-0.160	-0.093
177/178	0.098	0.809	0.694	0.600	0.514	2.000	-0.711	-0.502
181/182	0.098	0.360	0.309	0.267	0.229	2.000	-0.262	-0.169
183/184	0.098	0.397	0.340	0.294	0.252	2.000	-0.298	-0.196
185/186	0.098	0.643	0.551	0.477	0.409	2.000	-0.544	-0.379
189/190	0.098	0.667	0.572	0.495	0.424	2.000	-0.569	-0.397
191/192	0.098	0.569	0.488	0.422	0.362	2.000	-0.470	-0.324
193/194	0.098	0.705	0.604	0.523	0.448	2.000	-0.606	-0.425
195/196	0.098	0.521	0.447	0.387	0.331	2.000	-0.423	-0.288
201/202	0.098	0.813	0.697	0.603	0.517	2.000	-0.715	-0.505
203/204	0.098	0.786	0.674	0.583	0.500	2.000	-0.688	-0.485
205/206	0.098	0.536	0.459	0.397	0.341	2.000	-0.437	-0.299
209/210	0.098	0.777	0.666	0.577	0.494	2.000	-0.679	-0.478
211/212	0.098	0.649	0.557	0.482	0.413	2.000	-0.551	-0.383
215/216	0.098	0.412	0.354	0.306	0.262	2.000	-0.314	-0.208
217/218	0.098	0.407	0.349	0.302	0.259	2.000	-0.309	-0.204
219/220	0.098	0.323	0.277	0.240	0.206	2.000	-0.225	-0.142
221/222	0.098	0.418	0.358	0.310	0.266	2.000	-0.320	-0.212
223/224	0.098	0.787	0.675	0.584	0.501	2.000	-0.689	-0.486
227/228	0.098	1.512	1.296	1.121	0.961	2.000	-1.413	-1.023
251/252	0.098	0.888	0.762	0.659	0.565	2.000	-0.790	-0.561
253/254	0.098	0.645	0.553	0.479	0.410	2.000	-0.547	-0.380
255/256	0.098	0.918	0.787	0.681	0.584	2.000	-0.820	-0.583
263/264	0.098	0.812	0.696	0.602	0.516	2.000	-0.713	-0.504
265/266	0.098	0.497	0.426	0.369	0.316	2.000	-0.399	-0.270
265/266	0.098	0.497	0.426	0.369	0.316	2.000	-0.399	-0.270
267/268	0.098	0.485	0.416	0.360	0.308	2.000	-0.387	-0.261
269/270	0.098	0.571	0.489	0.423	0.363	2.000	-0.473	-0.325

271/272	0.098	0.556	0.476	0.412	0.353	2.000	-0.457	-0.314
273/274	0.098	1.059	0.908	0.786	0.674	2.000	-0.961	-0.687
275/276	0.098	0.561	0.481	0.416	0.357	2.000	-0.463	-0.318
281/282	0.098	5.808	4.980	4.309	3.694	2.000	-5.710	-4.210
291/292	0.098	2.045	1.753	1.517	1.301	2.000	-1.947	-1.419
295/296	0.098	1.242	1.065	0.922	0.790	2.000	-1.144	-0.823
297/298	0.098	1.074	0.921	0.797	0.683	2.000	-0.976	-0.699
299/300	0.098	0.641	0.550	0.476	0.408	2.000	-0.543	-0.377
301/302	0.098	0.621	0.533	0.461	0.395	2.000	-0.523	-0.363
303/304	0.098	0.619	0.530	0.459	0.394	2.000	-0.520	-0.361
305/306	0.098	0.505	0.433	0.375	0.321	2.000	-0.407	-0.276
307/308	0.100	3.596	3.083	2.667	2.287	2.000	-3.495	-2.567
309/310	0.104	5.984	5.130	4.439	3.806	2.000	-5.880	-4.335
311/312	0.098	0.392	0.336	0.291	0.250	2.000	-0.294	-0.193
321/322	0.098	1.272	1.091	0.944	0.809	2.000	-1.174	-0.846
323/324	0.098	1.061	0.910	0.787	0.675	2.000	-0.963	-0.689
325/326	0.098	0.664	0.569	0.492	0.422	2.000	-0.565	-0.394
327/328	0.098	1.272	1.091	0.944	0.809	2.000	-1.174	-0.846
329/330	0.098	1.078	0.924	0.800	0.686	2.000	-0.980	-0.701
331/332	0.098	2.280	1.955	1.691	1.450	2.000	-2.181	-1.593
333/334	0.098	0.994	0.853	0.738	0.633	2.000	-0.896	-0.639
335/336	0.098	2.477	2.123	1.837	1.575	2.000	-2.378	-1.739
337/338	0.098	2.122	1.820	1.575	1.350	2.000	-2.024	-1.476
339/340	0.098	1.941	1.664	1.440	1.234	2.000	-1.842	-1.341
341/342	0.098	0.992	0.850	0.736	0.631	2.000	-0.893	-0.637
343/344	0.098	2.452	2.102	1.819	1.560	2.000	-2.354	-1.721
345/346	0.098	0.524	0.450	0.389	0.333	2.000	-0.426	-0.291
347/348	0.098	0.872	0.748	0.647	0.555	2.000	-0.774	-0.549
349/350	0.098	1.225	1.050	0.909	0.779	2.000	-1.127	-0.810
351/352	0.098	0.294	0.252	0.218	0.187	2.000	-0.195	-0.120
353/354	0.098	0.275	0.236	0.204	0.175	2.000	-0.177	-0.106
355/356	0.098	0.487	0.418	0.361	0.310	2.000	-0.389	-0.263
357/358	0.098	0.424	0.364	0.315	0.270	2.000	-0.326	-0.217
359/360	0.098	0.419	0.359	0.311	0.266	2.000	-0.321	-0.212
363/364	0.098	0.335	0.287	0.249	0.213	2.000	-0.237	-0.150
365/366	0.098	0.361	0.310	0.268	0.230	2.000	-0.263	-0.170
367/368	0.098	0.335	0.287	0.249	0.213	2.000	-0.237	-0.150
369/370	0.098	0.376	0.322	0.279	0.239	2.000	-0.277	-0.180
371/372	0.098	0.628	0.538	0.466	0.399	2.000	-0.529	-0.367
373/374	0.098	0.434	0.372	0.322	0.276	2.000	-0.336	-0.224
375/376	0.098	0.436	0.374	0.323	0.277	2.000	-0.338	-0.225
377/378	0.098	0.433	0.371	0.321	0.275	2.000	-0.334	-0.223

379/380	0.098	0.500	0.429	0.371	0.318	2.000	-0.402	-0.273
381/382	0.098	0.318	0.272	0.236	0.202	2.000	-0.219	-0.137
383/384	0.098	0.318	0.273	0.236	0.202	2.000	-0.220	-0.138
385/386	0.098	0.370	0.317	0.274	0.235	2.000	-0.271	-0.176
387/388	0.098	0.441	0.378	0.327	0.281	2.000	-0.343	-0.229
389/390	0.098	0.532	0.456	0.395	0.338	2.000	-0.434	-0.296
391/392	0.098	0.531	0.456	0.394	0.338	2.000	-0.433	-0.296
395/396	0.098	0.498	0.427	0.369	0.317	2.000	-0.400	-0.271
397/398	0.098	0.864	0.741	0.641	0.550	2.000	-0.766	-0.543
399/400	0.098	1.492	1.279	1.106	0.949	2.000	-1.393	-1.008
401/402	0.098	0.420	0.360	0.312	0.267	2.000	-0.322	-0.213
403/404	0.098	0.438	0.375	0.325	0.278	2.000	-0.339	-0.226
405/406	0.098	0.451	0.386	0.334	0.287	2.000	-0.352	-0.236
407/408	0.098	0.339	0.291	0.252	0.216	2.000	-0.241	-0.153
409/410	0.098	0.393	0.337	0.292	0.250	2.000	-0.295	-0.193
411/412	0.098	0.773	0.663	0.573	0.492	2.000	-0.675	-0.475
413/414	0.098	0.510	0.437	0.378	0.324	2.000	-0.411	-0.280
415/416	0.098	0.644	0.553	0.478	0.410	2.000	-0.546	-0.380
417/418	0.098	0.499	0.427	0.370	0.317	2.000	-0.400	-0.272
421/422	0.098	0.464	0.398	0.344	0.295	2.000	-0.366	-0.246
423/424	0.098	0.365	0.313	0.270	0.232	2.000	-0.266	-0.172
425/426	0.098	0.427	0.366	0.316	0.271	2.000	-0.328	-0.218
427/428	0.098	0.288	0.247	0.214	0.183	2.000	-0.190	-0.115
431/432	0.098	0.576	0.494	0.427	0.366	2.000	-0.477	-0.329
451/452	0.098	7.489	6.421	5.555	4.763	2.000	-7.390	-5.457
453/454	0.098	0.684	0.587	0.507	0.435	2.000	-0.586	-0.409
455/456	0.098	0.800	0.686	0.593	0.509	2.000	-0.701	-0.495
457/458	0.098	0.404	0.346	0.299	0.257	2.000	-0.305	-0.201
459/460	0.098	0.776	0.665	0.576	0.494	2.000	-0.678	-0.477
461/462	0.102	4.317	3.701	3.202	2.745	2.000	-4.215	-3.100
463/464	0.101	4.460	3.824	3.308	2.837	2.000	-4.359	-3.208
467/468	0.098	2.558	2.193	1.897	1.627	2.000	-2.459	-1.799
469/470	0.106	0.382	0.327	0.283	0.243	2.000	-0.276	-0.177
471/472	0.104	0.429	0.368	0.318	0.273	2.000	-0.325	-0.215
475/476	0.098	1.732	1.485	1.285	1.102	2.000	-1.634	-1.187
477/478	0.098	3.312	2.840	2.457	2.107	2.000	-3.214	-2.359
479/480	0.098	9.119	7.819	6.765	5.800	2.000	-9.021	-6.667
481/482	0.098	5.138	4.405	3.812	3.268	2.000	-5.039	-3.713
485/486	0.078	0.202	0.173	0.150	0.128	2.000	-0.124	-0.072
487/488	0.098	0.523	0.448	0.388	0.333	2.000	-0.425	-0.290
489/490	0.098	0.469	0.402	0.348	0.299	2.000	-0.371	-0.250
501/502	0.098	0.344	0.295	0.255	0.219	2.000	-0.245	-0.157
503/504	0.098	0.673	0.577	0.499	0.428	2.000	-0.574	-0.401
505/506	0.098	0.410	0.351	0.304	0.261	2.000	-0.312	-0.206

App. Table 1-15 Average Time taken by Through Good Trains on April 2, 1987

Section	Target (hours) each way	Actual		Sections.	Target (hours) each way	Actual	
		Up.	Dn.			Up.	Dn.
KC-KOT	4-45	5-45	5-11				
KOT-TDM	2-30	2-59	2-09				
TDM-ROH	6-45	6-45	6-55	LLM-RWP	6-45	8-15	8-45
ROH-KPR	5-45	8-08	6-45	GLR-PSC	7-15	10-00	9-50
KPR-SMA	3-45	3-50	4-00	KDA-ATCY	9-30	10-30	10-15
SMA-KWL	6-00	6-20	6-02	ATCY-PSC	5-45	5-00	5-30
KWL-SWAL	5-30	7-31	7-10	ROH-SIB	8-30	9-05	9-10
SWAL-LHR	5-30	7-20	7-24	SIB-KLR	5-00	5-09	5-05
LHR-LLM	5-15	7-02	6-40				
SMA-KDA	19-00	23-35	.....				

Source : P.R

App. Table 1-16 Pakistan Railways: Journey Time

Train	Section	April '65 Journey Time.	April '85 Journey Time.	April '87 Journey Time.
5 Up Tezrao	Karachi - Peshawar	32' - 15"	35' - 00"	33' - 15"
6 Dn 〃	Peshawar - Karachi	32' - 45"	35' - 05"	33' - 45"
7 Up Tezgam	Karachi - Rawalpindi	26' - 05"	27' - 00"	25' - 00"
8 Dn 〃	Rawalpindi - Karachi	26' - 10"	26' - 45"	25' - 05"
9 Up Shaheen	Karachi - Sialkot	24' - 45"	27' - 55"	26' - 50"
10 Dn 〃	Sialkot - Karachi	25' - 15"	28' - 40"	27' - 40"
3 UP Bolan	Karachi - Quetta	19' - 40"	21' - 10"	20' - 25"
4 Dn 〃	Quetta - Karachi	20' - 10"	21' - 10"	20' - 45"
33/24 Up Quetta Exp.	Quetta - Rawalpindi	29' - 15"	32' - 45"	31' - 40"
34/24 Dn 〃 〃	Rawalpindi - Quetta	29' - 50"	32' - 30"	31' - 05"
43 Up Rachna	Lahore - Faisalabad	2' - 0"	2' - 55"	2' - 30"
44 Dn 〃	Faisalabad - Lahore	2' - 0"	2' - 55"	2' - 20"

Source : P.R. TIME TABLE

App. Table 1-17 Renewal of Tracks

Period	Track Length (km)	
	Rail	Sleepers
1	2	3
1st plan (1955-60)	1,922	1,365
2nd plan (1960-65)	1,467	2,320
3rd plan (1965-70)	973	1,189
4th plan (1970-75)	1,196	1,713
5th plan (1978-83)	474	630
6th plan (1984-88) *	499	633
Total	6,531	7,850

* Provisional
Source : P.R. TRACK REHABILITATION AND IMPROVEMENT PROGRAM (1977-83)

App. Table 1-18 Statement Showing Position of Overage/Worm Out Rail & Sleepers on 30-6-1988 (If no Renewals are Carried Out)

DIVISION	LENGTH OF OVERAGE (Km)	
	RAILS	SLEEPERS
Sukkur	929.66	930.03
Rawalpindi	1,099.49	940.03
Quetta	1,346.10	1,074.26
Multan	1,107.60	829.83
Lahore	983.32	785.99
Karachi	818.39	761.71
Total :	6,284.56	5,321.85
Say :	6,285.00	5,322.00

Source : P.R.

App. Table 1-19 Inventory of Motive Power Rolling Stock (Actual Numbers) Broad Gauge Lines

(22, 03, 1987)

		Steam Locomotive			Diesel Electric Locomotive			Electric Locomotive	Diesel Railcars	Trailers	Passenger Coaching Vehicles	Other Coaching Vehicles	Freight Wagons	
													4 Wheelers	Bogies
Total in fleet		241 *			524+8=532			29	20	138	2362	466	30768	3416
		Main Line	Branch Line	Shunter	Main Line	Branch Line	Shunter							
Age	Steam Less than 20 years	-	-	-										
	Bet.21 & 45 years	4	20	9										
	Over 46 years	5	33	103										
	Diesel Elect: Less than 10 years				122	48	22							
	Bet.11 & 20 years				73	40	7							
	Bet.21 & 30 years				24	65	40							
	Over 31 years.				-	-	-							
	Electric. Less than 10 years							-						
	Bet.11 & 20 years							29						
	Bet.21 & 35 years							-						
	Over 36 years.							-						
	Passenger Less 10 years								-	12	1148	63		
	Carriers. Bet.11 & 35 years								20	126	1157	251		
	Bet.36 & 45 years								-	-	10	23		
	Over 45 years.								-	-	47	129		
	Freight Less than 10 years												1657	
	Wagon Bet. 11 & 40 years												27515	* *
	Bet.41 & 45 years												2330	
	Over 45 years.												2682	
	Carrying Less than 10 tons												-	-
	Capacity Bet. 11 & 15 tons												-	-
	of Bet. 16 & 20 tons												30768	-
	Freight Bet. 21 & 25 tons												-	3059
	Wagon Bet. 26 & 30 tons												-	-
	Bet. 31 & 35 tons												-	-
	Bet. 36 & 40 tons												-	-
	Bet. 41 & 45 tons												-	-
	Bet. 46 & 50 tons												-	60
	Over 51 tons												-	297

Note:- *) Only 189 Locomotives are in working out of which 15 Nos. are ineffective. The remaining 52 steam Locomotives are stored.

* *) Life of Bogie stock not available. For the purpose it is amalgamated with four wheelers.

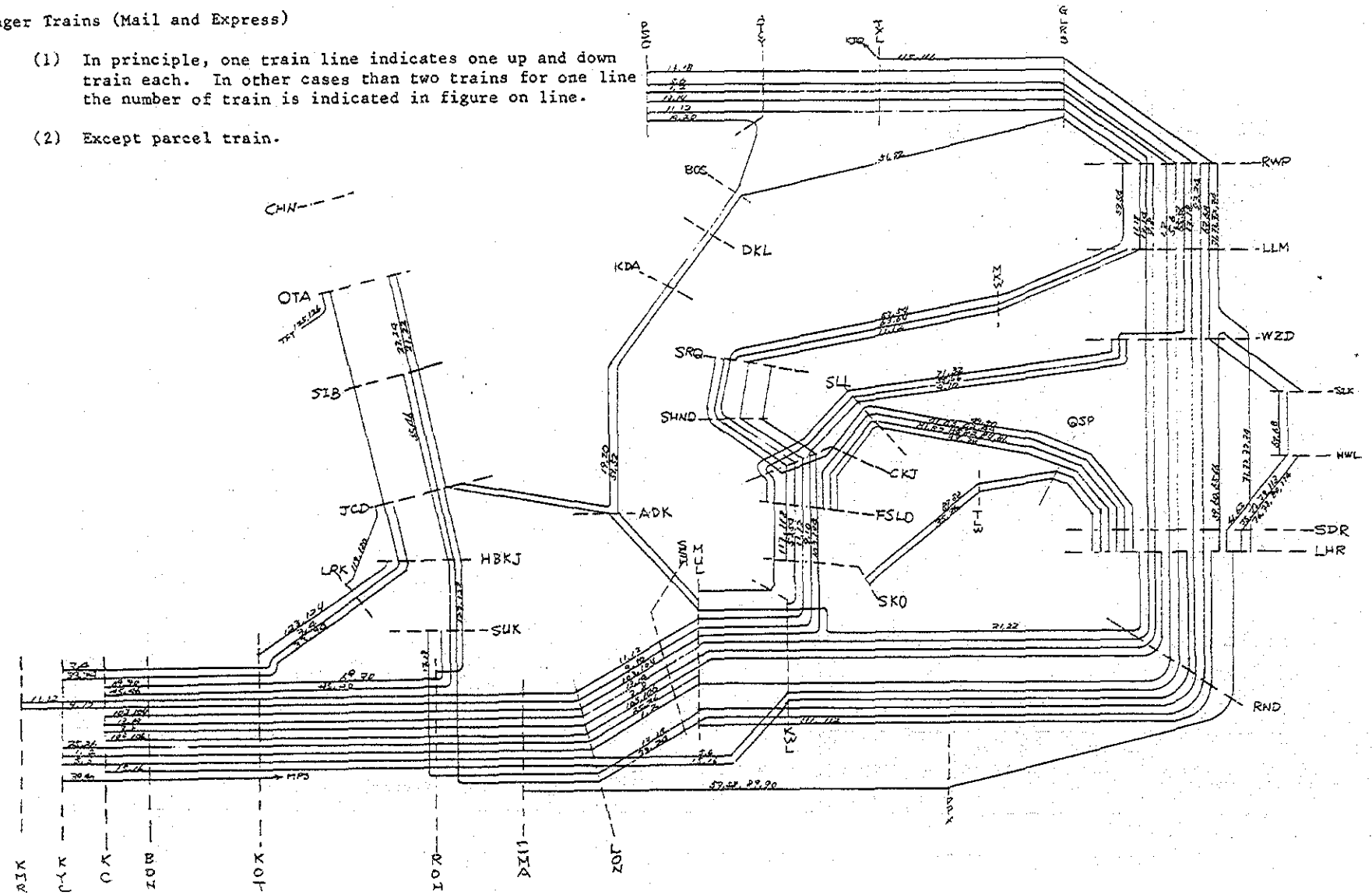
Source: P. R.

App. Fig. 1-1 Train Operation System Diagram (1)

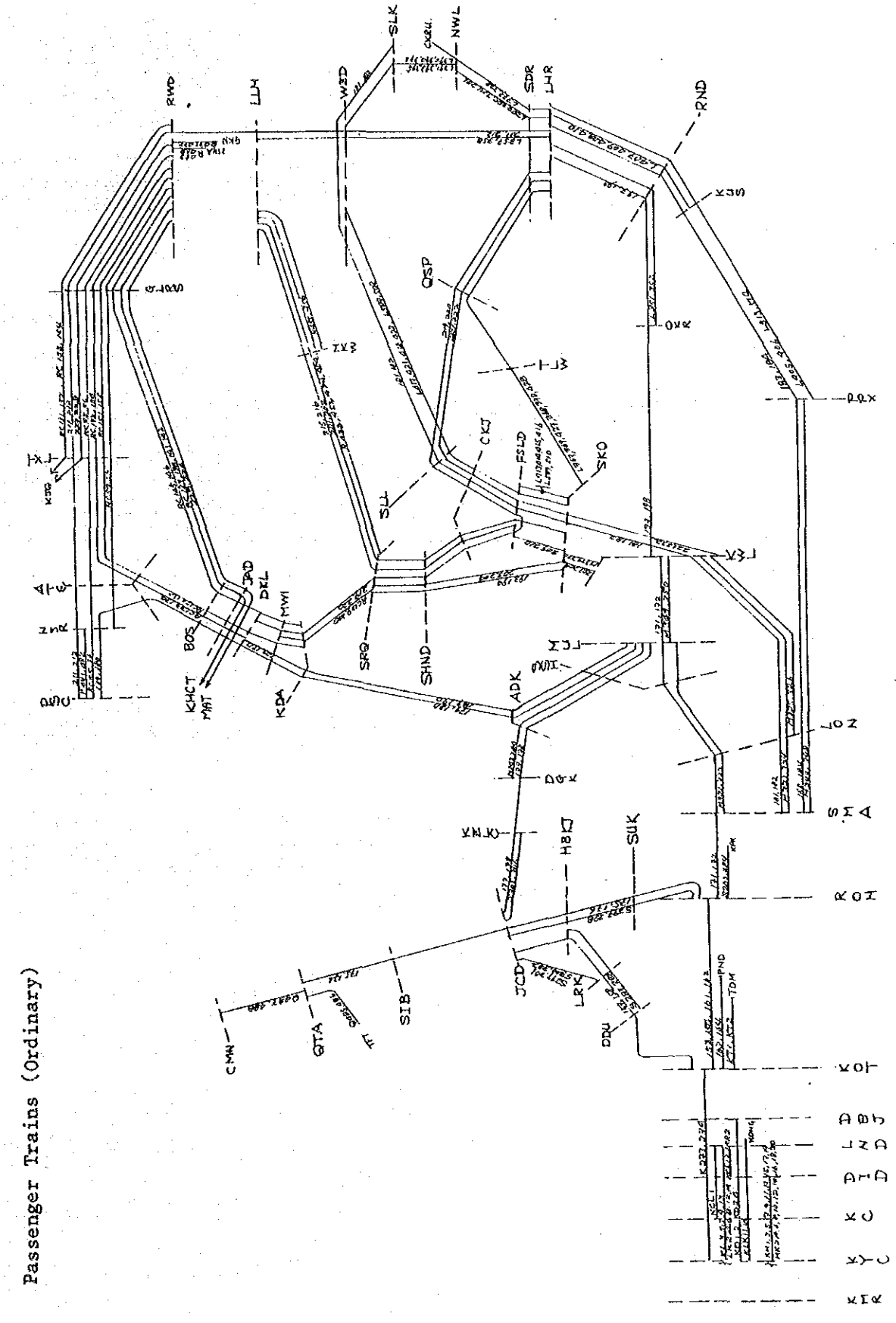
Passenger Trains (Mail and Express)

Note: (1) In principle, one train line indicates one up and down train each. In other cases than two trains for one line the number of train is indicated in figure on line.

(2) Except parcel train.



App. Fig. 1-1 Train Operation System Diagram (2)



Appendix 2 : Railway Assigned Traffic Volume (1)-(6)

(1) 1985/86 RAILWAY LINK VOLUME (Passenger/Day)

LINK#	FROM	TO	KM	UPPER	LOWER	TOTAL
1	1	2	40.0	902	25,426	26,328
2	2	3	128.7	902	25,375	26,277
3	3	4	8.5	902	25,083	25,985
4	4	5	99.4	0	51	51
5	4	6	67.0	41	4,846	4,887
6	4	7	54.3	1,004	33,291	34,295
7	7	8	60.3	979	28,535	29,514
8	8	9	117.5	984	29,341	30,325
9	9	10	25.3	975	28,522	29,497
10	10	11	36.3	210	5,910	6,120
11	11	12	51.5	212	5,934	6,146
12	11	13	61.2	21	1,529	1,550
13	12	13	135.1	0	0	0
14	10	14	212.2	882	25,399	26,281
15	14	15	122.9	846	21,657	22,503
16	15	16	27.8	840	21,118	21,958
17	16	17	67.1	520	13,139	13,659
18	16	18	91.0	253	6,209	6,462
19	17	18	64.0	516	14,477	14,993
20	18	19	118.0	618	15,936	16,554
21	19	20	126.4	605	16,331	16,936
22	16	21	343.4	67	1,771	1,838
23	15	61	182.2	4	455	459
24	20	21	26.6	67	1,771	1,838
25	20	22	40.0	672	18,102	18,774
26	22	23	7.2	602	28,912	29,514
27	23	26	92.8	189	11,602	11,791
28	25	26	42.4	28	7,416	7,444
29	24	25	61.5	47	2,857	2,904
30	23	24	78.6	93	5,714	5,807
31	23	28	32.8	341	13,576	13,917
32	27	28	57.8	4	7,978	7,982
33	26	27	110.2	9	3,568	3,577
34	28	29	220.2	0	0	0
35	27	30	24.9	13	11,547	11,560
36	29	30	126.4	8	10,271	10,279
37	18	29	62.5	93	8,983	9,076
38	29	31	59.7	36	3,550	3,586
39	31	32	86.7	22	6,795	6,817
40	30	32	68.1	5	1,275	1,280
41	32	33	19.6	21	6,484	6,505
42	33	35	74.5	2	1,791	1,793
43	33	34	45.4	6	1,694	1,700
44	34	35	95.3	2	157	159
45	35	36	72.3	4	1,948	1,952
46	26	36	32.6	266	13,571	13,837
47	36	37	29.6	262	12,543	12,805
48	37	39	83.3	237	10,867	11,104
49	38	39	74.6	0	0	0
50	39	40	39.3	237	10,867	11,104
51	40	41	32.0	49	4,038	4,087
52	41	42	50.0	50	3,298	3,348
53	42	43	31.0	10	489	499
54	40	43	89.3	7	1,709	1,716
55	41	49	55.0	3	1,151	1,154
56	42	62	48.7	49	1,617	1,666
57	46	62	23.0	2	196	198
58	46	47	42.1	0	23	23
59	45	62	43.1	47	1,421	1,468
60	43	44	26.5	17	2,198	2,215
61	44	48	60.3	1	436	437
62	44	50	87.4	17	1,843	1,860
63	50	51	49.8	17	1,848	1,865
64	50	52	82.6	0	5	5
65	52	53	75.0	0	0	0
66	34	51	85.4	8	1,851	1,859
67	51	54	230.5	15	850	865
68	17	54	71.6	9	2,403	2,412
69	54	55	77.6	16	862	878
70	12	55	350.0	23	611	634
71	12	56	155.8	235	5,294	5,529
72	56	57	116.3	235	5,258	5,493
73	57	58	24.6	243	5,448	5,691
74	57	60	154.6	8	102	110
75	58	59	328.1	0	0	0
76	3	13	284.9	33	1,997	2,030

(2) 1992/93 RAILWAY LINK VOLUME (Passenger/Day)

LINK#	FROM	TO	KM	UPPER	LOWER	TOTAL
1	1	2	40.0	1,454	29,912	31,366
2	2	3	128.7	1,454	29,875	31,329
3	3	4	8.5	1,429	29,741	31,170
4	4	5	99.4	0	51	51
5	4	6	67.0	40	4,850	4,890
6	4	7	54.3	1,625	38,395	40,020
7	7	8	60.3	1,599	33,717	35,316
8	8	9	117.5	1,604	34,678	36,282
9	9	10	25.3	1,595	33,884	35,479
10	10	11	36.3	342	6,373	6,715
11	11	12	51.5	344	6,398	6,742
12	11	13	61.2	20	1,527	1,547
13	12	13	135.1	0	0	0
14	10	14	212.2	1,407	31,077	32,484
15	14	15	122.9	1,405	26,441	27,846
16	15	16	27.8	1,401	25,830	27,231
17	16	17	67.1	868	16,159	17,027
18	16	18	91.0	414	7,571	7,985
19	17	18	64.0	844	17,242	18,086
20	18	19	118.0	1,078	18,897	19,975
21	19	20	126.4	1,064	19,331	20,395
22	16	21	343.4	118	2,100	2,218
23	15	61	182.2	3	435	438
24	20	21	26.6	118	2,100	2,218
25	20	22	40.0	1,182	21,431	22,613
26	22	23	7.2	1,061	30,804	31,865
27	23	26	92.8	458	12,504	12,962
28	25	26	42.4	27	7,493	7,520
29	24	25	61.5	113	3,079	3,192
30	23	24	78.6	226	6,159	6,385
31	23	28	32.8	399	14,121	14,520
32	27	28	57.8	4	7,978	7,982
33	26	27	110.2	13	3,660	3,673
34	28	29	220.2	0	0	0
35	27	30	24.9	17	11,638	11,655
36	29	30	126.4	12	10,363	10,375
37	18	29	62.5	149	9,379	9,528
38	29	31	59.7	54	3,550	3,604
39	31	32	86.7	42	6,844	6,886
40	30	32	68.1	5	1,275	1,280
41	32	33	19.6	40	6,533	6,573
42	33	35	74.5	2	1,789	1,791
43	33	34	45.4	8	1,694	1,702
44	34	35	95.3	2	157	159
45	35	36	72.3	4	1,946	1,950
46	26	36	32.6	649	14,810	15,459
47	36	37	29.6	636	13,738	14,374
48	37	39	83.3	612	11,959	12,571
49	38	39	74.6	0	0	0
50	39	40	39.3	612	11,959	12,571
51	40	41	32.0	400	4,611	5,011
52	41	42	50.0	387	3,866	4,253
53	42	43	31.0	80	776	856
54	40	43	89.3	2	1,711	1,713
55	41	49	55.0	17	1,157	1,174
56	42	62	48.7	457	2,369	2,826
57	46	62	23.0	71	227	298
58	46	47	42.1	5	23	28
59	45	62	43.1	386	2,142	2,528
60	43	44	26.5	82	2,487	2,569
61	44	48	60.3	1	436	437
62	44	50	87.4	82	2,132	2,214
63	50	51	49.8	100	3,046	3,146
64	50	52	82.6	18	913	931
65	52	53	75.0	2	47	49
66	34	51	85.4	10	1,851	1,861
67	51	54	230.5	96	2,046	2,142
68	17	54	71.6	32	2,657	2,689
69	54	55	77.6	82	1,870	1,952
70	12	55	350.0	86	1,700	1,786
71	12	56	155.8	428	6,820	7,248
72	56	57	116.3	417	6,650	7,067
73	57	58	24.6	421	6,822	7,243
74	57	60	154.6	8	102	110
75	58	59	328.1	0	661	661
76	3	13	284.9	33	1,997	2,030

(3) 2005/06 RAILWAY LINK VOLUME (Passenger/Day)

LINK#	FROM	TO	KM	UPPER	LOWER	TOTAL
1	1	2	40.0	1,737	41,624	43,361
2	2	3	128.7	1,738	41,595	43,333
3	3	4	8.5	1,727	42,118	43,845
4	4	5	99.4	0	51	51
5	4	6	67.0	41	4,887	4,928
6	4	7	54.3	2,031	51,709	53,740
7	7	8	60.3	2,005	47,105	49,110
8	8	9	117.5	2,010	48,365	50,375
9	9	10	25.3	2,001	47,613	49,614
10	10	11	36.3	380	7,560	7,940
11	11	12	51.5	383	7,597	7,980
12	11	13	61.2	20	1,516	1,536
13	12	13	135.1	0	0	0
14	10	14	212.2	1,842	45,329	47,171
15	14	15	122.9	1,849	38,673	40,522
16	15	16	27.8	1,842	36,899	38,741
17	16	17	67.1	1,138	23,046	24,184
18	16	18	91.0	546	10,873	11,419
19	17	18	64.0	1,112	23,946	25,058
20	18	19	118.0	1,436	26,817	28,253
21	19	20	126.4	1,420	27,058	28,478
22	16	21	343.4	158	2,980	3,138
23	15	61	182.2	3	481	484
24	20	21	26.6	158	2,980	3,138
25	20	22	40.0	1,578	30,038	31,616
26	22	23	7.2	1,401	35,678	37,079
27	23	26	92.8	622	14,926	15,548
28	25	26	42.4	28	7,576	7,604
29	24	25	61.5	153	3,676	3,829
30	23	24	78.6	306	7,352	7,658
31	23	28	32.8	494	15,380	15,874
32	27	28	57.8	4	7,978	7,982
33	26	27	110.2	18	3,714	3,732
34	28	29	220.2	0	0	0
35	27	30	24.9	22	11,693	11,715
36	29	30	126.4	17	10,417	10,434
37	18	29	62.5	180	10,520	10,700
38	29	31	59.7	63	3,868	3,931
39	31	32	86.7	50	7,026	7,076
40	30	32	68.1	5	1,275	1,280
41	32	33	19.6	48	6,714	6,762
42	33	35	74.5	2	1,789	1,791
43	33	34	45.4	9	1,694	1,703
44	34	35	95.3	2	157	159
45	35	36	72.3	4	1,946	1,950
46	26	36	32.6	891	18,188	19,079
47	36	37	29.6	877	17,014	17,891
48	37	39	83.3	847	15,028	15,875
49	38	39	74.6	0	0	0
50	39	40	39.3	847	15,028	15,875
51	40	41	32.0	592	5,628	6,220
52	41	42	50.0	579	4,883	5,462
53	42	43	31.0	126	897	1,023
54	40	43	89.3	2	2,041	2,043
55	41	49	55.0	17	1,156	1,173
56	42	62	48.7	695	3,431	4,126
57	46	62	23.0	73	231	304
58	46	47	42.1	8	24	32
59	45	62	43.1	622	3,199	3,821
60	43	44	26.5	129	2,939	3,068
61	44	48	60.3	1	436	437
62	44	50	87.4	128	2,585	2,713
63	50	51	49.8	147	4,291	4,438
64	50	52	82.6	19	1,706	1,725
65	52	53	75.0	3	80	83
66	34	51	85.4	11	1,851	1,862
67	51	54	230.5	144	3,322	3,466
68	17	54	71.6	35	2,842	2,877
69	54	55	77.6	129	2,717	2,846
70	12	55	350.0	132	2,551	2,683
71	12	56	155.8	513	8,588	9,101
72	56	57	116.3	500	8,232	8,732
73	57	58	24.6	502	8,232	8,734
74	57	60	154.6	8	102	110
75	58	59	328.1	0	1,324	1,324
76	3	13	284.9	33	1,997	2,030

(4)' 1985/86 RAILWAY LINK VOLUME (Ton/Day)

LINK#	FROM	TO	KM	FROM-->TO	TO-->FROM	TOTAL
1	1	2	40.0	9,409	2,387	11,796
2	2	3	128.7	11,444	3,377	14,821
3	3	4	8.5	11,683	3,304	14,987
4	4	5	99.4	0	0	0
5	4	6	67.0	193	47	240
6	4	7	54.3	12,928	3,381	16,309
7	7	8	60.3	12,943	3,483	16,426
8	8	9	117.5	12,973	3,545	16,518
9	9	10	25.3	13,031	3,563	16,594
10	10	11	36.3	1,652	2,134	3,786
11	11	12	51.5	1,622	1,802	3,424
12	11	13	61.2	45	347	392
13	12	13	135.1	0	0	0
14	10	14	212.2	13,298	2,621	15,919
15	14	15	122.9	13,228	2,518	15,746
16	15	16	27.8	12,874	2,601	15,475
17	16	17	67.1	6,207	4,063	10,270
18	16	18	91.0	8,965	1,511	10,476
19	17	18	64.0	2,988	504	3,492
20	18	19	118.0	7,808	1,213	9,021
21	19	20	126.4	7,188	1,112	8,300
22	16	21	343.4	799	124	923
23	15	61	182.2	113	106	219
24	20	21	26.6	799	124	923
25	20	22	40.0	7,986	1,235	9,221
26	22	23	7.2	4,042	1,334	5,376
27	23	26	92.8	2,309	714	3,023
28	25	26	42.4	166	243	409
29	24	25	61.5	569	176	745
30	23	24	78.6	1,138	352	1,490
31	23	28	32.8	613	286	899
32	27	28	57.8	188	79	267
33	26	27	110.2	44	188	232
34	28	29	220.2	0	0	0
35	27	30	24.9	123	377	500
36	29	30	126.4	228	110	338
37	18	29	62.5	2,488	528	3,016
38	29	31	59.7	648	461	1,109
39	31	32	86.7	484	505	989
40	30	32	68.1	14	148	162
41	32	33	19.6	491	646	1,137
42	33	35	74.5	60	34	94
43	33	34	45.4	290	305	595
44	34	35	95.3	0	0	0
45	35	36	72.3	60	34	94
46	26	36	32.6	2,658	569	3,227
47	36	37	29.6	2,215	786	3,001
48	37	39	83.3	2,215	786	3,001
49	38	39	74.6	0	0	0
50	39	40	39.3	2,215	786	3,001
51	40	41	32.0	1,060	230	1,290
52	41	42	50.0	480	192	672
53	42	43	31.0	476	2,456	2,932
54	40	43	89.3	435	445	880
55	41	49	55.0	633	91	724
56	42	62	48.7	2,616	222	2,838
57	46	62	23.0	12	542	554
58	46	47	42.1	247	1	248
59	45	62	43.1	224	2,088	2,312
60	43	44	26.5	910	2,901	3,811
61	44	48	60.3	448	169	617
62	44	50	87.4	907	3,177	4,084
63	50	51	49.8	892	3,210	4,102
64	50	52	82.6	59	12	71
65	52	53	75.0	12	7	19
66	34	51	85.4	290	305	595
67	51	54	230.5	1,051	3,417	4,468
68	17	54	71.6	3,218	3,559	6,777
69	54	55	77.6	928	742	1,670
70	12	55	350.0	74	9	83
71	12	56	155.8	1,557	1,396	2,953
72	56	57	116.3	1,267	568	1,835
73	57	58	24.6	1,085	532	1,617
74	57	60	154.6	213	43	256
75	58	59	328.1	0	1	1
76	3	13	284.9	0	0	0

(5) 1992/93 RAILWAY LINK VOLUME (Ton/Day)

LINK#	FROM	TO	KM	FROM-->TO	TO-->FROM	TOTAL
1	1	2	40.0	14,713	9,372	24,085
2	2	3	128.7	14,815	9,668	24,483
3	3	4	8.5	15,137	9,702	24,839
4	4	5	99.4	221	54	275
5	4	6	67.0	272	47	319
6	4	7	54.3	15,512	10,441	25,953
7	7	8	60.3	15,542	10,477	26,019
8	8	9	117.5	15,503	10,653	26,156
9	9	10	25.3	15,528	10,671	26,199
10	10	11	36.3	1,331	3,017	4,348
11	11	12	51.5	1,167	2,844	4,011
12	11	13	61.2	178	188	366
13	12	13	135.1	0	0	0
14	10	14	212.2	16,323	9,981	26,304
15	14	15	122.9	16,157	10,066	26,223
16	15	16	27.8	15,676	9,788	25,464
17	16	17	67.1	5,501	4,665	10,166
18	16	18	91.0	9,350	4,991	14,341
19	17	18	64.0	3,117	1,664	4,781
20	18	19	118.0	9,700	3,931	13,631
21	19	20	126.4	8,807	2,563	11,370
22	16	21	343.4	979	285	1,264
23	15	61	182.2	176	379	555
24	20	21	26.6	979	285	1,264
25	20	22	40.0	9,785	2,847	12,632
26	22	23	7.2	6,170	2,655	8,825
27	23	26	92.8	3,590	1,461	5,051
28	25	26	42.4	296	266	562
29	24	25	61.5	884	360	1,244
30	23	24	78.6	1,768	720	2,488
31	23	28	32.8	828	491	1,319
32	27	28	57.8	66	33	99
33	26	27	110.2	59	20	79
34	28	29	220.2	0	0	0
35	27	30	24.9	92	86	178
36	29	30	126.4	39	79	118
37	18	29	62.5	2,008	1,632	3,640
38	29	31	59.7	1,156	930	2,086
39	31	32	86.7	743	482	1,225
40	30	32	68.1	13	47	60
41	32	33	19.6	747	520	1,267
42	33	35	74.5	34	13	47
43	33	34	45.4	34	68	102
44	34	35	95.3	0	0	0
45	35	36	72.3	34	13	47
46	26	36	32.6	4,199	1,321	5,520
47	36	37	29.6	3,792	1,461	5,253
48	37	39	83.3	3,311	1,271	4,582
49	38	39	74.6	0	0	0
50	39	40	39.3	3,311	1,271	4,582
51	40	41	32.0	1,734	589	2,323
52	41	42	50.0	210	131	341
53	42	43	31.0	1,709	1,361	3,070
54	40	43	89.3	202	75	277
55	41	49	55.0	1,552	486	2,038
56	42	62	48.7	1,296	1,061	2,357
57	46	62	23.0	506	345	851
58	46	47	42.1	139	328	467
59	45	62	43.1	558	953	1,511
60	43	44	26.5	1,911	1,436	3,347
61	44	48	60.3	214	330	544
62	44	50	87.4	2,151	1,561	3,712
63	50	51	49.8	2,274	1,858	4,132
64	50	52	82.6	317	143	460
65	52	53	75.0	109	99	208
66	34	51	85.4	34	68	102
67	51	54	230.5	2,714	2,144	4,858
68	17	54	71.6	2,384	3,002	5,386
69	54	55	77.6	313	161	474
70	12	55	350.0	9	12	21
71	12	56	155.8	1,182	2,581	3,763
72	56	57	116.3	826	1,944	2,770
73	57	58	24.6	522	1,127	1,649
74	57	60	154.6	245	380	625
75	58	59	328.1	108	783	891
76	3	13	284.9	0	0	0

(6) 2005/06 RAILWAY LINK VOLUME (Ton/Day)

LINK#	FROM	TO	KM	FROM-->TO	TO-->FROM	TOTAL
1	1	2	40.0	27,133	35,107	62,240
2	2	3	128.7	27,639	35,973	63,612
3	3	4	8.5	28,564	35,925	64,489
4	4	5	99.4	1,128	115	1,243
5	4	6	67.0	819	147	966
6	4	7	54.3	30,297	39,577	69,874
7	7	8	60.3	30,420	39,699	70,119
8	8	9	117.5	30,368	40,245	70,613
9	9	10	25.3	30,707	40,572	71,279
10	10	11	36.3	3,762	12,490	16,252
11	11	12	51.5	3,425	12,121	15,546
12	11	13	61.2	379	411	790
13	12	13	135.1	0	0	0
14	10	14	212.2	34,308	35,722	70,030
15	14	15	122.9	33,720	35,624	69,344
16	15	16	27.8	32,240	33,932	66,172
17	16	17	67.1	11,509	16,809	28,318
18	16	18	91.0	19,094	16,742	35,836
19	17	18	64.0	6,365	5,581	11,946
20	18	19	118.0	19,863	10,584	30,447
21	19	20	126.4	18,884	7,581	26,465
22	16	21	343.4	2,098	842	2,940
23	15	61	182.2	385	1,092	1,477
24	20	21	26.6	2,098	842	2,940
25	20	22	40.0	20,982	8,423	29,405
26	22	23	7.2	11,364	7,724	19,088
27	23	26	92.8	6,681	4,339	11,020
28	25	26	42.4	698	527	1,225
29	24	25	61.5	1,645	1,069	2,714
30	23	24	78.6	3,290	2,137	5,427
31	23	28	32.8	1,613	1,467	3,080
32	27	28	57.8	207	94	301
33	26	27	110.2	183	65	248
34	28	29	220.2	0	0	0
35	27	30	24.9	277	272	549
36	29	30	126.4	120	240	360
37	18	29	62.5	3,370	6,199	9,569
38	29	31	59.7	1,495	3,699	5,194
39	31	32	86.7	1,021	1,885	2,906
40	30	32	68.1	37	152	189
41	32	33	19.6	1,028	2,008	3,036
42	33	35	74.5	115	37	152
43	33	34	45.4	242	290	532
44	34	35	95.3	0	0	0
45	35	36	72.3	115	37	152
46	26	36	32.6	8,030	4,997	13,027
47	36	37	29.6	7,357	5,445	12,802
48	37	39	83.3	6,660	4,919	11,579
49	38	39	74.6	0	0	0
50	39	40	39.3	6,660	4,919	11,579
51	40	41	32.0	3,192	3,025	6,217
52	41	42	50.0	894	765	1,659
53	42	43	31.0	4,804	3,521	8,325
54	40	43	89.3	597	261	858
55	41	49	55.0	2,823	2,785	5,608
56	42	62	48.7	3,190	2,877	6,067
57	46	62	23.0	1,408	429	1,837
58	46	47	42.1	147	928	1,075
59	45	62	43.1	1,478	2,769	4,247
60	43	44	26.5	5,401	3,782	9,183
61	44	48	60.3	294	1,103	1,397
62	44	50	87.4	6,239	3,811	10,050
63	50	51	49.8	6,768	4,304	11,072
64	50	52	82.6	565	601	1,166
65	52	53	75.0	321	438	759
66	34	51	85.4	242	290	532
67	51	54	230.5	8,124	4,399	12,523
68	17	54	71.6	5,144	11,228	16,372
69	54	55	77.6	1,527	1,261	2,788
70	12	55	350.0	30	31	61
71	12	56	155.8	3,466	11,475	14,941
72	56	57	116.3	2,605	8,774	11,379
73	57	58	24.6	1,910	7,290	9,200
74	57	60	154.6	631	579	1,210
75	58	59	328.1	390	3,556	3,946
76	3	13	284.9	0	0	0

Appendix 3. Process of Calculation of No. of Trains and Rolling Stock

1. Calculation of No. of Trains

(a) In Case of Passenger Trains

1) Calculation of No. of Trains

The formula for calculation of No. of Trains is shown below:

$$N = \frac{V}{C} \times 0.7$$

where: N: No. of trains
V: Assigned traffic volume (one way)
0.7: Conversion factor to assigned traffic volume
C: 1,188 (average seating capacity)

Average seating capacity is decided under the consideration to increase upper class passengers. It is shown below:

Code			Seat	
AC	-	2	32	Upper class
N	-	2	56	
SLR	-	1	44	Lower class
S/F	-	12	1,056	
Total		17 coaches	1,188	

2) Necessary No. of Trains on Operation (NP_1)

It is decided in the light of existing operation system and the location of reversing station.

(b) In Case of Freight Trains

1) Calculation of Necessary No. of Trains (N)

The formula for calculation of necessary No. of trains is shown below:

$$N_F = \frac{W}{T \times E} \times 1.1$$

where: N_F: Number of trains
W: Freight traffic volume (one way)
T: Sectionwise tractive capacity per engine (2000t, 1800t, 1100t, 600t)
E: 0.6 (loading capacity ratio in case of 25% vacant car ratio)
1.1: Coefficient of unduration.

2. Calculation of No. of Locomotives

(a) In Case of Passenger Trains

1) Calculation of Train - Kms (T.K)

Average No. of trains by section (NP_2) = Necessary No. of trains NP (NP_1) + No. of existing ordinary trains

T·K = NP_2 x Distance of section x 2

2) Calculation of Necessary No. of Locomotives

No. of locomotives = Train-Kms ÷ engine-Kms x spare ratio (1.15). The way of thinking about engine-Kms is described in section 3.

(b) In Case of Freight Trains

1) Calculation of train-Km (T.K)

T.K. = Necessary No. of trains (NF) x Distance by section x 2.

2) Calculation of necessary No. of Locomotives.

Same as passenger trains.

3) Calculation of total necessary No. of D.E.L.

Total necessary number of D.E.L. includes No. of D.E.L. for shunting and pilot in 2005-06.

Necessary No. of D.E.L. (for shunting and pilot)
= (No. of E.L. + No. of D.E.L) x 0.3

Coefficient (0.3) mean the ratio of No. of D.E.L. for shunting and pilot to total No. of D.E.L. for freight based on actual result in 1985-86.

However, in case of 1992-93, 125 locomotives are appropriated for Shunting and pilot, as existing No. of locomotives for shunting and pilot are 125 locomotives.

3. Calculation of Engine-Kms in the Future

(1) Present engine-Kms which is the base for calculation of No. of locomotives.

According to Pakistan Railway year book P-138, engine-Kms of E.L. for freight is set for 300 km/day in the light of actual results in 1979-80.

The engine-Kms of D.E.L. for freight is also set for 210 km/day taking into account the actual results in several past years.

In regard to the engine-Kms of E.L. for passenger it is calculated based on the engine-Kms of E.L. for goods in 1986-87, as shown below:

Engine-Kms of E.L. for passenger = Engine-Kms of E.L. for freight (300) x 1.93*
= 570 km/day.

The measuring of co-efficient (1.93) is shown below:

According to Pakistan Railway year book P-138

All engine-Kms of E.L. in use and freight engine-Kms of E.L. in use was 287 km/day and 228 km/day, respectively.

These figures were attained by 7 E.L. for passenger and 18 E.L. for goods.

Therefore, engine-Kms of E.L. for passenger $\frac{287x25 - 228x18}{7} = 439^k$

Co-efficient x = 439/228 = 1.93

With regard to engine-Kms of D.E.L. for passenger, it is calculated by the following formula.

Engine-Kms of D.E.L. for passenger = 28,428*/(192** x 365)
= 410 kms/day

* Train-Kms in 1985-86
** Assigned No. of D.E.L. for passenger.

Conclusion of Basic Engine-Kms

	Goods	Passenger
E.L.	300	570
D.E.L.	210	410

(2) Engine-Kms in Future

Engine-Kms in future is determined in view of increasing the efficiency due to speed up, improvement of signalling, long run operation and so on.

Engine-Kms in future are shown in the following table.

Engine-Kms in the Future

	1992-93*	2005-06		Remarks
E.L.				
Goods	300	360	(140)**	Efficiency will increase about 20% due to speed-up improvement of signalling and long rund operation.
Passenger	570	680	(270)	"
D.E.L.				
Goods	210	250		"
Passenger	410	490		"

* It is not considered to increase efficiency due to process of investments in 1992-93.

** The section between Sibi and Quetta has decreased efficiency about 20% due to steep grade.

In case of calculating number of trains, this section needs 2 locomotives for transport. It was considered decreasing the efficiency about 40% on calculation.

4. Calculation of Number of Wagons

As already stated in Interim Report, when the average turn round time is 16 days, about 25,000 wagons are needed to transport 8,269 billion ton-Kms freight.

On the assumption that the number of wagons for freight transport is directly proportionate to ton-Kms, and considering that the turn round time is reduced to 10.2 days by the speed up of freight trains, introduction of wagon control system, improvement in collection of freight at stations.

It is concluded that 67,630 wagons are needed for the estimated freight transport of 32,468 billion ton-Kms in 2005/06; calculated formula is shown below:

$$\text{Total No. of wagons} = 32.468^{*} \text{ billion ton-Kms} / 8{,}269^{**} \times 10.2 \text{ days} / 16 \text{ days} \times 25{,}400^{***} \text{ wagons} \times \frac{1}{0.94}^{****}$$

* ton-Kms in 2005/06
** ton-Kms in 1985-86
*** Necessary No. of wagons for 8.269 billion ton-Kms Transport Volume in 1985-86.
**** Spare ratio

The newly manufactured No. of wagons are calculated by deducting the useful No. of wagons in the light of over-aged wagons to be expected in 2005-06.

5. Calculation of Number of Carriages

On the assumption that the number of carriages is directly proportionate to passenger-Kms.

Total No. of Carriages = 24,910 pass-Kms/18,287* x 2200**
= 2,998 vehicles.

* Passenger-Kms in 1983-84 which is the largest figure in past years.
** Number of carriages in 1983-84.

The newly manufactured No. of carriages are calculated by deducting the useful No. of carriages in the light of over-aged carriages to be expected in 2005-06.

Appendix 4. List of Projects and Cost Estimation

(Rs. million)

No	Name of Projects	Estimated total Cost	Allocation for 1988-1993					Total for 1992-93	Beyond 1992-93	Ranking	Remarks
			1988-89	1989-90	1990-91	1991-92	1992-93				
1	Signalling (Auto Block) Pipri ~ Meting Hyderabad ~ Tando Adam	81	40	41				81		A	
2	Signalling (Auto Block) Tando Adam~ Rohri	127	40	40	47			127		A	
3	Signalling (Auto Block) Rohri ~ Khanpur	110							110	C	
4	Signalling (Auto Block) Khanpur ~ Lodhran	78							78	C	
5	Signalling (Auto Block) Lodhran ~ Khanewal (Loop and Chord)	118					25	25	93	B	
6	Signalling (Auto Block) Khanewal~ Sahiwal	62							62	C	
7	Signalling (Auto Block) Sahiwal ~ Lahore	86					28	28	58	B	
8	Signalling (Auto Block) Lahore~ Lalamusa	69							69	C	
9	Signalling (Auto Block) Lalamusa~ Rawalpindi	83							83	C	
10	Signalling (Auto Block) Rohri ~ Sibi	127							127	C	
11	Signalling (Auto Block) Sibi~ Quetta	73							73	C	

(Rs. million)

No	Name of Projects	Estimated total Cost	Allocation for 1988-1993					Total for 1992-93	Beyond 1992-93	Ranking	Remarks
			1988-89	1989-90	1990-91	1991-92	1992-93				
12	Signalling (tokenless) Khanewal～ Faisalabad	113				25	25	50	63	B	
13	Signalling (tokenless) Chakjhumra～ Sargodha	63				15	15	30	33	B	
14	Signalling (tokenless) Sargodha～ Lalamusa	90							90	C	
15	Signalling (tokenless) Sanglahill～ Wazirabad	72							72	C	
16	Signalling (tokenless) Shershah～ Kundian	171							171	C	
17	Signalling (tokenless) Kundian ～ Attock City	95							95	C	
18	Signalling (tokenless) Taxila～ Peshawar	81				20	20	40	41	B	
19	Signalling (Interlock) Kotri ～ Hingoro Road	292	58	58	58	58	60	292		A	
20	Signalling (Interlock) Deranawas ～ Lodhran	58							58	C	
21	Signalling (Interlock) Lodhran ～ Khanewal (Loop, Chord)	248			20	20	26	66	182	B	
22	Signalling (Interlock) Khanewal～ Sahiwal	102							102	C	

(Rs. million)

No	Name of Projects	Estimated total Cost	Allocation for 1988-1993					Total for 1992-93	Beyond 1992-93	Ranking	Remarks
			1988-89	1989-90	1990-91	1991-92	1992-93				
23	Signalling (Interlock) Sahiwal ~ Lahore	175			30	30	28	88	87	B	
24	Signalling (Interlock) Lahore~ Lalamusa	154							154	C	
25	Signalling (Interlock) Lalamusa~ Rawalpindi	183							183	C	
26	Signalling (Interlock) Rohri ~ Sibi	175							175	C	
27	Signalling (Interlock) Sibi~ Quetta	161							161	C	
28	Signalling (CTC) Karachi ~ Rawalpindi	392							392	C	
29	Computer System Seat Reservation System	400			100	150	150	400		A	
30	Computer System Freight Information System	400	100	150	150			400		A	
31	Communication (Cable) Karachi ~ Tando Adam	236							236	C	
32	Communication (Cable) Tando Adam~ Khanpur	456							456	B	
33	Communication (Cable) Khanpur ~ Sahiwal (Loop and Chord)	405	35	35				70	335	B	

(Rs. million)

No	Name of Projects	Estimated total Cost	Allocation for 1988-1993					Total for 1992-93	Beyond 1992-93	Ranking	Remarks
			1988-89	1989-90	1990-91	1991-92	1992-93				
34	Communication (Cable) Sahiwal ~ Lalamusa	299			40	57		97	202	B	
35	Communication (Cable) Lalamusa~ Rawalpindi	159				60	68	128	31	B	
36	Electrification Kiamari ~ Samasata	4,939							4,939	C	
37	Electrification Samasata~ Khanewal (Chord)	532					90	90	442	B	
38	Electrification Lodhran ~ Khanewal (Loop)	573							573	C	
39	Electrification Sibi~ Quetta	656							656	C	
40	Electrification Lahore~ Rawalpindi	181							181	C	Start to build
41	Track Doubling Lodhran ~ Shershah	288							288	C	
42	Track Doubling Multan~ Khanewal	196	40	52	52	52		196		A	
43	Track Doubling Khanewal~ Sahiwal	476							476	C	
44	Track Doubling Sahiwal ~ Raiwind	504					60	60	444	B	

(Rs. million)

No	Name of Projects	Estimated total Cost	Allocation for 1988-1993					Total for 1992-93	Beyond 1992-93	Ranking	Remarks
			1988-89	1989-90	1990-91	1991-92	1992-93				
45	Track Doubling Khanewal～ Sahiwal (Electrification)	371							371	C	
46	Track Doubling Sahiwal ～ Raiwind (Electrification)	297							297	C	
47	Track Renewal Karachi ～ Peshawar	1,661	664	332	332	166	167	1,661		A	
48	Track Renewal Rohri ～ Quetta	540	216	108	108	54	54	540		A	
49	Track Renewal Khanewal～ Wazirabad	875	175	175	175	175	175	875		A	
50	Track Renewal Shershah～ Attock City	719	144	144	144	144	143	719		A	
51	Track Renewal Chak Jhumra ～ Lalamusa	951	190	190	190	190	191	951		A	
52	Track Renewal Kotri ～ Habibkot	342	68	68	68	68	70	342		A	
53	Track Renewal Jacobabad ～ Kashmor Colony	258	26	26	52	52	102	258		A	
54	Track Renewal Lodhran ～ Kasur	510	51	51	102	102	204	510		A	
55	Track Renewal Shorkot ～ Shahinabad	199	20	20	40	40	79	199		A	

(Rs. million)

No	Name of Projects	Estimated total Cost	Allocation for 1988-1993					Total for 1992-93	Beyond 1992-93	Ranking	Remarks
			1988-89	1989-90	1990-91	1991-92	1992-93				
56	Track Renewal Shorkot ~ Qila Sheikhpura	521	13	13	26	26	52	130	391	B	
57	Track Renewal Shahdara Bagh ~ Narowal	171	17	17	34	34	69	171		A	
58	Track Renewal Other "Secondary" Section	856	21	21	42	42	84	210	646	B	
59	Improvement of Freight Terminal	1,700							1,700	C	
60	Locomotive Factory	1,520	310	310	310	310	280	1,520		A	
61	Improvement of Moghalpura Workshop	500							500	C	
62	Rolling Stock Electrification Karachi ~ Samasata	9,538							9,538	C	
63	Rolling Stock Electrification Sibi~ Quetta	2,546							2,546	B	
64	Rolling Stock Electrification Samasata~ Lahore	1,520							1,520	C	
65	Rolling Stock Electrification Khanewal~ Lahore	1,026		114	190	190		494	532	A	
66	Rolling Stock D.E.L Purchase	2,592		511	511	511		1,533	1,059	A	

(Rs. million)

No	Name of Projects	Estimated total Cost	Allocation for 1988-1993					Total for 1992-93	Beyond 1992-93	Ranking	Remarks
			1988-89	1989-90	1990-91	1991-92	1992-93				
67	Rolling Stock D.E.L Re-Condition	7,344	292	292	292	292	584	1,752	5,592	A	
68	Rolling Stock Coaches Replace	3,920	55	55	55	55	58	278	3,642	A	
69	Rolling Stock Wagons (Bogie)	14,890	475	475	475	475	468	2,368	12,522	A	
70	Minor Projects and Miscellaneous	6,971	305	330	364	341	338	1,678	5,293		10%
	Total	76,677	3,355	3,628	4,007	3,754	3,713	18,457	58,220		