Chapter 9. PORT PLAN

9.1 Planning Approach

9.1.1 Function Allotment of Port Activities between Karachi and Qasim Port

The ports of Karachi and Qasim have the same hinterland and transportation system. The port of Karachi is in a sense a mature port, opened a century ago. Thus, most of Pakistan's port related functions and assets have been developed here, and now handles 64 % of Pakistan's seaborne trade and 66 % of the country's container trade. The port of Qasim, meanwhile, was established in the early 1980's in order to relieve the heavy congestion at the port of Karachi and was planned to be a maritime industrial cargo handling port. However, at present, the port handles not only industrial cargoes but also container and wheat.

As for transportation of valuable general cargoes such as machinery and chemicals, not only economical but also swift, safe and convenient transportation measures are essential. For that purpose, containerization has progressed remarkably in international shipping. This worldwide tendency is expected to take hold in Pakistan also. In 2003/04, a total container volume of about 1.2 million TEUs was handled at the ports of Karachi and Qasim with the specialized container terminals and conventional berths. Container cargo traffic at Karachi port steadily increased from 505,000 TEUs in 1997/98 to 824,000 TEUs in 2003/04. Meanwhile, with a container terminal at the Qasim port, the container handling volume rapidly increased from 133,000 TEUs in 1997/98 to 421,000 TEUs in 2003/04. At present, the ports of Karachi and Qasim are planning additional container terminal development according to the studies on private sector participation on a BOT basis. However, if these development plans are not carried out, handling capacity will be insufficient to meet the forecast demand in the target year of 2024/25. Therefore, it is necessary to periodically review new berth requirements at both ports.

Concerning dry bulk handling at the ports, general cargo, wheat, fertilizer etc. are handled at berth Nos.2 - 4 in Qasim port and at the conventional berth in Karachi port because these ports do not yet have an exclusive use berth for dry bulk cargo. In order to meet the future demand, it is necessary to increase cargo-handling productivities. Therefore, it is necessary to provide specialized modern dry bulk handling facilities at both ports.

As mentioned above, the functional allotment of port activities between the two ports is the same. Therefore, it is very important to develop the two ports to meet the forecast demand in the target year of 2024/25. In this regard, the development should be well coordinated.

9.1.2 Gwadar Port

Gwadar port is located at the entrance of the Persian Gulf and about 460 km from Karachi. The Cabinet of Pakistan made a decision in March 1991 to construct a deep water sea port at Gwadar by the end of 1995. In March 2002 the development of PC-I and Master Plan were approved, and the construction work of Phase-I was started with a Chinese soft loan and technical assistance. This part of the port area has subsequently been completed and the approach channel and harbour are currently being deepened to -10.5 m.

Figure 9.1.1 shows the Master plan development of Gwadar port consisting of Phase I and II.

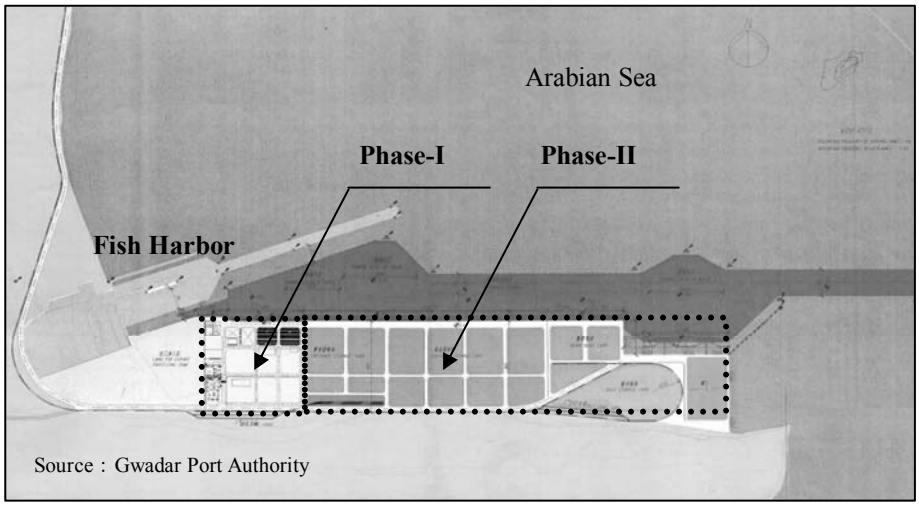


Figure 9.1.1 Master Plan of the Gwadar Port

Table 9.1.1 Development of Gwadar Port (Phase I and II)

Port Facility	Items
Phase-I	
1 Service Berth	100m
3 Multipurpose Berths	602m
Approach Channel	4.5km : -11.5m ~ -12.5m
Turning Basin	450m diameter
Phase-II	
4 Container Berths	
1 Bulk Cargo Terminal	for 100,000DWT
1 Grain Terminal	
1 RO-RO Terminal	
2 Oil Terminals	for 200,000DWT

Source : Gwadar Port Authority

Phase II of the Project is planned for construction on a BOO/BOT basis at an estimated cost of US$ 600 million.

According to the MTDF, the ports of Karachi and Qasim enjoy a monopoly situation in that over 95% of the international trade passes through those ports. Therefore, those two ports can be regarded as a lifeline of the Pakistan economy.

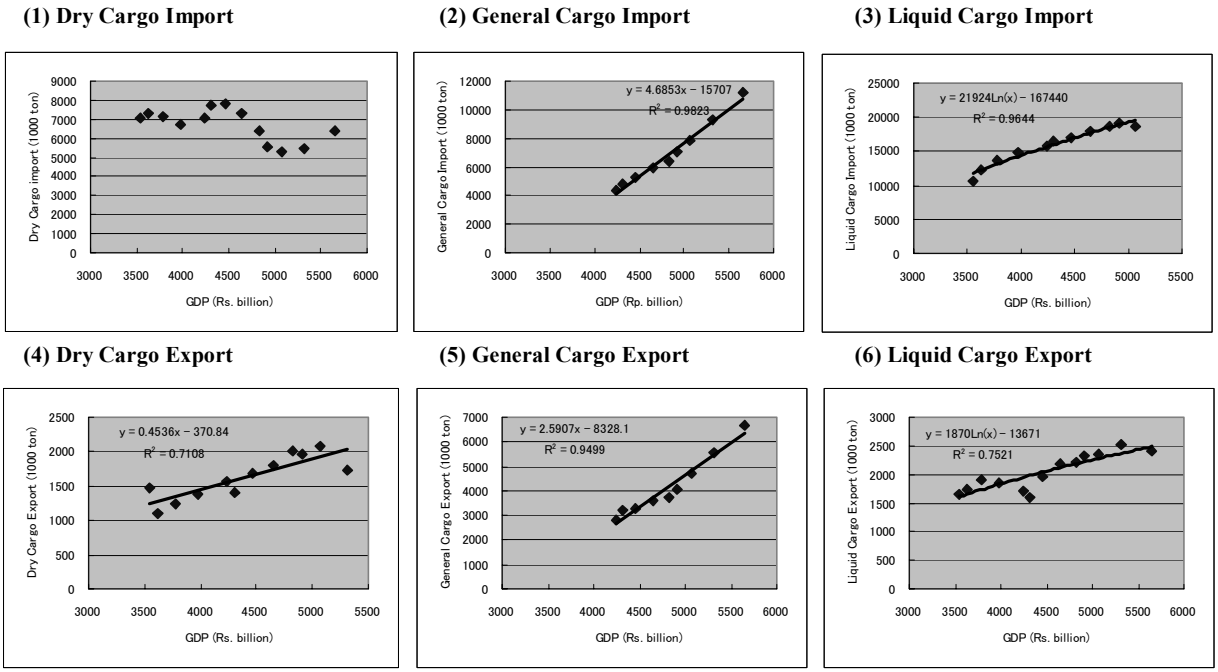
However, there are potential risks that a natural disaster or a blocked port caused by vessel collision may devastate the two ports. In this kind of situation, the physical distribution system of Pakistan comes to standstill. In order to avoid this risk, it is necessary to consider a third port, which can be used in such an emergency. One of the candidates for a third port is the port of Gwadar.

In addition to developing the port so as to avoid the above-mentioned risks, Gwadar port can be developed as a base for oil stock for Asian oil importing countries, enjoying a location near the oil producing countries. With the recent fluctuating political situation around oil producing countries, it is vitally important to keep a sustainable oil supply. Therefore, developing an oil stock base with funding from the Asian oil importing countries can be considered. Developing such an oil stock base might also contribute to establishing close relationships with those oil importing countries. In order for that, it is expected to negotiate with the OPEC regarding the development of an oil stock base, while promoting the fund raising from the oil importing countries.

9.2 Demand - Supply Analysis

9.2.1 Seaborne Throughput

The past trend in international trade has a strong correlation with GDP, except for the import of dry cargo, as shown in Figure 9.2.1. Based on this fact, linear models were developed by applying the least squared error method. Table 9.2.1 shows the resultant models. After a series of trial-and-error's to determine the best fit equation, the an annual growth rate was used for the import of dry cargo and semi-log linear equations were applied for import and export of liquid bulk cargo,.



Source: JICA Study Team

Figure 9.2.1 Correlation between GDP and Trade Volume

Table 9.2.1 Trade Volume Forecast Model

Export/ Import	Commodity Type	Model	Correlation Coefficient
Import	Dry Bulk Cargo	Annual Growth Rate =0.5% (1999 – 2003)	-
	General Cargo	Y = 4.6853X-15707	0.9911
	Liquid Cargo	Y = 21924 Ln(X) - 167440	0.9820
Export	Dry Bulk Cargo	Y = 0.4536 X – 370.84	0.8431
	General Cargo	Y = 2.5907 X – 8328.1	0.9746
	Liquid Cargo	Y = 1870 Ln(X) +13671	0.8672

Note: Y: Annual trade volume in 1000 ton, X: GDP in Rs billion at 2004 price
Source: JICA Study Team

The volumes of international trade in the future were estimated as shown in Table 9.2.2, using the models for the future GDP scenarios given in Chapter 4. Due to the ambitious assumption of high economic growth in the future, the international trade will show a significant increase over the next 20 years (by 2.1 times in the low growth scenario, and 3.9 times in the high growth scenario). In particular, the increase in general cargo import will be significant at 3.1 to 6.9 times the current case, which implies a sizeable increase in container cargo.

In the medium growth scenario, imports will increase by 2.9 times the current level over the next 20 years and exports by 3.4 times. This result is used as a control total in the PTPS.

Table 9.2.2 Forecast of Future Trade Volume

(1) High Growth Scenario

Year	GDP	Import (1000ton)			Export (1000ton)		
	(Rp. Billion at 2004pr.)	Dry Bulk	General	Liquid	Dry Bulk	General	Liquid
2000	4,918	5,692	6,773	19,571	2,061	4,107	1,950
2005	6,559	6,441	11,303	25,241	2,604	6,714	2,764
2010	9,513	9,256	18,314	33,393	3,944	10,219	3,459
2015	13,721	13,302	29,675	41,423	5,853	15,555	4,144
2020	19,790	19,117	48,082	49,452	8,606	23,677	4,829
2025	28,543	27,473	77,906	57,482	12,576	36,040	5,514
2030	41,168	39,482	126,230	65,512	18,303	54,858	6,199

(2) Medium Growth Scenario

Year	GDP	Import (1000ton)			Export (1000ton)		
	(Rp. Billion at 2004pr.)	Dry Bulk	General	Liquid	Dry Bulk	General	Liquid
2000	4,918	5,692	6,773	19,571	2,061	4,107	1,950
2005	6,559	6,441	11,303	25,241	2,604	6,714	2,764
2010	9,199	8,276	16,908	32,658	3,802	9,412	3,396
2015	12,604	10,633	25,292	39,561	5,346	13,196	3,985
2020	16,867	13,662	37,833	45,949	7,280	18,501	4,530
2025	22,045	17,554	56,593	51,818	9,629	25,939	5,031
2030	28,135	22,554	84,655	57,166	12,391	36,366	5,487

(3) Low Growth Scenario

Year	GDP	Import (1000ton)			Export (1000ton)		
	(Rp. Billion at 2004pr.)	Dry Bulk	General	Liquid	Dry Bulk	General	Liquid
2000	4,918	5,692	6,773	19,571	2,061	4,107	1,950
2005	6,559	6,441	11,303	25,241	2,604	6,714	2,764
2010	8,531	7,619	14,960	31,003	3,499	8,283	3,255
2015	10,379	9,011	19,799	35,302	4,337	10,218	3,622
2020	12,627	10,659	26,203	39,602	5,357	12,606	3,989
2025	15,363	12,608	34,679	43,901	6,598	15,552	4,355
2030	18,691	14,913	45,897	48,200	8,108	19,187	4,722

Source: JICA Study Team

The future demand for import and export cargo in 2024/2025 by commodity item was estimated from the demand forecast of general cargo, dry bulk cargo and liquid bulk cargo based on the medium growth scenario as shown in Table 9.2.3.

Table 9.2.3 Demand Forecast for Import/Export Cargo

Unit: '000 tons

Commodities		2003/04	2024/25
Import		**33,422**	**125,955**
	General Cargo	**11,206**	**56,593**
	Dyes and Chemicals	72	1,024
	Tea	37	193
	Iron and Steel	734	2,825
	Other Cargoes	10,363	52,552
	Dry Bulk Cargo	**6,392**	**17,544**
	Fertilizer & Phosphate	2,068	3,950
	Iron ore	1,770	5,629
	Coal & Coke	2,265	2,807
	Wheat	66	4,680
	Other Cargoes	223	478
	Liquid Bulk Cargo	**15,824**	**51,818**
	Crude Oil & Petroleum Products	12,322	41,426
	Edible oils	2,385	4,380
	Chemicals	1,097	5,593
	LPG	20	420
Export		**10,034**	**40,599**
	General Cargo	**6,647**	**25,939**
	Cotton & Yarn, Textile	299	5,695
	Other Cargoes	6,348	20,244
	Dry Bulk Cargo	**976**	**9,629**
	Rice	761	6,032
	Other Cargoes	216	3,597
	Liquid Bulk Cargo	**2,411**	**5,031**
	Molasses	1,525	4,280
	Crude Oil & Petroleum Products	886	751
Grand Total		**43,456**	**166,554**

Source: JICA Study Team

The volume of imported cargo is 126 million tons, accounting for 75.6% of the total. As for imported cargo, liquid bulk cargo such as crude oil and petroleum products, chemicals and edible oil, accounts for 32.9%, 4.4% and 3.5% of the total, while the major commodities of dry cargo are wheat, fertilizer, iron ore, coal and others, accounting for 2.8%, 2.4%, 3.4%, 1.7% and 0.3% of the total respectively.

(1) Forecast of Container Cargo Volume

a) Method of Forecast

The number of containers and the volume of container cargo for export/import trade in Pakistan were forecast by the following procedure: a) Selection of containerizable cargo. b) Estimation of the ratio of container cargo to containerizable cargo. c) Estimation of the number of containers and volume of container cargo.

b) Containerizable Cargo

The main commodities of containerzable cargo are sugar, iron and steel and other dry cargoes for import, and sugar, cotton and other dry cargoes for export.

c) Ratio of Containerization

The ratio of container cargo volume to containerizable cargo volume was estimated using a logistic curve based on the data of Karachi port as shown in Table 9.2.4.

Table 9.2.4 Percentage of Containerization

Year	Containerizable Cargo ('000 tons)			Containered Cargo ('000 tons)			Ratio (%)		
	Import	Export	Total	Import	Export	Total	Import	Export	Total
1997/98	4,329	3,862	8,191	3,259	2,625	5,885	75.3	68.0	71.8
1998/99	4,558	3,284	7,843	3,680	2,642	6,323	80.7	80.4	80.6
1999/00	5,062	3,631	8,694	4,031	2,989	7,021	79.6	82.3	80.8
2000/01	6,186	4,327	10,513	4,250	3,330	7,580	68.7	77.0	72.1
2001/02	6,198	3,936	10,134	4,942	3,524	8,466	79.7	89.5	83.5
2002/03	6,241	4,005	10,246	5,125	3,653	8,778	82.1	91.2	85.7
2003/04	7,271	3,685	10,956	5,943	3,359	9,302	81.7	91.2	84.9

Source: KPT

Table 9.2.5 shows the comparison between the actual ratio of containerization to containerizable cargo and the estimated ratio by logistic curve (see Figure 9.2.2).

Table 9.2.5 Ratio of Containerization

Year	Import		Export	
	Actual	Estimation	Actual	Estimation
1997/98	75.3	76.0	68.0	71.7
1998/99	80.7	77.4	80.4	77.7
1999/00	79.6	78.6	82.3	82.5
2000/01	68.7	79.6	77.0	86.0
2001/02	79.7	80.5	89.5	88.7
2002/03	82.1	81.3	91.2	90.6
2003/04	81.7	81.9	91.2	91.9
2024/25		84.9		95.0

Source: JICA Study Team

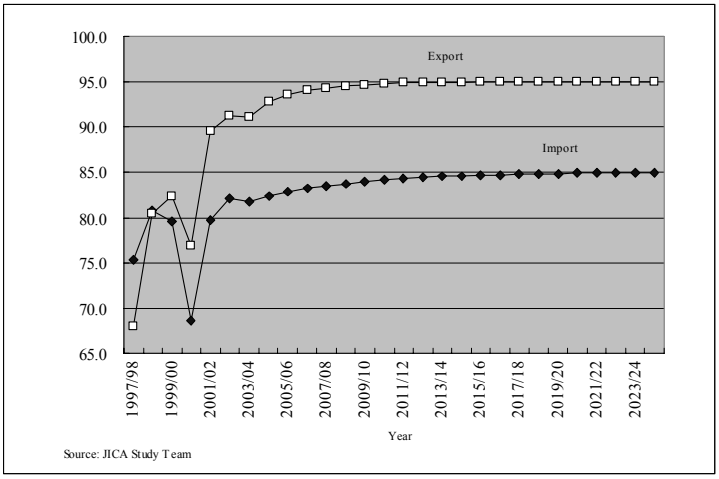


Figure 9.2.2 Logistic Curve for Estimation of Containerization

d) Volume of Containers (TEU)

The container cargo volume per TEU has been estimated using the past data at Karachi port, which gives 15.2 tons/TEU and 13.5 tons/TEU for import and export respectively, and an empty ratio for import and export of 7.8% and 34.7% in the target years of 2024/25.

Table 9.2.6 shows the container cargo volume and the number of containers for the planning

period.

Table 9.2.6 Container Cargo Volume and Number of Containers

Import			Export			Total		
	2003/04	2024/25		2003/04	2024/25		2003/04	2024/25
1. Total Containerizable Cargo	11,206	56,593	1. Total Containerizable Cargo	6,392	25,939	1. Total Containerizable Cargo	17,598	82,532
Dyes and Chemicals	72	1,024	Cotton & Yarn, Textile	299	5,695			
Tea	37	193	Other Cargoes	6,093	20,244			
Iron and Steel	734	2,825						
Other Cargoes	10,363	52,552						
2. Total Containerized Cargo	8,367	48,047	2. Total Containerized Cargo	5,948	24,642	2. Total Containerized Cargo	14,314	72,690
Containerized Ratio (%)	74.7	84.9	Containerized Ratio (%)	93.1	95.0	Containerized Ratio (%)	81.3	88.1
3. Total TEU ('000)	639	3,422	3. Total TEU ('000)	608	2,790	3. Total TEU ('000)	1,247	6,212
Loaded Container	577	3,156	Loaded Container	431	1,822	Loaded Container	1,008	4,978
Empty Container	62	266	Empty Container	176	968	Empty Container	238	1,234

Source: JICA Study Team

(2) Cargo Throughput at the Two Ports

The results of the cargo classification and allocation of cargo at each port are shown in Table 9.2.7.

Table 9.2.7 Cargo Classification and Allocation at Each Port

Commodities		Karachi Port		Qasim Port	
General Cargo					
Dyes and Chemicals	1,024	General Cargo Berth	7,311	General Cargo Berth	2,531
Tea	193	Container Berth	42,160	Container Berth	30,530
Iron and Steel	2,825	(3,6000,000 TEU)		(2,6100,000 TEU)	
Cotton & Yarn, Textile	5,695				
Other Cargoes	72,796				
Sub-total	82,532		49,471		33,061
Dry Bulk Cargo					
Fertilizer & Rock Phosphate	3,950	Dry Bulk Cargo Berth	10,115	Dry Bulk Cargo Berth	9,324
Iron Ore	5,629			Iron Ore & Coal Berth	7,734
Coal	2,807				
Wheat	4,680				
Rice	6,032				
Other Cargoes	4,075				
Sub-total	27,173	Sub-total	10,115	Sub-total	17,058
Liquid Bulk Cargo					
Crude Oil & Petroleum Products	42,177	Oil Berth	30,181	Oil Berth (FOTCO)	19,618
Edible Oils	4,380			Liquid Berth (ENGRO)	3,021
Chemicals	5,593			Liquid Berth	4,028
LPG	420				
Molasses	4,280				
Sub-total	56,849	Sub-total	30,181	Sub-total	26,668
Grand Total	166,554	Total	89,768	Total	76,787

Source: JICA Study Team

9.2.2 Required Scale of Port Facilities

One of the most important factors in determining the scale of a wharf is its number of its berths. Methods used to determine the number of berths include the following: (a) a method to determine the number macroscopically by giving the standard value of handled tonnage per meter of berth length as a postulate, and (b) a method to determine the number of berths by assuming the frequency of ship entries and the cargo handling capacity. Here, the (b) method has been used to determine the number of berths for the two ports.

The required scale under the Master Plan (2024/2025) must be in accordance with the volume of cargo handled. The port facilities necessary to handle this cargo was determined by referring to the past performance at the two ports.

(1) Karachi Port

Berth requirements for each type of cargo at Karachi port was examined in the following four sections to cope with the forecast demand.

a) General Cargo (Conventional Berth)

The required number of general cargo berths was calculated according to the procedures as shown in Table 9.2.8. Eleven (11) berths are required, which is deemed reasonable judging from the berth occupancy rate of 66.4% shown in the table.

Table 9.2.8 Required Number of General Cargo Berths

	Item	Calculation		
		Unit	Formula	
a.	Volume of Cargo Handled	'000 tons		7,300
b.	Average Cargo Handled Volume	tons/vessel		10,000
c.	Number of Vessel Calls	calls/year	a/b	730
d.	Cargo Handling Productivity	tons/hour		140
e.	Total Berthing Hours	hours/year	b/d x c	52,143
f.	Available Hours for Using Berths	hours/year	21 hr. x 340 days	7,140
Required Number of Berths				
g.	Berth Occupancy Rate (%)	B: number of berths		e/(f x B)
		10		73.0
		11		66.4
		12		60.9

Source: JICA Study Team

b) Dry Bulk Cargo Berths (Conventional Berths)

The required number of dry cargo berths was calculated according to the procedures as shown in Table 9.2.9. Three (3) berths are required, which is deemed reasonable judging from the berth occupancy rate of 67.5% shown in the table.

Table 9.2.9 Required Number of Dry Cargo Berths

	Item	Calculation		
		Unit	Formula	
a.	Volume of Cargo Handled	'000 tons		10,115
b.	Average Cargo Handled Volume	tons/vessel		30,000
c.	Number of Vessel Calls	calls/year	a/b	337
d.	Cargo Handling Productivity	tons/hour		700
e.	Total Berthing Hours	hours/year	b/d x c	14,450
f.	Available Hours for Using Berths	hours/year	21 hr. x 340 days	7,140
Required Number of Berths				
g.	Berth Occupancy Rate (%)	B: number of berths		e/(f x B)
		2		101.2
		3		67.5
		4		50.6

Source: JICA Study Team

c) Container Berths

The required number of container berths was calculated according to the procedures as shown in Table 9.2.10. Nine (9) berths are required, which is deemed reasonable judging from the berth occupancy rate of 61.9% shown in the table.

Table 9.2.10 Required Number of Container Cargo Berths

	Item	Calculation		
		Unit	Formula	
a.	Volume of Cargo Handled	'000 tons		42,160
a'.	Number of Containers	'000 TEUs		3,600
		'000 Boxes		2,667
b.	Average Cargo Handled Volume	TEUs/vessel		3,000
		(boxes/vessel)		2,222
c.	Number of Vessel Calls	calls/year	a/b	1,200
d.	Cargo Handling Productivity	boxes/hour		67
e.	Total Berthing Hours	hours/year	b/d x c	39,801
f.	Available Hours for Using Berths	hours/year	21 x 340	7,140
Required Number of Berths				
g.	Berth Occupancy Rate (%)	B: number of berths		e/(f x B)
		8		69.7
		9		61.9
		10		55.7

Source: JICA Study Team

d) Liquid Bulk Cargo Berths

The required number of liquid bulk cargo berths was calculated according to the procedures as shown in Table 9.2.11. Three (3) berths are required, which is deemed reasonable judging from the berth occupancy rate of 78.3% shown in the table.

Table 9.2.11 Required Number of Liquid Bulk Cargo Berths

	Item	Calculation		
		Unit	Formula	
a.	Volume of Cargo Handled	'000 tons		30,181
b.	Average Cargo Handled Volume	tons/vessel		60,000
c.	Number of Vessel Calls	calls/year	a/b	503
d.	Cargo Handling Productivity	tons/hour		1,800
e.	Total Berthing Hours	hours/year	b/d x c	16,767
f.	Available Hours for Using Berths	hours/year	21 x 340	7,140
Required Number of Berths				
g.	Berth Occupancy Rate (%)	B: number of berths	e/(f x B)	
		2	117.4	
		3	78.3	
		4	58.7	

Source: JICA Study Team

(2) Qasim Port

Berth requirements for each type of cargo were examined at Qasim port in the following seven sections to cope with the forecast demand.

a) General Cargo Berths (Marginal Wharf)

The required number of general cargo berths was calculated according to the procedures as shown in Table 9.2.12. Four (4) berths are required, which is deemed reasonable judging from the berth occupancy rate of 62.5% shown in the table.

Table 9.2.12 Required Number of General Cargo Berths

	Item	Calculation		
		Unit	Formula	
a.	Volume of Cargo Handled	'000 tons		2,500
b.	Average Cargo Handled Volume	tons/vessel		10,000
c.	Number of Vessel Calls	calls/year	a/b	250
d.	Cargo Handling Productivity	tons/hour		140
e.	Total Berthing Hours	hours/year	b/d x c	17,857
f.	Available Hours for Using Berths	hours/year	21 hr. x 340 days	7,140
Required Number of Berths				
g.	Berth Occupancy Rate (%)	B: number of berths	e/(f x B)	
		3	83.4	
		4	62.5	
		5	50.0	

Source: JICA Study Team

b) Dry Bulk Cargo Berths (Wheat and Fertilizer)

The required number of dry bulk cargo berths was calculated according to the procedures as shown in Table 9.2.13. Five (5) berths are required, which is deemed reasonable judging from the berth occupancy rate of 65.3% shown in the table.

Table 9.2.13 Required Number of Dry Bulk Cargo Berths

	Item	Calculation		
		Unit	Formula	
a.	Volume of Cargo Handled	'000 tons		9,324
b.	Average Cargo Handled Volume	tons/vessel		16,000
c.	Number of Vessel Calls	calls/year	a/b	583
d.	Cargo Handling Productivity	tons/hour		400
e.	Total Berthing Hours	hours/year	b/d x c	23,309
f.	Available Hours for Using Berths	hours/year	21 hr. x 340 days	7,140
Required Number of Berths				
g.	Berth Occupancy Rate (%)	B: number of berths	e/(f x B)	
		4	81.6	
		5	65.3	
		6	54.4	

Source: JICA Study Team

c) Liquid Cargo Berths (Edible Oil)

The required number of edible oil berths was calculated according to the procedures as shown in Table 9.2.14. Two (2) berths are required, which is deemed reasonable judging from the berth occupancy rate of 62.7% shown in the table.

Table 9.2.14 Required Number of Liquid Cargo Oil Berths

	Item	Calculation		
		Unit	Formula	
a.	Volume of Cargo Handled	'000 tons		4,028
b.	Average Cargo Handled Volume	tons/vessel		13,000
c.	Number of Vessel Calls	calls/year	a/b	310
d.	Cargo Handling Productivity	tons/hour		450
e.	Total Berthing Hours	hours/year	b/d x c	8,951
f.	Available Hours for Using Berths	hours/year	21 hr. x 340 days	7,140
Required Number of Berths				
g.	Berth Occupancy Rate (%)	B: number of berths	e/(f x B)	
		1	125.4	
		2	62.7	
		3	41.8	

Source: JICA Study Team

d) Container Berths

The required number of container berths was calculated according to the procedures as shown in Table 9.2.15. Seven (7) berths are required, which is deemed reasonable judging from the berth occupancy rate of 57.9% shown in the table.

Table 9.2.15 Required Number of Container Cargo Berths

	Item	Calculation		
		Unit	Formula	
a.	Volume of Cargo Handled	'000 tons		30,530
a'.	Number of Containers	'000 TEUs		2,610
		'000 boxes		1,940
b.	Average Cargo Handled Volume	TEUs/vessel		3,000
		(boxes/vessel)		2,230
c.	Number of Vessel Calls	calls/year	a/b	870
d.	Cargo Handling Productivity	boxes/hour		67
e.	Total Berthing Hours	hours/year	b/d x c	28,955
f.	Available Hours for Using Berths	hours/year	21 hr. x 340 days	7,140
Required Number of Berths				
g.	Berth Occupancy Rate (%)	B: number of berths	e/(f x B)	
		6	67.6	
		7	57.9	
		8	50.7	

Source: JICA Study Team

e) Iron Ore and Coal Berths (IOCB)

The required number of iron ore and coal berths was calculated according to the procedures as shown in Table 9.2.16. Two (2) berths are required, which is deemed reasonable judging from the berth occupancy rate of 67.7% shown in the table.

Table 9.2.16 Required Number of Iron Ore and Coal Berths

	Item	Calculation		
		Unit	Formula	
a.	Volume of Cargo Handled	'000 tons		7,734
b.	Average Cargo Handled Volume	tons/vessel		44,000
c.	Number of Vessel Calls	calls/year	a/b	176
d.	Cargo Handling Productivity	tons/hour		800
e.	Total Berthing Hours	hours/year	b/d x c	9,668
f.	Available Hours for Using Berths	hours/year	21 hr. x 340 days	7,140
Required Number of Berths				
g.	Berth Occupancy Rate (%)	B: number of berths	e/(f x B)	
		1	135.4	
		2	67.7	
		3	45.1	

Source: JICA Study Team

f) Crude Oil and Others Berths (FOTOCO Terminal)

The required number of crude oil and others berths was calculated according to the procedures as shown in Table 9.2.17. Three (3) berths are required, which is deemed reasonable judging from the berth occupancy rate of 61.1% shown in the table.

Table 9.2.17 Required Number of Crude Oil and Others Berths

	Item	Calculation		
		Unit	Formula	
a.	Volume of Cargo Handled	'000 tons		19,618
b.	Average Cargo Handled Volume	tons/vessel		56,000
c.	Number of Vessel Calls	calls/year	a/b	350
d.	Cargo Handling Productivity	tons/hour		1,500
e.	Total Berthing Hours	hours/year	b/d x c	13,079
f.	Available Hours for Using Berths	hours/year	21 hr. x 340 days	7,140
Required Number of Berths				
g.	Berth Occupancy Rate (%)	B: number of berths	e/(f x B)	
		2	91.6	
		3	61.1	
		4	45.8	

Source: JICA Study Team

g) Chemical Berths (ENGRO Terminal)

The required number of chemicals berths was calculated according to the procedures as shown in Table 9.2.18. Three (3) berths are required, which is deemed reasonable judging from the berth occupancy rate of 61.3% shown in the table.

Table 9.2.18 Required Number of Chemical Berths

	Item	Calculation		
		Unit	Formula	
a.	Volume of Cargo Handled	'000 tons		3,021
b.	Average Cargo Handled Volume	tons/vessel		7,000
c.	Number of Vessel Calls	calls/year	a/b	432
d.	Cargo Handling Productivity	tons/hour		230
e.	Total Berthing Hours	hours/year	b/d x c	13,136
f.	Available Hours for Using Berths	hours/year	21 hr. x 340 days	7,140
Required Number of Berths				
g.	Berth Occupancy Rate (%)	B: number of berths	e/(f x B)	
		2	92.0	
		3	61.3	
		4	46.0	

Source: JICA Study Team

The results of the calculations of berth requirements at the two ports are as shown in Table 9.2.19.

Table 9.2.19 Berth Requirements at the Two Ports

Port	Cargoes		Existing Berths				Required Berths							
	Commodities	Volume (000 tons)	Name of Berth	Number of Berths		Length (m)	Name of Berth	Existing Berths		Number of Berths Conv. / New		Total	Length (m)	Depth (m)	Average Ship Size (DWT)
Karachi			Conventional Berth				Conventional Berth								
	General Cargo	7,311	Nos. 1- 17	17	-4	13 2,055	General Cargo			11		11	1,931	-9.1/-11.5	10,000
	Container Cargo	42,160	Nos. 18-23	6		6 976	Dry Bulk	23		3		3	624	-12.5	30,000
	Dry Bulk Cargo	10,115	Nos. 24-30	7	-3	4 669	Others		-23	4		4	808	-	
	Liquid Bulk Cargo	30,181	Cintainer			2 1,200	Container	2		1		3	1,537	-12.5	23,000
			Subtotal	30		25 4,900	Subtotal	25	-23	19	0	21	4,900		
			OP Nos. I - III	3		3	OP Nos. I - III	3			0	3	-	-13.4	60,000
							Container (New)				6	6	2,100	-13.5	40,000
	Total	89,767	Total	33		28 4,900	Total	28	-23	19	6	30	7,000		
Qasim			Marginal Wharf				Marginal Wharf								
	General Cargo	2,531	Nos. 1-4	4		4 800	General Cargo	4	-4	4		4	800	-10.0	10,000
	Container Cargo	30,530	Nos. 5- 7	3	-3	0									
	Dry Bulk Cargo	17,058	Container	2		2 600	Container	2				2	600	-12.0	25,000
	Liquid Bulk Cargo	26,668	Subtotal	9	-3	6 1,400	Subtotal	6	-4	4		6	1,400		
			IOC Berth	1		1	Container				5	5	1,500	-13.5	40,000
			FOTCO Termial	1		1	Dry Bulk Cargo				5	5	1,250	-13.5	20,000
			ENGRO Terminal	1		1	Liquid Cargo				2	2	-	-12.0	13,000
							IOC Berth	1			1	2	-	-12.0	44,000
							FOTCO Termial	1			2	3	-	-13.5	56,000
							ENGRO Terminal	1			2	3	-	-10.0/-12.0	10,000
			Subtotal	3		3	Subtotal	3			17	20	2,750		
	Total	76,787	Total	12	-3	9 1,400	Total	9	-4	4	17	26	4,150		

Source: JICA Study Team

9.3 Development Plan

9.3.1 Effective Utilization of the Existing Facilities

Due to the limited available space within the existing port area, especially at Karachi port, the effective utilization of the existing facilities (including the possibility of conversion of wharves to meet the forecast demand at the two ports) is important. The effective utilization of existing facilities for the development at the two ports is necessary from the viewpoint of minimizing the total investment cost and to maximize its effect.

9.3.2 Strengthening of the Container Terminal

The volume of containers to be handled at both ports in 2024/25 is estimated as 6.2 million TEUs. In order to cope with the progress of containerization, container terminal operation by the private sector using their own handling equipment has been progressing by leasing the existing facilities. However, the cargo-handling capacity of these terminals is insufficient to handle the above volume of containers. Therefore, an additional container terminal will be required by the year 2024/25.

9.3.3 Modernization of the Dry Bulk Terminal

The volume of wheat to be handled at Qasim port in 2024/25 is estimated as 17.1 million tons. At present, Marginal Wharf Berth Nos. 2-4 are handling wheat and the handling productivity is rather high at about 120 tons per hour, which seems to be a result of good management/operation. However, the present cargo-handling capacity is insufficient to meet the forecast demand. Therefore, it is necessary to provide specialized dry bulk handling facilities. At Karachi port, various kinds of dry bulk cargoes are being handled at conventional berths, such as fertilizer, rice, phosphate, scrap, etc. Therefore, it is necessary to provide specialized dry bulk handling facilities.

9.3.4 Establishment of Additional Liquid Terminal

The volume of liquid bulk to be handled at both ports in 2024/25 is 56.8 million tons: 30.1 million tons at Karachi port and 26.7 million tons at Qasim port. At Qasim port, the liquid bulk has been handled at Marginal Wharf No.1, terminals of FOTCO and ENGRO. However, the present handling capacity is insufficient to meet the forecast demand. Therefore, it is necessary to provide an additional liquid bulk handling terminal.

9.3.5 Layout Plan

The layout plans of Karachi Port and Qasim Port are illustrated in Figure 9.3.1 and Figure 9.3.2, respectively.

Chapter 8. RAILWAY PLAN

8.1 Planning Approach

8.1.1 Role of Railway Transport at Present

Railway transport has a long history beginning in 1861 and has occupied a principal position in land transport in the past. Most of the passengers and freight were previously transported by rail, whereas road transport serviced only short-distance feeder transport needs and transport on routes not having enough demand to justify construction of railways.

However, transport by automobiles, having capability of door-to-door transport and time flexibility, has grown as a competitor of railway transport, and occupied a main position in land transport instead of railways. Recently, with the development of aviation, long-distance transport of high-end clients and products is shifting to air transport.

Now, road transport deals with all types of passenger and cargo including short-distance, long-distance, multi-direction and point-to-point transport. Therefore, road transport is a vital mode as a fundamental land transport means.

However, railway has the following advantages;

- "Safe, punctual, comfortable and fast" as advantages in the service aspect
- "Inexpensive, low environmental impact, saving natural resources and saving space" as advantages in the social aspect

However, railway transport units are large because trains are composed of a number of heavy vehicles. In addition, railways require independent infrastructure, operating organization and operation/maintenance staff. Therefore, railways can only provide the advantages in the social aspect for the mass transport and still be commercially viable. Additionally, railways can only provide the advantages in the service aspect after the management is in sound condition.

Therefore, the raison d'etre of railways only exists for mass transport, in which railway can exercise its advantages and be economically viable, and therein railways can survive as competitive businesses.

Besides, since railway does not have advantages such as door-to-door through transport and time flexibility, railways can not compete with automobiles at the same cost level, even though railways have the above advantages in the service aspect. This situation has been changing in the recent past, because of worsening problems with global warming due to CO_2 emissions and political restrictions are imposed on. However, if transport cost is high, it is difficult to politically force shippers into shifting to railway transport.

In these days, despite the existence of highways and roads, the reason for investment in railway is to establish an efficient transport system. This system has low environmental impact and specializes in the followings;

- Middle/long-distance high-speed intercity passenger transport
- Commuter transport in metropolitan regions (Remarks: Commuter transport[1] in large city areas such as Karachi and Lahore can be one of the important roles of railways, but they hardly exist at present.)
- Middle/long-distance high-speed mass freight transport as a main part of multimodal transport (Remarks: This must be direct container/bulk transport between centres. Since automobiles and trucks excel in feeder transport, normally, general cargo, which incurs expense for transhipment, is not suitable for railway transport.)

[1] Commuter transport is out of scope of this Study; however, to formulate future plans on improvement and management reform of railway, this category should be taken into consideration.

Accordingly, future investment in railways shall concentrate intensively on the above.

For railways as means of future land transport, the Pakistan Railways possesses good route alignments like the main line, which coincide with the principal stream of people and products, and has the advantages that land and road beds, which account for major part of the cost for the infrastructure of railways, were already constructed.

8.1.2 Profitable Market

(1) Profitability by Business Units

Notwithstanding its price competitiveness, the railway business is now losing market share year by year. It is envisaged that this may be caused by the fact that the demand for railway's service are gradually being decreased as the rapidly developing motor transport erodes railway's share of the transport market.

Table 8.1.1 shows the calculation of unit profits of the PR by business units.

Table 8.1.1 Unit Profits of PR by Business Units

	1999/ 2000	2000/ 01	2001/ 02	2002/ 03	2003/ 04	Average
(A) Revenues for Passengers etc, (Rs. Million)	5,604	6,408	7,375	8,335	9,146	7,374
(B) Revenues for Freight (Rs. Million)	3,969	4,715	4,790	5,071	4,566	4,622
(C) Passenger-Kilometres (Million)	18,498	19,590	20,783	22,306	23,045	20,844
(D) Ton-Kilometres (Million)	3,753	4,520	4,573	4,820	4,769	4,487
Unit Revenues (Rs.)						
(E)=(A)/(C) Passenger Services	0.303	0.327	0.355	0.374	0.397	0.351
(F)=(B)/(D) Freight Services	1.057	1.043	1.047	1.052	0.957	1.031
Unit Costs (Rs.)						
(G) Passenger Services	0.484	0.493	0.482	0.512	0.522	0.499
(H) Freight Services	0.493	0.488	0.500	0.510	0.535	0.505
Unit Profits (Rs.)						
(E)-(G) Passenger Services	**-0.181**	**-0.166**	**-0.128**	**-0.139**	**-0.125**	**-0.148**
(F)-(H) Freight Services	**0.565**	**0.555**	**0.548**	**0.542**	**0.423**	**0.526**

Sources: Prepared by JICA Study Team with Data from P.R. Yearbook 2000/01, 2003/04

According to Table 8.1.1, the unit profits of the freight services continue to show positive figures, even though the positive figures are in decline. On the other hand, the unit profits of the passenger services continue to show negative figures. As mentioned later, the continuous losses of the passenger services are caused by the unprofitable train operations on light traffic lines (see the detailed analysis in the next section). Therefore, one of the ways for the PR to maintain profitability is to reduce the unprofitable passenger services and increase the freight services by reforming the business structure. With regards to the passenger services, it is necessary to reduce the unprofitable runs and channel the business resources into the main corridors. With regards to the freight services, it is necessary to expand the business opportunity by developing container transport services to meet the freight transport demands.

(2) Unprofitable Passenger Services

The train operations with negative marginal profits (revenues - variable costs) cannot contribute to recovering the fixed costs. Therefore, the trains with negative marginal profits can be regarded as unprofitable trains.

One of the benchmarks to identify the unprofitable trains is the number of passengers or coaches per train. A necessary number of passengers per train for the positive marginal profits can be calculated by dividing the average costs per train-kilometer by the average revenues per passenger-kilometer, because it can be assumed that the revenues are in proportion to the number of passenger-kilometer, while the variable costs are in proportion to train-kilometer. Table 8.1.2 shows this calculation, based on the data from the year 2000/01 to 2003/04.

Table 8.1.2 Calculation of Necessary Number of Passengers per Train

FY	Average per Year (2000/01-2003/04)
(A)Total Variable Costs Total (Millions)	10,296.9
(B)Train Kilometer (Thousands)	37,335.0
(C)=(A)/(B)Variable Costs per Train Kilometers (Rs.)	**275.8**
(D)Revenues from Passengers (Rs. Million)	7,815.9
(E)Passenger-Kilometer (Million)	21,430.8
(F)=(D)/(E) Unit Revenues of Passenger Services (Rs.)	**0.36**
(C)/(F)	**756**

Sources: Prepared by JICA Study Team with Data from P.R. Yearbook 2003/04

According to Table 8.1.2, in order to maintain the positive marginal profits, it is necessary to carry more than 756 passengers per train. This means that 11.7 coaches per train are needed for positive marginal profits[1]. Accordingly, the trains, which carry 11coaches or less, cannot contribute to recovering the fixed costs. By reducing the train operations with negative marginal profits, the PR can improve the financial status of the passenger services. Table 8.1.3 shows the comparison of the basic data between the main corridors and the other branch lines in 2003/04.

Table 8.1.3 Comparison of Basic Data of Passenger Services

	Main Corridor	Branch Line	Total
(A) Average Number of Coaches per Train	**12.6**	**8.0**	**10.8**
(B) Estimated Financial Status			
Revenues (Rs. Million)	6,451.20	2,694.70	9,145.90
Variable Costs (Rs. Million)	5,615.50	3,679.20	9,294.70
Marginal Profits (Rs. Million)	835.7	-984.5	-148.8

Sources: Prepared by JICA Study Team

As seen in the line (A) in Table 8.1.3, the average number of coaches per train is 12.6 in the main corridor, while the average number of coaches per train is 8.0 in the other branch lines. According to the above-mentioned analysis that the trains which carry 11coaches or less cannot contribute to recovering the fixed costs, it is deemed that the train operations on the branch lines cannot contribute to making profits. The line (B) in the table shows the estimated breakdown of the financial situation of the passenger services. Therefore, it can be concluded that the PR should reduce the train operations on the branch lines and concentrate

[1] In the year 2003/04, the number of passenger kilometres was 23,045 million and the number of coach kilometres was 355.6 million. Therefore, it can be assumed that one train can carried around 65 passengers (23,045 millions / 355.6 millions = 64.8).

on the passenger service on the main corridor to maintain its profitability.

On the other hand, this analysis is based on the present situation of the PR. There might be some room to reduce the necessary number of passengers or coaches for the positive marginal profits by increasing the tariff levels and/or decreasing the operation costs. Therefore, by improving the business efficiency of the passenger services, the train operations on the branch lines can also contribute to making profits.

However, as mentioned earlier, the analysis, so far, is based on the existing data. More detailed data will create more precise analysis, which leads to more useful decision making. Therefore, it is recommended to remodel the present financial systems with modern commercial accounting practice, in order to precisely grasp the financial & accounting data of the railway business.

8.1.3 Target Market

In order to make the railway competitive to other modes of transport including airlines an aggressive management improvement and a huge amount of capital investments in infrastructure improvement and development will be required. For the passenger transport it is important to factor in the "public service" components in the business plan as the railway remains a "affordable" means of mode of transport system for the country's population, but the freight operation can maximize its advantages in services, i.e. high-speed mass freight transport and focus on the creation of profit-centres by the container and bulk traffics on the Karachi-Lahore mainline as a start.

(1) Container Transport

First, since container transport has potential demand, it is essential for the Pakistan Railways to establish a container transport system as early as possible.

In 2003/04 the number of containers handled at Karachi and Qasim Ports amounted to 1,244,000 TEUs and has grown steadily since. There were 637,000 TEUs of imported containers and 109,000 TEUs of bonded containers were transported to up-counties, and those transported by railway are only 17,000 TEUs.

The container transport system need to include the following: high power locomotives, high performance wagons, stable infrastructures, suitable container stations at the port side, modern logistic centres in the up-country side, a sophisticated operation system, a computerized sales system, etc. In order to develop container transport, a time table for train operation should be established and published in advance so that users of container trains are able to make out an accurate transport schedule. In addition, an appropriate operation adjustment system which minimizes delays is essential for freight transport as well as for passenger transport.

The Pakistan Railways offers container transport services between Karachi/Qasim ports and dry ports at Lahore, Faisalabad, Rawalpindi, Peshawar and Quetta. Dry ports in up-countries are sufficient for present needs. However, improvement and expansion of these facilities are desirable for the future development of railway container transport.

(2) Bulk Transport

It is also necessary to build a bulk transport system. The main commodity of railway bulk transport has been petroleum; however, transport of petroleum by railway will be terminated within a few years because the pipeline for petroleum transport will be commissioned. Instead of petroleum, the following commodities (coal, cement, aggregate, fertiliser and grain) will become the main commodities for railway bulk transport.

8.1.4 Improvement of Management

Railways today are competitive with road transport in land transport and aviation in inland transport. Now that a limited amount of national budget will be invested in railways hereafter, the following efforts are absolutely necessary;

- Streamlining of management to win out in cost competition, and
- Establishment of a management structure to demonstrate the advantages in the service aspect.

If management, service and facilities remain inefficient and if railway loses competitiveness and can not play a role as transport means, further investment from the precious budget will come to nothing.

The Pakistan Railways has not changed its management, service, facilities and rolling stock in accordance with the change in transport structure. In addition, although unsuited business has already lost demand, insufficient management and facilities still have being preserved.

First of all, the Government of Pakistan should get back to the basics that railways exist for the purpose of transport. Railways do not exist to maintain vested interests including employment. Employment and welfare are different policies of the government. The preservation of the vested interests (of policymakers, staff and beneficiaries of welfare services) should not be the goal of policy.

The improvement of railway management is a vital condition to make investments aiming at the establishment of sustainable railway. In these days, the railway company should be managed independently and with self-responsibility under the customer-oriented management concept in a competitive environment.

Government expenditure should cover, primarily, the capital charge for infrastructure (including the cost of the maintenance backlogs from the past) based on the transport and environmental policies that determine the roles of the railways and roads in the transport system.

As for the infrastructure, railways have to be able to conduct on their own account the infrastructure management (on-ground train operation and drawing up of diagrams) and the maintenance of infrastructure, which are common to all types of transport.

Railways have to be able to conduct the following activities on their account: the purchase and maintenance of rolling stock, business activities such as train operations, sales, services for passengers and handling of cargo, railway transport business and capital charges for them. If railways are not able to provide transport service on their own account under the condition that sound and sustainable infrastructure is secured from the viewpoint of the function, maintenance level and usage cost of infrastructure, then the role of railways is deemed ended, and railways should pull out of the transport service. (It can be seen that such transport service has not reached the level of mass transport in which railway can demonstrate its advantages and road transport is able to serve as the fundamental transport mode.)

As long as railways management is self-sustaining and with self-responsibility, the fare should be decided on a commercial basis. Although the charges for freight transport is on commercial basis, that of passenger transport is regulated. If the government choose to provide transport service at a low fare as part of a welfare policy, the government should compensate for the resulting deficit as a public service obligation. In this case, the government should choose, not exclusive to railway, the optimal transport mode to accomplish the goal of the welfare policy.

Railways should abolish the obligation of cross-subsidies such as support for light-traffic lines. Since railways are not in a monopoly like the old days, cross-subsidies raise the transport cost and weaken the competitiveness of railway. Therefore, cross-subsidies should be avoided. If a line shall be maintained or newly constructed with an eye to the future under

the policy target of "balanced development of the nation's land", not only the capital charge, but also the expenses should be paid out or compensated by the government under the policy.

8.1.5 Development of the Corridor and a High-Speed Freight Transport System

In order to increase the passenger and freight transport capacity and create profit centres it is essential to focus on the revitalization of the infrastructure on the Corridor linking Karachi to Lahore, Rawalpindi and Peshawar. The Corridor links the landlocked Punjab with the country's international ports located in the Karachi area. The concentration of Pakistan's population and economic, industrial, commercial and transport activities in the narrow 1,700 km corridor provides traffic densities ideal for development of high-speed freight transport services

The development of the Corridor and a high-speed freight system first on the Karachi-Lahore mainline by container and bulk transport system will, in addition to the improvement of railway infrastructure, require the procurement of a large quantity of high performance locomotives, high performance wagons and rehabilitations/expansions of container/bulk stations, logistic centres, dry ports, etc.

8.1.6 On-going and Proposed Projects

As mentioned, the Pakistan Railways has many backlogs of projects desirable to be carried out.

The Medium Term Development Framework (MTDF) 2005-10 and Public Sector Development Program (PSDP) 2005-06 list on-going projects and new projects. The total amount of budgets for the five years is Rs. 59,549 million and that for the fiscal year 2005/06 is Rs. 9,849 million. However, it is questionable whether the selected projects are to be given proper priority or not. For example, the projects for improvement and reinforcement of signalling systems are left out from the list. Recently, a serious accident occurred at Sharhad. It is the time to take up the project.

Current investment projects, on-going or proposed, are listed in Table 8.1.4, together with improvement of the signalling systems proposed by the study team.

Table 8.1.4 Current Investment Projects

No.	Projects	Estimated cost (Rs. Million)			Remarks
		Total	- 2004/05	2005/06 -	
On-going					
M 1 P 3	Procurement/manufacture of 175 passenger coaches	7,776	5, 953	1,823	
M 2 P 2	Procurement 69 DE locos	11,151	4,188	6,963	
M 3 P 1	Track rehabilitation and modernization of sleeper factory	11,192	5,686	5,506	
M 4 P 4	Recommissioning of 55 DE Locos	879	232	647	
M 5 P 6	Replacement of breakdown cranes and procurement of relief train	(M 5)407 (P 9)395	(M 5)285 (P 9)285	(M 5)121 (P 9)110	
M 6 P 5	1,300 high capacity wagons	5,870	1,727	4,143	
M 7 P 9	Doubling of track Lodhran - Multan - Khanewal	3,297	434	2,864	Including signalling system
M 8 P 8	Rehabilitation of 450 passenger coaches	2,145	1,300	845	
M 9	Other projects	148	122	26	
P 7	Strengthening of bridges	112	112		
P10	Underpass at Renala at railway crossing No.147	26	10	16	
P11	Conversion of Mirpur Khas - Khokhropar section from metre gauge to broad gauge	1,000	300	700	In MTDF allocated as “New” (M10)
	Sub total of MTDF Sub total of PSDP	42,865 43,844	19,927 20,227	22,937 23,617	
New					
M10	Conversion of Mirpur Khas - Khokhrapar section from metre gauge to broad gauge	700	300	400	In PSDP allocated as “On-going” (P11)
M11 P12	Dualization of track from Khanewal to Raiwind	5,712		5,712	
M12	Dualization of track from Shahdara Bagh to Lala Musa	1,288		1,288	
M13	Upgrading and improvement of track from Khampur to Lala Musa	3,500		3,500	Continued beyond 2009/10
M14	Doubling of track from Lahore to Faisalabad section	3,840		3,840	
M15	Procurement/manufacture/ and assembling of 75 diesel locomotive	12,700		12,700	Continued beyond 2009/10
M16	Procurement/manufacture/ and assembly of 1,000 freight wagons	4,800		4,800	Continued beyond 2009/10
M17	Procurement/manufacture/ and assembly of 150 passenger coaches	5,977		5,977	
M18	Railway yard and railway linkage from Gwadar Port to container yard	2,500		2,500	
M19	Rail link to Gwadar Port	12,000		12.000	Continued beyond 2009/10
M20	Up-gradation Rohri - Quetta - Taftan	15,000		15,000	Continued beyond 2009/10
M21	Feasibility study for rail link from Kundian to Peshawar	10		10	
M22	Feasibility study for rail link from Bostan to Peshawar	10		10	
M23	Provision of road over bridge at Chowrangi Chowk EPZ Karachi (50%)	250		250	Continued beyond 2009/10
	Sub total of MTDF Sub total of PSDP	68,287 5,712	300	68,517 5,712	
Total					
	Total of MTDF Total of PSDP	111,152 49,556	20,227 20,227	91,454 23,617	
	Total	11,778		11,778	

Source : Medium Term Development Framework (MTDF) 2005-10
Public Sector Development Program (PSDP) 2005-06
Pakistan Railways (Information for the Study)

Note : “M 1” means “No.1” in MTDF, “P 1” means “No.1” in PSDP

8.2 Demand- Supply Analysis

8.2.1 Target Demand for Passenger Transport

Currently passenger transport numbers of the Pakistan Railways is steady for express services for middle/long distance intercity transport. The number of railway passengers, which had been decreasing due to motorization, reached the bottom in 1998/99, and now it is on a track of recovery.

Target demand for passenger transport in the master plan is set out assuming that the role and share will be constant and demand will increase corresponding to the economic development of the Country.

Target demand for passenger transport for railway development planning is shown below (Table 8.2.1). Target demand for each line is set out based on the increase factors of Table 8.2.1 and estimated current passenger traffic density (Passenger-km of section / section length / day) shown in Table 8.2.2. （As the Pakistan Railways have no such statistics, this is estimated for reference on the assumption that passenger-km of a section is roughly in proportion to coach-km of the section.）

Table 8.2.1 Target Demand for Railway Passenger Transport

Year	Assumed Passenger Demand	
	Passenger-km (million)	%
2004/05	24,238	100
2010/11	28,124	116
2015/16	33,185	137
2025/26	47,219	195

Source: Demand forecast of the Study
2004/05 (Actual): PR Year Book

8.2.2 Target Demand for Freight Transport

At the present, the Pakistan Railways does not offer suitable freight transport services which customers demand. Therefore, the actual current transport volume cannot be used as a basis of future demand.

Target demand in the master plan of the Pakistan Railways is set out based on traffic survey and a policy of expected future modal split in this Study. The target demand was calculated based on the modal split model for possible demand in freight transport by rail as explained in Chapter 4. Figure 8.2.1 illustrates the possible demand in 2015 and 2025.

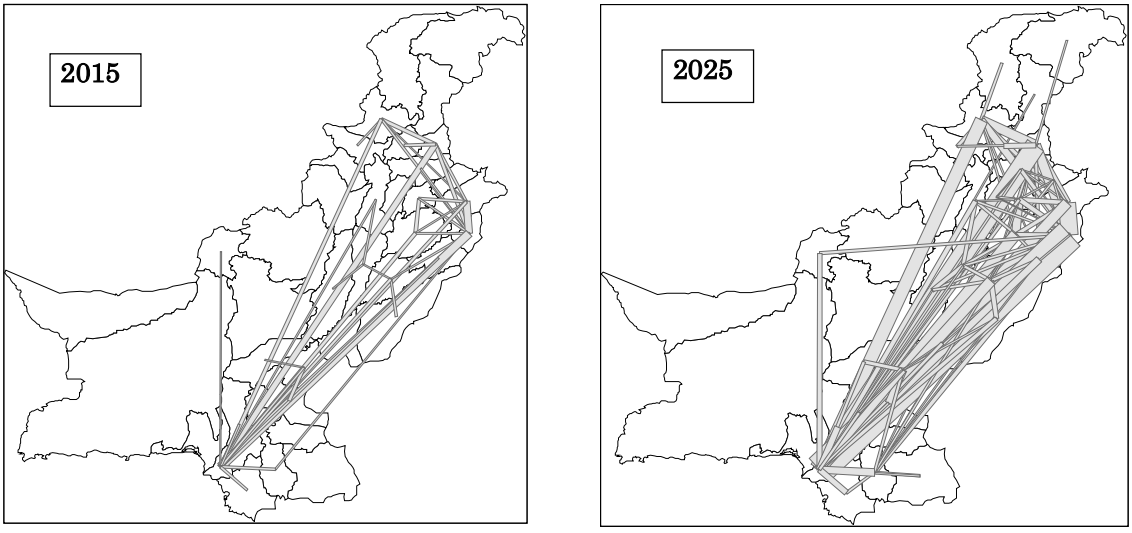


Figure 8.2.1 Possible Demand in Freight Transport by Rail (Tonnage)

Table 8.2.2 Estimated Passenger Traffic Density of Each Lime

Sr. No	Section			No. of Train/day	Train-km /day	No. of Coach/day	Coach-km /day	Passenger-km/year (assumption)	Passenger-km/day (assumption)	Passenger-km/km/day (assumption)
	Start	End	Rout-km							
1	Karachi	Kotri	165	42.0	6,930	562.0	92,730	2,224,835,571	6,095,440	36,942
2	Kotri	Hyderabad	9	42.0	378	560.0	5,040	120,922,800	331,295	36,811
3	Hyderabad	Padidan	175	38.0	6,650	524.0	91,700	2,200,123,173	6,027,735	34,444
4	Padidan	Rohri Jn.	123	36.0	4,428	510.0	62,730	1,505,056,997	4,123,444	33,524
7	Samasatta Jn.	Lodhran Jn.	28	38.0	1,064	508.0	14,224	341,271,014	934,989	33,392
6	Khanpur	Samasatta Jn.	123	36.0	4,428	496.0	61,008	1,463,741,707	4,010,251	32,604
5	Rohri Jn.	Khanpur	215	36.0	7,740	492.0	105,780	2,537,939,250	6,953,258	32,341
13	Pattoki	Lahore Jn.	84	28.0	2,352	356.0	29,904	717,475,282	1,965,686	23,401
12	Okara	Pattoki	46	26.0	1,196	344.0	15,824	379,659,205	1,040,162	22,612
11	Khanewal Jn.	Okara	201	24.0	4,824	326.0	65,526	1,572,140,360	4,307,234	21,429
9	Multan Cantt	Khanewal Jn.	49	28.0	1,372	302.0	14,798	355,042,778	972,720	19,851
48	Faisalabad	Chack Jhumra Jn.	20	34.0	680	280.0	5,600	134,358,667	368,106	18,405
8	Lodhran Jn.	Multan Cantt	86	20.0	1,720	268.0	23,048	552,981,885	1,515,019	17,616
16	Lala Musa	Rawalpindi	157	26.0	4,082	232.0	36,424	873,907,159	2,394,266	15,250
10	Lodhran Jn.	Khanewal Jn.	90	16.0	1,440	216.0	19,440	466,416,516	1,277,853	14,198
54	Chak Jhumra Jn.	Lahore	122	22.0	2,684	210.0	25,620	614,690,902	1,684,085	13,804
15	Wazirabad Jn.	Lala Musa	32	22.0	704	190.0	6,080	145,875,124	399,658	12,489
14	Lahore Jn.	Wazirabad Jn.	100	22.0	2,200	186.0	18,600	446,262,716	1,222,638	12,226
47	Shorkot Cantt	Faisalabad	107	16.0	1,712	174.0	18,618	446,694,583	1,223,821	11,438
46	Khanewal Jn.	Shorkot Cantt	63	18.0	1,134	172.0	10,836	259,984,021	712,285	11,306
19	Rohri Jn.	Sukkur	4	18.0	72	160.0	640	15,355,276	42,069	10,517
21	Habib Kot	Jacobabad	51	16.0	816	144.0	7,344	176,201,795	482,745	9,466
57	Lahore	Narowal	86	16.0	1,376	136.0	11,696	280,617,673	768,816	8,940
20	Sukkur	Habib Kot	29	16.0	464	128.0	3,712	89,060,602	244,002	8,414
28	Hyderabad	Mirpur Khas Jn.	67	18.0	1,206	126.0	8,442	202,545,691	554,920	8,282
22	Jacobabad	Sibi Jn.	156	12.0	1,872	108.0	16,848	404,227,647	1,107,473	7,099
52	Malakwal Jn.	Lalamusa	73	18.0	1,314	98.0	7,154	171,643,197	470,255	6,442
51	Sargodha Jn.	Malakwal Jn.	75	18.0	1,350	92.0	6,900	165,549,072	453,559	6,047
23	Sibi Jn.	Quetta	141	10.0	1,410	90.0	12,690	304,466,337	834,154	5,916
17	Rawalpindi	Attock City Jn.	82	12.0	984	84.0	6,888	165,261,160	452,770	5,522
18	Attock City Jn.	Peshawar Cantt.	91	10.0	910	80.0	7,280	174,666,267	478,538	5,259
26	Dadu	Larkana Jn.	103	10.0	1,030	78.0	8,034	192,756,702	528,101	5,127
59	Wazirabad Jn.	Sialkot Jn.	43	10.0	430	76.0	3,268	78,407,879	214,816	4,996
45	Jand Jn.	Attock City	58	10.0	580	76.0	4,408	105,759,465	289,752	4,996
42	Kundian Jn.	Daud Khel Jn.	49	10.0	490	76.0	3,724	89,348,514	244,790	4,996
60	Sialkot Jn.	Narowal Jn.	62	8.0	496	68.0	4,216	101,152,882	277,131	4,470
25	Kotri Jn.	Dadu	181	8.0	1,448	68.0	12,308	295,301,156	809,044	4,470
44	Daud Khel Jn.	Jand Jn.	88	8.0	704	64.0	5,632	135,126,431	370,209	4,207
41	Kot Adu Jn.	Kundian Jn.	231	8.0	1,848	64.0	14,784	354,706,881	971,800	4,207
40	Multan Cantt	Kot Adu Jn.	87	8.0	696	64.0	5,568	133,590,903	366,002	4,207
27	Larkana Jn.	Habib Kot	63	8.0	504	64.0	4,032	96,738,240	265,036	4,207
38	Pakpattan	Kasur Jn.	140	8.0	1,120	62.0	8,680	208,255,934	570,564	4,075
50	Shorkot Cantt	Sargodha Jn.	166	8.0	1,328	56.0	9,296	223,035,387	611,056	3,681
55	Chak Jhumra Jn.	Sargodha Jn	88	8.0	704	56.0	4,928	118,235,627	323,933	3,681
39	Kasur Jn.	Lahore	68	6.0	408	50.0	3,400	81,574,905	223,493	3,287
49	Chack Jhumra Jn.	Wazirabad Jn.	135	8.0	1,080	42.0	5,670	136,038,150	372,707	2,761
36	Jacobabad	Kot Adu Jn.	428	4.0	1,712	40.0	17,120	410,753,639	1,125,352	2,629
37	Lodhran Jn.	Pakpattan	204	4.0	816	38.0	7,752	185,990,783	509,564	2,498
43	Daud Khel Jn.	Mari Indus	9	6.0	54	36.0	324	7,773,609	21,298	2,366
53	Lahore	Shorkot Cantt.	261	6.0	1,566	34.0	8,874	212,910,502	583,316	2,235
61	Pind Dadan Khan	Malakwal Jn.	19	8.0	152	32.0	608	14,587,512	39,966	2,103
66	Rawalpindi	Jand Jn.	118	4.0	472	26.0	3,068	73,609,355	201,669	1,709
56	Sargodha Jn	Kundian	132	4.0	528	24.0	3,168	76,008,617	208,243	1,578
65	Rawalpindi	Havelian	88	2.0	176	16.0	1,408	33,781,608	92,552	1,052
63	Khewra	Malakwal Jn.	24	4.0	96	16.0	384	9,213,166	25,242	1,052
67	Kohat Cant.	Jand Jn.	61	2.0	122	8.0	488	11,708,398	32,078	526
64	Gharibwal	Malakwal	22	2.0	44	8.0	176	4,222,701	11,569	526
62	Bhera	Malakwal Jn.	29	2.0	58	8.0	232	5,566,288	15,250	526
35	Amruka	Samasata Jn.	257	2.0	514	8.0	2,056	49,328,825	135,147	526
24	Quetta	Chaman	242	1.7	415	6.8	1,646	39,482,254	108,171	447
70	Wagah	Lahore Jn.	24	0.6	14	6.0	144	3,454,937	9,466	394
69	Sibi	Khost	133	2.0	266	6.0	798	19,146,110	52,455	394
58	Narowal	Chak Amru	53	0.3	15	2.4	127	3,051,861	8,361	158
34	Larkana Jn.	Jacobabad	136	0.3	41	2.1	286	6,852,292	18,773	138
30	Pithoro Jn.	MirpurKhas	36	0.4	14	1.6	58	1,381,975	3,786	105
31	Hyderabad Jn.	Badin	100	0.3	29	1.5	150	3,598,893	9,860	99
29	Khokhropar	Pithoro Jn.	90	0.3	26	1.2	108	2,591,203	7,099	79
32	Mirpur Khas	Nawabshah	129	0.1	17	0.5	69	1,650,692	4,522	35
68	Quetta	Khu-i-Taftan	633	0.1	84	0.5	317	7,593,664	20,805	33
33	Mirpur Khas	Pithoro Jn.	192	0.1	27	0.4	77	1,842,633	5,048	26
	Total (per Day)		7,832		90,417	9,441.0	960,508		63,137,274	
	*Total (per YEAR)*365=*				*33,002,076*	*3,445,977*	*350,585,457*	23,045,105,000		
					(in Year Book: 31,944,000)			*23,045,105,000*		
								Coach-Km/day		
								960,508		
								23,993		

	Primary A	>20,000	
	Primary B	20,000-8,000	
	Secondary	8,000-4,000	
	Tertiary and MG	4,000-2,000	
		2,000-1,000	
		1,000>	

The target demand for freight transport for railway development planning is shown below in Table 8.2.3.

Table 8.2.3 Target Demand for Railway Freight Transport

Year	Assumed Freight Demand			
	Total Ton-km		Maximum Sectional Transport Volume of Karachi – Lahore	
	Ton-km (billion)	%	Thousand Ton (Total of Both Directions)	%
2005/06	6	---	N.A.	---
2015/16	37	100	90	100
2025/26	111	300	280	311

Source: Demand forecast of JICA Study Team

Based on the demand, the number of necessary rolling stocks by the fiscal year of 2014/15 and from 2015/16 to 2024/25 is calculated as shown in Table 8.2.4.

Table 8.2.4 Rolling Stock Procurement Plan

	DL 3000HP	DL Smaller	Pas. EL	Frt. EL	Pas. Coach	Frt. Wagon
Number to remain out of the existing at the end of 2014/15*	216	256			1,290	2,850
Necessary number at the end of 2014/15	336	436			2,370	3,900
Number to be procured by 2014/15 **	120	180			1,080	1,050
Number to be present at the beginning of 2015/16	336	436			2,370	3,900
Number to remain out of the above at the end of 2024/25	254	333			2,117	3,320
Necessary number at the end of 2024/25	254	333	150	180	3,347	7,920
Number to be procured 2015/16 to 2024/25 **			150	180	1,230	4,600

Source: Estimation of Study Team

Remarks: DL 3000HP; Diesel locomotives of 3,000 HP engine
DL Smaller; Diesel locomotives of less than 2,400 HP engine
Pas. EL; Electric locomotives for mainly passenger trains
Frt.. EL; Electric locomotives for heavy freight trains
Pas. Coach; Coaches for passenger transport
Frt. Wagons; High performance wagons for freight transport
* Including the rolling stock not yet commissioned but already listed in MTDF
** "Procure" means purchase, manufacture, assembly and heavy rehabilitation.

8.3 Development Plan

8.3.1 General

The investment in railways should satisfy the target demand and be suitable to lay the foundation for reform and revitalisation of the railways and in accordance with the following premises:

- To specialise in the transport field in which railways have advantages
- To develop infrastructure in order to strengthen the capacity in accordance with demand, to improve transport service and to operate effectively;
- To secure a high safety level, and
- To purchase and rehabilitate rolling stock in accordance with demand, and to increase transport volume.

The development plan up to the year 2025 shall be divided into the following three stages; short-term, medium-term and long-term. The target year of the short-term plan is the fiscal year 2009/10, the same as MTDF 2005-10. And that of the medium-term and long-term plans shall be the fiscal years 2014/15 and 2024/25 respectively.

Basically, the short-term plan is being promoted along MTDF2005-10, which has already started. MTDF2005-10 includes the on-going projects listed in the Emergency Repair Plan (ERP).

Projects in the short-term, medium-term and long-term plan are composed of the investments in infrastructure and rolling stock. The investments in infrastructure are executed on the basis of the policies for transport, environment and national land development. The investments in rolling stock and service facilities are to be conducted using operating enterprises on their own responsibility, because with road transport as a competitor of railways, operating enterprises procure their carriages (automobiles, trucks and so on) on their own responsibility.

As long as sustainable infrastructure is secured, operating enterprises are able to establish business plans, purchase rolling stock and realise transport business. In other words, the railway routes with demands for mass transport, to which this scheme is applicable, are the routes generating a good effect of the investments in infrastructures.

The short-term plan should put emphasis to complete intensively the structural improvement of the section between Karachi and Lahore in the main corridor. The section has enough potential demand of mass transport to sustain railway transport business; however, service level is different from the level of customers' demand and the actual transport volume of the main corridor does not reach at the level of the potential demand due to the lack of investment and maintenance in 1990s.

The medium-term plan includes the rehabilitation of important sections after the section between Karachi - Lahore and the further reinforcement and improvement of infrastructure and service between Karachi - Lahore. At the same time, during the period of medium and long-term plan, structures such as bridges will be rehabilitated in accordance to the urgency and importance of sections.

By the year 2025, the signalling systems, which are aging and have no spare parts, will be renewed in continuing lines. The signalling systems include lower-standard system responding to the role of line.

The electrification plan between Karachi and Lahore will be established according to the growth of transport demand, taking account of supply and demand of high-power locomotives.

Management reform of the Pakistan Railways should be done in parallel with the investments. Infrastructure investments should be executed with a view to promote the reform. The relationships between management reform and investments in infrastructure and rolling stock / service facilities are shown in Figure 8.3.1.

It is desirable to gradually promote the investments in rolling stock in step with demand and the progress of infrastructure improvement. And it is necessary to replace aging rolling stock.

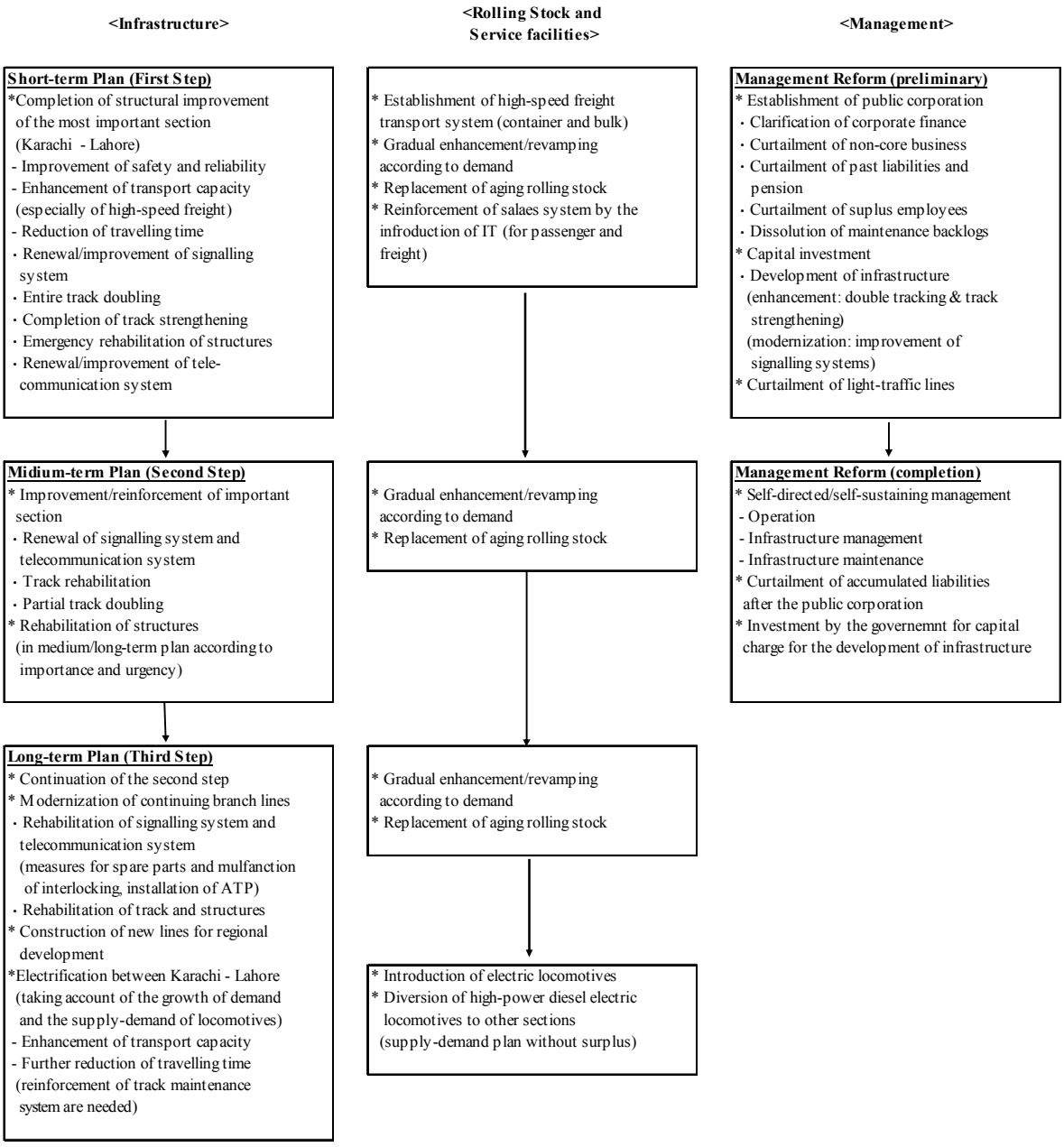


Figure 8.3.1 Relationships between Management Reform and Investments

Figure 8.3.2 illustrates the development plan by stage.

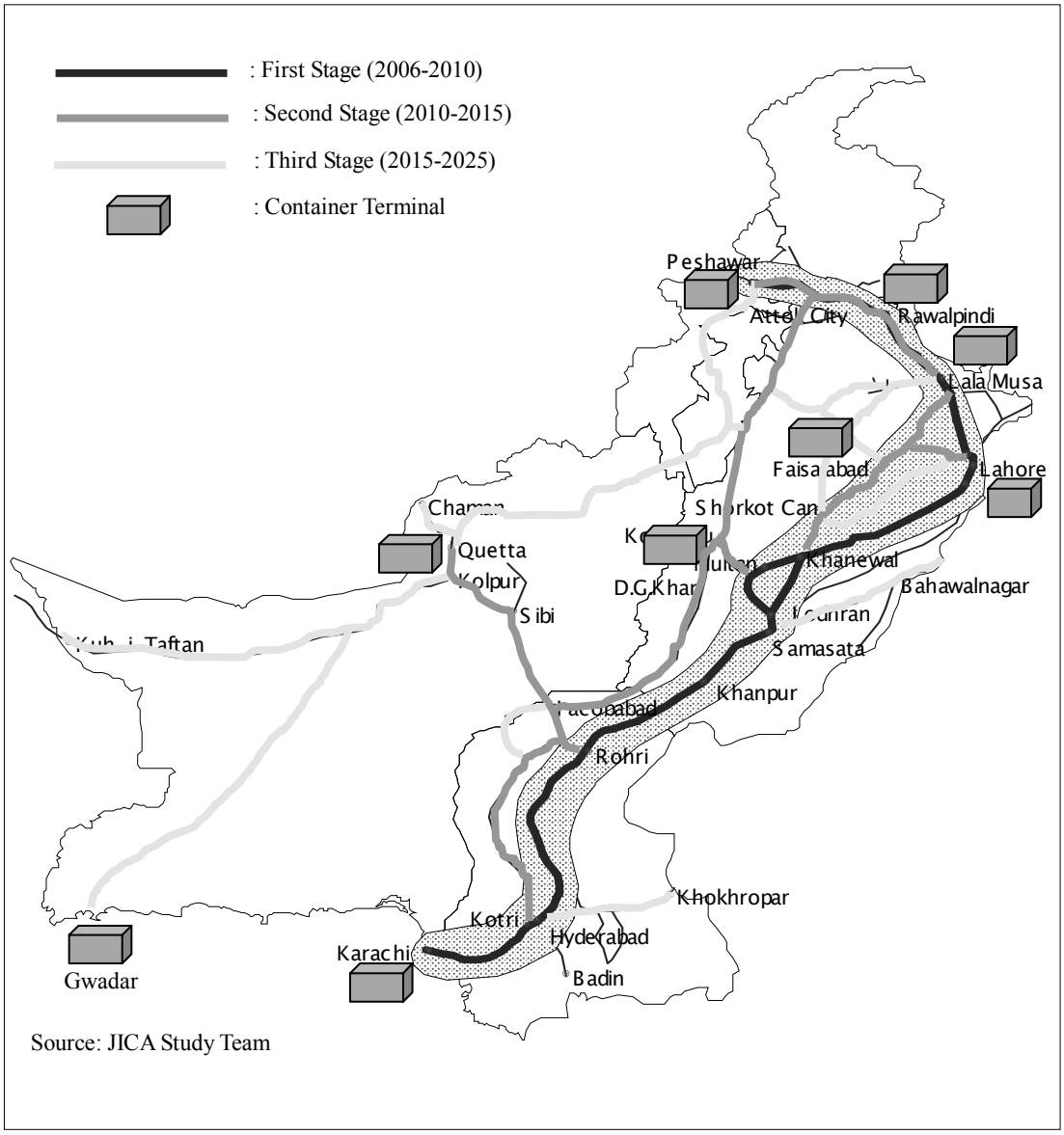


Figure 8.3.2 Development Plan of Railway System and Container Terminals

8.3.2 Short-term Plan (First Stage)

(1) Structural Improvement between Karachi and Lahore

Most of the traffic by railway is transported through the section between Karachi and Lahore (1,219km) in the main corridor (Karachi – Multan – Lahore – Rawalpindi – Peshawar) and it is expected to be so in the future as well. There is a large potential demand for high-speed container transport through the route from Karachi/Qasim port to the Punjab region including Lahore, Faisalabad and Multan, and Rawalpindi/Islamabad, Peshawar and Afghanistan.

First of all, the Pakistan Railways should complete the structural improvements and the modernisation of infrastructure of the section between Karachi and Lahore. Furthermore, the Pakistan Railways should gradually invest in rolling stock and establishes a freight transport system mainly composed of high-speed container and bulk transport and reinforces the competitiveness of high-speed inter-city passenger transport by the improvement of service quality such as increased frequency and speed. And as a result, the position of railways in land transport will be ensured.

Container transport currently operates only one round trip a day. In order to establish the high-speed container transport system and to turn potential demand into actual demand, the Pakistan Railways should set the number of regular and scheduled container trains to meet the demand in the same manner as passenger trains, and thereby should sell the service of container transport. More than five round trips (assumed based on the number of imported containers) of high speed container trains with enough loads from Karachi/Qasim port could be operating now, if the Pakistan Railways were able to offer such transport service.

Besides, it is desirable to efficiently conduct the bulk transport on a regular and scheduled basis, since bulk transport of coal and so on is incorporated into the operating system of customers.

The present maximum and average train speed of freight trains (55 km/hr and 22 km/hr respectively) does not meet customers' needs; however, taking economical efficiency into account, heavy freight trains (about 1,800tons) do not need to run at high speed like passenger trains, and an acceptable speed of freight trains is 70-80 km/hr as against the 100-120 km/hr of passenger trains. (Though it is possible to operate freight trains at the same high speed as passenger trains, it is necessary either use 2 locomotives or to decrease the volume of freight. In this regard, if customers require freight service at high speed, and moreover, they pay increased charges for high-speed freight service, high-speed freight transport is feasible.)

Actually, under the current infrastructure, it is impossible to set as many regularly scheduled high-speed freight trains as passenger trains on the existing diagram. The reasons are the followings;

- When exchanging and overtaking in a single track section, the travelling time of passenger trains, which currently prevail over freight trains, becomes longer if their priority is equal with freight trains. Therefore, the service level of passenger transport comes down, and the competitiveness weakens. (The operation of a small number of high-speed freight trains as the first step in the establishment of high-speed freight transport system has only small influence on the operation of passenger trains and does not cause any problems.)
- When the number of freight trains is increased, waiting for exchanging and overtaking in the single-track section also is increased. This situation makes travelling time longer.
- The travel time of freight train can not be reduced without lowering the service level of passenger trains, even if high performance wagons are introduced.

In order to fully establish the high-speed freight transport system, it is necessary to take the following measures and thereby to get rid of causes for the increase of travelling time of passenger trains.

- Renewal and improvement of the signalling systems
- Completion of track strengthening work
- Track-doubling work all along the main corridor (245km of single track section remaining between Khanewal and Raiwind out of 1,219km)
- Improvement of telecommunication systems

Their effects are shown as below;

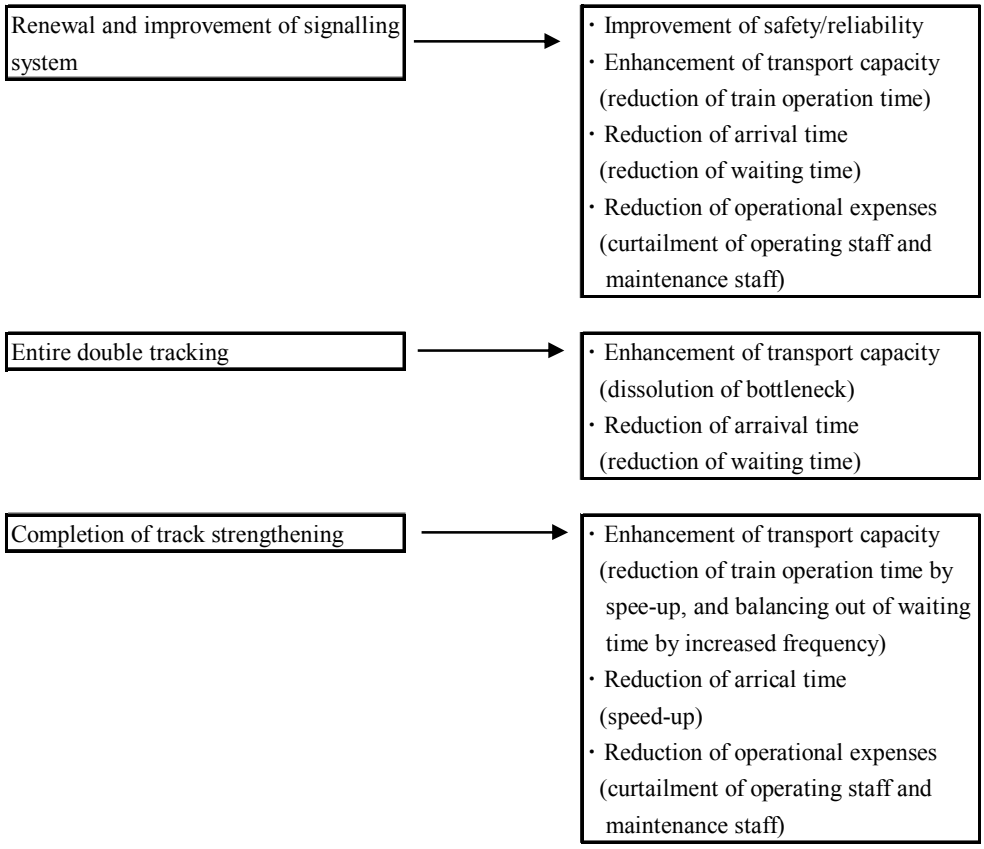


Figure 8.3.3 Effects of Project

(2) The Infrastructure Investment Plan

a) Renewal and Improvement of Signalling Systems

The old style and aging signalling system is one of the three major infrastructure defects in the section between Karachi and Lahore. Together with the remaining single track section and unfinished track strengthening, the old style and aging signalling system is an obstacle to the development of the Pakistan Railways.

An automatic block system is only installed in the section between Karachi City and Hyderabad (179 km). And the relay interlocking system has only been adopted sporadically. Most of the signals are semaphores. In addition, automatic train protection (ATP), which is a back-up system to prevent accidents caused by human errors such as oversight, has not been installed at all.

As stated above, despite the fact that 80% of the route between Karachi and Lahore is double-tracked and has high-standard tracks, the transport capacity, the service level of transport and the safety are not adequate due to the old style and aging signalling systems. In addition, despite having the potential demand, the Pakistan Railways does not utilize the double track adequately. And the present transport operation requires a large number of staff, and therefore, the management is inefficient. The improvement and reinforcement of the signalling system need to be done urgently.

Therefore the renewal and improvement of the signalling system between Karachi City and Lahore as early as possible is necessary. This project is not listed in MTDF 2005- 10. However, after the serious accident at Sarhad on 13 July 2005, the Ministry of Railway and Pakistan Railways have been moving to execute.

The section for the renewal and improvement of the signalling system is: Karachi City – Lodhran – Multan/Shujabad (both) – Khanewal – Lahore – Shahdra Bagh, including the

branch line to Moghalpura. Its contents are as follows;

- Installation of an automatic block system for entire section (The system between Karachi City and Hyderabad is to be rehabilitated.)
- Installation of relay interlocking devices or computerised interlocking devices at all stations (The relay interlocking devices, which have been installed already, are to be rehabilitated.)
- Adoption of coloured light signals
- Installation of an automatic train protect system (ATP)
- Adoption of a centralised train control system (CTC)
- Automatic warnings and barriers for at-grade crossings

b) Completion of Double-tracking

Only the 245 km section between Khanewal and Raiwaind is remaining as a single-track section. (The improvement of the single-track section between Lodhran and Khanewal via Multan is under construction for completion at the end of the year 2005/06.)

The remaining single-track section causes the following issues;

- This section is the bottleneck of the section between Karachi City and Lahore where the demand stays constant. The transport capacity is limited to the level of the bottleneck section. This means the existing double-track section is not utilized efficiently.
- The average speed of express trains slows greatly due to the waiting time for train exchange. Once delayed, unexpected waiting time amplifies further delay of the train operation.
- Due to the waiting for train exchange and being overtaken, average speed of freight trains is quite slow.
- Even if the system of high-speed freight transport is established, it will be difficult to significantly reduce the travelling time of high-speed freight train under the circumstances.

It is desirable to complete the double-tracking work urgently in order to improve the transport capacity of the entire route and the transport efficiency and service level by reduction of travelling time as well as to establish a system of high-speed freight transport.

The single-track section is located in flatland with low embankments would be adequate. There are no large rivers, and it is not necessary to construct large structures. Bridge piers for the double track over small rivers have already been constructed. Land has been secured.

Under these circumstances, there are no difficulties in cost or construction.

The double-tracking project is recognized as an on-going project in MTDF2005 -2010 and PSDP2005/06, and the commencement of the project is scheduled for 2005/06. It is desirable to construct the project on the schedule.

The improvement of the signalling system for this section is included in the signalling system project.

c) Electrification

The Khanewal – Lahore section was electrified 35 year ago. The renewal of electrification facilities for the section is included in another plan, or in the electrification project in the section between Khanewal and Samasata. The contents of the project are the extension and rehabilitation of the existing electrified section. The priority of this electrification project is lower than the double-tracking project. From the viewpoint of the efficient usage of capital, the electrification project is not a project that can be constructed simultaneously with the double-tracking project. It is also impossible to conduct the electrified train operation on one track out of double track, and it is necessary to halt the electrified train operation for a while.

All electric locomotives are aging because they were introduced 35 years ago. Since then, no

new electric locomotives have been introduced. There are few electric locomotives in use now. Since diesel locomotives haul most trains even in the electrified section, not problems are expected with availability of locomotives if electric locomotives are not in use. Even if the double-track section is electrified and new electric locomotives are commissioned, the operational efficiency of these locomotives is low because it is necessary to change to diesel locomotives at Khanewal. From the investment viewpoint, the project of new electric locomotives is of low investment efficiency. At the same time, the operational efficiency of diesel locomotives also becomes low.

d) Track Strengthening and Rehabilitation

In the most important section, Karachi – Lahore, track strengthening and rehabilitation work has been executed due to its priority; however, there is a section that is as yet uncompleted. Though replacement of rails and installation of prestressed concrete sleepers are almost finished, reinforcement of ballast thickness is less advanced. Rails, sleepers and ballast are important components of railway track. Due to the insufficient thickness, ballast does not function properly as a shock absorber, and the inadequate thickness of ballast causes damage to the track, and in addition causes an increase in maintenance work. Therefore, it is necessary to complete the track strengthening and rehabilitation work urgently.

At the beginning of track rehabilitation, 100RS (100lb/yard, or about 50kg/m) rail was used, but currently UIC54 (54kg/m) rail is used.

The progress of the work on the Karachi – Lahore section up to June 30, 2005 is shown below.

- Replacement of rails : 97 %
- Installation of PC sleepers : 97 %
- Reinforcement of ballast thickness : 23 %

Currently, it is possible to operate trains at the speed of 105 km/hr for almost the entire section between Karachi and Lahore; however, it is necessary to complete the track strengthening and rehabilitation work in order to operate trains at the speed of 120 km/hr as the first step toward high-speed passenger service.

The increased frequency of regular and scheduled freight trains creates and increases the waiting time of passenger trains. Since increases in maximum trains speed resulting from the track strengthening will offset the increase of travelling time of passenger trains, it is possible thereby to avoid a deterioration in passenger transport service. Therefore, track strengthening is needed for the establishment of a high-speed freight transport system.

Only after the track strengthening, it will be possible to ensure an acceptable level of track maintenance by carrying out constant maintenance works and thereby, sound management of transport service can be provided. Inadequate track structure needs a lot of maintenance staff and has a higher cost or speed restrictions, which cause a deterioration of service level. As long as the timing of speed restrictions and accrual of extra maintenance expenses are unforeseeable, it is difficult to establish proper railway management procedures.

In addition to the reinforcement of the physical structure of the track, the establishment of a track maintenance system is also required to keep the track in a good condition and to continuously provide transport service. In fact, it is necessary to accomplish the following tasks as part of the track strengthening; the securing of track maintenance machines such as a multiple tie-tamper, the development of a maintenance depot for effective usage of track maintenance machines and appropriate staff allocation.

e) Other Investment Projects in Infrastructure at the First Stage

It is desirable to execute the following project in the first stage simultaneously with the structural improvement of the Karachi - Lahore section.

- Inspection and establishment of a long-term plan for rehabilitation and renewal of structures along all the lines
- Renewal and improvement of the telecommunication system for the Karachi - Lahore section
- Urgent rehabilitation of structures in dangerous condition along all the lines
- Urgent rehabilitation of track and signalling systems along all the lines

The Pakistan Railways has a history of more than 100years, and this also means that more than 100 years has passed since the construction of some of structures. There are various conditions of the structures such as; adequate to use as it is, requiring reinforcement and repair, and requiring replacement. And, from the viewpoint of safe train operation, there are various conditions such as; having no problem for the present, adequate to use at a slow speed, adequate to use with constant inspection, and requiring urgent measures. The urgent issues are to completely inspect aged structures and to establish a long-term plan for rehabilitation and renewal according to the importance of the lines and the condition of the structures. If there are structures requiring urgent rehabilitation or replacement, the rehabilitation or replacement will be done in the short-term plan.

In addition to the signalling system, the telecommunication system is also aging and decrepit and needs to be improved or rehabilitated. Telecommunication facilities are essential for smooth train operation control and back-up for safe train operation. Both passenger transport and freight transport require the strengthening of the telecommunication system for the improvement of service to increase sales and to provide information service and for the reinforcement of competitiveness. It is easy to lay down fibre-optic cables along the side of the track. In addition, in parallel with the development of the telecommunication network for the railways, it is possible to develop the telecommunication business nationwide by laying down capacious fibre-optic cables. First of all, it is desirable to urgently renew and improve the telecommunication system of Karachi - Lahore section.

In other sections also, infrastructures are aging and decrepit due to the shortage of investment and maintenance. Therefore, it is necessary to inspect and urgently rehabilitate the important infrastructures for train operation such as tracks and signalling systems.

(3) Investment Plan for Rolling Stock

a) Fundamentals of the Investment in Rolling Stock

The rolling stock of the Pakistan Railways are aging and do not have enough performance to maintain present transport capacity due to the lack of investment and maintenance in the 1990s. And the rolling stock can not respond to the enhancement of transport capacity and the change of transport structure.

The progression of aging of rolling stock, the shortage of spare parts and wastage of parts raises the failure rate, and reduces the availability factor. In addition, frequent failure during train operation causes deterioration in the quality level of transport service. Currently the Pakistan Railways copes with such situation by maintenance works. However, the maintenance work causes an increase in operation expenses due, in part, to the increase in maintenance staff. The Pakistan Railways is faced with the deterioration of service and efficiency today.

Especially in freight transport, despite the fact that the role of the railways is specialized in high-speed mass transport between centres by container or bulk transport, not only the number, but also the quality of rolling stock is far from adequate for the high-speed mass transport between centres. There were only 130 wagons for high-speed container transport at the end of the year 2004/05, and the Pakistan Railways provides only one round trip a day for high-speed container transport.

There should be enough rolling stock to meet the transport demand and if there is enough

demand to justify the continuing role of the railways and furthermore that the infrastructures are well-maintained, railways should be able to procure their rolling stock with their own funds.

Consequently, given that the structural improvement of infrastructure will be promoted, it is possible to procure rolling stock with various finance sources, including private funds, in order to establish the high-speed transport system over the Karachi – Lahore section, which has potential demand for high-speed mass transport by container or bulk transport.

b) Locomotives

i) Importance of introduction of laboursaving-type locomotives

In the near future, accompanied with economic growth, employment cost will become more expensive than at present, therefore, labour saving is necessary for continuation of the railway. It is important to introduce labour saving-type locomotives, such as inverter-control induction/synchronous motor type locomotives from now on. If not, in the future railway operating enterprises will suffer lack of skilled workers for locomotive maintenance when transport demand increase vastly, even though at present they have many workers at rather low salaries.

ii) 3000HP high-power diesel locomotives

3000HP high-power diesel locomotives are the main locomotives that are essential for intercity high-speed passenger transport and high-speed freight transport on the Main Line. Currently, the Pakistan Railways owns 115 of the 3000HP locomotives.

3000HP high-power diesel locomotives are absolutely necessary to establish the high-speed container freight transport system in the section between Karachi and Lahore. And it is necessary to increase the number of the locomotives for the increased frequency of trains contributing to reducing the congestion of intercity high-speed passenger transport, the improvement of service, and the reinforcement of competitiveness.

Presently, the procurement of 44 locomotives is in progress under “the project for procurement of 69 Chinese locomotives” listed as on-going project in MTDF 2005-10, and 21 diesel locomotives have already been commissioned as of the end of 2004/05.

Furthermore, the procurement of 30 locomotives is planned under “the project for procurement of 75 locomotives” listed as new projects in MTDF 2005-10.

Although 36 of the GMU-30 locomotives currently held are 30 years old, the Pakistan Railway will maintain and retain them because no replacement plan has been approved yet. There is a rehabilitation plan including replacement of engines, but this plan is not listed in MTDF 2005-10.

As the structural improvement of the Karachi – Lahore section progresses by intensive investments in infrastructure, it is necessary to execute the above plans for investments in rolling stock.

The number of 3000HP high-power diesel locomotives for the intercity high-speed passenger transport between Karachi and Lahore and the high-speed freight transport between Karachi and up-country mainly by container or bulk transport will be 138 nos. This figure can meet immediate demand.

iii) 2000(2400)HP middle-size diesel locomotives

2000HP middle-size diesel locomotives are used for middle/short-set passenger trains, slow freight trains and lines with weight restrictions.

Since locomotives with axle load of 22.86 tons are not allowed to run in sections other than the Karachi - Lahore section (including via Faisalabad) or have speed restrictions imposed due to the aging of tracks and structures, 2000HP middle-size diesel locomotives are in use.

The axle load is 17.78/17.27 tons. Some of the 2000HP middle-size diesel locomotives, including China-made locomotives, are of heavy axle load, and those are not able to run on unimportant lines.

The Pakistan Railways owns 276 of the 2000HP middle-size diesel locomotives, out of which 48 locomotives are of heavy axle load. There are 9 locomotives, of which the age exceeds 30 years (excluding rehabilitated locomotives).

Presently, the procurement of 25 of the locomotives is in progress under "the project for procurement of 69 Chinese locomotives" listed as an on-going project in MTDF 2005-10, and 7 diesel locomotives have been already commissioned by the end of 2004/05.

Furthermore, the procurement of 30 of the locomotives is planned under "the project for procurement of 75 locomotives" listed as new projects in MTDF 2005-10.

In addition, the rehabilitation of 55 locomotives is planned under "the plan for recommissioning of 55 locomotives" listed as new projects in MTDF 2005-10. This figure meets the demand of sections other than the Karachi - Lahore section.

iv) 1500HP or less small-size diesel locomotives

1500HP small-size diesel locomotives are used for short-set passenger trains on branch lines. The axle load is 16.76 tons or less. There are 76 locomotives and their age is about 30 years. There are 57 locomotives of 1200HP or less, mainly used for shunting. Their age is over 40 years.

The procurement of 15 of this type of locomotive is planned under "the project for procurement of 75 locomotives" listed as new projects in MTDF 2005-10.

Short-set passenger trains on branch lines may have come to the end of their role in railways. And all currently held small-size diesel locomotives are aging. However, since this type of locomotive is not only for current short-set passenger trains on branch lines, but also for other light works, it is necessary to supplement a few numbers of this type of locomotives.

c) Passenger Coaches

Currently, passenger trains mainly engage in middle/long-distance intercity high-speed transport. Short-distance local transport has shifted almost totally into automobiles. In this regard, railway lost its role. Consequently, future investments are mainly for the increased frequency of intercity high-speed trains and the improvement of service. The issue is to increase of the number of passenger coaches and the refurbishment of accommodations.

Passenger coaches are classified as economy class and upper class such as air-conditioned lower, air-conditioned lower special and air-conditioned parlour. In expectation of the improvement of national living standard and the service level of competitors, it is important to increase the number of, refurbish, improve and renew passenger coaches. The reinforcement of upper-class service leads to an increase in income and contributes to making railway management stable.

In case the service level does not meet customers' needs and competitions, even though service life of coaches is still remaining, it is easy to refurbish the accommodation of coaches. And rehabilitation including refurbishment of accommodation of old passenger coaches also is applicable.

In order to determine the appropriate type of passenger coaches, it is important to understand customers' needs through marketing activities. It is desirable to consider the following items;

- Whether the Pakistan Railways should expand sleeper compartment service or not, instead of the current uncertain rule depending on congestions?
- Are berths available during the night time?
- Should the Pakistan Railways set out sleeper service to raise income if there is enough space?

- Whether economy and air-conditioned lower class are specialized in sitter service to improve comfort or not?
- Do customers prefer compartments or not?
- Whether the Pakistan Railways should provide comfortable service exclusive to sitter for middle-distance intercity transport or not?
- Is small-capacity and expensive air-conditioned sleeper class is competitive with aviation?

The procurement of 175 passenger coaches is in progress under the project of "Procurement/manufacture of 175 passenger coaches" listed as on-going project in MTDF 2005-10. And 108 passenger coaches have already been commissioned as of the end of 2004/05.

In addition, the rehabilitation of 450 passenger coaches is in progress under the project of "Rehabilitation of 450 passenger coaches". This project includes the conversion to air-conditioned lower special. By the end of 2004/05, 317 coaches had been converted.

Furthermore, the procurement of 150 passenger coaches is planned under the project of "Procurement, manufacture and assembly of 150 passenger coaches"

After 2005/06, 217 coaches will be added, or an increase of 11%. It is desirable to procure or manufacture passenger coaches after 2005/06 as well, responding to the growth in transport volume and congestion reduction.

d) Freight Wagons

Currently, railway freight transport is composed of direct railway transport between centres by block train and then distribution by truck. The Pakistan Railways have few wagons for container or bulk transport, or high-speed container wagons or commodity specialized high-speed wagons. Few high-power locomotives are allocated for freight transport. Therefore, the Pakistan Railways currently hardly ever operates long-distance high-speed mass transport.

The Pakistan Railways has no freight wagons for container or bulk transport other than commissioned ones out of the 1300 wagons from China. Covered wagons require loading and unloading of general cargo by manpower, and have no future. And covered wagons will be replaced with container wagons in the future. It is necessary to urgently increase the number of containers and wagons appropriate for each commodity and to develop efficient freight transport, in which way railways can demonstrate its advantages.

Most of the wagons currently in hand are four-wheelers. The maximum speed of this type of wagons is limited to 55 km/hr. In addition, running stability is lacking, and almost all are aging. Therefore, four-wheelers should be retired upon the introduction of new freight wagons.

After the completion of the oil pipeline, transport of oil and petroleum products by tank wagons will be terminated. Though most of the tank wagons are of four-wheelers, it is possible to convert a part of the newer bogie wagons into the appropriate wagons.

As for future container transport, railway attracts not only bonded containers, but also containers after customs clearance and goods transhipped after customs clearance and transported as general cargo by railway and truck into railway container transport.

As for bulk transport, it is necessary to plan projects including the development of a transport base with loading/unloading equipment and the manufacturing of wagons for bulk transport.

Presently, the procurement of 1300 freight wagons is in progress under the project of "1300 high capacity wagons" listed as on-going project in MTDF 2005-10, and 377 freight wagons have been already commissioned by the end of 2004/05.

Furthermore, the procurement of 1000 freight wagons is planned under the project of "Procurement/manufacture and assembly of 1000 freight wagons" listed as new projects in MTDF 2005-10.

Except for the above freight wagons, the Pakistan Railways does not own freight wagons suitable for high-speed freight transport. In order to establish the high-speed freight transport system, it is absolutely necessary to accomplish these projects.

It should be noted that covered wagons now in use are not suitable for future railway freight transport because goods are loaded/unloaded only by manpower. In addition to containers and bulk, there is the mass transport suitable for railways such as the transport of goods from manufacturing factories to warehouses at logistic centres. However, with the development of the economy, the time will come in the near future that loading/unloading by manpower seems in no way practical. Therefore, it is necessary to procure or manufacture the full-open side door type freight wagons, which are suitable for loading/unloading by fork lifts.

(4) Service Facilities, Loading/Unloading and Logistic Facilities

To develop railways passenger transport as an attractive service, it is important to improve not only rolling stock and operating time, but also the ticket sales system, waiting lounges, canteens and kiosks. It is possible to improve the service system and facilities by private-sector capital, not by large investment as infrastructures, under the situation that the improvement of infrastructure and rolling stock make railway passenger transport stable.

The improvement of the sales system for reserved-seat tickets is especially important because passengers mainly use railways for long-distance trips. The Pakistan Railways should utilize travel agencies in business districts so that passengers do not need to go to the stations for advance reserved-seat tickets. At the same time, the Pakistan Railways should improve the service of ticket counters at the stations so that it does not take a long time to buy tickets. For the above, the enhancement of a computerised ticketing system is indispensable, and the computerised system will facilitate credible sales control and demand statistics.

Freight transport is positioned as a part of the logistic system from origin to destination. Consequently, reliability and punctuality are important for train operation. As for container transport, the establishment of a sales system is essential. Since bulk transport is incorporated into the operating system of manufacturing factories, regular/scheduled transport on a long-term contract is the main business.

Since railways can not provide door-to-door transport service, the function of the base station is to be a contact point between the railway and trucks or ships. And the improvement of the dry ports, container centres, logistic centres, commodity-wise transport centres and so on is essential for the development of railways freight transport. These facilities need to have comprehensive functions for not only loading/unloading of railways, but also as a logistic base. However, the railways company does not need to own all these facilities, and it is possible to develop those facilities by private-sector finance including private funds.

8.3.3 Medium-term Plan (Second Stage)

(1) Infrastructure Investment Plan

After the completion of the structural improvements for the Karachi - Lahore section, the important sections after the Karachi - Lahore section such as the Lahore - Rawalpindi - Peshawar section, Khanewal - Faisalabad - Lahore section, Faisalabad - Wazirabad section and Rohri - Quetta section will be improved. The main projects are track rehabilitation, renewal and improvement of signalling/telecommunication systems and partial track-doubling in heavy traffic sections. Those projects are necessary for safe and stable transport and streamlining of management, and reduce the requirements for handling and maintenance staff. The existing signalling systems will be replaced with new systems of a

standard corresponding to the transport demand and importance of the section. Thereby, it is possible to reduce the number of switching staff at the stations and solve the difficulties of procurement of spare parts for required maintenance.

Based on the rehabilitation plan for structures and the long-term replacement plan established in the short-term plan, the rehabilitation and replacement work for the structures are to be promoted according to the urgency of the work and the importance of the sections. The long-term plan takes over this project.

(2) Rolling Stock Investment Plan

There are no projects for rolling stock listed in MTDF 2005-10, other than the projects commented as "continued beyond 2009/10" in the MTDF.

It is possible to promote investments in rolling stock in accordance with demand therefore, the investment plan for rolling stock is to procure the number corresponding to estimated demand.

The main locomotive is a 3000HP high-power type because the transport between Karachi and Lahore is dominant and the increase of transport volume is expected to be great. During the Second Stage, the Pakistan Railways will have rehabilitated tracks of sections other than Karachi – Lahore section, and the sections where high-power locomotives can run will expand.

The increase, rehabilitation and refurbishment of passenger coaches will proceed continuously, and at the same time improvement of service, reinforcement of transport capacity and reduction of congestion are to be promoted. It is important to adapt type and accommodation of coaches to customers' needs.

As for freight wagons, the qualitative change to flat wagons for containers should be promoted. Over aged four-wheeler wagons have low occupancy efficiency in terms of locomotives and tracks. And occupancy efficiency of the wagons is quite low. Securing the operability of four-wheelers entails expenses for maintenance staff and facilities. Therefore, it is desirable to urgently retire the four-wheelers.

8.3.4 Long-term Plan (Third Stage)

(1) Long-term Investment Plan for Infrastructure and Rolling Stock

In the long-term plan after 2015/16, the target is to realize long-term projects listed in MTDF 2005-10. Besides, the renewal of signalling and telecommunication systems and the track rehabilitation are promoted for unfinished lines. These lines have small transport volume and low significance, therefore, the renewal and the rehabilitation are conducted at a certain standard, realized at low cost and solve the problem that old style and aging facilities required a large number of switching and maintenance staff. By this time, with the economic growth, employment cost will become more expensive than at the present, therefore, labour saving is necessary for continuation of the railways.

Rehabilitation and replacement of structures in the long-term plan are to be continuously executed.

By eliminating light-traffic lines, which have lost their role with the railways, from the national railway network, those lines do not need investments.

As for rolling stock, manufacturing, replacement and refurbishment are to be promoted in accordance to sharply increasing demand trends and changing customers' needs.

(2) Electrification

The section between Karachi and Lahore (1,219 km) has large passenger and freight demand, and it will grow together with the economic growth of the country. For a large transport

volume, electrification is advantageous, because of low rolling stock procurement cost, maintenance cost and availability of high traction power. Power cost depends on electric power supply and track conditions and operation of the railways.

This section has few sections of steep gradient and most trains are express which rarely stop. Therefore, little resource saving effects from regenerative brakes is expected. If the portion of electric power sources other than petroleum is high, railway electrification can reduce the country's consumption of petroleum. If hydro and atomic power is a large portion of total generation, exhaust of CO_2 can be reduced.

As electrification can easily run high power locomotives, speed-up of heavy freight trains, further speed-up of passenger trains and increase of acceleration of all trains can be economically carried out. Therefore, electrification makes it possible to utilize to the utmost the improved infrastructure of the advanced signalling systems, double-track and strengthened tracks.

On the other hand, as electrification requires huge investment for facilities, it needs careful study to decide if it is a candidate for execution. Transport demand is the most important factor of the decision. Another factor is demand and supply of 3000HP high power locomotives in order to avoid a surplus of locomotives which can only enter the limited section allowing 22.86 ton axle load.

Transport demand in this section (Karachi - Lahore) is nearly equal throughout and most of the trains operate through. Therefore, partial electrification that makes efficiency of locomotives and drivers low by changing on the way is not preferable, and the project should be for electrification of the entire section from Karachi to Lahore though phased construction is necessary.

A study on electrification between Karachi and Lahore (including rehabilitation of the currently electrified section) needs to be carried out in the medium-term plan looking ahead to growth of demand.

In accordance with the target demand based on the demand forecast in this Study, electrification construction works between Karachi and Lahore will need to start within the medium-term plan.

8.3.5 Curtailment of Light Traffic Lines

One of the most important problems of railway management reform is how to deal with light traffic lines. Their traffic volume is insufficient to operate railway lines which are suitable for mass transport now that the road transport system has been developed.

Some lines of the Pakistan Railways do not have enough demand for their subsistence and have already lost their roles with the railways. They are reducing the efficiency of the railways system. And it is preferable to separate those lines from the nationwide railway system and to entrust them to provincial governments. Each line should be managed independently by its own standard or changed over to road transport.

Passenger transport needs speed, frequency, and punctuality as well as safety. Therefore, demand large enough to sustain such conditions is required. Estimated passenger traffic density (Passenger-km of section / section length / day) is shown in Table 8.2.2.

It can be said that the traffic density of less than 1,000 passengers per day is insufficient. For example, in Japan lines less than 4,000 passengers per day were separated from the nationwide railway system and entrusted to the decision of the regions in the reform and privatization of Japanese National Railways in 1987.

Freight transport does not necessarily require high speed and frequency if the haulage distance is not so long as branch lines of light traffic. Therefore, the transport of huge volumes by a small number of trains, for example a train per day, can be continued at low speed with small infrastructure maintenance cost. Thus some branch lines can be managed

exclusively for freight transport. However, if the remaining traffic is only feeder transport of containers and the number of trains is not sufficient even though the haulage volume is huge, then it is more effective to shift such container transport from the railways to road transport because of easy transhipment.

8.4 Master Plan Projects

8.4.1 Railway Infrastructure

(1) The Objective of the Railway Infrastructure Improvements

The objective of the improvement of railway infrastructure is to revitalize the underutilized railway infrastructure and develop a high speed freight transport system in the Karachi-Lahore Corridor. The high speed freight transport system will maximize the inherent advantage of railways, i.e. long haulage and massive transport by block trains, and enhance railway's competitiveness. The system will maximize the container and bulk transport among selected stations such as large-scale freight stations, dry ports, container centres, logistic centres, etc. to operate by the "station -to-station direct transport".

(2) The Prioritization of the Investment Projects

Investment projects and their priorities are established based on the objectives of the railway infrastructure improvement stated herein and the situation analysis of the infrastructure, rolling stock and train operation which is detailed in the preceding section of this Chapter. The investment projects are also identified and the schedule and estimated cost of projects are detailed in Table 8.4.7 in "7.4.4 Schedule and Cost". The investment projects shall be implemented in three stages. The target year of the first stage is the fiscal year 2009/2010 corresponding to MTDF 2005-10 and those of the second and third stages shall be the fiscal year 2014/15 and 2024/25, respectively. The major infrastructure improvement and modernization projects are listed below:

a) First Stage (2006-2010)

- Doubling of track from Lahore to Khanewal via Multan
- Doubling of track from Khanewal to Raiwind.
- Doubling of track from Lahore to Faisalabad
- Doubling of track from Shahdara Bagh to Lala Musa (1st Phase).
- Rehabilitation/replacement structure on Karachi-Lahore(1st stage)
- Modernization of signalling system on the Karachi- Lahore section
- Modernization of signalling system on the Lahore-Faisalabad section
- Modernization of signalling system on the Lahore-Rawalpindi(1st Phase)
- Improvement and modernization of telecommunication system(1st Phase)
- Upgrading and improvement of track from Khampur to Lala Musa.
- Rehabilitation and repairs of bridges and stations in the Corridor.
- Expansion/improvement of container stations in up-country area.
- Improvement of freight stations in Karachi for container/bulk transport.
- Establishment of operational diagram.

b) Second Stage (2010-2015)

- Doubling of track from Shahdara Bagh to Lala Musa (2nd Phase)
- Doubling of track from Lara Musa to Rawalpindi
- Doubling of track from Lodhran to Khanewal
- Upgrading and Improvement of track from Khanewal to Wazirabad.
- Rehabilitation/replacement structure on Karachi-Lahore(continue 1st Phase)
- Improvement and modernization of telecommunication system(2nd Phase)
- Improvement of signalling system from Rawalpindi to Peshawar
- Improvement of signalling system from Khanewal to Wazirabad

- Improvement of signalling system from Multan to Attock City
- Improvement of signalling system from Kotri to Habib kot
- Improvement of signalling system from Jacobabad to Kot Adu
- Rehabilitation of track from Rawalpindi to Peshawar
- Rehabilitation of track from Jacobabad to Kot Adu
- Rehabilitation of track on the Rohri-Quetta-Taftan section(1st Phase)

c) Third Stage (2015-2025)

- Rehabilitation /replacement of structures on Karachi-Lahore (2nd Phase)
- Rehabilitation of track on the Rohri-Quetta-Taftan section(continuation of 2nd Stage).
- Rehabilitation/ replacement of structures of other lines
- Improvement and modernization of signalling system on other lines
- Improvement and modernization of telecommunication system on other lines
- Upgrading and improvement of track on all regional lines.
- Construction of new lines for regional development including rail link to Gwadar Port.
- Construction of railway yard and railway linkage between Gwadar Port and container yard.
- Electrification of the Karachi-Lahore line

d) Estimated Cost

- The estimated cost of the improvement programme is Rs. 546 billion which includes the costs of rolling stock specified in Table 8.4.7.
- The break down of the total cost is: Rs. 107 billion for the First stage, Rs. 130 billion for the Second Stage and Rs.309 billion for the Third Stage.
- These costs need to be financed by the government and external assistance during the next 20 years.

8.4.2 Rolling Stock Fleet

Rolling stock can be increased, rehabilitated and remodelled by small numbers corresponding to demands and customers' requirements. The plan is proposed along this line.

Investment for rolling stock will suit private funds if reform of the Pakistan Railway progresses. For example, a container transport enterprise can procure locomotives and wagons using its own funds.

Rolling stock will be used for more than 30 years, and it is essential to be procured and designed foreseeing various conditions; not only transport demand but also customer orientation, supply and demand of skilled employees, change of requirement of types accompanied with infrastructure projects for example electrification and track/bridge reinforcement, etc.

Especially, "maintenance free" is an important factor because skilled employees will become more difficult to obtain corresponding to development of the Pakistan economy even though the Pakistan Railways have many skilled employees at present. Loading and unloading by manpower will also become difficult.

It is essential to recognize that the existing 4-wheeler will soon become unusable because of a mismatch with customers' requirements. Brake vans will become unnecessary in the lines where automatic block systems and improved communication systems are provided.

8.4.3 Project Evaluation

(1) Effect of Signalling System

The following effects are expected from the investment in the signalling system;

- Improvement of safety and reliability

- Reinforcement of transport capacity (reduction of train intervals)
- Reduction of travelling time (reduction of waiting time)
- Reduction of expenses for train operation (reduction of operation and maintenance staff)

a) Improvement of safety and reliability

The visibility of signals becomes high and back-up system prevents human errors such as oversight of a signal and over speed. Therefore, the safety and reliability of railway is greatly improved.

b) Reinforcement of transport capacity (reduction of train intervals)

With the existing system only one train is allowed to run in a section between adjacent stations despite the double track; however, with improved system trains can operate with "2 block section clear" and short signalling system handling time. (Signals located between stations are changed automatically instantly.) Therefore, the train intervals can be reduced significantly, and at the same time, the number of trains can be increased.

This situation reinforces the transport capacity.

Operation intervals depend on the headways of block signals. The below comparison chart is a sample of the reduction of operation intervals.

Reduction of Operation Interval

Speed	Operation interval under the improved system	Operation interval under the existing system	
		10 km *	15 km *
100 km/hr	4 min. 20 sec.	10 min. 30 sec.	13 min. 50 sec.
70 km/hr	6 min. 10 sec.	13 min. 40 sec.	18 min. 00 sec.
55 km/hr	7 min. 50 sec.	16 min. 40 sec.	22 min. 00 sec.

Assumptions:
- Operation interval between non-stop trains
- Headway of block signals of the improved system: less than 3 km
- Time to switch signal lever of the existing system: 3 minutes
- Distance between first sight of the passing signal and the centre of the station in the existing system: 2.5 km
- Sight distance of the signal: 1200m

Remarks *: distance between stations

c) Reduction of travelling time (reduction of waiting time)

As stated below, a new (or rehabilitated) signalling system makes the waiting time of slow trains shorter, especially freight trains. The waiting time is dependent on the distance between stations (current system), the interval of block system (after the improvement) and the speed of the overtaking train. The comparison of the waiting time before/after the improvement is as follows;

System	Under existing system	Under improved system
Operation	- Running time of the overtaking train between the sign to have to sight the passing signal of the preceding station and the next station - And time for handling signal levers twice	- Running time of the overtaking train between the sign to have to sight the block signal of 2 blocks before the home signal and the spot to clear the block signal of 2 blocks after the starting signal
Waiting Time	22 minutes	7 minutes 40 seconds

Assumptions:
- Distance between signals of improved system
  Block signal – 3000m- Block signal – 2000m – Home signal – 1000m – Starting signal – 2000m – Block signal – 3000m – Block signal
- Distance between stations of the existing system: 12 km

- Time to switch lever of the existing system: 3 minutes
- Distance between the sign to have to sight the passing signal and the centre of the station in the existing system: 2.5 km
- Signal sight distance: 1200m
- Speed of passing train: 100 km/hr

d) Reduction of expenses for train operation (reduction of operation and maintenance staff)

By the improvement of signalling system and the introduction of CTC, staff for switching signals at middle stations becomes unnecessary because the signal levers are operated by remote control from the dispatching centre. And also at major stations, it is possible to significantly reduce the number of staff. In addition, it is also possible to reduce the number of stations.

Maintenance staff also can be reduced considerably, because old signalling equipment, which often requires inspection, repair and adjustment, is replaced with modern maintenance-free equipment.

The problem of procurement of spare parts also is solved. In this regard, it is possible to save maintenance cost.

(2) Capacity Expansion

The study proposes improvement of the infrastructures, such as improvement of the signalling system, track strengthening/rehabilitation and double-tracking. Increased line capacity as a result of the projects is estimated as below. The estimation is made based on "Scott's Formula" that is used by the Pakistan Railways.

a) Line Capacity of Double-track in Karachi - Lahore

Estimated line capacity of double-track in Karachi - Lahore (at present and after infrastructure improvement) is shown below Table 8.4.1.

Table 8.4.1 Estimated Line Capacity of Double-track in Karachi - Lahore for Each Stage

Stage	Line Capacity	Infrastructure	Freight wagons
Present	38 pair trains/day	Tokenless block	Mainly 4 wheelers
Infrastructure Improvement	83 pair trains/day	Automatic block, double-track, strengthened track	Mainly 4 wheelers
	121 pair trains/day	Automatic block, double-track, strengthened track	Mainly high performance wagons
Electrification	151 pair trains/day	Electrified, in addition to above	Mainly high performance wagons
Further Reinforcement	168 pair trains/day	Shortening block section, increase of passing loops, extension of station effective length, strengthening substation	Almost all high performance wagons

Remarks: Generalized estimation on the assumption that the longest distance between stations is 1.5 km in case tokenless block is applied.
Source: JICA Study Team

Estimated line capacity at present is 38 pair of trains per day, and 18-19 pairs of passenger trains are in service, which provide about half of the line capacity. There is margin to make 19 pair of freight trains if the capacity is shared evenly between freight and passenger trains. However, until completion of the infrastructure improvements, freight trains will be forced to wait for passenger trains because the existing service level of passenger service cannot be lowered.

After completion of the infrastructure improvements, the main line between Karachi and Lahore will have sufficient line capacity and margin to raise service level of both passenger and freight transport.

In the fiscal year 2014/15, estimated line capacity will be 83 pair of trains per day, which can be increased to 121 pair of trains per day by changing freight wagons from 4-weelers to high performance wagons, and then the assumed number of trains will be 89 (29 passenger, and 60 freight) pair of trains per day. The line capacity will be sufficient for further growth of traffic.

Electrification can reinforce the capacity more by increasing operation speed, acceleration and hauling capacity.

Estimated transport capacity of a freight train is shown below in Table 8.4.2. In order to adopt to estimate line capacity, it is necessary to take into consideration imbalance of transport volume between directions. The proportion of transport volume up-country to down-country is assumed to be 6 to 4.

Table 8.4.2 Estimated Transport Capacity of a Freight Train

Type	Hauling Capacity	Average Transport capacity	Conditions
3,000HP DL	1,800 ton	1,080 ton	Maximum operation speed: 80 km/hr Station effective length: 600 m (as existing)
3,900kW EL	2,000 ton	1,200 ton	Maximum operation speed: 100km/hr Station effective length: 600 m (as existing)
7,000kW EL	3,000 ton	1,800 ton	Maximum operation speed: 80 km/hr Station effective length: 900 m (extended)

Source: JICA Study Team

b) Line Capacity of Single track in Primary A Lines

Estimated line capacity of single track in primary A lines (at present and after infrastructure improvement) is shown below Table 8.4.3.

Table 8.4.3 Estimated Line Capacity of Single track in Primary A Lines for Each Stage

Stage	Line Capacity	Infrastructure	Freight wagons
Present	46 trains/day	Tokenless block	Mainly 4 wheelers
Infrastructure Improvement	57 trains/day	Automatic block, single track, strengthened/rehabilitated track	Mainly 4 wheelers
	78 trains/day	Automatic block, single track, strengthened/rehabilitated track	Mainly high performance

Remarks: Generalized estimation on the assumption that the longest distance between stations is 12 km in case tokenless block is applied
Source: JICA Study Team

Estimated line capacity at present is 46 trains per day, and 18-26 passenger trains are in service, which is about half of the line capacity. There is a margin to run 20-28 freight trains. However, until completion of the infrastructure improvements, freight trains will be forced to wait for passenger trains because the existing service level of passenger service cannot be lowered.

After completion of infrastructure improvement, line capacities will be increased. While the freight wagons are mainly 4 wheelers, there will be 57 trains per day. And after they are changed to high performance wagons, it increases to 76 trains per day.

c) Line Capacity of Single-track in Other Lines

Estimated line capacities of single-track in other lines to be improved (at present and after

infrastructure improvement) are shown below Table 8.4.4.

Table 8.4.4 Estimated Line Capacity of Single-track in Other Lines on Each Stage

Stage	Line Capacity	Infrastructure	Freight wagons
Present	38 trains/day	Tokenless block	Mainly 4 wheelers
Infrastructure Improvement	42 trains/day	New type tokenless block, single track, rehabilitated track	Mainly 4 wheelers
	61trains/day	New type tokenless block, single track, rehabilitated track	Mainly high performance

Remarks: Generalized estimation on the assumption that the longest distance between stations is 15 km
Source: JICA Study Team

Estimated line capacity at present is 38 trains per day, and less than 18 passenger trains are in service, which is less than half of the line capacity. There is enough margin to offer freight services.

After completion of infrastructure improvements, line capacities will be increased. While the freight wagons are still mainly 4 wheelers, it will be 42 trains per day. And after they are changed to high performance wagons, it increases to 61 trains per day.

(3) Impact on Modal Share

Investments in infrastructure and train operation, including the completion of track rehabilitation, track-doubling and modernization of signalling systems on the Main Corridor will improve the safety and reliability, increase speeds up to 140 km/h, and increase frequency of train operation. It is expected that the share of rail in passenger traffic which is now 9.4% will increase substantially for medium and long-distance traffic due to the increased speed, efficiency, safety/reliability and services. The freight traffic is expected to increase dramatically due to the new marketing and service delivery systems and by 2015 railway's share will reach 20% level of the total transport volume.

(4) Economic Evaluation

Economic Indicators such as Economic Internal Rate of Return (EIRR) and Net Present Value (NPV) were calculated for the Railway Master Plan base on the following assumptions:

- Economic benefit consists of savings in passenger travel time and vehicle operating cost (VOC) on road network. Time values to convert travel time to monetary value are the same as used for roads in Chapter 6.
- Evaluation period is set for 30 years from 2005/06 to 2034/45.
- Total investment cost for railway is allocated for 20 years.
- The investment effect begins to appear from 2010/11.
- Road network is such that only and all road projects in MTDF are carried out.
- In "Without Case", freight transport by rail is fixed at 10.2 billion ton-km after 2010/11.
- Residual values are not considered.

The economic transport cost by rail was calculated using the following formula:

Transport cost by rail per ton = 0.39 D (km) + 468 Rs./ton

The yearly allocation of the total investment cost at Rs. 274.6 billion was assumed as shown in Table 8.4.5.

Table 8.4.5 Cost Allocation for Economic Evaluation

Rs. Billion

Short-term (5years) 2005/06-09/10	Medium-term (5 years) 2010/11-14/15	Long-term (10 years) 2015/16-24/25
12.343	11.407	15.580

Note: Assumption by JICA Study Team

Traffic assignment was carried out to calculate travel time saving and VOC saving. The yearly savings are summarized as shown in Table 8.4.6.

Table 8.4.6 Travel Time Saving and VOC Saving

Rs. Billion

Year	2015	2020	2025
Travel Time Saving	2.3	10.8	60.0
VOC Saving	46.9	97.4	229.7
Total	49.2	108.2	289.7

Note: Calculated by JICA Study Team

The EIRR was calculated at 23.2%, and NPV worked out to be Rs. 120.2 billion at a discount rate of 15%.

8.4.4 Schedule and Cost

The proposed development plans are listed in Table 8.4.7. The plans in "Medium Term Development Framework (MTDF) 2005-2010 are all included.

Schedules and estimated costs of the projects are also shown in the Table. The total of estimated costs amounts to Rs. 546 billion for 2005-2025. And those for the short term plan, 2005-2010, amount to Rs. 107 billion, those for the medium term plan, 2010-2015, amount to Rs. 130 billion and those for the long term plan, 2015-2025 amounts to Rs. 309 billion.

Schedules of some projects are revised from MTDF.

Table 8.4.7 Schedule and Estimated Cost of the Project

No.	Projects	Schedule and Estimated Cost (Rs. Million)				
		Total	2005 - 2010	2010 - 2015	2015 - 2025	
1	Procurement/manufacture of 175 passenger coaches	(7,776) 1,823	1,823			A
2	Procurement 69 DE locos	(11,151) 6,963	6,963			A
3	Track rehabilitation and modernization of sleeper factory	(11,192) 5,506	5,506			A
4	Recommissioning of 55 DE Locos	(879) 647	647			A
5	Replacement of breakdown cranes and procurement of relief train	(407) 121	121			A
6	1,300 high capacity wagons	(5,870) 4,143	4,143			A
7	Doubling of track Lodhran - Multan - Khanewal	(3,297) 2,864	2,864			* A
8	Rehabilitation of 450 passenger coaches	(2,145) 845	845			A
9	Other projects	(148) 26	26			A
10	Conversion of Mirpur Khas - Khokhropar section to broad gauge	(700) 400	400			A
11	Dualization of track from Khanewal to Raiwind	5,712	5,712			A
12	Dualization of track from Shahdara Bagh to Lala Musa	3,600	1,288	2,312		D
13	Upgrading and improvement of track from Khampur to Lala Musa	3,500	3,500			B
14	Doubling of track from Lahore to Faisalabad section	3,840	2,940	900		C
15	Procurement/manufacture/ and assembling of 75 diesel locomotives	12,700	12,700			B

No.	Projects	Schedule and Estimated Cost (Rs. Million)				
		Total	2005 - 2010	2010 - 2015	2015 - 2025	
16	Procurement/manufacture/ and assembly of 1,000 freight wagons	4,800	3,600	1,200		B
17	Procurement/manufacture/ and assembly of 150 passenger coaches	5,977	5,977			A
18	Railway yard and railway linkage from Gwadar Port to container yard	2,500	2,500			C
19	Rail link to Gwadar Port	12,000	6,500	5,500		C
20	Up-gradation Rohri - Quetta - Taftan	15,000		4,450	10,550	C
21	Feasibility study for rail link from Kundian to Peshawar	10	10			A
22	Feasibility study for rail link from Bostan to Peshawar	10	10			A
23	Provision of road over bridge at Chowrangi Chowk EPZ (50%)	250	250			A
24	Improvement of signalling system, Karachi - Lahore	15,000	15,000			
25	Improvement of signalling system, Lahore - Rawalpindi	2,900	900	2,000		
26	Improvement of signalling system, Rawalpindi - Peshawar	1,300		1,300		
27	Improvement of signalling system, Faisalabad - Lahore	1,700	1,000	700		
28	Improvement of signalling system, Khanewal - Wazirabad	2,100		2,100		
29	Improvement of sgnalling system, Rohri - Quetta	2,900		2,900		
30	Improvement/rehabilitation of tele-communication system (1st phase)	5,000	5,000			
31	Improvement/rehabilitation of tele-communication system (2nd phase)	3,000		3,000		
32	Improvement of signalling system, Multanl - Attock City	2,500		2,500		
33	Improvement of signalling system, Kotri - Habib kot	1,700		1,700		
34	Improvement of signalling system, Jacobabad - Kot Adu	2,100		2,100		
35	Improvement of signalling system, other lines continued	9,000			9,000	
36	Improvement/rehabilitation of tele-communication system (3rd phase)	2,000			2,000	
37	Urgent rehabilitation of signalling and telecommunication systems	1,000	1,000			
38	Doubling of track, Lala Musa - Rawalpindi	7,100		7,100		
39	Doubling of track, Lodhran - Khanewal (Via Chord)	2,100		2,100		
40	Rehabilitation of track, Rawalpindi - Peshawar	700		700		
41	Rehabilitation of track, Multanl - Attock City	2,000		2,000		
42	Rehabilitation of track, Kotri - Habib kot	1,400		1,400		
43	Rehabilitation of track, Jacobabad - Kot Adu	1,700		1,700		
44	Rehabilitation of track, other lines continued	6,000			6,000	

No.	Projects	Schedule and Estimated Cost (Rs. Million)				
		Total	2005 - 2010	2010 - 2015	2015 - 2025	
45	Planning investigation and rehabilitation of structures	200	200			
46	Rehabilitation/replacement of structures, Karachi - Lahore (1st phase)	5,000	2,000	3,000		
47	Rehabilitation/replacement of structures, Karachi - Lahore (2nd phase)	5,000			5,000	
48	Urgent rehabilitation of structures of other lines	2,000	2,000			
49	Rehabilitation/replacement of structures of other lines	10,000			10,000	
50	Improvement of passenger station and ticketing system	3,000	2,000	1,000		
51	Improvement of freight stations in Karachi for container/bulk transport	3,000	3,000			
52	Expansion/improvement of container stations in up-country area	5,000	5,000			
53	Expansion of freight stations in Karachi for container/bulk transport	5,000			5,000	
54	Expansion/improvement of container stations in up-country area (2)	7,000			7,000	
55	Procurement/manufacture/assembling of 120 diesel locomotives (3000HP)	22,000	3,000	19,000		
56	Procurement/manufacture/assembling of 180 diesel locomotives (2000HP)	27,000	3,000	24,000		
57	Procurement/manufacture/assembly of 150 electric locomotives (Passenger)	30,000			30,000	
58	Procurement/manufacture/assembly of 180 electric locomotives (Freight)	50,000			50,000	
59	Procurement/manufacture/assembly of 550 passenger coaches	25,000		25,000		
60	Heavy rehabilitation/modification of 530 passenger coaches	11,000	5,000	6,000		
61	Procurement/manufacture/assembly of 1,230 passenger coaches	56,000			56,000	
62	Procurement/manufacture/ and assembly of 1,050 freight wagons	5,800		5,800		
63	Procurement/manufacture/ and assembly of 4,600 freight wagons	25,000			25,000	
64	Expansion and modernisation of locomotive/rolling stock repair shops	15,000			15,000	
65	Expansion and modernisation of locomotive/rolling stock depot	15,000			15,000	
66	Feasibility study of electrification, Karachi - Lahore	50	50			
67	Construction/rehabilitation of Electrification, Karachi - Lahore	27,000		7,000	20,000	
68	Increase of transport capacity , Karachi - Lahore, in addition to electrification	3,800		1,200	2,600	**
69	New link, Bostan - Zhob - D.I.Khan - Kohat - Peshawar	20,000		7,000	13,000	
			2005 - 10	2010 - 15	2015 - 25	
	Calculated total	544,287	116,475	146,662	281,150	
	Total	**544,000**	**116,000**	**147,000**	**281,000**	

Notes: Total estimated cost written upper in (xxx): It includes the portion executed up to 2004/05.
Total estimated cost written lower: It includes only the portion to be executed after 2005/06.
"A" in the column of Remarks means that the project is listed in MTDF 2005-10
"B" in the column of Remarks means that the project is listed in MTDF 2005-10, and schedule is moved up.
"C" in the column of Remarks means that the project is listed in MTDF 2005-10, and schedule is postponed.
"D" in the column of Remarks means that the project is listed in MTDF 2005-10, and estimated cost is revised.
* Including signalling system
** Extension of station effective length, reduction of blocking distance and increase of passing loops
Source: JICA Study Team

8.5 Reform of Pakistan Railways

8.5.1 Overview

The Government of Pakistan (GOP) has launched a plan to transform Pakistan Railways (PR) into a public corporation and drafted a Pakistan Railways Corporation Act 2005. Under the Act a new public corporation to be named Pakistan Railways Corporation (PRC) will be created with more autonomy and powers in its governance. The ultimate goal of the institutional reform is to complete the transition from a state-owned railway to private ownership. However, considering the current state of the financial structure of PR and railway infrastructure, it is unlikely that the institutional reform alone can complete the transition. Lessons learned from international experience in privatization reveal that the financially troubled railways are difficult to sell "as is" and that a transition requires a multi-step reorganization and financial recuperation. These lessons have relevancies to Pakistan.

In order to complete the transition it is necessary for the railways to establish the sustainability of the financial structure and demonstrate its economic viability before the transition. The transition or the ultimate privatization of PR will be a slow process and it may take 15-20 years from today provided that the improvement and development of the railway infrastructure are carried out in a systematic and timely fashion. This section of the JICA Study focuses on the transition or the ultimate privatization of PR and, having reviewed the proposed institutional reform and its effects on the railway industry, attempts to address the issues that are critical for the successful transition.

8.5.2 Historical Perspective of PR Privatization

PR was organized as a department of the Ministry of Railways and this form of organization has proven increasingly ineffective in coping with competition when the national railway's pre-eminent position was challenged increasingly in post-deregulation era.

In 1996, GOP published an "Open Access Policy (OAP)". The goal of the government was to build the railway industry's commercial capabilities and reputation for quality services through private sector participation. GOP solicited private sector bids to transport fuel oil by rail on behalf of Pakistan State Oil (PSO) to the upcountry's private power stations. There was no positive reaction from the private sector.

In 1997, GOP went step further and announced its plan for PR privatization. The plan was to: (i) restructure PR into three core businesses -passenger, freight and infrastructure-, (ii) create a new Railway Resettlement Agency a public entity to retain all surplus assets and liabilities, including redundant labour, real estate, debts and liabilities including pension and environmental clean up and (iii) establish a new Railway Regulatory Authority to regulate the largely private sector rail industry. The government's plan was to sell the core business of PR in almost "as is" condition. Sale of a large state-own railway like the PR which has over 90,000 employees, huge liabilities, i.e. pensions, post retirement benefits/privileges and un-kept railway infrastructure and obsolete rolling stock will require a multi-phased reorganization, and financial recuperation. The government's decision to complete the transition without the processes that were proven to be necessary was inappropriate and ill advised. Subsequently, the plan, although it was not implemented, impacted negatively on the moral of PR employees and railway infrastructure as it was seen by the PR employees as an act of "abandonment" and by the government it was understood as the end to the government subsidy to the financially troubled railway.

It must be noted that in 1995, JICA Study on National Transport Plan in the Islamic Republic of Pakistan recommended the creation of a Pakistan Railway Corporation, similar to PIA, with Ministerial the representation on the Board. The ownership and overall direction of the railway would remain in the public sector, but day-to-day running of the railway would be passed on to commercially oriented managers with clearly defined targets and

responsibilities. The study concluded that, ultimately, given the hope for gain in railway productivity and profitability, such a structure would be suitable for the privatization of the railways, if that was politically desirable. The JICA approach to the Pakistan Railways privatization is clearly based on the "Corporatization-Reorganization-Privatization" principles.

8.5.3 Proposed Institutional Reform

(1) Pakistan Railways Corporation Act, 2005

In 2005, the GOP renewed its PR privatization efforts. The focus was shifted from the outright sale of PR assets to corporatization. A new railway law was drafted and it has been presented to the stakeholders, i.e. federal ministries and provincial governments, for their reviews and approvals. It is expected that the new law will be enacted by June 2006.

a) The salient features of the Pakistan Railways Act, 2005

- Creation of a wholly owned public corporation that may be called the Pakistan Railways Corporation (PRC).
- The Board of PRC consists of a Chairman, CEO, and nine directors: three from the GOP, three from PRC and three from the private sector. The CEO will be recruited from the private sector.
- The Board has the power and authority to make decisions and administer the affairs of PRC, including the determination of tariffs and rates at which PRC will provide Railway service.
- Transfer all non-core activities, i.e. schools, hospitals, etc. to a new holding company to be created under the MOR.
- Transfer of all assets, rights, powers, authorities, privilege, properties movable and immovable, cash and bank balance to PRC.
- Transfer of all debts/loans or overdrafts and all liabilities, i.e. pension, post retirement benefits and general provident fund transferred to GOP.
- Development, improvement and rehabilitation of railway fixed infrastructure and rolling stock remain the responsibility of GOP as part of PSDP.
- Costs of unprofitable passenger services/routes are compensated for GOP as Public Service Obligations or defence requirements.

b) Rationale of the Reform

- Creation of a commercially oriented railway. The institutional structure of PR contains weak incentives to increase efficiency. Such structures suppress commercial incentives, distort business and investment decisions and sap management responsibility and accountability. PR cannot be an effective player in a competitive transport market while it is a government department.
- Creation of lines of business management. Lines of business management facilitates greater management responsibility and accountability and enables profit centre accounting, hence better performance, monitoring lines of business management simplifies and focuses marketing and business development functions.
- Curtailment of non-core activities. Non-core activities create management complexity, divert attention and also create an excuse for high costs. Ownership of supply industries precludes the benefits of competitive tendering and the rigor of normal commercial supplier contracts, further, non-core activities absorb scarce railway investment.
- Financing Structure and self-sufficiency in train operation. The financing structure is ad hoc and unsustainable. With no clear long-term strategy or short-term goal and no value for money test, or monitoring to underpin budgetary support. Such systems also create few incentives for management to focus on net costs rather than gross revenue and expenditure separately.
- Reduction of surplus employees. Overstaffing encourages sloppy management and poor staff moral, as well as higher costs.

c) Expected effects of institutional reform on the performance of the railways

To increase the railway industry's commercial capabilities it is necessary, first, to transform PR into a commercially oriented enterprise through institutional reform and management reorganization. The GOP's policy and strategy are clear and the reasons for the reform are convincing. The Pakistan Railways Corporation Act of 2005 and the institutional reform as proposed are, however, the first step towards the PR privatization. Under the new Act, the GOP will provide the new Corporation (PRC) with more autonomy and powers, including the determination of tariffs and fares and free the PRC from all debts and liabilities, including pensions and post retirement benefits/privileges. Furthermore, the GOP will continue to fund the costs of capital investment required by the improvements and rehabilitations of railway fixed infrastructure and rolling stock as part of PSDP. As a public corporation the PRC will be exempted from all taxes. Under these terms and conditions, there is no doubt that the PRC can improve the efficiency and productivity in the train operation for passengers and, to a certain extent, for the freight services

By management improvement and with continuous subsidy from the GOP for procurement and maintenance of rolling stock and for the development and improvement of infrastructure it is expected that the corporatization can turn the railways industry around.

The institutional reform, however, has its limits and it is not likely to deliver the improvements required for the ultimate privatization. In order to attract element of the private sector into the industry it is essential to demonstrate, not only the economic viability of the railways industry, but also the competitiveness and profitability.

The objective of the corporatization is to complete the transformation of PR into an autonomous public corporation which is ultimately capable of self-financing of the corporate affairs including the infrastructure management (ground operations), procurement and maintenance of rolling stock, resolution of the maintenance back log and the rationalization of labour redundancy and settlement of liabilities, etc. To ensure the smooth transition from the corporatization to privatization the PRC has to make extraordinary efforts towards management improvement parallel with the improvement and strengthening of the railways infrastructure. Management improvement has to focus on the winning of the cost competition, first, in the middle/long distance intercity passenger transport and middle/long distance freight transport. To achieve this target the management has to develop a business practice equipped with a sophisticated and computerized ticketing and marketing systems in addition to the modernization of infrastructure, rolling stock and service facilities that enable a fast, efficient and competitive delivery service. If the PRC can not achieve the goal during the next 10 years it will be faced with the same old problem -deficit financing- and the risk of GOP needing to resume subsidy to railway industry increases.

8.5.4 The Overall Effects of the Corporatization

Provided that the management improvements and investments are carried out in line with the investment and development plans mentioned above it can be anticipated that the corporatization of Pakistan Railways could produce the following effects:

(1) General

- Train operation capacity on the Corridor will be increased in terms of volume and revenue.
- Competitiveness of both passenger and freight transport with other modes in intercity middle/long distance passenger transport and middle/long distance freight transport will be increased.
- Opportunities for private sector capital and management expertise being injected into railway related industries increased.

(2) Train Operation Capacity

- Carrying capacity of passenger transport, particularly, express trains will be increased.
- Passenger demand and real yields will be increased due to the improved speed, safety/reliability and services.
- Freight transport services demand and revenue will be increased.
- Container transport services demand and revenues earned will be increased.
- Bulk transport services demand and revenue will be increased.

(3) Infrastructure

- Track reinforcement, double-tracking, modernization of signalling and telecommunication systems and better maintenance will have:
- Reduced bottlenecks and eased speed restrictions.
- Reduced waiting time and the subsequent travelling time.
- Increased safety/reliability.

(4) Rolling Stock and Service Facilities

- Replacement of obsolete rolling stock completed by procurement of a fleet of high performance locomotives, high performance wagons and passenger coaches.

(5) Institutional Efficiencies

- Incentives to increase efficiency enhanced.
- Opportunities for private sector participation enhanced
- Labour and capital productivity improved

(6) Financial Structure

- Self-sufficiency achieved.
- The financing structure becomes sustainable.
- Maintenance back log from the past resolved

The following basic requirements for the ultimate privatization met:

- Increased transport Capacity
- Sustainable financial structure
- Increased economic viability

8.5.5 The Steps towards the Ultimate Privatization

(1) Conversion of Freight Operation Business and Passenger Operation Units of PRC to Joint Stock Corporations (2015)

- All assets of the passenger and freight operations are to be transferred to joint stock corporations and ultimately privatized through a series of public offerings after the Initial Public Offering (IPO) in 2020
- PRC will function as a "Resettlement Corporation" after the separation and transformation of the operation unit, rail maintenance unit and infrastructure units into joint stock corporations and retain all surplus assets, liabilities, labour redundancy, etc. or as an option create a Railway Resettlement Corporation.
- PRC will hold 100% of the shares of the new joint stock corporations until the IPOs of these joint stock corporations.

(2) Conversion of Rail Maintenance Business to a Joint Stock Corporation (2015-20)

- The rail maintenance Business of PRC will be privatized through an IPO. The new

company will provide maintenance services to PRC rail infrastructure, including civil engineering and building, signal engineering and fixed equipment maintenance. It will also undertake large-scale and small-scale track renewals works and heavy mechanized track maintenance

(3) Conversion of Infrastructure Unit to a joint Stock Corporation (2015-20) - An option

- Infrastructure (track, fixed facilities, stations, bridges and right of way) will be converted to a joint stock company. Financing of construction and rehabilitation remain the responsibility of the Government until this unit is sold. PRC retains 100% of the share of the new joint stock infrastructure corporation.
- There is an option for PRC to retain the infrastructure and enter a lease agreement with the private passenger and freight transport companies or charge these private companies access fees.

(4) Public Offering of Joint Stock Corporations

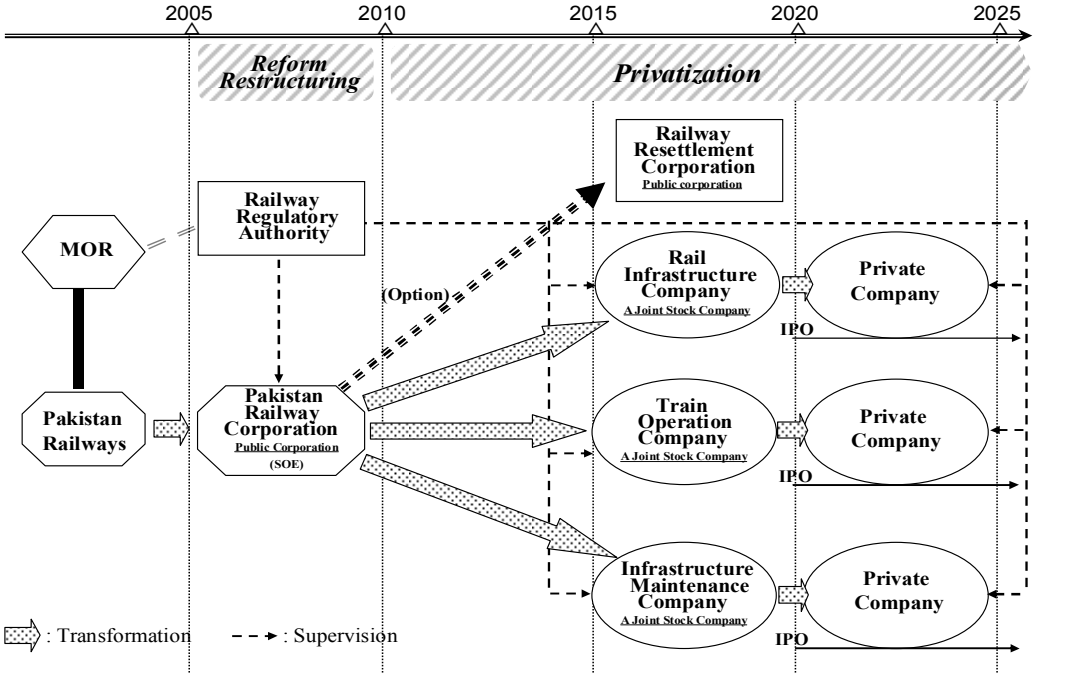
- Initial public offerings (IPO's) of the following joint stock corporations, as these corporations matured and demonstrated compliance with the listing requirements of the Karachi Stock Exchange.

  (i)Train Operation Company (2020)
  (ii)Infrastructure Maintenance Company (2020))
  (iii)Rail Infrastructure Company (2020-25)-An Option

(5) Establishment of Railway Resettlement Corporation (2015) - An Option

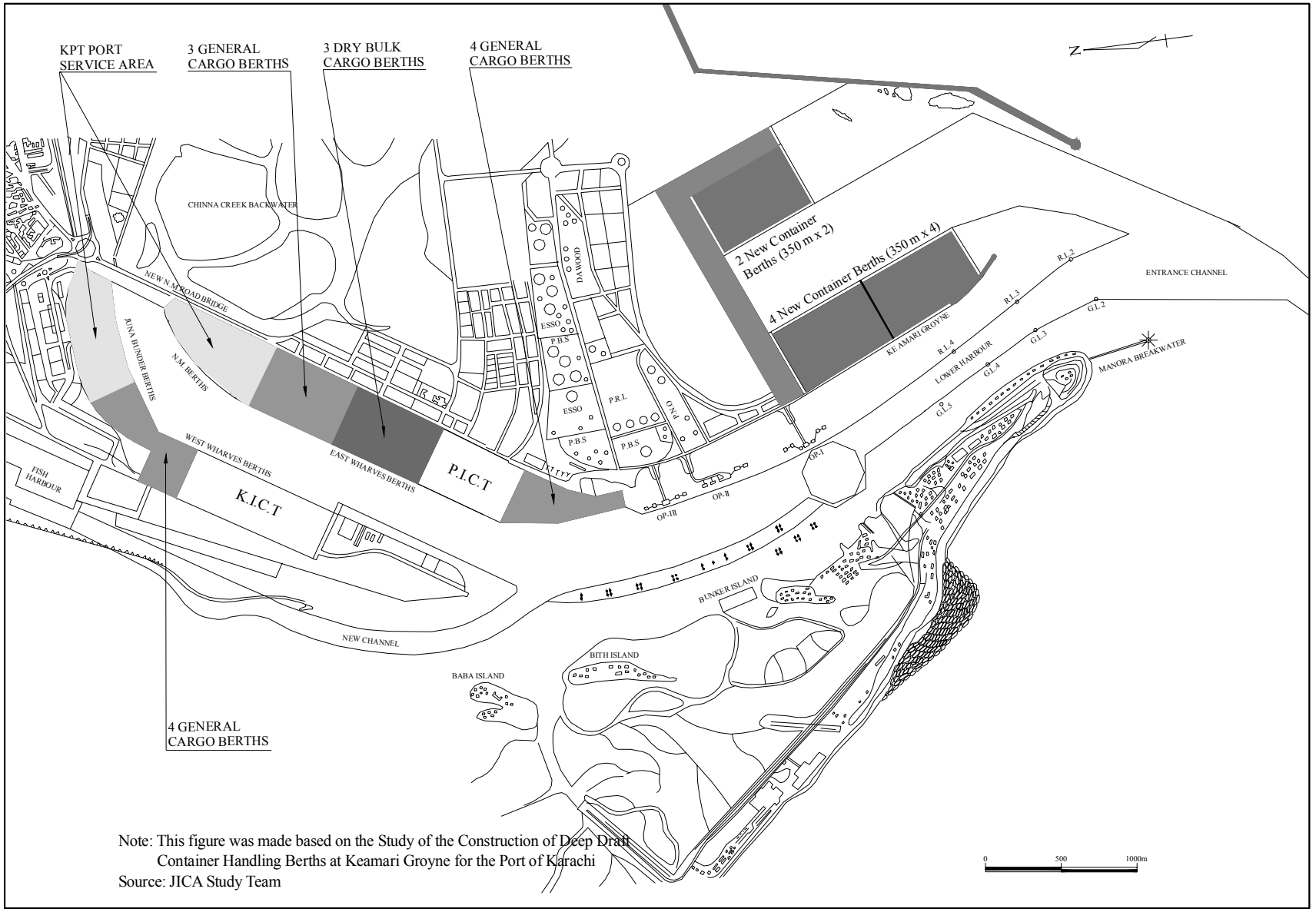
In 1987, an independent settlement entity Japan National Railways Resettlement Corporation proved very useful in managing the "work out' in Japan where the government organized an intermediary to serve as the government's trustee in managing the orderly disposition of non-core assets and of outstanding liabilities. Retain all surplus assets and liabilities, including labour, real estate, debts. Until all business units or divisions are privatized (in the form of a joint stock company) PRC functions as a resettlement corporation. The Railway Resettlement Corporation, a public corporation, then takes over the PRC's functions.

The attached diagram will illustrate the process of privatization and outline a time table.



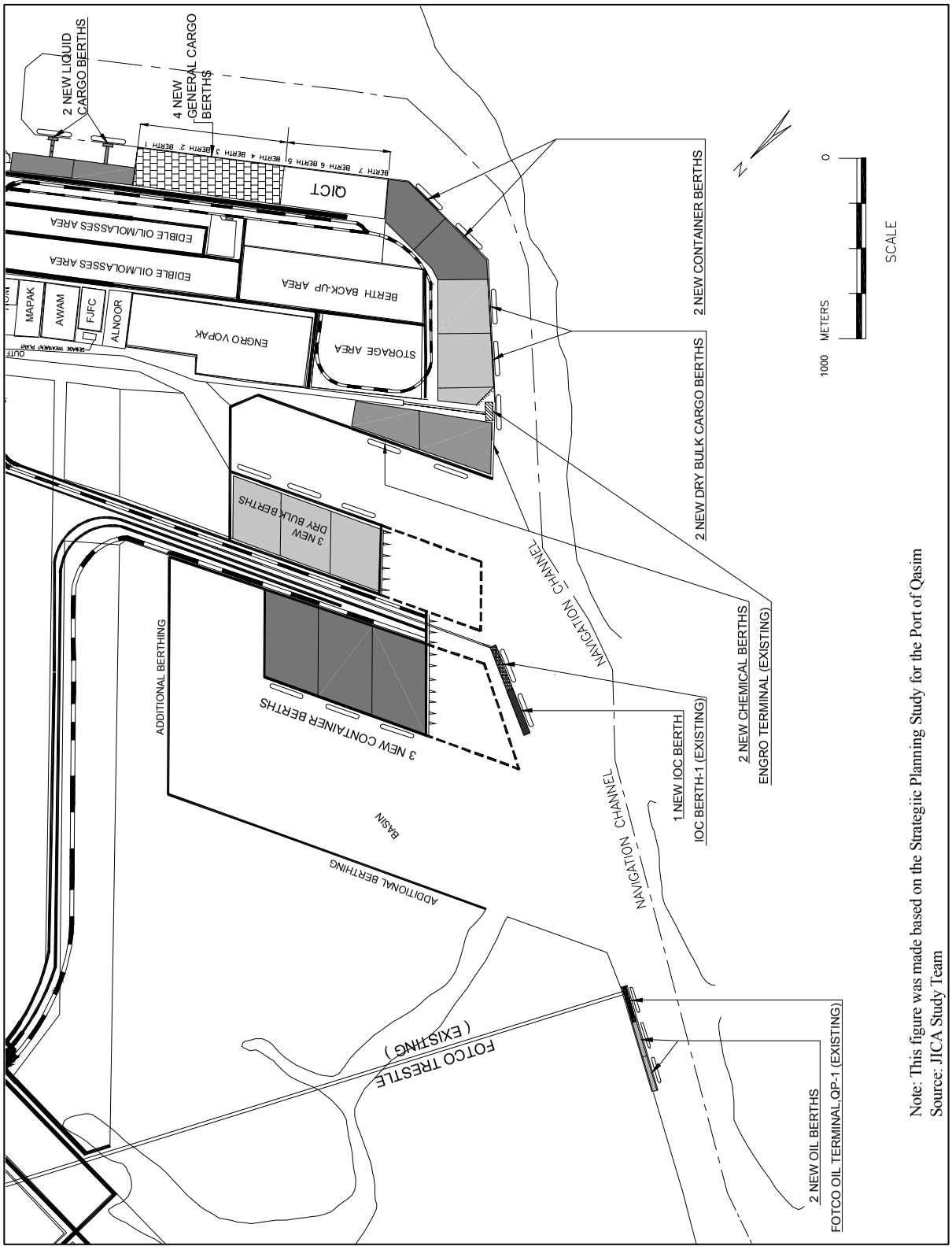
Source: JICA Study Team

Figure 8.5.1 Outline of Time Table for Pakistan Railways Privatization



Note: This figure was made based on the Study of the Construction of Deep Draft Container Handling Berths at Keamari Groyne for the Port of Karachi
Source: JICA Study Team

Figure 9.3.1 Layout Plan at Karachi Port (Master Plan)



Note: This figure was made based on the Strategiic Planning Study for the Port of Qasim
Source: JICA Study Team

Figure 9.3.2 Layout Plan at Qasim Port (Master Plan)

9.3.6 Public and Private Partnership

For successful port maintenance and operation by the PPP scheme, roles and responsibilities have to be allotted properly between the public and private sector. Table XXX shows actual role demarcation of about 30 examples of PPP schemes. The public sector is responsible in most cases for non-profit generating facilities such as channels, mooring facilities, dredging and wharfs, while the private sector undertakes construction of warehouses and installation of cargo handling facilities. Port is operated by the private sector in 76% cases and land is procured by the public sector in all cases.

PPP scheme participated by foreign enterprises is believed advantageous to a developing countries in several aspects such as financing, transfer of operation know how and effective utilization of facilities. On the other hand, however, risks of disadvantages of hindrance of fostering domestic industries, profit drain and unfair bidding also exist. Therefore, the most appropriate PPP scheme should be looked for with full consideration of technology level of the country and results of financial assessment.

Figure 9.3.3 Roles Sharing of Public and Private Sector in PPP Port Projects (%)

Item		Public	Public/ Private	Private	Total
Planning		62	35	3	100
Construction	Channeling, Mooring	96	0	4	100
	Channel Dredging	65	4	31	100
	wharf	54	19	27	100
	yard	46	12	42	100
	Transit warehouse	30	8	62	100
	Handling machinery	15	35	50	100
Ownership	Land	100	0	0	100
	Terminal Facilities	38	42	20	100
Terminal Operator		12	12	76	100
Tugging, Pilotage		46	8	46	100

Source: Study on PPP Port Project, 2003, OCDI

9.4 Master Plan Projects

9.4.1 MTDF Projects

KPT and PQA have prepared a development plan for the period through 2005/10, which is mentioned in MTDF and has been approved by the National Council Planning. Project details, such as handling capacity, construction period and start of operation, are shown in Table 9.4.1.

Table 9.4.1 Development Plan for the Ports

	Name of Project	Planning				Finance (million Rp.)		
		Handling Capacity (mil. Tons (TEUs)/year)	Costruction Period (year-year)	Start of Operation (Month, year)	Based on Study Repot (Yes/No)	Self Financing/ Corporation	Private Sector Financing	Total
Port Qasim Authority (PQA)								
1	2nd Iron Ore and Coal Berth	8	2007 - 09	Oct. 09	Yes	-	2,925	2,925
2	2nd Container Terminal	1	2007 - 09	Nov. 09	Yes	-	3,510	3,510
3	2nd Oil Jetty at FOTCO	9	2007 - 09	Dec. 09	Yes	-	1,170	1,170
4	Coal/ Clinker Terminal	4	2008 - 10	Oct. 10	Yes	-	1,755	1,755
5	Liquid Cargo Terminal	4	2006 - 07	Mar. 08	Yes	-	667	667
6	LPG Terminal	0.5	2004 - 05	Mar. 06	Yes	-	1,463	1,463
7	Marine Workshop	-	2006 - 08	Apr. 09	Yes	-	585	585
8	Desalination Plant	-	2006 - 07	Dec. 07	Yes	-	1,463	1,463
9	Through Own Resources	-	-	-	-	3,094	-	3,094
10	Projects through Peripheral Development Charges	-	2005 - 10	-	No	618	-	618
	Total PQA					3,712	13,538	17,250
Karachi Port Trust (KPT)								
1	Capital Dredging for Deepening of Channel	-	-	-	Yes	180	-	180
2	Reconstruction of Oil Pier-2	-	-	-	Yes	1,500	-	1,500
3	Development of a Cargo Village on KPT Estate in Western Backwater Area	1,300 acres	2006 - 08	-	Yes	6,300	26,400	32,700
4	Construction of Deep Draught Berths at Keamari Groyne	10 Berth of -18.0m	2006 - 08	-	Yes	30,600	18,000	48,600
5	Procurement of Anchor Hoist Vessel	250 ton	-	-	-	258	-	258
6	Procurement of Two Self Propelled Split Type Hopper Bargers	850 m^3	2005 - 06	-	-	120	-	120
7	Procurement of Self Propelled Water Barge	100 ton	-	-	Yes	120	-	120
8	Container Terminal at Berths 6- 9	350,000 TEUs	2002 - 08	in operation	-	-	4,500	4,500
9	Setting up of Dry Bulk Cargo Handling Terminal (US$20M)	215,000 m^2	24 months	-	-	-	1,800	1,800
10	Construction of Port Tower Complex	-	-	5 years	-	-	40,000	40,000
11	Setting up of Desalination Plant	-	-	-	-	-	3,687	3,687
12	Roads and Construction of Bridge under Tameer-e-Karachi Programme	-	2004 - 06	2006	-	2,500	-	2,500
	KPT Flyover at Korangi Road	-	-	-	-	-	-	-
	Mai Kolachi Road Ending at Submarine Chowk	-	-	-	-	-	-	-
	M.T. Khan Road from Jinnah Bridge to PIDC Bridge	-	-	-	-	-	-	-
	Rehabilitation of M.A. Jinnah Road	-	-	-	-	-	-	-
13	Procurement of Trailor Suction Hopper Dredger	6,000 m^3	2006 - 07	Aug. 07	-	3,616	-	3,616
14	Container Terminal at Berths 28-30	700,000 TEUs	2005 - 08	in operation	Yes	900	2,400	3,300
15	Procurement of Backhoe Dredger	1,000 m^3/hour	2005 - 06	6-May	-	900		900
	Total KPT					46,094	96,787	142,882

Source: KPT, PQA and MTDF (2005-10)

9.4.2 Projects for the Master Plan

The overall projects for the Master Plan of the port sector are proposed as shown in Table 9.4.2.

It should be noted that costs for each project are assumed based on the past study reports and are quoted from the Government's working group report.

Table 9.4.2 List of Port Projects (Master Plan)

(Rs. In million)

Name of Project	Project Cost	Remarks
Port Qasim Authority (PQA)		
Construction of Iron Ore and Coal Berth (1 Berth)	2,925	Private Sector
Construction of Container Berth (5 Berths)	17,550	Private Sector
Construction of Oil Berth (FOTCO: 2 Berths)	2,340	Private Sector
Construction of Dry Bulk Cargo Berth (5 Berths)	8,775	Private Sector
Construction of Chemical Berth (ENGRO: 2 Berths)	4,680	Private Sector
Construction of Liquid Cargo Berth (2 Berths)	1,334	Private Sector
Marine Workshop	585	Private Sector
Desalination Plant	1,463	Private Sector
Through Own Resources	3,094	
Projects through Peripheral Development Charges	618	
Total	43,364	
Karachi Port Trust (KPT)		
Capital Dredging for Deepening of Channel	180	
Construction of Container Terminal (6 Berths)	29,160	Private Sector: 10,800
Construction of Port Tower Complex	40,000	Private Sector
Container Terminal at Berths 28-30 (26-27)	3,300	Private Sector: 2,400
Container Terminal at Berths 6-9	4,500	Private Sector
Construction of Dry Bulk Cargo Berths (3 Berths)	1,800	Private Sector
Development of a Cargo Village on KPT	32,700	Private Sector: 26,400
Tameer-e-Karachi Programme	2,500	
Procurement of Anchor Hoist Vessel	258	
Procurement of Backhoe Dredger	900	
Procurement of Self Propelled Water Barge	120	
Procurement of Trailor Suction Hopper Dredger	3,616	
Procurement of Two Hopper Bargers	120	
Setting up of Desalination Plant	3,687	Private Sector: 3,687
Total	122,842	

Note: This table was made based on the information from KPT and PQA
Source: JICA Study Team

9.4.3 Implementation Schedule

The construction plan with a target year of 2024/25 must naturally be executed in gradual stages.

Table 9.4.3 shows the time period required for each stage and the main project being undertaken.

Table 9.4.3 Stage Plan for Construction of the Master Plan

Year	2003 /04	2004 /05	2005 /06	2006 /07	2007 /08	2008 /09	2009 /10	2010 /11	2011 /12	2012 /13	2013 /14	2014 /15	2015 /16	2016 /17	2017 /18	2018 /19	2019 /20	2020 /21	2021 /22	2022 /23	2023 /24	2024 /25
Karachi Port																						
Container Berth			2 Berths + Others																			
					2 Berths					1 Berth								1 Berth				
Others																						
Qasim Port																						
Container Berth			1 Berth																			
				2 Berths					1 Berth									1 Berth				
Dry Bulk Cargo Berth			3 Berths												1 Berth				1 Berth			
Liquid Bulk Cargo Berth			1 Berth				1 Berth															
FOTCO Terminal				1 Berth					1 Berth													
IOC Berth				1 Berth																		
ENGRO Terminal					1 Berth													1 Berth				
Others																						

Source: JICA Study Team

Chapter 10. AIRPORT PLAN

10.1 Planning Approach

10.1.1 Introduction

Air transport can play an important role for long-distance passenger movement, especially Karachi – Islamabad, Karachi – Peshawar, Karachi - Lahore, Karachi – Quetta, Quetta – Lahore, Quetta – Islamabad, and Quetta – Peshawar in view of the air traffic demand. A fast, safe and reliable transport mode on these routes is necessary and essential for those who can not spend time travelling on land for hundreds kilometres, although the share of total passenger movement taken by air transport will be small.

In addition, there are some routes that are very important in view of their social implications. The airports in Chitral, Gilgit, Skardu, Gwadar, Panjgur, Turbat, Pasni and Jiawni are such important destinations.

On the other hand, there are some airports that are losing competitiveness because of the development and expansion of the road network.

10.1.2 Planning Process

PTPS focused on land transport and the analysis in the aviation sector has been limited. Therefore, PTPS reviewed the demand forecast in MTDF, and reviewed the projects in MTDF and the existing CAA plan.

10.2 Demand- Supply Analysis

10.2.1 Analysis of the Past Trend

The previous JICA Study projected that domestic air passenger traffic would reach 19.3 million (terminal passenger traffic) in 2005/06, however it only reached 5.9 million in 2003/04 and is estimated to reach a maximum of 6.5 – 7.0 in 2005/06. The large difference is attributed to the sharp drop in domestic passenger in the late 1990's: the number of passengers decreased by 45% from 1995/96 to 2001/02. According to the MTDF this decrease was caused by private airlines suspending the operation of unprofitable routes. It is understood that CAA user charges at domestic airports were so high that private airline companies had to withdraw from low demand routes. This demonstrates the characteristics of traffic demand: without the transport system, no demand can be observed even if the potential demand is stable.

International transit is another factor of demand for domestic flights. As Karachi is the gateway for international flights to and from Pakistan, there has been strong demand for flights between Islamabad and Karachi. The transit demand would decrease if Islamabad was to accept more and more direct flights to and from foreign countries. Such a demand can be considered as "unwilling demand".

Figure 10.2.1 shows a methodology for analysing passenger demand.

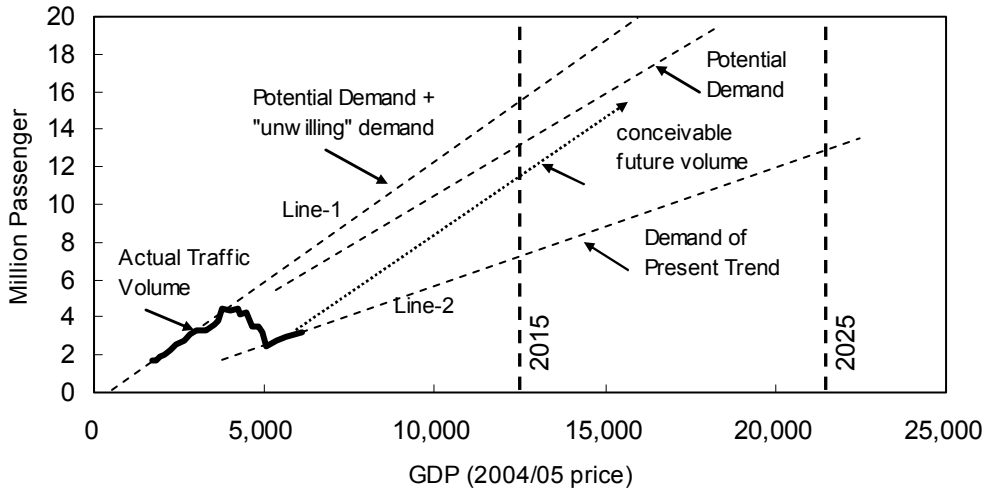


Figure 10.2.1 Air Passenger Demand Analysis

A trend line (Line 1) of the actual traffic up to 1995/96 might consist of "potential demand" and the "unwilling demand".

A trend line (Line 2) of the recent increase in passengers reflects the demand when no routes that were previously abolished are reopened. The actual demand should lie between the two lines. From a regression analysis, the two lines can be expressed as the following formulae:

D1 = 1,151X – 270,431 (R2=0.9822, Sample size=21)
D2 = 692X – 994,107 (R2=0.9924, Sample size=4)
Where,
D1: Air passenger volume of "Line 1" (million)
D2: Air passenger volume of "Line 2" (million)
X: GDP at 2004/05 price (Billion)

10.2.2 Projection of Air Transport Demand in Pakistan

The volume of domestic passengers was estimated by the two formulae mentioned above and are shown in Table 10.2.1. The conceivable future demand would lie between the two values.

Table 10.2.1 Projection of Air Passenger Traffic by Trend Method

(Million Passengers)

	2010	2015	2020	2025
Line 1	10.3 7.23%	14.2 6.65%	19.1 6.10%	25.1 5.57%
Line 2	5.4 8.67%	7.7 7.54%	10.7 6.68%	14.2 5.96%

Note: Figure with % means the annual average growth rate in the last five years
Source: JICA Study Team

The JICA Study Team set the target for the volume of future air passengers taking into account the above analysis. These volumes are shown in Table 10.2.2. It is assumed that the demand will increase at an annual rate of 7% after 2015.

Table 10.2.2 Projection of Air Passenger Demand (Target)

(Million Passengers)

	2010	2015	2020	2025
Future Demand	5.4 *8.67%*	7.7 *7.54%*	11.1 *7.0%*	16.0 *7.0%*

Source: JICA Study Team

10.3 Development Plan

10.3.1 ASF (Airport Security Force)

- Establishment of training programmes for the security staff. ASF has to train its staff to deal with all risk situations.
- Instalment of new security devices and programs, which meet ICAO standards, and the improvement of facilities for more safety and comfort for passengers.

10.3.2 CAA (Civil Aviation Authority)

- Installation of AIS (Aeronautical Information System) in order to deal with the increasing number of international over-flights and domestic flights
- Installation of an ATC back-up system at control centres at Karachi and Lahore for the better crisis management and as a supplement to each other.
- Improvement of ATC facilities for safer aircraft operation such as Remote Air to Grand Radio System, Radar and ADS (Automatic Dependent System) in northern mountain area
- Improvement of CATC (Civil Aviation Training Centre) in order to deal with the highly specialized staff that must be brought up to speed with the technical advancement of aviation.

10.3.3 PIA (Pakistan International Airline)

- In coming years, a better quality from the safety viewpoint will be targeted as well through means such as the acquisition of ISO9001 certification.
- According to the aviation forecast, the number of seat demand is anticipated to double in the next ten years.

10.4 Master Plan Projects

10.4.1 Existing Projects

Table 10.4.1 to Table 10.4.3 are the list of existing plans based on MTDF and information from CAA (Civil Aviation Authority) headquarters. The projects of Nos. 1 to 7 are funded by the Pakistan government, and the total budget is approximately Rs. 1,300 million The projects of Nos. 8 to 27 are funded by CAA, and the total budget is approximately Rs. 17,500 million, but this figure does not include the budget for the expansion of airports the northern area. Also, there are investment projects from the private sector such as the purchase of aircrafts for PIA (Pakistan International Airlines). The budget for the purchase is 116,350 million Rs.

Table 10.4.1 Current Aviation-Related Projects by ASF

Code	Name of the Project	The Project Site/Section	Cost Millon Rs.	Fund
1	Construction of barrack accomodation at small airports	Muzaffarabad, Gilgit, D.I.Khan, Rawalakot and Nawabshah)	12	GOP
2	Construction of barrack accomodation	Islamabad Airport	15	GOP
3	Construction of other accomodation for CSO (North)	Islamabad Airport	9	GOP
4	Construction of barrack accomodation	Quetta Airport	19	GOP
5	Construction of barrack accomodation	Multan Airport	16	GOP
6	Construction of barrack accomodation	Faisalabad Airport	21	GOP
7	Security up-grade plan at all airport		1,200	GOP

Source: MTDF

Table 10.4.2 Current Aviation-Related Projects

	Name of the Project	The Project Site/Section	Cost Millon Rs.	Fund
8	New Islamabad International Airport	New Airport at Pind Ranjha	12,800	CAA
9	Training	CAA ATS(Air Traffic Service)	25	CAA
10	Procurement of ATC simulator (Radar / Non-Radar)	CAA ATS(Air Traffic Service)	260	CAA
11	Introduction of future air navigation system (CSN/ ATM)	CAA ATS(Air Traffic Service)	300	CAA
12	Technical and support equipment for operations	CAA ATS(Air Traffic Service)	700	CAA
13	New Air Terminal Complex and allied works at Lahore	Lahor	390	CAA
14	Rehabilitation / Widenning of old main R/W at JIAP	Karachi	800	CAA
15	Runways, Taxiways and Apron report cycle at Airport	All airports	500	CAA
16	Expansion of Terminal Infrastructure at Airports	All airports	500	CAA
17	Procurement of Fire Crash tenders for Airports	CAA ATS(Air Traffic Service)	300	CAA
18	Replacement of Medium Fire Crash Tenders		120	CAA
19	Installation of AFL System		130	CAA
20	Misc. Equipment	CAA ATS(Air Traffic Service)	55	CAA
21	Other Operational works at all Airports	CAA ATS(Air Traffic Service)	408	CAA
22	Upgrade of Gwader Airports (Grant by Oman Govt.)	Gwadar	150	Oman Govt.
23	Construction New Gwadar Airport	Guarandani, 26km east of Gwadar		CAA
24	Development of Peshawar Airport	Peshawar		CAA
25	Expansion of Multan Airport	Multan		CAA
26	Up-gradation of Turbat Airport	Turbat		CAA
27	Construction of New Sialkot Airport	Sialkot	18,730	SCCI

Source: MTDF, CAA

Table 10.4.3 Current Aviation-Related Projects by PIA

	Name of the Project	Cost Millon Rs.	Fund
28	Purchase of 4 Nos. A310-300 Aircraft {on lease basis by PIA} [US$75million]	4,500	PIA
29	Purchase of 7 Nos. New Turbo-Prop Aircraft by PIA{US$105million}	6,300	PIA
30	Purchase of 2 Nos. Boeing 777-200 LR Aircraft [US$360million]	21,600	PIA
31	Purchase of 4 Nos. Boeing 777-300 LR Aircraft [US$760million]	45,600	PIA
32	Purchase of 8 Nos. Narrow Body Twin jet Aircraft {on lease/purchase basisby PIA basis by PIA}[US$470million]	28,200	PIA
33	Infrastructure by PIA {LC Rs. 1,850 million + FEC US$ 30 million}	3,650	PIA
34	Purchase of Aircraft (Purchase+Lease) [US$110million by Pvt Sector]	6,600	PIA

Source: MTDF & CAA

10.4.2 Proposed Projects

Table 10.4.4 shows the recommended projects and cost information from PTPS as future project for aviation sector. The procurement plan of airlines aircrafts is not included.

Table 10.4.4 Proposed Projects of Airport Development

Executing Agency	Name of the Project	The Project Site/Section	Term		Cost Million Rs.	Fund
			From	To		
ASF	Security up-grade plan at all airport	All airports	2010	2025	3,000	GOP
ASF	Security up-grade plan at all airport	All airports	2010	2025	200	GOP
CAA	Renew Radar System	CAA	2010	2025	4,000	CAA
CAA	Up grade ATC facilities at all airport	Research and Installation for northern area	2010	2025	10,000	CAA
CAA	Install AIS system	All airports	2015	2025	1,000	CAA
CAA	Install satellite ADSB	CAA	2015	2025	1,000	CAA
CAA	CATC Upgrade Project	CAA	2015	2025	400	CAA
GOP	City Transportation for New Islamabad airport	Rail Transportation between Islamabad, airport, Rawalpindi station	2010	2025		GOP

Source: JICA Study Team

It is natural to cover the expense of airport security, airport facilities and ATC facilities with the income from the aviation sector, which has the principle benefit. If CAA strengthens its revenue system it should satisfy the various requirements.

PIA had Rs. 11,082 million gross profits in 2003 and Rs. 8,734 million in 2004 according to the PIA annual finance report. The management situation is healthy and the required project funding can be supported by an increase of capital and self-financing.

Chapter 11. IMPLEMENTATION PROGRAM

11.1 Implementation Schedule

The implementation schedule of the Master Plan was prepared by each transport sub-sector (Chapter 6 – Chapter 9) in order to estimate the amount of investment allocation in the periods of:

- Short-Term: FY2005/06 – 2009/10
- Medium-Term: FY2010/11 – 2014/15
- Long-Term: FY2015/16 – 2024/25

Based on the implementation schedule, the required investment over the next 20 years was calculated at Rs. 2.06 trillion in total, of which the road sector accounted for 1.13 trillion (54.7%) and the railway sector Rs. 537 billion (26.1%) as shown in Table 11.1.1. The investment costs include ongoing & committed projects, new MTDF projects, and additional projects proposed by PTPS. Maintenance work for roads and private sector investment in vehicle fleets for road transport are excluded in the table. Transport equipment costs for the procurement of vehicles (buses and trucks) for passenger and freight transport were estimated at Rs. 5.52 billion (Chapter 6).

The projects in the Master Plan are listed in Table 11.1.2 and Table 11.1.3 for road and railway sub-sectors.

Table 11.1.1 Investment Requirement

Rs. Million

Sector	Project Group		PSDP 2005/06	Investment Requirement (2006/07 - 2024/25) 2006/7-2009/10 4 years	2010/11-2014/15 5 years	2015/16-2024/25 10 years	Total
Road	MTDF	On-going (PSDP)	19,904	64,710	12,594	0	77,304
		Committed (PSDP)	-	16,500	38,053	2,939	57,492
		New (PSDP)	-	67,891	99,617	19,574	187,081
		New (BOT/PPP)	292	28,127	35,096	15,426	78,650
	PTPS	PSDP	-	23,901	226,977	359,586	610,465
		BOT/PPP	-	2,430	39,263	74,230	115,923
	Total		20,196	203,559	451,601	471,755	1,126,915
Railway	MTDF	On-going (PSDP)	9,449	13,489			13,489
		New (PSDP)	400	44,987	14,362	10,550	69,899
	PTPS	PSDP	-	48,150	132,300	270,600	451,050
	Total		9,849	106,626	146,662	281,150	534,438
Port	Karachi Port Trust (KPT)		-	113,122	4,680	4,680	122,842
	Port Qasim Authority (PQA)		-	29,324	4,680	9,360	43,364
	Por Gwadar		3,744	5,770	25,000	25,000	55,770
	Total		3,744	148,216	34,360	39,040	221,976
Airport	ASF		38	1,256	1,500	2,000	4,756
	CAA		-	36,168	16,400		52,568
	PIA		-	116,450			116,450
	Total		38	153,874	17,900	2,000	173,774
Grad Total			33,827	612,276	650,523	793,945	2,057,104

Source: JICA Study Team

Table 11.1.2 Proposed Cost Allocation of the Master Plan Projects (Road)

Rs. Million

PTPS Code	Project Name	Project Cost Rs. M	Accumulated Expenditure , June 05	MTDF (2005/06 - 2009/10)			Medium 2010/11-2014/15	Long 2015/16-2024/25
					PSDP 2005/06	Short-term 2006/07-09/10		
	Ongoing Project							
10	Marakan Coastal Road	15,010	10,153	4,366	1,500	2,866	492	0
20	M-1	26,862	23,882	2,980	2,370	610	0	0
30	M-3	6,877	6,010	611	1	610	0	0
40	Karachi Northan Bypass	2,928	2,704	800	800	0	0	0
50	Lyari Express Way	5,081	2,420	2,661	600	2,061	0	0
60	N75, Islamabad-Muzaffarabad Road	7,660	3,324	4,206	950	3,256	0	0
72	N55, Indus Highway Project (Phase III)	0	633	5,923	750	5,173	0	0
80	N15, Mansehra Naran Jalkhad Road	3,821	3,625	196	154	43	0	0
100	N5, Rahim Yar Khan-Bahawarpur	7,283	5,322	1,961	400	1,561	0	0
110	N5, Okara-Lahore (Okara bypass)	4,462	4,405	190	190	0	0	0
120	N5, Kharian-Rawalpindi	5,554	5,479	40	40	0	0	0
130	N5, Chablat Nowshera (incl. flyover)	3,700	3,546	295	100	195	0	0
140	Lowari Tunnel & Access Road	7,983	1,239	6,745	1,150	5,595	0	0
150	Bridge on River Jhelum at Azad Pattan AJK	71	45	26	13	13	0	0
160	N65, Dera Allah Yar-Nutal Section	771	979	50	50	0	0	0
170	N65, Nutal-Sibi-Dhadar Section	1,710	733	977	150	827	0	0
180	Improvement of KKH (N-35) NWFP	552	540	12	0	12	0	0
190	N50, D.I. Khan-Mughalkot Road	1,903	1,753	350	350	0	0	0
200	N70, Qila Saifullah-Loralai-Bewala	2,841	1,304	1,537	350	1,187	0	0
220	M-8, Gwadar-Hoshab-Khuzdar Road	16,640	2,144	8,450	1,450	7,000	6,046	0
230	M-8, Khori-Quba Saeed Khan	4,000	456	3,544	500	3,044	0	0
240	N65, Realignment of N65 near Jaccobabad	478	258	220	100	120	0	0
250	Bridge over River Chenab at Sharshah	1,023	393	630	370	260	0	0
260	M2, Khanqah Dogran Interchange	144	43	101	100	1	0	0
280	Lalamusa-Thotha Rai Bahadur	60	38	22	0	22	0	0
290	N45, Noshera-Chakdara	1,620	142	1,478	1	1,477	0	0
300	F/S	700	62	410	50	360	228	0
470	N5 Highway Rehabilitation Project, WB	19,943	1,116	15,616	3,116	12,500	3,211	0
540	N25, Kalat-Quetta-Chaman (ADB)	6,671	0	6,671	2,300	4,371	0	0
551	Peshawar-Torkham Dual Carriageway	12,787	1	10,669	1,169	9,500	2,117	0
552	Malana Junction- Sarai Gambia Dualization	0	0	0	0	0	0	0
553	Badabher-Dara Adam Khel, Rehab of existing road	0	0	0	0	0	0	0
554	Sarai Gambila-Bannu-Miran Shah-Ghulam Khan	0	0	0	0	0	0	0
650	Kohat Tunnel Access Road	6,627	6,568	58	0	58	0	0
670	N25, Karao-Wad Section	2,500	0	2,000	10	1,990	500	0
	Ongoing Projects Sub-total	178,261	89,316	83,794	19,084	64,710	12,594	0
	Committed Projects							
480	Rehabilitation of 518km of N5	14,610	0	6,500	0	6,500	8,110	0
530	Motorway Link (Gujranwala-Pindi Bhattian)	6,000	0	0	0	0	6,000	0
561	N25, Hab-Utral	3,176	0	1,003	37	966	2,173	0
562	N70, Multan-Muzaffaragarh	1,352	0	426	16	410	926	0
563	N50, Khanozai-Mughalkot Section	12,422	0	3,926	143	3,783	5,576	2,939
564	N35, Dualization of Hassanabdal-Mansera	3,363	0	1,062	39	1,023	2,301	0
565	N65, Sukker - Jacobab Bypass	2,429	0	765	28	737	1,664	0
566	Tarnol-Fatejang-Kohat Road	3,848	0	1,215	44	1,171	2,633	0
567	N70 (Qila Saifullah-Wiagum Rud)	4,632	0	1,463	53	1,410	3,170	0
570	Malakand Tunnel/Bypass	6,000	0	500	0	500	5,500	0
902	N70, Mughalkot-Zhob Road	2,100	0	0	0	0	0	0
	Committed Projects Sub-total	59,932	0	16,860	360	16,500	38,053	2,939
	MTDF New Projects							
310	Quetta Western Bypass	226	0	226	80	146	0	0
335	Larkana Bridge	2,500	0	2,000	0	2,000	500	0
340	Five bridges on Gilgit-Shardu Road (S-1)	215	0	215	80	135	0	0
350	N40, Noshki-Dalbandin	1,986	0	2,110	129	1,981	0	0
360	N15, Jalkhad-Chillas	1,827	5	1,822	1	1,821	0	0
370	KKH-Skardu Road	4,000	0	1,300	0	1,300	2,700	0
380	N5, Ghaggar Phatak Bridge to Kotri	2,850	0	2,850	0	2,850	0	0
390	N80, Jand-Kohat Road	1,000	0	1,000	0	1,000	0	0
400	Hassan Abdal Bypass	500	0	0	0	0	500	0
410	Dhakpattan Bridge	520	0	520	50	470	0	0
415	N55 Dadu Ratodero Fence+Ser. Rd.	3,750	0	0	0	0	3,750	0
420	Other Projects	1,214	0	1,000	0	1,000	214	0
421	Interchange at Kot Sarwar for Hafizabad	86	0	0	0	0	86	0
422	Roads in Rawalpindi	1,000	0	0	0	0	1,000	0
450	Hoshab-Srab	12,100	0	10,500	0	10,500	1,600	0
460	M-7	18,000	0	15,000	0	15,000	3,000	0
491	Bridge (Kotri-Sajjawal bridge), jerruk	2,500	0	0	0	0	0	2,500
492	Bridge (Kotri-Dadu Moro bridge),San-Sakar	2,500	0	0	0	0	2,000	500
493	Bridge (Kahndhkot-Ghotki)	2,500	0	0	0	0	0	2,500
494	Rail cum Road Bridge, Chachran-Mithankot	2,500	0	0	0	0	2,000	500
495	Bridge (Taunsa-Leiah)	2,500	0	0	0	0	2,000	500
496	Bridge over River Indus at Kalur Kot	2,500	0	0	0	0	0	2,500
497	Bridge over River Indus (Mianwali-Isa Khel)	2,500	0	0	0	0	0	2,500

Source: NHA, JICA Study Team

cont. of Table 11.1.2

Rs. Million

PTPS Code	Project Name	Project Cost Rs. M	Accumulated Expenditure , June 05	MTDF (2005/06 - 2009/10)			Medium 2010/11-2014/15	Long 2015/16-2024/25
					PSDP 2005/06	Short-term 2006/07-09/10		
500	ITS Corridor	6,000	0	2,200	0	2,200	3,800	0
510	M5, Khanewal-Rajanpur	42,000	0	2,000	0	2,000	22,000	18,000
520	N5, Service Road along with Fence, WB	4,200	0	0	0	0	4,200	0
580	N45	6,000	0	200	0	200	5,800	0
590	Kohala-Muzafarabad Road	3,000	0	250	0	250	2,750	0
591	Murree-Kohala Road	3,000	0	250	0	250	2,750	0
600	N40, Lakpass-Noshki	3,600	0	450	0	450	3,150	0
610	Hyderabad-Mirpurkhas-Khokhropar Road	8,880	0	700	0	700	8,180	0
620	Chakdara - Kalam Road	6,500	0	500	0	500	6,000	0
630	Khawaza Khala-Besham Road	3,300	0	350	0	350	2,950	0
640	N65, Sibi-Quetta	6,350	0	3,200	0	3,200	3,150	0
660	N70, D.G.Khan-Sakhi Sarawar-Bewala	6,200	0	2,810	10	2,800	3,390	0
661	2nd Bridge on Indus at Gazi Ghat (N70)	500	0	0	0	0	495	0
680	Khushalgar Birdge(N80)	3,500	0	2,100	100	2,000	1,400	0
690	N55, Indus Highway Project (Phase III-a)	6,000	0	4,000	0	4,000	2,000	0
700	KKH	18,500	0	3,000	0	3,000	10,000	5,500
810	M-4, Faisalabad-Multan	22,080	0	8,832	0	8,832	13,248	0
820	Periodic Overlay on M2 & Realignment of Salt Rang	8,000	0	2,400	0	2,400	5,600	0
830	M-6, Ratodero-Rajanpur	21,600	0	8,000	0	8,000	13,600	0
840	M-9, Karachi-Hyderabad	6,000	0	6,000	0	6,000	0	0
850	Peshawar Northan Bypass	3,078	0	3,173	100	3,073	0	0
860	Rawalpindi Bypass	3,489	0	3,489	45	3,444	0	0
870	N25, Lakpass Tunnel	570	3	567	1	566	0	0
890	N-5, Shahdara Flyover	4,500	0	3,746	146	3,600	900	0
	MTDF New Projects Sub-total	266,121	8	96,760	742	96,018	134,713	35,000
	PTPS New Projects							
330	Bridge over Chenab at Riwaz	700	0	0	0	0	700	0
655	Second Kohat Tunnel	6,000	0	0	0	0	6,000	0
900	Panjub East-West Corridor-1	55,068	0	2,203	0	2,203	17,071	35,794
901	Mianwali-Lakki Road	5,378	0	807	0	807	4,302	269
905	Panjab East-West Corridor-2	60,618	0	2,425	0	2,425	15,761	42,433
910	Panjab East-West Corridor-3	69,420	0	2,083	0	2,083	20,826	46,511
915	Panjub North-South Corridor-1	70,122	0	0	0	0	10,518	59,604
920	Bahawalpur, Bahawal Nagar, Sulemanki Road	34,722	0	1,736	0	1,736	12,153	20,833
925	Panjub North-South Corridor-2	11,232	0	1,685	0	1,685	3,931	5,616
930	Sialkot, Wazirabad, Pindi Bhattian Road	24,648	0	0	0	0	0	24,648
935	Sialkot, Gujranwala, Sheikhpura Road	14,838	0	0	0	0	0	14,838
940	Faisalabad, Samundari, Kacha Khu Road	22,818	0	0	0	0	5,705	17,114
945	Lahore, Jaranwala, Faisalabad, Jhang Road	31,770	0	0	0	0	15,885	15,885
951	M11	29,645	0	0	0	0	0	29,645
952	M12	8,673	0	0	0	0	0	8,673
953	M13	12,575	0	0	0	0	10,060	2,515
954	M14	11,395	0	0	0	0	0	11,395
955	M15&M19	51,230	0	0	0	0	0	0
956	M16	29,336	0	0	0	0	7,334	22,002
957	M17	20,526	0	0	0	0	0	0
958	M18	20,273	0	0	0	0	0	0
959	N55 (Dadu-Kotri) 4-Lane	10,000	0	0	0	0	10,000	0
961	Garh Maharaja Bridge	1,000	0	0	0	0	1,000	0
962	Chistian-Burewala Bridge	500	0	0	0	0	500	0
963	Mohammadwala Bridge	600	0	0	0	0	600	0
964	Jhelum, Gatalian Mirpur Bridge	1,250	0	0	0	0	1,250	0
966	Samundari-Shahiwal Road	2,660	0	0	0	0	1,862	798
967	Jaranwala-Okara Road	2,700	0	0	0	0	1,890	810
968	Lahore Bridge	950	0	0	0	0	475	475
969	Victoria Bridge	1,000	0	0	0	0	1,000	0
971	Pind D. Khan-Jhelum Road	4,462	0	892	0	892	3,570	0
972	Hyderabad-Bidin-Thata Road	11,048	0	0	0	0	0	11,048
973	Mianwali-Shakardarra-Lachi Road	6,517	0	652	0	652	5,865	0
974	N65 Dualization	23,645	0	0	0	0	0	23,645
975	Lower Topa – Mansehra Road	11,616	0	2,323	0	2,323	9,293	0
980	Qasim Port Access	3,878	0	3,878	0	3,878	0	0
981	Karachi Port Access	15,000	0	0	0	0	15,000	0
982	Bridge on River Indus (Khanote-Hala old)	2,500	0	0	0	0	2,500	0
983	Bridge on River Indus (Daultpur-Shehwan)	2,500	0	0	0	0	2,500	0
985	N55 Dualization (Kohat-D.I.Khan)	14,230	0	0	0	0	14,230	0
986	N55 Dualization (D.I.Khan-D.G.Khan)	9,600	0	0	0	0	9,600	0
987	N55 Dualization (Rajanpur-Ratodero)	11,630	0	0	0	0	5,815	5,815
990	Sindh Coastal Highway	20,309	0	2,031	0	2,031	16,247	2,031
1000	Urban Bypass	45,536	0	3,188	0	3,188	10,929	31,420
1002	Lahore Peripheral Road	24,299	0	2,430	0	2,430	21,869	0
	PTPS New Projects Sub-total	818,417	0	26,331	0	26,331	266,241	433,816
	Grand Total	1,322,731	89,325	223,745	20,186	203,559	451,601	471,755

Source: NHA, JICA Study Team

Table 11.1.3 Proposed Cost Allocation of the Master Plan Projects (Rail)

Rs. Million

PTPS Code	Project Name	Project Cost Rs. M	Accumulated Expenditure , June 05	MTDF (2005/06 - 2009/10)			Medium 2010/11-2014/15	Long 2015/16-2024/25
					PSDP 2005/06	Short-term 2006/07-09/10		
	Ongoing Project							
1	Procurement/manufacture of 175 passenger coaches	7,776	5,953	1,823	1,401	422	0	0
2	Procurement of 69 DE locos	11,151	4,188	6,963	2,234	4,729	0	0
3	Track rehabilitation and modernization of sleeper factory	11,192	5,686	5,506	2,000	3,506	0	0
4	Recommissioning of 55 DE locos	879	232	647	500	147	0	0
5	Replacement of breakdown cranes and procurement of relief train	407	286	121	63	58	0	0
6	1,300 high capacity wagons	5,870	1,727	4,143	1,500	2,643	0	0
7	Doubling of track Lodhran-Multan-Khanewal	3,297	433	2,864	750	2,114	0	0
8	Rehabilitation of 450 passenger coaches	2,145	1,300	845	575	270	0	0
9	Other projects	148	122	26	26	0	0	0
	Ongoing Projects Sub-total	42,865	19,927	22,938	9,049	13,889	0	0
	MTDF New Projects					0		
10	Conversion of Mirpur Khas - Khokhropar section to broad gauge	700	300	400	400	0	0	0
11	Dualization of track from Khanewal to Raiwind	5,712	0	5,712	400	5,312	0	0
12	Dualization of track from Shahdara Bagh to Lala Musa	3,600	0	1,288	0	1,288	2,312	0
13	Upgrading and improvement of track from Khampur to Lala Musa	3,500	0	3,500	0	3,500	0	0
14	Doubling of track from Lahore to Faisalabad section	3,840	0	2,940	0	2,940	900	0
15	Procurement/manufacture and assembling of 75 diesel locomotives	12,700	0	12,700	0	12,700	0	0
16	Procurement/manufacture and assembly of 1,000 freight wagons	4,800	0	3,600	0	3,600	1,200	0
17	Procurement/manufacture and assembly of 150 passenger coaches	5,977	0	5,977	0	5,977	0	0
18	Railway yard and railway linkage from Gwadar Port to container yard	2,500	0	2,500	0	2,500	0	0
19	Rail link to Gwadar Port	12,000	0	6,500	0	6,500	5,500	0
20	Up-gradation Rohri - Quetta - Taftan	15,000	0	0	0	0	4,450	10,550
21	Feasibility study for rail link from Kundian to Peshawar	10	0	10	0	10	0	0
22	Feasibility study for rail link from Bostan to Peshawar	10	0	10	0	10	0	0
23	Provision of road over bridge at Chowrangi Chowk EPZ (50%)	250	0	250	0	250	0	0
	MTDF New Projects Sub-total	70,599	300	45,387	800	44,587	14,362	10,550
	PTPS New Projects					0		
24	Improvement of signalling system Karachi - Lahore	15,000	0	15,000	0	15,000	0	0
25	Improvement of signalling system Lahore - Rawalpindi	2,900	0	900	0	900	2,000	0
26	Improvement of signalling system Rawalpindi - Peshawar	1,300	0	0	0	0	1,300	0
27	Improvement of signalling system Faisalabad - Lahore	1,700	0	1,000	0	1,000	700	0
28	Improvement of signalling system Khanewal - Wazirabad	2,100	0	0	0	0	2,100	0
29	Improvement of signalling system Rohri - Quetta	2,900	0	0	0	0	2,900	0
30	Improvement/rehabilitation of telecommunication system (1st phase)	5,000	0	5,000	0	5,000	0	0
31	Improvement/rehabilitation of telecommunication system (2nd phase)	3,000	0	0	0	0	3,000	0
32	Improvement of signalling system Multan - Attock City	2,500	0	0	0	0	2,500	0
33	Improvement of signalling system Kotri - Habib Kot	1,700	0	0	0	0	1,700	0
34	Improvement of signalling system Jacobabad - Kot Adu	2,100	0	0	0	0	2,100	0
35	Improvement of signalling system other lines continued	9,000	0	0	0	0	0	9,000
36	Improvement/rehabilitation of telecommunication system (3rd phase)	2,000	0	0	0	0	0	2,000
37	Urgent rehabilitation of signalling and telecommunication systems	1,000	0	1,000	0	1,000	0	0
38	Doubling of track Lala Musa - Rawalpindi	7,100	0	0	0	0	7,100	0
39	Doubling of track Lodhran - Khanewal (Via Chord)	2,100	0	0	0	0	2,100	0

Source: MTDF, JICA Study Team

cont. of Table 11.1.3.

Rs. Million

PTPS Code	Project Name	Project Cost Rs. M	Accumulated Expenditure , June 05	MTDF (2005/06 - 2009/10)			Medium 2010/11- 2014/15	Long 2015/16- 2024/25
					PSDP 2005/06	Short-term 2006/07-09/10		
PR40	Rehabilitation of track Rawalpindi - Peshawar	700	0	0	0	0	700	0
PR41	Rehabilitation of track Multan - Attock City	2,000	0	0	0	0	2,000	0
PR42	Rehabilitation of track Kotri - Habib Kot	1,400	0	0	0	0	1,400	0
PR43	Rehabilitation of track Jacobabad - Kot Adu	1,700	0	0	0	0	1,700	0
PR44	Rehabilitation of track other lines continued	6,000	0	0	0	0	0	6,000
PR45	Planning investigation and rehabilitation of structures	200	0	200	0	200	0	0
PR46	Rehabilitation/replacement of structures Karachi - Lahore (1st phase)	5,000	0	2,000	0	2,000	3,000	0
PR47	Rehabilitation/replacement of structures Karachi - Lahore (2nd phase)	5,000	0	0	0	0	0	5,000
PR48	Urgent rehabilitation of structures of other lines	2,000	0	2,000	0	2,000	0	0
PR49	Rehabilitation/replacement of structures of other lines	10,000	0	0	0	0	0	10,000
PR50	Improvement of passenger station and ticketing system	3,000	0	2,000	0	2,000	1,000	0
PR51	Improvement of freight stations in Karachi for container/bulk transport	3,000	0	3,000	0	3,000	0	0
PR52	Expansion/improvement of container stations in up-country area	5,000	0	5,000	0	5,000	0	0
PR53	Expansion of freight stations in Karachi for container/bulk transport	5,000	0	0	0	0	0	5,000
PR54	Expansion/improvement of container stations in up-country area (2)	7,000	0	0	0	0	0	7,000
PR55	Procurement/manufacture/assembling of 120 diesel locomotives (3000HP)	22,000	0	3,000	0	3,000	19,000	0
PR56	Procurement/manufacture/assembling of 180 diesel locomotives (2000HP)	27,000	0	3,000	0	3,000	24,000	0
PR57	Procurement/manufacture/assembly of 150 electric locomotives (Passenger)	30,000	0	0	0	0	0	30,000
PR58	Procurement/manufacture/assembly of 180 electric locomotives (Freight)	50,000	0	0	0	0	0	50,000
PR59	Procurement/manufacture/assembly of 550 passenger coaches	25,000	0	0	0	0	25,000	0
PR60	Heavy rehabilitation/modification of 530 passenger coaches	11,000	0	5,000	0	5,000	6,000	0
PR61	Procurement/manufacture/assembly of 1,230 passenger coaches	56,000	0	0	0	0	0	56,000
PR62	Procurement/manufacture/assembly of 1,050 freight wagons	5,800	0	0	0	0	5,800	0
PR63	Procurement/manufacture/assembly of 7,600 freight wagons	25,000	0	0	0	0	0	25,000
PR64	Expansion and modernisation of locomotives/rolling stock repair shops	15,000	0	0	0	0	0	15,000
PR65	Expansion and modernisation of locomotives/rolling stock depot	15,000	0	0	0	0	0	15,000
PR66	Feasibility study of electrification Karachi - Lahore	50	0	50	0	50	0	0
PR67	Construction/rehabilitation of electrification Karachi - Lahore	27,000	0	0	0	0	7,000	20,000
PR68	Increase of transport capacity Karachi - Lahore in addition to electrification	3,800	0	0	0	0	1,200	2,600
PR69	New link Bostan - Zhob - D.I.Khan - Kohat - Peshawar	20,000	0	0	0	0	7,000	13,000
	PTPS New Projects Sub-total	451,050	0	48,150	0	48,150	132,300	270,600
	Grand Total	564,514	20,227	116,475	9,849	106,626	146,662	281,150

Source: MTDF, JICA Study Team

11.2 Short-Term Plan

11.2.1 Infrastructure Development

The period of the Short-Term Plan in PTPS is 2005/06 – 2009/10. On the other hand, the Public Sector Development Programme (PSDP) for 2005/06 was approved in June 2005, when the Master Plan Phase of PTPS started. Therefore, the Short-Term Plan includes the already approved components in 2005/06 and the coming projects in 2006/07 – 2009/10.

Projects that should be commenced in the period of FY 2006/07 – 2009/10 were identified in the sector plans (Chapter 6 – 9). In the road sector, on-going projects require Rs. 64.7 billion, accounting for 31.8% of the total investment in roads at Rs. 203.6 billion. Of the total, MTDF projects account for Rs. 177.2 billion, while the proposed new PTPS projects account for Rs. 26.3 billion. The Short-Term Plan for roads includes Rs. 28.1 million of private funded projects, accounting for 13.8% of the total. Soft loans from ADB, World Bank, JBIC and others account for Rs. 48.9 million (24.0%). The rest of Rs. 124.9 million for four years should be funded by the Government of Pakistan. Road projects for the Short-Term Plan are listed in Table 11.2.1.

In addition to the MTDF Railway Projects at Rs. 49.5 billion, the additional investment cost of Rs. 48.1 billion was proposed for strengthening the main corridor, including a signalling system and procurement of locomotives. Railway projects for the Short-Term Plan are listed in Table 11.2.2.

In the port and aviation sector, MTDF Projects are the short-term projects, amounting to Rs. 148.2 billion and Rs. 153.9 billion, respectively. Private sector investment accounts for 55.7% in port sector. Karachi and Qasim Port will be developed by self-financing and private sector investment while Port Gwadar needs to be funded by PSDP. Ports and aviation projects are listed in Table 11.2.3 and Table 11.2.4.

11.2.2 Institutional & Financial Reform

The following programs are recommended as institutional & financial reforms in the Short -Term Plan:

- Establishment of Transport Coordination Mechanism,
- Capacity Building of National Transport Research Centre,
- Establishment of Highway Research and Training Centre,
- Establishment of Road Development Fund,
- Dept-Equity Swap of NHA,
- Improvement of Accounting System of Pakistan Railways

As mentioned in Chapter 10.2, institutional reform relating to decision-making mechanisms is recommended. The establishment of the Transport Coordination Mechanism is listed in the short-term plan because improvement of the prioritization system for transport projects will be important for the next five-year plan (2010/11 – 2014/15). Capacity building of NTRC is also an important project in the short-term. Especially, strengthening a database system for traffic safety should be an urgent program for policy-making in traffic safety. To improve the quality of pavement and maintenance works, a Highway Research and Training Centre should be established in the short-term.

The proposed financial reforms of NHA are the short-term programs.

The reform of Pakistan Railways (PR) is one of the most important projects in PTPS. In the short-term, the accounting system of PR should be improved as proposed in Chapter 10.1. In addition, the three business units in PR (passenger, freight and infrastructure) should be clearly separated.

Table 11.2.1 List of Short-Term Projects (Road)

Rs. Million

PTPS Code	Project Name	Short-term Cost (2006/07-2009/10)								After 2009/10
			Funding			Yearly Allocation				
			PSDP	Loans	Private	06/07	07/08	08/09	09/10	
10	Marakan Coastal Road	2,866	2,866	0	0	300	500	1,066	1,000	492
20	M-1	610	610	0	0	610	0	0	0	0
30	M-3	610	610	0	0	211	399	0	0	0
50	Lyari Express Way	2,061	2,061	0	0	1,000	600	461	0	0
60	N75, Islamabad-Muzaffarabad Road	3,256	3,256	0	0	1,300	1,300	656	0	0
72	N55, Indus Highway Project (Phase III)	5,173	5,173	0	0	848	1,500	1,500	1,325	0
80	N15, Mansehra Naran Jalkhad Road	43	43	0	0	43	0	0	0	0
100	N5, Rahim Yar Khan-Bahawarpur	1,561	1,561	0	0	1,000	561	0	0	0
130	N5, Chablat Nowshera (incl. flyover)	195	195	0	0	195	0	0	0	0
140	Lowari Tunnel & Access Road	5,595	5,595	0	0	2,000	1,500	1,500	595	0
150	Bridge on River Jhelum at Azad Pattan AJK	13	13	0	0	13	0	0	0	0
170	N65, Nutal-Sibi-Dhadar Section	827	827	0	0	827	0	0	0	0
180	Improvement of KKH (N-35) NWFP	12	12	0	0	12	0	0	0	0
200	N70, Qila Saifullah-Loralai-Bewala	1,187	1,187	0	0	400	692	94	0	0
220	M-8, Gwadar-Hoshab-Khuzdar Road	7,000	7,000	0	0	2,500	1,500	1,500	1,500	6,046
230	M-8, Khori-Quba Saeed Khan	3,044	3,044	0	0	1,200	1,200	644	0	0
240	N65, Realignment of N65 near Jaccobabad	120	120	0	0	120	0	0	0	0
250	Bridge over River Chenab at Sharshah	260	260	0	0	260	0	0	0	0
280	Lalamusa-Thotha Rai Bahadur	22	22	0	0	22	0	0	0	0
290	N45, Noshera-Chakdara	1,477	1,477	0	0	650	500	327	0	0
300	F/S	360	360	0	0	90	90	90	90	228
470	N5 Highway Rehabilitation Project, WB	12,500	2,938	9,563	0	3,000	3,000	3,500	3,000	3,211
540	N25, Kalat-Quetta-Chaman (ADB)	4,371	1,355	3,016	0	1,200	1,500	1,500	171	0
551	Peshawar-Torkham Dual Carriageway	9,500	3,800	5,700	0	2,000	2,500	2,500	2,500	2,117
650	Kohat Tunnel Access Road	58	12	47	0	58	0	0	0	0
670	N25, Karao-Wad Section	1,990	398	0	0	500	500	500	490	500
480	Rehabilitation of 518km of N5	6,500	1,300	5,200	0	1,500	1,500	1,500	2,000	8,110
561	N25, Hab-Utral	966	193	773	0	203	203	254	305	2,173
562	N70, Multan-Muzaffaragarh	410	82	328	0	88	88	108	130	926
563	N50, Khanozai-Mughalkot Section	3,783	757	3,026	0	796	796	996	1,194	8,515
564	N35, Dualization of Hassanabdal-Mansera	1,023	205	818	0	215	215	269	323	2,301
565	N65, Sukker - Jacobab Bypass	737	147	590	0	155	155	194	233	1,664
566	Tarnol-Fatejang-Kohat Road	1,171	234	937	0	246	246	308	370	2,633
567	N70 (Qila Saifullah-Wiagum Rud)	1,410	282	1,128	0	297	297	371	445	3,170
570	Malakand Tunnel/Bypass	500	100	400	0	0	0	0	500	5,500
310	Quetta Western Bypass	146	146	0	0	100	46	0	0	0
335	Larkana Bridge	2,000	2,000	0	0	0	0	0	0	500
340	Five bridges on Gilgit-Shardu Road (S-1)	135	135	0	0	100	35	0	0	0
350	N40, Noshki-Dalbandin	1,981	1,981	0	0	50	800	800	207	0
360	N15, Jalkhad-Chillas	1,821	1,821	0	0	400	500	450	471	0
370	KKH-Skardu Road	1,300	1,300	0	0	0	0	650	650	2,700
380	N5, Ghaggar Phatak Bridge to Kotri	2,850	2,850	0	0	0	0	900	1,950	0
390	N80, Jand-Kohat Road	1,000	1,000	0	0	100	450	400	50	0
410	Dhakpattan Bridge	470	470	0	0	170	300	0	0	0
420	Other Projects	1,000	1,000	0	0	0	0	0	1,000	214
450	Hoshab-Srab	10,500	10,500	0	0	3,000	2,500	2,500	2,500	1,600
460	M-7	15,000	15,000	0	0	3,500	3,500	4,000	4,000	3,000
500	ITS Corridor	2,200	440	1,760	0	0	0	1,000	1,200	3,800
510	M5, Khanewal-Rajanpur	2,000	0	286	1,714	0	0	0	2,000	40,000
580	N45	200	40	160	0	0	0	0	200	5,800
590	Kohala-Muzafarabad Road	250	50	200	0	0	0	0	250	2,750
591	Murree-Kohala Road	250	50	200	0	0	0	0	250	2,750
600	N40, Lakpass-Noshki	450	90	360	0	0	0	0	450	3,150
610	Hyderabad-Mirpurkhas-Khokhropar Road	700	140	560	0	0	0	0	700	8,180
620	Chakdara - Kalam Road	500	100	400	0	0	0	0	500	6,000
630	Khawaza Khala-Besham Road	350	70	280	0	0	0	0	350	2,950
640	N65, Sibi-Quetta	3,200	640	2,560	0	0	0	0	500	3,150
660	N70, D.G.Khan-Sakhi Sarawar-Bewala	2,800	560	2,240	0	0	500	1,100	1,200	3,390
680	Khushalgar Birdge(N80)	2,000	400	1,600	0	0	0	1,000	1,000	1,400
690	N55, Indus Highway Project (Phase III-a)	4,000	800	3,200	0	0	1,000	1,500	1,500	2,000
700	KKH	3,000	0	3,000	0	0	0	1,000	2,000	15,500
810	M-4, Faisalabad-Multan	8,832	0	0	8,832	2,208	2,208	2,208	2,208	13,248
820	Periodic Overlay on M2 & Realignment of Salt Range	2,400	895	607	898	1,200	1,200	0	0	5,600
830	M-6, Ratodero-Rajanpur	8,000	8,000	0	0	0	2,000	3,000	3,000	13,600
840	M-9, Karachi-Hyderabad	6,000	0	0	6,000	2,000	2,000	2,000	0	0
850	Peshawar Northan Bypass	3,073	0	0	3,073	768	768	768	768	0
860	Rawalpindi Bypass	3,444	0	0	3,444	1,148	1,148	1,148	0	0
870	N25, Lakpass Tunnel	566	0	0	566	283	283	0	0	0
890	N-5, Shahdara Flyover	3,600	0	0	3,600	0	1,800	1,800	0	900

Source: NHA, JICA Study Team

cont. of Table 11.2.1

PTPS Code	Project Name	Short-term Cost (2006/07-2009/10)								After 2009/10
			Funding			Yearly Allocation				
			PSDP	Loans	Private	06/07	07/08	08/09	09/10	
900	Panjub East-West Corridor-1	2,203	2,203	0	0	0	0	0	2,203	52,865
901	Mianwali-Lakki Road	807	807	0	0	0	0	0	807	4,571
905	Panjab East-West Corridor-2	2,425	2,425	0	0	0	0	0	2,425	58,193
910	Panjab East-West Corridor-3	2,083	2,083	0	0	0	0	0	2,083	67,337
920	Bahawalpur, Bahawal Nagar, Sulemanki Road	1,736	1,736	0	0	0	0	0	1,736	32,986
925	Panjub North-South Corridor-2	1,685	1,685	0	0	0	0	0	1,685	9,547
971	Pind D. Khan-Jhelum Road	892	892	0	0	0	0	0	892	3,570
973	Mianwali-Shakardarra-Lachi Road	652	652	0	0	0	0	0	652	5,865
975	Lower Topa – Mansehra Road	2,323	2,323	0	0	0	0	0	2,323	9,293
980	Qasim Port Access	3,878	3,878	0	0	0	1,939	1,939	0	0
990	Sindh Coastal Highway	2,031	2,031	0	0	0	0	0	0	18,278
1000	Urban Bypass	3,188	3,188	0	0	0	0	0	3,188	42,348
1002	Lahore Peripheral Road	2,430	2,430	0	0	0	0	0	2,430	21,869
Total		203,558	124,901	48,938	28,127	38,886	44,319	48,001	65,497	516,492

Source: NHA, JICA Study Team

Table 11.2.2 List of Short-Term Projects (Railway)

Rs. Million

PTPS Code	Project Name	Short-term Cost (2006/07-2009/10)								After 2009/10
			Funding			Yearly Allocation				
			PSDP	Loans	Private	06/07	07/08	08/09	09/10	
PR01	Procurement/manufacture of 175passenger coaches	422	422	0	0	422	0	0	0	0
PR02	Procurement 69 DE locos	4,729	0	4,729	0	1,750	2,000	979	0	0
PR03	Track rehab. & modernization of sleeper factory	3,506	3,506	0	0	1,500	1,500	506	0	0
PR04	Recommissioning of 55 DE locos	147	147	0	0	147	0	0	0	0
PR05	Replacement of breakdown cranes and procurement of releif train	59	59	0	0	59	0	0	0	0
PR06	1,300 high capacity wagons	2,643	2,643	0	0	1,000	1,100	543	0	0
PR07	Doubling of track Lodhran - Multan - Khanewal	2,114	2,114	0	0	950	1,000	164	0	0
PR08	Rehabilitation of 450 passenger coaches	270	270	0	0	270	0	0	0	0
PR11	Dualization of track (Khanewal - Raiwind)	5,312	5,312	0	0	1,000	1,150	1,562	1,600	0
PR12	Dualization of track (Shahdara Bagh-Lala Musa)	1,288	1,288	0	0	10	400	300	578	2,312
PR13	Upgrading and improvement of track from Khampur to Lala Musa	3,500	3,500	0	0	50	740	985	1,725	0
PR14	Doubling of track (Lahore - Faisalabad)	2,940	2,940	0	0	115	191	957	1,677	900
PR15	Procurement/manufacture and assembly of 75 diesel locomotives	12,700	12,700	0	0	1,010	1,010	6,055	4,625	0
PR16	Procurement/manufacture and assembly of 1,000 freight wagons	3,600	3,600	0	0	370	460	1,200	1,570	1,200
PR17	Procurement/manufacture and assembly of 150 passenger coaches	5,977	5,977	0	0	596	1,600	1,697	2,084	0
PR18	Railway yard and railway linkage from Gwadar Port to container yard	2,500	2,500	0	0	500	600	600	800	0
PR19	Rail link to Gwadar Port	6,500	6,500	0	0	1,595	1,000	1,750	2,155	5,500
PR21	F/S for rail link from Kundian to Peshawar	10	10	0	0	10	0	0	0	0
PR22	F/S for rail link from Bostan to Peshawar	10	10	0	0	10	0	0	0	0
PR23	Provision of road over bridge at Chowrangi Chowk EPZ (50%)	250	250	0	0	250	0	0	0	0
PR24	Improvement of signalling system Karachi - Lahore	15,000	15,000	0	0	0	3,500	5,500	6,000	0
PR25	Improvement of signalling system Lahore - Rawalpinc	900	900	0	0	0	0	0	900	2,000
PR27	Improvement of signalling system Faisalabad - Lahore	1,000	1,000	0	0	0	0	400	600	700
PR30	Improvement/rehabilitation of telecommunication system (1st phase)	5,000	5,000	0	0	0	1,000	2,000	2,000	0
PR37	Urgent rehabilitation of signalling and telecommunication systems	1,000	1,000	0	0	0	200	300	500	0
PR45	Planning investigation and rehabilitation of structures	200	200	0	0	0	100	100	0	0
PR46	Rehabilitation/replacement of structures Karachi - Lahore (1st phase)	2,000	2,000	0	0	0	500	700	800	3,000
PR48	Urgent rehabilitation of structures of other lines	2,000	2,000	0	0	0	500	700	800	0
PR50	Improvement of passenger station and ticketing system	2,000	2,000	0	0	0	450	650	900	1,000
PR51	Improvement of freight stations in Karachi for container/bulk transport	3,000	3,000	0	0	0	800	1,000	1,200	0
PR54	Expansion/improvement of container stations in up-country area	5,000	5,000	0	0	0	1,000	1,750	2,250	0
PR55	Procurement/manucfacture/assembling of 180 diesel locomotives (3000HP)	3,000	3,000	0	0	0	0	0	3,000	19,000
PR56	Procurement/manufacture/assembling of 160 diesel locomotives (2000HP)	3,000	3,000	0	0	0	0	0	3,000	24,000
PR60	Rehabilitation/modification of 450passenger coaches	5,000	5,000	0	0	0	0	2,000	3,000	6,000
PR66	F/S of electrification Karachi - Lahore	50	50	0	0	0	0	0	50	0
Total		106,627	101,898	4,729	0	11,614	20,801	32,398	41,814	65,612

Source: MTDF, JICA Study Team

Table 11.2.3 List of Short-Term Projects (Port)

Rs. Million

PTPS Code	Project Name	Short-term Cost (2006/07-2009/10)								After 2009/10
			Funding			Yearly Allocation				
			PSDP/ Self Fin*	Loans	Private	06/07	07/08	08/09	09/10	
Port Qasim Authority (PQA)										
PQA01	2nd Iron Ore and Coal Berth	2,925	0	0	2,925	0	1,000	1,000	925	0
PQA02	2nd Container Terminal	3,510	0	0	3,510	0	1,150	1,160	1,200	0
PQA03	2nd Oil Jetty at FOTCO	1,170	0	0	1,170	0	370	400	400	0
PQA04	Coal/ Clinker Terminal	1,755	0	0	1,755	0	0	1,000	755	0
PQA05	Liquid Cargo Terminal	667	0	0	667	667	0	0	0	0
PQA07	Marine Workshop	585	0	0	585	200	200	185	0	0
PQA08	Desalination Plant	1,463	0	0	1,463	1,463	0	0	0	0
PQA09	Other Projects	3,712	3,712	0	0	712	1,000	1,000	1,000	0
	Sub-total	15,787	3,712	0	12,075	3,042	3,720	4,745	4,280	0
Karachi Port Trust (KPT)										
KPT01	Capital Dredging for Deeping of Channel	180	180	0	0	180	0	0	0	0
KPT02	Reconstruction of Oil Pier-2	1,500	1,500	0	0	400	400	400	300	0
KPT03	Development of a Cargo Villaon KPT Estate	32,700	6,300	0	26,400	11,000	11,000	10,700	0	0
KPT04	Construction of Deep Draught Berths at Keamari Gro	48,600	30,600	0	18,000	16,000	16,000	16,000	600	0
KPT05	Procurement of Anchor Hoist Vessel	258	258	0	0	258	0	0	0	0
KPT07	Procurement of self propelled Water Berge	120	120	0	0	0	120	0	0	0
KPT08	Container Terminal at Berths 6-9	4,500	0	0	4,500	1,500	1,500	1,500	0	0
KPT09	Setting up of Dry Bulk Cargo Handling Terminal	1,800	0	0	1,800	0	0	900	900	0
KPT10	Construction of Port Tower Complex	40,000	0	0	40,000	10,000	10,000	10,000	10,000	0
KPT11	Setting up of Desalination Plant	3,687	0	0	3,687	1,000	1,000	1,000	687	0
KPT13	Procurement of Trailor Suction Hopper Dredger	3,616	3,616	0	0	3,616	0	0	0	0
KPT14	Container Terminal at Berths 28-30	3,300	900	0	2,400	1,100	1,100	1,100	0	0
	Sub-total	140,261	43,474	0	96,787	45,054	41,120	41,600	12,487	0
Gwdar Port										
GP01	Gwadar Deep Sea Port, Phase-I	3,870	3,250	620	0	3,870	0	0	0	0
GP02	Gwadar Deep Sea Port, Phase-II	35,600	32,600	3,000	0	8,900	8,900	8,900	8,900	0
	Sub-total	39,470	35,850	3,620	0	12,770	8,900	8,900	8,900	0
Total		195,518	83,036	3,620	108,862	60,866	53,740	55,245	25,667	0

* Self Financing/ Corporation

Source: MTDF, JICA Study Team

Table 11.2.4 List of Short-Term Projects (Air)

Rs. Million

PTPS Code	Project Name	Short-term Cost (2006/07-2009/10)								After 2009/10
			Funding			Yearly Allocation				
			PSDP/ Self Fin*	Loans	Private	06/07	07/08	08/09	09/10	
Air Security Force										
ASF01 -ASF06	Construction of barrack accommodation at airports	43	43	0	0	23	20	0	0	0
ASF07	Security up-grade plan at all airports	1,203	1,203	0	0	300	300	300	303	0
	Sub-total	1,246	1,246	0	0	323	320	300	303	0
Civil Aviation Ahthority										
CAA01	New Islamabad International Airport	12,800	116,450	0	6,600	3,200	3,200	3,200	3,200	0
CAA02	Training	25	25	0	0	10	5	5	5	0
CAA03	Procurement of ATC simulator (Radar / Non-Radar)	260	260	0	0	260	0	0	0	0
CAA04	Introduction of future air navigation system(CSN/ATM	300	300	0	0	300	0	0	0	0
CAA05	Technical and support equipment for operations	700	700	0	0	0	200	200	100	0
CAA06	New air Terminal Complex and allied works at Lahore	390	390	0	0	390	0	0	0	0
CAA07	Rehabilitation / Widenning of old main R/W at JIAP	800	800	0	0	400	400	0	0	0
CAA08	Runways, Taxiways and Apron report cycle at Airport	500	500	0	0	200	100	100	100	0
CAA09	Expansion of Terminal Infrastructure at Airports	500	500	0	0	200	100	100	100	0
CAA10	Procurement of Fire Crash tenders for Airports	300	300	0	0	300	0	0	0	0
CAA11	replacement of Medium Fire Crash Tenders	120	120	0	0	120	0	0	0	0
CAA12	Installation of AFL System	130	130	0	0	130	0	0	0	0
CAA13	Misc. Equipment	55	55	0	0	0	55	0	0	0
CAA14	Other Operational works at all Airports	408	408	0	0	0	0	200	208	0
CAA15	Upgradation of Gwader Airports	150	150	0	0	0	150	0	0	0
	Sub-total	17,438	121,088	0	6,600	5,510	4,210	3,805	3,713	0
Air Lines										
AL01- AL06	Purchase of aircrafts & infrastructure by PIA	109,850	109,850	0	0	27,460	27,460	27,460	27,470	0
AL07	Purchase of aircrafts by private sector	6,600	0	0	6,600	1,650	1,650	1,650	1,650	0
	Sub-total	116,450	109,850	0	6,600	29,110	29,110	29,110	29,120	0
Total		135,134	232,184	0	13,200	34,943	33,640	33,215	33,136	0

* Self Financing/ Corporation

Source: JICA Study Team

11.2.3 PTPS Priority Projects

The PTPS Priority projects selected for the next stage of MTDF (or in parallel with MTDF) in view of their contribution to the national economy are:

- Capacity Expansion of Karachi – Lahore Railway Corridor;
- The Second Khohat Tunnel;
- M-13 (Lahore – Sialkot Motorway) Construction;
- M-16 (Hyderabad –Nawabshah – Khaipur Desert Road) Construction;
- Murree – Muzaffarabad Road Improvement;
- Bridge Construction in Punjab;
- Karachi Southern Bypass ;
- Qasim Port Access;
- Lahore Strategic Peripheral Route Development;
- Lahore Multi-modal Terminal Construction;
- Bypass Construction

It is recommended to carry out feasibility studies and make implementation program for these project as soon as possible.

(1) Capacity Expansion of Karachi – Lahore Railway Corridor

Reform of Pakistan Railways is essential to achieve the desirable modal share between road and rail, and the capacity expansion of railway between Karachi and Lahore is the most important step for the reform. Upgrade of signalling system is the major component of the project, and the total cost for signalling system component is estimated at about US$ 240 million.

(2) The Second Kohat Tunnel Project

According to the Corridor Analysis, Peshawar-Kohat Corridor needs two 2-lane roads or one 4-lane road by 2015, which means that Kohat Tunnel (2-lane) will face continuous congestion unless capacity of the corridor is expanded. Since there is no alternative route for this corridor, it is necessary to expand the capacity of Kohat Tunnel. The construction cost is at about US$125 million in rough estimation.

(3) M-13 (Lahore – Sialkot Motorway) Construction

Sialkot, Gujranwala, and Gujrat form an industrial triangle having the Export Processing Zone (EPZ), the Sialkot Dry Port Trust, and the Sialkot International Airport (SIA) that was developed on Build, Own and Operate basis. SIA is scheduled to open by June in 2006. A huge traffic demand is expected between Lahore and Sialkot in the near future, but the existing Lahore –Sialkot route has one of the most congested sections of N-5 between Lahore and Gujranwala. A Motorway was proposed in PTPS to connect Lahore and Sialkot. The construction cost is about US$ 325 million in rough estimation.

(4) M-16 (Hyderabad –Nawabshah – Khaipur Desert Road) Construction

N-5 runs in Sindh connecting major cities and play an important role in forming a regional corridor in the east of River Indus. On the other hand, N-5 carries a large number of inter-provincial and long-distance traffic for Karachi – Lahore and Karachi – Islamabad. The demand-supply analysis found out the desirable route between Hyderabad and Khaipur that can connect the north and south of Sindh in a shorter distance at high speed. The length of M-16 is about 287km and the total cost is estimated at about $US 278 million.

(5) Murree – Muzaffarabad Road Improvement

The earthquake of magnitude 7.6 in October 8, 2005 left devastating damages to the northern region in Pakistan. Reconstruction of infrastructure in the damaged area became an important issue for regional development. Especially, improvement of Murree-Muzaffarabad Road is very important to support the reconstruction of the regional economy damaged by the earthquake.

(6) Bridge Construction in Punjab

Development of cross river transport is one of the key components of road sector in PTPS. Several bridges were proposed by Punjab Province and evaluated in PTPS. They are: i) three bridges over River Chanab at Garh Maharaja, Head Mohammadwala, and Chund; ii) two bridges over River Jhelum at Gatalian Mirpur, Malikwal – Pind Dadan Khan, iii) four bridges over River Ravi at Qutab Shahana, Syedwala, and Lahore – Shahdrah, and iv) a bridge over River Sutlaj to link Chistian Burewala Road. It is necessary to set priority for these bridges and the nationwide O/D matrices and the demand forecast model produced in PTPS can be used to carry out the scenario analysis.

(7) Karachi Southern Bypass

In the medium growth scenario, import will increase 2.9 times in 20 years and export at 3.4 times. Although the most of the cargos from Karachi should be carried by rail in the future, there will still remain the necessity to provide a bypass route for not only trucks but also cars because of increase in traffic demand in Karachi. The Karachi Southern Bypass will connect Karachi Port and Qasim Port in the total length of 37.5km. The total cost US$ 250 million.

(8) Qasim Port Access

The Super Highway (M-9) and N-5 is connected by a narrow 2-lane road on which traffic volume amounts to about 3,000. Of the total traffic, trucks account for 80% and the total PCU is calculated at 7,800. Since this is the important access route between Port Qasim and the Super Highway.

(9) Lahore Strategic Peripheral Route Development

Lahore is the most congested bottleneck for transport of GT Road – Wahgha border with India, Wahgha border – the southern section of N-5, and N-5 itself. The Master Plan stressed the importance of bypass projects for national transport. This project will form a circular road of Lahore to solve the bottleneck. Since Lahore is growing rapidly and expanding the urbanized area, this road should be constructed as soon as possible. The total cost is estimated at about US$ 389 million.

(10) Lahore Multi-Modal Terminal Construction

Lahore is one of the most important transfer points for rail-to-truck, truck-to-tuck and rail-to-rail transfer points, and the regional centre for freight distribution. Although there are dry depot of Pakistan Railways and truck terminal of National Logistic Cell (NLC), it will be difficult to handle the future demand at these terminals. The Master Plan proposes to construct a multi-modal freight terminal along the Lahore Strategic Peripheral Road. The total cost is about US$150 in rough estimation.

(11) Bypass Construction

PTPS emphasized the important to eliminate bottlenecks of transport and identified 19 cities where bypass construction is required. Since urbanization is rapid in Pakistan, it is necessary to make a master plan of bypass project for the major cities as soon as possible.

Chapter 12. ROAD RESTORATION IN AJK AND NWFP

12.1 Earthquake

On the morning of October 8, 2005, an earthquake of magnitude 7.6 on the Richter scale struck South Asia (10.8 earthquake), and left devastating damages to the northern regions of the Azad Jummu and Kashmir (AJK) and the North-West Frontier Province (NWFP). Numerous private houses and public buildings were flattened and many social and economic infrastructures were damaged or destroyed. It was reported that more than 73,000 people were killed, 70,000 people were injured, 2.8 million people were displaced without shelters and more than 1.6 million people are not provided with enough food. There was concern that the living condition of the people in the affected areas would become severe in the coming harsh winter.

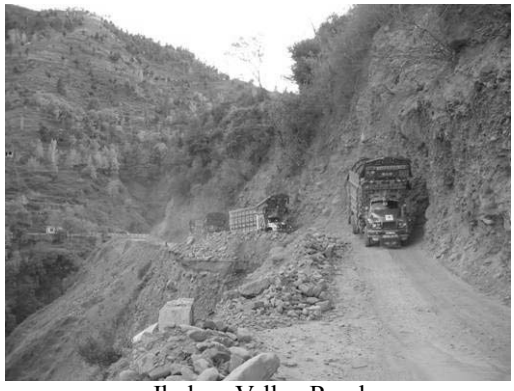
The Preliminary Damage and Needs Assessment by ADB and the World Bank (October 24 - November 5, 2005) estimated the overall cost associated with the earthquake at US$ 5.2 billion, which includes the estimated costs of relief, livelihood support for victims, and reconstruction. The donor conference held on November 19, 2005 in Islamabad pledged US$ 5.8 billion, US$ 0.6 billion more than the estimated overall cost.

Major damages in transport sector were to the mountainous roads in AJK and NWFP, largely due to landslides and slope failures. The intensity of damages varies, which can be categorized to the following types according to the above Preliminary Damage and Needs Assessment: (i) major landslides causing loss of an entire section of mountain slope and the road traversing through it, (ii) minor landslide depositing a large amount of debris on the road and the mountainside remaining unstable, (iii) flow of debris including large boulders on the road, (iv) severe cracking in the road structure due to embankment failure and upheaval of earth, and (v) unstable mountainside slope that may potentially lead to a landslide. Bridges were also affected by the earthquake, but the damages were not extensive.

Also, according to the Preliminary Damage and Needs Assessment, the damage to the road network in AJK and NWFP was estimated as follows (refer to Table 12.5.1):

1) In the three affected districts of AJK, Muzaffarabad, Poonch and Bagh, it is estimated that about 2,366 km roads were damaged. Of this, 203 km were major roads, 761 km were other paved roads, and 182 km were unpaved roads for a total of 1,146 km representing 45% of the total PWD-managed roads. Among major roads, two primary arteries in AJK, the Neelem Valley Road and, to a lesser extent the Jehlum Valley Road were severely damaged. Another 1,220 km of local unpaved roads developed with community participation and managed by LGRD were also damaged. This represents 44% of the total LGRD roads in the affected districts. The associated damage in AJK is estimated as Rs. 9,190 million.

Neelum Valley Road at Kohori



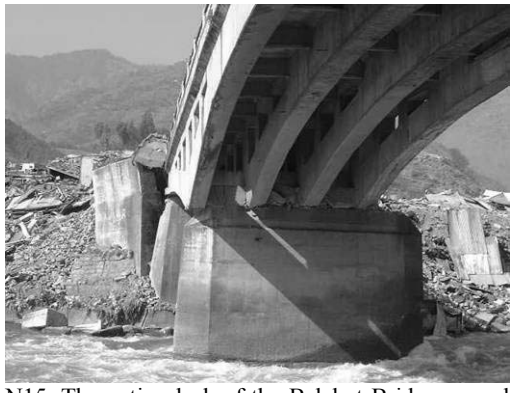
Jhelum Valley Road

2) In NWFP, about 2,063 km roads were damaged, representing 31% of the total road network in the five affected districts of Abbotabad, Battagram, Kohistan, Mansehra and Shangla. Of this, 652 km are provincial highways managed by FHA, 1,016 km are other paved provincial roads managed by the districts, 367 km are unpaved district roads, and 27 km are urban roads managed by municipal agencies. Estimates of the associated damage in NWFP are to the tune of Rs. 7,494 million.

Large scale slope failure on provincial highway in NWFP, Shinkiarai - Nawaz Abad Road in Mansehra District

3) The three national highways, damaged by the earthquake include Mansehra - Pattan (N35), Mansehra - Naran (N15) and Kohala - Muzaffarabad (N75). The damaged length is about 194 km representing 72% of the total length. Estimates of associated damage to the national highways are Rs. 3,481 million.

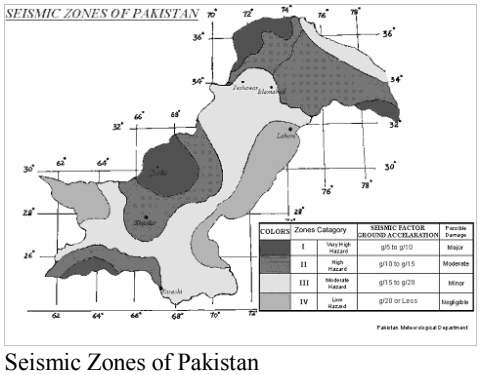
N35: Collapsed roadway by landslide



N15: The entire deck of the Balakot Bridge moved about 1 m downstream side

The earthquakes and active faults in northern Pakistan and adjacent parts of India and Afghanistan are the direct result of the Indian subcontinent moving northward and colliding with the Eurasian continent. However, the above situation of the vulnerability of the road network to earthquakes is not a problem in the northern regions alone, but is common to all Pakistan. According to the map of Seismic Zone of Pakistan prepared by the Pakistan Meteorological Department, the affected area is categorized as "II. High Hazard" zone and possible damage is "Moderate", while the north-eastern region of NWFP, central area including Quetta, and the coastal area of Balochistan are categorized as "I. Very High Hazard" zone and the possible damage is "Major". In this sense, the lessons obtained from the 10.8 earthquake should be reflected for future strengthening of the road network in Pakistan.

Although the present master plan study is not intended to analyze the earthquake damages and restoration measures in detail, the Study Team members had a chance to visit the Jhelum Valley Road and understood the vulnerable situation of the road. This following sections summarize the damages observed and discusses the direction for restoration of the Jhelum Valley Road and strengthening of the road network in Pakistan.



Seismic Zones of Pakistan
Source: Pakistan Meteorological Department

12.2 Damages on the Jhelum Valley Road

1) Jhelum Valley Road

The Jhelum Valley Road is a 57 km long mountainous road running on the left bank of the Jhelum Valley River. It starts from Muzaffarabad, the capital of AJK, runs easterly passing through towns of Garthi Dopata, Hattian Bala, Chinari, and reaches Chakothi near the Line of Control (LoC). It functions as a lifeline in this region without any alternative artery. This is one of the routes where bus operation was agreed as part of Confidence Building Measures (CBMs) by summit level diplomacy between Pakistan and India. A fortnightly bus operation has started on this route connecting Muzaffarabad with Uri and Srinagar in India.

The road runs along the Jhelum Valley with continuous curves. The carriageway width is 5 m paved, with 1-1.5 m wide shoulders on both sides. In Muzaffarabad - Garthi Dopata section, the road formation is about 10 m above the river bed. It gradually increases in altitude and is located 40-50 m above the river bed in the east of Hattian Bala. The valley side is high cliff and stone masonry walls are constructed in many sections. Guard blocks, guide posts or guardrails are installed along the shoulder edges mostly. The hill side slopes are high and steep, 1:0.3 to 1:0.5 in grade, which are mostly unprotected. Slope protection works of gabions and stone masonry walls are observed in very limited sections.

Standard section, 5 m carriageway and 1-1.5 m shoulders

2) General Geological Setting

The Jhelum Valley Road is constructed by cutting through high and steep mountain slopes or cliffs of rocks or river terraces of the Jhelum River.

The geology of the area is composed mainly of sandstone and intercalated with thin shale bed, which is overlain locally by river terrace and talus. The river terrace sediments contain great quantities of rounded boulders, mostly 10 to 50 cm in size and occasionally 2 meters or more. The talus sediments are distributed locally on the hill slopes to a depth of 1 to 5 meters.

Scars and deformation of landslides are observed on many mountain slopes.

3) Landslide on hillside slopes triggered by the 10.8 Earthquake

The 10.8 Earthquake triggered numerous landslides. These landslides caused a severe damage to the roads by landslide or blockage. The main landslide damages are of three types; i) soil collapse, ii) rock mass collapse, and iii) slide. Their characteristics and some recommendations for hazard mitigation are described below.

a) Soil Collapse

Situation

Soil collapses occurred mostly on the steep cliffs of river terraces. These cliffs are approximately 50 to 100 meters in height with a slope angle of 70 to 80 degrees. Some open vertical cracks about 20 to 30m long and 2 to 5 cm wide, are observed on the collapsed cliff face.

Soil Collapse

The river terrace sediments are very hard, with natural faces that are nearly vertical, as observed on the stable cliff around the collapsed cliff. The river terrace sediment contains large amount of rounded rock blocks of about 10 to 50 cm in size and a matrix of clay, silt and sand.

Occurrence Mechanism

The soil collapses on the cliff were probably attributed to the tensional and open cracks whose openings were further increased by the shaking of the 10.8 Earthquake. The tensional and open cracks may have originally arisen from stress releases along the road as a result of road slope cut or stream incision.

On-going Hazard

The cracked areas on the cliff faces are likely to collapse again in future earthquakes and heavy rainfalls. Further, some big boulders that were loosened by the shaking of the 10.8 Earthquake are very likely to fall down under the force of gravity or triggered by another events. If these loosened boulders fall down, they will severely damage any structures or people they hit.

Recommendations for hazard mitigation

The unstable parts, including the cracked areas and loosened boulders on the cliff faces should be removed. If economically feasible, the cliff faces around the collapsed area should be excavated to a slope of 1:0.5 in order to remove load from the viewpoint of safety design and maintenance.

b) Rock Mass Collapse

Situation

Small rock mass collapses and unstable rock mass are also one of the main landslide types along the Jhelum Valley Road. They mainly occurred on the steep cliffs of sandstone and shale outcrops with a volume of 10^2 to 10^4 m. The sandstone in which these rock mass collapses have occurred is strongly jointed and cracked by two intersecting discontinuities; one is horizontal and the other vertical. After rock mass collapses, the exposed sandstone is mostly deteriorated into CL class and locally into D class rock mass, and the shale is weathered into D class rock mass.

Rock Mass Collapse

Occurrence Mechanism

The rock mass before the collapse was strongly fractured and weathered. Its occurrence probably starts from topple collapse on the lower port of the hillslope immediately above the road and develops into a rock mass collapse. The 2005 earthquake is the main triggering factor causing the rock mass collapses.

Ongoing Hazard

On the basis of the field inspection, large-scale rock mass collapse along the Jhelum Valley Road was considered to be much less likely to occur because of the exposed CL class or higher class rock mass. However, some rock fall, minor rock mass collapse around the collapsed areas may take place during and/or after earthquake or heavy rainfall. These collapses are small in volume, but they will cause considerable damage to road facilities and local people.

Recommendations for hazard mitigation

The loosened and unstable rock blocks should be removed; some large cracks should be filled with mortar or concrete.

The exposed rock mass face should be covered by mortar spraying work to prevent from further weathering and fracturing.

Some large and steep rock slopes, if unstable or potentially unstable, should be stabilized by using rock anchor.

c) Slide

Situation

Six slide areas were identified along the Jhelum Valley Road. These slides are mainly distributed on the gentler hill slopes of 20 to 40 degrees and have a width of 150 to 400 meters.

Slide

In these slide areas, road surfaces and road shoulders are cracked and collapsed due to slide movement. The road surface is depressed but has not totally failed. Some continuous and open cracks, 5 to 50 cm wide are observable around most of the sides and heads of these slide areas. On the hillslopes immediately above the road, small collapses are also visible.

The slide areas are underlain by sandstone and shale as well as the overlying soil layer of 2 to 5 m in thickness.

Occurrence Mechanism

These slides seemed to be old slides and were reactivated by the 2005 earthquake. Because they were old slides, pre-existing sheared or weakened planes (sliding planes) are present in these slides. The earthquake shaking pushes out the unstable parts above the sliding plane and also leads to reduced strength of the sliding plane by liquefying it if underground water exists around the sliding plane.

Ongoing Hazard

These slides are, as a whole, less likely to move out in the near future, however, if no action is taken to stabilize them, they will move continuously and long with small triggers of earthquakes and rainfalls. Further, because open cracks are extensively developed in the slide areas, infiltration of surface water and rainfall into the sliding planes will lead to increased pore water pressure and reduced strength of the sliding planes, thereby reducing the stability of the slide areas, consequently causing the whole slide areas to slide down.

In the worst case, on sliding down, the upper slopes may become unstable.

d) Recommendations for hazard mitigation

Private houses within these areas should be moved into safe places.

Detailed geological investigations should be carried to define the scale of these slide areas and to clarify their occurrence mechanism.

Moreover, conceivable measures for these slide areas are as follows:

- Cutting at the head portion
- Filling combined with retaining wall at the foot portion

- Filling the open cracks with clay
- Surface drainage
- Ground anchor and pile works

Damages on valley-side slopes

On the valley side, collapse of stone masonry wall is a major cause of failure. Due to collapse of walls, shoulders or even carriageway fell down for nearly one-fourth of the entire length of the Jhelum Valley Road.

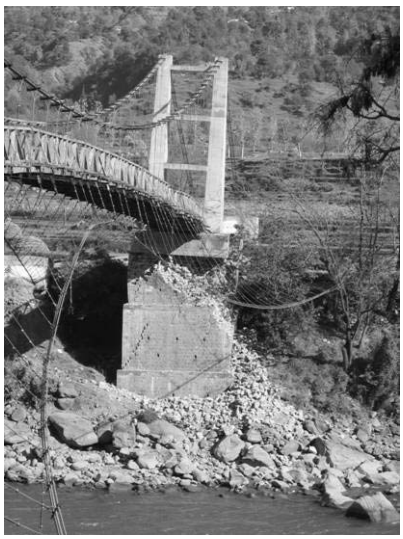

Collapsed stone masonry walls


Failure of one-lane width on valley side

5) Damages on bridges and structures

There are 13 bridges along the main Jhelum Valley Road to cross the rivers that flow into the Jhelum Valley. The length of these bridges rages from 10 m to 55 m. Long bridges are PC girder bridges (there are two 2-span bridges which uses PC girders for longer span and RC girders for shorter span), and short bridges are RC girder, RC slab and stone masonry arch bridges. Among the 13 bridges, four were seriously affected by the earthquake and require reconstruction or major rehabilitation. In addition, the Naily bridge, 40 m long PC girder (4 girders) located about 40 km from Muzaffarabad suffered damage. Half of the superstructure was moved 30 cm in a lateral direction, and the unmoved one-lane width is utilized at present. Though it is judged possible to bring the moved part back to the original position by jacking-up since no serious damage is observed to the structure itself, this damage could be negated if the four girders could be tightened by transverse prestressing and if stoppers to prevent the bridge from falling are constructed.

Besides the bridges on the main route, suspension bridges are spanned over the Jhelum Valley to connect to villages on the opposite bank. They have 3 m wide wooden deck and are basically for pedestrian use, though very light vehicles are permitted to pass. By the 10.8 earthquake, one bridge fell down completely, one bridge is on the verge of falling-down, and the decks of two bridges are twisted.


Suspension bridge over the Jhelum Valley, on the verge of falling down

The main damage to the bridges and structures caused by the 10.8 earthquake is collapse of stone masonry structure. Stone masonry is, by nature, of low quake resistance. Added to this, the stone masonry structures on the Jhelum Valley Road seem to have insufficient bonding cement mortar in quantity and strength and have no resistance to strong quakes. There was no serious damage to the abutments of RC bridges, while almost all stone masonry abutments collapsed, resulting in entire bridge failure.

Collapsed stone masonry abutments of Subri Bridge, 6.6 km from Muzaffarabad

For some bridges, the stone masonry walls on the approach embankment collapsed, which limits vehicle passage even though the bridge structure itself suffered no damage.

Damaged bridge approach

12.3 Guideline for Restoration of the Jhelum Valley Road

Since the Jhelum Valley Road is the sole regional artery, its restoration is urgent. However, the valley side shoulders have collapsed, or are at great risk of falling down in many locations, so restoration to secure full 2-lane width with sufficient shoulders is quite difficult to complete in a short time. Meanwhile, it is planned to federalize the Jhelum Valley Road and NHA considers its widening in accordance with the national road standard (7.3 m wide carriageway plus wider shoulders). To realize this, it is necessary to widen the road to the hillside by at least 4-5 m, but the cuttings should be quite high and undertaking construction while keeping the road open to traffic is not easy. Considering the huge investment required for protection of the cut slopes and additional land acquisition, stage-wise restoration and widening should be a realistic program.

It is considered appropriate to restore the Jhelum Valley Road in the following order of priority.

First Priority

1) Securing safe vehicle passage

Securing trafficability is not just a matter of economic feasibility, but essential and urgent measure to maintain the lifeline for the villagers living in the areas along the Jhelum Valley Road.

After the earthquake, the army endeavoured to remove debris which covered the road surface in order to secure traffic, but there are sections where only one-lane passing width has been marginally secured. It is anticipated that the slopes jolted by the 10.8 earthquake would further fail after rainfall and snowfall. Continual maintenance works will be required, including periodical patrols to monitor the road condition. Provision of sufficient maintenance equipment is required. Even before the 10.8 earthquake, the Public Works Department (PWD) had a difficulty to maintain the roads under its responsibility because of a shortage of serviceable equipment. The required types and

number of maintenance equipment should be reviewed as early as possible and be provided.

One-lane width section should be permitted partially, with provision of emergency parking space for to allow vehicles to pass each other at appropriate intervals and deployment of traffic controllers as required. Temporary detours should be constructed if necessary.

2) Securing access to the villages on the opposite bank

Reconstruction of damaged suspension bridges over the Jhelum Valley is urgently needed to save the villages from isolation. It is estimated that approximately 200,000 people are living in the northern areas of the Jehlum Valley Road, and suspension bridges are really a lifeline for their living.

3) Reconstruction of seriously damaged bridges

Reconstruction of seriously damaged bridges causing bottlenecks should have a higher priority. New bridges should be constructed with 2-lane width, since it is difficult to widen the bridges at a later stage.

4) Investigation of the road conditions

Along the entire length of the Jhelum Valley Road, the road conditions, stability of the roadside slopes in particular, should be investigated from the viewpoint of disaster prevention. The results should be compiled in a hazard map to be utilized for maintenance and planning of further reinforcement of road structure.

Second Priority

5) Treatment of slide areas

As explained earlier, six slide areas are identified along the Jhelum Valley Road. Though these slides are less likely to move out in the near future, detailed investigations and studies are required to evaluate the risks of further movement. Necessary measures should be taken, since further movement might lead to total failure and long time closure of the roadway.

6) Engineering study of road structure

An engineering study should be undertaken focusing on the safety and reliability of road structures. The strength of the present structure should be checked. Slope protection works appropriate to the topographic and geotechnical conditions of the Jhelum Valley Road should be introduced through deliberate study and taking economical feasibility into account.

7) Feasibility study for securing 2-lane road

Full restoration of the Jhelum Valley Road to the national highway standard requires a vast investment. Appropriate standards should be studied, the balance between investment and maintenance effort should be discussed and agreed among the stakeholders, and the most appropriate solution should be proposed.

12.4 Related Recommendations for Road Network Development

Roads are one of the most important lifelines, particularly when disaster occurs. By the 10.8 earthquake, the vulnerability of the Pakistan road network has become apparent in many areas. In preparing a plan for road network development, considerations should be given to increasing the reliability of the network against earthquake disasters. To minimize damages when disasters occur, rather than to prevent damages completely, should be a general guideline. In this sense, it is worthwhile referring to the practices in Japan, which is a quake prone country where 21% of the world's large scale earthquakes (more then M6.0) occurs.

1) Redundancy - network effect

One of the serious problems after a quake is the isolation of towns and villages, caused by severed roads. Reinforcement of the road network by providing alternative routes increases redundancy by the network effect. More attention should be given to the road network in mountainous regions where provision of sufficient alternative routes is difficult, and thus, where the reliability of the network of limited links is more important. The roads like those connecting the Jhelum Valley Road and the Neelum Valley Road need to receive more attention in this sense.

2) Quake resistant structures

Most of structures seriously damaged or collapsed by the 10.8 earthquake are stone masonry. Stone masonry is less quake resistant and should not be used for the important structure as bridge abutment. It is recommended to check all the bridges on the arteries and prepare a program to replace stone masonry abutments to RC structures to increase their quake resistance.

The related recommendation is to install stoppers to prevent bridges from falling on the major bridges along arteries. Some of the Japanese practices, which were standardized after the Kobe earthquake in 1995, are presented below for reference.

3) Slope protection works

For road construction in the mountainous regions, high cuttings and embankments are inevitable. Though slope protection works are not much introduced in Pakistan except for widely used stone masonry for river side walls, it is considered necessary to pay more attention to slope protection to increase stability against slope failure. Typical structures applicable to the conditions of the Jhelum Valley Road are listed below.

- Vegetation
- RC retaining wall
- Mortar spraying
- Cast-in-place concrete crib works
- Rock bolts
- Rock fall prevention fence (or net)
- Reinforced earth wall
- Anchor work
- Pile work

12.5 Restoration of Bridges on the Jhelum Valley Road as a Pilot Project

JICA decided to restore the damaged bridges on the Jhelum Valley Road in the framework of the present study as a pilot project. The candidate bridges are listed below:

No.	Bridge Name	Location (from Muzaffarabad)	Existing Bridge	
			Type	Length
1.	Subri	Km. 6+600	RC girder	18 m
2.	Tundali	Km. 10+100	Masonry Arch	28 m
3.	Seri	Km. 31+200	RC slab	11 m
4.	n.a.	Km. 41+300	Culvert (RC slab)	4 m (opening)
5.	Kucha	Km. 42+600	Masonry Arch	4.5 m (opening)

Topographic survey and geotechnical investigations for the design of new structures were commenced in early January 2006. The construction is expected to start in coming May 2006.

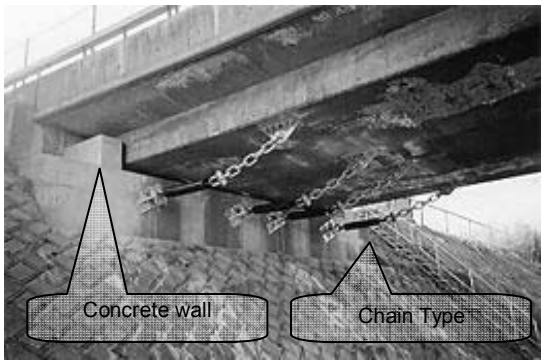
Examples of measures for bridge falling prevention in Japan

Purpose

To prevent bridge falling by limiting girder displacement during an earthquake

Chain connection between substructure (abutment) and superstructure and provision of concrete walls on bridge seat

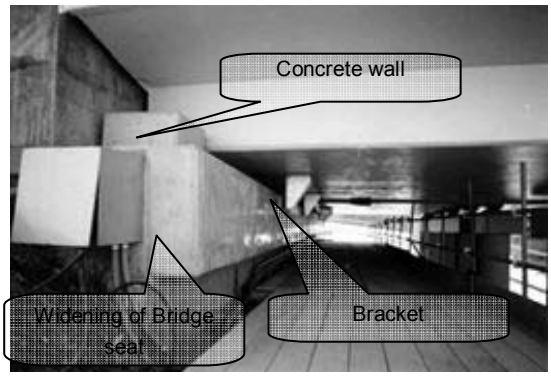
(Before)



(After)

Provision of salience on under surface of substructure or bridge seat of superstructure.

(Before)



(After)

Widening of bridge seat (on pier) to prevent the superstructure from falling down when a large relative displacement occurs between superstructure and substructure.

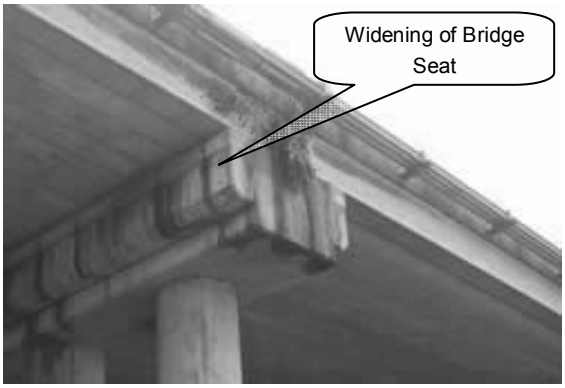


Table 12.5.1 Road Damages

(Quoted from the Preliminary Damage and Needs Assessment by ADB and the World Bank)

Summary of Road Damage in AJK

Agency		PWD			LGRD	Total
Type of Road		Major	High	Low	Low	
Muzaffarabad	Total Length (km)	156	748	323	978	2,205
	Damaged Length (km)	83	396	171	587	1.237
	Damage Cost (PRs Million)	668	2.522	282	956	4,630
Poonch	Total Length (km)	167	523	12	983	1,685
	Damaged Length (km)	65	204	5	393	667
	Damage Cost (PRs Million)	423	2.224	11	590	2,247
Bagh	Total Length (km)	154	446	16	799	1,415
	Damaged Length (km)	55	161	6	240	461
	Damage Cost (PRs Million)	638	1,172	23	479	2,312
Total	Total Length (km)	477	1,717	351	2,760	5,205
	Damaged Length (km)	203	761	182	1,220	2,366
	Damage Cost (PRs Million)	1,729	4,918	517	2,026	9,190

PWD: Public Works Department, LGRD: Local Government & Rural Development Department
Major: Main highways, High: Paved roads, Low: Earthen/shingled roads.

Summary of Road Damage in NWFP

Agency		FHA		W&S/DC		MC		Total
		Provincial Highways	Secondary Highways	Access Roads		Urban Roads		
Type of Road		High	High	High	Low	High	Low	
Abbottbad	Total Length (km)	58	230	560	949	123	21	1,940
	Damaged Length (km)	5	29	255	0	15	3	306
	Damage Cost (PRs Million)	43	186	511	0	76	5	821
Battagram	Total Length (km)	103	108	88	54	0	0	354
	Damaged Length (km)	43	99	88	54	0	0	284
	Damage Cost (PRs Million)	366	645	260	68	0	0	1,338
Kohistan	Total Length (km)	27	127	161	317	0	0	632
	Damaged Length (km)	6	40	142	208	0	0	396
	Damage Cost (PRs Million)	51	261	419	260	0	0	991
Mansehra	Total Length (km)	253	347	333	2,229	29	21	3,212
	Damaged Length (km)	31	298	333	0	5	4	671
	Damage Cost (PRs Million)	264	1,943	638	0	27	8	2,878
Shangla	Total Length (km)	107	93	213	105	0	0	519
	Damaged Length (km)	44	58	198	105	0	0	405
	Damage Cost (PRs Million)	374	376	584	131	0	0	1,465
Total	Total Length (km)	549	905	1,356	3,549	152	42	6,658
	Damaged Length (km)	129	523	1,016	367	21	6	2,063
	Damage Cost (PRs Million)	1.097	3,411	2,412	459	103	13	7,494

FHA: Frontier Highway Authority, W&S: Works and Services Department, DC: District Council, MC: Municipal Committee.
High: Paved roads, Low: Earthen/shingled roads.

Summary of Damage to National Highways

	N35: Mansehra - Pattan	N15: Mansehra - Naran	N75: Kohala - Muzaffarabad	Total
Total Length (km)	141	93	40	274
Damaged Length (km)	80	98	16	194
Damage Cost (PRs Million)	1,080	2.191	210	3,481