CHAPTER 9
STRATEGY FOR INTER-MODAL TRANSPORT BY RAILWAY

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Due to the advance of motorization in recent years, the volume of the commodities shipped by railway operators in each country has dropped drastically due to the shift from rail to road for land transportation. This has caused railway operators to face numerous managerial and financial issues. However, from 1990 on Indian Railways has been able to increase its volume of transported commodities. Indian Railways is an interesting case in that most of the railways in other countries have seen a reduction in the transport volume of commodities during the same time period. It is important to note that road development in India has been considerably slower than in other developing countries and the existing roads have not been capable of bearing the burden of the increased transport demand that has resulted from economic growth. However, it appears that the road infrastructure will be steadily developed in the years ahead. In other countries, the development of more sophisticated and diversified road transport services, such as door to door service, have been starting to meet customer needs.. As the upgrading of road transport is carried out in India, such road transport services will also begin to compete with railway transport in this country as well.

Road transport will be the competitor in the long-distance freight transport market targeted by DFC. Therefore, in the years ahead, if rail transport cannot compete with road transport, there is the risk that the use of rail transport will decline just as it did in other countries in the past.

A disadvantage of railway transport is that it cannot complete the entire transport route by itself. Road transport, on the other hand, can provide the door-to-door (customer-to-customer) service. Rail transport must make connections with other modes of transport (mostly to road transport) to complete the entire transport route. As the number of connections increases, so do the transport costs, transport time, manpower needs and transport uncertainties. It is imperative that rail operators address this weak link in their transport route and ensure that they can provide inter-modal transport service that can compete with road transport.

Railway transport has an undisputable economical advantage over road transport. The amount of fuel per tonne kilometre consumed by railway transport is significantly less than by road transport. Railway transport is also innately more efficient and environmentally friendly than road transport. Rail transport can compete with road transport if the weak point presented above – intermodal connections – can be overcome.

In this chapter a basic study will be carried out to identify the strategies and the requirements for fully securing a competitive advantage over road transport by using the transport capacity that can be obtained by combining the full utilization of the DFC in an efficient inter-modal transport system. On the Eastern Corridor, rail transport is the predominant mode of transport for the long-distance shipment of bulk cargo, such as coal or steel products. The Western Corridor of the DFC is used for transporting containers to and from the ports at the western coast. Here is where railway transport will face severe competition from road transport, which makes the implementation of an inter-modal transport system in cooperation with the ports and ICD as an urgent issue. Accordingly in this chapter the strategy of inter-modal transport by rail with particular regard to the container transport in Western Corridor will be studied.

9.1 PRESENT SITUATION OF LONG DISTANCE ROAD TRANSPORT

Road transport is the strongest competitor of rail transport in the Western Corridor. This section addresses the factors that affect road transport as a competitor of railway transport.

9.1.1 Problems of road transport

While the growth of railway transport volume has been slow in India, the volume of road transport has grown rapidly in recent years. New and improved roads along with the improved performance of trucks seem to have contributed to this trend. However, road transport has the following problems.

(1) Road conditions

India has an established network of roads and the demand for road transport has grown steadily. However, the roads themselves are often in poor condition with lots of cave-ins and potholes caused by problems in the base foundation of the pavement and the severe climate conditions. In addition, slow-moving horse carts, camel wagons and agricultural tractors also use the trunk roads, which reduces the running speed of the trucks and thereby reduces the transport capacity of these roads. It is important to note that under these conditions, trucks can not maintain high travel speeds for a long time.

(2) Fuel costs

Since India imports oil, fuel cost is one of the problems associated with road transport. The fuel consumption per ton-km for road transport is much higher than that for rail transport, causing the ratio of the fuel cost to the total transport cost to become higher.

According to a survey report issued by the JICA Study Team, the cost of fuel accounts for about 60% of revenue of long distance road transporter in India (See Table 9-1).

Table 9-1 Cost Ratio to Revenue of Long Distance Road Transporter

Item	Cost Ratio (%)
Fuel cost（35Rs/ℓ、4km/ℓ、325km/day）	58
Manpower and labor costs （2 drivers and 1 assistant）	17
Administrative expenses (repair costs, cost of insurance against loss, depreciation expenses, office work costs, and interest rate）	16
Profit (amount before taxes; corporate income tax is 40%, the net profit rate is 5%）	8

Source: JICA Study Team

(3) State tax

The states of India have their own independent authority similar to states in the United States. When trucks move across state borders they pay a state tax (*Octroi*) and a value added tax (V.A.T.) to each state. The JICA study team found that some states classify items differently with different tax rates (See Table 9-2).

It takes two hours on average to examine the freight and to collect the tax at each state border. When a truck travels to the adjacent state, it has to wait four hours on average for the tax assessment alone. The tax is a burden to shippers and the waiting time is a burden to transporters.

Table 9-2 List of Interstate Transit Documentation

Corridor	State	No.of Invoices	Need of LST,CST &TIN	Starting series of TIN No.	Type of Sales Tax Form/Road Permit	Entry tax	Octroi	Transit Pass Required for other states material	Other Information
W	Delhi	3copies	Yes	7	Not Required	No	No	Nc	
E	Haryana	3copies	Yes	6	Form 38	No	No	Nc	Incase value of materials is less than Rs.25000/- permit not required
S	Rajasthan	3copies	Yes	8	Form 18A	No	No	Yes	ST form 18B required for Govt parties
T	Gujarat	3copies	Yes	24	Form 402 for outgoing & Form 403 for incoming material	No	AHMD,BRD,BHR,JMR,RKT & SURAT	Yes	
	Maharashtra	3copies	Yes	27	Not Required	No	Yes	Nc	Value of material is required
E	Punjab	3copies	Yes	3	Not Required	No	Yes	Yes	
A	Haryana	3copies	Yes	6	Form 38	No	No	Nc	Incase value of materials is less than Rs.25000/- permit not required
S	Uttar Pradesh	3copies	Yes	NA	Form 31/32	No	No	Yes	Present Series of permit is FQQ&FRR almost every year the series will get changed.
T	Bihar	3copies	Yes	10	Form D9	No	No	Nc	Validity period to be checked & minimum 15 day remaining

*LST: Local Sales Tax CST: Central Sales Tax TIN: Taxpayer's Identification No.

9.1.2 Improvement of road transport

The road transport problems mentioned above increase the competitive position of railway transport. However, these adverse circumstances presently being experienced by road transport are expected to improve as outlined below. As a result, the growth rate of road transport volume will be faster than that of railway transport volume in the years ahead.

(1) Construction of expressways

The National Highways Authority of India (NHAI) is planning the construction of highways and expressways throughout India (See Table 9-3). The expressway, in principle, is

exclusively designed so that high-speed vehicles can travel smoothly. The construction of these highways and expressways will help to solve the road transport problems previously described.

Table 9-3 Planning of Highways and Expressways

Phase	Planning	Distance (km)	Cost (Crore Rs)
I & II	5,846 km long high-density traffic route connects India's Golden Quadrilateral. Development of the North-West Corridor and the East-West Corridor	13,000	42,000
III	Development of 11,530km of national highways	10,000	55,000
IV	Improving the condition of the remaining 20,000 km of national highways by reinforcing and/or widening to 2-lane roads	20,000	25,000
V	Widening of about 6,500 km of national highways to 6-lanes	5,000	17,500
VI	Construction of about 1,000 km of expressways	1,000	15,000
VII	Adding ring roads, additional fly-overs and bypasses	N.A.	15,000
	Total	49,000	169,500*

*Development costs are changed to 220,000 Crores
Source: Web site of National Highways Authority of India

(2) Mitigation of taxes

A national standard for CST (Central Sales Tax) and VAT will be implemented by 2010. In addition, when trucks travel along highways in and out of multiple states, the freight will be examined only once. It is expected that the examination of freight at state boundaries will basically be abolished.

9.2 THE PROBLEMS OF INTER-MODAL TRANSPORT BY RAILWAY

The lack of infrastructure has been the major reason for the decline of railway growth. If the railways had more transport capacity, they would be able to transport more commodities. The lack of the transport capacity is one of the reasons for the reduction of railway's share of the ground transport market. However, according to the report by the JICA study team, there are other reasons why customers avoid railway service (See Table 9-4).

According to the report, the railway provides poor service quality in the following three categories on the survey: (1) "It takes time to transport" (Not speedy), (2) "The arrival time cannot be estimated" (Not punctual) and (3) "Service is poor" (Not customer oriented). However, in comparison, the report did not indicate service problems for other survey categories, such as: "With damage" and "Not Cheap." This means that railway transport is a comparatively secure and a reasonably priced mode of transport. A new category of "Not customer oriented" was added to the survey, as there were a lot of suggestions from various quarters. In general, this category is not included in surveys in developed nations, but it was added to clarify the features of railway transport in India.

In the following section, the concrete problems facing railway transport will be presented. In Figure 9-1, the problems outlined above are shown using the scenario of a container being transported between a port and an inland container depot (ICD). This example will help to better clarify the problems faced. In addition, Figure 9-2 presents a diagram of the institutions comprising the JNP and the flow of a container in the JNP. JNP is the biggest container port in India and the biggest origin/destination of the containers for Western Corridor of DFC.

Out of the issues that are pointed out in Table 9-4, this section will address the improvement of the infrastructures of ports, roads and railways that are managed by authorities and institutions. These plans are shown in *Chapter 4 4.8*. Here problems of inter-modal transport other than the improvement of the related infrastructures will be studied.

Table 9-4 Problems by Nodes/Modes of Inter-modal Transport by Railway

Survey Item	Port	Container Yard、Rail Yard (Yard)	Rail Transportation(Rail)	Inland Container Depot(ICD)	Delivery (Truck)
It takes time to transport (Not Speedy)	**[P1]** Vessels may have to wait offshore more than ten days.	**[Y1]**A container stays several days even up to 10 days in the container yard. The total transport time becomes longer than for road transport alone.	**[R1]**It takes a lot of time for issuing SMTP and its transmission to the customs authority of destination.	**[I1]**Cargo work in the warehouses of ICD is done manually, so it is inefficient.	**[T1]** In urban areas, there are traffic restrictions on the movement of trucks. The delivery time for container trucks is limited.
	[P2] Vessels are ordered to go to another port due to congestion at the piers.	**[Y2]**It takes much time for loading containers at the RY. A RMG loads a container onto a wagon from a trailer truck along the rail side. The work is simple, but trailer trucks are crowding the area of the RY.	**[R8]** The lack of capacity for transportation on a port branch line and on a feeder line that connects to the trunk line frequently cause trains to be stabled in the marshalling yard.		
		[Y3]When the train with the containers for other port operator arrives, these containers are unloaded and transferred by original port operator. It takes a long time for unloading			
Arrival time cannot be estimated(Not punctual)		**[Y5]**Containers not loaded onto a train according to the order of the arrival at the port (i.e. first in, first out is not carried out). CONCOR cannot support the claim from a consignee because it is the port operator that transfers the containers to the RY, and loads them onto the wagons.	**[R2]**The containers to a small ICD will be stabled at the CY for a long time because a train to haul them will not be planned until there are a number of containers awaiting transport.	**[I2]**As arrival time cannot be identified, some customers must ask for custom clearance at a very late time. This is one of the major causes of the back log of containers in TKD.	
			[R3]The time table of freight trains is not made public and the train on which a container will be loaded is not decided beforehand.		
Service is poor (Not customer oriented)			**[R4]**Consignees must visit the HP of CONCR every morning to check the departure of their containers as the information of the container is not posted on a container information system of CONCOR until after a train departs	**[I3]** There is little storage space of the freight.	**[T2] It is difficult to arrange for a** high-quality truck forwarder.
			[R5] CONCOR tariffs are publicly announced so there is no room for the shipper to negotiate its fare individually.		**[T3]** The truck fleet is dilapidated and this leads to damaged loads.
			[R6]The arrival time to ICD for containers cannot be identified so the consignee must have more inventory than required in order to minimize risks.		
			[R7] Fare negotiations of an authorization fare are not possible		
Others				**[I4]**There are consignees who resell their cargo to their customers even before custom clearance.	

Abbreviations
RY : Railway Yard
CY : Container Yard
HP : Homepage
SMTP: Semi Manifest for Transport Permission
RTG: Rail Mounted Gantry crane
ICD: Inland Container Depot

The problems that can be solved by maintenance of infrastructure are shaded.

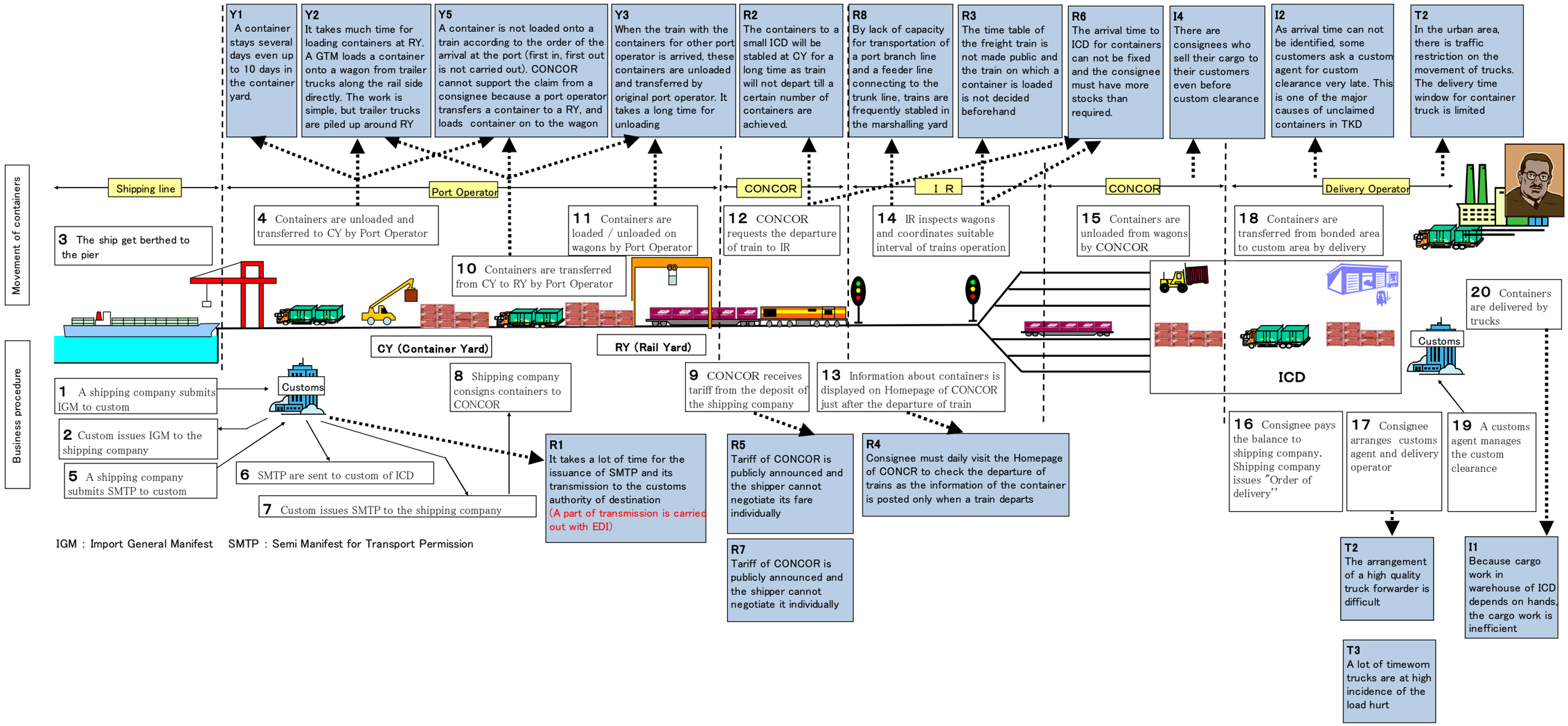


Figure 9-1 Major problems encountered during transport of international containers via rail from JNP to Delhi

Figure 9-2 Present Layout of Intermodal Transport from JNPT to Delhi

(1) Not speedy

The actual transport time required for rail transport from JNP to an ICD around Delhi is less than three days. According to a survey by the JICA Study Team, however, the total transport of a debarked container from a port to the ICD takes on average twenty one days and at minimum seven days (See Table 9-5).

Table 9-5 Transport Days of Debarked Containers from Port to ICD

Process	JICA Study Team			"N" Corporation *2	
	Honda*1	Project management team		Minimum	Maximum
		Minimum	Maximum		
From the unloading site to the port to starting the train at port ICD	2	7	12	7	12
Train travel time	2	2	3	2	4
Unloading at ICD and customs clearance	2	2	3	2	4
Delivery to a consignee	1	1	1	1	1
Total	7	12	19	12	21

*1: According to an interview with Honda Corporation
*2: According to an interview with a Japanese-affiliated "N" corporation (April, 2007)

The reasons would be inferred as follows:

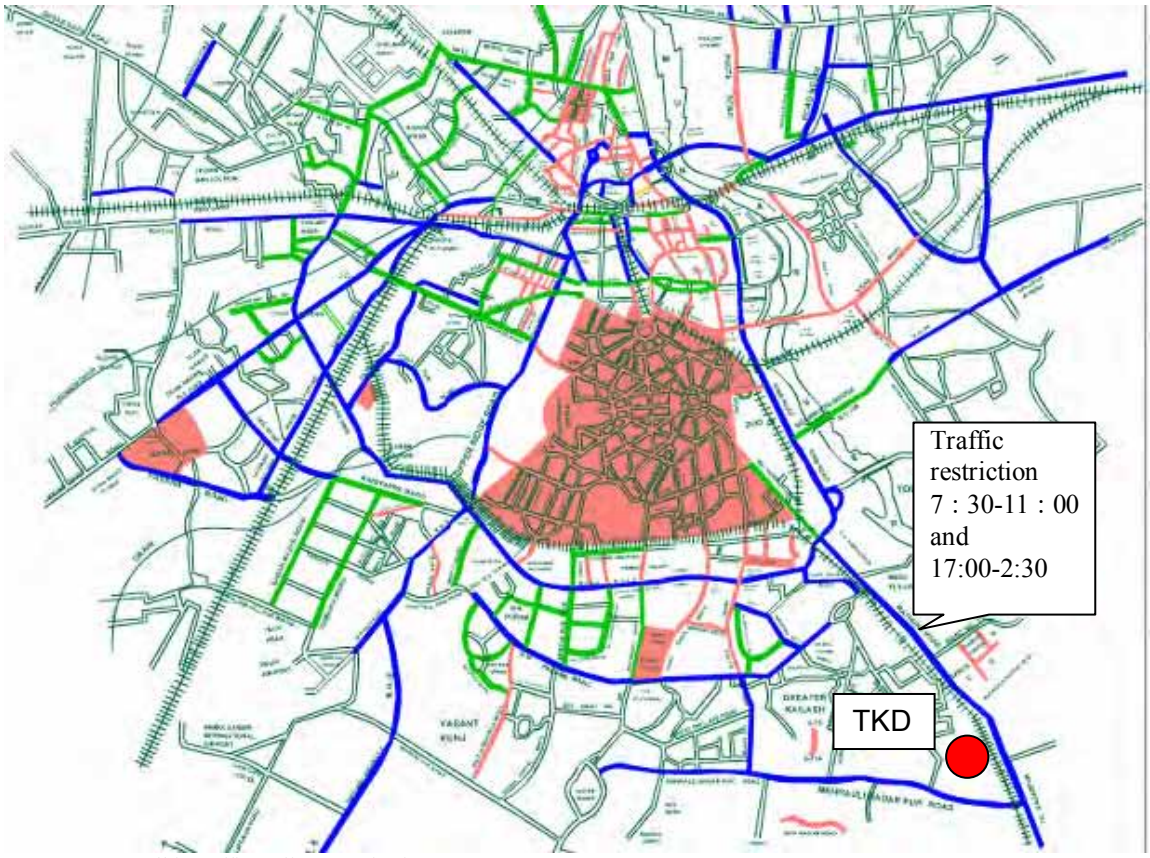
1) The first-in container is not necessarily the first one loaded onto a train at ports. This is because the ports have no system to distribute containers in order.

2) In the container yard, a debarked container from a vessel is directly loaded onto the trains using trailer trucks and gantry cranes. Because the areas around the handling loops in the rail yard are congested with the trailer trucks, more time is needed than would be expected for such simple activities.

3) When an international container is being transported by rail, the custom clearance is carried out at an Inland Container Depot and not at the port. (However, when a container is being transported by road, the custom clearance is carried out at the port) The Semi Manifest for Transport Permission (SMTP) is necessary for transporting an import bonded container to an ICD by rail. The SMTP is issued by a customs office at JNP to the shipping company after a customs officer at the destination ICD examines the freight. It therefore takes a lot of time to examine the freight and issue the SMTP. Issuance of the SMTP is now expected to become more efficient with the introduction of EDI.

4) Traffic restrictions, such as entrance restrictions in urban areas in the peak hours of morning and evening, make transport time longer (See Figure 9-3).

5) When there is mixed cargo, a port operator must wait until the other operators have handled their containers. This also increases transport time (See Figure 9-1).



Source: Delhi Traffic Police's Web Site

Figure 9-3 Restrictions on the Movement of Vehicles in the Urban Area of Delhi

(2) Not punctual

Containers must wait for a considerable time before being loaded onto trains in the port of JNP, though the length of such waits does fluctuate. Since these containers do not have

tracking systems, their locations and/or schedules are not known to institutions or companies. Due to these problems, railway transport remains an uncertain transport mode because the arrival date of cargo cannot be fixed.

The reasons for these problems are as follows:

1) A train will not depart unless its freight capacity is full. Containers on a train to a low-volume ICD are compelled to wait for additional containers until that train is fully loaded before it leaves. Table 9-6 shows the number of trains that left for each ICD during ten-day periods in May and June 2007. Among the nineteen ICDs, only three ICDs were served by trains more than once a day: Tuglakabad, Dadri and Ludhiana. For eleven other ICDs, a total of 10 or 16 trains were operated in each 10-day period. This fact says that the frequency of train operation for these ICDs is once a week or every 10 days.
2) It is CONCOR that manages the preparation of trains for containers with IR, and it is a port operator that unloads containers from a ship and takes them to the yard. The handling of containers at the port is not integrated so CONCOR cannot readily respond to requests from shippers.
3) Train departure and arrival are not confirmed because there is no train schedule.

Table 9-6 The Number of Trains from JNP (year 2007)

ICD	5/8-5/17	6/8-6/17
Tuglakabad（TKD）	65	71
Dadri(DDR)	21	26
Ludhiana(DDL)	12	13
Sabarmati(SBI)	8	9
Nagpur(NGP)	6	7
Mulund(NGSM)	6	7
Sanathnagar(SNF)	6	5
Moradabad(MB)	5	3
Others (11 ICD)	16	10
Total	145	151

*It was calculated using the CONCOR website. .
*Colored cells: more than one running a day.

(3) With damage

A survey conducted by the JICA study team found that freight items are loaded onto containers by manual labor and there were reports of damaged items. It was not clear, however, at what handling point the freight items were damaged. It is also possible that the damage was caused by truck accidents, which occur quite often. Trains meanwhile are not recognized as a source of damage according to the survey.

(4) Not cheap

Some India-based Japanese companies do not use the railway transport service thinking that the railway tariff is unreasonably higher than that for road transport. Some other companies, in contrast, use the railway because the tariff for railways is comparatively lower than those associated with truck transport. Generally it appears that there is a significant difference in the evaluation of consigners about freight charge between trains and trucks.

(5) Not customer oriented

At first the category of "Not customer oriented" was not intended to be treated as an independent category because "Customer oriented" is included with all items. But through meetings and discussions, it became clear that the railway transport service is not a mode for customers to easily use. It seems that India's old bureaucratic service system still remains. Reasons for not being customer-oriented are listed below:

1) CONCOR provides train tracking information through its web site. However, there is no freight reservation system and as a result shippers cannot track their freight before its departure. So the consignees access the home page of CONCOR every morning to get information about the departure of their containers from JNP.
2) When a shipper proposes consignment to CONCOR, the shipper must pay the tariff at ICD in advance (Deposit system was introduced for the shippers who transport large amounts. But this is also a kind of payment in advance.) This system is an inconvenience to shippers. TKD has just started to introduce credit settlement as well as an electronic settlement and application system for some shippers who transport large amounts.
3) Railway transport has only one tariff rate. Because CONCOR's fare system is an authorization system, the shipper cannot negotiate rates individually.

9.3 TARGETS FOR INTERMODAL TRANSPORTATION BY RAILWAYS

Solutions for the present problems of intermodal transport by railway were considered based on *Chapter 8.1* "Realization of Effective Logistics," which elaborates on similar experiences in Japan. A comparison of the tariffs for railways and roads was carried out in order to seek a better solution. Future policies for intermodal transport in India are considered next.

9.3.1 Minimizing lost time by improving cooperation among companies

Table 9-7 shows the solution and its effect for shortening of the transport time of inter-modal transport including railway. The problems of intermodal transport using railway are mainly a result of lack of cooperation among companies and institutions. It is necessary to introduce a new system or scheme for supporting intermodal transport. Specifically, the related companies and institutions, such as port operators, railway operators and customs, have to cooperate effectively to improve the flow of freight.

Negotiation and consultation with authorized institutions must be done by MOR and DFCCIL, who are primarily responsible for intermodal transport by railway development. The intermodal transport system will not be developed without their complete cooperation. Moreover, the railway-related problems should not be taken for granted and never should be underestimated.

Table 9-7 Solutions and Their Effects on the "Not Speedy" Problem

No.	Solutions	Effects	Problems to be improved
1	- Structure a system that links railway train reservation information and container handling information of ports. (Add information terminals to container handling machinery in the ports, and/or information-sharing with railways and ports)	- Containers to be loaded onto trains are distributed directly to RY in order of the shipment. This would help to save lay over time in the CY.	Y1 Y2
2	- Distribute containers for rail transport directly to the railway yard (RY) and those for road transport to the container yard (CY). (Enough space to lay over the containers to be transported by trains is required at the RY.)	- Eliminating unnecessary transshipment would improve the efficiency of handling machinery.	
3	- Integrate IGM (Import General Manifest) and SMTP (Semi Manifest for Transport Permission). (Note: this integration was suggested by the Planning Committee in November 2005). - Introduce an advance approval system.	- This would eliminate the inconvenience and time associated with applying for the SMTP.	R1
4	- Set rules for the prompt distribution of containers of other port operators in railway yard. (Refer to 8.1.3)	- Loading/unloading time would be saved. - Shuttle service of trains would be at more frequent intervals.	Y3
5	- Clarify the delivery district for each ICD from the viewpoint of geographical convenience. In urban areas, the ICD must become a base for small-lot freight. (The ICDs will need to build a warehouse.)	- Freight will be delivered in good time. - The number of containers laying over in ICDs will go down.	T1
6	- Mechanize logistics activities in ICDs to reduce human labor. (For example, use pallets and forklifts.)	- The efficiency of the ICD will improve.	I1

* Shaded cells show the solutions that need to be enforced preferentially.

9.3.2 Clarifying train schedules

Table 9-8 shows the solutions and its effects of clarifying the arrival time of containers. A lack of pre-determined train schedules results in claims of "not easy to use" by shippers. It is essential for enhancement of the quality of the information provision service to first clarify the train schedule and be able to track the location of containers.

Table 9-8 Solutions and their effects on the "Not punctual" problem

No.	Solutions	Effects	Problems to be improved
1	- Set train schedules and publicize the departure and arrival times.	- Shippers can be certain of the train schedule and the status of their freight. - Shippers can manage their logistics activities in a timely manner.	R3
2	- Regulate the operation of trains in order to keep to the schedule by railway transport clause of forwarder. (Even when the trains are not fully loaded)		R2
3	- Introduce a train reservation system. - Inform shippers of the schedule.		R6
4	- Introduce container tracking system. (IR and railway operator) (Refer to *8.1.2(3)*)		R4 I12
5	- Integrate the port's container handling system and container tracking system. (Refer to *8.1.2(3)*) - Inform shippers of the status of containers.		Y5
6	- Certify highly qualified logistics companies and publicize their certifications. (Evaluation criteria should include years in business, the number of vehicles, the number of claims from shippers, and so on.)	- Shippers can select the right logistics company.	T2 T3

* Shaded cells show the solutions that need to be enforced preferentially.

9.3.3 Improvement of service quality

Table 9-9 shows the solutions and their effects on satisfying the needs of the customers. . Railway transporters still follow traditional concepts of service, which means old Indian bureaucratic service. Road transporters in competition with railway transporters have taken steps to improve their service quality and improve customer orientation.

Table 9-9 Solutions and Their Effects on the "Not Customer-oriented" Problem

No.	Solutions	Effects	Problems to be improved
1	- Introduce an electronic application system and a future payment system to all ICDs (Refer to *8.1.3 (2)*). (A deposit and credit system could be introduced.)	- Shippers can save time when making applications. - New payment system can increase the demand for railway transport.	R5
2	- Establish credit guarantee organizations that support the future payment system. (Refer to *8.1.3 (2)*)	- Transport companies can use the future payment system to pay railway tariffs.	R5
3	- Accommodate major shippers respectively	- New business opportunities can be expected.	R7

* Colored cells show the solutions that need to be enforced preferentially.

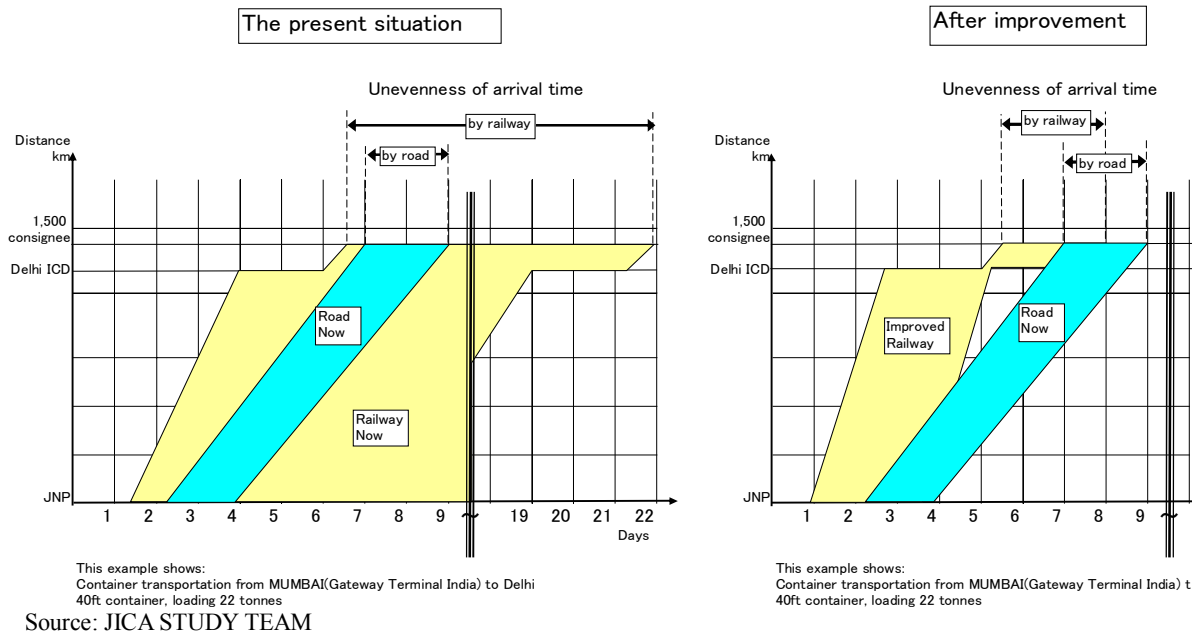
9.3.4 Estimation of improvement effect by inter-modal transport strategy

Improvements in railway transport in India are affected by the solutions shown in *8.1.1 (3)*. Figure 9-4 explains the relationship of intermodal transport using railway and road transport in terms of distance and time variables. The left figure shows the present situation. The right one shows the improved situation, provided that the above solutions are implemented. For example, in the improved case, it takes six days to transport containers between Mumbai and Delhi (the light-colored portion in the right graph of Figure 9-4).

At present, road transport presents less variation in transport days than that of railways. This means road transport provides shippers with some certainty. As a result, road transport has been able to increase its share in spite of its higher cost.

With improvements in railway transport, the variation in transport days would be reduced. In addition, railway transport would be slightly superior to road transport in terms of time but the difference is not so large that it would create an antagonistic relationship between them. When the DFC is completed, railway transport will only take one day and will offer this advantage over road transport.

It must be noted that the conditions of road transport will also be improved to shorten transport time. That implies railway transport has to do more to enhance its attractiveness to stay competitive with road transport.



Source: JICA STUDY TEAM

Figure 9-4 Effect of the Solutions (without consideration of DFC)

9.3.5 Transport of value-added commodities

In this section the relation of intermodal transportation using railway and road transport in terms of container loading weights and the tariffs will be examined. Figure 9-5 represents the relation of container loading weights and the tariffs for 20-foot and 40-foot containers being transported along the Mumbai-Delhi route.

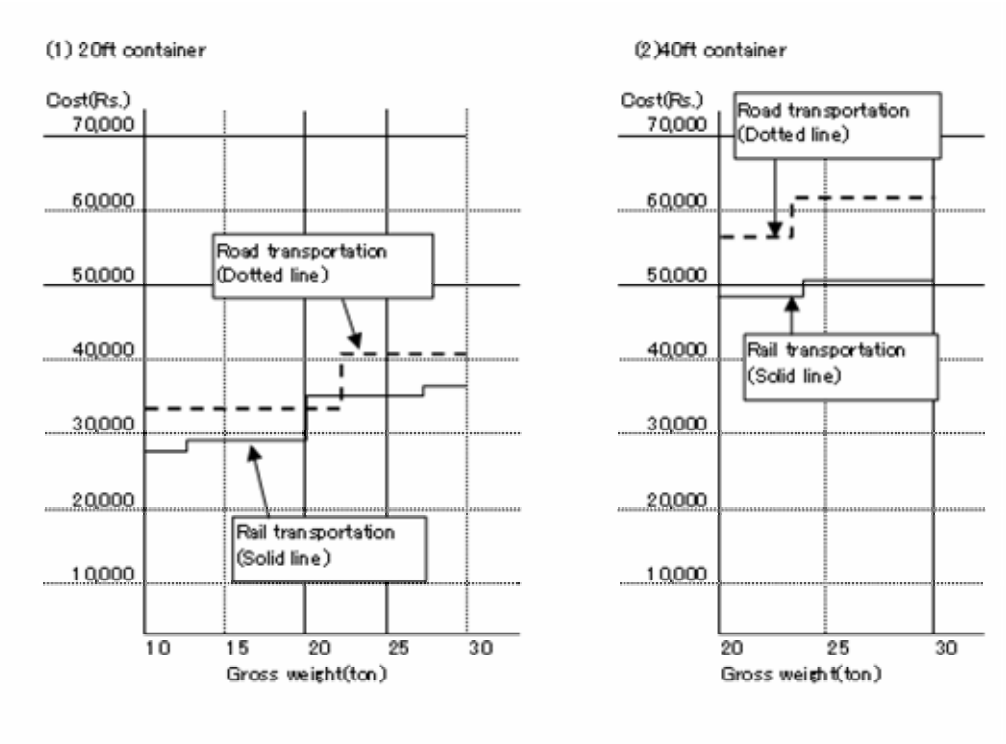
Railway transport tariffs have a detailed division by weight. Road transport has a two-division tariff: less than or greater than 20 tons of freight net weight. As shown in the figure, the road transport tariff jumps to the higher level around 22 tons for both the 20 foot and 40 foot container. The railway transport tariff is based on gross weight, which is about 2 to 3 tons more than the net weight of the freight. This is because the weight of container itself is the object of the tariff in railway transport.

The road transport tariff is higher than the railway transport tariff, except in the range of 20 to 22 tons gross weight for a 20-foot container. Railway transport would have been chosen regardless of freight weight, but the reality is different. The PETS-II report of RITES, however, found that the proportion of heavy containers in railway transport was more than

60% of the total number of containers. ("Heavy container" in this chapter means containers that are loaded with more than 20 tons of freight in railway transport.)

Under the same tariff condition, trucks become fuel-efficient when loaded with light containers. Therefore, road transporters have tried to get the containers that are loaded with light freight. That has forced railway transporters to transport the heavy containers.

When freight is loaded into a container and is transported, this light cargo seems to be high value-added commodities that are able to bear the burden of a high tariff. Thus, it is necessary for railway transporters to get these light containers by adjusting their service system and tariff system to satisfy these customers of light containers.



Source: JICA Study Team

Figure 9-5 Tariff Unit Price in 20 and 40 foot Containers

9.4 THE PROPOSAL ROLES OF DFCCIL AND IR IN INTERMODAL TRANSPORT

When the construction of the DFC is completed, the persistent problem of lack of transport capacity will be improved. From the viewpoint of infrastructure, the railway should be able to offer a high quality of services for customers (shippers and consignees). Furthermore, MOR will be able to provide high quality customer services by introducing 15 private capital investors into the container transport business.

Leaving customer service to 15 railway operation companies would put DFCCIL in charge of operation and maintenance of DFC. However, to the extent that intermodal transport will be common issue for not only for these 15 operators but also the DFC, DFCCIL and MOR, they all must manage to obtain more customers in collaboration with each other. DFCCIL and MOR, which have power in the government, shall secure leadership in intermodal transport and tackle this common issue. Here the common issues for the improvement of the inter-modal transport are condensed into the following three necessary conditions. We also provide general strategies for addressing these conditions.

9.4.1 Realization of visible logistics over the whole transport system

As explained in *8.8.12*, visible logistics – the ability to know the status of operations from the start to finish of the transport route – is the first tool that should obtained.

As mentioned before, there has been poor performance with intermodal transport using railways. The realization of visible logistics will be a significant step towards increasing the volume of railway transport and improving its performance.

The role of visible logistics must be considered over the whole transport system including railway transport and road transport. It is essential that all companies and institutions involved in intermodal transport (shipping companies, port operators, customs, customs clearance agents, railway operators, IR, DFCCIL, delivery companies and others) participate in and comply with the visible logistics initiative.

It is also necessary to configure the entire system for the cooperative dissemination of information as one part of the required infrastructure when forming a partnership deal with MOR and DFCCIL. Doing this will also enable the participating companies and institutions to reduce their expenditures for the logistic information systems. As the portal business for the information is one of the major successful fields at current business, MOR and DFCCIL should take this opportunity to develop a successful business model for logistics and transport in India.

Note: Visible logistics means that the stakeholders (consigners, consignees and transporters) can grasp and share the information about the status of the cargo (present location, status and the arrival time and so on) as well as information about the cargo (consigners, consignees, commodity items and packaging) while it is in transport.

9.4.2 Consolidation of common structures for railway operators

Competition among railway operators is vital and inevitable in transport, and this results in better services for the customers. However, cooperation among operators is needed to realize a more efficient transport service. Visible logistics, as mentioned above, is one that requires such cooperation. It is the task of MOR and DFCCIL to initiate and achieve cooperation among the transport operators.

In addition to the visible logistics, the following are some other specific measures to be considered.

(1) Establishing credit guarantee organizations

Railway tariffs are paid in advance by shippers even though there is a future clearance system. Establishing credit guarantee organizations will lessen the burdens on shippers because the credit guarantee organizations perform a role similar to that of an insurance company.

The more participants there are, the greater the tariff reduction realized. So it will be better to extend the service to all railway operators.

(2) Establishing a mutual account system

Railway operators can be ranked into four categories, from 1 to 4 by MOR. Category 1 operators can take nation-wide deals, while the others are limited in their own territories. Each operator may need facilities where freight departs and arrives. India, however, has a large land area so it is not realistic for each operator to have its own facilities in every city or

area. Responding to every shipper's demands would be very difficult for railway operators. A mutual account system would help railway operators satisfy shippers with reasonable tariffs (Refer to *8.1.3 (2)*. Its introduction will be recommended.

9.4.3 Promoting a metropolitan area ICD plan

Shippers in India say railway transport is more suitable for export containers than road transport. This is not only because the railway tariff is cheaper but also because shippers can end their transport responsibilities at a local ICD. Shipping companies take on the responsibility after the companies take possession of the freight from shippers at an ICD.

The ICD, a transport node, plays a significant role as a terminal point for transporters. Besides the construction of the DFC, the role of the ICD in freight consolidation and distribution in metropolitan areas is an important factor in railway transport. Establishing a supply of freight wagons at the ICD is planned as one of the major aims of PPP (Public and Private Partnership) for the DFC.

The construction of an ICD is a project carried out by companies engaged in railway freight operation. Land prices in metropolitan areas are so expensive that the construction of an ICD is a high-risk investment for railway operators. The construction of the ICD should be supported by DFCCIL to lessen the operators' business risk and to ensure good progress on the project.

When the DFC cannot integrate itself with the existing ICDs of metropolitan areas such as TKD and Dadri, it is necessary to establish an ICD in metropolitan areas as a first step of the project. Feasibility Study Volume shows in detail the way to achieve the project.

CHAPTER 10
STUDY OF ALTERNATIVES

CHAPTER 10 STUDY OF ALTERNATIVES

10.1 PROCESS OF ALTERNATIVES EVALUATION

The construction project of the Indian trunk freight railway routes has been proposed to cope with the rapid growth of passenger and freight transportation demands in the future. But there are other conceivable measures (alternatives) to meet the future transportation demands. The study of the alternatives which is being conducted based on the Inter-modal Development Scenario under the Overall Study Approach of the Inception Report from both the intangible (socio-economic) and tangible (railway technology) aspects. In addition to cost-benefit analysis of the alternatives, multi-angle evaluation is conducted with regard to financial viability, environmental impact and sustainability. By comparison with other measures, the new freight line construction should be ratified as the best solution. The alternative study is conducted by setting three "with-project" alternatives:

1) Construction of New Freight Lines (Alt.1),

2) Construction of New Passenger Lines (Alt.2),

3) Improvement of Existing Lines (Alt.3),

And fourth alternative, 4) Without-Project (Zero Option) is also studied.

The process of the alternatives study is as follows.

1) Setting of alternatives:	To identify functions and purposes of respective alternatives and define routes of respective alternatives.
2) Evaluation of merits and demerits of each alternative:	In order to recognize the peculiarities of each alternative, merits and demerits of respective alternatives are evaluated qualitatively.
3) Preliminary (first stage) evaluation by comparison of demand and capacity:	The future demand (using tentative figures) and the line capacity are compared and consideration is made on whether or not the alternative can meet the demand. It shall be noted that since study on the line capacity is not complete at this stage, the evaluation is done using provisional figures regarding line capacities in this report.
4) Second stage cost evaluation:	The cost of each alternative is estimated and evaluated.

In this chapter, descriptions are made as to the process taken and results obtained so far in the alternatives study.

10.2 POLICIES AND ISSUES FACING THE ALTERNATIVES STUDY

Predominant conditions of the alternatives study are as follows.

1) The main objective is to enhance the freight transportation capacity of the IR system on Mumbai-Delhi and Kolkata–Delhi Corridors, with due consideration for the increase in passenger demand on IR trains.
2) The increase of speed for passenger transportation is not included in the objective of the study.

The overall process of the alternative study is as follows.

i) The RITES report is reviewed especially concerning the methodology it uses for the demand forecast and further enhance the precision of the result of this demand forecast in JICA study.
ii) After the preliminary site survey, the actual conditions of the referenced routes are assessed and compiled with regards to train operation, available line capacities, railway facilities for tracks, signaling, freight yard and others relevant data.
iii) Then the bottleneck sections and the issues to be tackled are identified and examined.
iv) Evaluation and comparison of the alternatives are conducted regarding the possibility of meeting the future traffic demand, transportation efficiency and economy, financial conditions, environment (natural and social), project sustainability and others, giving consideration to energy consumption and the its influence on the environment.

10.2.1 Alt.1: Construction of New Dedicated Freight Corridor (DFC)

To cope with the increase in the railway freight transportation, a new line is constructed and used exclusively for freight transportation. The specifications of the line are commensurate with the high axle load and double-stacked container transportation. The new and existing railway lines are presumed to be used as classified below.

New line: exclusively for the long-distance trunk freight transportation

Existing line: for both the whole passenger service and the local freight transportation

10.2.2 Alt.2: Construction of New Dedicated Passenger Corridor

The new passenger line is aligned along the existing main passenger routes and new stations constructed at the large stations and intermediate junctions. The medium and long-distance passenger service is shifted out of the existing line. The aim is to mitigate the tight condition on the existing line and enhance its freight carrying capacity. The same maximum train speed as that of the existing lines is employed for the new passenger corridors, because the passenger service improvement by increasing the train speed is not a part of the Project brief.

The new and existing railway lines are presumed to be used as classified below. And if the line capacity of the existing line is insufficient, improvements are made to the extent that it satisfies the whole demand.

New line: exclusively for the inter-city express passenger service

Existing line: for both the whole freight transportation and the local passenger service

10.2.3 Alt.3: Improvement of Existing Lines

To cope with the increase in the freight transportation, improvements are made to the existing lines to enhance their carrying capacities. To differentiate from new line construction, addition of new tracks is excluded from objective of this alternative.

The details of the necessary improvements will be set up using the following process.

1) Following the review of RITES report, the preliminary site survey, and JICA demand forecast, major bottlenecks on the study routes are identified.

2) To identify the route to be improved considering current usage of respective sections of existing railway network and functions of respective lines.

3) After establishing the improvement measures of train operation and facilities (signaling, power supply, station and yard, civil and track structures, locomotives, rolling stocks, etc), the possibility to accommodate the future traffic demand is examined for the target year 2022.

4) If the line capacities of the existing lines are insufficient, improvement is made further to the extent that it satisfies the whole demand.

10.2.4 Zero Option (Without Project)

Any new projects, which are not committed to be implemented, are ignored and the present state of the facilities and train operation is taken as the base for estimating the possible carrying capacity. Note that ongoing projects and those definitely to be undertaken by MOR up to the year 2011 are included in this option. The state of supply and demand in the target year 2022 is examined and the result is used as the base case for evaluation of other alternatives. In this case, when the traffic demand exceeds the railway capacity, it is presumed that portion of demand shifts to the road traffic.

10.3 ROUTE SETTING IN THE ALTERNATIVES STUDY

The route setting is conducted taking into, the overall account as per the RITES report, the Preliminary Survey of JICA Study Team for Task 0, Preliminary Site Survey and other relevant information.

10.3.1 Alt.1: Construction of New Dedicated Freight Corridor (DFC)

The setting of the routes of this Alternative shall be made according to the proposal stipulated in the RITES report, in principle, as described below and shown in Figure 10-1.

(1) Eastern Corridor: Ludhiana-Khurja-Allahabad-Son Ngar

- The route, Ludhiana-Khurja-Allahabad-Sonnagar, is currently the main route for the predominant bulk commodity transportation (e.g. coal).

- Section between Sonnagar and Howrah, is excluded from this study according to the Minute of Meeting of the First Steering Committee Meeting.

- The section between Dadri and Khurja, the connection of the West and East corridors, should be considered from the standpoint of the overall Indian logistics and the relevant data is collected in the preliminary site survey to form the basic policy. Especially, as Dadri is the terminal ICD of the West Corridor, detailed study is required taking into

account, the policies of MOR and the RITES Phase-Ⅱ Study. Proposals for this section should be discussed in detail during the next stage of the Study.

(2) Western Corridor: Mumbai-Ahmedabad-Ajmer-Phulera-Rewari-Delhi (North Route)

Since a large amount of the container and cargo traffic is moving directly from the JNP and Gujarat ports to Delhi and the northern region of India, this route is best suited as the West Corridor study route from viewpoint of port connectivity with these major ports. The North Route is also superior to the South Route (Mumbai-Vadodara-Kota-Delhi) in terms of ease of construction and its economical costs.

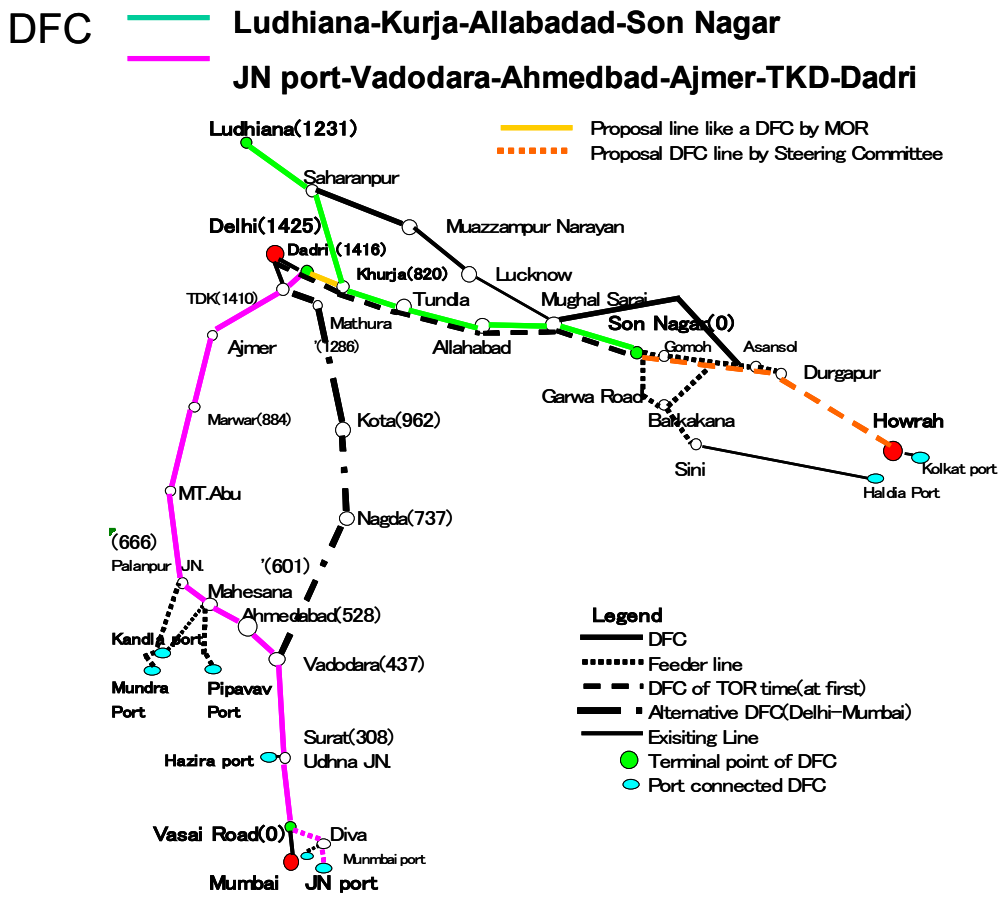


Figure 10-1 Proposed Route for Alt.1 (New Dedicated Freight Corridors)

10.3.2 Alt.2: Construction of New Dedicated Passenger Corridor

The line of this alternative was selected as the route which has the potential of passenger demand and is being also used for trunk freight transport targeted by the Project as mention below and shown in Figure 10-2.

(1) Eastern Corridor: Khurja - Sonnagar

- There are many large cities along the route and passenger traffic will grow further according to the RITES report. This route is proper as a study route for the new passenger line construction.

- The Sonnagar－Howrah section is excluded due to the same reason as presented earlier in Alternative 1.

- The Ludhiana-Khurja section has a smaller volume of passenger traffic in relation to its passenger carrying capacity. Therefore, it is assumed not to include this section in the study route.

(2) Western Corridor: Munbai-Vadodara-Kota-Delhi (South Route)

- Along the South Route, Vadodara-Kota-Mathra-Delhi, there are many large cities and both passenger and freight traffic demands are great. Therefore, the south route is proper as a route of this alternative.

- Along the North Route, Vadodara-Ahmedabad-Marwar-Delhi, there are no large cities other than Ahmedabad, and, therefore, this route is not proper as a route of this alternative.

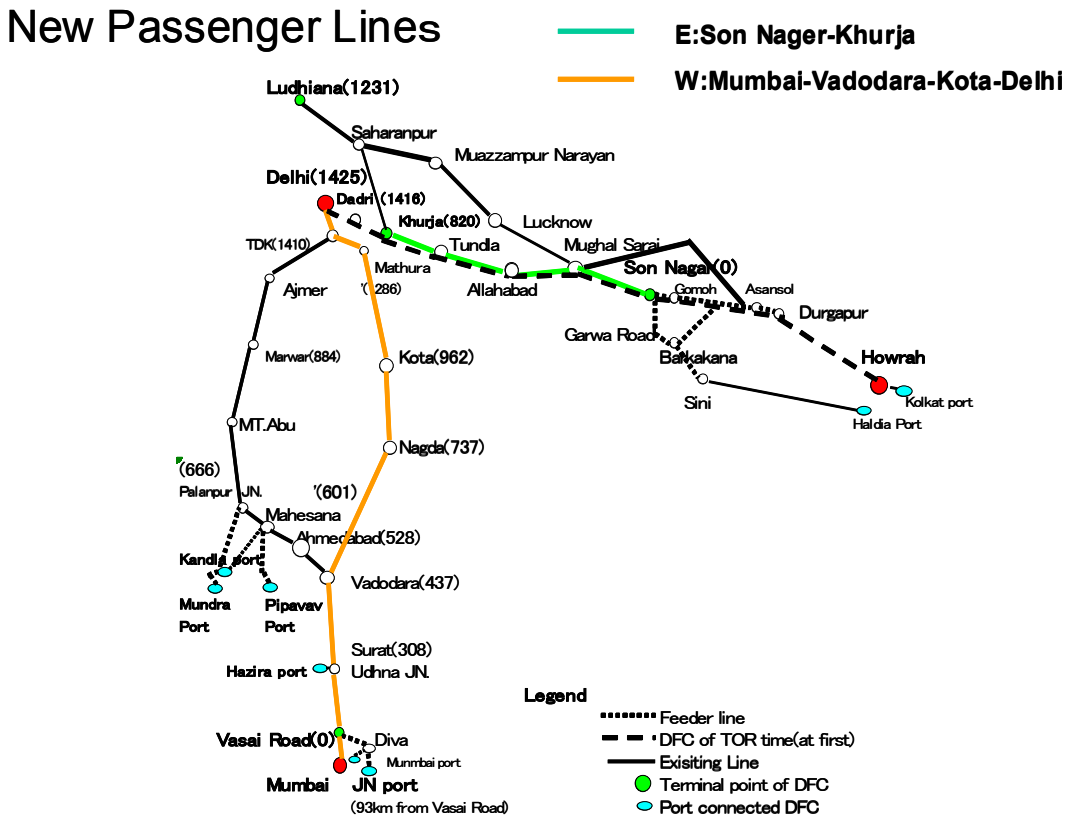


Figure 10-2 Proposed Route for Alt.2 (New Dedicated Passenger Corridors)

10.3.3 Alt.3: Improvement of Existing Lines

The routes of this alternative are defined as the ones, now operating the long-distance freight transport, which is the objective of this project. Both for Eastern and Western Corridors, two routes, one that is the most critical and the other that is the primary bypass route, are selected. These selected routes are those being classified as the Important Broad Gauge (IBG) Routes.

(1) East Corridor: a) Ludhiana-Khurja-Allahabad-Sonnagar
b) Ludhiana-Moradabad-Lucknow-Mugal Sarai

a) Route, entirely of BG, double-track and electrified, is the main and most busy freight/passenger route of the Eastern Corridor.

b) Route is mainly BG, though non-electrified and partially single-track, is the important bypass route and is proper route for existing line improvement.

(2) Western Corridor: a) Mumbai-Vadodara-Kota-Mathura-Delhi
b) Vadodara-Ahmedabad–Ajmer–Jaipur–Bandikuni-Rewari-Delhi

a) Route, entirely of BG, double-tracked and electrified, is the main and busiest route connecting Mumbai and Delhi, and both the passenger and freight traffic on this route continues to increase substantially in the future.

b) Route, though of BG, single-track and non-electrified, is the main transportation route from Mundra, Kandla ports of the Gujarat state via Ahmedabad to Delhi including the northern regions of India. The double-stack container train operations have been carried out on this route.

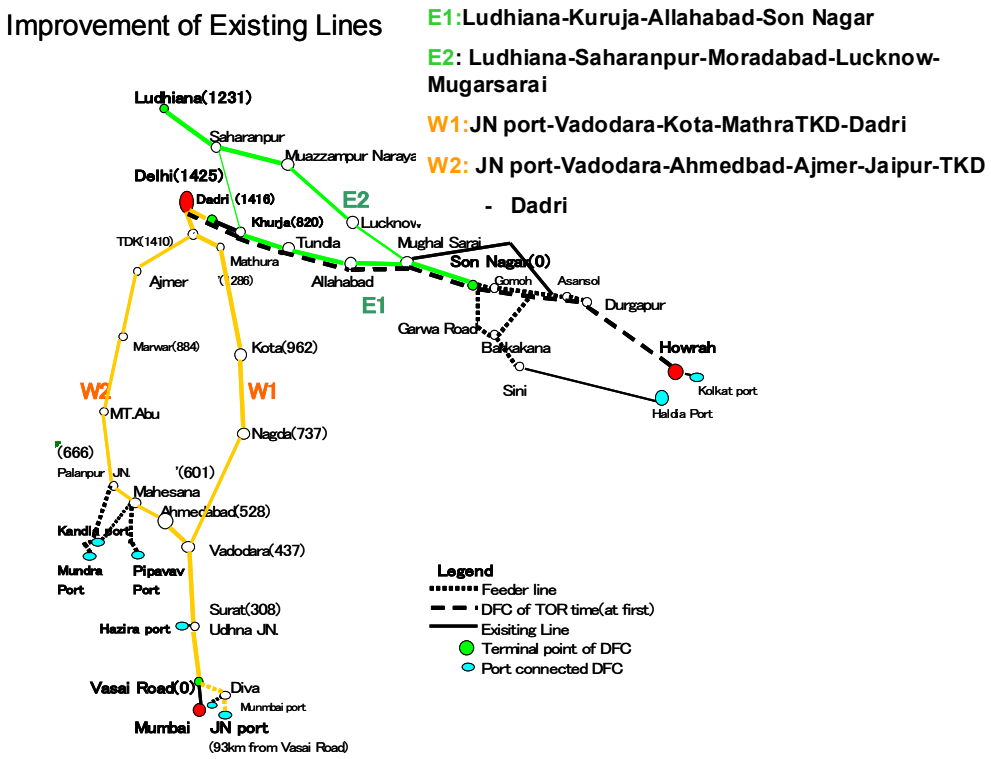


Figure 10-3 Proposed Route for Alt.3 (Improvement of Existing Lines)

10.3.4 Zero Option (Without Project)

For both the Eastern and Western Corridors, the study routes are the same as those selected for the existing line improvement (Alt.3). The study is conducted on the premise that, in principle, no new projects are undertaken to increase their line capacities.

10.4 DESIGN STANDARDS OF ALTERNATIVES

The design standards are set according to the results of the review of the RITES report, the preliminary site survey and the Task 0 study. They are shown in Table 10-1 (Features and Construction Standards of Alternatives). The conceptual design of alternatives is shown in *Volume 4 Technical Working Paper Task 0&1, 10-(1), (2), (3).*

Table 10-1 Features and Construction Standards of Alternatives

No.	Items		Alt. 1 Construction of New Dedicated Freight Corridor	Alt. 2 Construction of New Dedicated Passenger Corridor	Alt. 3 Improvement of Existing Line
1	Gauge		1,676 mm	Ditto	Ditto
2	Speed Potential	Max. Speed	100 km/h	130 km/h	SQ
3	Single Line/Double Line		Double line	Double line	SQ
4	Type of Traffic	Trailing Loads	15,000 t	24 cars	SQ
		Electrified/Diesel	Unresolved	Electrified	SQ
		Double stack/Single stack	Unresolved	-	Single stack
5	Ruling Gradient	Ruling Gradient	1/200	1/100	SQ
		Steepest Gradient in Yards	1/400	1/400	SQ
6	Curves	Horizontal Maximum Degree	2.5º (≅700 m)	2.5º (≅700 m)	SQ
		Vertical Maximum Radius	2,500 m	2,500 m	SQ
7	Permanent way	Axle Load	25t, 30t (bridge)	20.3 t	SQ
8	Rails		60 kg/900 UTS	Ditto	Ditto
9	Sleepers	Main Line	PSC 1660 nos/km	Ditto	Ditto
		Loop line	PSC 1540 nos/km	Ditto	Ditto
10	Fastenings		Special type for heavy traffic	Normal type	SQ
11	Ballast		300 mm	Ditto	Ditto
12	Points & Crossings	Points	60kg rail 1/12 curved switches PSC sleepers	60kg rail 1/12 curved switches PSC sleepers	SQ
		Crossing	CMS crossing	CMS crossing	SQ
13	Spacing of Tracks		6.0 m	5.3 m	SQ
14	Formation	Bank	13 m in width 2H:1V in bank slopes 1.5 m berm at every 6 m	12.2 m in width 2H:1V in bank slopes 1.5 m berm at every 6 m	SQ
		Cutting	12.5 m in width 1:1 in slopes 1.5 m berm at every 6 m	12.5 m in width 1:1 in slopes 1.5 m berm at every 6 m	SQ
		Blanketing	0.75 m depth	0.75 m depth	SQ
15	Clearance	MMD	(In case of double stack) Height: 7080 mm Width: 4890 mm	Height: 4265 mm Width: 3300 mm	SQ
		Fixed Structure Clearance	(In case of double stack) Height: 7300 mm Width: 2750 mm	Height: 6250 mm Width: 2135 mm	SQ
16	Road Crossings/ Level Crossings	Criterion for Providing ROBs or RUBs**	100,000 TVUs	100,000 TVUs	SQ
17	Stations	Eastern Corridor	8 nos between Sonnagar & Dadri	17 nos between Sonnagar & Khurja	SQ
		Western Corridor	13 nos between JNPT & Dadri	18 nos between Vasai Road & TKD	SQ
		Loop Length	1,500 m/750 m	686 m	SQ
18	Bridges	Standard of loading	30 tones	25 tones	SQ
19	Tunnel		Nil	2 nos	SQ
20	Electrification		25 kv ac	25 kv ac	SQ
21	Block/Signal		Automatic signal, ATP	Ditto	ditto

SQ: Status Quo
* The route alignment of Alternative 3 (new passenger line) shall be planned basically parallel with the existing line.
** The forecasted TUEs on 2011-12 shall be the criterion for providing ROB or RUB

10.5 QUALITATIVE COMPARISON OF ALTERNATIVES IN RELATION TO MERITS AND DEMERITS

The characteristics and constraints of alternatives are specified and qualitative evaluation was made in relation to their merits and demerits. The advantages and disadvantages of the new passenger line construction (Alt.2) and the existing line improvement (Alt.3), the counterproposals to the new freight line construction, are listed in Table 10-2 (Advantages and Disadvantages of Alt.2 and Alt.3 against Alt.1).

Table 10-2 Advantages and disadvantages of Alt.2 and Alt3 against Alt.1 (DFC)

	Alt-2 New Passenger Line	Alt-3 Existing Line Improvement
Advantages against Alt.1 (DFC option)	【in terms of Cost】	
	1) Construction cost of infrastructure can be reduced by applying lower axle design load	1) Initial investment can be minimized by employing stage-wise development
	【in terms of Service Expandability】	
	2) Inter city rapid passenger service will be possible by shortening the travel time because of the exclusive use of the new line for passenger service.	
Disadvantages against Alt.1 (DFC option)	【in terms of Cost】	
	1) As more stations are required on the new line, the construction cost of stations will be increased. 2) Judging from the purpose of this alternative, the new line cannot bypass major cities. Therefore magnitude of resettlement will be large.	1) As extent of improvement of transportation capacity for one line is limited, the improvement of multiple lines might be required. 2) Since all trains should pass existing stations/yards, improvement of these stations/yards, including improvement of signaling system and track alignment improvement, will induce the cost increase. 3) Since all trains passing existing stations are required slow speed operations at these stations, traveling time will be longer than the Alt.1. In addition, As the halting time for waiting passenger train is required. Therefore more wagons are required to transport the same transportation volume. 4) Many replacement of bridges are required if axle load of 25 tonne is applied. 5) As improvement of vertical alignment is difficult, the steep slope bottle neck can never be removed. When the same transportation capacity as other sections is required for the bottle neck section, the additional investment will be required to reinforce the capacity, such as usage of high power locomotive, booster locomotive and additional wagons, and improvement of the signals. 6) Since the existing stations are used after the improvement the improvement of transportation capacity by adoption of longer train is not applicable because of limit of effective length of the sidings (Unpractical). If improvement of stations to accommodate longer trains, a large cost investment is required for the improvement to the station. 7) The unit price for the construction will be higher because of improvement works should be done under normal operating condition.
	【in terms Economy】	
	3) As new line should pass urbanized area at more places than Alt.1, the influence of interception at level crossing will cause higher economic loss.	8) As all trains should pass existing urbanized area, the influence of interception at level crossing will cause higher economic loss.
	【in terms of Social environment】	
	4) Judging from the purpose of this alternative, the new line cannot bypass major cities. Therefore magnitude of resettlement will be large. 5) As new line should pass urbanized area at more places than Alt.1, the influence of interception at level crossing will cause larger social disturbance. 6) In case Diesel locomotive is used, influence of the exhaust gases will be higher.	9) Influence of difficulty on road traffic due to interception at level crossing will be larger, because all trains pass through the urbanized area having heavy road traffic. 10) In case Diesel locomotive is used, influence of the exhaust gases will be higher.
	【in terms of expandability for future demand】	
	7) Since all freight trains use the existing lines, it's difficult to accept double stack container transport system. 8) Improvement of vertical alignment at the bottle neck sections is impossible (for existing line).	1) Since the all freight train use the existing lines, itis difficult to accept double stack container transport system. 2) Improvement of vertical alignment at the bottle neck sections is impossible.

10.6 SCREENING OF ALTERNATIVES FROM ENVIRONMENT AND SOCIAL CONSIDERATION VIEWPOINT

10.6.1 Dedicated Freight Corridor

(1) Eastern Corridor

There are significant impacts caused by the implementation of Project as follows:

1) There are 11 diversions stretching over 233.5 km in order to avoid urban areas. Despite the fact that number of PAPs are reduced, there would be a nominal number of local residents subject to resettlement;

2) There are 2 major bridges, 9 medium bridges and 55 small bridges to be constructed and these would cause negative impacts on the natural condition of the rivers;

3) There are a number of agricultural plots subject to land acquisition. Depending on the land tenure system, a number of tenant farmers would become subject to involuntary changes of occupation and/or resettlement;

4) Diversion out-lined through agricultural areas would bisect the existing coherent agricultural communities;

5) Vegetation including large trees grown along the railway would have to be cut depending on the required right of way width;

6) A number of wetland areas forming habitat for a variety of bird species would be affected by the Project;

7) Solid waste disposed by the construction works as well as noise, vibration and dust emanating during the construction period would be temporary impact to the local community but could be intensive during the construction period;

8) Construction works of the Project could contribute to the local economy to some extent as local residents could enjoy a temporary period of improvement of small-scale business for the construction workers as well as to seize the opportunity for casual labor.

Thus appropriate land acquisition measures and rehabilitation for resettlement should be elaborated during the latter half of the project study period. It is also important to hold stakeholder meetings in each state and districts along the railway lines in order to disseminate information and reach an agreement with PAPs on the implementation of the Project.

(2) Western Corridor

The significant impacts caused by the implementation of Project as follows:

1) There are 9 diversions stretching over 332.5 km in order to avoid urban areas. Despite the fact that a number of PAPs are reduced, there would be a nominal number of local residents subject to resettlement;

2) There are 13 major bridges, 24 medium bridges and 167 small bridges to be constructed and these would cause negative impacts on the natural conditions of the rivers;

3) There are a number of agricultural plots subject to land acquisition. Depending on the land tenure system, a number of tenant farmers would become subject to involuntary changes of occupation and/or resettlement;

4) Diversion of tracks going through agricultural areas would bisect the existing coherent agricultural communities;

5) Vegetation including large trees grown in the wooded areas along the railway would have to be cut depending on the required right of way width;

6) Two areas of protective forest reserves in Maharashtra would be affected by the Project;

7) Four swamp areas of coastal zone along the railway lines would be affected to some extent by the Project;

8) Solid waste disposed by the construction works as well as noise, vibration and dust emanating during the construction period would be temporary impact to the local community but could be intensive during the construction period;

9) Construction works of the Project could contribute to the local economy to some extent as local residents could enjoy a temporary period of improvement of small-scale business for the construction workers as well as to seize the opportunity for casual labor.

Thus appropriate land acquisition measures and rehabilitation for resettlement should be elaborated during the latter half of the project study period. It is also important to hold stakeholder meetings in each state and districts along the railway lines in order to disseminate information and reach an agreement with PAPs on the implementation of the Project.

10.6.2 Dedicated Passenger Corridor

(1) Eastern Corridor

There are a number of significant environmental impacts noted to occur as follows:

1) As per Chapter 5.5, there are 25 urban centers in the Eastern Corridor subject to a length of 4 km of elevated tracks and stations that are to be constructed. This would hamper the commercial activities and residential areas of the urban centers alongside of existing railway;

2) There are relatively a large number of titled and non-titled residents in the vicinity of the existing stations who would have to be involved in resettlement arrangement;

3) Solid waste disposed by the construction works as well as noise, vibration and dust emanating during the construction period would be a temporary impact to the local community but could be intensive during the construction period;

4) Construction works of the Project could contribute to the local economy to some extent as local residents could enjoy a temporary period of improvement of small-scale business for the construction workers as well as seize an opportunity for casual labor.

(2) Western Corridor

There are a number of significant environmental impact noted, as follows:

1) As per *Chapter 5*, there are 33 urban centers in the Western Corridor subject to a length of 4 km of elevated tracks and stations that are to be constructed. This would hamper the

commercial activities and residential areas of the urban centers alongside the existing railway;

2) There are relatively a large number of titled and non-titled residents in the vicinity of the existing stations would have to be involved in resettlement arrangement;

3) There is "Keoladeo Ghana Lake Bird Sanctuary" some 176 km to the south of Delhi. It is located in Bharatpur District of Rajastan State. This bird sanctuary is one of the Lamsar Sites and Wetlands in India。 There are 375 bird species and mammals as well as other wildlife observed in the sanctuary. Of the wildlife, the following species are listed in the Red Data Book of WWF as endangered species:

   a. Lesser Adutant Stork(Leptoptilos Javanicus);
   b. Great Spotted Eagle (*Aquila Clanga*); and
   c. Sarus Crane (Grus antigone).

4) There are two protection forest areas, one in Kota District in Rajastan State and the other in Panch Mahal District in Gujarat State, subject to strip-felling of trees as the new passenger lines pass through these forest areas;

5) Solid waste disposed by the construction works as well as noise, vibration and dust emanating during the construction period would be a temporary impact to the local community but could be intensive during the construction period;

6) Construction works of the Project could contribute to the local economy to some extent as local residents could enjoy a temporary period of improvement of small-scale business for the construction workers as well as seize the opportunity for casual labor.

10.6.3 Improvement of Existing Lines

(1) Eastern Corridor

Case 1: Signal System Improvement

Since no large scale construction works are involved as signal system including railway crossing system improvement works are carried out along the existing railway lines, there are no direct significant impacts caused to the natural and social environment. On the other hand, the following long term indirect effect should take place:

1) Ever increasing urban population would not be able to enjoy improvement of the railway services if no passenger railway line system was improved as a result of the project intervention;

2) Increase of railway traffic could cause increase of railway accidents unless otherwise local population is well-informed and educated on the behavior at the railway crossing; and

3) Ever increasing local business in each state would significantly benefit for their business opportunities in terms of transporting their products in the future.

Case 2: Involving Double-track Construction Works

In the case the existing railways are improved with a number of sections with double-track construction works, the following is noted:

1) There are a number of agricultural plots subject to land acquisition. Depending on the type of land tenure system, a number of tenant farmers would become subject to involuntary changes of occupation and/or resettlement;

2) Vegetation including large trees grown along the railway would have to be cut depending on the required width of right of way;

3) A number of spots of water ponds where bird species are forming habitats would be affected by the Project;

4) Solid waste disposed by the construction works as well as noise, vibration and dust emanating during the construction period would be a temporary impact to the local community but could be intensive during the construction period;

5) Construction works of the Project could contribute to the local economy to some extent as local residents could enjoy a temporary period of improvement of small-scale business for the construction workers as well as to seize the opportunity for casual labor.

Thus appropriate land acquisition measures and rehabilitation for resettlement should be elaborated during the latter half of the project study period. It is also important to hold stakeholder meetings in each state and districts along the railway lines in order to disseminate information and reach an agreement with PAPs on the implementation of the Project.

(2) Western Corridor

Case 1: Signal System Improvement

Since no large scale construction works are involved as signal system including railway crossing system improvement works are carried out along the existing railway lines, there are no direct significant impacts caused to the natural and social environment. On the other hand, the following long term indirect effect should take place:

1) Ever increasing urban population would not be able to enjoy improvement of the railway services if no passenger railway line system was improved as a result of the project intervention;

2) Increase of railway traffic could cause increase of railway accidents unless otherwise local population is well-informed and educated on the behavior at the railway crossing; and

3) Ever increasing local business in each state would significantly benefit for their business opportunities in terms of transporting their products in the future.

Case 2: Involving Double-track Construction Works

In the case the existing railways are improved with a number of sections requiring double-track construction works, the following is noted:

1) There are a number of agricultural plots subject to land acquisition. Depending on the type of land tenure system, a number of tenant farmers would become subject to involuntary changes of occupation and/or resettlement;

2) Vegetation including large trees grown along the railway would have to be cut depending on the required right of way width;

3) An area of coastal swamp where bird species are forming habitats would be affected by the Project;

4) There is "Keoladeo Ghana Lake Bird Sanctuary" some 176 km to the south of Delhi. It is located in Bharatpur District of Rajastan State. This bird sanctuary is one of the Lamsar Sites and Wetlands in India. There are 375 bird species and mammals as well as other wildlife observed in the sanctuary. Of these wildlife, the following species are listed in the Red Data Book of WWF as endangered species:

   a. Lesser Adutant Stork*(Leptoptilos Javanicus*);
   b. Greater Spotted Eagle (*Aquila Clanga*); and
   c. Sarus Crane (Grus antigone).

5) Solid waste disposed by the construction works as well as noise, vibration and dust emanating during the construction period would be a temporary impact to the local community but could be intensive during the construction period;

6) Construction works of the Project could contribute to the local economy to some extent as local residents could enjoy a temporary period of improvement of small-scale business for the construction workers as well as to seize the opportunity for casual labor.

Thus appropriate land acquisition measures and rehabilitation for resettlement plan should be elaborated during the latter half of the study period. It is also important to hold stakeholder meetings in each state and districts along the railway lines in order to disseminate information and reach an agreement with PAPs on the implementation of the Project. Further, a full-scale of EIA study would be required to be carried out as sensitive area of "Keoladeo Ghana Lake Bird Sanctuary" is located next to the railway line.

10.6.4 Zero Option

Zero option needs road development as the alternative transport method to railway which causes serious impact to the environment. In this report, the incremental CO_2 emission from trucks and buses in case of zero option is calculated as trial.

(1) CO_2 Emission Increase by Trucks

1) Western Corridor

The CO_2 emission for the Western Corridor was indicatively calculated based on the difference of the truck traffic increase between "With Project" and "Without Project" of DFC with the following conditions:

- Period of 2011 to 2031;

- Increase of the number of 25 tonne truck (estimated fuel efficiency of 3.10 km/l) travelling 987 km/day.

The Table 10-3 shows the calculation. As a result, North Route of Western Corridor would have an increase of 691 trucks/day in 2011 without DFC Project. This would increase to 10,949 trucks/day in 2031. The conversion of this number to CO_2 will result in an increase of 0.5 t/km/day of CO_2 in 2011 and 8.0 t/km/day of CO_2 in 2031.

In the same way, the South Route of Western Corridor will have an increase of 0.3 t/km/day of CO_2 in 2011 and 3.0 t/km/day of CO_2 in 2031.

Table 10-3 Increase of CO_2 Emission for the Western Corridor Without DFC Project: Trucks

Year	North Route							
	Quantity (vehicle/day)			Fuel Efficiency (km/l)	Increased Diesel Consumption (litre/987km)	Energy (GJ)	CO_2 Emission	
	Without	With	Increase				(t/987km)	(t/km)
2011-12	692	1	691	3.10	219,877.7	8,157.5	603.7	0.5
2016-17	2,608	8	2,600	3.10	827,862.0	30,713.7	2,273.1	1.9
2021-22	4,846	50	4,796	3.10	1,526,987.5	56,651.2	4,192.8	3.5
2026-27	8,105	165	7,940	3.10	2,528,134.6	93,793.8	6,941.7	5.8
2031-32	11,336	387	10,949	3.10	3,486,009.7	129,331.0	9,571.8	8.0

Year	South Route							
	Quantity (vehicle/day)			Fuel Efficiency (km/l)	Increased Diesel Consumption (litre/987km)	Energy (GJ)	CO_2 Emission	
	Without	With	Increase				(t/987km)	(t/km)
2011-12	887	407	480	3.10	152,725.6	5,666.1	419.3	0.3
2016-17	2,172	899	1,273	3.10	405,361.3	15,038.9	1,113.0	0.9
2021-22	3,455	1,480	1,975	3.10	628,875.7	23,331.3	1,726.7	1.4
2026-27	4,924	2,106	2,818	3.10	897,071.9	33,281.4	2,463.2	2.1
2031-32	6,924	2,756	4,168	3.10	1,327,126.4	49,236.4	3,644.0	3.0

Obs: Number of truck for 25 tones load traveling 978 km. (Intermediary results)
Diesel energy conversion: 0.0371 GJ/litre, CO_2 Emission: 74.01 $kgCO_2/GJ$. (IPCC data)
Fuel efficiency: Japan Ministry of National Transport

2) Eastern Corridor

The calculation of CO2 emission for the Eastern Corridor was done in the same way, but for a traveling distance of 980 km/day/truck was used. Table 10-4 shows the calculation.

Table 10-4 Increase of CO_2 Emission for the Eastern Corridor Without DFC (Trucks)

Year	Quantity (vehicle/day)			Fuel Efficiency (km/l)	Increased Diesel Consumption (litre/980km)	Energy (GJ)	CO_2 Emission	
	Without	With	Increase				(t/980km)	(t/km)
2011-12	317	0.0	317	3.10	100,220.9	3,718.2	275.2	0.2
2016-17	1,046	0.0	1,046	3.10	330,746.8	12,270.7	908.2	0.8
2021-22	1,917	0.0	1,917	3.10	605,921.3	22,479.7	1,663.7	1.4
2026-27	2,616	1.0	2,615	3.10	826,656.9	30,669.0	2,269.8	1.9
2031-32	4,752	30.0	4,722	3.10	1,492,734.4	55,380.4	4,098.7	3.4

Obs: Number of truck for 25 tones load traveling 980 km. (Intermediary results)
Diesel energy conversion: 0.0371 GJ/litre, CO_2 Emission: 74.01 $kgCO_2/GJ$. (IPCC data)
Fuel efficiency: Japan Ministry of National Transport

As a result, Western Corridor will have an increase of 0.2 t/km/day of CO2 in 2011 and 3.4 t/km/day of CO2 in 2031 if there was no DFC Project.

To summarize, the preliminary estimation of the difference between "With Project" and "Without Project" of DFC in terms of CO_2 emission due to the increase of truck traffic indicated that in 2031 CO_2 emission will be increased to 11.0 t/km/day for the Western Corridor and 3.4 t/km/day for the Eastern Corridor i.e. the Western Corridor will have much higher increase of traffic volume emitting CO_2.

(2) CO2 Emission Increase by Buses

1) Western Corridor

The CO_2 emission increase by the bus traffic increment was also evaluated the same was as above. Table 10-5 shows this calculation.

Table 10-5 Increase of CO_2 Emission for the Western Corridor Without DFC: Buses

Year	North Route							
	Quantity (vehicle/day)			Fuel Efficiency (km/l)	Increased Diesel Consumption (litre/978km)	Energy (GJ)	CO_2 Emission	
	Without	With	Increase				(t/978km)	(t/km)
2011-12	88	2	86	3.62	23,254.4	862.7	63.9	0.05
2016-17	417	7	410	3.62	110,768.0	4,109.5	304.1	0.25
2021-22	943	24	919	3.62	248,282.3	9,211.3	681.7	0.57
2026-27	1,872	76	1,796	3.62	485,272.3	18,003.6	1,332.4	1.11
2031-32	2,936	440	2,496	3.62	674,406.4	25,020.5	1,851.8	1.54

Year	South Route							
	Quantity (vehicle/day)			Fuel Efficiency (km/l)	Increased Diesel Consumption (litre/978km)	Energy (GJ)	CO_2 Emission	
	Without	With	Increase				(t/978km)	(t/km)
2011-12	294	259	35	3.62	9,415.0	349.3	25.9	0.02
2016-17	550	498	52	3.62	14,016.5	520.0	38.5	0.03
2021-22	872	804	68	3.62	18,285.0	678.4	50.2	0.04
2026-27	1,374	1,307	67	3.62	18,224.5	676.1	50.0	0.04
2031-32	2,091	1,883	208	3.62	56,247.6	2,086.8	154.4	0.13

Obs: Number of buses for 35 persons traveling 978 km. (Intermediary results)
Diesel energy conversion: 0.0371 GJ/litre, CO_2 Emission: 74.01 $kgCO_2/GJ$. (IPCC data)
Fuel efficiency: Japan Ministry of National Transport

2) Eastern Corridor

The CO_2 emission increase by the bus traffic increment was also evaluated the same was as above. Table 10-6 shows the calculation.

Table 10-6 Increase of CO_2 Emission for the Eastern Corridor Without DFC: Buses

Year	Quantity (vehicle/day)			Fuel Efficiency (km/l)	Increased Diesel Consumption (litre/950km)	Energy (GJ)	CO_2 Emission	
	Without	With	Increase				(t/950km)	(t/km)
2011-12	65	0.0	65	3.62	17,169.2	637.0	47.1	0.0
2016-17	278	0.0	278	3.62	73,044.9	2,710.0	200.6	0.2
2021-22	623	0.0	623	3.62	163,388.9	6,061.7	448.6	0.4
2026-27	1,253	3.0	1,250	3.62	328,044.7	12,170.5	900.7	0.8
2031-32	1,975	40.0	1,935	3.62	507,693.7	18,835.4	1,394.0	1.2

Obs: Number of buses for 35 persons traveling 978 km. (Intermediary results)
Diesel energy conversion: 0.0371 GJ/litre, CO_2 Emission: 74.01 $kgCO_2/GJ$. (IPCC data)
Fuel efficiency: Japan Ministry of National Transport

The result indicates that the CO2 emission increase by buses was smaller than the increase made by trucks. It also indicates that the emission is higher for the Western Corridor as is indicated in the case of truck increase. However, the difference between the Western Corridor and Eastern Corridor is not as high as that of the results of the case of truck increase.

(3) Carbon Dioxide Absorption

CO2 offset is indicatively calculated in this section. The Ministry of Environment of the Japanese Government published a document showing that 20 to 30 m tall Cedar of 50 years old can absorb 14 kg of CO2 per year. As a rough calculation, an emission of 1.0 t/day of CO2 will result in 365 t/year and this is converted to the quantity of Cedar necessary to absorb CO2 and the result will be 26,071 trees. By the same calculation, Table 10-7 indicates that some 4.5 million trees are necessary to offset CO_2 as DFC Project is not implemented.

Table 10-7 Number of Cedar Trees Necessary to Absorb the CO_2 Emitted in 1 Year

Type	Section	CO_2 Emission		Number of Cedar Necessary to Absorb the Emitted CO_2 (trees)	Necessary Area (ha)
		(t/km/day)	(t/km/year)		
Truck	West	11.01	40,363	2,883,083	961.0
	East	3.42	12,518	894,152	298.1
Bus	West	1.67	6,127	437,664	145.9
	East	1.16	4,258	304,110	101.4

Obs: Usually Cedars are planted in 3,000 trees/ha density.

10.7 EVALUATION OF ALTERNATIVES

10.7.1 Evaluation by means of Comparison between Traffic Demand and Line Capacity

For primary evaluation of respective alternatives, comparison of traffic demands and line capacities, which were estimated in the Chapter 7, were carried out by comparing the traffic demand in year 2004-05, 2011-12, 2016-17, 2021-22, and 2031-32. Regarding line capacities of the various types of the track, following figures were adopted in this study based on the deliberation made in Chapter 7 and actual train operation.

i) Single track: 20-train/day/direction

ii) Double track of existing lines without automatic signaling system: 50-trains/day/direction

iii) Double track of existing line with automatic signaling system: 110-train/day/direction

iv) New double track line (DFC and DPC): 140-train/day/direction

v) Triple track of existing line(Mughal Sarai-Sonnagar): 150-train/day/direction

In this sub-chapter, the demand-capacity comparison was conducted regarding the Existing Line Improvement (ELI) Option, the Dedicated Passenger Corridor (DPC) and the Dedicated Freight (DFC) option for the Eastern Corridor and the Western Corridor respectively.

In the comparison, evaluation of respective alternatives are made considering entire freight and passenger traffic demand of the corridor including those for new and existing lines.

(1) Demand-Capacity Comparison for the Eastern Corridor

1) Evaluation of the Existing Line Improvement (ELI) Option

Figure 10-4 shows relation between future traffic demand and line capacity of several representative sections of the Eastern Corridor and Figure 10-5 shows traffic distribution pattern between Sonnagar and Ludhiana. From these figure, it is concluded that ;

a) Demand of the route via Kanpur (E1 Route) exceeds the line capacity in year 2011-12 and far exceeds the capacity by more than 40% in year 2021-22.

b) On the other hand route via Lucknow still has margin to accommodate additional demand even in year 2030.

c) Although it can be considered that a part of the excess traffic on the route via Kanpur can be converted to the route via Lucknow, the convertible traffic should be limited to those which move in the far east between Mughal Sarai and Ludhiana area through Kanpur. According to the present traffic pattern shown in the Figure 10-5, traffic

volume of this through transport is only 4-train/day/direction and equivalent to 10% of the total traffic volume of the Kanpur route.

d) Therefore it was judged that demand excess condition of the Kanpur route as for the section between Mughal Sarai and Khurja can not be relieved even the convertible traffic is taken into account and a new line is required by around year 2015.

e) Sonnagar - Mughal Sarai section has margin in the line capacity till around year 2025. Suggestions for this section will be subject to further study together with Khurja-Ludhiana section, for which RITES study is not completed yet

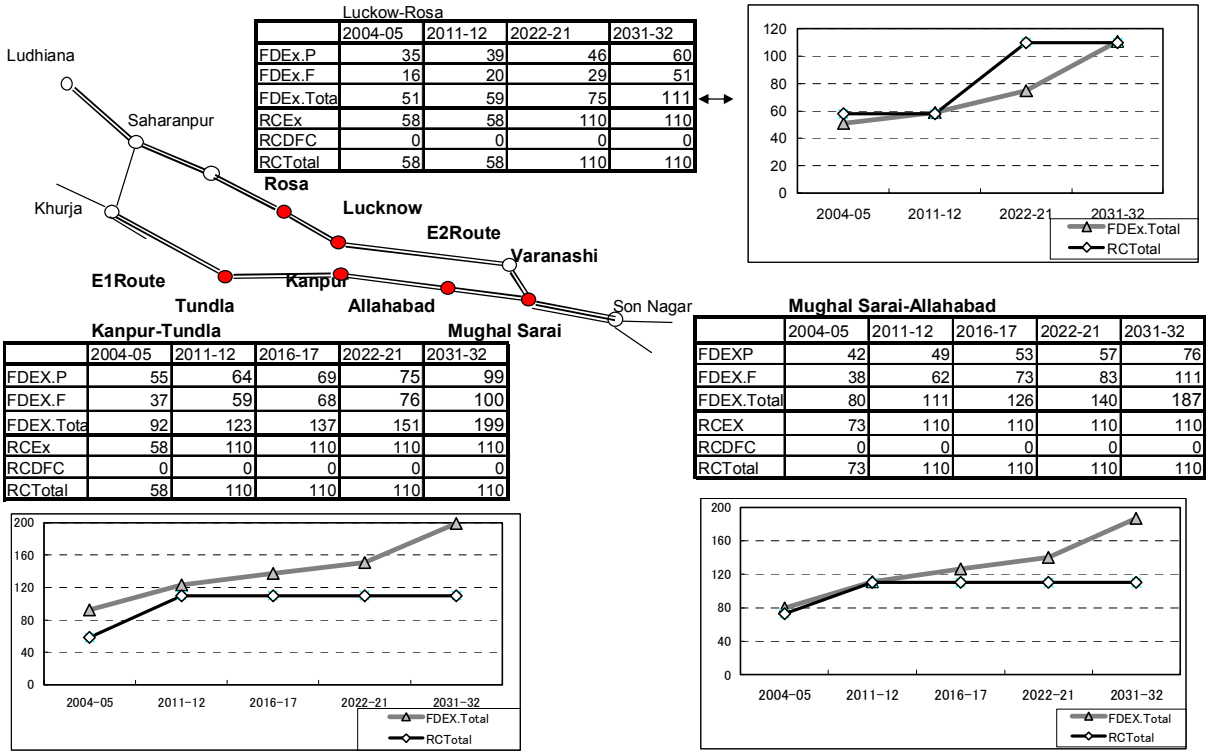


Figure 10-4 Relation between Demand and Line Capacity of ELI Option Case of the Eastern Corridor

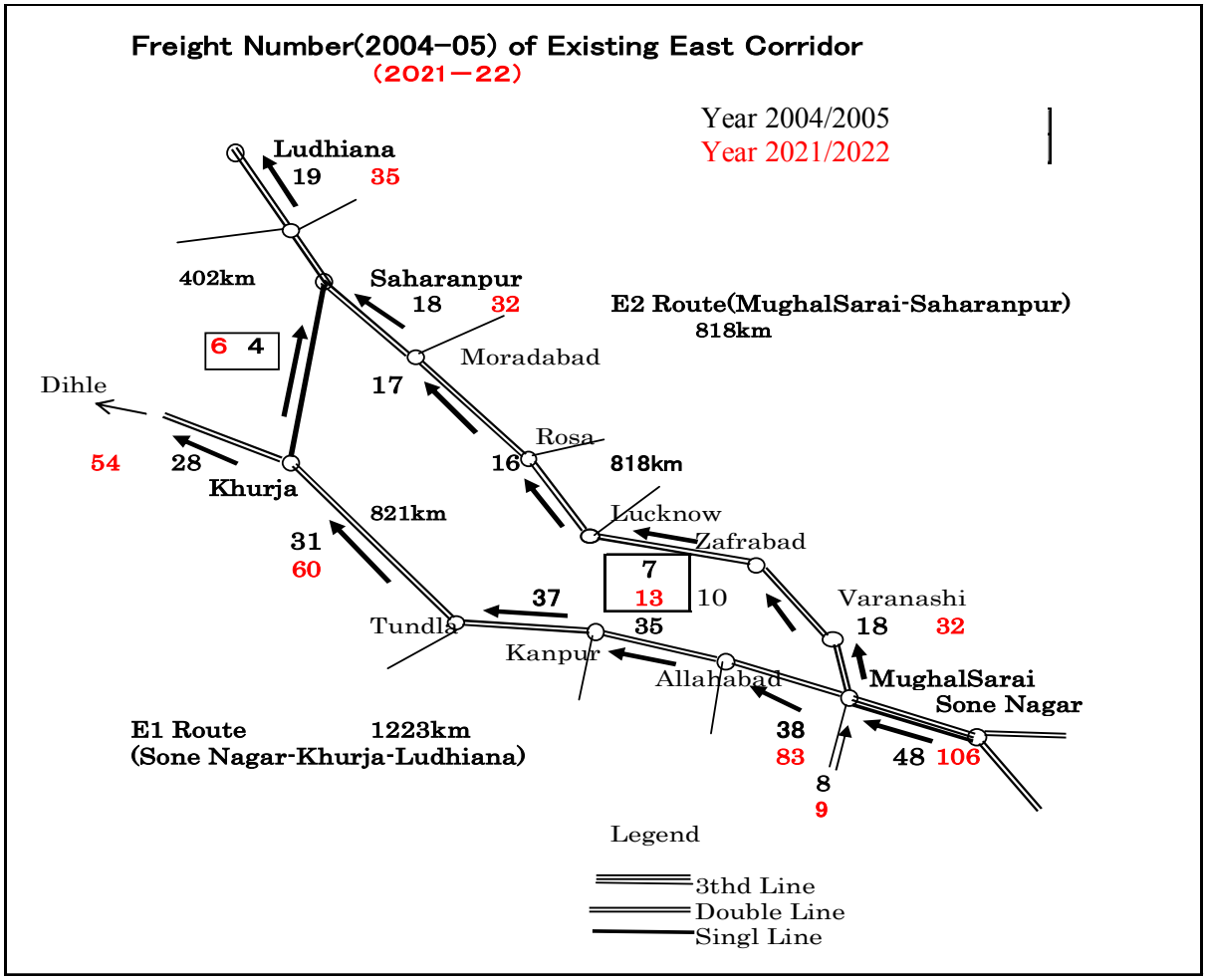


Figure 10-5 Traffic Distribution Pattern of the Eastern Corridor (Unit: Trains/day/direction)

2) Evaluation of the Dedicated Passenger Corridor (DPC) Option

Figure 10-6 shows relation between future traffic demand and line capacity of several representative sections in the case of DPC Option. From this figure, it is confirmed that;

a) DPC (a new line) can satisfy the demand till year 2031-32 with occupancy rate of only 55% to 75% even in year 2031-32. It means that DPC is not utilized effectively.

b) On the other hand, existing line of Kanpur route can not accommodate the future demand after around year 2025 and Lucknow route can not accommodate it after year 2030.

c) Hence, it can be concluded that DPC option is not well balanced option since new line has surplus capacity for future demand but existing lines donot have enough capacity for the future demand.

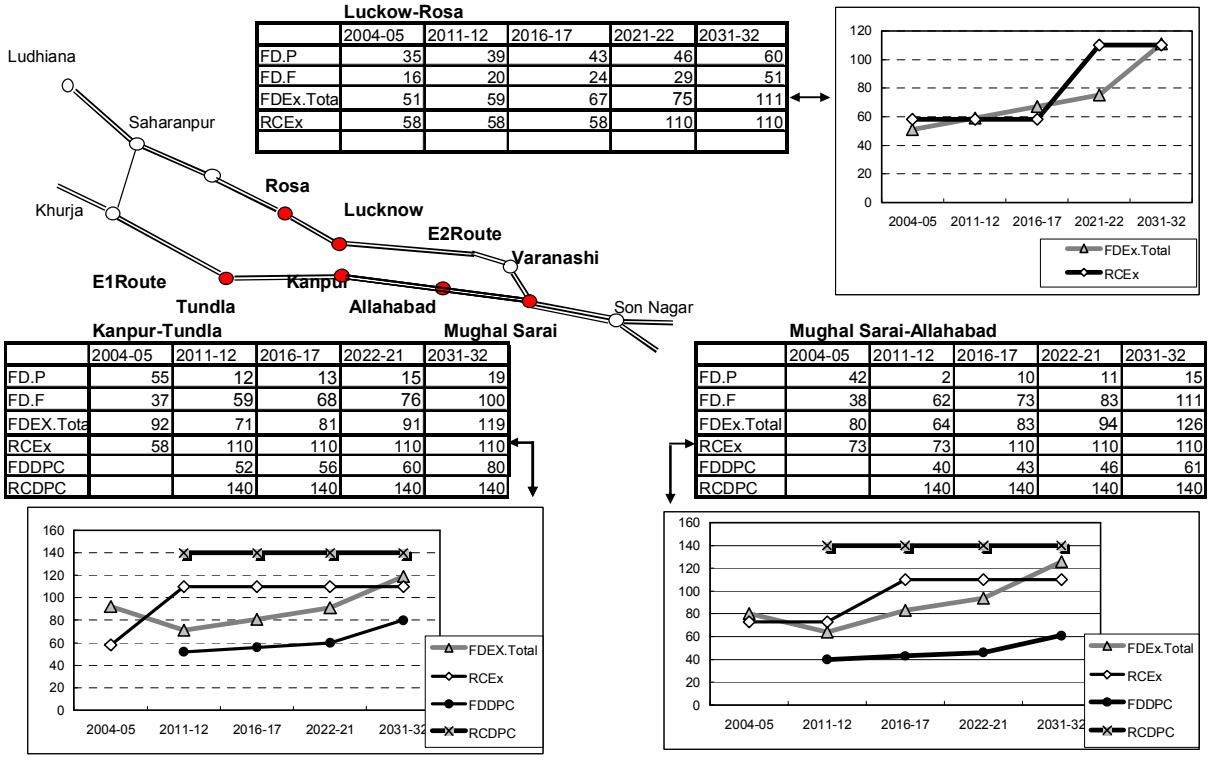


Figure 10-6 Relation between Demand and Line Capacity of DPC Option Case of the Eastern Corridor

3) Evaluation of the Dedicated Freight Corridor (DFC) Option

Figure 10-7 shows relation between future traffic demand and line capacity of several representative sections in the case of DFC Option. From this figure, it is confirmed that ;

a) DFC (new line) can satisfy the demand till year 2031-32 with occupancy rate of only 60% （Kanpur-Tundla section） to 86% (Mughal Sarai- Allahabad section) in year 2031-32.

b) Existing lines of both Kanpur and Lucknow routes can accommodate the demand till around year 2030 as well.

c) It can be concluded that DFC option is well balanced option since new line and existing lines can satisfy future traffic demands till year 2031-32.

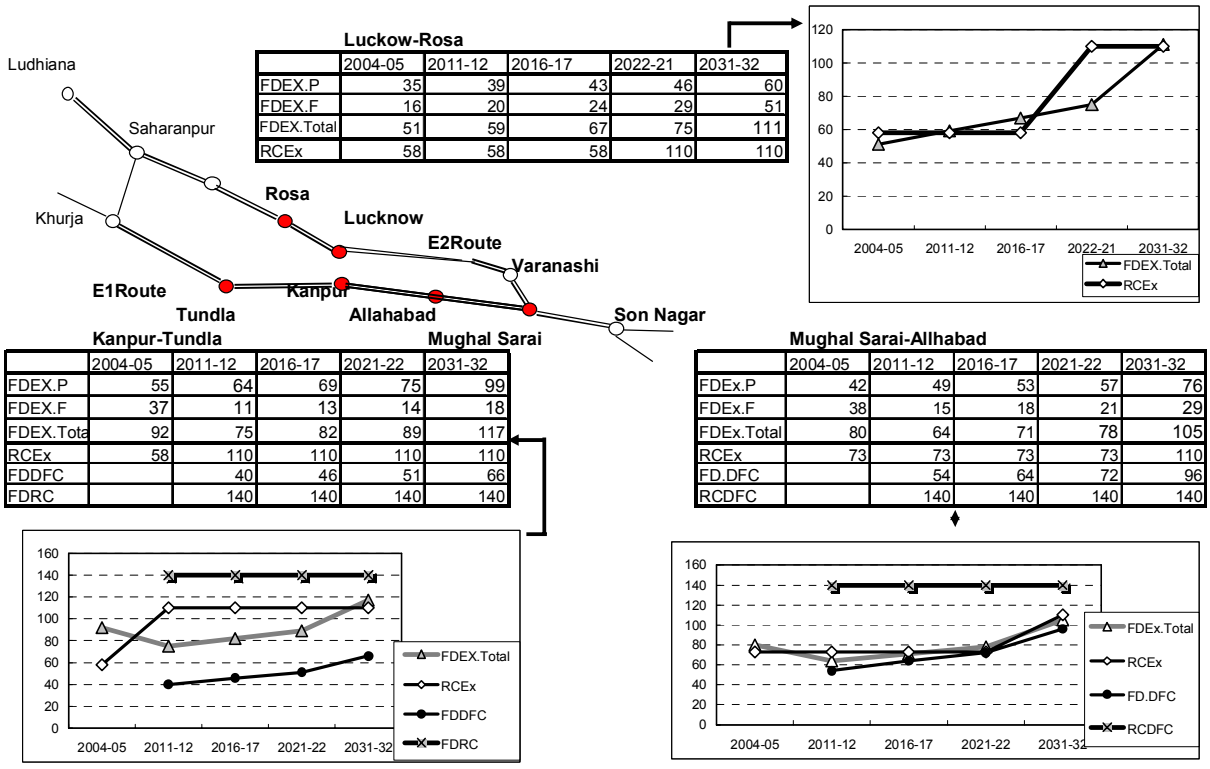


Figure 10-7 Relation between Demand and Line Capacity of DFC Option Case of the Eastern Corridor

(2) Demand-Capacity Comparison for the Western Corridor

1) Evaluation of the Existing Line Improvement (ELI) Option

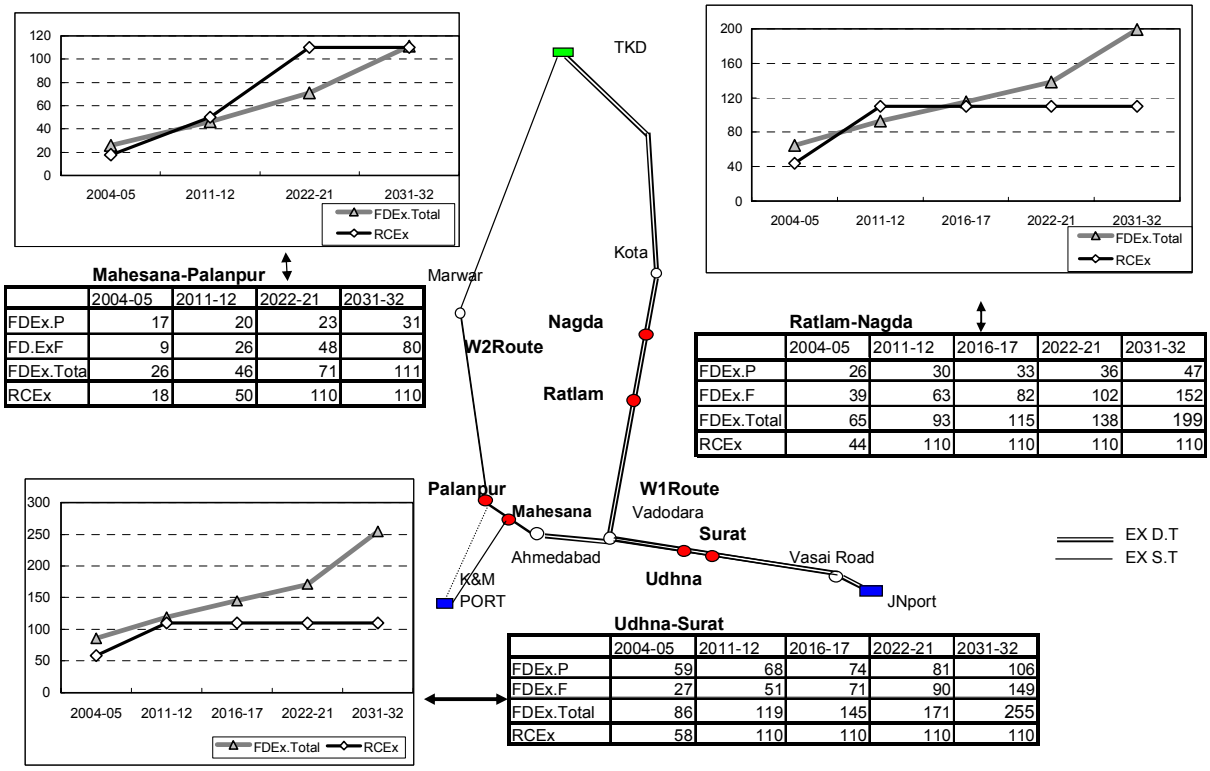
Relation between future traffic demand and line capacity of several representative sections of the Eastern Corridor is shown in Figure 10-8. From the figure, it is concluded that;

a) Present demand of Mumbai - Vadodara section already exceeds the line capacity. This section needs a new line urgently, in the immediate future.

b) Regarding section between Vadodara and Delhi via Kota, the demand will exceed the capacity in around year 2015 and then will need new line to be constructed.

c) As for the section between Ahmedabad and Delhi via Palanpur, traffic demand has currently exceeded the capacity of the single track and needs double track works to commence in series.

d) It can be concluded that future traffic demand after year 2015-16 cannot be accommodated by means of the ELI Option alone and needs construction of a new line for the whole stretch keeping in view of demand/capacity relationship.



Mahesana-Palanpur

	2004-05	2011-12	2022-21	2031-32
FDEx.P	17	20	23	31
FD.ExF	9	26	48	80
FDEx.Tota	26	46	71	111
RCEx	18	50	110	110

Ratlam-Nagda

	2004-05	2011-12	2016-17	2022-21	2031-32
FDEx.P	26	30	33	36	47
FDEx.F	39	63	82	102	152
FDEx.Total	65	93	115	138	199
RCEx	44	110	110	110	110

Udhna-Surat

	2004-05	2011-12	2016-17	2022-21	2031-32
FDEx.P	59	68	74	81	106
FDEx.F	27	51	71	90	149
FDEx.Total	86	119	145	171	255
RCEx	58	110	110	110	110

Figure 10-8 Western Corridor Comparison figure for line capacity and forecast demand of ELI

2) Evaluation of the Dedicated Passenger Corridor (DPC) Option

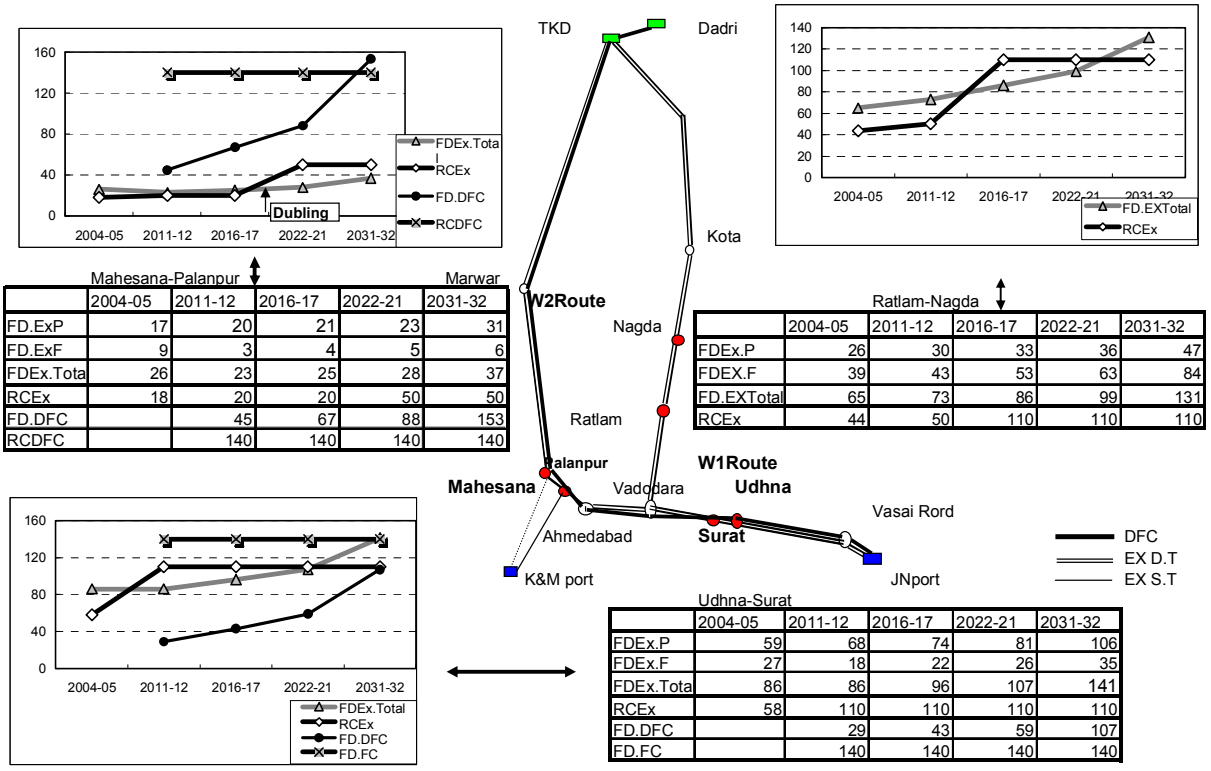
Figure 10-9 shows relation between future traffic demand and line capacity of several representative sections in the case of DPC Option. From this figure, it is confirmed that ;

a) DPC (a new line) can satisfy the demand till year 2031-32 with occupancy rate of only 30% to 60% even in year 2031-32. Similar to the Eastern Corridor, it means that DPC is not utilized effectively.

b) On the contrary, Mumbai - Vadodara section and Vadodara - Kota section of the existing lines cannot accommodate the future demand after year 2020.

c) Demand on Ahmedabad - Delhi section of the existing line will require automatic signaling system in addition to double track improvements in future.

d) Similar to the Eastern Corridor, it can be concluded that DPC option for this corridor is not an ideal option since new line has surplus capacity for future demand but existing lines do not have enough capacity for the future demand.



Mahesana-Palanpur / Marwar

	2004-05	2011-12	2016-17	2022-21	2031-32
FD.ExP	17	20	21	23	31
FD.ExF	9	3	4	5	6
FDEx.Tota	26	23	25	28	37
RCEx	18	20	20	50	50
FD.DFC		45	67	88	153
RCDFC		140	140	140	140

Ratlam-Nagda

	2004-05	2011-12	2016-17	2022-21	2031-32
FDEx.P	26	30	33	36	47
FDEX.F	39	43	53	63	84
FD.EXTotal	65	73	86	99	131
RCEx	44	50	110	110	110

Udhna-Surat

	2004-05	2011-12	2016-17	2022-21	2031-32
FDEx.P	59	68	74	81	106
FDEx.F	27	18	22	26	35
FDEx.Tota	86	86	96	107	141
RCEx	58	110	110	110	110
FD.DFC		29	43	59	107
FD.FC		140	140	140	140

Figure 10-9 Relation between Demand and Line Capacity of DPC Option Case of the Western Corridor

3) Evaluation of the Dedicated Freight Corridor (DFC) Option

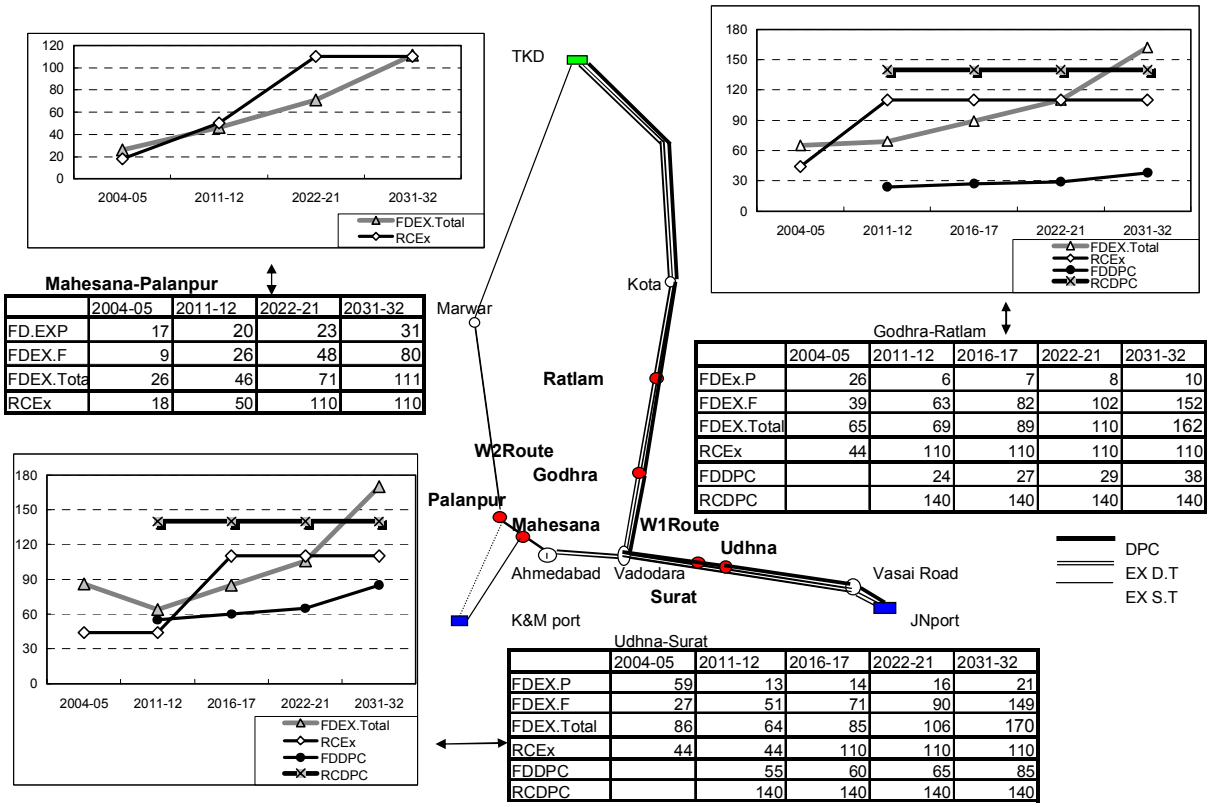
Figure 10-10 shows relation between future traffic demand and line capacity of several representative sections in the case of DPC Option. From this figure, it is confirmed that ;

a) DFC (a new line) will be able to satisfy the demand till around year 2030.

b) Demand of the Mumbai - Vadodara section of the existing line exceeds the capacity again after around year 2026 even if there is DFC in place and may require another counter measures like construction of a dedicated passenger corridor for this section.

c) Demand requirements of Ahmedabad - Delhi section on the existing line will exceed the capacity of single track before year 2012 and will then require double track improvement in series.

d) Vadodara - Kota - Delhi section of the existing route can satisfy the future demand up to year 2026 if DFC is in place during this period.



Mahesana-Palanpur	2004-05	2011-12	2022-21	2031-32
FD.EXP	17	20	23	31
FDEX.F	9	26	48	80
FDEX.Tota	26	46	71	111
RCEx	18	50	110	110

Godhra-Ratlam	2004-05	2011-12	2016-17	2022-21	2031-32
FDEx.P	26	6	7	8	10
FDEX.F	39	63	82	102	152
FDEX.Total	65	69	89	110	162
RCEx	44	110	110	110	110
FDDPC		24	27	29	38
RCDPC		140	140	140	140

Udhna-Surat	2004-05	2011-12	2016-17	2022-21	2031-32
FDEX.P	59	13	14	16	21
FDEX.F	27	51	71	90	149
FDEX.Total	86	64	85	106	170
RCEx	44	44	110	110	110
FDDPC		55	60	65	85
RCDPC		140	140	140	140

Figure 10-10 Relation between Demand and Line Capacity of DFC Option Case of the Western Corridor

(3) Summary of Chronological Relation between Demand / Capacity

Table 10-8 and Table 10-9 shows the Chronological Relation between Traffic Demand and Line Capacity for the Eastern and the Western Corridor respectively. Meanings of the respective cells classified by deferent color background are as follows.

i) Yellow color cell: means saturation of the capacity of single track. It needs double track improvement without automatic signaling system for the single track section

ii) Blue color cell: means saturation of the capacity of double track without automatic signaling system. It needs improvement of the double track section by means of automatic signaling system

iii) Red Color cell: means saturation of the capacity of double track with automatic signaling system. It needs improvement by construction of an additional new line

Table 10-8 Chronological Relation between Demand and Capacity for the Eastern corridor

Line Capacity

Existing Line	Single Track	20 trains/day
	Double Track	50 trains/day
	Double Track with Auto Signal	110 trains/day

DFC	140 trains/day
DPC	140 trains/day

(Number shows the Demand)

Item			Existing Track	2004-05	2011-12	2016-17	2021-22	2026-27	2031-32
Improvement of Existing Line									
Route E1	Mughal Sarai-Allahabad		Double	80	111	126	141	156	187
	Kanpur-Tundla		Double	92	122	137	151	168	199
Route E2	Luknow-Rosa		Double	51	59	67	76	95	112
DPC									
Route E1	Mughal Sarai-Allahabad	DPC	Double		40	43	46	53	61
		Existing Line	Double	80	71	83	95	103	126
	Kanpur-Tundla	DPC	Double		52	56	60	69	80
		Existing Line	Double	92	70	81	91	99	119
Route E2	Luknow-Rosa	Existing Line	Double	51	59	67	76	95	112
DFC									
Route E1	Mughal Sarai-Allahabad	DFC	Double		52	61	69	74	91
		Existing Line	Double	80	59	65	72	82	96
	Kanpur-Tundla	DFC	Double		53	61	68	73	89
		Existing Line	Double	92	69	76	83	95	110
Route E2	Luknow-Rosa	Existing Line	Double	51	59	67	76	95	112

Capacity Saturation of Double Track (DT)
Capacity Saturation of DT with Auto Signal

Improvement of Single Track: i) Double Tracking, ii) Auto Signallization
Improvement of Double Track: i) Auto Signallization

Table 10-9 Chronological Relation between Demand and Capacity for the Western corridor

Line Capacity

Existing Line	Single Track	20 trains/day
	Double Track	50 trains/day
	Double Track with Auto Signal	110 trains/day

DFC	140 trains/day
DPC	140 trains/day

(Number shows the Demand)

Item			Existing Track	2004-05	2011-12	2016-17	2021-22	2026-27	2031-32
Improvement of Existing Line									
Route W1	Udhna-Surat		Double	86	119	145	171	212	255
	Ratlam-Nagda		Double	65	93	115	137	167	199
Route W2	Mahesana-Palanpur		Single	26	45	58	71	85	99
DPC									
Route W1	Udhna-Surat	DPC	Double		54	59	65	74	85
	(Mumbai - Vadodara)	Existing Line	Double	86	65	86	106	138	170
	Ratlam-Nagda	DPC	Double		24	26	29	33	38
	(Vadodara - Kota)	Existing Line	Double	65	69	89	108	134	161
Route W2	Mahesana-Palanpur	Existing Line	Single	26	45	58	71	85	99
	(Ahmedabad - Delhi)								
DFC									
Route W1	Udhna-Surat	DFC	Double		33	49	64	89	114
	(Mumbai - Vadodara)	Existing Line	Double	86	86	96	107	123	141
	Ratlam-Nagda	Existing Line	Double	65	73	86	98	114	131
	(Vadodara - Kota)								
Route W2	Mahesana-Palanpur	DFC	Double		43	62	82	112	142
	(Ahmedabad - Delhi)	Existing Line	Single	26	23	25	28	32	36

Capacity Saturation of Single Track
Capacity Saturation of Double Track (DT)
Capacity Saturation of DT with Auto Signal

Improvement of Single Track: i) Double Tracking, ii) Auto Signallization
Improvement of Double Track: i) Auto Signallization

10.7.2 Comparison of the DPC Option and DFC Option by Construction Cost

As studied in the previous clauses, the DPC is not a preferable option from the view point of relationship between the traffic demand and the line capacity and hence has no advantage. Since the DPC has only one advantageous factor, that is DPC can reduce the construction cost of bridges due to adoption of lower axle load, the Study team evaluated approximate cost estimate based on the preliminary design shown in the *Volume 4 Technical Working Paper Task0&1, 10-(1), (2), (3)* and compared both options in terms of total construction cost. The Table 10-10 shows design condition of DPC and DFC option applied for the cost comparison and Table 10-11 shows the result of the cost estimate of both DPC and DFC options in comparasion.

Though the DPC routes were generally aligned along the DFC, to serve passengers, the new DPC lines must enter the central city areas to be connected to the existing stations to ensure accessibility of the passengers. To avoid additional traffic interference to the road traffic by DPC and minimize resettlement problem in the urban area, the DPC should have new elevated stations, constructed above the existing stations, which inevitably increase the civil construction costs substantially. Consequently despite the cost reduction by the narrowed right of way and lower axle load, the total construction cost of DPC is higher than that of the DFC by 50% for Western corridor and 40% for Eastern corridor.

Based on these results, DPC option was judged to be totally disadvantageous over the DFC, and was dropped as a viable alternative.

Table 10-10 Summary of Design Condition and Other Assumptions for the Cost Comparison

Corridor	Eastern Corridor		Western Corridor	
Option	DFC	DPC	DFC	DPC
Route and Section to be Compared	Sonnagar – Khurja		Vasai Rd. - TKD via Ahmedabad	Vasai Rd. – TKD via Kota
Route Length	821Km	821Km	1,364Km	1,318Km
Usage of New Track	Freight only	Passenger only	Freight only	Passenger only
Type of Structure	Embankment	Embankment + Viaduct (City Area)	Embankment	Embankment + Viaduct (City Area)
Traction System	Electrified	Electrified	Diesel	Diesel*)
Type of Track	Ballasted Double-Track	Ballasted Double-Track	Ballasted Double-Track	Ballasted Double-Track
Distance of Track	5.5 m	5.3 m	5.5 m	5.3 m
Axle Load	25.0 Ton	20.3 Ton	25.0 Ton	20.3 Ton
Design load of Bridge	30.0 Ton	20.3 Ton	30.0 Ton	20.3 Ton
Nos. of Station	7Stations	25 Stations	11 Stations	33 Stations
Length of Platform	1,500 m	605 m	1,500 m	605 m

*) Although electrification should be preferable for DPC option, diesel traction system is assumed for DPC option in this study for comparison purpose only

Table 10-11 Comparison of Construction Cost of DPC&DFC Options

Item (all costs are in Rs. Crores)	(1) DPC	(2) DFC	Difference (1) - (2)
East corridor (Sonnagar-Khruja) 812km	10,601 Cr. 13.06 Cr./km	7,039 Cr. 8.67 Cr./km	3,562 Cr. 4.39 Cr./km
WestCorridor DPC (Vasai Rd-Kota-TKD) 1,316km DFC (VasaiRoad-Ahmedabad-Dadri-TKD) 1,364km	15,373 Cr. 11.68 Cr./km	10,928 Cr. 8.01 Cr./km	4,445Cr. 3.67 Cr./km
Total DPC 2,128km DFC 2,176km	25,974 Cr. 11.68 Cr./km	17,967 Cr. 8.01 Cr./km	8,007 Cr. 3.67 Cr./km

10.7.3 Comprehensive Evaluation Result

The evaluation results are summarized in Table 10-12. This table says that;

1) Improvement of Existing Line cannot satisfy the future traffic demand in 2011 from the viewpoint of line capacity.

2) The Dedicated Freight Corridor is the most advantageous from the viewpoint of line capacity.

3) Improvement of Existing Line is the most advantageous from viewpoint of construction cost, and the Dedicated Freight Corridor follows it.

4) Improvement of Existing Line has advantage to other two alternatives from viewpoint of social environment impact.

From above evaluation results, it is concluded that Dedicated Freight Corridor is the optimum option among three alternatives.

Table 10-12 Comprehensive Evaluation Results of Alternatives

	DFC		DPC		IEL	
	Eastern	Western	Eastern	Western	Eastern	Western
Construction Cost (Cr. Rs.)	7,039	10,928	10,601	15,373	6,125 (Total of 4 routes)	
	B	B	D	D	A	A
Saturation Year of Line Capacity of Existing Line	2022	2030	2025	2020	2011	2011
	B	B	C	C	D	D
Possibility of Resettlement and Land Acquisition (Initial Screening)	Resettlement and Land Acquisition in the Detoured Section	Resettlement and Land Acquisition in the Detoured Section Two areas of protection fores	Large Number of Resettlement in Urbanized Sections	Large Number of Resettlement in Urbanized Sections "Keoladeo Ghana Lake Bird Sanctuary"	No Direct Serious Impact	No Direct Serious Impact
	C	C	D	D	B	B
Comprehensive Evaluation	A	A	C	C	B	B

CHAPTER 11
ENVIRONMENTAL AND SOCIAL CONSIDERATIONS STUDY (ESCS)

CHAPTER 11 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS STUDY (ESCS)[12]

11.1 ALTERNATIVE ANALYSIS

11.1.1 Setting of Alternatives

In the alternative analysis, without-project case, so-called Zero-option, means that excessive demand over the current freight transportation capability of the railway is allocated to the road transport in principle, without any additional infrastructure investment for expanding present capability of freight transportation by railway. On the other, in the with-project case, three alternatives are considered with increase of transportation capability of the railway; improvement of the existing railway lines, development of Dedicated Passenger Corridor (DPC), and development of Dedicated Freight Corridors (DFC).

The alternative for improvement of the existing railway lines consists of improvement of present signal system, station, and level crossing, electrification of non-electrified section to meet future demand. The Dedicated Passenger Corridor (DPC) develops new railway line for express passenger trains among cities and let freight train and local passenger train pass through smoothly in present railway line. In this case, high-speed express passenger train system is not subject to the alternative. On the other, the Dedicated Freight Corridors (DFC) develops new freight railway line for long-distance freight train and let all passenger trains and local freight train smoothly in present railway line to meet future demand of transportation.

Both DPC and DFC need to develop new railway lines, though locations of railway lines are different. However, in the case of DPC, since stations are required to locate in the urban canter, involuntary resettlement may occur in the land acquisition for the development, but less possibility for the DFC. Details on analysis of three alternatives are discussed in Chapter 10 of this report.

11.1.2 Environmental Scoping for Each Alternative

Environmental and social impacts for each alternative including the zero option were preliminary examined by using the environmental impact matrix.

(1) Zero Option

- Noise pollution level will be increased, at least frequency, with increase of train operation. For other environmental matters, there will be no direct environmental impacts caused by the Project;
- Because of no improvement on level crossings, number of railway accidents may increase as the number of trains gradually increase according to future increase of demand for both passenger and freight; and
- Because the number of trains gradually increases, waiting time at the level crossing may increase contributing traffic congestions especially in the urban areas.

In the case of zero option, it is expected that project cost would become much higher comparing to that of the present estimation as well as demand for the increased passengers or freight will not be met at the same time, when the project implementation is reconsidered after demands for passengers or freight exceed provision. Table 11-1 and Table 11-2 show environmental impact matrixes of the zero option.

[1] The ESCS is equivalent to the Environmental and Social Considerations Study at IEE Level under the JICA Guidelines for Environmental Social Considerations (2004).

[2] The contents in this chapter is based on the study results in Task 0&1. Therefore, some revisions were made in Task 2 study.

(2) Improvement of the Existing Railway Lines

There are two cases of improvement of the existing railway lines and environmental impacts of each option are summarized as follows:

1) Improvement of Present Signal and Track System

- Noise pollution level will be increased, at least frequency, with increase of train operation. For other environmental matters, installation of signal and track system takes place within the area of railway's right of way. Thus there is no significant direct impact caused by the Project;
- Since the level crossing is not improved by the Project, railway accidents may increase to some extent with increase of the number of trains; and
- Increased waiting time at the railway crossing with increase of the number of trains will be a cause of further traffic congestions in urban areas.

2) Construction of Double-tracks and Improvement of Present Signal and Track System

- As double-track railway is constructed alongside the existing railway lines, agricultural areas and roads along the existing railways will be affected due to additional land acquisition;
- Since there is no detour routes are considered to construct, a large number of involuntary resettlement for both legal residents and illegal occupants will be caused in the urban areas due to the land acquisition;
- Bisecting a patch of agricultural field due to the land acquisition between stations may cause livelihood loss for the farmers, especially in the case where more than half of farm land is lost for a farmer. In the case, adequate compensation and assistance are required for livelihood recovery as well as in the involuntary resettlement case;
- Railway accidents will be reduced if Road-over Bridges (ROBs) or Road-under Bridges (RUBs) are constructed. On the other, non-motorized transportation operators would suffer from climbing slopes of ROB or RUB; and
- In the Western Corridor, Vadodara-Kota-Agra-Delhi is the route subject to improvement under this option. At the location approximately 176 km to south of Delhi is Kaoladeo Ghana Lake Bird Sanctuary and the existing railway line is passing through the sanctuary. Thus, detailed environmental study on protected species in this area has to be carried out.

Table 11-3 to Table 11-6 show environmental impact matrixes of the option of Improvement of the Existing Railway Lines.

(3) Dedicated Passenger Corridor (DPC)

Environmental impacts of dedicated passenger corridor are summarized as follows:

- Construction of 4-km long elevated railway line and passenger stations required in 58 urban centres will cause large impacts on socio-economic environment;
- Railway passenger services would be greatly improved;
- Railway accidents will be reduced if Road-over Bridges (ROBs) or Road-under Bridges (RUBs) are constructed. On the other, non-motorized transportation operators would suffer from climbing slopes of ROB or RUB; and
- The traffic congestion is partially reduced at urban centres since the number of level crossing of railway decreases.

Table 11-7 and Table 11-8 show environmental impact matrixes of DPC alternative.

(4) Dedicated Freight Corridors (DFC)

Scope of the construction of dedicated freight corridors (DFC) is briefly shown in Section 15.3. Because of various railway facilities are constructed, impacts on the natural and social environment would not be insignificant. Environmental impacts of DFC Project are summarized as follows;

- Detour railway routes by-passing large to medium size urban centres at 26 locations are planned to construct to minimize the number of households to be resettled. However, there are more than 1,300 households subject to the resettlement. Thus appropriate resettlement and rehabilitation plan has to be elaborated based on National Rehabilitation Policy of 2006;
- A large area of farm land acquisition for construction of junction stations or crossing stations is required. Bisecting a patch of agricultural field due to land acquisition between stations as well as land acquisition in the detour railway section, may cause livelihood loss for the farmers, especially in the case where more than half of farm land is lost for a farmer. In the case, adequate compensation and assistant are required for livelihood recovery as well as in the involuntary resettlement case;
- Railway accidents will be reduced if Road-over Bridges (ROBs) or Road-under Bridges (RUBs) are constructed. On the other, non-motorized transportation operators would suffer from climbing slopes of ROB or RUB;
- Planned tunnel section is located in the middle of agricultural field on the plateaux around Sohna Hill in Gurgaon, Haryana State. It may cause lowering ground water of the area with significant impacts on the agricultural activities in the area.

Table 11-9 and Table 11-10 show environmental impact matrixes of the DFC alternative.

Table 11-1 Impact Matrix of Zero Option Alternative (Eastern Corridor)

a. Zero Option: Eastern Corridor

	No.	Items of the Environment Subject to Negative/Positive Changes \ Project Activities	Overall Evaluation on the Project	Pre-construction Stage			Construction Stage									Post-construction Stage					
				Survey/Study on the Project	Information on the Project	Participation to the SH Meeting	Land Acquisition and Resettlement	Clearing Vegetation/Top Soil for Preparation of the Construction Works	Earth Moving: Cutting and Filling of the Construction Works	Preparation of the Construction Areas, Work Camp and Mobilization of Construction Plants and Materials	Construction of Railway, Bridges, Access Road and Haul Road	Construction Works for Stations, Installation of Signals and Related Facilities	Emanation of Dust, Noise, Vibration and Traffic Congestions	Localized Employment Opportunities of the Construction Works	Localized Business Opportunities Related to the Construction Works	Improvement of Freight/Passenger Trains	Improved Structures of Stations and Other Facilities	Improvement of Railway Safety	Improvement of Employment Opportunities	Improvement of Passenger-oriented Business	Improvement of Freight-oriented Business
Social Environment	1	Livelihood of the Local Communities																			
		a. General	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		b. Socially and Physically Disadvantaged	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		c. Women and Children	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		d. Minority and Scheduled Caste	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	Social Cohesion and Physical Continuity of the Local Communities	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	Local Road/Water and/or Motorised/Non-motorised Transportation System	C-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C-	-	-	-
	4	Distribution of the Benefit of the Project	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5	Effect on the Social and Cultural Events and Tradition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	Effect on the Local Economic Activities																			
		a. Among the Sectors of Commerce and Industry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		b. Among the Local Business Communities	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7	Effect on the Water Rights/Commons for Grazing etc.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8	Public Hygiene and Health Care of the Local Communities		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9	Vulnerability/Resilience of the Society to Natural Disaster		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10	Traffic Safety	B-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	B-	-	-	-
	11	Changes on the Land Use and the Landscape	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Natural Environment	12	Geographical Conditions	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	13	Geological Conditions	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	14	Soil Erosion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	15	Faunal Ecology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	16	Flora Ecology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	17	Effects on the Ground Water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	18	Effect on the Surface Water Body (River, Lakes, etc)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	19	Effect on the Coastal Environment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	20	Oceanographic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	21	Effect on the Natural/Ecological Reserves and Sanctuaries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	22	Localised Climatic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	23	Effect on the Global Warming Issues	C-	-	-	-	-	-	-	-	-	-	-	-	-	C-	-	-	-	-	-
Pollution	24	Air Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	25	Water Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	26	Soil Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	27	Solid Waste and/or Industrial Discharge Management	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	28	Noise and Vibration	C-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	29	Large Scale Ground Settlement	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C-	-	-	-	-
	30	Emanating Odour	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	31	Pollution on the Water Bottom/Sludge and Its Effect on the Aquatic Life	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Legend: A - Significant changes expected; B - Relatively significant changes expected; C - Not significant but subject to further study; - - Neglectable impact;
A+, B+, C+ indicates relatively positive changes; A-, B-, C- indicates relatively negative changes;
A+/A-, B+/B-, C+/C- indicates that there would be positive impact while negative impact could also occur.

Table 11-2 Impact Matrix of Zero Option Alternative (Western Corridor)

b. Zero Option: Western Corridor

	No.	Items of the Environment Subject to Negative/Positive Changes \ Project Activities	Overall Evaluation on the Project	Pre-construction Stage: Survey/Study on the Project	Pre-construction Stage: Information on the Project	Pre-construction Stage: Participation to the SH Meeting	Construction Stage: Land Acquisition and Resettlement	Construction Stage: Clearing Vegetation/Top Soil for Preparation of the Construction Works	Construction Stage: Earth Moving: Cutting and Filling of the Construction Works	Construction Stage: Preparation of the Construction Areas, Work Camp and Mobilization of Construction Plants and Materials	Construction Stage: Construction of Railway, Bridges, Access Road and Haul Road	Construction Stage: Construction Works for Stations, Installation of Signals and Related Facilities	Construction Stage: Emanation of Dust, Noise, Vibration and Traffic Congestions	Construction Stage: Localized Employment Opportunities of the Construction Works	Construction Stage: Localized Business Opportunities Related to the Construction Works	Post-construction Stage: Improvement of Freight/Passenger Trains	Post-construction Stage: Improved Structures of Stations and Other Facilities	Post-construction Stage: Improvement of Railway Safety	Post-construction Stage: Improvement of Employment Opportunities	Post-construction Stage: Improvement of Passenger-oriented Business	Post-construction Stage: Improvement of Freight-oriented Business
Social Environment	1	Livelihood of the Local Communities																			
		a. General	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		b. Socially and Physically Disadvantaged	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		c. Women and Children	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		d. Minority and Scheduled Caste	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	Social Cohesion and Physical Continuity of the Local Communities	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	Local Road/Water and/or Motorised/Non-motorised Transportation System	C-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C-	-	-	-
	4	Distribution of the Benefit of the Project	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5	Effect on the Social and Cultural Events and Tradition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	Effect on the Local Economic Activities																			
		a. Among the Sectors of Commerce and Industry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		b. Among the Local Business Communities	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7	Effect on the Water Rights/Commons for Grazing etc.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8	Public Hygiene and Health Care of the Local Communities		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9	Vulnerability/Resilience of the Society to Natural Disaster		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10	Traffic Safety	B-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	B-	-	-	-
	11	Changes on the Land Use and the Landscape	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Natural Environment	12	Geographical Conditions	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	13	Geological Conditions	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	14	Soil Erosion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	15	Faunal Ecology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	16	Flora Ecology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	17	Effects on the Ground Water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	18	Effect on the Surface Water Body (River, Lakes, etc)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	19	Effect on the Coastal Environment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	20	Oceanographic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	21	Effect on the Natural/Ecological Reserves and Sanctuaries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	22	Localised Climatic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	23	Effect on the Global Warming Issues	C-	-	-	-	-	-	-	-	-	-	-	-	-	C-	-	-	-	-	-
Pollution	24	Air Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	25	Water Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	26	Soil Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	27	Solid Waste and/or Industrial Discharge Management	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	28	Noise and Vibration	C-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	29	Large Scale Ground Settlement	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C-	-	-	-	-
	30	Emanating Odour	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	31	Pollution on the Water Bottom/Sludge and Its Effect on the Aquatic Life	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Legend: A - Significant changes expected; B - Relatively significant changes expected; C - Not significant but subject to further study; - - Neglectable impact;
A+, B+, C+ indicates relatively positive changes; A-, B-, C- indicates relatively negative changes;
A+/A-, B+/B-, C+/C- indicates that there would be positive impact while negative impact could also occur.

Table 11-3 Impact Matrix of Modification of Existing Line Alternative (Improvement of Present Signal and Track System: Eastern Corridor)

a - 1. Improvement of the Existing Lines: Eastern Corridor - Signal System Improvement Without Double-truck Construction Works

		Project Activities / Items of the Environment Subject to Negative/Positive Changes		Pre-construction Stage			Construction Stage									Post-construction Stage					
	No.		Overall Evaluation on the Project	Survey/Study on the Project	Information on the Project	Participation to the SH Meeting	Land Acquisition and Resettlement	Clearing Vegetation/Top Soil for Preparation of the Construction Works	Earth Moving: Cutting and Filling of the Construction Works	Preparation of the Construction Areas, Work Camp and Mobilization of Construction Plants and Materials	Construction of Railway, Bridges, Access Road and Haul Road	Construction Works for Stations, Installation of Signals and Related Facilities	Emanation of Dust, Noise, Vibration and Traffic Congestions	Localized Employment Opportunities of the Construction Works	Localized Business Opportunities Related to the Construction Works	Improvement of Freight/Passenger Trains	Improved Structures of Stations and Other Facilities	Improvement of Railway Safety	Improvement of Employment Opportunities	Improvement of Passenger-oriented Business	Improvement of Freight-oriented Business
Social Environment	1	Livelihood of the Local Communities																			
		a. General	C+	-	-	-	-	-	-	-	-	-	-	-	-	C+	-	-	C+	C+	C+
		b. Socially and Physically Disadvantaged	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		c. Women and Children	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		d. Minority and Scheduled Caste	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	Social Cohesion and Physical Continuity of the Local Communities	C+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C+	-	C+	-
	3	Local Road/Water and/or Motorised/Non-motorised Transportation System	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4	Distribution of the Benefit of the Project	C+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C+
	5	Effect on the Social and Cultural Events and Tradition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	Effect on the Local Economic Activities																			
	7	a. Among the Sectors of Commerce and Industry	C+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C+
	8	b. Among the Local Business Communities	C+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C+
	9	Effect on the Water Rights/Commons for Grazing etc.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10	Public Hygiene and Health Care of the Local Communities	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11	Vulnerability/Resilience of the Society to Natural Disaster	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12	Traffic Safety	B+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	B+	-	-	-
	13	Changes on the Land Use and the Landscape	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Natural Environment	14	Geographical Conditions	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	15	Geological Conditions	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	16	Soil Erosion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	17	Faunal Ecology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	18	Flora Ecology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	19	Effects on the Ground Water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	20	Effect on the Surface Water Body (River, Lakes, etc)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	21	Effect on the Coastal Environment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	22	Oceanographic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	23	Effect on the Natural/Ecological Reserves and Sanctuaries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	24	Localised Climatic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	25	Effect on the Global Warming Issues	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pollution	26	Air Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	27	Water Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	28	Soil Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	29	Solid Waste and/or Industrial Discharge Management	C+	-	-	-	-	-	-	-	-	-	-	-	-	C+	-	-	-	-	-
	30	Noise and Vibration	C+	-	-	-	-	-	-	-	-	-	-	-	-	C+	-	-	-	-	-
	31	Large Scale Ground Settlement	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	32	Emanating Odour	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	33	Pollution on the Water Bottom/Sludge and Its Effect on the Aquatic Life	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Legend: A - Significant changes expected; B - Relatively significant changes expected; C - Not significant but subject to further study; - - Neglectable impact;
A+, B+, C+ indicates relatively positive changes; A-, B-, C- indicates relatively negative changes;
A+/A-, B+/B-, C+/C- indicates that there would be positive impact while negative impact could also occur.

Table 11-4 Impact Matrix of Modification of Existing Line Alternative (Improvement of Present Signal and Track System: Western Corridor)

a - 2. Improvement of the Existing Lines: Western Corridor - Signal System Improvement Without Double-truck Construction Works

	No.	Items of the Environment Subject to Negative/Positive Changes \ Project Activities	Overall Evaluation on the Project	Pre-construction Stage: Survey/Study on the Project	Pre-construction Stage: Information on the Project	Pre-construction Stage: Participation to the SH Meeting	Construction Stage: Land Acquisition and Resettlement	Construction Stage: Clearing Vegetation/Top Soil for Preparation of the Construction Works	Construction Stage: Earth Moving: Cutting and Filling of the Construction Works	Construction Stage: Preparation of the Construction Areas, Work Camp and Mobilization of Construction Plants and Materials	Construction Stage: Construction of Railway, Bridges, Access Road and Haul Road	Construction Stage: Construction Works for Stations, Installation of Signals and Related Facilities	Construction Stage: Emanation of Dust, Noise, Vibration and Traffic Congestions	Construction Stage: Localized Employment Opportunities of the Construction Works	Construction Stage: Localized Business Opportunities Related to the Construction Works	Post-construction Stage: Improvement of Freight/Passenger Trains	Post-construction Stage: Improved Structures of Stations and Other Facilities	Post-construction Stage: Improvement of Railway Safety	Post-construction Stage: Improvement of Employment Opportunities	Post-construction Stage: Improvement of Passenger-oriented Business	Post-construction Stage: Improvement of Freight-oriented Business
Social Environment	1	Livelihood of the Local Communities																			
		a. General	C+	-	-	-	-	-	-	-	-	-	-	-	-	C+	-	-	C+	C+	C+
		b. Socially and Physically Disadvantaged	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		c. Women and Children	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		d. Minority and Scheduled Caste	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	Social Cohesion and Physical Continuity of the Local Communities	C+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C+	-	C+	-
	3	Local Road/Water and/or Motorised/Non-motorised Transportation System	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4	Distribution of the Benefit of the Project	C+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C+
	5	Effect on the Social and Cultural Events and Tradition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	Effect on the Local Economic Activities																			
	7	a. Among the Sectors of Commerce and Industry	C+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C+
	8	b. Among the Local Business Communities	C+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C+
	9	Effect on the Water Rights/Commons for Grazing etc.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10	Public Hygiene and Health Care of the Local Communities	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11	Vulnerability/Resilience of the Society to Natural Disaster	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12	Traffic Safety	B+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	B+	-	-	-
	13	Changes on the Land Use and the Landscape	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Natural Environment	14	Geographical Conditions	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	15	Geological Conditions	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	16	Soil Erosion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	17	Faunal Ecology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	18	Flora Ecology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	19	Effects on the Ground Water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	20	Effect on the Surface Water Body (River, Lakes, etc)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	21	Effect on the Coastal Environment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	22	Oceanographic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	23	Effect on the Natural/Ecological Reserves and Sanctuaries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	24	Localised Climatic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	25	Effect on the Global Warming Issues	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pollution	26	Air Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	27	Water Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	28	Soil Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	29	Solid Waste and/or Industrial Discharge Management	C+	-	-	-	-	-	-	-	-	-	-	-	-	C+	-	-	-	-	-
	30	Noise and Vibration	C+	-	-	-	-	-	-	-	-	-	-	-	-	C+	-	-	-	-	-
	31	Large Scale Ground Settlement	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	32	Emanating Odour	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	33	Pollution on the Water Bottom/Sludge and Its Effect on the Aquatic Life	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Legend: A - Significant changes expected; B - Relatively significant changes expected; C - Not significant but subject to further study; - - Neglectable impact;
A+, B+, C+ indicates relatively positive changes; A-, B-, C- indicates relatively negative changes;
A+/A-, B+/B-, C+/C- indicates that there would be positive impact while negative impact could also occur.

Table 11-5 Impact Matrix of Modification of Existing Line Alternative (Construction of Double-tracks and Improvement of Present Signal and Track System: Eastern Corridor)

b - 1. Improvement of the Existing Lines: Eastern Corridor - Signal System Improvement With Double-truck Construction Works

	No.	Items of the Environment Subject to Negative/Positive Changes / Project Activities	Overall Evaluation on the Project	Pre-construction Stage			Construction Stage									Post-construction Stage					
				Survey/Study on the Project	Information on the Project	Participation to the SH Meeting	Land Acquisition and Resettlement	Clearing Vegetation/Top Soil for Preparation of the Construction Works	Earth Moving: Cutting and Filling of the Construction Works	Preparation of the Construction Areas, Work Camp and Mobilization of Construction Plants and Materials	Construction of Railway, Bridges, Access Road and Haul Road	Construction Works for Stations, Installation of Signals and Related Facilities	Emanation of Dust, Noise, Vibration and Traffic Congestions	Localized Employment Opportunities of the Construction Works	Localized Business Opportunities Related to the Construction Works	Improvement of Freight/Passenger Trains	Improved Structures of Stations and Other Facilities	Improvement of Railway Safety	Improvement of Employment Opportunities	Improvement of Passenger-oriented Business	Improvement of Freight-oriented Business
Social Environment	1	Livelihood of the Local Communities																			
		a. General	A-	C-/+	C-/+	C-/+	A-	C-	C-	C-	C-	-	C-	C+	C+	C+	-	C+/C-	C+	C+	C+
		b. Socially and Physically Disadvantaged	A-	C-/+	C-/+	C-/+	A-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		c. Women and Children	A-	C-/+	C-/+	C-/+	A-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		d. Minority and Scheduled Caste	A-	C-/+	C-/+	C-/+	A-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	Social Cohesion and Physical Continuity of the Local Communities	A-	C-/+	C-/+	C-/+	A-	-	-	-	-	-	-	-	-	-	-	C+	-	C+	-
	3	Local Road/Water and/or Motorised/Non-motorised Transportation System	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C+
	4	Distribution of the Benefit of the Project	C+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C+	-	-	C+
	5	Effect on the Social and Cultural Events and Tradition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	Effect on the Local Economic Activities																			
	7	a. Among the Sectors of Commerce and Industry	B-/C+	-	-	-	B-	-	-	-	-	-	-	-	C+	-	-	-	-	-	C+
	8	b. Among the Local Business Communities	B-/C+	-	-	-	B-	-	-	-	-	-	-	-	C+	-	-	-	-	-	C+
	9	Effect on the Water Rights/Commons for Grazing etc.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10	Public Hygiene and Health Care of the Local Communities	-	-	-	-	-	C-	C-	C-	C-	-	C-	-	-	-	-	-	-	-	-
	11	Vulnerability/Resilience of the Society to Natural Disaster	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12	Traffic Safety	B+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	B+	-	-	-
	13	Changes on the Land Use and the Landscape	C-	-	-	-	C-	C-	C-	C-	C-	-	-	-	-	-	-	-	-	-	-
Natural Environment	14	Geographical Conditions	C-	-	-	-	-	-	-	-	C-	-	-	-	-	-	-	-	-	-	-
	15	Geological Conditions	C-	-	-	-	-	-	C-	-	C-	-	-	-	-	-	-	-	-	-	-
	16	Soil Erosion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	17	Faunal Ecology	C-	-	-	-	-	C-	C-	C-	C-	-	-	-	-	-	-	-	-	-	-
	18	Flora Ecology	B-	-	-	-	-	B-	B-	B-	B-	-	-	-	-	-	-	-	-	-	-
	19	Effects on the Ground Water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	20	Effect on the Surface Water Body (River, Lakes, etc)	B-	-	-	-	-	-	-	-	B-	-	-	-	-	-	-	-	-	-	-
	21	Effect on the Coastal Environment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	22	Oceanographic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	23	Effect on the Natural/Ecological Reserves and Sanctuaries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	24	Localised Climatic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	25	Effect on the Global Warming Issues	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pollution	26	Air Pollution	C-	-	-	-	-	C-	C-	C-	C-	-	C-	-	-	-	-	-	-	-	-
	27	Water Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	28	Soil Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	29	Solid Waste and/or Industrial Discharge Management	C-	-	-	-	-	C-	C-	C-	C-	-	C-	-	-	-	-	-	-	-	-
	30	Noise and Vibration	C-	-	-	-	-	C-	C-	C-	C-	-	C-	-	-	C-	-	-	-	-	-
	31	Large Scale Ground Settlement	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	32	Emanating Odour	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	33	Pollution on the Water Bottom/Sludge and Its Effect on the Aquatic Life	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Legend: A - Significant changes expected; B - Relatively significant changes expected; C - Not significant but subject to further study; - - Neglectable impact;
A+, B+, C+ indicates relatively positive changes; A-, B-, C- indicates relatively negative changes;
A+/A-, B+/B-, C+/C- indicates that there would be positive impact while negative impact could also occur.

Table 11-6 Impact Matrix of Modification of Existing Line Alternative (Construction of Double-tracks and Improvement of Present Signal and Track System: Western Corridor)

b - 2. Improvement of the Existing Lines: Western Corridor - Signal System Improvement With Double-truck Construction Works

	No.	Items of the Environment Subject to Negative/Positive Changes / Project Activities	Overall Evaluation on the Project	Pre-construction Stage			Construction Stage									Post-construction Stage					
				Survey/Study on the Project	Information on the Project	Participation to the SH Meeting	Land Acquisition and Resettlement	Clearing Vegetation/Top Soil for Preparation of the Construction Works	Earth Moving: Cutting and Filling of the Construction Works	Preparation of the Construction Areas, Work Camp and Mobilization of Construction Plants and Materials	Construction of Railway, Bridges, Access Road and Haul Road	Construction Works for Stations, Installation of Signals and Related Facilities	Emanation of Dust, Noise, Vibration and Traffic Congestions	Localized Employment Opportunities of the Construction Works	Localized Business Opportunities Related to the Construction Works	Improvement of Freight/Passenger Trains	Improved Structures of Stations and Other Facilities	Improvement of Railway Safety	Improvement of Employment Opportunities	Improvement of Passenger-oriented Business	Improvement of Freight-oriented Business
Social Environment	1	Livelihood of the Local Communities																			
		a. General	A-	C-/+	C-/+	C-/+	A-	C-	C-	C-	C-	-	C-	C+	C+	C+	-	C+/C-	C+	C+	C+
		b. Socially and Physically Disadvantaged	A-	C-/+	C-/+	C-/+	A-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		c. Women and Children	A-	C-/+	C-/+	C-/+	A-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		d. Minority and Scheduled Caste	A-	C-/+	C-/+	C-/+	A-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	Social Cohesion and Physical Continuity of the Local Communities	A-	C-/+	C-/+	C-/+	A-	-	-	-	-	-	-	-	-	-	-	C+	-	C+	-
	3	Local Road/Water and/or Motorised/Non-motorised Transportation System	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C+
	4	Distribution of the Benefit of the Project	C+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C+	-	-	C+
	5	Effect on the Social and Cultural Events and Tradition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	Effect on the Local Economic Activities																			
	7	a. Among the Sectors of Commerce and Industry	B-/C+	-	-	-	B-	-	-	-	-	-	-	-	C+	-	-	-	-	-	C+
	8	b. Among the Local Business Communities	B-/C+	-	-	-	B-	-	-	-	-	-	-	-	C+	-	-	-	-	-	C+
	9	Effect on the Water Rights/Commons for Grazing etc.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10	Public Hygiene and Health Care of the Local Communities	-	-	-	-	-	C-	C-	C-	C-	-	C-	-	-	-	-	-	-	-	-
	11	Vulnerability/Resilience of the Society to Natural Disaster	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12	Traffic Safety	B+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	B+	-	-	-
	13	Changes on the Land Use and the Landscape	C-	-	-	-	C-	C-	C-	C-	C-	-	-	-	-	-	-	-	-	-	-
Natural Environment	14	Geographical Conditions	C-	-	-	-	-	-	-	-	C-	-	-	-	-	-	-	-	-	-	-
	15	Geological Conditions	C-	-	-	-	-	-	C-	-	C-	-	-	-	-	-	-	-	-	-	-
	16	Soil Erosion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	17	Faunal Ecology	C-	-	-	-	-	C-	C-	C-	C-	-	-	-	-	-	-	-	-	-	-
	18	Flora Ecology	B-	-	-	-	-	B-	B-	B-	B-	-	-	-	-	-	-	-	-	-	-
	19	Effects on the Ground Water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	20	Effect on the Surface Water Body (River, Lakes, etc)	B-	-	-	-	-	-	-	-	B-	-	-	-	-	-	-	-	-	-	-
	21	Effect on the Coastal Environment	C-	-	-	-	-	C-	C-	C-	C-	-	-	-	-	-	-	-	-	-	-
	22	Oceanographic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	23	Effect on the Natural/Ecological Reserves and Sanctuaries	B-	-	-	-	-	B-	B-	B-	B-	-	-	-	-	-	-	-	-	-	-
	24	Localised Climatic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	25	Effect on the Global Warming Issues	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pollution	26	Air Pollution	C-	-	-	-	-	C-	C-	C-	C-	-	C-	-	-	-	-	-	-	-	-
	27	Water Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	28	Soil Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	29	Solid Waste and/or Industrial Discharge Management	C-	-	-	-	-	C-	C-	C-	C-	-	C-	-	-	-	-	-	-	-	-
	30	Noise and Vibration	C-	-	-	-	-	C-	C-	C-	C-	-	C-	-	-	C-	-	-	-	-	-
	31	Large Scale Ground Settlement	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	32	Emanating Odour	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	33	Pollution on the Water Bottom/Sludge and Its Effect on the Aquatic Life	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Legend: A - Significant changes expected; B - Relatively significant changes expected; C - Not significant but subject to further study; - - Neglectable impact;
A+, B+, C+ indicates relatively positive changes; A-, B-, C- indicates relatively negative changes;
A+/A-, B+/B-, C+/C- indicates that there would be positive impact while negative impact could also occur.

Table 11-7 Impact Matrix of Dedicated Passenger Corridor (DPC) Alternative (Eastern Corridor)

a. New Passenger Lines: Eastern Corridor - Double-truck Construction Works and Elevated Station Construction Works

	No.	Items of the Environment Subject to Negative/Positive Changes / Project Activities	Overall Evaluation on the Project	Pre-construction Stage			Construction Stage									Post-construction Stage					
				Survey/Study on the Project	Information on the Project	Participation to the SH Meeting	Land Acquisition and Resettlement	Clearing Vegetation/Top Soil for Preparation of the Construction Works	Earth Moving: Cutting and Filling of the Construction Works	Preparation of the Construction Areas, Work Camp and Mobilization of Construction Plants and Materials	Construction of Railway, Bridges, Access Road and Haul Road	Construction Works for Stations, Installation of Signals and Related Facilities	Emanation of Dust, Noise, Vibration and Traffic Congestions	Localized Employment Opportunities of the Construction Works	Localized Business Opportunities Related to the Construction Works	Improvement of Freight/Passenger Trains	Improved Structures of Stations and Other Facilities	Improvement of Railway Safety	Improvement of Employment Opportunities	Improvement of Passenger-oriented Business	Improvement of Freight-oriented Business
Social Environment	1	Livelihood of the Local Communities																			
		a. General	A-	C-/+	C-/+	C-/+	A-	C-	C-	C-	C-	A-	C-	C+	C+	C+	-	C+/C-	C+	C+	C+
		b. Socially and Physically Disadvantaged	A-	C-/+	C-/+	C-/+	A-	-	-	-	-	A-	-	-	-	-	-	-	-	-	-
		c. Women and Children	A-	C-/+	C-/+	C-/+	A-	-	-	-	-	A-	-	-	-	-	-	-	-	-	-
		d. Minority and Scheduled Caste	A-	C-/+	C-/+	C-/+	A-	-	-	-	-	A-	-	-	-	-	-	-	-	-	-
	2	Social Cohesion and Physical Continuity of the Local Communities	A-	C-/+	C-/+	C-/+	A-	-	-	-	-	A-	-	-	-	-	-	C+	-	C+	-
	3	Local Road/Water and/or Motorised/Non-motorised Transportation System	B+	-	-	-	-	-	-	-	-	-	-	-	-	B+	B+	-	-	-	C+
	4	Distribution of the Benefit of the Project	B+	-	-	-	-	-	-	-	-	-	B-	B+	B+	-	-	C+	-	B-/+	C+
	5	Effect on the Social and Cultural Events and Tradition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	Effect on the Local Economic Activities																			
	7	a. Among the Sectors of Commerce and Industry	B-/+	-	-	-	B-	-	-	-	-	-	-	-	C+	-	-	-	-	B-/+	C+
	8	b. Among the Local Business Communities	B-/+	-	-	-	B-	-	-	-	-	-	-	-	C+	-	-	-	-	B-/+	C+
	9	Effect on the Water Rights/Commons for Grazing etc.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10	Public Hygiene and Health Care of the Local Communities	-	-	-	-	-	C-	C-	C-	C-	-	C-	-	-	-	-	-	-	-	-
	11	Vulnerability/Resilience of the Society to Natural Disaster	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12	Traffic Safety	B+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	B+	-	-	-
	13	Changes on the Land Use and the Landscape	C-	-	-	-	C-	C-	C-	C-	C-	-	-	-	-	-	-	-	-	-	-
Natural Environment	14	Geographical Conditions	C-	-	-	-	-	-	-	-	C-	-	-	-	-	-	-	-	-	-	-
	15	Geological Conditions	C-	-	-	-	-	-	C-	-	C-	-	-	-	-	-	-	-	-	-	-
	16	Soil Erosion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	17	Faunal Ecology	C-	-	-	-	-	C-	C-	C-	C-	-	-	-	-	-	-	-	-	-	-
	18	Flora Ecology	B-	-	-	-	-	B-	B-	B-	B-	-	-	-	-	-	-	-	-	-	-
	19	Effects on the Ground Water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	20	Effect on the Surface Water Body (River, Lakes, etc)	B-	-	-	-	-	-	-	-	B-	-	-	-	-	-	-	-	-	-	-
	21	Effect on the Coastal Environment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	22	Oceanographic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	23	Effect on the Natural/Ecological Reserves and Sanctuaries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	24	Localised Climatic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	25	Effect on the Global Warming Issues	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pollution	26	Air Pollution	C-	-	-	-	-	C-	C-	C-	C-	-	C-	-	-	-	-	-	-	-	-
	27	Water Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	28	Soil Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	29	Solid Waste and/or Industrial Discharge Management	C-	-	-	-	-	C-	C-	C-	C-	-	C-	-	-	-	-	-	-	-	-
	30	Noise and Vibration	C-	-	-	-	-	C-	C-	C-	C-	-	C-	-	-	C-	-	-	-	-	-
	31	Large Scale Ground Settlement	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	32	Emanating Odour	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	33	Pollution on the Water Bottom/Sludge and Its Effect on the Aquatic Life	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Legend: A - Significant changes expected; B - Relatively significant changes expected; C - Not significant but subject to further study; - - Neglectable impact;
A+, B+, C+ indicates relatively positive changes; A-, B-, C- indicates relatively negative changes;
A+/A-, B+/B-, C+/C- indicates that there would be positive impact while negative impact could also occur.

Table 11-8 Impact Matrix of Dedicated Passenger Corridor (DPC) Alternative (Western Corridor)

b. New Passenger Lines: Western Corridor - Double-track Construction Works and Elevated Station Construction Works

	No.	Items of the Environment Subject to Negative/Positive Changes / Project Activities	Overall Evaluation on the Project	Pre-construction Stage			Construction Stage									Post-construction Stage					
				Survey/Study on the Project	Information on the Project	Participation to the SH Meeting	Land Acquisition and Resettlement	Clearing Vegetation/Top Soil for Preparation of the Construction Works	Earth Moving: Cutting and Filling of the Construction Works	Preparation of the Construction Areas, Work Camp and Mobilization of Construction Plants and Materials	Construction of Railway, Bridges, Access Road and Haul Road	Construction Works for Stations, Installation of Signals and Related Facilities	Emanation of Dust, Noise, Vibration and Traffic Congestions	Localized Employment Opportunities of the Construction Works	Localized Business Opportunities Related to the Construction Works	Improvement of Freight/Passenger Trains	Improved Structures of Stations and Other Facilities	Improvement of Railway Safety	Improvement of Employment Opportunities	Improvement of Passenger-oriented Business	Improvement of Freight-oriented Business
Social Environment	1	Livelihood of the Local Communities																			
		a. General	A-	C-/+	C-/+	C-/+	A-	C-	C-	C-	C-	A-	C-	C+	C+	C+	-	C+/C-	C+	C+	C+
		b. Socially and Physically Disadvantaged	A-	C-/+	C-/+	C-/+	A-	-	-	-	-	A-	-	-	-	-	-	-	-	-	-
		c. Women and Children	A-	C-/+	C-/+	C-/+	A-	-	-	-	-	A-	-	-	-	-	-	-	-	-	-
		d. Minority and Scheduled Caste	A-	C-/+	C-/+	C-/+	A-	-	-	-	-	A-	-	-	-	-	-	-	-	-	-
	2	Social Cohesion and Physical Continuity of the Local Communities	A-	C-/+	C-/+	C-/+	A-	-	-	-	-	A-	-	-	-	-	-	C+	-	C+	-
	3	Local Road/Water and/or Motorised/Non-motorised Transportation System	B+	-	-	-	-	-	-	-	-	-	-	-	-	B+	B+	-	-	-	C+
	4	Distribution of the Benefit of the Project	B+	-	-	-	-	-	-	-	-	-	B-	B+	B+	-	-	C+	-	B-/+	C+
	5	Effect on the Social and Cultural Events and Tradition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	Effect on the Local Economic Activities																			
	7	a. Among the Sectors of Commerce and Industry	B-/+	-	-	-	B-	-	-	-	-	-	-	-	C+	-	-	-	-	B-/+	C+
	8	b. Among the Local Business Communities	B-/+	-	-	-	B-	-	-	-	-	-	-	-	C+	-	-	-	-	B-/+	C+
	9	Effect on the Water Rights/Commons for Grazing etc.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10	Public Hygiene and Health Care of the Local Communities	-	-	-	-	-	C-	C-	C-	C-	-	C-	-	-	-	-	-	-	-	-
	11	Vulnerability/Resilience of the Society to Natural Disaster	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12	Traffic Safety	B+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	B+	-	-	-
	13	Changes on the Land Use and the Landscape	C-	-	-	-	C-	C-	C-	C-	C-	-	-	-	-	-	-	-	-	-	-
Natural Environment	14	Geographical Conditions	C-	-	-	-	-	-	-	-	C-	-	-	-	-	-	-	-	-	-	-
	15	Geological Conditions	C-	-	-	-	-	-	C-	-	C-	-	-	-	-	-	-	-	-	-	-
	16	Soil Erosion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	17	Faunal Ecology	C-	-	-	-	-	C-	C-	C-	C-	-	-	-	-	-	-	-	-	-	-
	18	Flora Ecology	B-	-	-	-	-	B-	B-	B-	B-	-	-	-	-	-	-	-	-	-	-
	19	Effects on the Ground Water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	20	Effect on the Surface Water Body (River, Lakes, etc)	B-	-	-	-	-	-	-	-	B-	-	-	-	-	-	-	-	-	-	-
	21	Effect on the Coastal Environment	C-	-	-	-	-	C-	C-	C-	C-	-	-	-	-	-	-	-	-	-	-
	22	Oceanographic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	23	Effect on the Natural/Ecological Reserves and Sanctuaries	A-	-	-	-	-	A-	A-	A-	A-	-	-	-	-	-	-	-	-	-	-
	24	Localised Climatic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	25	Effect on the Global Warming Issues	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pollution	26	Air Pollution	C-	-	-	-	-	C-	C-	C-	C-	-	C-	-	-	-	-	-	-	-	-
	27	Water Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	28	Soil Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	29	Solid Waste and/or Industrial Discharge Management	C-	-	-	-	-	C-	C-	C-	C-	-	C-	-	-	-	-	-	-	-	-
	30	Noise and Vibration	C-	-	-	-	-	C-	C-	C-	C-	-	-	-	-	C-	-	-	-	-	-
	31	Large Scale Ground Settlement	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	32	Emanating Odour	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	33	Pollution on the Water Bottom/Sludge and Its Effect on the Aquatic Life	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Legend: A - Significant changes expected; B - Relatively significant changes expected; C - Not significant but subject to further study; - - Neglectable impact;
A+, B+, C+ indicates relatively positive changes; A-, B-, C- indicates relatively negative changes;
A+/A-, B+/B-, C+/C- indicates that there would be positive impact while negative impact could also occur.

Table 11-9 Impact Matrix of Dedicated Freight Corridor (DFC) Alternative (Eastern Corridor)

a. Construction of Dedicated Freight Corridor: Eastern Corridor - Double-truck Construction Works Including Divsersions

	No.	Items of the Environment Subject to Negative/Positive Changes / Project Activities	Overall Evaluation on the Project	Pre-construction Stage: Survey/Study on the Project	Pre-construction Stage: Information on the Project	Pre-construction Stage: Participation to the SH Meeting	Construction Stage: Land Acquisition and Resettlement	Construction Stage: Clearing Vegetation/Top Soil for Preparation of the Construction Works	Construction Stage: Earth Moving: Cutting and Filling of the Construction Works	Construction Stage: Preparation of the Construction Areas, Work Camp and Mobilization of Construction Plants and Materials	Construction Stage: Construction of Railway, Bridges, Access Road and Haul Road	Construction Stage: Construction Works for Stations, Installation of Signals and Related Facilities	Construction Stage: Emanation of Dust, Noise, Vibration and Traffic Congestions	Construction Stage: Localized Employment Opportunities of the Construction Works	Construction Stage: Localized Business Opportunities Related to the Construction Works	Post-construction Stage: Improvement of Freight/Passenger Trains	Post-construction Stage: Improved Structures of Stations and Other Facilities	Post-construction Stage: Improvement of Railway Safety	Post-construction Stage: Improvement of Employment Opportunities	Post-construction Stage: Improvement of Passenger-oriented Business	Post-construction Stage: Improvement of Freight-oriented Business
Social Environment	1	Livelihood of the Local Communities																			
		a. General	A-	C-/+	C-/+	C-/+	A-	C-	C-	C-	C-	-	C-	C+	C+	C+	-	C+/C-	C+	C+	C+
		b. Socially and Physically Disadvantaged	A-	C-/+	C-/+	C-/+	A-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		c. Women and Children	A-	C-/+	C-/+	C-/+	A-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		d. Minority and Scheduled Caste	A-	C-/+	C-/+	C-/+	A-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	Social Cohesion and Physical Continuity of the Local Communities	A-	C-/+	C-/+	C-/+	A-	-	-	-	-	-	-	-	-	-	-	C+	-	C+	-
	3	Local Road/Water and/or Motorised/Non-motorised Transportation System	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C+
	4	Distribution of the Benefit of the Project	C+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C+	-	-	C+
	5	Effect on the Social and Cultural Events and Tradition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	Effect on the Local Economic Activities																			
	7	a. Among the Sectors of Commerce and Industry	B-/C+	-	-	-	B-	-	-	-	-	-	-	-	C+	-	-	-	-	-	C+
	8	b. Among the Local Business Communities	B-/C+	-	-	-	B-	-	-	-	-	-	-	-	C+	-	-	-	-	-	C+
	9	Effect on the Water Rights/Commons for Grazing etc.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10	Public Hygiene and Health Care of the Local Communities	C-	-	-	-	-	C-	C-	C-	C-	-	C-	-	-	-	-	-	-	-	-
	11	Vulnerability/Resilience of the Society to Natural Disaster	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12	Traffic Safety	C+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C+	-	-	-
	13	Changes on the Land Use and the Landscape	C-	-	-	-	C-	C-	C-	C-	C-	-	-	-	-	-	-	-	-	-	-
Natural Environment	14	Geographical Conditions	C-	-	-	-	-	-	-	-	C-	-	-	-	-	-	-	-	-	-	-
	15	Geological Conditions	C-	-	-	-	-	-	C-	-	C-	-	-	-	-	-	-	-	-	-	-
	16	Soil Erosion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	17	Faunal Ecology	C-	-	-	-	-	C-	C-	C-	C-	-	-	-	-	-	-	-	-	-	-
	18	Flora Ecology	B-	-	-	-	-	B-	B-	B-	B-	-	-	-	-	-	-	-	-	-	-
	19	Effects on the Ground Water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	20	Effect on the Surface Water Body (River, Lakes, etc)	B-	-	-	-	-	-	-	-	B-	-	-	-	-	-	-	-	-	-	-
	21	Effect on the Coastal Environment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	22	Oceanographic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	23	Effect on the Natural/Ecological Reserves and Sanctuaries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	24	Localised Climatic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	25	Effect on the Global Warming Issues	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pollution	26	Air Pollution	C-	-	-	-	-	C-	C-	C-	C-	-	C-	-	-	-	-	-	-	-	-
	27	Water Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	28	Soil Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	29	Solid Waste and/or Industrial Discharge Management	C-	-	-	-	-	C-	C-	C-	C-	-	C-	-	-	-	-	-	-	-	-
	30	Noise and Vibration	C-	-	-	-	-	C-	C-	C-	C-	-	C-	-	-	C-	-	-	-	-	-
	31	Large Scale Ground Settlement	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	32	Emanating Odour	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	33	Pollution on the Water Bottom/Sludge and Its Effect on the Aquatic Life	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Legend: A - Significant changes expected; B - Relatively significant changes expected; C - Not significant but subject to further study; - - Neglectable impact;
A+, B+, C+ indicates relatively positive changes; A-, B-, C- indicates relatively negative changes;
A+/A-, B+/B-, C+/C- indicates that there would be positive impact while negative impact could also occur.

Table 11-10 Impact Matrix of Dedicated Freight Corridor (DFC) Alternative (Western Corridor)

b. Construction of Dedicated Freight Corridor: Western Corridor - Double-truck Construction Works Including Divsersions

	No.	Project Activities / Items of the Environment Subject to Negative/Positive Changes	Overall Evaluation on the Project	Pre-construction Stage			Construction Stage									Post-construction Stage					
				Survey/Study on the Project	Information on the Project	Participation to the SH Meeting	Land Acquisition and Resettlement	Clearing Vegetation/Top Soil for Preparation of the Construction Works	Earth Moving: Cutting and Filling of the Construction Works	Preparation of the Construction Areas, Work Camp and Mobilization of Construction Plants and Materials	Construction of Railway, Bridges, Access Road and Haul Road	Construction Works for Stations, Installation of Signals and Related Facilities	Emanation of Dust, Noise, Vibration and Traffic Congestions	Localized Employment Opportunities of the Construction Works	Localized Business Opportunities Related to the Construction Works	Improvement of Freight/Passenger Trains	Improved Structures of Stations and Other Facilities	Improvement of Railway Safety	Improvement of Employment Opportunities	Improvement of Passenger-oriented Business	Improvement of Freight-oriented Business
Social Environment	1	Livelihood of the Local Communities																			
		a. General	A-	C-/+	C-/+	C-/+	A-	C-	C-	C-	C-	-	C-	C+	C+	C+	-	C+/C-	C+	C+	C+
		b. Socially and Physically Disadvantaged	A-	C-/+	C-/+	C-/+	A-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		c. Women and Children	A-	C-/+	C-/+	C-/+	A-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		d. Minority and Scheduled Caste	A-	C-/+	C-/+	C-/+	A-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	Social Cohesion and Physical Continuity of the Local Communities	A-	C-/+	C-/+	C-/+	A-	-	-	-	-	-	-	-	-	-	-	C+	-	C+	-
	3	Local Road/Water and/or Motorised/Non-motorised Transportation System	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C+
	4	Distribution of the Benefit of the Project	C+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C+	-	-	C+
	5	Effect on the Social and Cultural Events and Tradition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	Effect on the Local Economic Activities																			
	7	a. Among the Sectors of Commerce and Industry	B-/C+	-	-	-	B-	-	-	-	-	-	-	-	C+	-	-	-	-	-	C+
	8	b. Among the Local Business Communities	B-/C+	-	-	-	B-	-	-	-	-	-	-	-	C+	-	-	-	-	-	C+
	9	Effect on the Water Rights/Commons for Grazing etc.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10	Public Hygiene and Health Care of the Local Communities	-	-	-	-	-	C-	C-	C-	C-	-	C-	-	-	-	-	-	-	-	-
	11	Vulnerability/Resilience of the Society to Natural Disaster	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12	Traffic Safety	C+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C+	-	-	-
	13	Changes on the Land Use and the Landscape	C-	-	-	-	C-	C-	C-	C-	C-	-	-	-	-	-	-	-	-	-	-
Natural Environment	14	Geographical Conditions	C-	-	-	-	-	-	-	-	C-	-	-	-	-	-	-	-	-	-	-
	15	Geological Conditions	C-	-	-	-	-	-	C-	-	C-	-	-	-	-	-	-	-	-	-	-
	16	Soil Erosion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	17	Faunal Ecology	C-	-	-	-	-	C-	C-	C-	C-	-	-	-	-	-	-	-	-	-	-
	18	Flora Ecology	B-	-	-	-	-	B-	B-	B-	B-	-	-	-	-	-	-	-	-	-	-
	19	Effects on the Ground Water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	20	Effect on the Surface Water Body (River, Lakes, etc)	B-	-	-	-	-	-	-	-	B-	-	-	-	-	-	-	-	-	-	-
	21	Effect on the Coastal Environment	C-	-	-	-	-	C-	C-	C-	C-	-	-	-	-	-	-	-	-	-	-
	22	Oceanographic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	23	Effect on the Natural/Ecological Reserves and Sanctuaries	-	-	-	-	-	C-	C-	-	-	-	-	-	-	-	-	-	-	-	-
	24	Localised Climatic Changes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	25	Effect on the Global Warming Issues	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pollution	26	Air Pollution	C-	-	-	-	-	C-	C-	C-	C-	-	C-	-	-	-	-	-	-	-	-
	27	Water Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	28	Soil Pollution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	29	Solid Waste and/or Industrial Discharge Management	C-	-	-	-	-	C-	C-	C-	C-	-	C-	-	-	-	-	-	-	-	-
	30	Noise and Vibration	C-	-	-	-	-	C-	C-	C-	C-	-	C-	-	-	C-	-	-	-	-	-
	31	Large Scale Ground Settlement	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	32	Emanating Odour	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	33	Pollution on the Water Bottom/Sludge and Its Effect on the Aquatic Life	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Legend: A - Significant changes expected; B - Relatively significant changes expected; C - Not significant but subject to further study; - - Neglectable impact;
A+, B+, C+ indicates relatively positive changes; A-, B-, C- indicates relatively negative changes;
A+/A-, B+/B-, C+/C- indicates that there would be positive impact while negative impact could also occur.

11.2 LAWS AND REGULATIONS ON ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

11.2.1 Indian Laws and Regulations on Environmental Clearance

Environmental laws and regulations in India related to the project are summarized below. Other environmental legislations are shown in *Volume 4 Technical Working Paper Task0&1, 11-(1)*.

(1) Notification of Ministry of Environment and Forests, 2006

This is an Indian government's guidelines for environmental impact assessment governing all of the development intervention that takes place within the boundaries of India, revised in 2006. Railway development project and bridge construction project are exempted from the environmental clearance.

(2) The Land Acquisition Act, 1894

This is a law on land acquisition promulgated in 1894. Land Acquisition of the railway development project is considered to fall into "Special Powers in Case of Emergency" Clause of the Land Acquisition Act. Under this clause, MOR is allowed to acquire land exclusively for railway development through District Collector. The land is acquired at market value and ex-gratia payment of Rs.10,000 over and the above the value of land acquisition is made.

(3) National Rehabilitation Policy 2006 (NRP-2006)

This is a policy of the Government of India on resettlement and rehabilitation of the households affected by implementation of projects.

The Land Acquisition Act-1894 has been a basic law for the land acquisition and resettlement in India. However, lack of considerations on compensation standard and resettlement assistance in the act has been pointed out, compared to the required levels by the international donors. Under the situation, Indian government promulgated National Policy on Resettlement and Rehabilitation–2003, and then revised the policy as National Rehabilitation Policy–2006. It is expected to pass the parliament session this year and that it would become as "National Rehabilitation Act of 2006", which makes new compensation scheme for resettlement and rehabilitation of the Project-affected Family (PAF) mandatory. Main responsible agency for the policy is the Ministry of Rural Development. In the policy, rules on involuntary resettlement are widely revised as follows.

- Negative impacts and losses should be informed to affected people of the resettlement through the survey on property loss, survey on impact of social environment, and consultation with residents.
- Negative impacts and losses should be alleviated to affected people of the resettlement under the legislative framework.
- Assistances for relocation and livelihood recovery should be planned to make level of livelihood of the affected people, at least, equal to previous level, or higher.
- Project-affected socially vulnerable people should be identified and be supported for improvement of livelihood level.
- The affected people of the resettlement should be equally compensated and receive various assistances for loss of land, trees, agricultural produce, commercial revenue, and income.
- Responsibilities should be clarified for implementation of various items mentioned in the resettlement action plan.

Although the National Rehabilitation Policy-2006 was revised from its in 2003 based on past experiences of projects under ADB and the World Bank, rules on illegal occupants or squatters are not clearly mentioned in the policy. In the DFC project, there is possibility of resettlement of squatters. Therefore, it is necessary to include supportive measures on squatters' resettlement in the resettlement action plan in accordance with the JICA Environmental Guidelines.

(4) Wildlife Protection Act, 1972

The Wildlife Protection Act was prescribed in 1972 to protect species by limiting hunting of wildlife species. Under the act, flora and fauna to be protected and harmful animals are categorized into 6 types below. Hunting and capture of the wildlife under the Schedule I to Schedule IV are prohibited

Schedule I: Animals to be protected at national level

Schedule II: Animals which hunting is allowed only in the special case

Schedule III: Large animals which license is required for hunting

Schedule IV: Small animals which license is required for hunting

Schedule V: harmful animals

Schedule VI: Plants to be protected at national level

In addition, the act is primal law on protected area, categorizing, (1) National Park and (2) Wildlife Sanctuary (WLS). In the National Park, demolition and damage of natural environment and habitat, and capture and gathering of wildlife are strictly regulated as well as transfer animals and plants without permission of the government. On the other, for the Wildlife Sanctuary, similar regulation is applied with the National Park. While the National Park prohibits livestock raising and entrance, the Wildlife Sanctuary does not have specific regulation.

The protected area is managed by Wildlife Division established under each state government. However, there is no Wildlife Division in some states while state forestry division manages the protected areas. In transferring the protected area into other purpose of land use, it might be possible to interpret the act, though it was judged that changing boundary and transferring into other purpose of the protected area are not allowed in principle according to the judicial precedent by the Supreme Court of India in 2002.

(5) Forest Conservation Act, 1980

The act prescribed in 1980 provides administrator of the forest. According to the act, all forest is under state ownership and managed by state forest division and district forest division. The forest is categorized into three types as (1) Reserved Forest, (2) Protected Forest, and (3) Unclassified Forest. The terms of "reserved" and "protected" do not mean neither ecological reservation nor ecosensitive area, but for the forest products and taxation by the Forest Division. In transfer the forest into other purpose of land use, compensation plantation is required by the project proponent's expenses after the environmental survey.

(6) Laws and Regulation on Air Quality

In 1994, National Ambient Air Quality Standard (NAAAQS) was enacted in India. NO_2, SO_2, SPM, RSPM(PM10), Pb, and CO are covered under the standard. The environmental standard values are prescribed for pollutants and area with annual average and 24-hour average. Regulated areas are divided into 3 areas; industrial area, residential area, and sensitive area. The sensitive area includes facilities such as historical/cultural area/property, schools, and hospital.

Table 11-11 Ambient Air Quality Standard

(Unit: μg/m^3)

Items	Average	Industrial Area	Residential Area	Sensitive Area
NO_2	Annual average	80	60	15
	24-hour average	120	80	30
SO_2	Annual average	80	60	15
	24-hour average	120	80	30
SPM	Annual average	360	140	70
	24-hour average	500	200	100
RSPM	Annual average	120	60	50
	24-hour average	150	100	85
Pb	Annual average	1.0	0.75	0.50
	24-hour average	1.5	1.00	0.75
NH_3	Annual average	0.1 mg/m^3	0.1 mg/m^3	0.1 mg/m^3
	24-hour average	0.4 mg/m^3	0.4 mg/m^3	0.4 mg/m^3
CO	Annual average	5.0	2.0	1.0
	24-hour average	10.0	4.0	2.0

Note: April 1998 for NH_3, April 1994 for other parameters
Source: Notification of Ministry of Environment and Forest, April 1998, April 1994

Water quality standards for the surface water such as river and lake are designated by purpose of use such as drinking water as follows.

Table 11-12 Use-based Classification of Surface Waters

Designated Best Use	Quality class	Primary Quality Criteria							
		(1) pH	(2) DO (mg/l)	(3) BOD (mg/l)	(4) Total Coliform (MPN/100ml)	(5) Free Ammonia (mg/l)	(6) Electrical Conductivity (microMHO /cm)	(7) Sodium Absorption Ratio	(8) Boron (mg/l)
Drinking water source w/o conventional treatment, but w/ chlorination	A	6.5 - 8.5	6 or more	2 or less	50 (not>5%-200, not>20%-500	NA	NA	NA	NA
Outdoor bathing (organized)	B	6.5 - 8.5	5 or more	3 or less	500 (not>5%-2000, not>20%-500	500	NA	NA	NA
Drinking water source with conventional treatment	C	6.0 - 9.0	4 or more	3 or less	5000 (not>5%-20000, not >20% -5000	NA	NA	NA	NA
Propagation of wildlife and fisheries	D	6.5 - 8.5	4 or more	NA	NA	1.2	NA	NA	NA
Irrigation, industrial cooling, and controlled waste disposal	E	6.0 - 8.5	NA	NA	NA	NA	2,250	26 or less	2

Source: Central Pollution Control Board, 2002

Regarding noise and vibration, only ambient noise standard is designated by category of area such as industrial, commercial, residential areas, and silence zone (see Table 11-21). However, these categories of area do not always match the designated land uses.

11.2.2 Procedures for Land Acquisition

Land acquisition for the project will be carried out under the responsibility of MOR upon completion of the Final Location Survey carried out by RITES. MOR is to notify District Collector for land acquisition based on the Final Location Survey. Main procedure is explained as follows:

(1) States Directly Affected by DFC Project except West Bengal

a) MOR notifies to District Collector concerned with the land acquisition for DFC Project;

b) District Collector prepares and carries out survey on the land and asset subject to acquisition or relocation. Number of households subject to resettlement and rehabilitation is also surveyed and inventory and valuation of them are duly created before District Collector notifies to state government;

c) State government notifies the contents of inventory made by District Collector on the official gazette as public notice. The date of notice usually becomes the official date of cut-off date for resettlement and rehabilitation arrangement;

d) If there are any people intending to enter the area, he/she has to notify District Collector seven days in advance in writing for obtaining permission;

e) State government publishes the notification on the two newspapers in circulation in the state, one in the local language and the other in English;

f) At the time of land acquisition and resettlement operation, MOR has to pay to District Collector 50% of the assessed cost of land acquisition plan for implementation;

g) Notification for land acquisition should also be published at the District Collector's office. In Bihar State, such notification should also be published at sub-district, gram panchayat, and village offices;

h) At the end of notification period, usually 30 days, District Collector finalizes full inventory survey and the result is disclosed to the general public;

i) Based on the final full inventory, District Collector notifies for disbursement of compensation to all the PAFs.

In general, the above process takes 18 months.

(2) In Case of West Bengal State

a) MOR is to notify Land and Land Reform Department of the state government with all of the evidences of final location survey and the result of full inventory survey including evidences of the title registration and ID card of the owner of titled registration.

b) The date MOR notified to West Bengal Stage Government should become cut-off date of the land acquisition and resettlement and rehabilitation. Any person intending to enter the area subject to land acquisition and resettlement and rehabilitation should in writing apply for permission. If entered, the state government should in writing demand for evaluation within 3 months;

c) Land and Land Reform Department of the West Bengal State Government is to notify District Collector within 10 days of the receipt of notification from MOR;

d) Upon receipt of notification from the state government relevant area's District Collector is requested to verify within 5 days.

e) Upon completion of the procedure of verification, notification made by MOR is verified within 5 days. However, more than 100 acres of land acquisition and resettlement and rehabilitation should be assessed and verified by the state legislature. If it was not the case, the notification should be sent back to MOR;

f) State government notifies on the local news papers, one in the local language and the other in English, the result of application made by MOR thereby within 30 days public hearing is held in the area relevant to project implementation;

g) Upon completion of public hearing, stage government issues Government Order within 10 days for implementation of land acquisition and resettlement and rehabilitation plan. At this time MOR is to pay 50% of the cost of land acquisition and resettlement and rehabilitation;

h) Notwithstanding the area of land acquisition and the number of PAFs, District Collector should notify within 30 days from the expired date of issue of the above government order for payment of land acquisition and resettlement and rehabilitation plan. Such notification is also send out to the state government;

i) State government is to verify the notification of District Collector within 10 days. At this time MOR has to complete 100% of the payment for land acquisition to the state government;

j) District Collector is to complete the payment within 30 days in the case of the area of acquisition less than 100 acres and 45 days for the area more than 100 acres;

k) Land owners and PAFs are requested to verify the receipt of payment and/or compensation within 75 days from the date of the receipt of notification. Those who failed to do so are notified within 12day from the date of expiration of the receiving period and this process is repeated for another 12 days;

l) Upon completion of the payment, District Collector transfers the title for implementation of the project.

The Government Order issued by the Land and Land Reform Department of West Bengal State Government, G.O.No.1701-LA-3M-07/06, 6th June, 2006 states that the above procedures is completed within 6-7 months.

11.3 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS STUDY AT IEE LEVEL

Between the end of December 2006 and the end of February 2007 for some 2 months in the initial year of the Study, an Environmental and Social Considerations Study at IEE Level, which was named under the study as Environment and Social Considerations Study (ESCS), was conducted for the DFC Project as preliminary environmental examination to prepare study plan of the Environment and Social Impact Mitigation Measures Study (ESIMMS)[3].

A local consulting firm has been selected in the middle of December 2006 and it has mobilized its personnel including local NGOs active in each state directly affected by the Project for stakeholder/public consultation meeting.

11.3.1 Study Area

Railway sections for the ESCS are shown in Table 11-13 and Figure 11-1. The sections are based on the sections established by the RITES Study. Six sections for the Western Corridor and four sections for the Eastern Corridor are subject to the ESCS.

[3] The ESIMMS is equivalent to the Environmental and Social Considerations Study at EIA Level under the JICA Guidelines for Environmental Social Considerations (2004).

Table 11-13 DFC Sections for the ESCS

No.	Section	Length
Western Corridor		
W-A1	Dadri-Rewari	128 km
W-A2	Rewari - Palanpur	645 km
W-A3	Palanpur-Ahmedabad	138 km
W-B1	Ahmedabad - Vadodara	145 km
W-B2	Vadodara - Vasai Road	348 km
W-B3	Vasai Road - JNPT	79 km
Sub-total		1,483 km
Eastern Corridor		
E-A	Mughal Sarai - Dadri	743 km
E-B	Son Nagar - Mughal Sarai	124 km
E-C1	Khurja - Kalanaur	205 km
E-C2	Kalanaur - Dandarikalan	164 km
Sub-total		1,236 km
Total		2,719 km

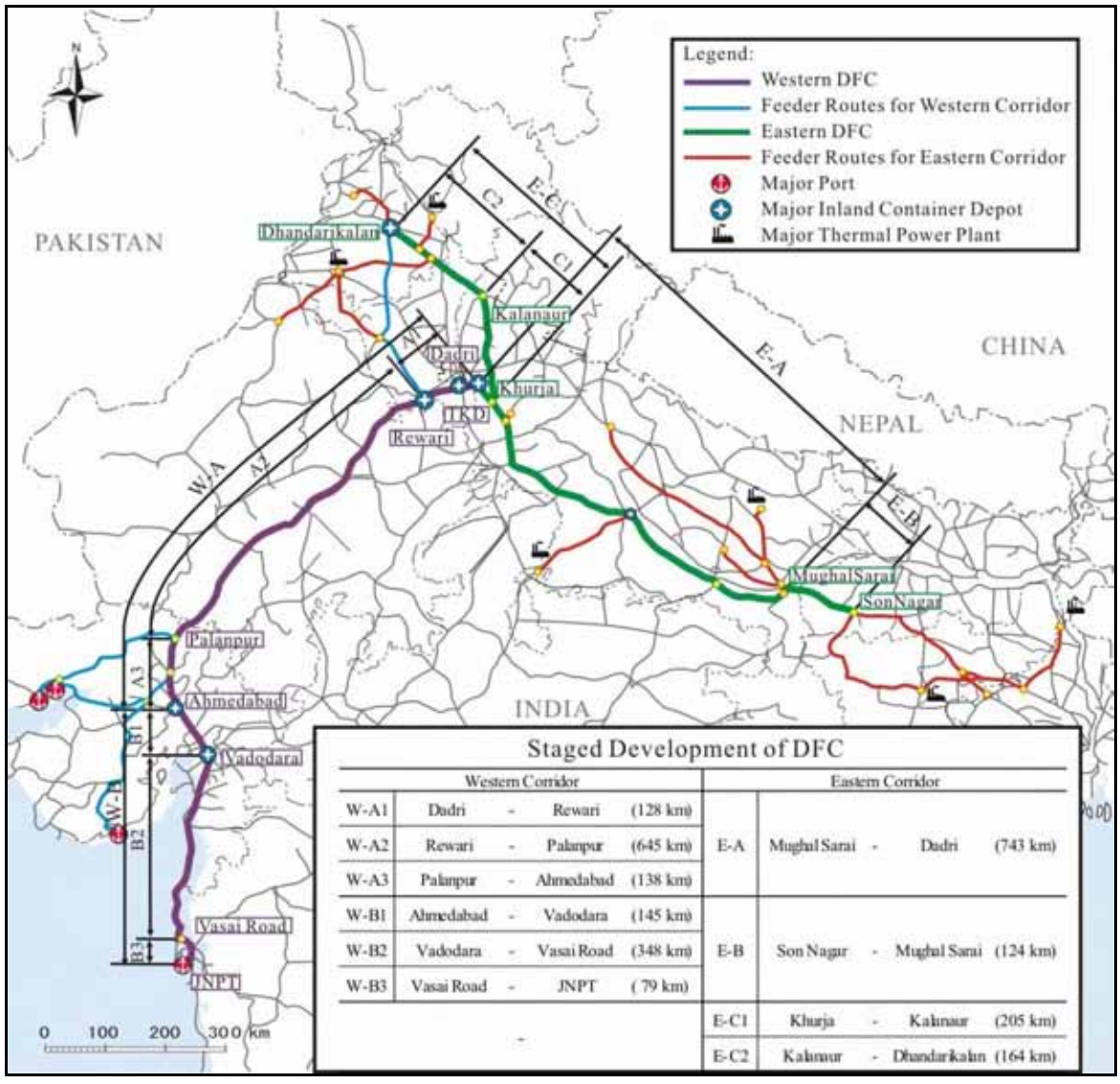


Figure 11-1 Locations of DFC Sections for the ESCS

11.3.2 Methodology and Items to be Studied

(1) Review of Existing Information and Data

In the ESCS, secondary data were collected from central, state, and district governments and related institutes, and review the following items. In addition, field reconnaissance was conducted to supplement lack of data and information.

1) Social environment: Data and information on social structure, land use (especially agricultural land and urban area), major facilities such as industrial, public, and religious facilities, economic conditions, education, employment, sanitary, heritage and cultural properties, and poverty were collected from Census Department, Revenue Department, Public Health Department, etc. at the central, state, and district governments. Lists of project-affected villages are shown in *Volume 4 Technical Working Paper Task0&1, 11-(2)*.

2) Natural environment: Data and information on geology and topography, meteorology, reserved and protected areas, forest, important ecology, habitat for endangered flora and fauna species, river, wetland, coast, etc. were collected from Census Department, Forest Department, Department of Agriculture, etc. at the central, state, and district governments. A list and figure of environmental protected areas in and around the study area are shown in *Volume 4 Technical Working Paper Task0&1, 11-(3)*.

3) Pollution: Air quality data on National Air Quality Monitoring Programme (NAMP) as static monitoring was collected from Central Pollution Control Board (CPCB), covering 308 locations across the nation. The data in the study area was reviewed. Regarding the water quality, water quality monitoring data was collected from CPCB, covering 1,019 locations across the nation and reviewed for the study area.

4) Geographic Information System (GIS) was prepared for the project to identify land use along 1-km stretch for both sides of the existing railway line and sensitive areas by using topographical map and satellite images. Land uses of respective states are shown in Table 11-14

State Name	Unit	Agriculture	Non-Agriculture	Open	Forest	Urban	Residential	Industrial	Others[2]	Total
Maharashtra	Area (km^2)	63.56	25.93	102.91	0.36	62.02	9.30	5.14	12.71	281.94
	%	22.54	9.20	36.50	0.13	22.00	3.30	1.82	4.51	100.00
Gujarat	Area (km^2)	380.93	16.46	464.46	0.47	99.75	26.47	10.07	18.30	1016.92
	%	37.46	1.62	45.67	0.05	9.81	2.60	0.99	1.80	100.00
Rajasthan	Area (km^2)	263.92	3.30	782.75	-	21.40	22.06	2.09	8.59	1104.12
	%	23.90	0.30	70.89	-	1.94	2.00	0.19	0.78	100.00
Haryana (Western Corridor)	Area (km^2)	57.29	10.20	252.34	-	28.45	6.40	0.36	3.53	358.57
	%	15.98	2.85	70.37	-	7.93	1.78	0.10	0.98	100.00
Haryana (Eastern Corridor)	Area (km^2)	54.52	8.04	62.16	-	16.18	2.74	0.79	1.52	145.95
	%	37.35	5.51	42.59	-	11.08	1.88	0.54	1.04	100.00
Punjab	Area (km^2)	87.87	9.39	139.81	-	26.24	6.36	4.81	2.51	276.99
	%	31.72	3.39	50.47	-	9.47	2.30	1.74	0.91	100.00
Delhi	Area (km^2)	1.46	12.17	17.96	0.28	39.18	-	-	0.57	71.63
	%	2.04	17.00	25.07	0.39	54.70	-	-	0.80	100.00
Uttar Pradesh	Area (km^2)	741.36	12.98	765.01	0.16	119.33	75.48	11.77	23.66	1749.76
	%	42.37	0.74	43.72	0.01	6.82	4.31	0.67	1.35	100.00
Bihar	Area (km^2)	66.36	0.69	66.31	-	2.18	6.25	-	1.03	142.82
	%	46.46	0.48	46.43	-	1.53	4.38	-	0.72	100.00

Note 1: The areas are defined as the area within 1 km from the existing railway track on both sides.
Note 2: "Others" includes airports, railway tracks and water bodies.
Source: JICA Study Team

Table 11-14 Land Uses of Respective States

(2) Field Surveys

To supplement the secondary data review mentioned above, the following field surveys were conducted.

1) Video capturing survey along the existing railway line: Digital video recording with GPS device was conducted along all existing railway line subject to the study to grasp natural conditions such as forest area, and social conditions such as dense residential area and squatter area subject to involuntary resettlement.

2) Measurement of railway noise and vibration: Since there is no data on railway noise and vibration under integrated manner among central and state levels, field measurement for the railway noise and vibration was conducted in 10 sites near Delhi to preliminarily obtain unit data.

11.3.3 Preliminary Findings of Environmental and Social Impacts

(1) Potential Environmental and Social Impact in Western Corridor

Potential environmental and social impacts in Eastern Corridor are summarized in Table 11-15, Table 11-16, and Table 11-17.

Table 11-15 Potential Environmental and Social Impacts in Western Corridor : Social Aspects

(1) Section W-B3: JNPT – Vasai Road
- There is one detour route avoiding densely populate urban centre planned to construct in this section. However, there appears to be no household subject to resettlement. - 6 ROBs and 3 ROBs are located between JNPT and Panvel Junction Stations and northern side of Panvel Junction Station, respectively. Among those, one resettlement will be expected to occur. Since an ROB between Mumbai and Pune Express Way are 4-lane expressway, socio-economic impacts caused by replacement of the ROB will be significant. Six building with 4 to 6 storey will be subject to the relocation in the section along the existing railway line at northern side of the Dombivli Station. 5 houses will be subject to the relocation near the Panvel Junction Station and a garden of large house will be subject to the land acquisition. - Some 250 squatters and 180 squatters will be subject to the resettlement in 2.5 km-long section at northern area and 500 m-long section at southern area of the Dombivli Station, respectively. Some 15 squatters will be subject to the resettlement at 11 km site from southern side of the Panvel Junction Station. - There are 2 junction stations and 1 crossing stations planned to construct in this section and a number of agricultural households would become subject to resettlement. Details are subject to further design for layout of the station as well as the area of land acquisition. - There are 29 ROBs and 40 RUBs planned to construction in this section. They are aimed to reduce level crossing which further reduces railway accidents. On the other hand, if constructed, non-motorized local transportation is required to climb slope of ROBs which cause inconvenience to the local business activities.
(2) Section W-B2: Vasai Road – Vadodara
- There are 3 detour routes planned to construct in this section in order to avoid densely populate urban centres. There are two by-pass routes that 235 households would be subject to resettlement. - There are 1 junction stations and 7 crossing stations planned to construct in this section and a number of agricultural households would become subject to resettlement. Details are subject to further design for layout of the station as well as the area of land acquisition. - In the section along the existing railway line, five middle-high rise buildings will be subject to the relocation in the eastern area of the Vasai Rd. Station, and 30 households will be subject to the resettlement due to new road construction caused by land acquisition of existing road for the project. Some 18 lower-middle building, one warehouse, and some 30 households will be subject to the relocation in the eastern area of the Virar Station. At the Ankeshowarl Station, some 15 houses will be subject to the relocation. - In the replacement of existing ROB in urban area of Vasai Rd., social impact will be limited to traffic regulation and disturbance during construction period. It is high possibility to relocate about 15 houses in Nala Sopara due to replacement of existing ROB located in urban area with houses, office building, and car park, though the impact may be changed by type of construction method. In Virar, it should be considered that replacement of a ROB which is under construction should be avoided by using measure based on coordination among the relevant agencies. In Sofale, since a ROB is located in marshland, no

social impact is expected in the replacement. There will be no resettlement caused by the replacement of ROB in the suburbs of Pargar City and social impact will be limited to traffic regulation and disturbance during construction period. Some 20 houses will be subject to the relocation in replacement of a ROB located in urban area of Boisar, though the impact may be changed by type of construction method. Although a ROB in Dahunu Rd. is located in the urban area, social impact will be limited to traffic regulation and disturbance during construction period due to less populated area. On the other, many resettlement will be occurred in Vapi residential area, where is densely populated. Since the ROB in Valsad is located in the suburbs, social impact will be limited to traffic regulation and disturbance during construction period.

- There are 133 ROBs and 167 RUBs planned to construction in this section. They are aimed to reduce level crossing which further reduces railway accidents. On the other hand, if constructed, non-motorized local transportation is required to climb slope of ROBs and RUBs which cause inconvenience to the local business activities.

(3) Section W-B1: Vadodara – Ahmedabad

- There is one detour route planned to construct in this section in order to avoid densely populate urban centre and 320 households would be subject to resettlement.
- There are 1 junction station and 6 crossing stations planned to construct in this section and a number of agricultural households would become subject to resettlement. Details are subject to further design for layout of the station as well as the area of land acquisition.
- Some 250 households will be subject to the resettlement due to development of detour section between Vadodara and Ahmedabad (till the Sabarmati Junction Station). In addition, land acquisition of farm land in the detour section cause more than 300 farmers may lose more than half of their farm land, assuming one farmer has 1.5 ha farm land.
- There are 8 ROBs and 82 RUBs planned to construction in this section. They are aimed to reduce level crossing which further reduces railway accidents. On the other hand, if constructed, non-motorized local transportation is required to climb slope of ROBs and RUBs which cause inconvenience to the local business activities.

(4) Section W-A3: Ahmedabad – Palanpur

- There is one detour route planned to construct in this section in order to avoid densely populate urban centre. However, there would be no household subject to resettlement.
- There are 2 junction stations planned to construct in this section and a number of agricultural households would become subject to resettlement. Details are subject to further design for layout of the station as well as the area of land acquisition.
- Some 30 households will be subject to the resettlement due to development of detour section between Ahmedabad and Mahesana (from Mahesana Junction Station to Northern part of Mahesana). In addition, land acquisition of farm land in the detour section cause more than 150 farmers may lose more than half of their farm land, assuming one farmer has 1.5 ha farm land.
- There are 57 ROBs and 72 RUBs planned to construction in this section. They are aimed to reduce level crossing which further reduces railway accidents. On the other hand, if constructed, non-motorized local transportation is required to climb slope of ROBs and RUBs which cause inconvenience to the local business activities.

(5) Section W-A2: Palanpur – Rewari

- There are 5 by-pass routes planned to construct in this section in order to avoid densely populate urban centres and two of the by-pass routes would cause 65 households subject to resettlement.
- There are 2 junction stations and 16 crossing stations planned to construct in this section and a number of agricultural households would become subject to resettlement. Details are subject to further design for layout of the station as well as the area of land acquisition.
- Resettlement of squatters may occur in Kori Station at some 25 households, eastern area of Vasai Road Station at some 45 households, eastern area of Nara Sopara Station at 35 households, Viral Station at some 20 households, Boisar Station at some 60 households, Gandhisumirithi Station at some 45 households, and Marori Station at 50 households.
- There are 299 ROBs and 318 RUBs planned to construction in this section. They are aimed to reduce level crossing which further reduces railway accidents. On the other hand, if constructed, non-motorized local transportation is required to climb slope of ROBs and RUBs which cause inconvenience to the local business activities.

(6) Section W-A1: Rewari – Dadri

- PETS-2 Report carried out by RITES shows that the route passes the area to the south of Sohna in

Gurgaon, Haryana generally from west to east. In the middle of agricultural filed, where mustard and wheat are grown between October – March, and legumes and corns are grown between April to September, the section is constructed with open-cut method. It requires land acquisition of 16-56 m wide of land and 6 km long. The section is then linked to 4 km long of tunnel, which is very likely to drain ground water being used for sprinkler irrigation. Further, the section goes to the area below Delhi Range's cliff and 2 km of elevated railway is constructed before 10 km section of embankment. Thus approximately 60 m wide and 12 km long agricultural field is further affected.

- Entire section is one detour route planned to construct in order to avoid densely populate urban centre of Delhi and there are 190 households appears to be subject to resettlement.
- There are 3 junction stations and 3 crossing stations planned to construct in this section and a number of agricultural households would become subject to resettlement. Details are subject to further design for layout of the station as well as the area of land acquisition.
- There are 9 ROBs and 72 RUBs planned to construction in this section. They are aimed to reduce level crossing which further reduces railway accidents. On the other hand, if constructed, non-motorized local transportation is required to climb slope of ROBs and RUBs which cause inconvenience to the local business activities.
- Resettlement of some 550 squatter households may occur in existing railway line between crossing section of Asaoti-Pilthera and Tuglakabad.

Table 11-16 Potential Environmental and Social Impacts in Western Corridor: Natural Environment

(1) Section W-B3: JNPT – Vasai Road
- DFC Project's railway line runs generally alongside the existing railway line on the western coast of India and there is no direct and significant impacts caused by the Project to the geography and geology of the section. - There are 3 patches of reserved forest near the railway line in Thane District and double-track construction works of DFC Project could cause direct impact to the forested area. - There are no other protection areas for endangered species and/or fragile ecosystem directly affected by the Project.
(2) Section W-B2: Vasai Road – Vadodara
- DFC Project's railway line runs generally alongside the existing railway line on the western coast of India and there is no direct and significant impacts caused by the Project to the geography and geology of the section. However, several patches of mangrove areas would be directly affected by the DFC Project's double-track construction works. Thus detailed environmental study should be carried out in this area. - There will be 12 bridges crossing over South Vaitarana, North Vaitarana, Daman Ganga, Par, Auranga, South Kaveri, North Kaveri, Ambika, North Poorna, Mindhola, Tapi, and Narmada River in this section. Thus morphology of the river, increasing turbidity of the river water quality and sedimentation to a slight extent may take place during the construction period. - There are no other protection areas for endangered species and/or fragile ecosystem directly affected by the Project.
(3) Section W-B1: Vadodara – Ahmedabad
- DFC Project's railway line runs generally alongside the existing railway line on the western coast of India. At a place near Vadodara, by-pass route over 145 km is planned to construct in the middle of agricultural area. Thus there would be no direct and significant impacts caused by the Project to the geography and geology of natural environment in this section. - There will be 1 bridge crossing over Ulhas River in this section. Thus morphology of the river, increasing turbidity of the river water quality and sedimentation to a slight extent may take place during the construction period. - There are no other protection areas for endangered species and/or fragile ecosystem directly affected by the Project.
(4) Section W-A3: Ahmedabad – Palanpur
- DFC Project's railway line generally follows the existing railway line in this section. At Palanpur, however, a section of 15 km of by-pass avoiding Palanpur is planned to construct. The route generally follows agricultural area and therefore there would be no direct and significant impacts caused by the Project to the geography and geology of natural environment in this section.

- There are no other protection areas for endangered species and/or fragile ecosystem directly affected by the Project.
(5) W-A2: Palanpur – Rewari
- This section passes through south-western portion of Aravalli Mountain Range. In places, there would be a relatively small section of rock cutting area as well as natural vegetation cutting area. - The existing railway line goes through Balaram Ambaji Wildlife Sanctuary at the northern end of Gujarat where the railway line is entering Rajasthan. As double-track construction works of DFC Project is carried out, there would be direct impacts to the wildlife sanctuary. Thus detailed study on the natural environment is necessary. *Volume 4 Technical Working Paper Task0&1, 11-(4)* shows proposed railway line passing through the Balaram Ambaji Wildlife Sanctuary. - The existing railway line goes through the area near-by Mt. Abu Wildlife Sanctuary. Thus it is necessary to carry out a survey if detailed study on the natural environment should be carried out. - There are a number of reserved forest areas alongside the railway line including the length approximately 2 km of forested areas near Kishangar in Rajasthan. Thus it is necessary to carry out a survey if detailed study on the natural environment should be carried out in these areas.
(6) Section W-A1: Rewari – Dadri
- DFC Project's railway line passes through the area to the south of Sohna in Gurgaon District of Haryana State. There is a possibility that the area appears to be in the close proximity of "Geo-physical Eco-sensitive Area", according to the Notification, New Delhi, 7th May 1992, issued by the Ministry of Environment and Forests. In this area, extraction of mineral resources, blasting, laying electric line, etc. are prohibited. These activities are subject to application for permission. Thus, detailed study on the natural environment would be necessary for EIA study. - As an open-cut section and a tunnel are constructed for DFC Project, there will be significant impact on the changes of ground water table. Thus a detailed study on the groundwater conditions as well as the impact of the loss of groundwater to the agricultural activity, if any, should be carried out. *Volume 4 Technical Working Paper Task0&1, 11-(4)* shows proposed railway line passing through the Aravalli Hills. - DFC Project's railway line goes through a patch of reserved forest near Gulistanpur village for a length of about 1.5 km in Gautam Budhnagar District in Utter Pradesh. Thus detailed study on the forest would be necessary.

Table 11-17 Potential Environmental and Social Impacts in Western Corridor: Pollution

(1) Section W-B3: JNPT – Vasai Road
- In the construction stage, negative impacts caused by air pollution, water pollution, waste disposal, and noise and vibration are expected through exploitation of construction materials and its transportation, land preparation work, plant and machinery operation, construction vehicle traffic, and construction works for various facilities relevant to the DFC. - In construction of bridge crossing over Ulhas River, water quality deterioration and sedimentation will be expected through construction of bridge piers and river bank, and excavation of river riverbed. - In the operation stage, negative impacts caused by vehicle emission gas, and noise and vibration from vehicles such as container trucks in accordance with relevant facilities, especially new FLP construction and expansion of the existing ICD. In addition, in the case where sensitive facilities such as school and hospital and residences locate along the DFC line, negative impacts caused by passage of the freight train will be expected in some extent.
(2) Section W-B2: Vasai Road – Vadodara
- In the construction stage, negative impacts caused by air pollution, water pollution, waste disposal, and noise and vibration are expected through exploitation of construction materials and its transportation, land preparation work, plant and machinery operation, construction vehicle traffic, and construction works for various facilities relevant to the DFC. - In construction of 12 important bridges, especially crossing over Narmada, Ambika, Par, and Tapi Rivers, water quality deterioration and sedimentation will be expected through construction of bridge piers and river bank, and excavation of river riverbed. - In the operation stage, negative impacts caused by vehicle emission gas, and noise and vibration from vehicles such as container trucks in accordance with relevant facilities, especially new FLP construction and expansion of the existing ICD. In addition, in the case where sensitive facilities such as school and hospital and residences locate along the DFC line, negative impacts caused by passage of the freight train

will be expected in some extent.
(3) Section W-B1: Vadodara – Ahmedabad
- In the construction stage, negative impacts caused by air pollution, water pollution, waste disposal, and noise and vibration are expected through exploitation of construction materials and its transportation, land preparation work, plant and machinery operation, construction vehicle traffic, and construction works for various facilities relevant to the DFC. - In construction of important bridge crossing over Mahi River, water quality deterioration and sedimentation will be expected through construction of bridge piers and river bank, and excavation of river riverbed. - In the operation stage, negative impacts caused by vehicle emission gas, and noise and vibration from vehicles such as container trucks in accordance with relevant facilities, especially new FLP construction and expansion of the existing ICD. In addition, in the case where sensitive facilities such as school and hospital and residences locate along the DFC line, negative impacts caused by passage of the freight train will be expected in some extent.
(4) Section W-A3: Ahmedabad – Palanpur
- In the construction stage, negative impacts caused by air pollution, water pollution, waste disposal, and noise and vibration are expected through exploitation of construction materials and its transportation, land preparation work, plant and machinery operation, construction vehicle traffic, and construction works for various facilities relevant to the DFC. - In construction of important bridges crossing over Sabarmati and Saraswati Rivers, water quality deterioration and sedimentation will be expected through construction of bridge piers and river bank, and excavation of river riverbed. - In the operation stage, negative impacts caused by vehicle emission gas, and noise and vibration from vehicles such as container trucks in accordance with relevant facilities, especially new FLP construction and expansion of the existing ICD. In addition, in the case where sensitive facilities such as school and hospital and residences locate along the DFC line, negative impacts caused by passage of the freight train will be expected in some extent.
(5) Section W-A2: Palanpur – Rewari
- In the construction stage, negative impacts caused by air pollution, water pollution, waste disposal, and noise and vibration are expected through exploitation of construction materials and its transportation, land preparation work, plant and machinery operation, construction vehicle traffic, and construction works for various facilities relevant to the DFC. - In the operation stage, negative impacts caused by vehicle emission gas, and noise and vibration from vehicles such as container trucks in accordance with relevant facilities, especially new FLP construction and expansion of the existing ICD. In addition, in the case where sensitive facilities such as school and hospital and residences locate along the DFC line, negative impacts caused by passage of the freight train will be expected in some extent.
(6) Section W-A1: Rewari – Dadri
- In the construction stage, negative impacts caused by air pollution, water pollution, waste disposal, and noise and vibration are expected through exploitation of construction materials and its transportation, land preparation work, plant and machinery operation, construction vehicle traffic, and construction works for various facilities relevant to the DFC. - In construction of important bridge crossing over Yamuna River, water quality deterioration and sedimentation will be expected through construction of bridge piers and river bank, and excavation of river riverbed. - In tunnel construction, underground water pollution may occur. Baseline surveys for geology and ground water system are required in further stage of the project. - In the operation stage, negative impacts caused by vehicle emission gas, and noise and vibration from vehicles such as container trucks in accordance with relevant facilities, especially new FLP construction and expansion of the existing ICD. In addition, in the case where sensitive facilities such as school and hospital and residences locate along the DFC line, negative impacts caused by passage of the freight train will be expected in some extent.

(2) Potential Environmental and Social Impacts in Eastern Corridor

Potential environmental and social impacts in Eastern Corridor are summarized in Table 11-18, Table 11-19, and Table 11-20.

Table 11-18 Potential Environmental and Social Impacts in Eastern Corridor: Social Aspects

(1) Section E-B: Son Nagar – Mughal Sarai
- There is one detour route avoiding densely populate urban centre planned to construct in this section and 15 households would be subject to resettlement. Details are subject to further design for layout of the station as well as the area of land acquisition. - There are one junction station and 3 crossing stations planned to construct in this section and a number of agricultural households would become subject to resettlement. Details are subject to further design for layout of the station as well as the area of land acquisition. - 45 households will be subject to the involuntary resettlement in the section of new line parallel to the existing railway line. - There are 38 ROBs and 49 RUBs planned to construction in this section. They are aimed to reduce level crossing which further reduces railway accidents. On the other hand, if constructed, non-motorized local transportation is required to climb slope of ROBs and RUBs which cause inconvenience to the local business activities.
(2) Section E-A: Mughal Sarai – Dadri (via Khurja)
- There are 6 detour routes avoiding densely populate urban centre planned to construct in this section and 435 households would be subject to resettlement. - There are 10 junction stations and 12 crossing stations planned to construct in this section and a number of agricultural households would become subject to resettlement. Details are subject to further design for layout of the station as well as the area of land acquisition. - 125 households will be subject to the involuntary resettlement in the section of new line parallel to the existing railway line. - Involuntary resettlement will occur for 25 squatter households in the section of new line parallel to the existing railway line and 5 squatter households in the site for replacement of ROB. - There are 232 ROBs and 295 RUBs planned to construction in this section. They are aimed to reduce level crossing which further reduces railway accidents. On the other hand, if constructed, non-motorized local transportation is required to climb slope of ROBs and RUBs which cause inconvenience to the local business activities.
(3) Section E-C1: Khurja – Kalanaur
- There is 3 detour route avoiding densely populate urban centre planned to construct in this section and 425 households would be subject to resettlement. - There are 1 junction stations and 22 crossing stations planned to construct in this section and a number of agricultural households would become subject to resettlement. Details are subject to further design for layout of the station as well as the area of land acquisition. - 120 households will be subject to the involuntary resettlement in the section of new line parallel to the existing railway line. - There are 64 ROBs and 131 RUBs planned to construction in this section. They are aimed to reduce level crossing which further reduces railway accidents. On the other hand, if constructed, non-motorized local transportation is required to climb slope of ROBs and RUBs which cause inconvenience to the local business activities.
(4) Section E-C2: Kalanaur – Ludhiana (Dandarikalan)
- There is 4 detour route avoiding densely populate urban centre planned to construct in this section and 425 households would be subject to resettlement. - There are 3 junction stations and 14 crossing stations planned to construct in this section and a number of agricultural households would become subject to resettlement. Details are subject to further design for layout of the station as well as the area of land acquisition. - 260 households will be subject to the involuntary resettlement in the section of new line parallel to the existing railway line. - There are 43 ROBs and 91 RUBs planned to construction in this section. They are aimed to reduce level crossing which further reduces railway accidents. On the other hand, if constructed, non-motorized local transportation is required to climb slope of ROBs and RUBs which cause inconvenience to the local business activities.

Table 11-19 Potential Environmental and Social Impacts in Eastern Corridor : Natural Environment

(1) Section E-B: Son Nagar – Mughal Sarai
- DFC Project's railway line runs alongside the existing railway line near the right bank of the River Ganga. Therefore there would be no direct impact to the river. - There is a patch of reserved forest near the railway line and double-track construction works of DFC Project could cause direct impact to the forested area. - There are no other protection areas for endangered species and/or fragile ecosystem directly affected by the Project.
(2) Section E-A: Mughal Sarai – Dadri (via Khurja)
- DFC Project's railway line runs alongside the existing railway line near the right bank of the River Ganga. Therefore there would be no direct impact to the river. - There is a patch of reserved forest near the railway line at Parpund in Utter Pradesh and double-track construction works of DFC Project could cause direct impact to the forested area. - There are no other protection areas for endangered species and/or fragile ecosystem directly affected by the Project.
(3) Section E-C1: Khurja – Kalanaur
- DFC Project's railway line runs alongside the existing railway line near the right bank of the River Ganga. Therefore there would be no direct impact to the river. - There is a patch of reserved forest near the railway line at Kalanaur and double-track construction works of DFC Project over the length of 500 m could cause direct impact to the forested area. - There are no other protection areas for endangered species and/or fragile ecosystem directly affected by the Project.
(4) Section E-C2: Kalanaur – Ludhiana (Dandarikalan)
- DFC Project's railway line runs alongside the existing railway line near the right bank of the River Ganga. Therefore there would be no direct impact to the river. - There are no other protection areas for endangered species and/or fragile ecosystem directly affected by the Project.

Table 11-20 Potential Environmental and Social Impacts in Eastern Corridor: Pollution

(1) Section E-B: Son Nagar – Mughal Sarai
- In the construction stage, negative impacts caused by air pollution, water pollution, waste disposal, and noise and vibration are expected through exploitation of construction materials and its transportation, land preparation work, plant and machinery operation, construction vehicle traffic, and construction works for various facilities relevant to the DFC. - In the bridge construction, water quality deterioration and sedimentation will be expected through construction of bridge piers and river bank, and excavation of river riverbed. However, important bridge is across only at Son River and the bridge is under construction. - In the operation stage, negative impacts caused by vehicle emission gas, and noise and vibration from vehicles such as container trucks in accordance with relevant facilities, especially new FLP construction and expansion of the existing ICD. In addition, in the case where sensitive facilities such as school and hospital and residences locate along the DFC line, negative impacts caused by passage of the freight train will be expected in some extent.
(2) Section E-A: Mughal Sarai – Dadri (via Khurja)
- In the construction stage, negative impacts caused by air pollution, water pollution, waste disposal, and noise and vibration are expected through exploitation of construction materials and its transportation, land preparation work, plant and machinery operation, construction vehicle traffic, and construction works for various facilities relevant to the DFC. - In construction of two bridges crossing over Tonse and Yamuna Rivers, water quality deterioration and sedimentation will be expected through construction of bridge piers and river bank, and excavation of river riverbed. - In the operation stage, negative impacts caused by vehicle emission gas, and noise and vibration from vehicles such as container trucks in accordance with relevant facilities, especially new FLP construction

and expansion of the existing ICD. In addition, in the case where sensitive facilities such as school and hospital and residences locate along the DFC line, negative impacts caused by passage of the freight train will be expected in some extent.
(3) Section E-C1: Khurja – Kalanaur
- In the construction stage, negative impacts caused by air pollution, water pollution, waste disposal, and noise and vibration are expected through exploitation of construction materials and its transportation, land preparation work, plant and machinery operation, construction vehicle traffic, and construction works for various facilities relevant to the DFC. - In construction of an important bridges crossing over Yamuna River, water quality deterioration and sedimentation will be expected through construction of bridge piers and river bank, and excavation of river riverbed. - In the operation stage, negative impacts caused by vehicle emission gas, and noise and vibration from vehicles such as container trucks in accordance with relevant facilities, especially new FLP construction and expansion of the existing ICD. In addition, in the case where sensitive facilities such as school and hospital and residences locate along the DFC line, negative impacts caused by passage of the freight train will be expected in some extent.
(4) Section E-C2: Kalanaur – Ludhiana
- In the construction stage, negative impacts caused by air pollution, water pollution, waste disposal, and noise and vibration are expected through exploitation of construction materials and its transportation, land preparation work, plant and machinery operation, construction vehicle traffic, and construction works for various facilities relevant to the DFC. - In construction of bridges crossing over Chaudah Dhara, Markanda, and Tangri Rivers, water quality deterioration and sedimentation will be expected through construction of bridge piers and river bank, and excavation of river riverbed. - In the operation stage, negative impacts caused by vehicle emission gas, and noise and vibration from vehicles such as container trucks in accordance with relevant facilities, especially new FLP construction and expansion of the existing ICD. In addition, in the case where sensitive facilities such as school and hospital and residences locate along the DFC line, negative impacts caused by passage of the freight train will be expected in some extent.

11.3.4 Supplementary Measurement of Railway Noise and Vibration Levels

(1) Objectives

This supplementary measurement was conducted under the ESCS since there is no existing railway noise and vibration data in India. Therefore, the purposes of measurement are 1) to obtain the baseline data of railway noise and vibration which will be used to predict and evaluate impacts of planned freight trains and 2) to identify survey components for the ESIMMS. More specifically, measurement of noise and vibration of trains running on the existing railways was conducted in order to obtain the unit levels of the basic noise and vibration by categories of car types, speed, etc.

(2) Noise and Vibration Standard and Regulation in India

India has a standard of ambient noise level only, and the standard sets up the maximum sound levels for industrial, commercial, and residential areas and silent zone for both day and night times as shown in Table 11-21.

Table 11-21 Ambient Noise Standard in India

Area Code	Category of Area Zone	Limits in dB L_{Aeq}	
		Daytime (6:00 - 22:00)	Night (22:00 - 6:00)
(A)	Industrial Area	75	70
(B)	Commercial Area	65	55
(C)	Residential Area	55	45
(D)	Silence Zone	50	40

Source: The Noise Pollution (Regulation and Control) Rules, 2000

On the other hand, there is no standard or regulation for noise and vibration except the above-mentioned ambient noise. No standard or guideline value for railway noise or railway vibration is provided by the government in India.

(3) Measurement of Railway Noise and Vibration

1) Measurement Categories

In general, railway noise and vibration levels are affected by the base structure such as foundation condition and ballast, and the train types such as car types, traction types, train length and weight, and train speed. Therefore, 16 train categories were prepared by the combination of the train type, traction type, load type, and route type as shown in Table 11-22. The noise and vibration measurement was conducted and summarized in accordance with the categories.

2) Selection of Noise and Vibration Measurement Sites

Because the noise and vibration measurement requires samples of various trains such as train types and traction types, the measurement sites were selected in and around Delhi area by considering its availability of various trains. Typical measurement sites of plain routes and bridge routes are shown in Figure 11-2.

3) Settings of Noise and Vibration Measurement Points

In Japan, the standard measurement point for railway noise and vibration is set at the boundary which is 12.5 m away from the centre of the railway track, and it was applied to this measurement survey. Additional 2 more measurement points were selected to examine the attenuation patterns; therefore, 3 measurement points, namely 5 m , 12.5 m and 25 m from centre of the track for single track sections, and 5 m, 12.5 m and 25 m from centre of nearest track for double track sections, were selected in total. Moreover, the sound level meter was set 1.2 m above the ground. The above-mentioned measurement points are shown in Figure 11-3.

Table 11-22 Categories of Train Operation for Railway Noise and Vibration Measurement

No.	Specification			
	Train	Traction	Load	Route
1	Freight Train	Diesel Traction	Container	Plain Route
2	Freight Train	Diesel Traction	Container	Bridge Route
3	Freight Train	Diesel Traction	Covered Wagon	Plain Route
4	Freight Train	Diesel Traction	Covered Wagon	Bridge Route
5	Freight Train	Diesel Traction	Open Wagon for bulk Transportation	Plain Route
6	Freight Train	Diesel Traction	Open Wagon for bulk Transportation	Bridge Route
7	Freight Train	Electrified Traction	Container	Plain Route
8	Freight Train	Electrified Traction	Container	Bridge Route
9	Freight Train	Electrified Traction	Covered Wagon	Plain Route
10	Freight Train	Electrified Traction	Covered Wagon	Bridge Route
11	Freight Train	Electrified Traction	Open Wagon for bulk Transportation	Plain Route
12	Freight Train	Electrified Traction	Open for Transportation	Bridge Route
13	Passenger Train	Diesel Traction	-	Plain Route
14	Passenger Train	Diesel Traction	-	Bridge Route
15	Passenger Train	Electrified Traction	-	Plain Route
16	Passenger Train	Electrified Traction	-	Bridge Route

Figure 11-2 Noise and Vibration Measurement Sites

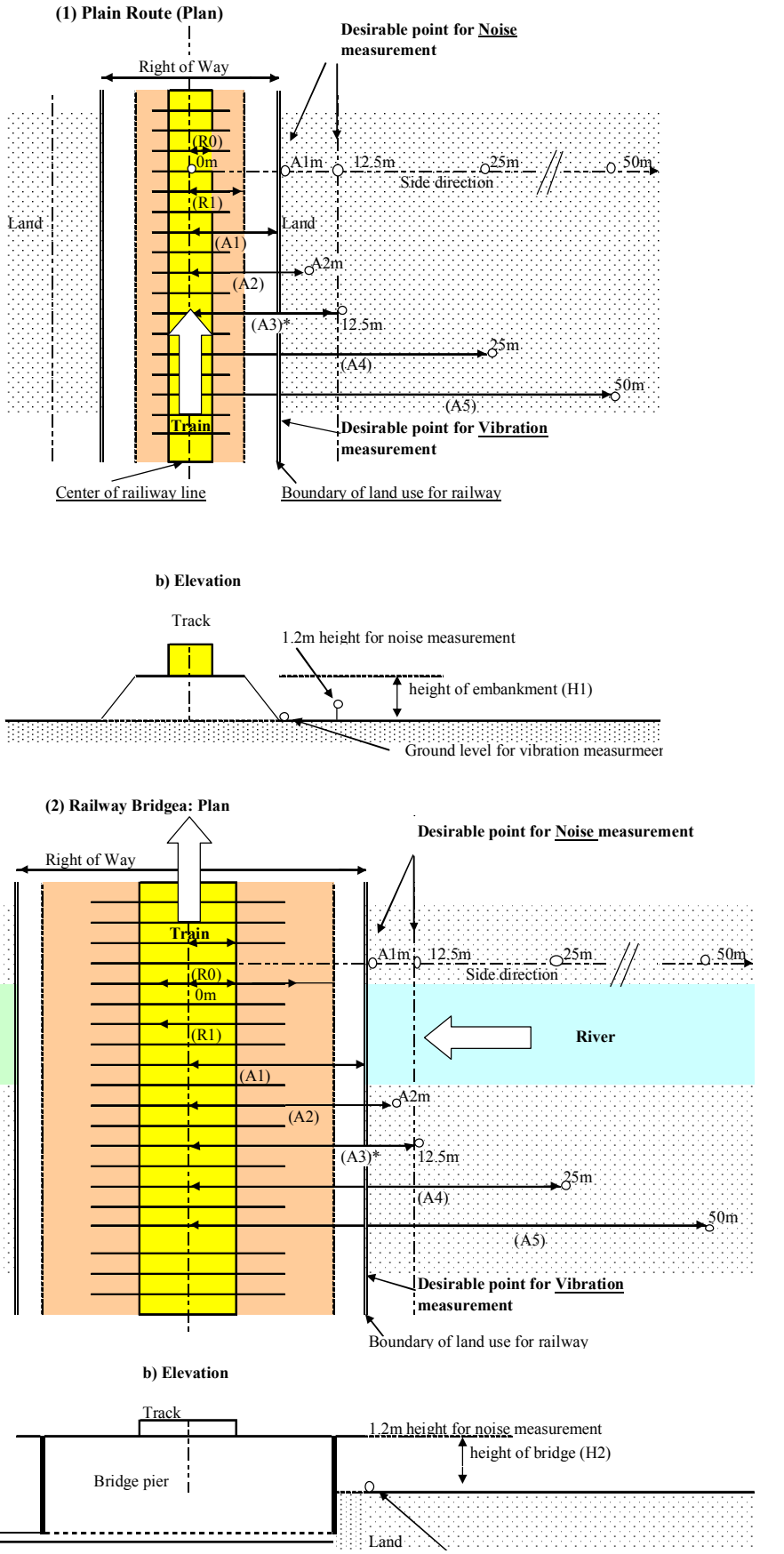


Figure 11-3 Noise and Vibration Measurement Points

4) Methodology for the Railway Noise Measurement

The measurement of the railway noise level was conducted with a noise level meter which was manufactured in India and widely used in India, CYGNET Model 200. The measurement results, such as Sound Pressure Level (L_p), Sound Exposure Level (L_{AE}), and Equivalent Continuous A-Weighted Sound Pressure Level (L_{Aeq}) were calculated by train categories which were described above.

5) Methodology for the Railway Vibration Measurement

The measurement of the railway vibration level was conducted with an IMPAQ vibration level meter which was manufactured in U.S.A., and capable of 4 sites simultaneous measurements. The measurement results of Maximum Vibration Level (L_p) of each passing train were recorded. To compare with the Japanese regulation value of railway vibration, the results obtained with the Indian vibration measurement method were converted in accordance with relevant Japanese methods specified by the Japanese Industrial Standards (JIS) of JIS Z 8735 Methods of Measurement for Vibration Level and JIS C 1510 Vibration Level Meters. The major difference between the Indian and Japanese methods is the targeted vibration direction. The Japanese vibration level focuses on only vertical movements (Z) which greatly affect human being. On the other hand, in India, the vertical direction (Z) and 2 horizontal directions (X and Y) are included for measurement in order to consider the impacts on structures and human beings inside of structures because of its weak structure of residential houses in India.

(4) Results of Railway Noise and Vibration Measurement

Results of noise and vibration measurement at the boundary are shown in Table 11-23. Compared with the Japanese railway noise guideline value[4], most categorized results of L_{Aeq} at 12.5 m away from the centre of the railway track exceed the guideline value for new lines during daytime of 60 dB. Additionally, it was found that the noise levels of the freight trains with diesel traction were higher than these of the passenger trains with electrified traction.

As for the vibration level, there is no category which L_p at 12.5 m from the centre of the railway track is more than the Japanese guideline value of 70 dB[5]. Moreover, there is no clear difference between the vibration levels of diesel traction and electrified traction.

[4] "Guideline for Noise Mitigation Measures When Building a New Line or Renovating Existing Rail Lines (20 Dec. 1998)"
[5] "Urgently Required Mitigation Measures for Shinkansen (Bullet Train) Vibration (12 March 1976)"

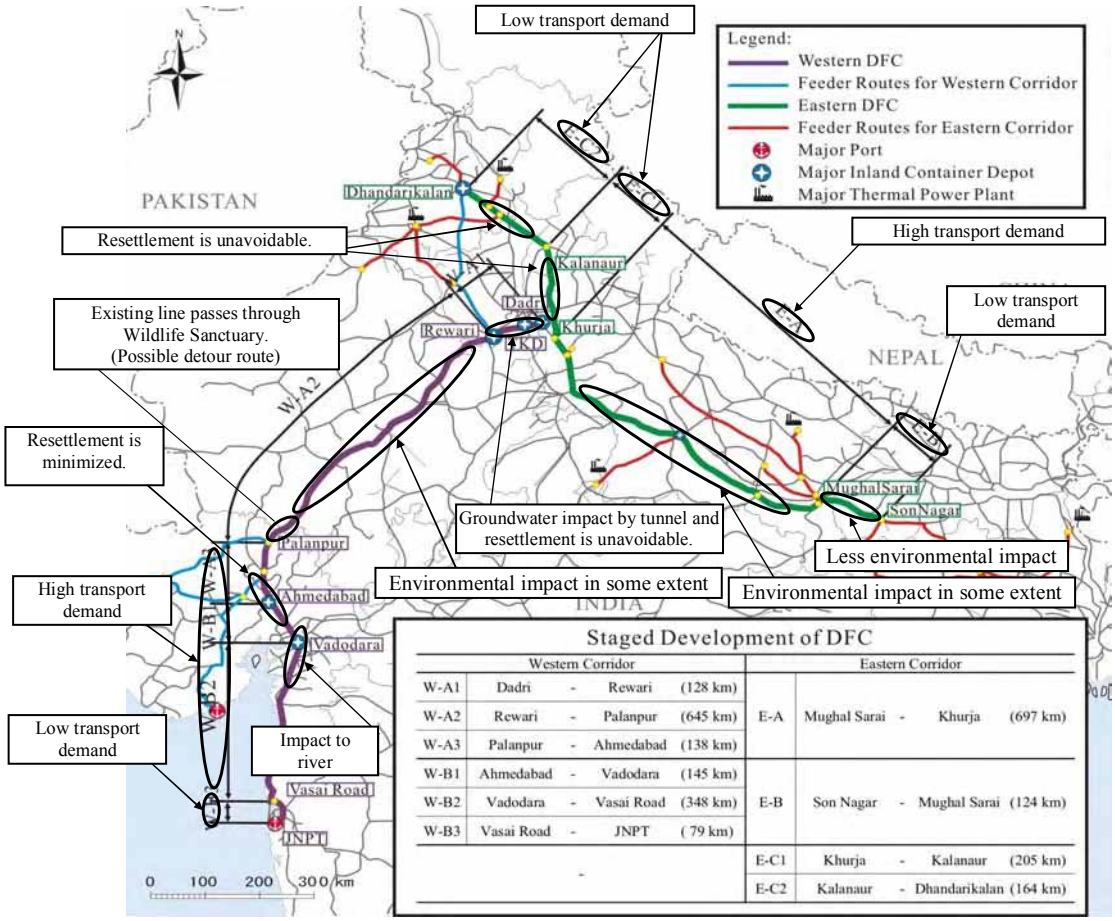
Table 11-23 Results of Railway Noise and Vibration Measurement

No.	Specification				Noise Level*			Vibration Level*
	Train	Traction	Load	Route	dB(L_p)**	dB(L_{AE})**	dB(L_{Aeq})**	dB(L_p)**
1	Freight Train	Diesel Traction	Container	Plain route	80-86	95-99	73-83	30-35
2	Freight Train	Diesel Traction	Container	Bridge	81-90	95-100	73-80	45-50
3	Freight Train	Diesel Traction	Covered Wagon	Plain route	82-88	91-101	73-86	32-37
4	Freight Train	Diesel Traction	Covered Wagon	Bridge	81-108	92-115	70-95	45-50
5	Freight Train	Diesel Traction	Open wagon for bulk transportation	Plain route	82-86	86-100	80-88	30-35
6	Freight Train	Diesel Traction	Open wagon for bulk transportation	Bridge	83-88	95-104	75-85	40-45
7	Freight Train	Electrified Traction	Container	Plain route	72-84	90-98	68-73	41-45
8	Freight Train	Electrified Traction	Container	Bridge	72-90	88-95	65-81	43-47
9	Freight Train	Electrified Traction	Covered Wagon	Plain route	75-80	85-98	72-78	33-36
10	Freight Train	Electrified Traction	Covered Wagon	Bridge	76-93	98-106	70-81	36-41
11	Freight Train	Electrified Traction	Open wagon for bulk transportation	Plain route	73-87	85-93	76-85	27-30
12	Freight Train	Electrified Traction	Open wagon for bulk transportation	Bridge	75-80	88-99	65-69	36-39
13	Passenger Train	Diesel Traction	-	Plain route	91-107	98-113	80-96	31-42
14	Passenger Train	Diesel Traction	-	Bridge	89-100	98-108	81-91	33-53
15	Passenger Train	Electrified Traction	-	Plain route	81-99	94-107	69-91	28-43
16	Passenger Train	Electrified Traction	-	Bridge	77-97	86-107	72-89	35-48

Note: * Value at distance of 12.5 m from centre of railway track.
** Minimum to maximum value observed in the measurement.

11.3.5 Narrow-Down of Study Area for ESIMMS

In the ESCS, all DFC route was divided into 10 sections; 6 sections for the Western Corridor and 4 sections for Eastern Corridor based on boundary of states. As result of ESCS, long-distance tunnel was proposed by Indian side between Rewari and Dadri (W-A1: 128 km). However, since technical examination has never been conduced, the section was excluded from the ESIMMS. In addition, sections for E-B (124 km), E-C1 (205 km), E-C2 (164 km), and W-B3 (79 km) were also excluded from the study area of the ESIMMS due to low development priority in terms of the demand as shown in Figure 11-4.



Staged Development of DFC

Western Corridor				Eastern Corridor			
W-A1	Dadri	- Rewari	(128 km)				
W-A2	Rewari	- Palanpur	(645 km)	E-A	Mughal Sarai	- Khurja	(697 km)
W-A3	Palanpur	- Ahmedabad	(138 km)				
W-B1	Ahmedabad	- Vadodara	(145 km)				
W-B2	Vadodara	- Vasai Road	(348 km)	E-B	Son Nagar	- Mughal Sarai	(124 km)
W-B3	Vasai Road	- JNPT	(79 km)				
				E-C1	Khurja	- Kalanaur	(205 km)
				E-C2	Kalanaur	- Dhandarikalan	(164 km)

Figure 11-4 Features by DFC Section

11.4 STAKEHOLDER/PUBLIC CONSULTATION MEETING

11.4.1 Policy for Implementation of Stakeholder/Public Consultation Meeting

(1) Objectives

The stakeholder/public consultation meeting under the study will be conducted based on the following objectives.

- To provide necessary information of the project to the stakeholders;
- To minimize negative impact to the stakeholders by collecting information on issue, anxiety, complaint, opinion on the project from the stakeholders;
- To establish relationship of mutual trust through communication with the stakeholders;
- To clarify concerns and relevant issues on the project;
- To clarify interests among the stakeholders in implementation of the project;
- To establish partnership among investor of the project, project implementation body and stakeholders; and
- To deliberate how each category of the stakeholder can be involved in planning and implementation of the project.

(2) Identification of the Stakeholders

Identification of the stakeholders for the stakeholder/public consultation meeting is comprehensively conducted, supposing that Ministry of Railway (MOR), Ministry of Environment and Forest (MOEF), Ministry of Rural Development (MORD), passengers who get benefit through the project, residents along the railway line including project-affected people, and private enterprises will be main stakeholders related to the project.

Category of the Stakeholders and their Impact Items and Concerns are shown below.

Table 11-24 Category of the Stakeholders and their Impact Items and Concerns

Category of Stakeholder	Main Impact Items and Concerns
(1) Stakeholders at decision making	- Initial stage of construction - Cost allocation - Responsible bodies for construction and operation - Framework of international cooperation
(2) Stakeholders at planning level	- Location of station - Access line plan such industrial park - Conflict such as truck industry and road administrations - Conservation of natural environment - Business opportunity such as transportation company and owners of the goods - Relevant industry such as construction and rolling stock manufacturing company
(3) Stakeholders to be affected by the project	- Noise, vibration, nature - Community and livelihood - Land acquisition, resettlement and compensation - Measures for illegal occupants and social vulnerable people

Methods of stakeholder/public consultation meeting by category of stakeholder are considered as following table.

Table 11-25 Method of Stakeholder/Public Consultation Meeting

Category of Stakeholder	Method of Stakeholder/Public Consultation Meeting
(1) Stakeholders at decision making	- Hearing by Integrated Management Group of the study, - Steering Committee, JICA Advisory Committee, and Task Force
(2) Stakeholders at planning level	- Implementation of stakeholder meeting (SHM) - Questionnaire survey in the above meting - The SHM is hold in each state in term of regional development - The SHM can be conducted before detailed alignment is not fixed. - Collection of opinion for alternatives and zero-option - Collection of opinion through the Web site
(3) Stakeholders to be affected by the project	- Consensus building among regional residents - Stakeholder meeting for representatives - Collecting opinions of local residents by using designated questionnaire form

(3) Mobilization Mechanism of Stakeholder/Public Consultation Meeting

Since the Study for large-scale project covers 10 states including Delhi with about 2,800 km long, it is very difficult to conduct a stakeholder/public consultation meeting for all project-affected residents. Under the circumstance, provision and exchange of information on the project will efficiently be conducted by utilizing present administrative structure in India.

Indian government consists of central government, state governments, and village level government as shown in Figure 11-5. The village level government is called as Local Urban Council (LUC) in urban area and Panchayat Raj Institution (PRI) in local area. Though "District" is a classification established by state for the purpose of implementation of various activities at geographical unit, there is no District government. At the district level, District Collector is a governmental official appointed by the state government to implement information transmission between state government and LUC/PRI District. On the other, representatives of the village level of government are selected by the election and means representative of local residents.

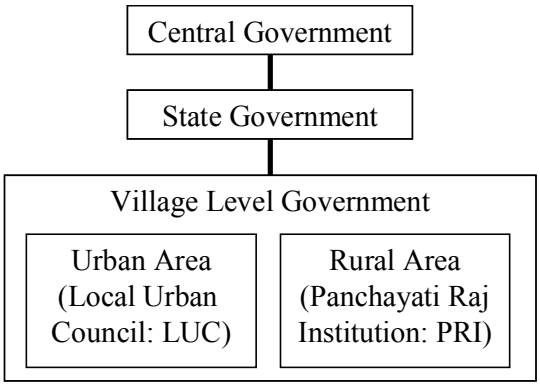


Figure 11-5 Administrative Structure in India

Through the Study, three stages of the stakeholder/public consultation meeting were planned as shown in Table 11-26. In each stage of the stakeholder/public consultation meeting, the meetings were held at various locations according to stage of the study and meeting subjects.

Table 11-26 Summary of the Stakeholder/Public Consultation Meeting

No.	Period	Subjects of Meeting	Main Contents
1	Beginning of the Study (Jan.-Feb., 2007)	- Understanding of the project - Request of cooperation for the study	- Explanation on the project including policy on environmental and social considerations
2	After IEE finish (around Jun., 2007)	- Common understanding on negative impact by the project - Exchange of opinion on minimization of environmental and social impacts	- Results of IEE Study - Results of alternative analysis
3	During EIA study (around Aug., 2007)	- Exchange of opinion on proposed mitigation measures - Understanding of project implementation	- Contents of EIA study - Explanation and discussion on proposed mitigation measures

11.4.2 Results of the First Stage Stakeholder/Public Consultation Meeting

A series of the first stage stakeholder/public consultation meeting was held in the respective states as following schedule.

Table 11-27 Schedule for the First Stage Stakeholder/Public Consultation Meeting

No.	State	Date	Location	Participants		
				Invited	Attended	%
1	Delhi	Feb. 3	Delhi	150	92	61%
2	Bihar	Feb. 9	Gaya	174	154	89%
3	Haryana	Feb.13	Ambaa (Shah)	150	96	64%
4	Rajastan	Feb. 14	Jaipur	150	76	51%
5	Jharkhand	Feb. 16	Dhanbad	164	148	90%
6	Punjab	Feb. 21	Fatehgarhsahib	150	113	75%
7	Gujarat	Feb. 24	Vadodara	150	91	61%
8	Utter Pradesh	Feb. 25	Ghaziabad	150	96	64%
9	West Bengal	Feb. 28	Howrah	150	116	77%
10	Maharashtra	Mar. 7	Mumbai	150	71	47%
			Total	1,538	1,053	68%

(1) Procedures and Arrangement for the Stakeholders/Public Consultation Meeting

Participants of the stakeholder/public consultation meeting were invited as following procedural steps.

a) Identification and analysis of the stakeholders

b) Submission of letter to hold the stakeholder/public consultation meeting to relevant states and obtaining the permission

c) Sending invitation letter to the stakeholders

- Invitation letters: relevant administrative bodies at state, district and lock/sub-district levels, private enterprises located in respective states, educational agencies, NGOs, and Gram Panchayat
- Public announcement by using auto tricycles with speaker: NGOs hired as meeting facilitators for each Gram Panchayat requested Gram Panchayat by letter or conversation to conduct area where existing railway exists.

d) Venue for the meeting: Meeting room in the hotel of major city in or near the proposed DFC project site in the respective state.

(2) Identification and Analysis of the Stakeholders

The stakeholders to be participated in the meeting were identified and their characteristics were assessed as following table.

Table 11-28 Categorization of Stakeholders by Type

Group	Assessment		Appropriate Participation
	Importance	Influence	
1	H	H	Need to establish good working relationships with the general public for effective collaboration and support for successful implementation of the Project.
2	H	M or L	Need to be treated carefully so that their interests will be protected and their needs satisfied.
3	M or L M	H M	Need to be well informed and consulted to reduce risk of their negative intervention.
4	M L	L L	Need to be informed for possible involvement in the subsequent stage.

Note: * H - High, M - Medium, L – Low

Table 11-29 Stakeholders by Group

Groups	Stakeholders
Group 1 (H, H)	Ministry of Railway
	Related Zonal Railway
	Central Ministry of Environment and Forest
	Each State's Pollution Control Board
	Each State's Department of Environment and Forest
Group 2 (H, M/L)	Districts of related State
	Sub-district of related District
	Blocks of related state
	Panchayat organizations of related state's Block
	District Magistrate of related districts
	Sub-district Development Authority of related sub-district
	Block Development Authority of related district
	Private firms along the railway as clients of shipping
	Local farming communities in the areas along the railway
	State-owned transportation companies
	Local residents subject to resettlement
Group 3 (M/L, H) (M, M)	Central Ministry of Finance
	NGOs active in the areas along the railway
	Truck Operator Unions of each State
	News media
	JICA
	Universities concerned with railway operation
Group 4 (M/L, L)	JBIC, ADB, UN and Other Donor Agencies

Note: * H - High, M - Medium, L – Low

(3) Prior Notice and Public Relations

Due to linear and vary long project, adequate method of the prior notice for the stakeholder/public consultation meeting is limited. Therefore, local government, local organizations, Panchayat and Development Council of respective District/Block were selected and invitation letters were sent to them. Prior notice for the first stage stakeholder/public consultation meeting was conducted as follows.

- Notice in the local newspapers
- Issue and distribution of invitation letter through the state government and local consultant hired by the JICA Study Team
- Local network by local NGOs
- Poster

It was not possible to invite residents to be directly affected and resettled in the first stage stakeholder/public consultation meeting, since the project-affected villages were not be able to identify appropriately by using result of the Feasibility Study conducted by the RITES, which has not yet determine the railway alignment. In addition, to approach the project-affected people to be potentially resettled is sensitive matter in the initial stage of the public involvement.

(4) Participation Rate and Social Structure of the Participants

Main participants of the stakeholder/public consultation meeting who were invited were local governmental agencies such as Zonal Railway, State Forest Division, Local Development Division, and development officer in district/block. In addition, members of state assembly attended the meeting in some states.

As shown in Table 11-27, 1,053 persons were attended the meeting in total. Participation rate was 68%. Participation from the public was 54%, 25% for Other Backward Class (OBC), 16% for Scheduled Caste (SC), and 5% for Scheduled Tribe (ST). Compared to the population structure in India, those participants rate were considered reasonable.

Table 11-30 Social Structure of the Participants

No	Social Status	No. of participants	%
1	General	570	54.1
2	Other backward class	259	24.6
3	Schedule caste	173	16.4
4	Schedule tribe	51	4.8
Total		1,053	100.0

During the stakeholder/public consultation meeting, simple questionnaire sheet was distributed to the participants to obtain characteristics of participants and intention on the project. Outline of the results obtained by the questionnaire are shown below.

1) Occupational Type of Participants

Table 11-31 Occupation of the Participants

Occupation	Number	%
Agriculture	303	28.8
Private service	330	31.4
Government Service	101	9.6
Business	319	30.3
Total	1,053	100

2) Intention to the Project

Table 11-32 Interest on DFC Project

Interest	Number	%
Yes	830	78.8
No	23	2.2
Comments Declined	200	19.0
Total	1,053	100.0

3) Income Structure of the Participants

Table 11-33 Level of Annual Income of the Participants

Annual Income	Number	%
Less than Rs.25,000	305	29.0
Rs.25,000-50,000	416	39.5
Rs.50,000-100,0000	260	24.9
Above Rs.100,0000	72	6.8
Total	1,053	100.0

4) Educational Level of the Participants

Table 11-34 Education Level of the Participants

Items	Number	%
Illiterate	35	3.3
Under-matriculation	248	23.6
Matriculation	412	39.1
Graduate	238	22.6
Professional Education	120	11.4
Total	1,053	100.0

(5) Summary of the Consultations

Table 11-35 shows categorized questions made by each state. The questions are categorized mainly six types below.

(a) Question on outline of the project

(b) Question on technical aspects of the project

(c) Question on positive impacts of the project

(d) Question on negative impacts of the project

(e) Question on natural environment including ecology, global warming, and reforestation

(f) Question on pollution including noise and vibration issues

Proceedings of the first stage stakeholder/public consultation meeting are summarised in *Volume 4 Technical Working Paper Task0&1, 11-(5)*.

Table 11-35 Category of Questions and Opinions by Participants

Questions and Opinions	State
A. Question on outline of the project	
- Period of the project and reason for delay - Financial source for the project	- Delhi, Haryana - Delhi, Haryana
B. Request from technical aspect	
- Question on selection of the route - Opinion that elevated-railway be applied	- Delhi - Punjab
C. Question and opinion on positive social environmental impact	
- Benefit of the project - Expectation of employment opportunity	- Delhi, Bihar, Haryana - Bihar, Jharkhand, Punjab
D. Question and opinion on negative social environmental impact	
- Question on loss of job opportunity for truck-related work - Question on compensation policy on land acquisition - Question on width of land to be acquired	- Delhi, Haryana, Rajasthan - Delhi, Bihar, Haryana, West Bengal - Gujarat, Jharkhand
E. Question on natural environment	
- Question on ecology, global warming, and reforestation	- Delhi, Haryana - Delhi - Bihar, Jharkhand, Punjab
F. Question on pollution issues	
- Question on impact of noise and vibration	- Delhi, Rajasthan, Bihar, Haryana

11.5 ESTABLISHMENT OF AND DISCUSSIONS WITH EWG

11.5.1 Background, Objectives and Roles of EWG

According to the environmental impact assessment guidelines issued by the Ministry of Environment and Forests (Notification, September 2006), environmental clearance is exempted for railway development. Thus, environmental study has not been conducted as well as social study in the PETS-II report, which was prepared by RITES, the Indian consulting firm undertaking feasibility study of DFC Project, to show basic plan of the project. Under the condition, JICA Study Team carried out the environmental and social considerations study at the planning stage of the Project if there would be or not be any significant environmental impacts caused by the Project based on the JICA Guidelines for the Environment and Social Considerations of 2004.

While it is one of the important tasks of JICA Study Team in terms of the review of feasibility report carried out by RITES from environmental and social considerations viewpoints, MOR does not have appropriate section specifically undertaking environmental study. Thus, as per Scope of Works signed by both the Government of India and Japan on 3rd February 2006, an Environmental Working Group for the DFC project (EWG) has been established under MOR.

EWG has been playing an active role in terms of which examination for the terms of reference and various presentation materials intended to make use of the Environmental and Social Consideration Studies at each stakeholder/public consultation meeting.

11.5.2 Composition of EWG

EWG consists of members from relevant governmental agencies as shown below.

Table 11-36 Members of EWG

Chairman	Mr. P.D.Sharma, Executive Director (Land & Amenities), MOR
Members	Mr. Rahul Agarwal, Director-Planning (Special), MOR
	Mr. Rajesh Agarwal, Director-Works, MOR
	Mr. Pankaj Asthana, Assistant Inspector General of Forests, MOEF
	Mr. A.Senthilvel, Additional Director-Impact Assessment, MOEF
	Dr. A.K.Singh, Director-Dept. of Land Resources, MORD
	Mr. G.B.Upadhava, Undersecretary, Dept. of Land Resources, MORD

JICA Study Team has selected the following three academic advisors. Participants of the academic adviser in the EWG meeting from second meeting was approved by the EWG after the selection process was explained by the JICA Study Team to the EWG. They are expected to interact with JICA Study Team and its subcontracted local consulting firms who undertake the series of Environmental and Social Considerations Studies at IEE and EIA Levels in terms of improving the studies. They are also expected to examine final draft of the Environmental and Social Considerations Study at EIA Level so as it becomes as an acceptable environmental study report for further application of project fund from donors.

Table 11-37 Members of Academic Adviser

1) Biologist	Dr. Gurshan S. Randhawa	Professor & Head of Department, Dept. of Biology, Indian Institute of Technology Roorkee
2) Sociologist	Dinesh K. Nuriyal	Professor, Dept. of Humanities, Indian Institute of Technology Roorkee
3) Environmentalist	Dr. A.A. Kazmi	Professor, Dept. of Civil Engineering,, Indian Institute of Technology Roorkee

11.5.3 Summary of EWG Meetings

(1) First and Second EWG Meetings

EWG inaugural meeting was held on 30th October, 2006 followed by the second meeting held on 6th December 2007. The following are major topics of discussions:

1) EWG is consisting of the members of Ministry of Environment and Forestry and Ministry Rural Development. Further, as deemed necessary members of resettlement commission of each state could be invited to EWG meetings in the future;
2) JICA Study Team's environmental study report, especially its Resettlement and Rehabilitation Plan (RRP), should be duly recognized as a part of the final report of the Project. However, recognition of its contents and organization for doing it is subject to further discussion;
3) Information regarding terms of reference for environmental study subletting to Indian consulting firm and the materials subject to use during the stakeholder/public consultation meeting should be examined by EWG;

(2) Third EWG Meeting

Agenda for the third EWG held on 28 February 2007 was shown below.

1) Progress of the ESCS
2) Further schedule
3) Participation of DFCCIL personnel in the EWG meeting
4) Participant of the academic advisors
5) Procedures on environmental and social considerations related to JBIC finance

(3) Forth EWG Meeting

Forth EWG meeting was held on 13 March, 2007. In the meeting, results of the Environmental and Social Considerations Study at IEE Level (ESCS) were presented by the local consultant firm subcontracted under the JICA Study Team. Comments and suggestions on the study were exchanged among the EWG members, JICA Study Team, and local consultant.

Meeting records of the EWG meetings mentioned above are shown in "Volume 4: Technical Working Paper Task 2, 10-(8)".

CHAPTER 12
PROJECT IMPLEMENTATION PLAN
FOR THE OPTIMUM PROPOSITION

CHAPTER 12 PROJECT IMPLEMENTATION PLAN FOR THE OPTIMUM PROPOSITION

12.1 OUTLINE COST ESTIMATE OF OPTIMUM PROPOSITION

The preliminary project cost was estimated to examine the viability of selected option, Dedicated Freight Corridor, as was evaluated in Chapter. The elaborated project cost estimates is presented in *Volume 3 Task2 Chapter 11*.

12.1.1 Outline Costs on PETS Report

JICA Study Team had received from Ministry of Railway (MOR), the Feasibility Report (PETS-1) dated January 2006, later on, the PETS-II interim report was provided in November 2006 and the PETS-II final report was made available in January 2007.

In this Chapter a comparison table (Table 12-1) of cost estimate from each report i.e. PETS-1, PETS-II (Draft) and PETS-II (Final) is attached herewith.

Also attached is a brief summary of estimation for Western (Table 12-2) and Eastern (Table12-3) corridors as per the PETS-II (Final).

Table 12-1 RITES Estimate Cost

CORRIDOR:	Eastern Corridor			Western Corridor		
Based Document:	PETS-1	PETS-2 (Draft)	PETS-2 (Final)	PETS-1	PETS-2 (Draft)	PETS-2 (Final)
Date of Issue:	Jan 2006	Nov 2006	Jan 2007	Jan 2006	Nov 2006	Jan 2007
Route:	Sonnager-Khurja-Ludhiana			Panvel-Dadri	JNPT-Dadri	
Route Length:	1,232 Km	1.278.65 Km	1.278.65 Km	1,461 Km	1,515 Km	1,515 Km
		(D-866.65 Km)	(D-866.65 Km)		(D-1,483.0 Km)	(D-1,483.0 Km)
		(S-412.00 Km)	(S-412.00 Km)		(S-32.0 Km)	(S-32.0 Km)
Estimated Cost:	(Rs)	(Rs)	(Rs)	(Rs)	(Rs)	(Rs)
Civil Engineering:	81,647,300,000	125,449,900,000	112,605,800,000	97,409,390,000	183,472,200,000	165,770,000,000
	77.3%	82.5%	87.6%	85.1%	94.2%	94.0%
Electrical Engineering:	6,130,800,000	15,691,700,000	6,904,400,000	621,100,000	1,337,000,000	707,000,000
	5.8%	10.3%	5.4%	0.5%	0.7%	0.4%
Mechanical Engineering:	3,207,700,000	89,000,000	129,000,000	1,500,000,000	133,300,000	173,000,000
	3.0%	0.1%	0.1%	1.3%	0.1%	0.1%
S&T Engineering:	14,677,700,000	10,759,600,000	8,840,900,000	14,925,500,000	9,919,200,000	9,619,900,000
	13.9%	7.1%	6.9%	13.0%	5.1%	5.5%
TOTAL COST:	105,663,500,000	151,990,200,000	128,480,100,000	114,455,990,000	194,861,700,000	176,269,900,000
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total Cost chargeable to Project:			115,887,900,000			165,921,100,000
Deduction made by Civil:			12,592,200,000			10,348,800,000

Unit Price per Km :	85,765,828	141,649,767	119,739,143	78,340,856	129,994,463	117,591,661
(Singlex1/2=Double T.)	100.0%	165.2%	139.6%	100.0%	165.9%	150.1%

Table 12-2 Estimated Cost of Western Corridor in PETS-II

Sub Head	Det. Head	DESCRIPTION	AMOUNT (x1,000 Rs.)		
			Interim Nov. 2006 (A)	Final Jan. 2007 (B)	Difference (A) – (B)
1110		Preliminary Expenses	741,500	741,500	0
1120		Land			
	1120A	Land - Railway	10,225,421	10,225,421	0
	1120B	Land - ROB	6,486,514	6,413,899	72,615
1130		Structural Engineering works - Formation works			
	1131(a)	Earth works	8,557,044	9,259,367	(702,323)
	1131(b)	Side Drains	345,430	345,430	0
	1131(c)	Walling	77,917	77,917	0
	1131(d)	Blanketing	13,900,245	4,623,646	9,276,599
	1132	Tunnels	3,232,000	3,494,600	(262,600)
1140		Structural Engineering works - P. Way			
	1141	Rails and Fastenings	26,559,934	24,618,975	1,940,959
	1142	Sleepers and Fastenings	9,425,128	9,425,128	0
	1143	Points and Crossings	1,065,199	1,313,143	(247,944)
	1144	Ballast	5,464,331	7,993,461	(2,529,130)
	1145	Fencing	12,661	12,661	0
	1146	Road Crossing other than ROB/RUB	593,880	593,880	0
	1147	Other Miscellaneous works	14,775	14,775	0
1150		Structural Engineering works - Bridges			
	1151	Major Bridges – Steel works	3,570,987	3,570,987	0
	1152A	Major Bridges – Railways (Masonery)	10,549,987	9,887,367	662,620
	1152B	Major Bridges - Flyover	11,734,868	10,829,403	905,465
	1152C	Major Bridges - ROBs	49,839,460	41,466,661	8,372,799
	1153	Major Bridges – Railways (miscellaneous)	505,000	505,000	0
	1155A	Minor Bridges – Railways	2,777,286	2,777,286	0
	1155B	Minor Bridges – RUB	406,612	406,612	0
1160		Structural Engineering works –Satations & Buildings			
	1161	Offices	393,858	1,190,594	(796,736)
	1162	Station Building & Shed	346,018	338,484	7,534
	1163	Workshop & Store Buildings etc	0	0	0
	1164	Other Service Buildings	10,231	10,231	0
	1165	Residential Buildingd	2,565,900	2,722,752	(156,852)
	1166	Staff Welfare	26,100	25,056	1,044
1170		Equipment, Plant & Machinery			
	1174	Plant & Equipment of Civil Engin. Dep.	1,981,741	1,981,741	0
	1178	Miscellaneous Plant & Office Equipments	28,600	28,600	0
	1179	Motor Vehicle & Service	30,680	30,680	0
1180		General Charges: Establishment	10,288,158	9,295,515	992,643
1181		General Charges: other than Establishment	1,714,693	1,549,253	165,441
		Gross Civil Engineering Costs	**183,472,158**	**165,770,025**	**17,702,133**
		Cost of ROB Charges to Safety Fund	0	10,348,800	(10,348,800)
		Civil Engin. Cost chargeable to project	**183,472,158**	**155,421,225**	**28,050,933**
		Electrical Engineering Cost	**1,337,000**	**706,990**	**630,010**
		S & T Engineering Cost	**9,919,218**	**9,619,917**	**299,301**
		Mechanical Engineering Cost	**133,300**	**173,000**	**(39,000)**
		Total Cost chargeable to Project	**194,861,676**	**165,921,132**	**28,940,544**

Table12-3 Estimated Cost of Eastern Corridor in PETS-II

Sub Head	Det. Head	DESCRIPTION	AMOUNT (x1,000 Rs.)		
			Interim Nov. 2006 (A)	Final Jan. 2007 (B)	Difference (A) – (B)
1110		Preliminary Expenses	490,860	490,860	0
1120		Land			
	1120A	Land - Railway	8,142,710	8,142,710	0
	1120B	Land - ROB	5,207,091	5,014,914	192,177
1130		Structural Engineering works - Formation works			
	1131(a)	Earth works	4,462,772	5,105,674	(642,902)
	1131(b)	Side Drains	351,559	351,559	0
	1131(c)	Walling	206,869	206,869	0
	1131(d)	Blanketing	12,508,220	4,119,821	8,388,399
	1132	Tunnels	0	0	0
1140		Structural Engineering works - P. Way			
	1141	Rails and Fastenings	19,563,455	18,127,447	1,436,008
	1142	Sleepers and Fastenings	6,997,255	6,997,255	0
	1143	Points and Crossings	1,145,384	1,272,606	(127,222)
	1144	Ballast	4,076,112	6,960,858	(1,884,746)
	1145	Fencing	10,754	10,754	0
	1146	Road Crossing other than ROB/RUB	404,000	404,000	0
	1147	Other Miscellaneous works	12,332	12,332	0
1150		Structural Engineering works - Bridges			
	1151	Major Bridges – Steel works	1,460,535	1,460,535	0
	1152A	Major Bridges – Railways (Masonery)	4,882,406	4,661,655	220,751
	1152B	Major Bridges - Flyover	6,988,118	6,988,118	0
	1152C	Major Bridges - ROBs	32,537,150	27,279,595	5,257,555
	1153	Major Bridges – Railways (miscellaneous)	126,250	126,250	0
	1155A	Minor Bridges – Railways	1,564,002	1,564,002	0
	1155B	Minor Bridges – RUB	373,027	373,027	0
1160		Structural Engineering works –Satations & Buildings			
	1161	Offices	577,897	1,297,191	(719,294)
	1162	Station Building & Shed	399,715	390,754	8,961
	1163	Workshop & Store Buildings etc	304,492	303,077	1,415
	1164	Other Service Buildings	7,545	7,545	0
	1165	Residential Buildingd	2,459,577	2,595,050	(135,473)
	1166	Staff Welfare	204,842	196,648	8,194
1170		Equipment, Plant & Machinery			
	1174	Plant & Equipment of Civil Engin. Dep.	1,719,745	1,719,745	0
	1178	Miscellaneous Plant & Office Equipments	33,280	33,280	0
	1179	Motor Vehicle & Service	24,960	24,960	0
1180		General Charges: Establishment	7,034,574	6,314,345	720,229
1181		General Charges: other than Establishment	1,172,429	1,052,391	120,038
		Gross Civil Engineering Costs	**125,449,918**	**112,606,827**	**12,844,091**
		Cost of ROB Charges to Safety Fund	0	(12,592,200)	**12,592,200**
		Civil Engin. Cost chargeable to project	**125,449,918**	**100,013,627**	**25,436,291**
		Electrical Engineering Cost	**15,691,702**	**6,904,400**	**8,787,302**
		S & T Engineering Cost	**10,759,589**	**8,840,864**	**1,918,724**
		Mechanical Engineering Cost	**89,000**	**129,000**	**(40,000)**
		Total Cost chargeable to Project	**151,990,209**	**115,887,892**	**36,102,317**

12.1.2 Approach for Review of Project Cost estimated in PETS-II Report

The project cost estimate as shown in PETS-II Report received from MOR on January 2007 is reviewed by the following procedure:

i) To pick out the target items which occupy 90% of the total project cost from main

items.

ii) To review the unit rate of the target items selected the above.

The table below shows the result of analysis for the project cost estimate for Western Corridor and Eastern Corridor in PETS-II Report from the viewpoint of items costs in percentage. Land cost is excluded from the item list to be reviewed, although it occupies one of the highest percentage of the cost in the table. Regarding the construction cost for Major Bridge-ROBs, PETS-II Report considered that subsidy for road safety would be applied for it partially. However, the subsidy is not considered in the review due to the lack of reliable evidence concerning the subsidised funding.

Table12-4: Content of PETS-II Estimation Cost for Western & Eastern Corridors

No.	Western Corridor			Eastern Corridor		
	Item	Poss. (%)	Cumulative (%)	Item	Poss. (%)	Cumulative (%)
1	Major Bridge -ROBs	23.5	23.5	Major Bridge -ROBs	21.2	21.2
2	Rails & Fastenings	14.0	37.5	Rails & Fastenings	14.1	35.3
3	Major Bridges -Flyover	6.1	43.6	S&T Engineerig Cost	6.9	42.2
4	Land -Railway	5.8	49.4	Land -Railway	6.3	48.6
5	Major Bridges -Railway	5.6	55.0	Sleeper & Fastenings	5.4	54.0
6	S&T Engineerig Cost	5.5	60.5	Major Bridges -Flyover	5.4	59.4
	Sleeper & Fastenings	5.3	65.8	Electrical Engineering Cost	5.4	64.8
7	GeneralCharges:Establishment	5.3	71.1	General Charges:Establishment	4.9	69.7
8	Earth Works	5.3	76.4	Ballast Works	4.6	74.3
9	Ballast Works	4.5	80.9	Earth Works	4.0	78.3
10	Land -ROB	3.6	84.5	Land -ROB	3.9	82.3
11	Blanketing	2.6	87.2	Major Bridges -Railway	3.6	85.9
12	Minor Bridges -Railway	2.0	89.2	Blanketing	3.2	89.1
13	Tunnel	2.0	91.2	Residential Buildings	2.0	91.1
14	Other Miscellaneous	7.8	100.0	Other Miscellaneous	8.9	100.0

Source: Analysis by JICA Study Team

The table above shows that land cost and general charges account for approximately 10% and 5% respectively of the project cost for each corridor. Since the land cost in the cost estimate of PETS-II Report is applied without fixing the final route.

From the reasons stated above, the project cost except land cost and general charges is reviewed and verified.

12.1.3 Approach for Review of Construction Cost of Main Items and Unit Rates used in PETS-II Report

The following 10 items are reviewed.

(1) Unit Rate of Earthwork

The unit rates related to the earthwork is reviewed in terms of appropriate machinery expenses. The detail is shown in *Section 12.1.4*.

(2) Construction Cost for Major Bridge-ROBs

PETS-II Report proposed to construct ROB or RUB for all crossing points of roads without any provision of level crossing on both the Western and Eastern corridors. However, it is not realistic to complete the DFC project including ROB and RUB construction within 5 years due to large scale of land acquisition and resettlement. In addition, there is no

obligation that DFCCIL to shoulder the costs for all ROB and RUB construction. From the reasons stated above, it is proposed to split ROBs and RUBs into two types: ROBs and RUBs which affect the project negatively or not, and to include the former as a part of the project. (The latter should be implemented by some other budget/project.) Regarding the crossing points wherein any ROBs or RUBs are not provided by the DFC project, level crossing with automatic protection system shall be installed to enhance the safety and minimize the gate crossing time.

(3) Bridge Construction Cost

The unit rates for bridge construction are reviewed and evaluated by the same way applied in Clause *12.1.3 (2)*. The detailed procedure is as following.

i) To calculate the unit rates per m^2 (including substructures and temporary works) of each type of bridge based on "Analysis of Unit Price" prepared by RITES.

ii) To compare the unit rates calculated by i) with the unit rates of the other projects at every bridge types, and evaluate them.

(4) Track Construction Cost

Track construction cost in PETS-II Report was estimated on condition that the rail is produced in India. The cost is reviewed based on the unit rate which is calculated on using the head hardened (HH) rails made in Japan. As for the cost of sleeper, the unit rate prepared by RITES is adopted because it is judged that the prices of sleeper will have no large difference.

(5) Electrification Cost

The cost item is added as an item for Western Corridor.

(6) Signalling System Cost

The cost is reviewed based on the application of the signaling system in Japan.

(7) Telecommunication System Cost

The cost is reviewed based on the application of the telecommunication system in Japan.

(8) General Charges: Establishment and General Charges: Other than establishment

PETS-II Report added up "General Charges: Establishment" and "General Charges: Other than establishment" as a part of construction cost. These costs are estimated for the purpose of discussion and coordination with central government, state governments and the other public organizations in the implementation stage, and design and supervision by the executing agency.

General Charges: Establishment is reviewed by the following manner.

i) Design and construction supervision cost is separated from General Charges: Establishment. (Design and construction supervision cost is considered as consultant's cost separately.)

ii) 30% of this cost estimated in PETS-II Report remains as the cost for discussion and coordination with central government, state governments and the other

public organizations in the implementation stage, based on the actual expense of Delhi MRT project.

General Charges: Other than establishment this amount is used as shown in PETS-II Report without any review hence the cost is for actual site expense such as vehicle rental cost, accommodation cost, etc.

(9) Procurement Cost for Rolling Stock

The cost for procurement of rolling stock is included in the project cost in consideration, as a necessity, although PETS-II Report had not considered this cost. The number of rolling stocks to be procured is described in *Volume4 Technical Working Paper Task&1, 12*.

(10) Land Cost

Land cost is not included in the scope of Yen-loan, hence Government of India has the obligation of acquiring the land and providing the compensation. The land cost is included in the project cost. At present, the land cost estimated in PETS-II Report is adopted directly because the alignment is not yet fixed.

12.1.4 Review of Unit Rate for Earth Work

At present, a number of construction projects are being executed continuously in India, and lack of the required number of machinery and equipment for construction is expected. In such a large-scale infrastructure project, such as for DFC Project, it is necessary to procure high performance and efficient materials from both domestic and foreign countries to make up for the shortage and to complete the project within five years.

The cost estimates in PETS-II Report do not mention about the performance and procurement detail of machinery and equipment for the DFC Project. Therefore, the JICA Study Team considered following items to complete the project on time.

- Procurement of high performance Japanese-made machinery and equipment
- Participation of Japanese overseas subsidiary
- Procurement of foreign products

Review of unit rate is based on plant depreciation cost and cost estimate standard in Japan by assumption of using high performance new machinery and equipment for the DFC Project. It is considered as a STEP (Special Terms for Economic Partnership) Loan possibility.

In addition, main machinery and equipments are assumed to be procured from Japan or other overseas subsidiary products, and international transport cost and customs clearance charges are not included.

The result of the review is shown in Table12-5.

Table12-5: Cost Review of Earth work Rates

No.	Works Desription	Machinery/Equipment	Unit	Rate (Rs.)
1	Excavation and soil pushing	Bulldozer 21 tonne class	m3	94
2	Subgrade excavtion	Backhoe 0.45 m3 class	m3	68
3	Excavation and loading	Backhoe 0.8 m3 class	m3	59
4	Hauling (10km distance max.)	Dump truck 10 tonne class	m3	366
5	Backfill	Backhoe 0.8 m3, Vibro-roller 0.8-1.1 tonne, tamper 60-100 kg	m3	148
6	Spreading and compaction	Buldozer 15 t class, Tyre-roller 8-20 tonne	m3	112

Source: Analysis by JICA Study Team

Unit rate of earth work in PETS-II report is Rs.107/m3 which is an average of earth work in cutting Rs.75/m3, embankment without borrow material Rs.150/m3 and embankment with borrow material Rs.470/m3.

Result of communicating and investigation from local major construction firms, JICA Study Team has confirmed that unit rate of earth work is in between Rs.110/m3 and Rs.200/m3.

Based on the above, JICA Study Team will use Rs.150/m3 as unit rate of earthwork in embankment.

Unit rate of blanketing work in PETS-II report is Rs.400/m3. From similar construction costs obtained during discussions with Local Contructing Firms, JICA Study Team considered that this unit rate is reasonable to adopt.

12.1.5 Review of Construction Cost for Bridges

(1) Check of Construction Cost for Bridges

The construction cost for bridges consists of the following items on PETS-II.

Table12-6: Detail of Bridge Costs on PETS-II

Det. Head	Type of Bridge	Western Corridor		Eastern Corridor	
		Cost (Rs.1,000)	%	Cost (Rs.1,000)	%
1151	Major Bridge (Steel)	3,570,987	5.1%	1,460,535	3.4%
1152A	Major Bridge (Masonry)	9,887,367	14.2%	4,661,655	11.0%
1152B	Major Bridge (Flyover)	10,829,403	15.6%	6,988,118	16.5%
1152C	Major Bridge (ROB's)	41,466,661	59.7%	27,279,595	64.3%
1153	Major Bridge (Misc.)	505,000	0.7%	126,250	0.3%
1155A	Minor Bridge (Railway)	2,777,286	4.0%	1,564,002	3.7%
1155A	Minor Bridge (RUB)	406,612	0.6%	373,027	0.9%
	TOTAL -1150:	69,443,316	100.0%	42,453,182	100.0%

Item of 1151、1152A、1152B、1152C shown on the above table take most of the construction cost. Particularly item 1152C (Major Bridge (ROB's)) conforms to more than 60% of the total cost.

For checking this, JICA team considers three bridge type such as Steel bridges (1151)、PC bridges (1152A) and ROB.

Actual construction cost of YAMUNA Bridge as a steel bridge and Son Bridge as PC bridge which are under construction are referred to cross check PETS-II cost estimate of superstructure and substructure separately. Regarding the cost for ROB, this is shown on the article *(2)*.

Results for the steel bridges and PC bridges are shown on the Table12-7.

Table12-7: Cost Review of Steel & Masonry Bridges

Corridor	Own Estimation (A)	PETS-II Cost (B)	Reference
Western		3,570,987,000	1151 Major Bridge-Steel
		9,887,367,000	1152A Major Bridge-Masonry
Total::	13,209,808,308	13,458,354,000	A/B= 0.98
Eastern		1,460,535,000	1151 Major Bridge-Steel
		4,661,655,000	1152A Major Bridge-Masonry
Total::	7,139,201,156	6,122,190,000	A/B= 1.17

Results of calculation by JICA team shows 98 % of PETS-II for Western corridor, 117 % for Eastern corridor. As there is not a large difference between JICA's results and PETS-II, Estimation cost on PETS-II shall be applied as JICA's Estimated costs.

(2) Check of Construction Cost for ROB

The following 9 bridge types which 18m span RCT girder and 30m span PC girder are minimum unit, are considered for the cost estimation on PETS-II as shown on Table12-8. Types from A to E show simple bridge structure. Types from F to I show complicated bridge structure with approach road, construction in the city, retaining wall and connectivity with the highway.

Comparison of the unit rate shall be applied for the checking of construction cost as general checking method.

Result of the cost review of each ROB types are shown on the *Table 12-8*.

Table12-8: Costs Review of Bridge -ROBs

No.	Type of ROB	Cost per Location (Rs)	Bridge Deck Space (m2)	Rate per Bridge Deck Space (Rs/m2)	Width
1	Type (A):	36,400,000	864.60	42,100	W=3.75m
2	Type (B):	52,900,000	1,257.60	42,064	W=7.50m
3	Type (C)	60,400,000	1,257.60	48,028	W=7.50m
4	Type (D)	112,500,000	2,593.92	43,371	W=7.50m
5	Type (E)	66,500,000	1,257.60	52,878	W=7.50m
6	Type (F)	500,000,000	2,593.92	192,758	W=7.50m
7	Type (G)	300,000,000	2,593.92	115,655	W=7.50m
8	Type (H)	93,600,000	864.60	108,258	W=3.75m
9	Type (I)	110,100,000	1,257.60	87,548	W=7.50m

From the above table, the unit rate of Types from A to E is between Rs. 42,000 to Rs. 53,000. (¥105,000 to ¥132,500 @ Rs.2.5/¥) . The rates are understood to be reasonable, when compared with similar construction in their neighboring countries.

Although the results of Types from F to I are higher than other types because of including accessories, the rates are understood to be reasonable. Accordingly, the unit rate of PETS-II shall be applied as JICA Study Team's unit rate.

The Railway Ministry has suggested a policy of abolishing all level crossings along the DFC Line and planning to construct ROB by DFCCIL finance budget.

JICA team decided to separate the ROB cost for the project, as those which are necessary and those not necessary. JICA team recommends implementing these separately, not as DFCCIL's scope with cost not applied to DFC project. Level crossing protection system will employed instead of the ROB and which will replaced for above Type (A), (B), (C), (D), (G), (H) and (I) ROBs. The cost has been calculated as ¥ 8,780 million as ROB cost. (10 million ¥ per location and 873 locations)

Action of Level crossing protection system

This system automatically begins warning to the crossing road during 40 seconds after train approach detection and then closes crossing gate. After crossing gate completely closed, crossing signal light and indicate meaning "GO" to the train. If crossing signal does not light, the train is not permitted to pass the crossing. (The warning time depends on the crossing road length.)
AF joint-less track circuit (closed type, length 20m) is installed at the location of train approach detecting and also AF joint-less track circuit (open type, length 20m) is installed at the location passing Lx. Warning continues till complete train passes the train passing detector. It is so called "Check In/Out method".
OFC, commonly used for signally, will be used for monitoring information transmission.

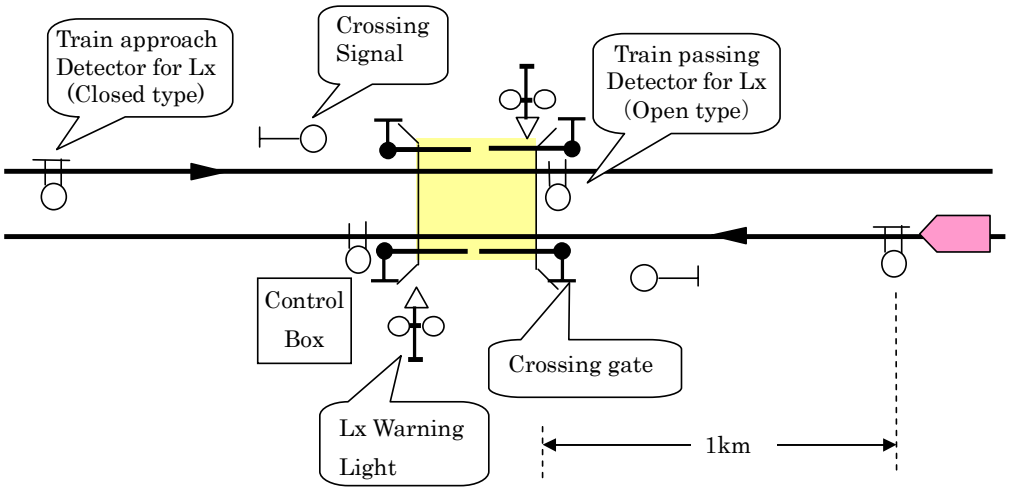


Table12-9: Estimate table for Lx protection system per 1Lx

Item	Description	Nos	Rate (¥1,000)	Price (¥1,000)	Remarks
1	Lx Warning Light	2	200	400	
2	Crossing Gate	4	400	1,600	
3	Crossing Signal	2	100	200	
4	Train detector(Closed)	2	400	800	
5	Train detector(Open)	2	400	800	
6	Control Box		1,000	1,000	
7	Installation Charges	LS	2,000	2,000	including E. Cables
8	Lx Monitor	1	1,000	1,000	Mounted in control Box
	Sub Total:			7,800	FOB Price
				2,200	Ocean Freight Charges
	Total:			10,000	

(3) Review and calculation of bridge (ROB) construction cost

Bridge (ROB) cost has been reviewed as following procedures.

1) Remove the costs of ROB cost (1152C) from PETS-II.（Alt-1）
2) Putting back the replacing ROB costs (SN5 & 6) as necessary（Alt-2）
3) Replacing the Level crossing protection system（Alt-3）

Table12-10: Alternatives for Bridge -ROBs Cost Consideration

EASTERN CORRIDOR					
1150	BRIDGES	PETS-II	Alt-1	Alt-2	Alt-3
		(Rs.1,000)	(Rs.1,000)	(Rs.1,000)	(Rs.1,000)
1151	Major Bridge (Steel)	1,460,535	1,460,535	1,460,535	1,460,535
1152A	Major Bridge (Masonry)	4,661,655	4,661,655	4,661,655	4,661,655
1152B	Major Bridge (Flyover)	6,988,118	6,988,118	6,988,118	6,988,118
1152C	Major Bridge (ROB's)	27,279,595	0	0	0
1153	Major Bridge (Miscellaneous)	126,250	126,250	126,250	126,250
1155A	Minor Bridge (Railway)	1,564,002	1,564,002	1,564,002	1,564,002
1155A	Minor Bridge (RUB)	373,027	373,027	373,027	373,027
	TOTAL	42,453,182	15,173,587	15,173,587	15,173,587
	Replacing ROB -Double T.	7 location		1,799,500	1,799,500
	Replacing ROB -Single T.	2 location		466,500	466,500
	Auto Railway Crossing -Double T	3,960,000Rs/location x263		0	1,041,480
	Auto Railway Crossing -Single T	3,960,000Rs/location x105		0	415,800
				17,439,587	18,896,867

WESTERN CORRIDOR					
1150	BRIDGES	PETS-II	Alt-1	Alt-2	Alt-3
		(Rs.1,000)	(Rs.1,000)	(Rs.1,000)	(Rs.1,000)
1151	Major Bridge (Steel)	3,570,987	3,570,987	3,570,987	3,570,987
1152A	Major Bridge (Masonry)	9,887,367	9,887,367	9,887,367	9,887,367
1152B	Major Bridge (Flyover)	10,829,403	10,829,403	10,829,403	10,829,403
1152C	Major Bridge (ROB's)	41,466,661	0	0	0
1153	Major Bridge (Miscellaneous)	505,000	505,000	505,000	505,000
1155A	Minor Bridge (Railway)	2,777,286	2,777,286	2,777,286	2,777,286
1155A	Minor Bridge (RUB)	406,612	406,612	406,612	406,612
	TOTAL	69,443,316	27,976,655	27,976,655	27,976,655
	Replacing ROB -Double T.	24 location		7,265,500	7,265,500
	Replacing ROB -Single T.			0	0
	Auto Railway Crossing -Double T	3,960,000Rs/location x505		0	1,999,800
	Auto Railway Crossing -Single T			0	0
				35,242,155	37,241,955

12.1.6 Review of Construction Cost for Track Work

The unit rate for track work in PETS-II Report was estimated based on the rail made in India. However, it is recommended to use the head hardened (HH) rail imported from Japan in terms of economy and long-term abrasion resistance. (There is a possibility to procure HH rail by using STEP scheme.) Based on the recommendation, the unit rate is reviewed based on the price of HH rail.

As the cost for sleeper, fastener, turnout, etc., it is evaluated that these unit rates prepared by RITES is appropriate and the same rates are adopted in this study.

12.1.7 Review of Electrification Cost

The study team proposed the electrification of the Western Corridor due to its economic and environmental advantage. The electrification cost for Western Corridor is estimated based on the same cost for Eastern Corridor. The electrification cost for Western Corridor is reviewed and modified as following table and total length shown in PETS-II Report.

Table12-11: Computation of Electrification Cost for Western Corridor

Section	Unit	Quantity	Rate (Rs.)	Amount (Rs.)	Rate Reference
Double Track	R.Km	1,483	6,303,000	9,347,349,000	PETS-II East. Corridor
Single Track	R.Km	32	3,494,000	111,808,000	PETS-II East. Corridor
Total:				9,459,157,000	

12.1.8 Review of the construction for Signalling system

The JICA Study Team estimated the cost of signaling system based on the Japanese signalling system in accordance with the station numbers as shown in PETS-II. The comparison of system specification between PETS-II and the JICA Study Team is shown in the following table. Estimated cost was calculated according to the specification of the JICA Study Team.

Table12-12: Comparison of Specification of Signalling System

	PETS-II	JICA Study Team
1. Length of Blocking	・Double Track Section - 2 Km ・Single Track Section - 10 Km	・3 Km – 5 Km
2. Block System	・ABS（Single Track Section） When line capacity increases, IBS is added. ・Automatic Block System ・Communication based Signalling system	・Automatic Block System
3. Train Detection （Block section）	・Track Circuit（Automatic Block） ・GPS（Communication based）	・Micro Balise
4. Train Control System	・TPWS （In case of Automatic Block Sys.）	・ATS-P
5. Signalling system in station area	・SSI（Electronic Interlocking System）	・Electronic Interlocking System

12.1.9 Review of the construction for Telecommunication system

There is no difference in the applicable system between PETS-II and JICA Study Team.

The comparison of the two is shown in Table12-13. According to these specifications we estimate the cost based on Japanese telecommunication.

Table12-13: Comparison of Specification of Telecommunication System

	PETS-II	JICA Study Team
1. Fixed Communication system		
1) Type	Optical Fibre Cable	Optical Fibre Cable
2) System	SDH (STM1,4)	SDH (STM1,4)
3) System configuration (redundancy)	Single system	Duplex system (Unit Redundancy)
4) Network configuration	Not specified	Loop
2. Mobile Communication system		
1) System	GSM-R	GSM-R
2) General Function	Voice, Data	Voice
3) Interval of base transceiver station	Not specified	7 Km
3. Exchange		
1) Type	Electronic Digital Exchange	Electronic Digital Exchange
2) Capacity	5,000 lines：Terminal Station 1,000 lines：Junction Station 256 lines：Crossing Station	5,000 lines：Terminal Station 1,000 lines：Junction Station 256 lines：Crossing Station
4. Dissipating Telephone		
1) Type	Selective calling system	Selective calling system
2) System	Not specified	Centralized

12.1.10 Cost Estimate for Rolling Stock Procurement

Calculation of initial investment amount.

Rolling stock cost (Locomotive)

Table12-14: Computation of Locomotive & Wagon Cost

Description	Specification	Rate (Rs.)	Nos	Estimate Amount (Rs)
Electric Locomotive	6 Axles, 9,000 HP	167,200,000	256	42,803,200,000
	8 Axles, 12,000 HP	193,000,000		
Diesel Locomotive	9,000 HP	154,100,000		
Wagon	Container Wagon-A、Wagon-B	2,295,000	13,286	30,491,370,000
Total:				73,294,570,000

Note：1) Required Nos of Locomotives are 119 for East. and 137 for West. at year 2011-2012.
2) Estimated Rates are based on the T/R-1 Chapter-9 Clause.9.9.2

12.2 ESTIMATION OF BUDGETARY PROJECT COST

12.2.1 Conditions of Estimation

Budgetary Project cost has been estimated as following conditions by JICA Study team.

1) Exchange rate has employed at 2.525 ¥/Rs which is based on an average figure of the reference rate of Reserve Bank of India period of 1st of April to end of October 2006.
2) All domestic taxes (ie, Commodity tax, service tax) have been included in the construction costs except import duties and taxes and domestic taxes for Japanese procurements due to not a clear tax strategy on this project.
3) Land acquisition cost has been removed from construction cost and included in the project cost.
4) Consultant cost has been computed based on the 5 years construction period for both Western and Eastern corridors simultaneously.

12.2.2 Budgetary Project Cost

According to the above estimation conditions and format, JICA study team's estimate project costs are as bellow Table12-15.

Table12-15: Structure and Amount of Budgetary Project Cost

Description	Amount (x1,000 Rs)	Remarks
Construction Cost for both Corridors	234,747,745	
Freight Cars & Wagons	73,294,570	Electric Loco. & Wagon
Consultant Cost	15,317,105	
Sub Total-1:	323,359,420	
Contingency	16,167,971	
Sub Total-2:	339,527,391	
Inflation	78,091,300	
Sub Total-3:	417,618,691	
Taxes for Overseas Consultant	5,725,113	
Land Cost	29,796,944	PETS-II Land Cost
Total Project Cost:	453,140,748	

(1) Construction cost for Western and Eastern Corridors

Study Team reviewed the PETS-II cost estimate of Civil engineering, Electrical engineering, Mechanical engineering, Signal & Telecom engineering and utility relocation, including the administration costs according to the clause *12.1.3* and other conditions. Study team also checked and justified the PETS-II rates and prices. Those items that were reviewed, then reflected into their costs. (see attached Table12-16: JICA Study Team's estimate of Construction Cost)

Major Bridge (ROB) is biggest amount in the PETS-II detail heading which has been drastically cut down due to replacement by level crossing protection system.

In the PETS-II, there is a huge volume of earth work encountered. (Approx. 150 million cu.m. This is the key to employ large number of construction machineries and plant for adhering to the construction schedule. Study team has reviewed and computed the earth works rates according the Japanese cost estimation guideline and also referred to the rates for domestic road/highway works and other neighboring countries. Thus, rate has been raised by 30 to 40% of PETS-II rate.

Study Team has recommended to employ Head Hardened rail (HH rail) instead of normal rails due to the information of rail defects and breakage, besides savings due to life-cycle costs. The HH rail prices have been used.

General Charge - Establishment cost is estimated 6% of Civil engineering cost in the PETS-II and other major project in India. According to the Study Team's analysis which included coordination costs with related governments, communication expenses and a part of consultant cost. Thus those costs have been split and removed from the consultant's cost.

Electrification costs for Western corridor are computed based on the rate of Eastern corridor. The cost are excluding the infrastructures cost such as transmission line and sub-stations.

Signal & Telecom costs are calculated by built up method based on the Japanese system. Thus costs have been raised by 20 – 30%.

Table12-16: JICA Study Team's estimate Construction Cost

Sub Head	Description	Estimate Amount		
		West. C (1,000 Rs)	East. C (1,000 Rs)	Total (1,000 Rs)
1110	Preliminary Expenses	741,500	490,860	1,232,360
1130	Structural Engineering works - Formation works			
1131(a)	Earth works	12,845,942	7,076,426	19,922,368
1131(b)	Side Drains	345,430	351,559	696,989
1131©	Walling	77,917	206,869	284,786
1131(d)	Blanketing	4,623,646	4,119,821	8,743,467
1132	Tunnels	3,494,600	0	3,494,600
1140	Structural Engineering works - P. Way			
1141	Rails and Fastenings	29,205,399	20,542,785	49,748,184
1142	Sleepers and Fastenings	9,425,128	6,997,255	16,422,383
1143	Points and Crossings	1,313,143	1,272,606	2,585,749
1144	Ballast	7,993,461	6,960,858	14,954,319
1145	Fencing	12,661	10,754	23,415
1146	Road Crossing other than ROB/RUB	593,880	404,000	997,880
1147	Other Miscellaneous works	14,775	12,332	27,107
1150	Structural Engineering works - Bridges			
1151	Major Bridges – Steel works	3,570,987	1,460,535	5,031,522
1152A	Major Bridges – Railways (Masonery)	9,887,367	4,661,655	14,549,022
1152B	Major Bridges - Flyover	10,829,403	6,988,118	17,817,521
1152C	Major Bridges - ROBs	9,265,300	3,723,280	12,988,580
1153	Major Bridges – Railways (miscellaneous)	505,000	126,250	631,250
1155A	Minor Bridges – Railways	2,777,286	1,564,002	4,341,288
1155B	Minor Bridges – RUB	406,612	373,027	779,639
1160	Structural Engineering works –Satations & Buildings			
1161	Offices	1,190,594	1,297,191	2,487,785
1162	Station Building & Shed	338,484	390,754	729,238
1163	Workshop & Store Buildings etc	0	303,077	303,077
1164	Other Service Buildings	10,231	7,545	17,776
1165	Residential Buildingd	2,722,752	2,595,050	5,317,802
1166	Staff Welfare	25,056	196,648	221,704
1170	Equipment, Plant & Machinery			
1174	Plant & Equipment of Civil Engin. Dep.	1,981,741	1,719,745	3,701,486
1178	Miscellaneous Plant & Office Equipments	28,600	33,280	61,880
1179	Motor Vehicle & Service	30,680	24,960	55,640
1180	General Charges: Establishment	0	0	0
1181	General Charges: other than Establishment	1,228,576	794,735	2,023,311
1190	Government Administration Cost	2,211,437	1,430,523	3,641,960
	Civil Engineering Cost	**117,697,588**	**76,135,600**	**193,833,188**
	Electrical Engineering Cost	**9,459,157**	**6,904,400**	**16,363,557**
	Mechanical Engineering Cost	**173,000**	**129,000**	**302,000**
	S & T Engineering Cost	**11,405,422**	**11,675,659**	**23,081,101**
	Utility Relocation Management Cost	**693,693**	**474,206**	**1,167,899**
	Total Construction Cost:	**139,432,349**	**95,321,265**	**234,747,745**

(2) Locomotives & Wagons Cost

Locomotives and wagons costs are computed based on the Electric locomotives (6 axle, 9,000 HP – 6,750 kW) and container wagons. The price of Electric locomotive are calculated based on addition to 30% of development cost on existing price in India. Quantities of locomotive and wagon are based on year 2011 – 2012 requirements.

(3) Consultant Cost

Study Team built up the cost based on the assumption made that is, 10 work Sites and 5 years of construction period for the total – 2,794 km Western and Eastern corridors. The cost has been calculated by built up method instead of percentage method due to this mega size of project. Also to add 0.5% of construction cost for management cost. Calculation sheet are as shown bellow.

(4) Contingency

The rate of contingency is estimated to be approximately 10% in the common project costs. However, Study Team used and calculated it as 5% of construction cost, locomotive & wagon cost and consultant cost due to size of project and less difficult works, such as tunnel and long-span bridges.

(5) Inflation

According to investigation and analysis of economic growth in India, Study Team assumed and calculated a 7 % per annum inflation rate for this construction period. Disbursement schedule are also assumed in 6 years period (including 1 year preliminary investigation period).

(6) Taxes for Overseas Consultant

Corporate tax, personal income tax and service tax is calculated by built up method based on the overseas consultant cost.

(7) Land Cost

As mentioned in the clause 5.2.1 in this chapter, Study team has put same amount of land cost of PETS-II due to no availability to final route plans.

12.3 CONSTRUCTION MANAGEMENT

12.3.1 Outline of DFC Project and Trend of Indian Construction Industries

The scale of this project according to RITES Preliminary FS Report is massive, since the amount of the soil of about 150 million cu m, besides construction of various structures and facilities for new railway lines totaling 2,700 km, is also to be dealt with. Therefore, not only technologies are required, to shape workable plans, design and define functions of facilities and structures, but also management mechanisms and organizations to build these facilities and structures become equally important. Hence, for this massive project Implementation, Indian Government has decided the establishment of SPV that forms the execution body of this project. According to this latest MOR policy decision, a DFCCI was established in November, 2006, to execute the project, as the SPV.

In the implementation of the construction project, there are three major methods in general, namely; 1) executing the design and construction, individually, 2) executing the design and construction by one company, and 3) the construction management method. Moreover, it is necessary that the items shown in the attached Table 12-17 must be considered carefully and exhaustively for the project execution, regardless of the final outcome of implementation strategy.

Indian construction industry is advancing positively with the introduction of the European and American style of management and technology in construction business, thus starting to get internationalized. Meanwhile with the recent trend of globalization, and also transparency of operation of the business and application of competitiveness are being acquired by the large local established contractors. Especially, the Construction Management (CM) method, which is in vogue and highlighted extensively in the recent years. This is a method, with an aim to promote the project efficiently and economically with a Construction Manager (CMR) executing and managing the project from planning to completion/commissioning during its project implementation, including its design, construction, and maintenance at all stages by various contracts, ensuring the owner's standpoint to complete the project in the cost, within the budget, also ensuring the quality expected in terms of work, without delay.

There are two forms of CM method one is known as "Pure CM method" and the other "At-risk CM method". The former is a method wherein, CMR doesn't undertake construction, and the latter is a method that CMR undertakes all construction.

In India, there are a lot of real life examples, but most of them were the Pure CM method which was ordered by various public authorities to centre owned PSU's and state owned PSU's like IRCON, RITES, UPSBC and State road and bridge construction agencies. However, the necessity of CM method of execution order placed on the private organizations other than the PSU's is currently under discussion.

The diagrams of Implementation structure and salient features of a Conventional Project style of execution and CM project style of execution are shown below in Figure 12-1.

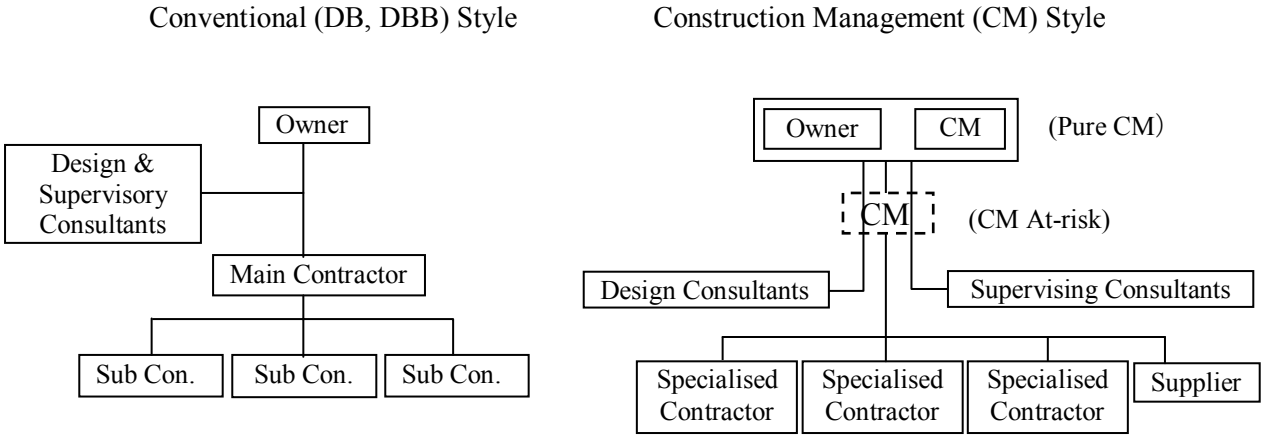


Figure 12-1 Comparison of Project Implementation Structure

Items to be considered risks in DFC project implementation by phase of the Project are indicated on the following Table 12-17.

Table 12-17 Risks to be Considered in DFC Project Implementation by Project Phase

Planning Phase	Design Phase	Bid & Contract Phase	Construction Phase	Post Construction Phase
[Project justification] • Technical feasibility • Economical feasibility • Political circumstances • Competing projects • Statutory/regulatory constraints • Public acceptance • Approval of competent authority [Funding & Financial] • Source of fund • Climate and market rate of bonds • FC exchange rate • Inflation rate • Bank interest rate • Approval of budget by parliament/ congress/cabinet etc. • Underestimate of project cost • Overestimate of IRR (demand forecast) [Scope of project implementation] • PDCA design • Clarity of objectives • Appropriate correspondence to change of plan • Accurate grasp of scale of plan and complexity degree • Accurate grasp of demand scale for material, machine, and laborer necessary for project implementation • Supply capacity of construction market and industry (Contractor, vendor, laborer, construction machinery, and consultant, etc.) • Certainty of law and standard for design and	[Design Consultants] • Design consultant's qualification, role, and cooperating spirit with other related organizations • Consultants' understanding concerning cost implication and process control • Prevention of imperfect design (error and oversight of design) • Quality assurance and quality control system(ISO) • Design accountability (design validity; adopting new technologies and/or construction methods, securing transparency and competition principle • System Integration skill • Corresponding adjustment with other related designers concerned • Professional Indemnity Insurance • Delay of design completion [Site Survey & Investigations] • Understanding of law and standards concerning design and construction • Understanding of complexity of project • Appropriate investigations of soil nature and geological features condition, hydrological condition, the ground condition, and banking material, etc • Appropriate data collection and testing result • Accurate	[Project implementation scheme (selective)] • Turn-key（TK） • Design & Build（DB） • Design-Bid-Build（DBD） • Design-Build-Operate-Maintain（DBOM） • Build-Operate-Transfer（BOT） • Joint Venture (JV) • Single prime • Multi-prime • PPP・PFI • Pure CM • CM at-risk [Contract (selective)] • Fixed Lump Sum Price (LS) • Unit Price (UP) • LS + UP • Cost + fee [Contractor] • Experiences and track records of similar projects • Type of business, capability, amount of the capital, and years of experience • Safety track records (accident records) • Guarantee ability evaluation and reputation • Experiences and track records in India • Cost, process, and document management capability • Past record concerning claim and arbitration, etc • Past record of observance of term and budget • Management and control capability of subcontractor(s) • Program of quality assurance and quality control [Market conditions] • Number of bidders	[Insurances] • Covered area and conditions • Wrap-up insurance • Owner's project insurance program [Site] • Access road • Traffic Jam/congestion • Differences of site conditions: - soil and geological conditions - Hydrological conditions - Meteorological conditions - Buried public utilities • Archaeological finds • Buried toxic waste finds • Adjacent buildings and structures protection • Public traffic obstruction and business obstruction prevention requirements [Work schedule] • Adjustment of working time table of adjacent contractors • (blasting work and waste material discharging traffic prohibitions etc.) • Delay of adjustment of time table for relocating underground and aboveground public utilities with authorities concerned • Unsatisfactory main contractor's effective management of subcontractor and ability shortage of subcontractor	• Individual performance test, system integration test, and trial run • Operation and maintenance organization establishment and operation • Skill training and capacity building program • Handing and taking over procedure of system • System trial operation and authorization of commercial operation • Warranty period, content, and conditions • Completion procedure of construction program (documentation of account books, authorization and approval letters, as-built drawings, contracts and addendum, and operation and maintenance manuals etc.)

Planning Phase	Design Phase	Bid & Contract Phase	Construction Phase	Post Construction Phase
construction works • Understanding of issues in project implementation • Flexible selection of alternatives	geographical and topographical survey result • Appropriate design revision • Changes in necessary concept corresponding to policy change • Influence and impact on adjacent buildings and/or structures [Cost estimate] • Stable/not eccentric cost estimate • Error of quantity estimate • Financial cost estimate • Escalation ratio and factor • Contingency • Force account budget • Correspondence of content of design and estimated value [Scheduling] • Milestone and key date schedule • Consistent schedule corresponding to concept • Homogenized time table for each part of construction (uniformity of detailed time table) [Land acquisition] • ROW design • Timely land acquisition • Timely resettlement [Regulatory conditions] • License, Approval, Authorization • Environmental regulation and consideration • Barrier Free • Delay of Approval and authorization • Infringement of patent right (intellectual property protection) • STEP LOAN condition	• Number of subcontractors, vendors and suppliers (supply capacity) • Unemployment rate of construction industry • Workload of regional contractors • General construction industry market conditions • Prices of materials, power, fuel, machines • Price index and market interest rate [Regulatory conditions] • License, Approval, Authorization • Environmental regulation and barrier free consideration • Encouragement of usage of local contractor • Tax and duty • Limitation of use of import material and equipment [Role of Owner and CMR (if CM method adopted)] • Clear mission of CMR and definition of authority • Intellectual property protection • Stable supply securing of construction materials and machines • Testing, inspection, and safety management systems • Arrangement of prompt procedure of commencement and site access • Cooperation system securing relation with public authorities, companies, and inhabitants group, etc • Setting up of	• Irregular and abnormal weather • Delay of progress according to contractor's financing deterioration due to owner's payment delay • Delay of land acquisition and site possession • Delay of approvals [Technology and method] • New technologies and construction methods introduction and adoption, and approval procedures • Noise, vibration, dust, waste mud, construction scrap, water pollution, and water vein dry-up measures • Relocation of public utilities • Misconduct of design and location of plants and temporary facilities • Construction deficiency • Accidents • Price rise prevention plan by shortage of materials • Management and integration system (hard and soft ware) [Force majeure/disaster] • Abnormal weather (continuous downpour・typhoon・tornado) • Earthquake • Flood • Fire • Terrorism • Riot • War	

Planning Phase	Design Phase	Bid & Contract Phase	Construction Phase	Post Construction Phase
	consideration and home product procurement obligation, etc.	communication system [Guarantees] • Performance Bond (PB) and Letter of Credit (LC) • Third party insurance • Consequential damages • Liquidated damages • Performance and quality • Cost and progress	[Labour Management] • Strike • Accident • Wage inflation • Sabotage • Unions • Material waste, theft	

12.3.2 Implementation Structure of Large-scale Projects Executed/Under Execution in India

(1) KONKAN Railway

This large-scale Railway project executed during India's post-independence era, which comprises of 760 km long double track, with 1,816 bridges (146 major bridges and 1,670 minor bridges) and 92 tunnels (max. length of a tunnel 6.5 km) was constructed in eight years from 1990 to 1998.The total project cost was Rs. 3,500 Cr. and was completed without using any finance from the foreign country as a first BOT based project. This project was constructed by M/s KRCL, a Government of India owned SPV. The implementation structure was the conventional style as Design-Bid-Build (DBB: is a method with the contractor selected by the competitive tendering based on a detailed design of the consultant and the contractor executes the construction and hence called as "Construction Only" in general.)

(2) Mumbai Suburban Railway

This is the Asia's largest commuter railway system carrying 5 to 6 million passengers/ day. It is located in India's largest city i.e. Mumbai. Mumbai Urban Transport Project (MUTP) presently under implementation has applied for the loan from World Bank to cover main portion of the construction cost. The execution form is a conventional model, with setting up of company, namely MRVC Ltd. equally owned by MOR and Government of Maharashtra.

(3) Mumbai MRT

Mumbai Metropolitan Regional Development Authority (MMRDA) is now implementing a MRT network system, which consists of 9 routes, widely covering the Mumbai city, which is largest populated city in India. The implementation of Line No. 1 has been just started by M/s RELIANCE Group consortium, as a BOT project. MMRDA has invested 26% in the SPV's equity.

(4) Delhi Metro Railway (Delhi MRT Project)

The construction of the commuter railway network of 196 km (construction to be carried out in three Phases) in total length within the Delhi Metropolitan area was planned in 1997 after GOI's approval of the project. The first stage of 67 km was completed in November 2006 and the second phase of construction of 55 km has commenced. The execution structure is both Design & Build (DB) and Design-Bid-Build (DBB) with the General Consultants (GC)

appointed for the Project execution. (DBB is a method with the contractor selected by the competitive tendering based on a detailed design of the consultant and the contractor executes the construction and hence called as "Construction Only" in general.)

(5) RVNL Projects

It is a new PSU of MOR that was established in 2002, and commenced its activities in 2005. RVNL is dealing with 46 predetermined projects of various sizes. Though 53 projects were to be executed at the time of its incorporation, due to certain changes a few number of new projects were added and some of the planned projects cancelled. RVNL is a PSU established for the purpose to implement these 46 projects only and adopting Public Private Partnership (PPP) scheme for financing most of these projects. The execution structures are, the Built-Operate-Transfer (BOT), pure CM, and conventional model DB・DBB, etc., depending on the character and the scale of the project.

(6) National Highway Authority of India (NHAI) Projects

The Project execution by NHAI varies. The NH-25(JBIC Loan) road widening project is DBB type, conventional model and then in some other cases, projects are executed by BOT with toll collection as means for capital and maintenance costs. NHAI have signed a MOU with M/s IRCON to construct all ROB's over Railway lines on CM basis. This pure CM is being executed by IRCON that is a PSU of MOR as Independent Engineer (IE)/Independent Consultant(IC) corresponding to CMR. The NH-8 flyover crossings Toll-road project from Gurgaon to Delh was first started as JV Concession method, but due to the financial logjam of JV, NHAI has taken over the execution of remaining works with new contractors.

(7) NOIDA – GREATER NOIDA Expressway

This project was awarded directly without calling for tender, to M/s IRCON on CM basis by NOIDA Authorities, with full responsibility for execution of the expressway. The direct cost of works and management costs of M/s IRCON with their overheads, profit and taxes were billed to NOIDA Authorities. The responsibility of keeping the project costs reasonable, quality in control and project executed within time was with M/s IRCON. The project was successfully completed on time.

12.3.3 Delhi Metro Rail Corporation (DMRC)

There is a similar project by a SPV for Delhi Mass Rapid Transport System (DMRTS) by Delhi Metro Rail Corporation (DMRC) wherein the financial cooperation by the JBIC loan has been carried out. However, it should be noted that needless to say that DMRTS project and this DFC project are substantially different in character, the former is an intra-urban passenger transportation system and the latter is an inter-city freight transportation system.

The Study Team was able to understand the following features in accordance with an investigation on the DMRTS project execution, which has been highly appreciated by the Government.

- Organizational structure assists the Managing Director to demonstrate dynamic leadership,

- Prompt decision making mechanism by highly motivated team taking conscious decisions for the project concerned,

- Clear corporate governance by establishment of simple chain of command,

- Technology reinforcement and effective support system by the specialist group.

They have executed an innovative organizational operation in each and every area of work, significantly different from conventional organizations though they may be typical in nature. Figure 12-2 shows the organization chart of DMRC management during the construction execution stage.

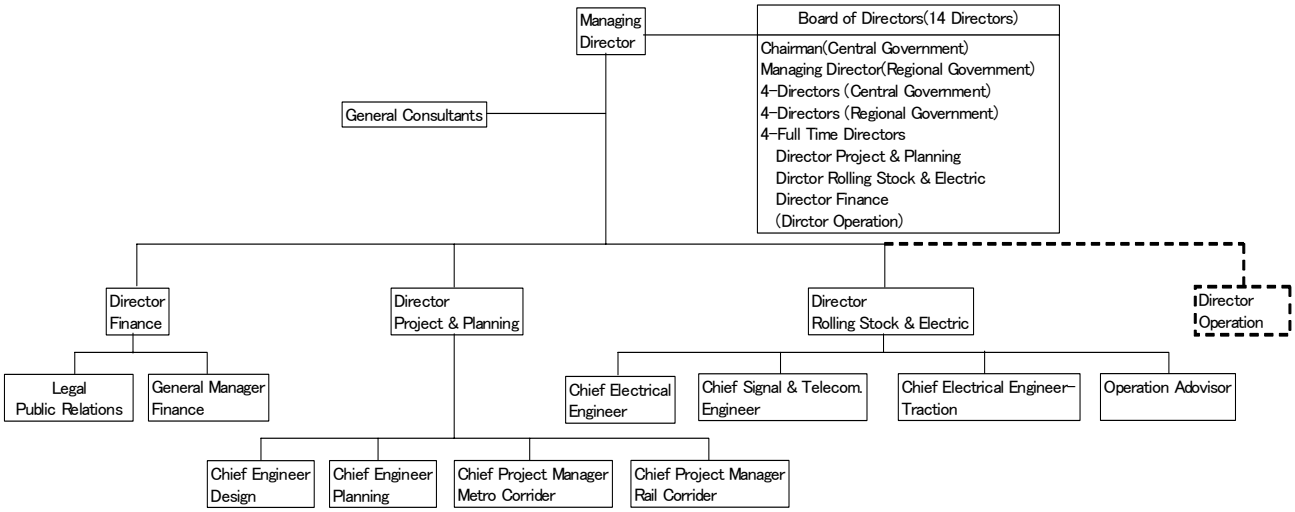


Figure 12-2 DMRC Managerial Organization Chart (Construction Stage)

The organization was managed based on the organization decision of the Board of Directors consisting of 14 Directors and by the MD and 4 full time Directors along with about 160 officers and staff. General Consultants (GC) was deployed, and the construction was executed by a series of engineering consulting services to carry out detailed design, tendering and the contracting support, construction supervision, and commissioning of the constructed system.

Figure 12-3 Shows the GC Managerial Organization Chart.

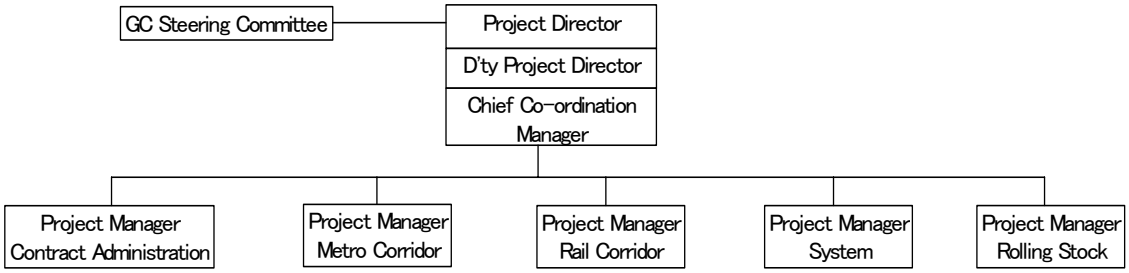


Figure 12-3 GC Managerial Organization Chart

The period in which GC had executed a series of comprehensive engineering services contract from the design to system commissioning was a total of eight years, consisting of two years for Pre-Construction Stage (design, tender, and support for contracting procedures) and 6 years for Construction Stage (construction supervision and system commissioning).

A total of 9,000 engineering man months (MM) were deployed during these eight years' though the assigned man-months (MM) were different at each different stage. The breakdown of the total MM was 1,200 MM for International experts and 7,800 MM for Indian experts.

The project's first phase has already been completed and commissioned. The commercial operation commenced according to schedule, and the construction of the second phase has already begun.

12.4 EFFORTS FOR FORMULATING SPV AND CHALLENGES OF THE SPV

Dedicated Freight Corridor (DFC) project became the national project under the Committee on Infrastructure, which established Task Force for recommending the role of Special Purpose Vehicle (SPV) for the project, the management vehicle of the project.

Efforts done for selecting best form of SPV by Task Force, Ministry of Railway (MOR) and Cabinet is stated in *12.5.1 and 12.5.2* describes the review of the organizational form that MOR developed as Public Private (Public) Partnership (PPP) in railway projects since 1986.

Then Challenges, given to DFC under authorized SPV are described in *12.5.3* preliminarily taking the analysis in 12.5.2 into consideration.

Lastly recent developments of DFC–SPV are stated in *12.5.4.*

12.4.1 Efforts Made for the Formation of the DFC-SPV

Task Force made their organizational recommendation on February 16, 2006, on which the MOR gave contradictory comments, resulting in Cabinet resolution by August 25th, 2006.

(1) Report of the Task Force

The Report responded to the direction of the Committee on Infrastructure, chaired by the Prime Minister, to suggest a new organizational structure for planning, financing, construction and operation of the DFC. The Task Force was comprised of members from Planning Commission, Railway Board and Department of Economic Affairs and was chaired by Shri Anwarul Hoda, Member from Planning Commission. The Report was approved by the Committee on Infrastructure on February 16, 2006.

1) Integrated Model or Separated Model.

The report summarized past railway experiences on integrated/separated models in EU and other countries, as presented below, and recommended an integrated model by the SPV with free access to the DFC rail facilities by other operators besides the SPV.

a) Comments from EU-Railway concerns

- "No clear view emerges on the 'best' model (integrated or separated)"[1]
- "As from the generally known situation in Great Britain, and also this analysis of the seven countries with institutional separation gives proof to the fact that separation has no benefits. It only brings in serious problems."[2]

b) Statements from EU-Railway institutions

- "There is no empirical evidence in Europe that separation between infrastructure and operating services leads to real improvements in railway system: just the other way around."[3]

[1] Community of European Railway and Infrastructure Company
[2] Public Transportation Union in Switzerland
[3] Executive Director, CER Infrastructure Co.

- The Swiss railway company SBB believes that the high quality of SBB rail services is only possible because it can optimize simultaneously the synergy of infrastructure and operation within one company under one management.4
- Despite the EU move towards separation almost all countries in the centre of Europe have retained the model of integrated holding companies (Germany, Poland, Switzerland, Austria, Italy, Belgium, Luxembourg) in order to maintain a high efficiency and productivity of the railway system as a whole. Separation has been effected mainly in countries at the periphery of Europe, i.e. without transit traffic and with considerable lower traffic intensity.
- The experience in quite a number of European countries (Germany, Poland, Switzerland, Austria, Italy, etc.) has however shown that the objective of competition can be achieved without giving up the model of an integrated company.

c) World Bank paper draws from the UK experience:

- "Bank clients that are not compelled to adopt the EU mandates to separate infrastructure from operations should carefully explore the alternatives before adopting the UK or EU approach."
- "Alternative approaches, such as creation and sale of a limited number of market-defined, integrated franchises might have worked equally well if not better."[5]

d) Dependency of Rail Track Corporations

- ARTC (Australian Rail Track Corporation) has been cash positive but earns significantly less than the replacement cost of its assets. The Australian Government has already committed to significant grants to uplift the quality and performance of the interstate rail network.
- In all EU countries except England both the infrastructure and operations remained mainly under public ownership and available evidence indicates that although they are not incurring cash loss, they are not generating enough revenue to give a return in the assets transferred to them and some of them continue to need periodic injection of capital from government.

2) Pros and Cons of Integrated/Separated models

Following table sums up Pros and Cons in both Integrated and Separated models.

Table 12-18 Pros and Cons in both Integrated and Separated models

Model	Pros.	Cons.
Integrated	Synergy	No competition
Separated *	Competition	Absent of Synergy /Higher cost

EU not fully adapted
EU's mandatory requirement is "Accounts be separated", Japan/USA "Not institutional separation"

3) Task Force Recommendation on Organizational Structure of DFC

a) Integration or Separation?

Task Force weighted the Pros and cons of both vertically integrated and completely separated models. The vertically integrated model has its own advantage by way of synergy between infrastructure and operation but the disadvantage is that it does not allow above-rail competition. The separated model allows above-rail

[4] CEO, SWISS railway company SBB
[5] Thompson, Louis S., Transport Papers, World Bank, TP-2 September 2004

competition but suffers from the absence of synergy and also higher costs. As the result, Task Force recommended that

SPV (Special Purpose Vehicle):

- Would seem to be best suited to carry out the task of planning, construction and operation of the dedicated freight corridor. The Indian Railways and other qualified operators would run goods trains on the tracks of the corridors and would be given non-discriminatory access for this purpose.
- Would also move the trains within the corridor on its system, but would not own or lease any rolling stock nor do any freight business other than haulage of freight trains.

b) Proposed Equity holders and its purposes

The Task Force believes that a more diversified ownership with other stakeholders, mainly from the public sector, such as CCL, SAIL, NMDC and NTPC, would be in the best interest of efficient management of the freight corridor, besides generating the requisite equity fund.

(2) Opinion of the MOR

The opinion towards the proposal from Task Force, coming up with following counter proposal. Minister of MOF and Minister of MOR met twice on August 4th and August 9th, 2006.

1) Integration or Separation?

MOR maintains the vertically integrated model by the hegemony of MOR over the SPV.

SPV Plans, Builds, Owns and Maintains the dedicated freight corridor and MOR move the trains within the corridor on SPV system, keeping Rolling Stock as the exclusive Operator.

2) Proposed Equity holders and its reasons.

MOR holds 100% equity of the SPV because, i) MOR can raise enough equity fund for SPV from its retained earnings in few years and ii) MOR is confident of efficient management by picking up major user's requirement.

(3) Cabinet resolution of Indian Government

Through negotiations between MOR and Ministry of Finance (MOF), The Cabinet of Indian Government passed following resolution regarding role and equity structure of the SPV of the dedicated freight corridor by August 25, 2006. Followings are highlight of the resolution.

As is clearly understood, Cabinet Resolution is closer to the MOR standpoint.

- MOR holds 100% of SPV Equity.
- SPV is named DFCCIL (DFC Corporation of India Ltd.)
- DFCCIL Plan, Build, Own and Maintain the dedicated freight corridor.
- MOR moves the trains within the corridor on SPV system, keeping Rolling Stock as the exclusive Operator.
- DFCCIL receives Track Access Fee from MOR.

12.4.2 Public-Private / Public-Public Partnership (PPP) Strategy of MOR

Mobilization of huge scale of fund source other than MOR is essential for capacity generation and modernization of Indian railway. More than Rs. 470 billion required to complete almost 240 sanctioned Projects. PPP scheme explained hereinafter has been developed since 1986 for this purpose.

The following Table 12-19 indicated the characteristics of the three types of PPP scheme. The SPV type is characterised by the shares exceeding 51% are held by MOR, operated by MOR, and substantially retain control of the SPV (facility company), which enables the SPV secure loan from international lending agencies.

Table 12-19 Comparison of Characteristic of PPP

Item	BOT	SPV	Commercial
Share	MOR, PSU, State Gov't, Port Authority	MOR (over 51%), PSU State Gov't, Port Authority	RVNL (50%), State Gov't, Port Authority
Railway Infrastructure	SPV Procures, builds, operates, and maintains	SPV Procures, builds, operate, (maintains)	SPV Procures, builds, operate
Operater	SPV	MOR	MOR
Revenue	Fare	Track Access Charge or Surcharge on dividend	Revenue Share
Debt	Commercial Bank Loan, Bond with LOC	Donor loan	Commercial Bank Loan, Bond with LOC

(1) BOT scheme of Konkan Railway

1) Background of the development

The railway runs along the West Coast line from Roha to Thokur with a total number of 2,000 bridges and 92 tunnels built through this mountainous terrain containing many rivers, the project has been biggest and perhaps most difficult undertaking. Konkan Railway Corporation Limited (KRCL) was incorporated as a Public Limited Company on the 19th July 1990.

The need to form a separate Company was felt as the Company could raise its own funds from the market. The project was envisaged under the BOT (Build-Operate-Transfer) and Project-Financing concept.

2) Outline of the Project

a) Route km: 741

b) Engineering Features: No. of Stations (60), Broad Gauge (1.676 m), No. of Tunnels (91), No. of Minor bridges & waterway length (1,679、5.113 km), No. of Major Bridges & waterway length (179、22.1 km), Longest Tunnel (6.5 km), Longest Bridge (2.1 km), No. of Road Over Bridge, Road Under Bridge & Foot Over Bridge (300)

c) Construction Period: From 1990 to January, 1998

d) Final Project Cost: Rs. 35.5 billion

e) History of Project Cost estimation (billion Rs.)

Table 12-20 Historical project costs estimated

Occasion	Total Project Cost	Cost of work	Financing Cost
At MOR sanction	8.67	8.67	0
Estimation at Project Hand-over to KRCL	10.43	10.43	0
Revised Estimate	16.4	13.9	2.5
Final actual Cost	35	25.2	9.8

3) Revenue Budget and current business performance

Revenue estimation projected by RITES in 1997-98 is compared with their performance in the following table. Passenger revenue projection is almost achieved but freight revenue budget is attained only 20% of its projection. (Even after doubling of freight revenue last year)

Table 12-21 Revenue Budget and current business performance

Revenue (Million Rs.)	2005-06	
	Rites Estimation on 1997-98	Actual achievement
Freight	769.6	151.5
Passenger	193.5	189.3

Freight shortage came from assumption error of each industry strategy like products change (Food), replaced by imported products (Food), Production cut (Steel), Reorganization (Cement).

4) Management Organization and its Authority

a) Board members : i) Chairman, and Managing Director, ii) Full Time Director 3, iii) Official Director from Railway Board 1, iv) Representative from Participating States 4, v) Non official Part Time Director 4.

b) Equity structure

Table 12-22 Equity structure

Share Holder	%
MOR	51
Govt. of Maharashtra	22
Govt. of Karnataka	15
Govt. of Goa	6
Govt. of Kerala	6

c) All the board members were appointed by Public Enterprise Selection Board because Central Government holds more than 51% of total Share of KRCL. There is no corporate governance in selecting board member in other word.

d) The board has no authority of deciding tariff, but MOR has.

e) The board has to get MOR approval for Capital Investment larger than Rs. 50 billion/ Year and Rs. 50 million/ Project.

5) Financing

a) Final Financing

Table 12-23 Final Financing (UNIT: billion Rs.)

Equity	8
Long term Loan (Bond)	22.5
ECB	4.09
Lease	0.86
Suppliers' Loan	0.1
Total	35.55

b) Features

- Bond issuing on project financing basis with support of Letter of Comfort from MOF.
- Taxable Bond and Tax-free Bond
- Bonds are subscribed by commercial banks, institutional investor and residents of the railway site.

6) Financial performance in 2005-06

a) P/L

- At first it posted a profit amounting to Rs.594 million after Depreciation and Amortization in 2005-06. But Profit after finance charge are levied is still in red of Rs. 2.43 billion because of the huge debt repayment schedule of Rs. 3 billion, resulting from accrued interest during delayed construction period.
- Retained loss amounts Rs. 28.8 billion.

b) BS

- Out of total application of funds of Rs. 60.5 billion, Rs. 28.8 billion is retained loss. Rs. 26.2 billion is borrowed from MOR and Bond balance is Rs. 26.3 billion. Accrued Interest increases by Rs. 880 million every year.

(2) SPV Scheme of MRVC (Mumbai Rail Vikas Corporation Ltd.)

The Mumbai Suburban Railway network caters to 6.3 million commuters everyday. It has the highest passenger density in the World. Overcrowding has grown to such an extent that 5,000 passengers are traveling per 9-car train during peak hours, as against the rated carrying capacity of 1,710. To enable the Mumbai Suburban Railway to meet the demands of the ever-growing passenger traffic, MOR and the Government of Maharashtra (GOM) joined hands to face the challenge. MRVC, a PSU of Govt. of India under MOR was incorporated with an equity capital of Rs. 25 crores shared in the ratio of 51:49 between MOR and GOM. The geographical jurisdiction of MRVC is from Churchgate to Dahanu Road on Western Railway and from CSTM to Kasara, Karjat/Khopoli and Panvel on Central Railway.

MRVC is the PSU most similar to the authorized DFCCIL scheme in terms of MOR equity share, Role, operation, revenue source and way of finance. Following table shows the similarity of two organizations. :

Table 12-24 Organizational similarity between DFCCIL and MRVC

	DFCCIL	MRVC
Equity Share(MOR)	100%	51%
Business line	DFC	Commuter line
Role of SPV	**Plan, Build**, Maintain	**Plan, Build**
Operation	MOR	MOR
Revenue source	Track Access Fee	Share of surcharge* to passengers
Major Debt	Donor	World Bank

1) Funding Plan

Funding plan is as follows:

- World Bank Funds: Rs.1,613.0 Cr.
  - For MOR Rs.806.5 Cr.
  - For GOM Rs.806.5 Cr.

- Counterpart Funds: Rs.1,512.0 Cr.
  - MOR Rs.756.0 Cr.
  - GOM Rs.756.0 Cr.

Total Rs.3,125.0 Cr.

2) Construction Cost Overrun

Construction Cost Overrun remains within World Bank's Contingency cost (Rs. 3,533 Cr.).

3) Completion-Delay

Construction period plan was extended from 2001-02:2006-07 to 2001-02:2007-08, because of the design change by MOR with additional plan and funding.

4) *Surcharge

- Surcharge has been levied on Mumbai Suburban Commuters w.e.f. 15.09.03
- Surcharge levied will be shared by GOM and MOR in the ratio 50:50
- MOR to pass on Surcharge to MOF towards Loan Repayment

(3) Commercial Scheme of RVNL (Rail Vikas Nigam Limited)

1) Company Outline

a) RVNL was registered and operationalized in 2003 as a wholly owned Government Company (PSU) under Company's Act. It is responsible for the Project Development, Financial Resource Mobilization and Implementation of the sub-projects forming part of the following two components of National Rail Vikas Yojana in a time-bound manner and to complete it by the year 2011:

- Strengthening of Golden Quadrilateral and its Diagonals connecting the four metro cities of Delhi-Mumbai-Chennai and Kolkata
- Port Connectivity and Development of corridors to Hinterland.

b) RVNL implements rail infrastructure projects on a commercial format through various PPP models through non-budgetary resources.

c) RVNL makes the project implementation process efficient both in terms of cost and time. (Without Completion-delay and Cost-overrun)

2) Business Outline

a) RVNL took over 53 projects from MOR, now is responsible for developing or waiting for development 46 projects after declining some and approving some more. All projects are expected to complete till 2010-11.

b) Interesting enough, most of the projects are schemed to have equity partners from provincial governments, port authorities/trust and major industrial groups and to have financing from ADB, SPV borrowing from commercial banks and bond financing subscribed by banks and institutional investors usually with oversubscription.

c) Viability-test is on combination of IRR and other financial indices. Threshold of IRR-test is funding cost + 2%.

d) Prevalent scheme is SPV and no BOT experience so far.

3) Typical example of the SPV (Commercial Scheme)

a) Kutch Railway Company Limited

- Gandhidham-Palanpur (309 km) Gauge Conversion Project
- IRR expectation is 15%
- Finance Scheme
  - Rs. 2 billion: **Equity** (Central Gov. (RVNL): 50%, Kandla Port Trust: 26%, Gujarat Adani Port Limited: 20%, Government of Gujarat: 4%)
  - Rs. 3 billion: **Borrowing** (Domestic Bank Syndication Loan)
  - Rs. 5 billion: Total Construction Cost
- Construction period: 2003-05 (No Completion Delay)
- Western Railway is actually responsible for development, maintenance and operation of the project. Repayment is planned by shared revenue with MOR based on MOR intricate rule. Financiers are basically relying on the fact that Central government will be responsible for the project to the end because of the 50% participation of RVNL, 100% owned by Central government, to the project company.

b) Pipavav Rail Corporation Limited

(4) Other PPP Scheme

1) Private Parties to run container trains

- MOR offered licenses for various corridors (Exim & Domestic) to 14 players from 2006 for generating Terminal and Wagon Capacity

2) Wagon Investment Scheme

- Wagon Procurement Scheme, launched in 2005-06, has guaranteed supply of rakes for loading with 10% rebate on freight charges

3) Development of Rail-side Warehouses and Logistic Park

- Warehouses development for materializing "Door-to-Door services", in the rail-side Land, leased for 30 years at nominal fees by Railways is obliged to share 5% minimum revenue with Railways

- State Governments are invited to participate in the Logistic Park venture, developing multi-user/multi-commodity rail handling and warehousing facilities.

12.4.3 Challenges of the DFC Project Through MOR's Experience

Indian government selected Integrated Model by MOR hegemony rather than by SPV, taking risk of insufficient competition and resulting inefficiency both in capital expenditure and operations as suggested in Task Force report.

At the same time it should be considered that MOR is now under reform procedures with the recommendation from ADB/WB.

We understand that MOR has learnt many lessons from past experience as stated in 12.1.2, with hope that the following challenge will be taken by MOR and DFCCIL, seriously.

Challenges are divided into ones for DFCCIL and others for MOR, because both are responsible for different challenge separately as independent entities.

(1) Challenges to DFCCIL

1) Corporate Governance of DFCCIL

There would be unexpected risks as follows, while completing 2,800 km-super scale project of DFC construction.

- Unexpected technical troubles occur during construction.
- Lawsuits occur by residents on land acquisition.
- Finance closing delays by unexpected trouble.
- Unexpected EPC troubles.
- Delay of getting environmental approval.

Corporate autonomy (governance) is essential for quick recovery from above mentioned unexpected troubles, in other words, eliminating another lengthy approval process by MOR.

2) Innovative Decision Making by the Board of DFCCIL

The role of DFCCIL is limited to "Plan, Build, Own and Maintenance of DFC-facilities", while the Operation of DFC is left to MOR. Decision-making of When and What type of new investments are deeply dependent on Freight-Users needs. As being experienced in UK privatization process, lack OF appreciation of Users-Needs or User-Freight tendency may lead to delay or poor decision making by the Board of DFCCIL.

Advisory Council, comprised of large freight users like CCL, SAL, NMDC, NTPC, is recommended for supporting DFCCIL Board Meetings, to get direct request from initial stage of Design and Alignment plan of DFC.

3) Efficient Investment

As Task Force pointed out, one of the drawbacks of Separation Model is "Higher Cost". DFCCIL has to cut off superfluous Capital expenditure other than safety investment after technical and financial scrutiny.

4) NO Completion Delay/ NO Cost-overrun

MOR has strong inclination to estimate construction cost lower than the Norm, because of usual lack of adequate Budget. In addition, MOR usually starts construction before making full scale assessment of detailed construction scrutiny, which result in completion delay/cost-overruns.

DFCCIL has to set up rules for evaluating and scrutinizing construction schedule and cost estimation to prevent completion delay/ cost-overrun.

DFCCIL has a lot to learn from precious KRCL experience as follows:

a) Completion Delay

- The project underwent much more difficult construction than envisaged in original plan.
- Unexpected lawsuit occurred from residents alongside the alignment.
- Closing of Bond Financing delayed 6 months by Capital Market scandal.

b) Cost-overrun occurred:

- By under-cost-estimation: Rs. 14.8 billion
- By Financing cost of Completion Delay: Rs. 9.8 billion
- By the financing cost accelerated by equity shortage.

(2) Challenges to MOR

1) MOR gives DFCCIL governance to its Director Meeting

PESB (Public Enterprise Selecting Board), together with MOR and Appointments Committee of the Cabinet can appoint all Directors and Chairman of PSUs, wherein the Central Government holds more than 51% of the shares. MOR should hand over corporate governance to DFCCIL in order to accomplish aforementioned, quick and innovating decision making by the board of DFCCIL, KEY to the project success.

2) Recovery of Railway Share of Inter-Modal freight volume

MOR freight revenue posted growth of +11%, as of 2004-05, +18% growth as of 2005-06. On the other hand, railway share of total Inter-Modal freight volume declined from 43% as of 1991-92 to 28% as of 2002-03.

MOR should consider the condition of declining share more seriously rather than be pleased with the growth rate of current freight revenue as the management in charge of national railways, because truck transportation in long distance, say more than 1,000 km, is absolutely inefficient from the national economy viewpoint.

MOR should promote combination-strategy of long distance railway plus short distance truck transportation.

3) Efficient Operations

Operational role of DFC is left in control of MOR. It is very important for MOR to set up an independent organization to handle total operation of DFC separated from the operation of Zonal Railways. Independent organization can only set up with new employee standard, suitable to newly invested DFC systems.

KRCL project (BOT) achieved new employee standard of 667 employees /741 km against Western Railway standard of 1,316 employees. DFC can expect further reduction of total employee standard because it does not involve passenger operation, which is more labor intensive and also because DFC will be more capital intensive.

12.4.4 Implementation Plan of SPV in DFC

Followings are recent development of DFCCIL after Cabinet resolution in August 2006.

(1) Management

DFCCIL was incorporated on November 3rd 2006. It will be managed by a Board of Directors consisting of the following:

- Managing Director
- Director (Finance)
- Director (Operations and Business Development)
- Director (Infrastructure)
- Director (Project and Planning)

(The Board of Director will be supported by the requisite number of officers and staff).

The incumbent of the post of Chairman Railway Board will also be the Chairman of DFCCIL.

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(2) Jobs undergoing

1) Business plan of the SPV has been rescheduled twice and MOR invites Expression of Interest for Consultancy Services of the business plan as follows and selecting process is still under short listed:

Table 12-25 TOR of Project Consultancy Services

Project Consultancy Services	TOR
1	Concession Agreement between the MOR and the SPV
2	Principles for fixation of Track Access Charges
3	Optimum contract packaging including the mix of PPP and EPC for construction of DRFC
4	Bidding Framework including evaluation parameters and draft Concession Agreement for PPP packages, joint venture agreement and other project documentation
5	Assessment and financing models for multi-modal logistics parks, freight terminals and other related land development activities
6	Financial projections for the SPV
7	Capital structure and financing options for the SPV
8	Assistance in the bidding process