CHAPTER 11
THE ESTIMATION OF THE PROJECT COST

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11.1 SCOPE OF THE PROJECT COST ESTIMATION AND IT'S CONDITIONS

The following costs are estimated as components of the Project Cost.

1) Construction Costs
   - Civil & Building works
   - Track works
   - Electrical & Electrification works
   - Mechanical works
   - Signal & Telecommunication works
   - Procurement of Construction, Maintenance & Inspection Vehicles and Equipments
   - ICD (Inland Container Depot) Construction
   - Locomotive Maintenance Depot Construction
2) Electric Locomotives Procurement Cost (including spare parts)
3) General Consultancy Services Cost
4) Physical Contingency
5) Price Escalation
6) Land acquisition and compensation Costs for Railway and Replacement of ROBs
7) General Administration Costs (including Preliminary expense)
8) Taxes (only related to Foreign Consultant)
9 Accrued Interests during Construction

In addition, following Costs are excluded from Project cost and noted for reference purpose.

a) Procurement Cost of Containers & Wagons

b) Construction of New Wagon Maintenance Depot

b) New ROBs Construction Cost (including cost of Land) – excluded from PETS-II report)

The conditions of cost estimation by JICA Study Team (JST) are stipulated in the following Table 11-1.

Table 11-1 Comparison of major estimate conditions between JST and PETS-II)

Description	JICA Study Team	PETS-II
Train Traction System	JST assumes Electric locomotive traction system for the both Corridors.	Traction systems assumed are Electric locomotive for the Eastern and Deisel locomotive for the Western corridor.
Double stack container (DSC) System	Well-type wagon, double stack container system for Western corridor and single stack for Eastern corridor for the time being.	Double stack container system on Flat-type wagon, for Western corridor and Well-type, double stack container system for Eastern corridor.
Procurement of Locomotives	According to the demand forecast based on the revised implementation schedule,	Outside the scope of the DFC project cost estimate.

	which has been used to calculate the number of locomotives upto at 10-years after opening of Phase I-a of project. (Year-2023) This cost is included in the Project cost of Phase I-a.	
Construction of New Locomotive Depot	JST have assumed a new locomotive depot for western DFC and its costs is included in the Project costs of Phase I-a.	Outside the scope of the DFC project cost esti mate.
Construction of New Container Terminal Depot (ICD)	JST have assumed a new ICD at Gurgaon area. The costs of the same is included in the Project costsof Phase I-a.	Out of scope of the DFC project costs.
Construction of branch-line (TKD to Pirthala Junction station) on the Western corridor	JST recommends betterment works for the existing line of due to the limited capacity of expansition of TKD depot. Hence its costs are not included in this Project cost.	Cost Estimate scope is not clear, but assumed no cost included in RITES PETS II report.
Construction of New ROBs	JST verified the validity and necessity of its construction costs to be included in the Project cost. JST introduced and recommended an alternative solution of adopting automatic level crossing system instead of ROBs. Thus the ROBs cost is removed from the project cost.	DFCCIL and Railway Safety Fund will take charge of the costs for new ROBs construction at 505 locations for Western corridor, 368 locations for Eastern corridor totaling -873 locations.
Construction of ROBs to be replaced	JST Project cost has taken into account the construction cost of replacing ROBs as per the JST route plan.	For Western – 24 locations and Eastern – 9 locations is the number of ROBs needing replacement, costs of which are included in the report.
Electrical/Electrification Works	Electrification system cost for the both corridors are included in the Project costs.	Electrification system for the Eastern corridor and no cost is assumed for electrification system for the Western corridor.
Signal & Telecommunication Works	The estimation has been made based on the latest AF track circuit systems.	The estimation was made based on the Track circuit type but it is not clear which system is adopted from the report.
General Consultancy Services	JST Assumed to employ an International Consulting firm for this STEP loan project. The costs of which have been calculated and divided into stagewise Project costs.	General charges (General Administration costs) have been included and it is assumed that a direct management style of construction supervision is adopted.
Physical Contingency	Capitalized 5% on the eligible portion of Yen loan.	Capitalized in the individual items.
Price Escalation	Price escalation has been added to the Project costs for the eligible portion of Yen loan included physical contingency.	Not specifically mentioned in the report.
Accrued Interest during Construction	Financial interest during construction has been included in the Project costs.	Not specifically mentioned in the report.

11.2 BASIC CONDITIONS OF THE COST ESTIMATION

The JST has estimated the Project cost based on the following conditions:

1) The Exchange rate of US $ / Indian Rs. and Japanese Yen / Indian Rs. is estimated based on the average of the reference exchange rate of Reserve Bank of India during the period

of 1st of December 2006 to end of May 2007.

Description	Average Rate
¥／Rs	2.770
Rs／US$	42.98

2) Estimated cost or price is a contract or purchase price as received from contractors or suppliers. Thus the estimated cost or price includes direct cost, indirect cost, overhead, profit and all necessary taxes excluding import duties.

3) All domestic taxes (i.e. Commodity tax, service tax) have been included in the construction costs except import duties and taxes and domestic taxes for overseas procurements due to imprecise understanding of these in relation to this project.

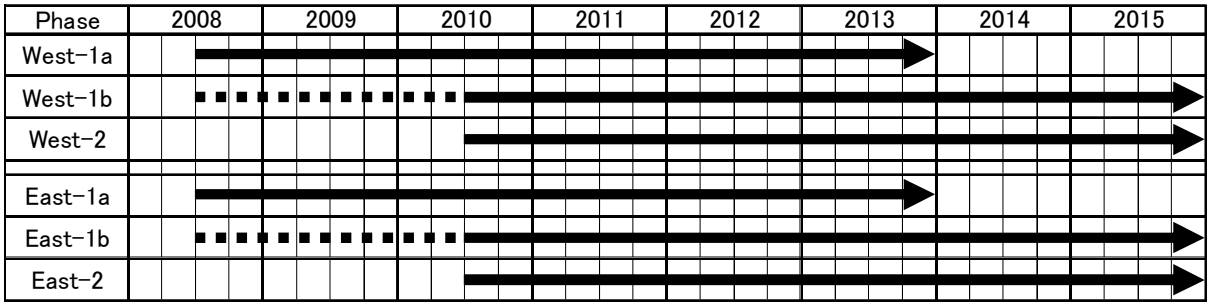
4) The rates and prices of the Year 2006-2007 are used for the cost estimation.

5) Scope of base-case estimation is taken as for the same routes as that of PETS-II, Dadri to JNPT for Western Corridor, Dadri to Sonnagar and Khurja to Dhandarikalan for Eastern Corridor. However the cost estimation is done as per the stagewise development of these sections as specified in the Construction cost para of this report.

6) The unit costs are divided into three (3) portions, machinery, material and labor cost and ratio among them for each portion was assumed based on the past studies in India. Subsequently, ratio between foreign and local currency for above three portions was assumed. Finally, by comparing ratios between these three portions, foreign and local currency in unit cost was estimated.

7) Implementation schedule is assumed as presented in Table 11-2 for the purpose of cost estimation.

Table 11-2 Assumed Implementation Schedule for the Phase



11.3 REVIEW OF PETS-II COST AND COST FRAME ALTERATION

The review of project cost mentioned in PETS-II has been carried out. The JST concentrated to determine DFC route and review PETS-II quantities and to investigate the uncertainity of items in the PETS-II report.

Land costs, detail design cost, track works cost, plants and equipments cost and General administration costs are included in Civil Engineering costs in PETS-II. Hence the cost estimate frame has been further clarified and altered as mentioned below to suit the concept of the Study team.

- Preliminary Expenses: The cost of General Consultancy services cost has originally been altered. However these costs are a difficult to be included in the GC services cost and treated as independent item.

- Land acquisition and compensation costs: This cost has been further clarified and separated as land cost for Railway, land cost for replacing ROBs and land costs for new ROBs, respectively.
- Construction cost of Hospital: This cost has been further clarified and could not justified to including in the eligible yen loan costs.

In the *Volume2 Task 0&1, Chapter 12* it has beeen mentioned that the review and verification of the major rates and prices in the PETS-II was required. Thereafter, JST made further revision to following rates and prices.

- Blanketing – Formation works: The rate has been revised to 500 Rs/m^3 instead of 400 Rs/m^3 in the PETS-II according to the investigation of material rates.
- Replacing ROB – Bridge works: Based on the outline design made by study team, prices are 10% less for ROBs in urban areas and 30% increase for ROBs in sub-urban areas as compare with PETS-II prices. The cost are adapted to the JST's cost estimates.
- Ballast – Track works: The material rate has been increased by 15% as compare with PETS-II material rate, based on the investigation of purchase rate of Northern Railway and market prices.
- Points & Crossings – Track works: The rates have been revised by a 20% increase as compared with PETS-II rate, due to the modification and change of crossings and use of Head Hardened rail (HH rail).

In addition, following costs are either revised or recently added to the project costs based on the further review and study.

1) Electrical/Electrification works

The estimated costs are based on electrification of both corridors i.e. Western and Eastern. Study team proposes Auto Transformer (AT) system instead of Booster tracton (BT) system as was proposed in the PETS-II report, while for Western corridor it was adopted due to its advantage in long-term cost performance.

Table 11-3 Detail costs of Electrical/Electrification work

Description	Western Corridor (Million Rs)	Eastern Corridor (Million Rs)	TOTAL (Million Rs)
Electrical/Electrification works			
OHE System	7,602	6,194	13,796
SCADA	69	68	137
TPSI works	8,201	6,442	14,643
General power supply	231	191	422
Civil works	831	636	1,467
Total (Electrical/Electrification):	16,934	13,531	30,465

2) Signal & Telecommunication Cost

Cost estimate of Signaling & Telecommunication works are as shown below in Table 11-4. Signalling works cost has been revised due to change to a proven system which is based on AF track circuit instead of Micro-Balise train detection system in the previous report. Also, the cost of Automatic level crossing system has been shifted from previous ROB construction cost to this category.

Table 11-4 Detail cost of Signalling & Telecom. Works

Description	Western Corridor (Million Rs)	Eastern Corridor		TOTAL (Million Rs)
		Double-line section (Million Rs)	Single-line section (Million Rs)	
Train Management System	148	50	102	300
Signalling System at Station	6,197	4,700	4,365	15,262
Signalling System between Station	13,498	4,606	2,225	20,328
Dispatching Telephone System	48	36	39	123
Fixed Communication System	1,233	750	419	2,402
Mobile Communication System	691	474	228	1,392
Digital Electronic Exchange System	108	94	81	283
Total (Signal & Telecom. Works):	21,922	10,709	7,458	40,090
Automatic Level Crossing System	2,214	1,153	460	3,827
Grand Total:	24,136	11,862	7,918	43,917

3) ICD（Inland Container Depot）Construction Cost

The out-line cost has been calculated for a newly established inland container depot which is expected to be built in Gurgaon area. This does not include land acquisition and compensation costs.

4) Vehicle Depots Construction Cost

The cost estimate for Electric locomotives depot to be established one for each Western and Eastern corridor is also included. This cost also does not include land acquisition and compensation costs.

5) Electric Locomotives procurement Cost

The procurement cost has been revised based on the implementation schedule as mentioned in Chapter 14 in this report. The required number of electric locomotives are based on demand forecasting at 10-years from the commissioning of Phase I-a (Year 2023).

Table 11-5 Detail Cost of Elecric Locomotives

Description	Quantity		Rate (Million Rs)	Amount (Million Rs)
	Western	Eastern		
E. Locomotive (8-axle s)	59	165	212	47,488
E. Locomotive (6-axle s)	202	5	130	26,910
Spare parts				1,153
Total:	261	170		75,551

11.4 CHARACTERISTICS OF THE PROJECT COSTS

The estimated costs are classified and then divided among the Investment body (DFCCIL), Ministry of Railways (MOR), Indian Railway (IR) and Private parties.

Electric Locomotives cost and the Locomotive Depot's construction cost are included in the Indian Railway's portion and some other in the project costs apportioned to DFCCIL's cost. The cost of Inland Container Depot will only be its basic construction cost, other costs for establishment will be taken up by private partners.

11.5 TRANS-SHIPMENT COST FOR FOREIGN AND LOCAL CURRENCY

Each cost and/or price shall be divided into foreign and local currency. (The cost or price is categorized into labor, materials and plant costs and further each cost is divided into foreign and local currency portion based on an assumption.)

Table 11-6 shows the Trans-shipment table for Foreign and Local Currency.

Table 11-6 Trans-shipment Cost - Table for Foreign and Local Currency

Description	Cost Allocation Ratio				Currency Ratio						Weight		Estimated Amount	Currency Allocation	
					Labor		Mate.		Plant						
	Labor		Mate.	Plant	F	L	F	L	F	L	F	L		Foreign	Local
	S	U													
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(Million Rs)	(Million Rs)	(Million Rs)
CIVIL & BUILDING															
Earth work-Cutting	5	5	50	40	0	100	0	100	15	85	6.0	94.0	186	11	174
Embankment works	5	5	50	40	0	100	0	100	15	85	6.0	94.0	23,874	1,432	22,441
Blanketing	5	5	55	35	0	100	0	100	20	80	7.0	93.0	9,969	698	9,271
Tunnel	10	5	45	40	0	100	10	90	40	60	20.5	79.5	3,495	716	2,778
Others	10	5	50	35	0	100	0	100	15	85	5.3	94.8	1,460	77	1,384
SubTotal-1:													38,983	2,934	36,049
Bridges-Steel	5	10	60	25	0	100	15	85	15	85	12.8	87.3	10,339	1,318	9,021
Bridges-Masonry	5	10	55	30	0	100	5	95	15	85	7.3	92.8	16,077	1,166	14,911
Bridges-Flyover	5	10	55	30	0	100	5	95	15	85	7.3	92.8	11,094	804	10,290
Bridges-Minor	5	10	55	30	0	100	5	95	15	85	7.3	92.8	8,079	586	7,493
Others	5	10	55	30	0	100	5	95	15	85	7.3	92.8	631	46	585
SubTotal-2:													46,221	3,920	42,301
Office Building	10	5	55	30	0	100	5	95	10	90	5.8	94.3	2,488	143	2,345
Station & Shed	10	5	55	30	0	100	5	95	10	90	5.8	94.3	729	42	687
Residential Building	10	5	55	30	0	100	10	90	10	90	8.5	91.5	5,318	452	4,866
Others	10	5	55	30	0	100	5	95	10	90	5.8	94.3	321	18	302
SubTotal-3:													8,856	655	8,200
Miscellaneous works	10	5	60	25	0	100	5	95	20	80	8.0	92.0	12,241	979	11,261
SubTotal-4:													12,241	979	11,261
PERMANENT WAY															
Rail & Fastening	5	5	80	10	0	100	80	20	15	85	65.5	34.5	47,532	31,134	16,399
Sleeper & Fastening	5	10	55	30	0	100	10	90	15	85	10.0	90.0	15,345	1,535	13,811
Point & Crossing	5	5	65	25	0	100	55	45	15	85	39.5	60.5	3,027	1,196	1,831
Ballast	5	5	60	30	0	100	0	100	20	80	6.0	94.0	14,844	891	13,953
Foot-over Bridge	5	10	55	30	0	100	0	100	15	85	4.5	95.5	997	45	952
Others	5	10	55	30	0	100	0	100	15	85	4.5	95.5	50	2	48
SubTotal-5:													81,795	34,802	46,994
O&M VEHICLES															
Plant & Equipment	0	0	0	100	0	0	0	0	80	20	80.0	20.0	3,819	3,055	764
ELECTRICAL															
											25.0	75.0	30,465	7,616	22,849
MECHANICAL															
											25.0	75.0	467	117	351
SIGNAL & TELECOM															
Signal & Telecom											61.0	39.0	37,749	23,027	14,722
ICD															
	5	5	50	40	0	100	5	95	15	85	8.5	91.5	3,000	255	2,745
VEHICLE DEPOT															
	5	5	50	40	0	100	5	95	15	85	8.5	91.5	717	61	656
Total (Construction):													264,313	77,422	186,892
ROLLING-STOCK															
Electric Locomotive	0	0	0	100	0	0	0	0	90	10	90.0	10.0	75,551	67,996	7,555
ENGINEERING SERVICE															
Detail Design Stage	85	5	5	5	75	25	0	100	5	95	67.8	32.3	1,814	1,229	585
Tender Assistance Stage	85	5	5	5	77	23	0	100	5	95	69.6	30.5	443	308	135
Construction Stage	80	5	5	10	74	26	0	100	15	85	64.4	35.6	6,594	4,247	2,347
TOTAL:													348,716	151,201	197,514
														43.36%	56.64%

Legend: W－Worker Cost、M－Material Cost、P－Plant Cost F－Foreign Currency、L－ Local Currency

11.6 RESULT OF PROJECT COST ESTIMATION

11.6.1 Sectional Project Cost Estimation

As mentioned in the *Chapter-3* earlier, the Study team estimated the project cost in every section to examine the scenario of stage development. Route division map is as shown Figure 11-1.

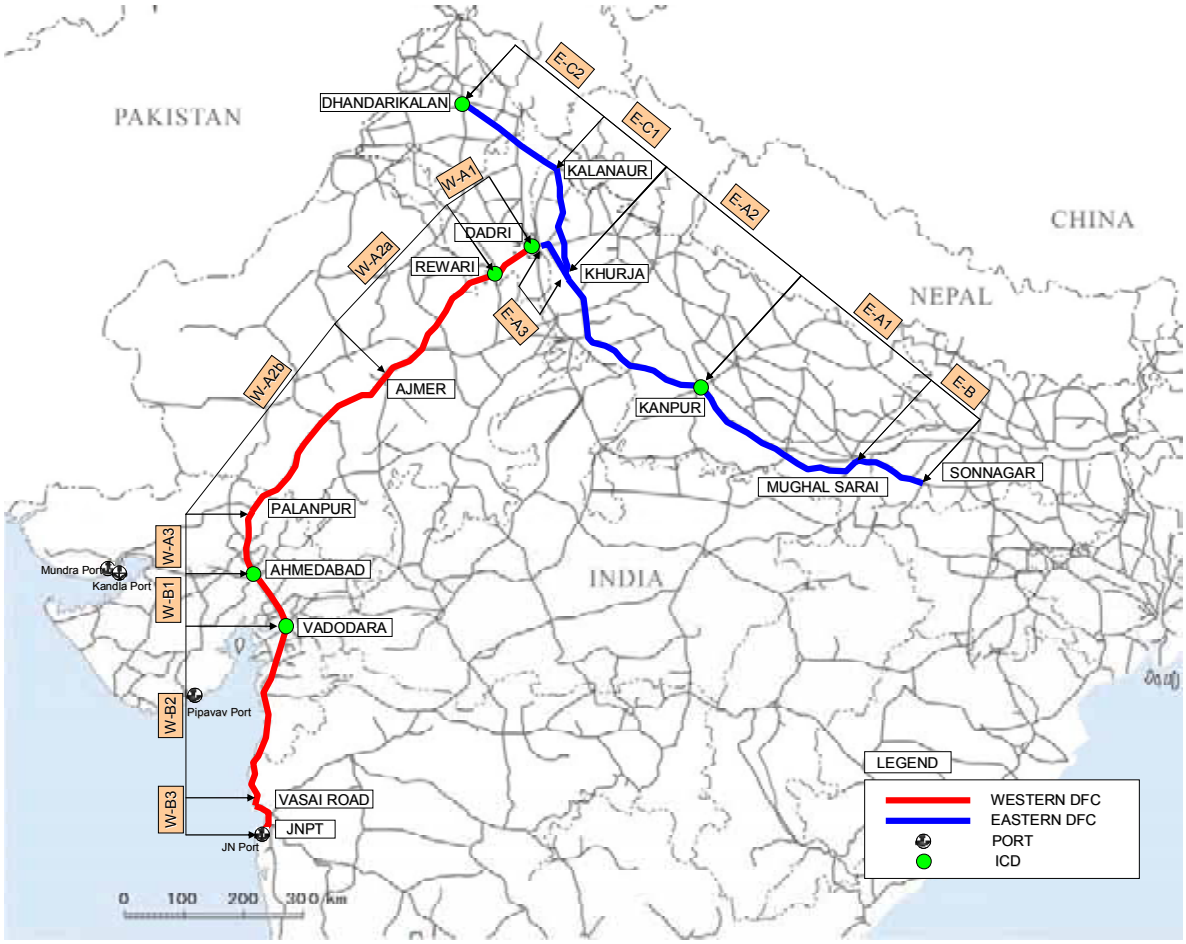


Figure 11-1 DFC Route Division Map for Stage Development

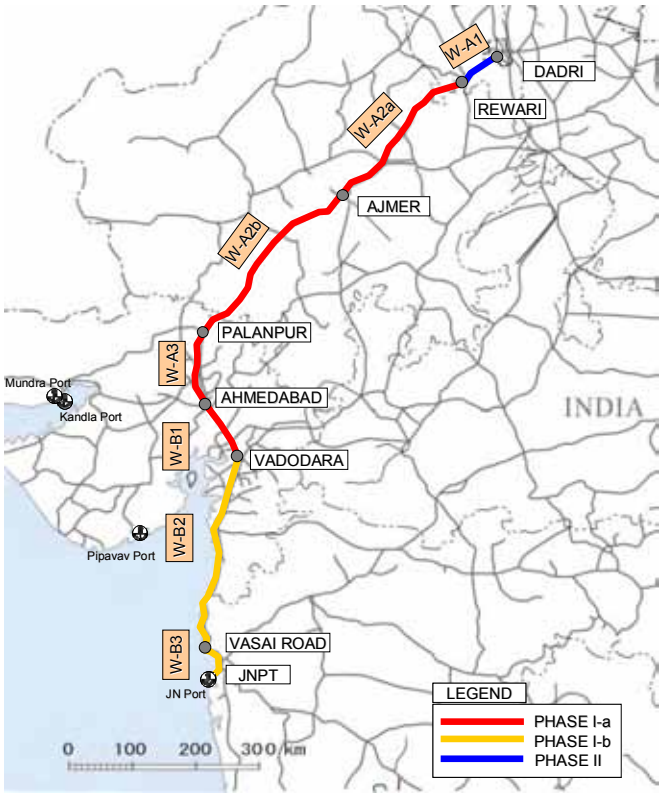


Figure 11-2 DFC Route Division Map for Stage Development (Western Corridor)

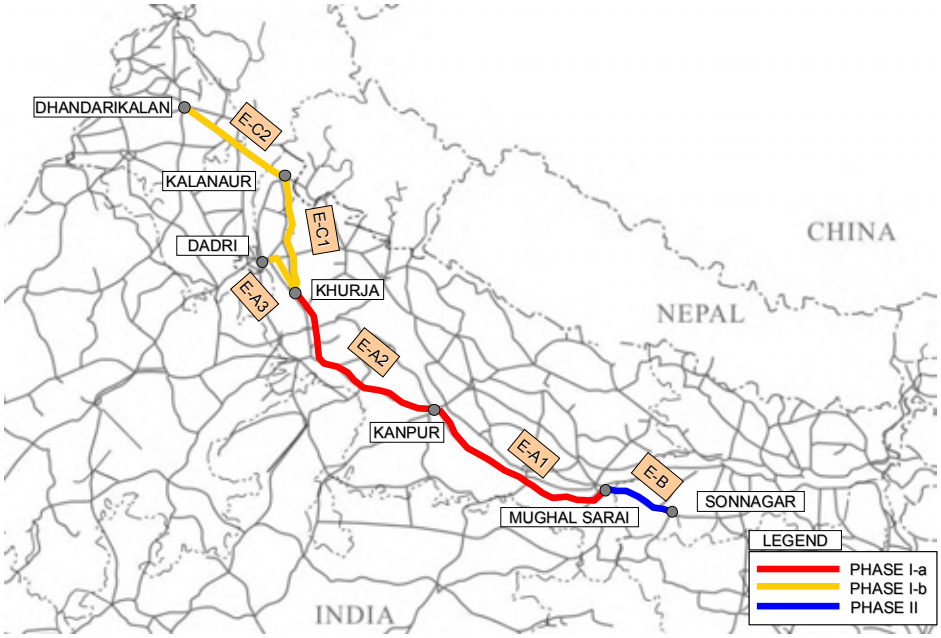


Figure 11-3 DFC Route Division Map for Stage Development (Eastern Corridor)

The project cost estimation for various scenarios is shown in Table 11-7 for the each section as described in Figure 11-1.

Table 11-7 Sectional Project Cost Matrix

	Corridor	Western Corridor									Eastern Corridor									TOTAL	
	Phase NO.	TOTAL	PHASE II	PHASE I-a				PHASE I-b		Whole Line	TOTAL for E-A & B (Double line)	TOTAL for E-C (Single line)	PHASE I-b	PHASE I-a		PHASE II	PHASE I-b		Whole Line		
	Section No.		W-A-1	W-A-2a	W-A-2b	W-A-3	W-B-1	W-B-2	W-B-3				E-A-3	E-A-2	E-A-1	E-B	E-C-1	E-C-2			
	Start		Dadri	Rewari	Ajmer	Palanpur	Ahmadabad	Vadodara	Vasai Road	Dadri			Dadri	Khurja	Kanpur	Mughalsarai	Khurja	Kalanaur	Dhandarikalan		
	End		Rewari	Ajmer	Palanpur	Ahmadabad	Vadodara	Vasai Road	JNPT	JNPT			Khurja	Kanpur	Mughalsarai	Son Nagar	Kalanaur	Dhandarikalan	Son Nagar		
	Unit	(Million Rs)	(Million Rs)	(Million Rs)	(Million Rs)	(Million Rs)	(Million Rs)	(Million Rs)	(Million Rs)	(Million Rs)	(Million Rs)	(Million Rs)	(Million Rs)	(Million Rs)	(Million Rs)	(Million Rs)	(Million Rs)	(Million Rs)	(Million Rs)	(Million Rs)	(%)
Project Cost	Civil & Building work	67,197	12,346	6,965	11,835	4,789	10,825	16,725	3,711	67,197	26,468	12,634	1,065	11,142	9,269	4,993	5,588	7,047	39,103	106,300	21.3
	Formation works (other than Tunnel)	21,925	2,524	3,435	4,457	2,591	4,543	3,699	676	21,925	9,128	4,435	297	5,145	2,750	936	2,138	2,297	13,563	35,488	7.1
	Formation works (Tunnel)	3,495	3,495	0	0	0	0	0	0	3,495	0	0	0	0	0	0	0	0	0	3,495	0.7
	Bridge works (exclud. ROB & items bellow)	22,812	3,551	820	2,944	1,035	4,326	8,098	2,038	22,812	5,310	2,636	94	828	2,856	1,532	613	2,023	7,946	30,758	6.2
	Bridge works (Flyovers)	6,279	1,402	786	1,958	63	376	1,567	126	6,279	3,606	1,210	323	924	804	1,554	532	677	4,815	11,094	2.2
	Bridge works (RUBs)	2,203	555	234	182	273	626	307	25	2,203	926	609	0	753	170	2	259	351	1,535	3,738	0.7
	Bridge works (Protection works)	505	0	0	0	0	0	379	126	505	126	0	0	0	126	0	0	0	126	631	0.1
	Station & Building works	4,262	368	874	980	397	417	1,000	227	4,262	3,109	1,484	162	1,366	1,134	447	843	641	4,594	8,856	1.8
	Miscellaneous works (missing in the PETS-2)	5,717	451	816	1,314	430	538	1,676	492	5,717	4,264	2,259	189	2,125	1,430	521	1,202	1,057	6,523	12,241	2.4
	Track work	45,785	3,649	9,045	11,477	3,867	4,242	10,729	2,776	45,785	27,203	8,807	1,417	11,944	9,930	3,912	5,020	3,787	36,010	81,795	16.4
	Electrical work	16,934	1,350	3,345	4,245	1,430	1,569	3,968	1,027	16,934	10,538	2,994	549	4,631	3,843	1,516	1,701	1,293	13,532	30,465	6.1
	Mechanical work	208	17	41	52	18	19	49	13	208	196	64	10	86	71	28	36	27	259	467	0.1
	Signaling & Telecommunication works	20,939	1,657	4,255	5,212	1,756	1,926	4,872	1,260	20,939	10,252	6,558	533	4,535	3,721	1,464	3,771	2,787	16,810	37,749	7.6
	Signaling work	16,498	1,315	3,259	4,136	1,394	1,528	3,866	1,000	16,498	7,696	5,229	401	3,382	2,806	1,107	2,971	2,259	12,925	29,423	5.9
	Traffic Control System	148	0	148	0	0	0	0	0	148	50	102	0	50	0	0	102	0	152	300	0.1
	Telecommunication work	2,080	166	411	521	176	193	487	126	2,080	1,354	766	71	595	494	195	435	331	2,120	4,200	0.8
	Automatic Level Crossing System	2,214	176	437	555	187	205	519	134	2,214	1,153	460	61	508	421	162	263	197	1,613	3,827	0.8
	Plant & Equipment Procurement	2,041	0	2,041				0	0	2,041	1,495	283	0	1,495		0	283		1,778	3,819	0.8
	ICD Construction work	3,000	0	3,000	0	0	0	0	0	3,000	0	0	0	0	0	0	0	0	0	3,000	0.6
	Sub Total-1 (DFCCIL):	156,104	19,019	27,162	33,332	12,371	19,091	36,343	8,786	156,104	76,153	31,340	3,574	33,085	27,581	11,913	16,257	15,082	107,493	263,596	52.7
	Locomotive Maintenance Depot	717	0	717	0	0	0	0	0	717	0	0	0	0	0	0	0	0	0	717	0.1
	Electric Locomotives Procurement	38,768	0	38,768				0	0	38,768	35,630	0	0	35,630		0	0	0	35,630	74,398	14.9
	Spare Parts for Electric Locomotives	566	0	566				0	0	566	587	0	0	587		0	0	0	587	1,153	0.2
	Sub Total-2 (IR):	40,051	0	10,551	9,834	9,834	9,834	0	0	40,051	36,217	0	0	18,108	18,108	0	0	0	36,217	76,268	15.3
	Sub Total-A:	196,155	19,019	37,712	43,166	22,205	28,925	36,343	8,786	196,155	112,370	31,340	3,574	51,193	45,690	11,913	16,257	15,082	143,709	339,865	68.0
	General Consultancy Service																				
	Detail Design & Tender Preparation Stage	1,113	209	695				209		1,113	584	117	117	234		234	117		701	1,814	0.4
	Tender Assistance Stage	272	51	170				51		272	142	28	28	57		57	28		171	443	0.1
	ES Service Cost during Construction	4,047	58	2,528				1,461		4,047	1,816	731	731	1,086		0	731		2,547	6,594	1.3
	Total for GC Service:	5,432	318	848	848	848	848	861	861	5,432	2,543	876	876	1,376		291	876		3,419	8,851	1.8
	Sub Total-B:	201,588	19,337	38,561	44,014	23,053	29,773	37,204	9,647	201,588	114,913	32,216	4,450	51,881	46,378	12,204	16,695	15,520	147,128	348,716	69.8
	Physical Contingency	10,079	967	1,928	2,201	1,153	1,489	1,860	482	10,079	5,746	1,611	222	2,594	2,319	610	835	776	7,356	17,436	3.5
	Price Escalation	18,838	1,807	3,603	4,113	2,154	2,782	3,477	901	18,838	10,739	3,011	416	4,848	4,334	1,140	1,560	1,450	13,749	32,587	6.5
	Sub Total-C:	230,505	22,111	44,092	50,328	26,360	34,044	42,540	11,030	230,505	131,397	36,838	5,088	59,324	53,031	13,954	19,090	17,747	168,234	398,739	79.8
	Land Acquisition cost for Railway	26,439	5,729	3,128	3,143	5,064	4,996	3,931	449	26,439	17,857	7,535	711	7,754	7,342	2,051	4,744	2,791	25,393	51,831	10.4
	Land Acquisition cost for Replacing ROB	201	0	0	9	0	0	88	105	201	91	11	0	0	48	43	11	0	102	303	0.1
	Preliminary Expenses (Survey & Design)	742	59	146	186	63	69	174	45	742	347	144	18	152	126	50	82	62	491	1,232	0.2
	Construction cost for Replacing ROB	6,465	0	0	87	0	0	3,427	2,951	6,465	897	1,171	0	0	174	723	1,171	0	2,068	8,533	1.7
	Construction cost for Hospital	25	2	5	6	2	2	6	1	25	133	64	7	58	48	19	36	28	197	222	0.0
	Utilities Relocation works	1,344	247	139	237	96	217	335	74	1,344	529	253	21	223	185	100	112	141	782	2,126	0.4
	General Administration Cost during Construction	9,857	786	1,947	2,471	833	913	2,310	598	9,857	4,879	1,864	254	2,144	1,779	702	1,059	805	6,744	16,601	3.3
	Taxes and Duties for Foreign Consultant	2,234	226	1,332				676		2,234	990	336	336	540		114	336		1,326	3,560	0.7
	Sub Total-D:	277,811	29,159	50,790	56,465	32,417	40,240	53,485	15,254	277,811	157,119	48,217	6,436	69,925	63,004	17,755	26,474	21,742	205,335	483,147	96.7
	Accrued Interest during Construction	9,608	1,009	1,757	1,953	1,121	1,392	1,850	528	9,608	5,434	1,668	223	2,418	2,179	614	916	752	7,102	16,710	3.3
	Sub Total (India portion):	56,915	8,057	8,455	8,090	7,179	7,588	12,795	4,751	56,915	31,157	13,047	1,570	13,020	12,152	4,415	8,299	4,747	44,203	101,118	20.2
	Grand Total:	287,420	30,168	52,547	58,418	33,538	41,632	55,335	15,781	287,420	162,553	49,884	6,658	72,343	65,183	18,369	27,390	27,242	212,437	499,857	100.0
Reference	ITEMS (excluded from the Project cost)																				
Reference only	Wagons Procurement	20,473								20,473	14,025								14,025	34,498	6.9
	Wagons Depot	526	0	526	0	0	0	0	0	526	1,979	0	0	1,979	0	0	0	0	1,979	2,505	0.5
	Cost for new ROBs in the PETS-2	23,780								23,780	8,972	3,427							12,399	36,178	7.2
	Land Acquisition Cost for new ROBs (PETS-2)	6,825	141	2,000	1,865	694	213	1,663	249	6,825			192	2,641	3,178	1,010	1,454	1,089	9,563	16,388	3.3

Following conditions and assumptions may be applicable for calculations.

1) Construction Costs
   - In the Civil & Building works, items of tunneling work, earthworks (cutting, embankment and blanketing) are allocated in each and every section of formation works. Items of bridge works, Railway bridges-Steel, Railway bridges-Concrete, Railway bridges-Flyover, Road over Bridges (ROB) and bridge protection works are also allocated and calculated section wise. Building works costs are divided according to the route length.
   - The costs of Track works, Electrical engineering works, Mechanical engineering works, Signal & Telecom Engineering works are divided according to the route length for each Western corridor and Eastern corridor which are also allocated according to double track or single track section.
   - Plant and equipment costs (construction, maintenance and service vehicles) are included in the Phase I-a section of each corridor.
   - New ICD construction costs and Locomotive depot construction costs are allocated to each designated section.
2) General consultancy services cost are not divided by sections. The costs allocation for stage development is mentioned in the *Clause 11.6.2*.
3) Rolling stock cost is also not divided by sections and the cost allocation for stage development is mentioned in the *Clause 11.6.2*.
4) The cost of Price escalation is divided for each corridor and then further divided into each section by in the ratio of its cost.
5) Physical contingency cost is divided for each corridor and sections by in the ratio of its cost.
6) Land acquisition and compensation costs are divided for the each section in the ratio of its cost.
7) Taxes for Foreign consultant are divided for each section in the same manner as GC services cost.
8) General administration costs are allocated for the each section according to the route length.
9) Accrued interest during construction is divided for each corridor and then further divided into each section in the ratio of its cost.

Overall costs allocation for the eligible portion of Yen-loan and the Indian Rupee portion are shown in the Table 11-8, and further divided for each corridor as shown in the Table 11-9.

Table 11-8 Overall Project Costs (Whole sections)

(Unit: Million Rs)

Description	Eligible portion of Yen-Loan	Indian portion	TOTAL	Ratio
1) Construction Costs (DFCCIL portion) (except those mentioned below in 2)	263,596	0	263,596	52.7%
2) Construction Costs (DFCCIL portion) (ROB, and Utilities relocation works)	0	10,881	10,881	2.2%
3) Construction Costs (IR portion)	717	0	717	0.1%
4) Electric Locomotive procurement costs	75,551	0	75,551	15.1%
5) General Consultancy Services Cost	8,851	0	8,851	1.8%
6) Physical Contingency	17,436	0	17,436	3.5%
7) Price Escalation	32,587	0	32,587	6.5%
8) Land acquisition and compensation Costs	0	52,134	52,134	10.4%
9) Preliminary expenses (Survey & Design)	0	1,232	1,232	0.2%
10) *General Administration Costs	0	16,601	16,601	3.3%
11) Taxes (For foreign consultants)	0	3,560	3,560	0.7%
12) Accrued Interest during construction	0	16,710	16,710	3.3%
Total Project Costs:	398,739	101,118	499,857	100.0%
Proportion (Donor – India):	79.8%	20.2%		
**Wagon procurement & Wagon Depot Costs			37,003	
**New ROB Construction & Land Cost			52,567	

Note) *Including Local Construction Supervisors Cost
**The Cost for reference purpose

Table 11-9 Overall Project Costs (by the Each Corridor)

(Unit: Million Rs)

Description	Western Corridor		Eastern Corridor		TOTAL
	Eligible portion of Yen-Loan	Indian portion	Eligible portion of Yen-Loan	Indian portion	
1) Construction Costs (DFCCIL portion) (except those mentioned below in 2)	156,104	0	107,493	0	263,596
2) Construction Costs (DFCCIL portion) (ROB and Utilities relocation works)	0	7,834	0	3,047	10,881
3) Construction Costs (IR portion)	717	0	0	0	717
4) Electric Locomotive procurement costs	39,334	0	36,217	0	75,551
5) General Consultancy Services Cost	5,432	0	3,419	0	8,851
6) Physical Contingency	10,079	0	7,356	0	17,436
7) Price Escalation	18,838	0	13,749	0	32,587
8) Land acquisition and compensation Costs	0	26,640	0	25,495	52,134
9) Preliminary expenses (Survey & Design)	0	742	0	491	1,232
10) *General Administration Costs	0	9,857	0	6,744	16,601
11) Taxes (For foreign consultants)	0	2,234	0	1,326	3,560
12) Accrued Interest during construction	0	9,608	0	7,102	16,710
Total Project Costs:	230,505	56,915	168,234	44,203	499,857
Proportion (Western – Eastern):	57.5%		42.5%		100%

Total project costs are Rs. 499.9 billion (approximately Yen 1,384.7 billion), and proportion of eligible for Yen loan and India is 79.8% and 20.2% respectively. The proportion of project cost for Western corridor and Eastern corridor is 57.5% and 42.5% respectively.

11.6.2 Estimation of stagewise Project Costs

The stagewise project costs have been estimated based on the Table 11-10 sectional project cost matrix. Each staged developments have been specified as per the following sections based on the evaluations described in the *Chapter 3*.

Table 11-10 Section of Stagewise Developments

Corridor	Western Corridor			Eastern Corridor		
Stage	Phase I-a	Phase I-b	Phase II	Phase I-a	Phase I-b	Phase 2
Section	Rewari - Vadodara	Vadodara - Vasai Rd. - JNPT	Dadri - Rewari	Mughal Sarai - Khurja	Khurja – Dadri and Khurja – Dhandari Kalan	Sonnagar – Mughal Sarai
Route Length	918 km Double-line	433 km Double-line	117 km Double-line	710 km Double-line	46 km Double-line 426 km Single-line	127 km Double-line

The cost estimation has taken into account the following points for stagewise project costs.

1) Estimated Electric Locomotive costs are based on 10 years demand forecast from the I-a stage opening (Year 2013) and all costs are allocated to Phase I-a development.
2) Cost of Consulting services and General administration for each stage is calculated by fixed cost (corresponding to the Core team) portion and floating cost (corresponding to the Zonal/Site team) portion.
3) Traffic control system cost in the signaling costs are allocated to the specified Phase I-a section. However its amount has negligible influence (smaller than 1% of signaling cost) so cost has been allocated to each section by route length.
4) Newly established Inland Container Depot (ICD) will be located at Gurgaon area in the Western corridor which belongs to the Rewari – Dadri section (W-A-1). However, its cost has been allocated to Phase I-a section (W-A-2a) due to the establishment of logistic infrastructures between Rewari and Delhi.

Estimated Staged Development Costs are shown in the Table 11-11.

Table 11-11 Stagewise Project Costs

(Unit: Million Rs)

Description	Phase I-a	Phase I-b	Phase II	TOTAL
1) Construction Costs (DFCCIL portion) (except those mentioned below in 2)	152,622	80,043	30,932	263,596
2) Construction Costs (DFCCIL portion) (ROB and Utilities relocation works)	1,480	8,310	1,091	10,881
3) Construction Costs (IR portion)	717	0	0	717
4) Electric Locomotive procurement costs	75,551	0	0	75,551
5) General Consultancy Services Cost	4,769	3,473	609	8,851
6) Physical Contingency	11,683	4,176	1,577	17,436
7) Price Escalation	21,835	7,805	2,947	32,587
8) Land acquisition and compensation Costs	31,482	12,830	7,822	52,134
9) Preliminary expenses (Survey & Design)	742	381	109	1,232
10) General Administration Costs	10,087	5,026	1,487	16,601
11 Taxes (For foreign consultants)	1,872	1,348	340	3,560
12) Accrued Interest during construction	10,820	4,268	1,623	16,710
Total Project Costs:	323,662	127,658	48,537	499,857
Proportion of Stagewise Project Costs:	64.8%	25.5%	9.7%	100.0%

The proportion of project costs for Phase I-a, Phase I-b and Phase II are approximately 64.8%, 25.5% and 9.7% respectively.

11.6.3 Project Costs Analysis by comparison (Phase I-a)

The following two Options have been examined and analyzed for consideration of Phase I-a development Plan and each Project Costs which is also mentioned in *Chapter 14*.

1) Option 1: The project is implemented by funding of all the eligible items of Yen Loan. (Fully Financed Yen Loan Plan)
2) Option 2: Critical items of civil works are carried out in advance by the India-side. (Plan for Advance Works financed by Indian side)

Option-1 Project costs are consistent with Phase I-a Project costs which have been mentioned in the Clause 11.6.2 The Option-2 Project costs are calculated with the following conditions.

a) All of Civil & Building works costs are borne with funds from Indian side.
b) 30% of procurement costs for Ballast materials and PC Sleepers are also borne by funding form Indian-side.

The estimated project costs for the each Option which are based on the above conditions are shown in the Table 11-12 and Table 11-13.

Table 11-12 Phase I-a Project Costs (Fully Financed Yen Loan Plan)

(Unit: Million Rs)

Description	Eligible Yen Loan Portion	India Portion	TOTAL	Ratio
1) Construction Costs (DFCCIL portion) (except those mentioned below in 2)	152,622	0	152,622	47.2%
2) Construction Costs (DFCCIL portion) (ROB and Utilities relocation works)	0	1,480	1,480	0.5%
3) Construction Costs (IR portion)	717	0	717	0.2%
4) Electric Locomotive procurement costs	75,551	0	75,551	23.3%
5) General Consultancy Services Cost	4,769	0	4,769	1.5%
6) Physical Contingency	11,683	0	11,683	3.6%
7) Price Escalation	21,835	0	21,835	6.7%
8) Land acquisition and compensation Costs	0	31,482	31,482	9.7%
9) Preliminary expenses (Survey & Design)	0	742	`742	0.2%
10) General Administration Costs	0	10,087	10,087	3.1%
11 Taxes (For foreign consultants)	0	1,872	1,872	0.6%
12) Accrued Interest during construction	0	10,820	10,820	3.3%
Total Project Cost:	267,178	56,484	323,662	100.0%
Proportion (Donor – India):	82.5%	17.5%	100.0%	
Proportion of (PhaseI-a/Whole section):	64.8%			

Table 11-13 Phase I-a Project Costs (Advance Works financed by Indian side)

(Unit: Million Rs)

Description	Eligible Yen Loan Portion	India Portion	TOTAL	Ratio
1) Construction Costs (DFCCIL portion) (except those mentioned below in 2)	98,833	53,789	152,622	47.2%
2) Construction Costs (DFCCIL portion) (ROB and Utilities relocation works)	0	1,480	1,480	0.5%
3) Construction Costs (IR portion)	717	0	717	0.2%
4) Electric Locomotive procurement costs	75,551	0	75,551	23.3%
5) General Consultancy Services Cost	4,769	0	4,769	1.5%
6) Physical Contingency	11,683	0	11,683	3.6%
7) Price Escalation	21,835	0	21,835	6.7%
8) Land acquisition and compensation Costs	0	31,482	31,482	9.7%
9) Preliminary expenses (Survey & Design)	0	742	742	0.2%
10) General Administration Costs	0	10,087	10,087	3.1%
11 Taxes (For foreign consultants)	0	1,872	1,872	0.6%
12) Accrued Interest during construction	0	10,820	10,820	3.3%
Total Project Cost:	213,389	110,273	323,662	100.0%
Proportion (Donor – India):	65.9%	34.1%	100.0%	
Proportion of (Phase I-a/Whole section):	64.8%			

The percentage of project cost to be funded by India in Phase I-a for Option 1 is 17.5% whereas for Option 2 is 34.1%.

CHAPTER 12
ECONOMIC AND FINANCIAL EVALUATION

CHAPTER 12 ECONOMIC AND FINANCIAL EVALUATION

12.1 OBJECTIVE OF THIS CHAPTER

This chapter aims to justify the feasibility of the project plan. All plan alternatives discussed in the previous chapters are compared while appraising and justifying investment feasibility of the DFC project through economic and financial quantitative analysis. While all the chapters are interrelated in carrying out the analyses, the following four chapters are directly relevant: Chapter 4 on "DEMAND FORCAST", Chapter 6 on "TRANSPORT PLANNING" for the number of rolling stock required and their prices, Chapter 9 on "OPERATION AND MAINTENANCE PLANNING" for operating costs and revenues, and Chapter 11 on "OUT-LINE OF THE ESTIMATION OF THE PROJECT COST" for construction costs.

12.2 ECONOMIC EVALUATION

Economic and Financial Evaluation: Justification of the DFC construction plan should be examined in terms of both economic analysis and financial analysis. Comparison of economic analysis is based on the viewpoint of whether India aims at optimal utilization of the national resources, while financial analysis is based on the viewpoint of whether private enterprises can aim at securing profitability. In case of funding for construction from foreign financing organizations, calculation of national EIRR index will be indispensable.

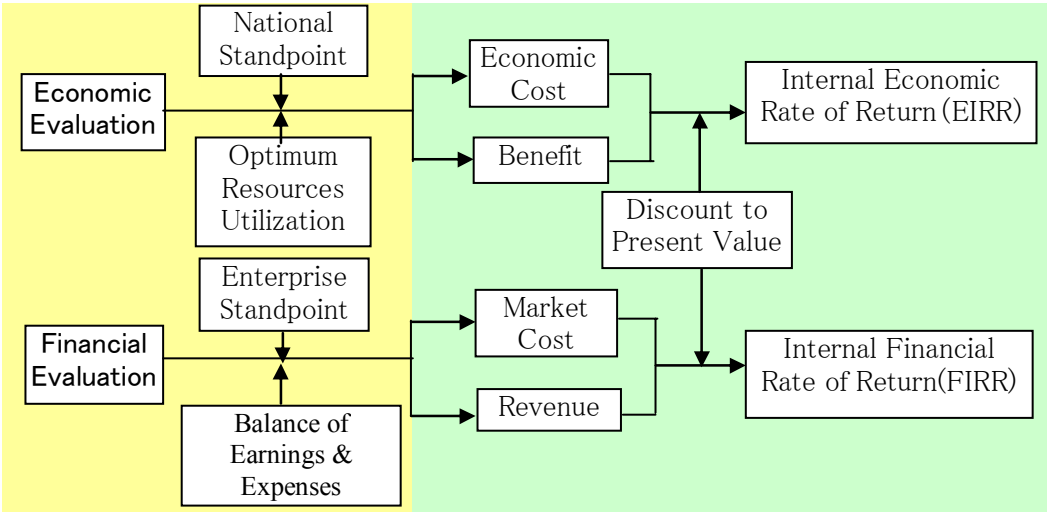


Figure 12-1 Evaluation Procedure for Economic and Financial Analysis

Evaluation Comparison Index: Economic evaluation compares economic costs with benefits, and the economic justification index uses the Economic Internal Rate of Return (EIRR). Financial evaluation compares market costs with revenues, and the financial justification index uses the Financial Internal Rate of Return (FIRR). Importance of EIRR takes priority over FIRR. The period of comparison extends up to 35 years of project life (See Figure 12-1).

12.3 CONCLUSION OF ECONOMIC EVALUATION

Table 12-1 and Table 12-2 show the results of investment feasibility analysis for the two DFCs, by dividing them into two sections: one for Western, and the second for Eastern DFC.

Total cost and benefits over 35 years of the project life discounted at the present value of 2007 were compared for the two sections. EIRR is as follows.

Economic Rate of Return of Western DFC: 14.09% B/C Ratio: 1.22
Economic Rate of Return of Eastern DFC: 15.26% B/C Ratio: 1.37

Investment Judgment: Both the Western DFC of 1468 km at a cost of Rs. 287,420 Million and the Eastern DFC of 1309 km at a cost of Rs. 212,437 Million are economically justified from the viewpoint of national economy, since the EIRR value is higher than the 12% opportunity cost of capital. Initial investment costs and yearly operational expenses will be fully covered by the time savings benefit to passengers and freight transport, operating expenses savings benefit of trains, vehicle operating savings benefit of trucks and buses, and savings benefit of exhaust gas and environmental pollution.

Table 12-1 Statement of the Internal Economic Rate of Return, Western DFC

Western DFC Million Rs.

Year	Invest. Cost	Rolling Stock	Total Cost	Time Saving		Working Expens		CO2	Total Benefit	Balance EIRR
				C.Train &Truck	P.Train &Bus	C.Train &Truck	P.Train &Bus	Truck &Bus		
2008-09	16,152		16,152							-16,152
2009-10	31,607		31,607							-31,607
2010-11	32,462		32,462							-32,462
2011-12	41,487	1,354	42,841							-42,841
2012-13	34,563		34,563							-34,563
2013-14	19,978	16,721	36,699	1,045	6,455	12,383	6,151	117	26,152	-10,547
2014-15	8,452	3,597	12,049	1,112	6,759	13,160	6,324	156	27,511	15,462
2015-16	2,874	3,899	6,773	1,182	7,106	14,030	6,502	205	29,026	22,253
2016-17		4,132	4,132	1,257	7,509	15,013	6,686	266	30,731	26,599
2017-18		4,935	4,935	1,336	7,979	16,139	6,877	342	32,674	27,739
2018-19		5,636	5,636	952	8,211	17,808	6,976	455	34,402	28,766
2019-20		2,762	2,762	930	8,676	18,466	7,188	513	35,773	33,010
2020-21		2,860	2,860	907	9,185	19,202	7,414	580	37,286	34,426
2021-22		2,973	2,973	881	9,742	20,029	7,648	654	38,953	35,981
2022-23		2,930	2,930	853	11,960	20,961	7,931	746	42,450	39,520
2023-24		3,136	3,136	833	11,534	21,993	7,923	824	43,107	39,971
2024-25		2,653	2,653	845	11,600	23,097	7,949	879	44,371	41,718
2025-26		2,575	2,575	857	12,417	24,291	7,993	943	46,501	43,926
2026-27		2,619	2,619	869	13,394	25,584	8,040	1,010	48,898	46,279
2027-28		1,583	1,583	881	14,563	26,987	8,091	1,083	51,606	50,022
2028-29		1,151	1,151	893	15,961	28,513	8,272	1,181	54,819	53,668
2029-30		463	463	883	17,369	29,895	8,080	1,229	57,456	56,993
2030-31		467	467	872	19,054	31,394	8,015	1,302	60,637	60,171
2031-32		471	471	828	21,068	32,608	7,957	1,380	63,840	63,370
2031-33		474	474	838	21,519	33,214	7,977	1,380	64,929	64,454
2033-34		282	282	848	21,984	33,840	7,998	1,381	66,051	65,768
2034-35		-7	-7	848	21,984	33,840	7,998	1,381	66,051	66,058
2035-36		-7	-7	848	21,984	33,840	7,998	1,381	66,051	66,058
2036-37		-7	-7	848	21,984	33,840	7,998	1,381	66,051	66,058
2037-38		-7	-7	848	21,984	33,840	7,998	1,381	66,051	66,058
2038-39		-7	-7	848	21,984	33,840	7,998	1,381	66,051	66,058
2039-40		-7	-7	848	21,984	33,840	7,998	1,381	66,051	66,058
2040-41		-7	-7	848	21,984	33,840	7,998	1,381	66,051	66,058
2041-42		-7	-7	848	21,984	33,840	7,998	1,381	66,051	66,058
2042-43		-7	-7	848	21,984	33,840	7,998	1,381	66,051	66,058
Total	187,576	67,605	255,180	27,532	461,903	783,163	229,976	29,054	1,531,629	14.09%

Judgment Reliability: There are many uncertain factors in this railway project, as the scale of investment is very high. There are many cost items, as well as many assumptions made in estimating savings benefits. The EIRR of the Western DFC is lower than that of the Eastern DFC; however, enough EIRR is secured even if benefits vary, and the permissible range of investment justification is high. Thus even if the input index is partially changed, this conclusion will generally not be affected.

Implementation Judgment: As construction delays result in the delay in generation of benefits and damage to the utilization of resources, construction of the DFC for both Western

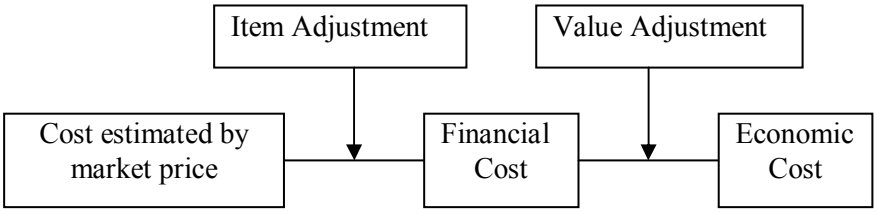
and Eastern DFC should be implemented as soon as possible, even if technical problems arise in each phase.

Table 12-2 Statement of the Internal Economic Rate of Return, Eastern DFC

Eastern DFC Million Rs.

Year	Invest. Cost	Rolling Stock	Total Cost	Time Saving		Working Expenses		CO2	Total Benefit	Balance EIRR
				C.Train &Truck	P.Train &Bus	C.Train &Truck	P.Train &Bus	Truck &Bus		
2008-09	12,377		12,377							-12,377
2009-10	24,068		24,068							-24,068
2010-11	24,701		24,701							-24,701
2011-12	29,563	1,809	31,372							-31,372
2012-13	23,899		23,899							-23,899
2013-14	12,560	19,477	32,037	13.9	6,365	8,672	5,982	120	21,154	-10,883
2014-15	4,889	4,067	8,956	15.2	6,729	9,179	6,145	192	22,261	13,305
2015-16	1,392	4,021	5,412	16.5	7,163	9,580	6,312	237	23,309	17,896
2016-17		4,501	4,501	17.9	7,686	9,867	6,483	293	24,346	19,845
2017-18		4,859	4,859	19.4	8,321	10,031	6,658	361	25,390	20,532
2018-19		5,495	5,495	21.0	8,778	10,066	6,738	444	26,047	20,552
2019-20		647	647	23.7	9,345	11,495	6,876	535	28,275	27,628
2020-21		534	534	26.6	9,997	12,999	7,017	586	30,625	30,091
2021-22		672	672	29.6	10,748	14,583	7,160	643	33,163	32,491
2022-23		552	552	32.9	11,617	16,255	7,305	704	35,913	35,361
2023-24		428	428	36.3	12,520	18,020	7,211	770	38,558	38,130
2024-25		548	548	38.2	13,463	18,475	7,194	853	40,024	39,476
2025-26		551	551	40.3	14,562	18,979	7,173	938	41,692	41,141
2026-27		357	357	42.5	15,839	19,535	7,147	1,034	43,598	43,240
2027-28		481	481	44.9	17,319	20,151	7,116	1,141	45,773	45,292
2028-29		437	437	47.6	19,031	20,833	7,080	1,262	48,254	47,817
2029-30		413	413	50.3	20,826	21,582	6,899	1,398	50,756	50,342
2030-31		295	295	53.1	22,937	22,395	6,710	1,532	53,627	53,332
2031-32		297	297	56.2	25,415	23,279	6,511	1,681	56,943	56,646
2031-33		300	300	57.5	26,009	23,728	6,511	1,848	58,154	57,855
2033-34		302	302	58.8	26,620	24,192	6,511	1,848	59,231	58,929
2034-35		-8	-8	58.8	26,620	27,307	6,511	1,849	62,346	62,354
2035-36		-8	-8	58.8	26,620	27,307	6,511	1,855	62,352	62,360
2036-37		-8	-8	58.8	26,620	27,307	6,511	1,855	62,352	62,360
2037-38		-8	-8	58.8	26,620	27,307	6,511	1,855	62,352	62,360
2038-39		-8	-8	58.8	26,620	27,307	6,511	1,855	62,353	62,361
2039-40		-8	-8	58.8	26,620	27,307	6,511	1,856	62,353	62,361
2040-41		-8	-8	58.8	26,620	27,307	6,511	1,856	62,353	62,361
2041-42		-8	-8	58.8	26,620	27,307	6,511	1,856	62,353	62,361
2042-43		-8	-8	58.8	26,620	27,307	6,511	1,856	62,354	62,362
Total	133,450	50,971	184,421	1,272	540,874	589,656	201,345	35,113	1,368,261	15.26%

12.4 CONSTRUCTION COSTS FOR ECONOMIC ANALYSIS



12.4.1 Construction Costs

Financial Cost: The following items were extracted from the construction cost as estimated by market price in Chapter 11.

1) Electric locomotives procurement
2) Spare parts for electric locomotives
3) Price escalation
4) Financial interest during construction

Rolling stock is a cost of DFC management, but cost fluctuates according to the transport demand, so it was calculated separately from the construction cost. Price escalation and interest during construction were eliminated because of the transfer items in economic activities.

Economic Costs: Financial costs are divided into domestic currency and foreign currency. Domestic currency is divided further into tradable goods and non-tradable goods, skilled labor and unskilled labor, and tax to correct price distortion, in order to estimate economic cost while evaluating the genuine value of resources. Shadow exchange coefficient is 0.91which is applied to non-tradable goods, and shadow wage rate of 0.77 is applied to unskilled workers.

As for the land costs of non-tradable goods, 7.5% of public land is used, which is obtained without spending money. These costs are regarded as zero for financial analysis, while it is not zero for economic cost since land resources are used. Public land cost estimate is included in the economic cost, based on average market prices.

Financial and Economic Costs: Table 12-3 shows the composition of economic costs of Western and Eastern DFC. These costs are used as the base case for economic analysis. *(Volume4 Technical Working Paper Task2, 12 Table12-1 'Conversion to Economic Cost from Financial Cost, Western and Eastern DFC',Table12-20 'Shadow Exchange Coefficient').*

Cost estimate by market price: Western Rs. 287,420 Million., Eastern Rs. 212,437 Million.
Cost eliminated for 4 items: Western Rs. 220,162 Million, Eastern Rs. 155,908 Million.
Cost adjusted by value (economic cost): Western Rs. 187,576 Million, Eastern Rs. 133,450 Million.

Table 12-3 Construction Costs for DFC Economic Evaluation

Million Rs.

Items	Western DFC		Eastern DFC	
	Financial	Economic	Financial	Economic
Civil &Building, Track	109,545	92,219	70,038	58,960
Electrical & Mechanical Work	17,142	14,310	13,791	11,512
Signaling & Telecommunication Work	24,124	20,641	20,420	17,472
Cosultancy Service	5,432	4,711	3,419	2,965
Physical Contingency	10,084	8,199	7,369	5,992
Land Acquisition	26,439	24,597	25,393	23,624
General Administration	10,598	8,785	7,235	5,997
Others	16,799	14,114	8,244	6,927
Total for Evaluation	220,162	187,576	155,908	133,450
Grand Total	287,420		212,437	

12.4.2 Economic Costs of Rolling Stock

Conversion to Economic Cost: Rolling stock consists of electric locomotives and freight cars. Locomotives are divided into 8 axles for bulk cargo and 6 axles for containers. The number of vehicles required in operation is calculated based on traffic demand, train-km, train operation planning. Locomotives for the DFC are assumed to be all new. Locomotives are also to be operated on the DFC feeder lines, but they are assumed to be operating within the DFC for investment cost calculation. Economic conversion to economic price from market price is as follows. (*Volume4 Technical Working Paper Task2,12 Table 12-2 'Conversion to Economic Cost from Financial Cost, Locomotive & Wagon'*).

Table 12-4 Rolling Stock Cost, Market Price and Economic Price

Million Rs.

Items	Financial Cost	Conversion Ratio	Economic Cost
Electric Locomotive for Bulk (8-Axle)	212.00	92.5%	196.1
Electric Locomotive for Container (6-Axle)	130.00	92.5%	120.2
Container & Bulk	2.162	80.6%	1.74

Economic Cost of Rolling Stock: Rolling stock will be used right from the DFC's opening year, but initially only 10 locomotives for both corridors' test operation are included from 2 year before opening. It is assumed that at the time of initial operation, 70% of the vehicles on the existing railroad will be used, and that their costs are 50% of the new products. The life of vehicles is estimated at 36 years for new rolling stock and 20 years for old wagons. *(Volume4 Technical Working Paper Task2, 12 Table12-3 shows 'Eastern DFC, Financial Cost, Number of Locomotives, Wagons and the Cost by Operation Years; Table12-4 shows Eastern DFC, Economic Cost, Number of Locomotives, Wagons and the Cost by Operation Years; Table12-5 shows Western DFC, Financial Cost, Number of Locomotives, Wagons and the Cost by Operation Years; Table12-6 shows Western DFC, Economic Cost, Number of Locomotives, Wagons and the Cost by Operation Years')*

Table 12-5 Classification of Rolling Stock, Number and Price

Million Rs.

West	Classification	No.	Financial	Economic
Electric Locomotive	for Container (6 Axle)	246	31,980	29,580
	for Bulk (8Axle)	68	14,416	13,334
Container	New	10,327	22,326	17,998
	Old	1,544	1,535	1,237
Bulk	New	2,441	5,277	4,254
	Old	1,503	1,494	1,201
Total			77,027	67,605
East	Classification	No.	Financial	Economic
Electric Locomotive	for Container (6 Axle)	6	780	721
	for Bulk (8Axle)	178	37,736	34,904
Container	New	207	448	361
	Old	63	63	50
Bulk	New	7,076	15,298	12,332
	Old	3,248	3,228	2,602
Total			57,552	50,971

12.5 TRAFFIC VOLUME FOR COST-BENEFIT CALCULATION

Traffic volume: The traffic volume estimated in Chapter 4 is divided as described below for benefits analysis. The basis for traffic flow is from origin to destination. For the case that assumes the DFC is not built ("without DFC"), traffic estimation was divided into traffic diverted to the parallel highway, and remaining traffic on the existing railway. Passenger traffic is also included in this traffic estimation analysis. Though the DFC is a project for cargo transport only, the DFC project benefits passenger trains as well.

Classifications of Traffic: For the case that assumes the DFC is built ("with DFC"), traffic was classified into four categories; 1) traffic using the DFC, 2) traffic remaining on the existing railways, 3) traffic connected to the DFC directly (feeder), and 4) traffic remaining on the parallel highway. Traffic on the parallel highway is classified into truck transport for freight, and bus transport for passengers. Thus in the economic analysis, all railway and highway traffic are to be analyzed, including the existing railway. The method of traffic distribution is explained in more detail in Chapter 4. The growth rate of traffic volume is not

fixed, because the opening period is divided in the first and second stages (see *Chapter 4, "DEMAND FORECAST"*).

Table 12-6 Traffic Volume with DFC and Without DFC for Economic Analysis

Freight(Billion Ton-km)	2013	2017	2018	2022	2023	2028	2031
Without DFC							
Existing Rail	426.2		467.7		510.3	557.6	588.1
Road	28.2		73.9		122.7	175.0	209.4
With DFC							
Eastern Corridor							
DFC	35.2		72.8		76.2	79.4	81.0
Feeder	49.7		91.3		97.7	103.9	106.9
Without Western Corridor							
Existing Rail	348.4		352.8		368.7	413.0	441.9
Road	15.8		39.3		77.8	119.0	147.1
Western Corridor							
DFC	29.2	32.6	67.5	86.0	90.6	113.5	128.2
Feeder	28.0	30.5	29.4	35.6	37.3	45.5	51.8
Without Eastern Corridor							
Existing Rail	374.1	397.9	406.8	432.0	439.7	475.3	500.7
Road	16.4	25.9	27.2	34.7	38.1	56.5	69.4
Passenger(Billion Pass.km)	2013	2017	2018	2022	2023	2028	2031
Without DFC Case							
Existing Rail	120.9	138.6	143.0	160.3	164.0	179.2	186.0
Road	2.0	4.8	5.5	9.7	11.4	23.4	34.1
With Eastern DFC							
Existing Rail (East	46.0	-	55.3	-	64.9	74.4	80.1
Existing Rail (Wes	57.3	-	68.3	-	78.9	85.9	89.6
Road	0.9	-	1.8	-	3.6	9.8	15.0
With Western DFC							
Existing Rail (East	45.4	-	53.4	-	60.5	65.7	68.0
Existing Rail (Wes	57.3	-	69.5	-	81.0	91.6	98.1
Road	1.2	-	3.7	-	8.7	17.5	24.8

12.6 COUNTABLE BENEFITS

Classifications of benefits: Countable benefits can be classified as follows. These are direct benefits from the DFC project. Economic and social impact is based on the macro analysis by Intermodal Research Units, which forecasts a ripple effect on households (income and employment), on productivity (GDP), on the government (tax revenue), and on economic and social effects not included in these benefits.

Benefits related to railways

1. Transportation time savings benefit
2. Working expense savings benefit for cargo trains and passenger trains
3. Investment cost (locomotives, freight cars) savings benefit

Direct benefits related to roads

4. Time savings benefit to passengers and freight
5. Capital cost savings benefit of vehicles
6. Road maintenance cost savings benefit
7. Traffic accident decrease benefit
8. Time and vehicle operating cost savings benefit gained from crossing of rail tracks using ROBs
9. Environmental improvement benefit (decrease of automobile exhaust gas)

Counted Benefit: From the list of countable benefits, the following 10 items were calculated. Other uncountable benefits are covered by about 10% plus benefits at sensitivity analysis. Improvement benefits of ports at both ends of the DFC main lines, and of ICD (Inland Container Depot) maintenance are handled as independent facilities not included in the DFC benefits.

1) Time savings benefit for cargo transported by cargo trains (cargo)
2) Time savings benefit for passengers transported by passenger trains (passenger)
3) Time savings benefit for cargo transported by trucks (cargo)
4) Time savings benefit for passenger buses (passenger)
5) Working expense savings benefit from efficient operation of cargo trains (train)
6) Working expense savings benefit from efficient operation of passenger trains (train)
7) Vehicle operating cost savings benefit for trucks (vehicle)
8) Vehicle operating cost savings benefit for buses (vehicle)
9) Benefit from decrease in exhaust gas of route trucks.
10) Benefit from decrease in exhaust gas of route buses.

12.7 "WITH" AND "WITHOUT"

Generation of Benefits: Benefits are generated both with and without the DFC project. In the case of "without DFC", only existing railroads and highways are analyzed. In the case of "with DFC", the DFC is added to the analysis. As a result of this, service conditions and allocated transport volume will change, thus generating benefits.

Figure 12-2 is a simplified chart showing the relationship between traffic volume and traveling speed used in calculating benefits.

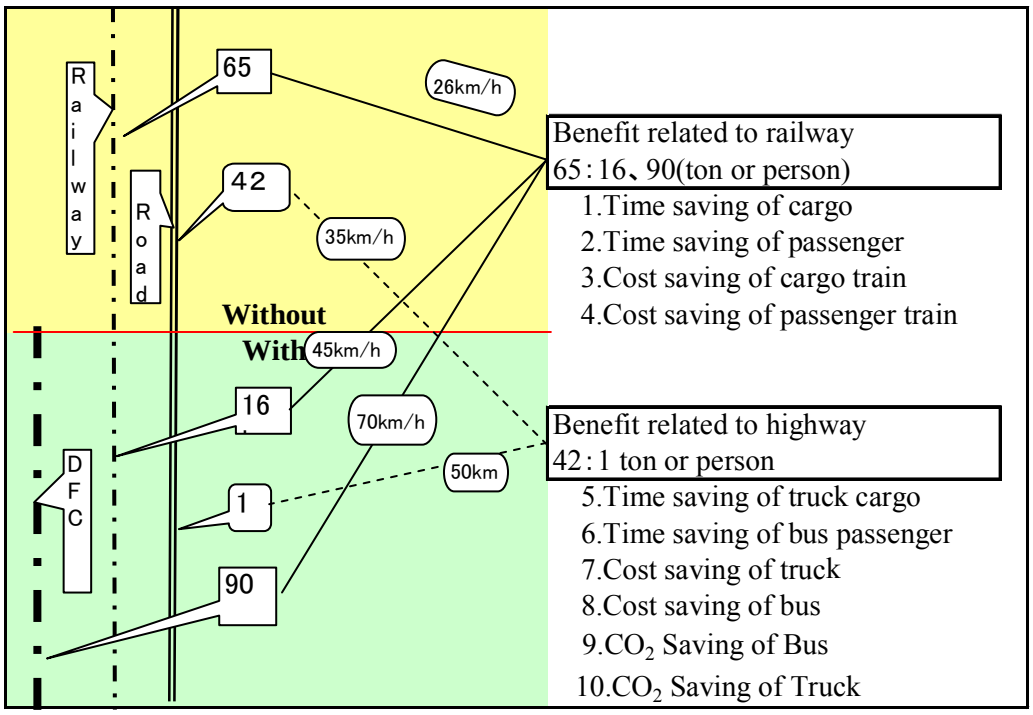


Figure 12-2 Change in Service Levels and Benefits Generated for With and Without DFC

Without DFC, the total traffic volume of 107 (tons or persons) is transported by railways carrying 65 and highways carrying 42. With DFC, the distribution changes to 90 carried by the DFC, 16 by the existing railways, and 1 by highways.

The difference in transport volume between "with DFC" and "without DFC" results in a difference in the service level of the DFC, existing railways, and highways, thus generating benefits. For example, there are differences in operating speed, transportation distance, transportation cost, transported items (cargo, passenger), and working expenses.

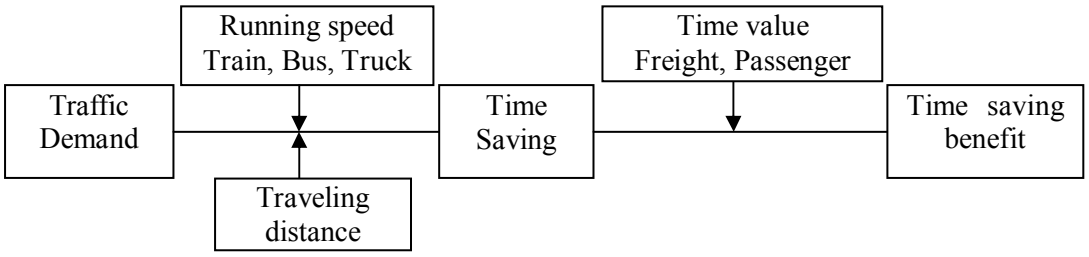
In the case above, existing railways gain time and working expenses benefits from the difference in service level between 65 "without DFC" and 16 and 90 "with DFC". Trucks and buses on the highways get time, cost, and exhaust gas savings benefit from the different service level between 42 "without DFC" and 1 "with DFC". This is the same for passengers.

These combinations of traffic volume and different service level sometime generate negative benefits. In some cases, it generates much higher operating costs for buses and trucks. The benefit brought about by the construction of the DFC is reflected by the aggregate of all benefits, including positive benefits, negative benefits and decrease of benefits.

12.8 TIME SAVINGS BENEFIT

12.8.1 Measurement of Time Savings Benefit

The time savings benefit for freight trains, passenger trains, and trucks and buses generated by the construction of the DFC are calculated based on changes in freight and passenger transport volume, driving speed, transport distance, and cargo time and passenger time value (see chart below).



12.8.2 Operating Speed

Operating Speed of Railways: The operating speed of railway in the case of "Without" vary according to freight cars, passenger cars, super-express, express, local, regional, number of operating trains, etc.. From the Annual Statistical Statement, the average speed was estimated at 26 km/h, considering the speed of container trains and bulk trains. The operating speed of the DFC is based on the operating schedule prepared by the Study Team. The degree of influence caused by the construction of the DFC on related lines varies depending on whether the line is a feeder lines directly connected to DFC or if it is an unconnected existing line.

For passenger carriages, speed will not increase even 'with DFC'. Instead, the number of operating trains will increase. The benefits in this case are generated by a decrease in waiting time resulting from increased frequency of trains. The average operating speed of freight and passenger trains is shown in Table 12-7 (see also *Chapter 6 "Transport Planning"*).

Table 12-7 Travelling Speed, With and Without DFC

Traveling Speed			
Cargo Train			
Without Project	Existing, Feeder		26 km/h
With Project	DFC		70 km/h
	Feeder	West (Container)	50 km/h
		East (Bulk)	40 km/h
	Existing		26 km/h
Passenger Train			
Without Project	Existing, Feeder		55 km/h
With Project	Feeder		55 km/h
	Existing		55 km/h
Truck & Bus			
Without Project			35 km/h
After 20years			20 km/h
With Project			50 km/h
After 20years			30 km/h

Travelling speed of trucks and buses: Running surveys of parallel national highways and improved national highways, as well as congestion surveys were conducted. While it is possible to run at 80~90 km/h on the completed expressway sections of the Western DFC such as the 140-km Ahmedabad-Vadodara segment, the following assumptions are made in consideration of factors such as vehicles running on opposite direction, vehicles violating rules on the passing lanes, and a mixture of 4-lane and 2-lane roads.

- Traveling speed "without DFC": decrease from 35 km/h to 20 km/h in 20 years
- Traveling speed "with DFC": decrease from 50 km/h to 30 km/h in 20 years

12.8.3 Unit time value of cargo

Price per ton: Time savings benefit for cargo was measured by converting cargo time saved for "with" and "without" into monetary value. The time value of cargo differs according to the content of the cargo. For the Western DFC, the main cargo transported are containers having a large variety of contents. However, most containers consist of import-export cargo, and the unit price per ton was thus estimated based on 20 import items and 21 export items, selected using import-export statistics. In the Eastern DFC, the main commodity is coal. Statistical data on coal is available annually in India, and the nationwide average price per ton was used (see *Volume4 Technical Working Paper Task2, 12 Table12-19 Unit Price and Time Value of Cargo, Western DFC*).

Western DFC commodities: 4,052 Rs./ton (average of imports and exports)

Eastern DFC commodities: 749 Rs./ton (mainly coal)

Time value per ton: Cargo lying in stock due to transport delays incurs costs by the hour. The cost per hour is equal to the short term interest rate (11% per annum) on the commodity price computed per hour. The cost of delayed cargo was computed per ton/hour by applying the economic price conversion coefficient of 85% to the cost per hour. The converted value of time saved is as below.

Western DFC commodities: 0.432 Rs./ton/hour

Eastern DFC commodities: 0.0080 Rs./ton/hour

12.8.4 Unit Time Value of Passengers

Characteristics of time value: The time value of passengers is higher than that of cargo. A great variety of passengers use trains: workers and non-workers, high income and low income earners, businessmen and tourists, students, children and the elderly. Detailed statistics on income groups in India are easily available, and there are many analyses in the field of time value in India. It is thus possible to calculate the time value of passengers, but generally accepted figures in other projects was adopted in this analysis.

Unit time value of passengers: The time savings value of existing railroad passengers and time savings value of bus passengers amounted to 2.10~9.3 Rs./passenger hour in 1999, and 5.3~21.4 Rs./passenger hour in 2004. After trial calculations, the average time value of 17.74 Rs./passenger hour was adopted for this analysis.

12.9 OPERATING EXPENSES SAVINGS BENEFIT

12.9.1 Savings Benefit for Railway Operating Expenses

For operating expenses "with DFC", data from the attached "General Estimate of Operating and Maintenance Costs" was used. Personnel expenses based on scaled-down personnel management and physical expenses based on efficient operating and maintenance management form the basis for estimating operating expenses. In particular, the unit personnel costs for railway stations, facilities, and electricity will decrease annually as the operation length and number of trains increase.

In the case of "without DFC", average operating expenses of the existing railway is derived from the Indian Railways Annual Statistics Report. It is calculated as 0.31 Rs./ton-km x 85% = 0.264 Rs./ton-km. Average operating expenses of existing railway 'with DFC' is assumed to drop by 5% (see *Chapter 9, "Operation and Maintenance Planning"*).

12.9.2 Vehicle Operating Costs and Running Benefits for Trucks and Buses

Pre-suppositions: The benefit is generated from the changes in traveling speed between "with DFC" and "without DFC". The average traveling distance of truck and buses are based on a survey of the origin and destination of each commodity. The traveling distance varies yearly: that of Western DFC is between 780km and 980km, while the Eastern DFC is between 500km and 520km. Average transport volume is estimated at 10 tons by truck and 35 passengers by bus from Enterprise Study of India.

Traveling speed and Running Costs: Vehicle operating costs increase as traveling speed decreases. The formula of the integral curve is from the formula tested by the Federal Highway Authority of United Stated, modified for India as follows. Purchase price for trucks is set at 1,135,264 Rs. and for buses at 1,335,605 Rs., converted to economic value:

・large size bus : $Y = 0.003464x^2 - 0.452039x + 24.768072 + 3.35$

・large size truck : $Y = 0.002082x^2 - 0.2603x + 17.274845 + 3.64$

Where X is traveling speed and Y is vehicle operating cost (fuel, lubricant oil, tires, etc.). The largest change occurs in fuel costs (80%). Some costs that are not affected by speed are overhead cost, crew costs, and capital cost. (See *Volume4 Technical Working Paper Task2, 12 Table 12-21, "Input Data for Unit Vehicle Operating Cost at Base Speeds"*)

12.10 CALCULATION OF BENEFIT FROM DECREASE OF VEHICLE EXHAUST GAS

Exhaust of CO_2: Environmental pollution caused by exhaust gases has led to problems of global warming. Increase in traffic and exhaust gases "without DFC" was compared to the benefits of decreasing road traffic and lower CO_2 emissions. The relationship between a decrease in speed and the resulting increase in fuel expenses can be calculated by the same formula as the one used for running costs benefit. Converting fuel consumption per 1 litre to calories, 1 litre of gasoline = 0.0371GJ calorie = weight of CO_2 per calorie 1= 74.01kg.

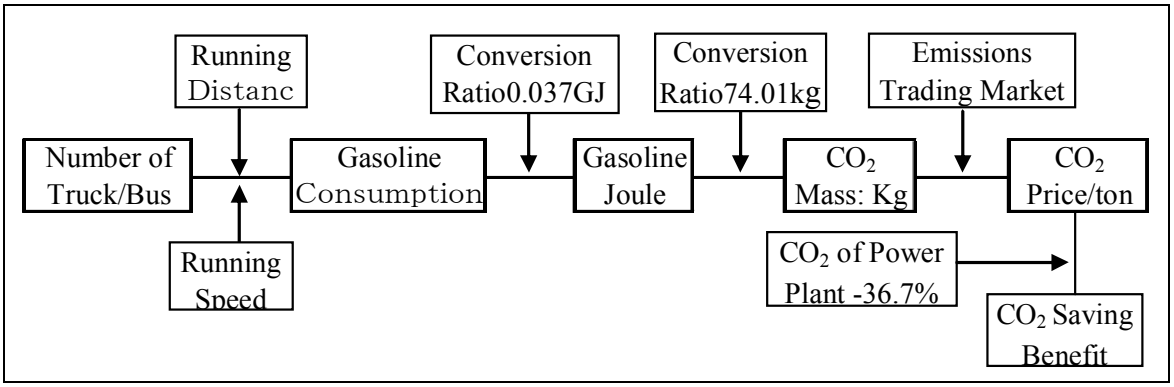


Figure 12-3 Calculation of Benefit from Decrease of Vehicle Exhaust Gas

Price of CO_2 per 1000 kg: Since there has been until now no demand for CO_2, it is ordinarily not priced. However, the CO_2 Emissions Trading Scheme has created a "demand" for CO_2. The trading price of CO_2 per 1000kg is determined in the same way as the stock market, but it is very unstable at present, ranging from 1 dollar to 23 dollars. 5 dollars/ton is assumed in the calculation of this benefit.

Power Plant CO_2: While electric locomotives do not directly emit **CO_2**, **CO_2** is produced by the power plant that supply electricity to the trains. A survey of railway **CO_2** by the Railway Research Institute in Japan reveals that the ratio of **CO_2** per ton-kg is 100 (trucks): 36.7 (railways). Thus, the benefit due to **CO_2** was calculated by subtracting power plant **CO_2** from the "without DFC" emissions of trucks and buses.

(Volume4 Technical Working Paper Task2, Table12-15 Western DFC, Truck, Benefit from Decrease of Automobile Exhaust Gas; Table12-16 Western DFC, Bus, Benefit from Decrease of Automobile Exhaust Gas; 12-17 Eastern DFC, Truck, Benefit from Decrease of Automobile Exhaust Gas; 12-18 Eastern DFC, Bus, Benefit from Decrease of Automobile Exhaust Gas)

12.11 RESULTS OF BENEFIT AND COSTS CALCULATION

Table 12-8 and Table 12-9 show the results of benefit and costs calculation. Benefits are generated not only for cargo, but also for passengers. Furthermore, positive benefits extend beyond railways to trucks & buses as well. On the other hand, trucks & buses generate CO_2, hence causing negative benefits.

In order to obtain an accurate grasp of benefits, the period of analysis was set at 20 years, from 2013/14 to 2033/34. However, in the cost-benefit analysis, the period between 2033/34 and 2042/43 has been covered as well. The main characteristics are as follows.

Table 12-8 Summary for the Total Benefit Stream, Western DFC

Western DFC Billion Rs.

Year	Time Saving				Working Expenses Saving				Co2 Saving		Grand Total
	Cargo		Passenger		Cargo		Passenger		Truck	Bus	
	Train	Truck	Train	Bus	Train	Truck	Train	Bus			
2008-09											
2009-10											
2010-11											
2011-12											
2012-13											
2013-14	1.0	0.0	5.9	0.6	11.5	0.9	6.1	0.0	0.1	0.0	26.2
2014-15	1.1	0.0	6.0	0.8	12.0	1.1	6.3	0.0	0.2	0.0	27.5
2015-16	1.1	0.0	6.1	1.0	12.5	1.5	6.5	0.0	0.2	0.0	29.0
2016-17	1.2	0.0	6.3	1.2	13.1	1.9	6.6	0.0	0.3	0.0	30.7
2017-18	1.3	0.1	6.4	1.5	13.6	2.5	6.8	0.0	0.3	0.0	32.7
2018-19	0.9	0.1	6.5	1.7	14.5	3.3	6.9	0.1	0.4	0.0	34.4
2019-20	0.8	0.1	6.7	2.0	14.6	3.9	7.1	0.1	0.5	0.0	35.8
2020-21	0.8	0.1	6.9	2.3	14.7	4.5	7.3	0.1	0.6	0.0	37.3
2021-22	0.8	0.1	7.1	2.6	14.8	5.2	7.6	0.1	0.6	0.0	39.0
2022-23	0.7	0.1	7.3	4.6	14.9	6.1	7.8	0.1	0.7	0.0	42.4
2023-24	0.7	0.2	7.2	4.3	15.0	7.0	7.8	0.1	0.8	0.0	43.1
2024-25	0.7	0.2	7.2	4.4	15.3	7.8	7.8	0.2	0.9	0.0	44.4
2025-26	0.7	0.2	7.2	5.2	15.6	8.7	7.8	0.2	0.9	0.0	46.5
2026-27	0.7	0.2	7.1	6.3	15.9	9.7	7.8	0.2	1.0	0.0	48.9
2027-28	0.6	0.2	7.1	7.5	16.2	10.8	7.8	0.3	1.1	0.0	51.6
2028-29	0.6	0.3	7.0	8.9	16.5	12.0	7.8	0.4	1.1	0.0	54.8
2029-30	0.6	0.3	6.8	10.5	16.6	13.3	7.7	0.4	1.2	0.0	57.5
2030-31	0.6	0.3	6.6	12.4	16.8	14.6	7.6	0.5	1.3	0.0	60.6
2031-32	0.5	0.3	6.4	14.7	16.6	16.0	7.4	0.5	1.4	0.0	63.8
2031-33	0.5	0.3	6.4	15.1	16.6	16.6	7.4	0.6	1.4	0.0	64.9
2033-34	0.5	0.4	6.4	15.6	16.6	17.3	7.4	0.6	1.4	0.0	66.1
2034-35	0.5	0.4	6.4	15.6	16.6	17.3	7.4	0.6	1.4	0.0	66.1
2035-36	0.5	0.4	6.4	15.6	16.6	17.3	7.4	0.6	1.4	0.0	66.1
2036-37	0.5	0.4	6.4	15.6	16.6	17.3	7.4	0.6	1.4	0.0	66.1
2037-38	0.5	0.4	6.4	15.6	16.6	17.3	7.4	0.6	1.4	0.0	66.1
2038-39	0.5	0.4	6.4	15.6	16.6	17.3	7.4	0.6	1.4	0.0	66.1
2039-40	0.5	0.4	6.4	15.6	16.6	17.3	7.4	0.6	1.4	0.0	66.1
2040-41	0.5	0.4	6.4	15.6	16.6	17.3	7.4	0.6	1.4	0.0	66.1
2041-42	0.5	0.4	6.4	15.6	16.6	17.3	7.4	0.6	1.4	0.0	66.1
2042-43	0.5	0.4	6.4	15.6	16.6	17.3	7.4	0.6	1.4	0.0	66.1
Total	20.8	6.7	198.4	263.5	462.9	320.3	220.3	9.7	28.5	0.5	1,532
%	1.4%	0.4%	13.0%	17.2%	30.2%	20.9%	14.4%	0.6%	1.9%	0.0%	100.0%

Table 12-9 Summary for the Total Benefit Stream, Eastern DFC

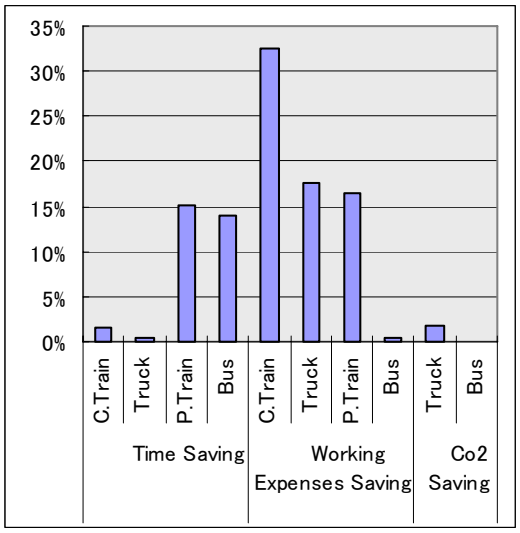
Eastern DFC

Year	Time Saving				Working Expenses Saving				Co2 Saving		Grand Total
	Cargo		Passenger		Cargo		Passenger		Truck	Bus	
	Train	Truck	Train	Bus	Train	Truck	Train	Bus			
2008-09											
2009-10											
2010-11											
2011-12											
2012-13											
2013-14	0.01	0.00	5.7	0.7	7.8	0.9	6.0	0.0	0.1	0.00	21
2014-15	0.01	0.00	5.8	0.9	8.1	1.1	6.1	0.0	0.1	0.07	22
2015-16	0.01	0.01	5.9	1.2	8.2	1.4	6.3	0.0	0.1	0.09	23
2016-17	0.01	0.01	6.1	1.6	8.1	1.8	6.5	0.0	0.2	0.11	24
2017-18	0.01	0.01	6.2	2.1	7.7	2.3	6.7	0.0	0.2	0.14	25
2018-19	0.01	0.01	6.3	2.5	7.1	2.9	6.7	0.0	0.3	0.17	26
2019-20	0.01	0.01	6.4	3.0	8.2	3.3	6.9	0.0	0.3	0.20	28
2020-21	0.01	0.02	6.5	3.5	9.2	3.8	7.0	0.0	0.4	0.23	31
2021-22	0.01	0.02	6.6	4.2	10.3	4.2	7.2	0.0	0.4	0.26	33
2022-23	0.01	0.02	6.7	4.9	11.5	4.8	7.3	0.0	0.4	0.30	36
2023-24	0.02	0.02	6.5	6.0	12.6	5.4	7.2	0.0	0.4	0.35	39
2024-25	0.02	0.02	6.4	7.0	12.5	6.0	7.2	0.0	0.4	0.41	40
2025-26	0.02	0.03	6.4	8.2	12.3	6.6	7.2	0.0	0.5	0.47	42
2026-27	0.01	0.03	6.3	9.6	12.2	7.4	7.1	0.0	0.5	0.55	44
2027-28	0.01	0.03	6.2	11.1	12.0	8.1	7.1	0.0	0.5	0.63	46
2028-29	0.01	0.03	6.1	13.0	11.8	9.0	7.1	0.0	0.5	0.73	48
2029-30	0.01	0.04	5.8	15.0	11.7	9.9	6.9	0.0	0.6	0.84	51
2030-31	0.01	0.04	5.5	17.4	11.6	10.8	6.7	0.0	0.6	0.95	54
2031-32	0.01	0.04	5.2	20.2	11.5	11.8	6.5	0.0	0.6	1.08	57
2031-33	0.01	0.04	5.2	20.8	11.5	12.2	6.5	0.0	0.6	1.23	58
2033-34	0.01	0.04	5.2	21.4	11.5	12.7	6.5	0.0	0.6	1.23	59
2034-35	0.01	0.04	5.2	21.4	11.5	15.8	6.5	0.0	0.6	1.23	62
2035-36	0.01	0.04	5.2	21.4	11.5	15.8	6.5	0.0	0.6	1.23	62
2036-37	0.01	0.04	5.2	21.4	11.5	15.8	6.5	0.0	0.6	1.23	62
2037-38	0.01	0.04	5.2	21.4	11.5	15.8	6.5	0.0	0.6	1.23	62
2038-39	0.01	0.04	5.2	21.4	11.5	15.8	6.5	0.0	0.6	1.23	62
2039-40	0.01	0.04	5.2	21.4	11.5	15.8	6.5	0.0	0.6	1.23	62
2040-41	0.01	0.04	5.2	21.4	11.5	15.8	6.5	0.0	0.6	1.23	62
2041-42	0.01	0.04	5.2	21.4	11.5	15.8	6.5	0.0	0.6	1.23	62
2042-43	0.01	0.04	5.2	21.4	11.5	15.8	6.5	0.0	0.6	1.23	62
Total	0.4	0.9	174.0	366.9	320.8	268.9	201.3	0.0	14.0	21.1	1,368
%	0.0%	0.1%	12.7%	26.8%	23.4%	19.6%	14.7%	0.0%	1.0%	1.5%	100%

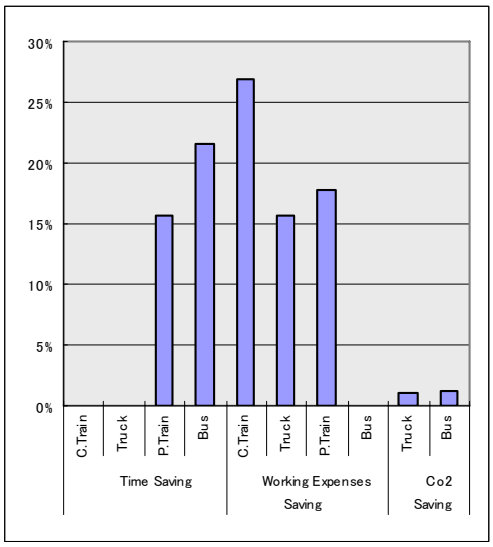
Characteristics of Total Benefits: The total component of benefits and order of benefits is as follows. The main benefits consist of the top five items, which amount to 95.8% in the Western DFC and 97.6% in the Eastern DFC.

Table 12-10 Components by Items of Result of Benefits Estimation

	Benefit Items	West	East
1	Working expenses saving of the cargo train by efficient	32.5%	26.9%
2	Vehicle operating saving benefit of the truck (vehicle)	17.7%	15.7%
3	Working expenses saving benefit of the passenger train by	16.5%	17.7%
4	Time saving benefit of the passengers by passenger train	15.2%	15.7%
5	Time saving benefit of the passenger bus (passenger)	14.5%	21.6%
6	Benefit of exhaust gas decrease of route trucks.	1.7%	1.0%
7	Time saving benefit of the cargo transported by cargo train	1.6%	0.1%
8	Vehicle operating cost saving benefit of the bus (vehicle)	0.5%	0.1%
9	Time saving benefit of the cargo transported by truck (cargo)	0.4%	0.1%
10	Benefit of exhaust gas decrease of route buses.	0.1%	1.2%



Western DFC



Eastern DFC

Figure 12-4 Benefits Components Graph

Time Savings Benefits: Cargo vs. Passengers: The purpose of constructing the DFC is to transport long-distance cargo quickly and inexpensively. However, the benefit analysis reveals that time savings benefit is actually larger for passengers than for cargo. Time savings benefit generated by the earlier arrival of cargo is very low. On the other hand, time savings benefit for passengers are very high, resulting from the shift of cargo previously transported in mixed passenger-cargo trains to all-cargo trains in the DFC. As the average running speed of passenger trains is 55 km/h for both "with DFC" and "without DFC" scenarios, the time savings benefit is not gained from an increase in the speed of passenger trains but from the higher number of extra trains that can be operated, resulting in the drastic reduction of passenger waiting time.

The ratio of time savings benefit for cargo trains and passenger trains is 5:95 for the Western DFC and 1:99 for the Eastern DFC.

The reason why passenger transport has higher benefit is that the value of persons is higher than the value of cargo. Time value of cargo per ton per hour is 0.043 Rs. in the Western DFC where containers are main cargo, and 0.008 Rs. in the Eastern DFC where coal is the main

cargo. On the other hand, value of person is 17.74 Rs. per person per hour, which is much higher. Passenger trains in India are very congested at present, and the construction of the DFC will contribute to the reduction of this problem. This ratio is about the same in the Eastern and Western Bypass Corridors.

Effects of Influence on Road Traffic: Savings of Traveling Cost of Trucks: Construction of the DFC has a big influence on road traffic. In the case of "without DFC", cargo and passengers which cannot be transported on the usual lines have to use parallel national highways. The difference in number of trucks per day between"with" and "without" (in other words, "forced out traffic") is shown in the table below. The average distance of this traffic is estimated at 980km for the Western DFC and 525km for the Eastern DFC.

Table 12-11 Number of Trucks/day on Parallel Highway "Without DFC"

Year	Western DFC	Eastern DFC
2013/14	4,138	6,735
2018/19	13,124	17,774
2023/24	23,694	23,464
2028/29	33,564	29,683

For "Without DFC", traveling speed is set at 35 km/h; and "With DFC" at 50km/h. Along with increase of traffic volume, traveling speed decreases. Thus traveling cost saving accounts for 17.5% of the total benefit of the Western DFC, and 15.7% of the Eastern DFC. Benefits for trucks on regular routes generated from a decrease of traffic congestion and by increase of speed of long–distance cargo to be transferred to DFC.

Effects of Influence on Road Traffic: Benefit of Exhaust Gas Reduction: This accounts for 1% of the total benefit. The price of CO_2 is traded in the same way as stocks in the stock market, and the price of gas emission rights fluctuate between 1 to 23 dollars. For the present calculation, the price is assumed to be 5 dollars per ton. If 1 ton is priced at 10 dollars, this benefit will account for 3% each of the Eastern and Western DFC.

In some cases, CO_2 savings benefit is included in railroad benefit, and in other cases it is not. It accounts only for 1% of the total benefits. However, total savings benefit of exhaust gas reduction of both the Western and Eastern DFC over a period of 30 years amounts to 58,700,000 Rs. If the DFC is not constructed, roads will overflow with vehicles, resulting in a big national loss (See *Chapter 10, "ENVIRONMENT AND SOCIAL IMPACT MEASURES MITIGATION STUDY (ESIMMS)"*).

Meaning of Time Savings Benefits of DFC: Importance of ICD: Time savings benefit and operating savings benefit from DFC construction is about the same at 50:50; however, there are specific characteristics depending on transport mode. In cargo transport time, the weight of time savings benefit is not large. Rather than time savings, other savings have more important meaning, such as port areas to connect transport, consolidation of ICD areas, access roads in the surrounding areas, delivery form, savings in delivery time, etc. Transport of freight in lesser time includes benefits of other than just time savings benefit, such as an increase of added value of cargo. In this report only direct benefits are calculated, and indirect added value is not estimated. Furthermore, implementation of the industrial estate and export corridor will raise added value. Accordingly, effects analysis by macro analysis should be considered.

1) Time savings benefit ・・Passenger transport by passenger trains & buses 〉 time savings of cargo trains & trucks
2) Operating cost savings・・Cargo transport by freight trains & trucks 〉 operating costs of passenger trains & buses

Operating Cost Savings Benefit of Cargo Trains: Operating cost savings benefit of cargo trains accounts for the largest benefit. For the Western DFC, it accounts for 33.2 % of the total benefit; for the Eastern DFC, it is 26.9%. Operating cost savings benefit of the cargo trains consist of DFC personnel cost savings, effective operational & maintenance system, and advantage of long distance transport. This is the benefit from comparison of engineering alternatives to operate in the optimum facilities.

(Refer to *Volume4 Technical Working Paper Task2, 12 Table 12-7 "Time Savings Benefit of Cargo on Cargo Trains & Trucks, Western DFC"; Table 12-8 "Time Savings Benefit of Passengers Transported by Train & Buses, Western DFC"; Table 12.9 "Time Savings Benefit of Cargo on Cargo Trains & Trucks, Eastern DFC"; Table 12.10 "Time Savings Benefit of Passengers Transported by Trains & Buses, Eastern DFC"; Table 12-11 "Working Expense Savings Benefit for Cargo Trains and Vehicle Operating of Trucks, Western DFC"; Table 12-12 "Working Expenses Saving Benefit for Passenger Trains and Vehicle Operating of Buses, Western DFC"; Table 12-13 "Working Expense Saving Benefit for Cargo Trains and Vehicle Operating of Trucks, Eastern DFC"; Table 12-14 "Working Expense Savings Benefit for Passenger Trains and Vehicle Operating of Buses, Eastern DFC"*)

12.12 SENSITIVITY ANALYSIS ON EIRR

Overall Examination: The EIRR of the DFC proves its feasibility as shown by the results of the evaluation. There are uncertain matters for evaluation, since the scale of the project is so large - the length of the Western DFC is 1468 km, and the Eastern DFC is 1309 km.

- Economic Internal Rate of Return of Western DFC i.e. EIRR is 14.09% (Base Case)

  B/C Ratio 1.22, Net Present Value (NPV) 35,510Million Rs.

- Economic Internal Rate of Return of Eastern DFC i.e. EIRR is 15.26% (Base Case)

  B/C Ratio 1.37, Net Present Value(NPV) 54,274 Million Rs.

Influence of increase of costs: If the costs increase by 30%, the EIRR of the Western DFCs discounted at the capital opportunity cost of 12% makes it unfeasible. Increase of 30% at market price means Rs. 82,960 Million for the Western DFC and Rs. 61,400 Million for the Eastern DFC. Since this much cost increase is not possible, this project will be feasible if estimated benefits are secured.

Table 12-12 Sensitivity Analysis – Western DFC

EIRR West				
	Cost / Base	10%	20%	30%
Benefit / Base	**14.09%**	**13.19%**	**12.40%**	11.70%
-10%	**12.95%**	**12.10%**	11.36%	x
-20%	11.74%	x	x	x
-30%	x	x	x	x

Table 12-13 Sensitivity Analysis – Eastern DFC

EIRR East				
	Cost / Base	10%	20%	30%
Benefit / Base	**15.26%**	**14.38%**	**13.61%**	**12.78%**
-10%	**14.11%**	**13.28%**	**12.56%**	11.90%
-20%	**12.89%**	**12.12%**	11.44%	x
-30%	11.60%	x	x	x

Influence of Changes of Benefits: Decrease of benefits affects the feasibility of the Western DFC at 20%, but for the Eastern DFC it remains feasible. Benefits have more effect than costs. Benefits were calculated for 10 items, out of which only 5 are important: time value savings benefit of passengers on trains and of passengers on buses, operational cost savings benefit of cargo trains and of trucks, and operational cost savings benefit of passenger trains. These benefits are calculated based on appropriate estimation of presumed unit value and on traffic demand, and will not change drastically.

12.13 FINANCIAL EVALUATION

Short-term index and long-term index: This section analyzes the feasibility of the construction plan from the financial side. The financial analysis in this chapter is to investigate uncertainty of long-term DFC railroad investment, and not a short-term management analysis. It is to prove profitability by comparing revenues and costs estimate for 35 years with revenues and costs discounted at present value. In order to prove the long term revenues and costs for 35 years, an index called the Financial Rate of Return (FIRR) is used in the analysis.

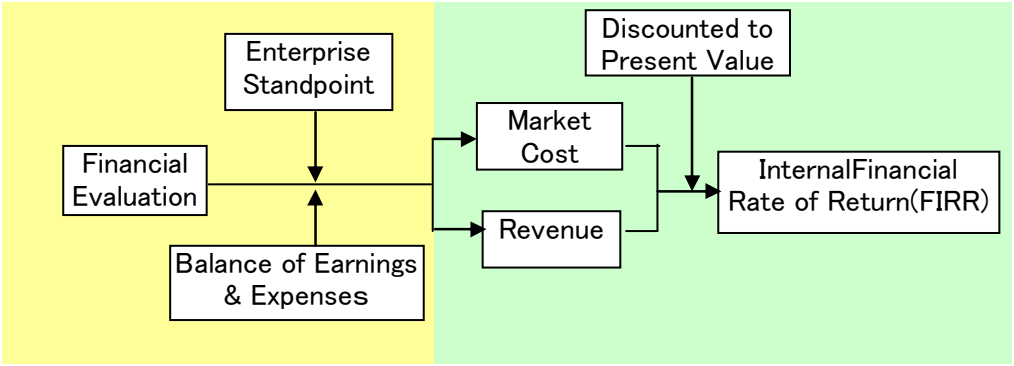


Figure 12-5 Evaluation Procedure for Financial Analysis

Enterprise and project durability: The DFC is to be undertaken by two enterprises: Indian Railways (IR) composed mainly of railroad management, and the Public Corporation in charge of construction and maintenance of infrastructure (DFCCIL). Financial analysis is undertaken to examine if the investment will be profitable for the two enterprises in totality. Accordingly, the total traffic using the DFC section is considered as the object of revenue. Division of revenue between the two enterprises will be analyzed in Chapter 13 "Management Plan Needed for DFCCIL," including interests on construction costs, escalation, and tax, as it is concerned with its business management.

12.14 CONCLUSION OF THE FINANCIAL EVALUATION

Internal Financial Rate of Return: Table 12-14 shows the results of the financial evaluation of the two DFC from the point of profitability of the project. Total costs and total revenues are compared for 35 years. The calculation is aimed at the ratio to be equal between the total discounted cost and total discounted revenue (FIRR). FIRR is as shown in the table.

Financial Rate of Return of Western DFC 9.08%

Financial Rate of Return of Eastern DFC 15.59%

Table 12-14 Internal Financial Rate of Return of Western DFC

Western DFC Million Rs.

year	Before Discounting					FIRR	
	Revenue	Capital Cost	Rolling Stock	Working Expenses	Total Cost	Discount Rate	Present Value
2008-09		18,958			18,958	100.0%	-18,958
2009-10		37,098			37,098	91.7%	-34,009
2010-11		38,101			38,101	84.0%	-32,021
2011-12		48,695	1,464		50,159	77.0%	-38,645
2012-13		40,568			40,568	70.6%	-28,654
2013-14	16,686	23,449	18,863	5,449	47,761	64.8%	-20,121
2014-15	19,599	9,921	4,012	6,404	20,336	59.4%	-438
2015-16	23,020	3,374	4,386	7,526	15,286	54.4%	4,209
2016-17	27,038		4,706	8,845	13,552	49.9%	6,728
2017-18	31,758		5,672	10,395	16,067	45.7%	7,176
2018-19	37,301		6,571	12,217	18,788	41.9%	7,762
2019-20	39,694		3,134	12,925	16,059	38.4%	9,085
2020-21	42,241		3,255	13,674	16,930	35.2%	8,919
2021-22	44,952		3,394	14,467	17,861	32.3%	8,751
2022-23	47,836		3,366	15,306	18,672	29.6%	8,637
2023-24	50,905		3,610	16,193	19,803	27.1%	8,444
2024-25	53,101		2,992	16,906	19,898	24.9%	8,264
2025-26	55,392		2,914	17,650	20,565	22.8%	7,946
2026-27	57,782		2,969	18,428	21,396	20.9%	7,611
2027-28	60,275		1,856	19,239	21,094	19.2%	7,513
2028-29	62,875		1,395	20,086	21,481	17.6%	7,277
2029-30	65,401		543	20,862	21,405	16.1%	7,090
2030-31	68,029		548	21,669	22,216	14.8%	6,768
2031-32	70,762		553	22,506	23,059	13.5%	6,461
2031-33	70,762		557	22,506	23,063	12.4%	5,923
2033-34	70,762		350	22,506	22,856	11.4%	5,453
2034-35	70,762		-9	22,506	22,497	10.4%	5,037
2035-36	70,762		-9	22,506	22,497	9.6%	4,617
2036-37	70,762		-9	22,506	22,497	8.8%	4,233
2037-38	70,762		-9	22,506	22,497	8.0%	3,880
2038-39	70,762		-9	22,506	22,497	7.4%	3,557
2039-40	70,762		-9	22,506	22,497	6.8%	3,261
2040-41	70,762		-9	22,506	22,497	6.2%	2,990
2041-42	70,762		-9	22,506	22,497	5.7%	2,741
2042-43	70,762		-9	22,506	22,497	5.2%	2,513
	1,653,028	220,162	77,027	528,314	825,503	9.08%	-0

Investment Feasibility: Therefore, low-interest rate and long term fund resources must be obtained. Profit and loss balance is excluded from the financial analysis. Management analysis, which is influenced by fund sources and financing conditions, is also excluded from the financial analysis. These flows are not discounted, but analyzed by actual figures, namely cash flows. This analysis of fund balance is in the area of management analysis, and is not included in FIRR.

Conclusion of investment feasibility of the analysis results: If the index is lower than the opportunity cost of capital, i.e. 12%, it means that implementation timing is too early, or that the scale is too big. In this evaluation, as the result of using every possible data for calculation, EIRR of the project was found higher than 12%: 14.09% for the Western DFC, and 15.26% for the Eastern DFC. The conclusion is that the project should be implemented. Investment scale and planning scale are not too large. If it is not implemented, national resources may be wasted. For the financial analysis, FIRR, which is the index of long-term investment evaluation, was found to be 9.08% for the Western DFC and 15.59% for the Eastern DFC. As for the Western DFC, it should be implemented from national viewpoint, since EIRR takes precedence over FIRR. The DFC needs low interest rate and long term repayment loan such as ODA for the implementation.

Table 12-15 Internal Financial Rate of Return of Eastern DFC

Eastern DFC Million Rs.

year	Before Discounting					FIRR	
	Revenue	Capital Cost	Rolling Stock	Working Expenses	Total Cost	Discount Rate	Present Value
2008-09		14,460			14,460	100.0%	-14,460
2009-10		28,119			28,119	86.5%	-24,326
2010-11		28,858			28,858	74.8%	-21,599
2011-12		34,538	1,956		36,494	64.8%	-23,631
2012-13		27,921			27,921	56.0%	-15,641
2013-14	26,271	14,674	21,911	4,155	40,740	48.5%	-7,012
2014-15	30,097	5,712	4,526	4,782	15,020	41.9%	6,321
2015-16	34,480	1,626	4,519	5,504	11,649	36.3%	8,282
2016-17	39,502		5,095	6,334	11,429	31.4%	8,809
2017-18	45,255		5,558	7,290	12,848	27.1%	8,798
2018-19	51,846		6,348	8,390	14,738	23.5%	8,716
2019-20	52,263		728	8,455	9,183	20.3%	8,754
2020-21	52,684		607	8,520	9,128	17.6%	7,657
2021-22	53,108		757	8,586	9,343	15.2%	6,656
2022-23	53,535		628	8,653	9,281	13.2%	5,823
2023-24	53,966		494	8,720	9,214	11.4%	5,094
2024-25	54,361		618	8,783	9,401	9.8%	4,427
2025-26	54,758		621	8,847	9,467	8.5%	3,859
2026-27	55,159		412	8,911	9,322	7.4%	3,378
2027-28	55,563		546	8,975	9,521	6.4%	2,936
2028-29	55,969		499	9,040	9,539	5.5%	2,561
2029-30	56,335		463	9,097	9,559	4.8%	2,232
2030-31	56,703		335	9,154	9,489	4.1%	1,949
2031-32	57,073		338	9,211	9,549	3.6%	1,698
2031-33	57,073		340	9,211	9,551	3.1%	1,469
2033-34	57,073		343	9,211	9,554	2.7%	1,270
2034-35	57,073		-10	9,211	9,201	2.3%	1,107
2035-36	57,073		-10	9,211	9,201	2.0%	958
2036-37	57,073		-10	9,211	9,201	1.7%	829
2037-38	57,073		-10	9,211	9,201	1.5%	717
2038-39	57,073		-10	9,211	9,201	1.3%	620
2039-40	57,073		-10	9,211	9,201	1.1%	537
2040-41	57,073		-10	9,211	9,201	1.0%	464
2041-42	57,073		-10	9,211	9,201	0.8%	402
2042-43	57,073		-10	9,211	9,201	0.7%	347
	1,566,731	155,908	57,552	252,727	466,187	15.59%	0

12.15 DFC FINANCIAL COSTS

12.15.1 Construction Costs

Financial Cost: The subjects of financial costs are: 1) construction costs, 2) operating costs, and 3) rolling stock costs such as locomotives and freight trains. For the construction cost calculation in financial analysis, price adjustments (economic price) as in the economic analysis are not conducted. For adjustment of items, the following four items were excluded, as in the case for economic analysis.

1) Electric locomotives procurement

2) Spare parts for electric locomotives

3) Price escalation

4) Financial interests during construction

Cost component for financial analysis and amount of cost is as follows.

Table 12-16 Financial Costs of Construction

Financial Cost Million Rs.

Items	Western DFC	Eastern DFC
Civil &Building, Track	109,545	70,038
Electrical & Mechanical Work	17,142	13,791
Signaling & Telecommunication Work	24,124	20,420
Cosultancy Service	5,432	3,419
Physical Contingency	10,084	7,369
Land Acquisition	26,439	25,393
General Administration	10,598	7,235
Others	16,799	8,244
Total for Financial Evaluation	220,162	155,908
Grand Total	287,420	212,437

Annual Distribution of Construction Costs: The period of construction is 6 years for Phase I-a, 8 years for Phase I-b, and 6 years for Phase II. Phase II starts two years after the start of Phase I-b. The construction cost is distributed yearly and combined for these 3 periods.

Table 12-17 Annual Distribution of Financial Costs of Construction

Finansial Cost Million Rs.

Year	Western DFC		Eastern DFC	
2008-09	18,958	9%	14,460	9%
2009-10	37,098	17%	28,119	18%
2010-11	38,101	17%	28,858	19%
2011-12	48,695	22%	34,538	22%
2012-13	40,568	18%	27,921	18%
2013-14	23,449	11%	14,674	9%
2014-15	9,921	5%	5,712	4%
2015-16	3,374	2%	1,626	1%
	220,162	100%	155,908	100%

12.15.2 Operating and maintenance costs of DFC

Personnel and facility costs: The cost items are divided into personnel costs and facility costs. Personnel costs of locomotive engineers and other train personnel change depending on train/km. Personnel costs of electricity, facilities, and stations change depending on the number of stations and operating km.

Operating unit costs decrease as transport volume increases. First, the unit cost of each item was increased, multiplying with train km and with operating km in order to find personnel costs. The standard estimation for unit personnel cost of the DFC is based on a smaller number of staff, different from the existing lines. The standard of property cost estimation is efficient operating and maintenance system (see *Chapter 9, "Operating and Maintenance Costs"section; Primary Standard of DFC*).

Facility costs consist of stations, power costs, electricity costs, building costs, general management cost, railroad police cost, etc. and they fluctuate according to operating km. Unit cost of property by facilities is listed in *Chapter 9 "Operating and Maintenance cost"*.

Locomotive: The required number and cost of locomotives for the first year of operation, 2013-14, are as follows. The unit cost of 8-wheel locomotive for bulk is estimated at 212 Million Rs. Unit cost of 6-wheel locomotive for containers is estimated at 130 Million Rs. (For details, see *Volume4 Technical Working Paper Task2,12 Table 12-3,Table 12-5, Number of Locomotives, Wagons and the Cost by Operation Years*)

	8-Wheel Locomotives for Bulk		6-Wheel Locomotives for Containers	
Western DFC	68cars	14,416Million Rs.	246cars	31,980 Million Rs
Eastern DFC	178cars	37,736 Million Rs.	6cars	780Million Rs.

Locomotives for the DFC are assumed to be all new. The locomotives actually run from the DFC directly onto the feeder lines, but the cost is estimated assuming they run within the DFC. The number of carriages is calculated based on transport demand, train km, and train operation plan. However, 20 carriages are to be purchased for trials in year 2011-12.

Cargo trains: For cargo trains, the number is assumed to be the same as the required number of locomotives. However, in the opening year it is assumed that 70% will come from existing trains, and the price is assumed to be 50% of the new product. The service life of trains is assumed as 36 years for the new trains, and 20 years for the existing carriages. (For more details, refer to *Chapter 6, "TRANSPORT PLANNING"*)

12.16 SENSITIVITY ANALYSIS OF FIRR

Renge of Feasibility: Freight revenue forms the basis of FIRR. It is estimated based on the present freight rate of Indian Railways, which is multiplied with estimated transport ton/km of the DFC. On the other hand, construction cost is estimated by items.

Cost of cars is based on the required number of cars linked with volume of demand. Operation cost is estimated on lower number of personnel as compared to existing lines and property costs of the DFC.

Under such conditions, FIRR of the basic case is as follows. Therefore, low-interest rate and long term fund resources must be secured.

Table 12-18 Sensitivity Analysis – Western DFC

FIRR West	Cost / Base	10%	20%	30%
Benefit / Base	**9.08%**	8.43%	x	x
-10%	7.80%	7.19%	x	x
-20%	x	x	x	x
-30%	x	x	x	x

Table 12-19 Sensitivity Analysis – Eastern DFC

FIRR East	Cost / Base	10%	20%	30%
Benefit / Base	**15.59%**	**14.61%**	**13.75%**	**12.98%**
-10%	**14.06%**	**13.15%**	**12.34%**	11.63
-20%	**12.42%**	**11.58%**	10.83%	10.17
-30%	10.64%	10.22	x	x

Freight and the benefits: Freight charges affect the calculation of FIRR to a great extent. According to the results of FIRR analysis, the freight charges of the Eastern DFC are too high, while that of the Western DFC is appropriate, if estimations of construction costs, carriage costs, and operational costs are correct. Figure 12-6 and Figure 12-7 compares freight charge

revenue and benefits. Usually in the case of expressways, toll revenue accounts for 70% of the benefits. Accordingly, highway users receive about 30% of user surplus.

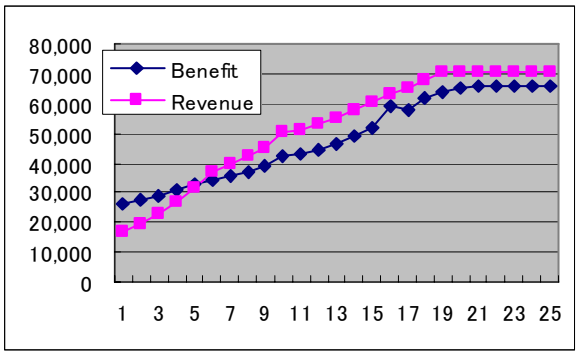


Figure 12-6 Revenue and Benefit, Western DFC

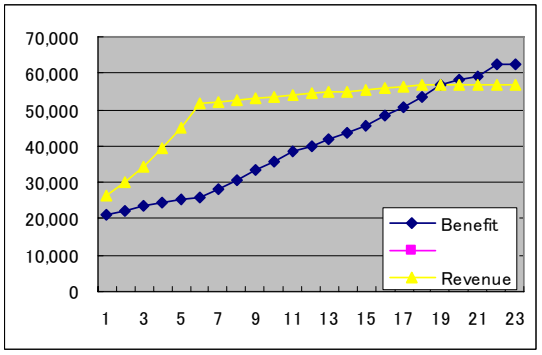


Figure 12-7 Revenue and Benefit, Eastern DFC

Difference of Revenue Curve: For the Western DFC, benefits and freight charge revenue are comparatively similar, but the freight revenue still exceeds the benefits. The freight revenue of the Eastern DFC is not similar to the benefits. Furthermore, freight revenue far exceeds the benefits.

When charges that are higher than the benefits are levied, users usually decrease. However, the main transport item of the Eastern DFC is coal. Coal is connected directly with electric power generation and depends heavily on railroads. Therefore, the DFC is advantageous. In addition, coal transport has high transport efficiency compared with container transport. Eight years later, when the DFC is 100% completed, demand on the DFC will increase rapidly. Because of these reasons, it is possible to set a high freight charge, and higher revenue leads to higher FIRR. However, giving consideration to the future use of coal as electric power generation, future demand growth rate is estimated to be low.

12.17 CONCLUSION OF ECONOMIC ANALYSIS AND FINANCIAL ANALYSIS

Method of determining investment timing and scale: The improvement of the existing cargo lines as an alternative is not enough to supply the present demand. Even if the passenger line is separated and improved, it will not be able to transport the present freight demand. Faced with this situation, planning has started on a large scale project, but the project's feasibility cannot be judged simply by overcapacity. As a method to prove the balance of supply and demand with facility investment, the Economic Internal Rate of Return (EIRR) index was developed. This method compares the huge costs with national benefits discounted at the present value, giving consideration to uncertainty in future.

Conclusion of investment feasibility of the analysis results: If the index is lower than the opportunity cost of capital, i.e. 12%, it means that implementation timing is too early, or that the scale is too big. In this evaluation, as the result of using every possible data for calculation, EIRR of the project was found higher than 12%: 14.09% for the Western DFC, and 15.26% for the Eastern DFC. The conclusion is that the project should be implemented. Investment scale and planning scale are not too large. If it is not implemented, national resources may be wasted.

For the financial analysis, FIRR, which is the index of long-term investment evaluation, was found to be 9.08% for the Western DFC and 15.59% for the Eastern DFC. Eastern DFC shows to be financially viable, but Western DFC shows relatively low FIRR. As for the Western DFC, it should be implemented from national viewpoint, since EIRR takes precedence over

FIRR. Western DFC needs low interest rate and long term repayment loan for the implementation.

Suitability of construction timing: The construction period was planned initially as 5 years. In the economic and financial calculation, construction period was assumed to be 15 years from the viewpoint of engineering. At the same time, the case of shorter construction period of 8 years was evaluated. In the case that the period is shortened to 8 years from 15 years, EIRR and FIRR usually decreases. As the result of the calculation, even if the construction period is shortened, the EIRR is high enough. The high figure of DFC proves that the project a very important national project.

Reliability of the analysis and securing source of fund: In the process of calculation, all kinds of data are inputted, including freight demand forecast till 35 years later, change of origin and destination, traveling speed, transport cost, and time value of people and goods. If wrong data is entered, the calculation loses its consistency.

Benefits of economic analysis are itemized into: 1) time savings, 2) savings of traveling cost and 3) reduction of exhaust gas. Time savings are itemized into persons and goods (freight carriages, passenger carriages, trucks, and buses). Savings in traveling costs is itemized into freight carriages, passenger carriages, trucks, and buses. Reduction of exhaust gas is itemized into trucks and buses. A total of 10 benefit items were analyzed. Therefore EIRR is a correct result. The high EIRR provides proof that satisfies the conditions for obtaining source of funds for construction from international organizations.

Economic and financial analysis and freight charge policy: Financial analysis regards freight revenue as the only item of benefit. Thus, while economic analysis is conducted upon accumulation of accurate data, in financial analysis, freight revenue is compared with 3 kinds of costs. Increase and decrease of construction costs does not affect FIRR very much, but increase and decrease of freight revenue have considerable effects. The validity of freight level is whether freight of DFC is within the benefits estimated in the economic analysis. As the result of comparison, freight revenue reaches more than the amount of benefit. This shows that the freight is invalid. The freight charges for this analysis are based on the list of charges in India. From the view point of economic analysis, railroad charges need to be within the benefits, from a standpoint of competition as well.

Rapid transport effects of DFC and Container Depots, ICD: As for the benefits of the DFC project, savings in operation and maintenance costs of trains is high, while weight of the time savings benefit of freight is low. Accordingly, we should pay more attention to on-time arrival, and inter-modal transport including improvement of container depots and ICDs at both ends of the DFC, rather than shorter time movement of goods. Movement of long distance freight is important for the increase of added value of freight, acquisition of foreign currency, and for macro effects. Beneficiaries of time savings are passengers rather than freight. From the mixed transport of freight and passengers, freight will be transferred to the DFC. Operating speed of passenger trains is not expected to increase, but the waiting time of passengers will be reduced with the increase of trains.

12.18 ECONOMIC IMPACT (MULTIPLIER) ANALYSIS

12.18.1 Introduction

The DFC Project will have a big impact on the socio-economy of India and the countryside in its surrounding. When the project starts, various activities such as the hiring of workers, procuring goods, buying external services, making contracts with construction companies commence. These investments are considered as initial final demand or direct impact. In real

economies, however, the direct demand will induce further demand or first direct impact. And output or production requirements occurring from the first indirect impact will induce further demand. It is like endless and inter-relational economic transactions. To make it simple, the linkage is illustrated as follows:

From (Investment) – (Direct Impact) – (Production) – (Income) – (Consumption) – (Production) to further economic linkage

In the process, employment, tax income and external trade will be also generated and intensified.

Moreover, the above-mentioned project effect can contribute to poverty reduction in a broad sense as indicated in the following points:

- The contribution to national economic growth increases employment and the income earning opportunity of the poor.
- The employment creation and the income earning opportunity of the poor living in areas previously without efficient transport links are facilitated by improving the traveling time described in the economic evaluation.
- Job opportunities for the poor are provided during construction period.

Intermodal Research Unit has measured the economic impact or multiplier effect by use of the Endogenous Household Consumption and import Input Output Model, or so-called the IO model. In this study, the economic impact was calculated and analyzed by using the model of Intermodal Research Unit's measurement. The conceptual flowchart of economic impact measurement based on IO model is as follows.

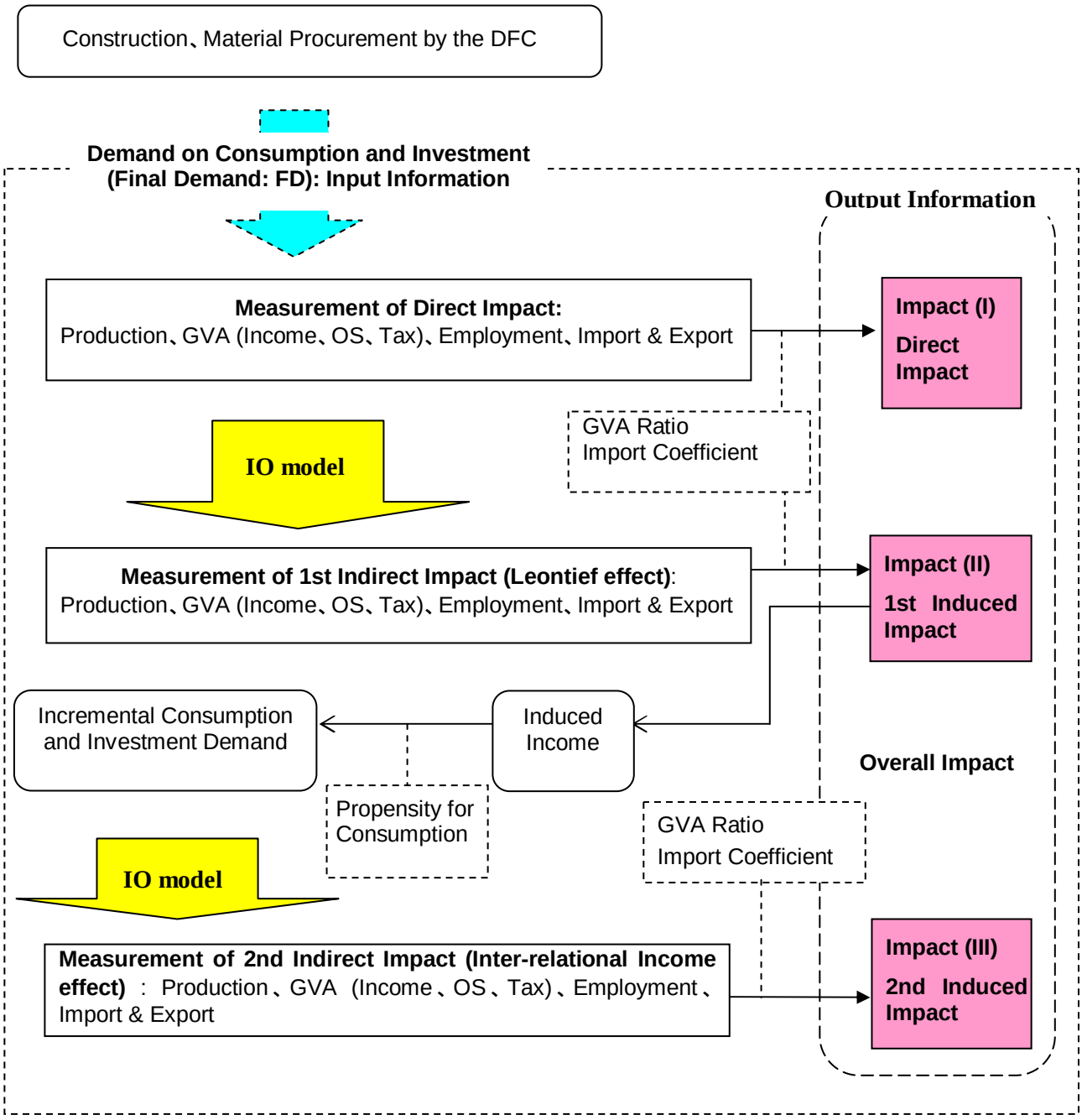


Figure 12-8 Concept of Overall Multiplier Effect

12.18.2 Methodology

The project cost was inputted into the IO model and the economic impact was measured. The model is calculated are as follows:

Induced Impact on Production : $\Delta \mathbf{X} = \Delta \mathbf{X}_1 + \Delta \mathbf{X}_2 = \hat{\mathbf{B}}\hat{\mathbf{K}}\left[\mathbf{I} - \hat{\mathbf{M}}\right]\Delta \mathbf{F}$

Induced Impact on GVA (Income, Tax, OS [Profit]) : $\Delta \mathbf{V} = \Delta \mathbf{V}_1 + \Delta \mathbf{V}_2 = \mathbf{v}\hat{\mathbf{B}}\hat{\mathbf{K}}\left[\mathbf{I} - \hat{\mathbf{M}}\right]\Delta \mathbf{F}$

Induced Impact on Employment : $\Delta \mathbf{L} = \Delta \mathbf{L}_1 + \Delta \mathbf{L}_2 = \mathbf{l}\hat{\mathbf{B}}\hat{\mathbf{K}}\left[\mathbf{I} - \hat{\mathbf{M}}\right]\Delta \mathbf{F}$

Induced Impact on Imports : $\Delta \mathbf{M} = \Delta \mathbf{M}_1 + \Delta \mathbf{M}_2 = \hat{\mathbf{M}}\hat{\mathbf{B}}\hat{\mathbf{K}}\left[\mathbf{I} - \hat{\mathbf{M}}\right]\Delta \mathbf{F}$

Induced Impact on Exports : $\Delta \mathbf{E} = \Delta \mathbf{E}_1 + \Delta \mathbf{E}_2 = \hat{\mathbf{E}}\hat{\mathbf{B}}\hat{\mathbf{K}}\left[\mathbf{I} - \hat{\mathbf{M}}\right]\Delta \mathbf{F}$

where

$\hat{\mathbf{B}} = \left[\mathbf{I} - (\mathbf{I} - \mathbf{M})\mathbf{A}\right]^{-1}$: Leontief Inverse Matrix (Macro Multiplier Matrix),

$\hat{\mathbf{K}} = \left[\mathbf{I} - (\mathbf{I} - \mathbf{M})\mathbf{CVB}\right]^{-1}$: Keynesian Inverse Matrix or Inter-relational Income Multiplier Matrix,

$\Delta \mathbf{F}$: Vector of Final Demand,

$\Delta \mathbf{X}_1$, $\Delta \mathbf{V}_1$, $\Delta \mathbf{L}_1$, $\Delta \mathbf{M}_1$, $\Delta \mathbf{E}_1$: Vectors of Induced Impact [Direct and 1st indirect spill over effect];

$\Delta \mathbf{X}_2$, $\Delta \mathbf{V}_2$, $\Delta \mathbf{L}_2$, $\Delta \mathbf{M}_2$, $\Delta \mathbf{E}_2$: Vectors of Induced Impact (2nd indirect induced impact),

$\hat{\mathbf{M}}$, $\hat{\mathbf{E}}$: Coefficient Matrix of Import and Export;

$\mathbf{C}$: Consumption Expenditure Ratio Matrix;

$\mathbf{v}$: GVA Ratio Matrix; and

$\mathbf{l}$: Labor Input Coefficient Matrix.

Measurement assumptions are made as shown below:

- Project cost: Rs. 348.7 Billion (local portion),
- Allocation Ratio of Investment by Industry: : Construction (Rs. 301.8 Billion) and Manufacturing (Rs. 46.9 Billion), respectively,
- DFC Construction Time: 8 Years,
- Average Consumption Propensity: 0.75,
- Share of import of the total investment: 30%

The economic impact was classified in consideration of the spread to the economic impact by the project as follows.

- Nationwide: Induced Impact on Production , GVA,
- Government: Induced Impact on Tax Revenue,
- Industry: Induced Impact on Profit (Operation Surplus),
- Household: Induced Impact on Income, Employment,
- International Trade: Import, Export

12.18.3 Economic Impact

Table 12-20 shows the calculation results.

Induced impact on production

The total output requirements induced by the DFC Project amount to Rs. 1,386 billion. The impact amount is bigger than the project investment by at least 4.0 times.

Induced impact on gross value added (GVA)

The total GVA requirements induced by the DFC Project amount to Rs. 700 billion. The impact amount is bigger than the project investment by 2.0 times.

Induced impact on tax revenue

This exercise estimates tax revenue from the domestic business sector starting from the DFC Project investment. The result indicates Rs. 22 billion or 6.3% of the DFC investment.

Induced impact on operating surplus

The DFC Project will create numerous business transactions and bring about reasonable operating surplus among contracted firms directly and indirectly. The total sum of the induced impact on operating surplus is estimated at Rs. 249 billion which accounts for 71.4% of the total DFC investment.

Induced impact on income and employment

It is part of the Project's spill over effect to the stakeholders. As a result, the induced impact on household income is estimated at Rs. 372 billion. Meanwhile, the employment opportunities created by the DFC Project amount to Rs. 1.1 million.

Induced impact on international trade

The effect on international trade & exports is Rs. 50 billion. This corresponds to 1.3% of Rs. 3,752 billion of 2004-05 export. On the other hand, the import is about Rs. 67 billion. This corresponds to 1.3 percent of Rs. 5,011 billion of 2004-05 import.

Impact on the poor

The induced impact on income and employment to the above-mentioned is going to reach the poor. The poor in this study area is estimated to be about 190 million people for 2004-05 years, according to the investigation of Planning Commission. These people are below the poverty level, who can expect further job opportunity and the increase of the income because of the increase of the convenience by shortening the travel time described in the economic valuation.

Table 12-20 Economic Impact of the DFC

(Unit: Billion Rps)

				Direct Inpact	1st Induced Impact	2nd Induced Impact	Total
Impact on Domestic Economy	Nation wide		Production	340.5	629.4	416.1	1,386.0
			GVA	152.6	298.5	248.6	699.7
	Economic Unit	Government	Tax	2.7	12.4	6.8	21.9
		Firms	Operating Surplus[OS]	37.7	108.4	102.7	248.8
		Household	Income	104.9	150.1	116.6	371.6
			Employment	0.25*	0.53*	0.32*	1.10*
Impat on Abroad	International Trade		Import	6.8	38.2	22.2	67.2
			Export	4.5	26.6	19.0	50.1

Note: * Millon persons

12.19 REGIONAL DEVELOPMENT EFFECTS

The effects gained by the DFC Project may be classified into two major categories: "direct effects" and "indirect effects". Direct effects are described in the economic evaluation. Indirect effects are induced by the direct effects. Most indirect effects can be represented as regional and national development effects.

The DFC Project has various far-reaching effects on a variety of individuals and economic sectors not only in areas where they are constructed, but also other parts of the wider region. It is important to promote regional development from the viewpoint of sustainable development where the balance of the country can be taken. The following effects can be indirectly expected by executing the DFC Project.

- Acceleration of Nationwide Development
- Promotion of Industry
- Promotion of Agriculture, Forestry and Fisheries
- Improvement in Living Conditions

Since many of these effects cannot be estimated in monetary terms, they are evaluated by means of comparing the transportation conditions in the existing railway network with those of the future railway network.

(1) Acceleration of Nationwide Development

The DFC Project will shorten distances between different areas in the study area in terms of traveling time. When the DFC Project is completed, the traveling time will be shortened by about 1/3 as shown in Figure 12-9. Through the improvement of transportation conditions such as less traveling time, the DFC Project will bring large opportunities for encouraging development of industry, agriculture and other socio-economic activities in the core cities as well as in their surrounding areas. These new conditions will provide jobs through industrial

development, reduce disparities in income, and produce a more balanced distribution of production.

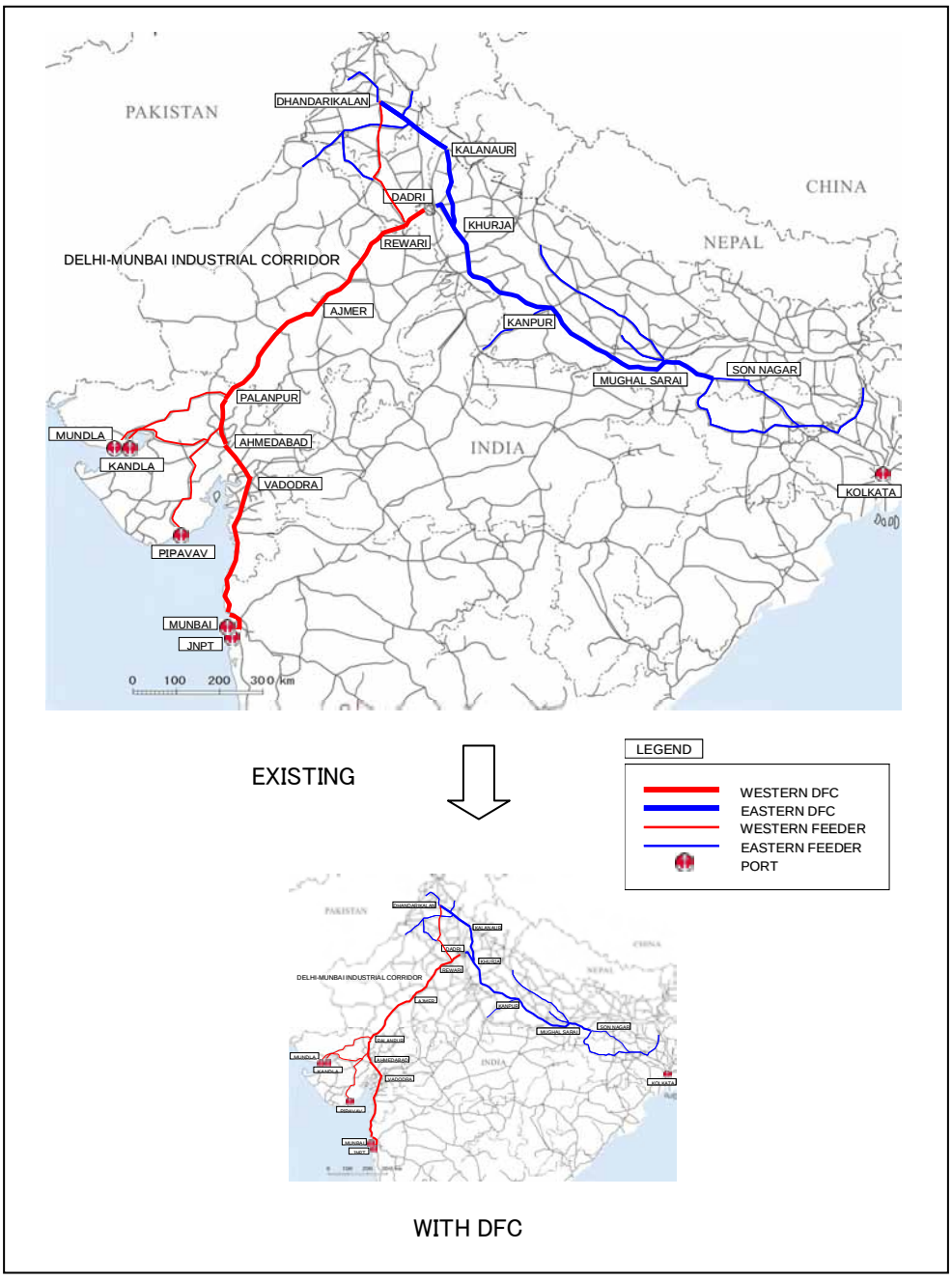


Figure 12-9 Betterment of Nationwide Development

Promotion of Industry

One of the most important impacts on regional development by the DFC Project is the location and relocation of manufacturing plants. Since the DFC Project will offer speedy and scheduled transport of raw materials and products, most factories and facilities of relevant businesses will be constructed along the DFC, especially in the vicinity of freight station.

The Government of India has further proposed consideration of establishing, promoting and facilitating the "Delhi-Mumbai Industrial Corridor (DMIC) along the alignment of Western DFC between Delhi and Mumbai. The joint initiative of the Governments of India and Japan, "Special Partnership Initiative (SEPI)", envisages cooperation in early realization of the DFC and assistance in promoting the DMIC with development of industrial estate and special economic regions with high physical and social infrastructure and facilitate investment from abroad.

Figure 12-10 shows the outline of the DMIC. The project influence area is extended up to 150 km on both sides of the alignment of the DFC. The project goals for the DMIC are double employment potential, triple industrial output and quadruple exports from seven investment regions and thirteen industrial areas.

On the other hand, the DFC Project has an important effect on promoting industries such as grain, fertilizer, limestone, cement, etc. on the northwest; and enhancing coal mines, steel plants, etc. on the southeast side in the Eastern DFC.

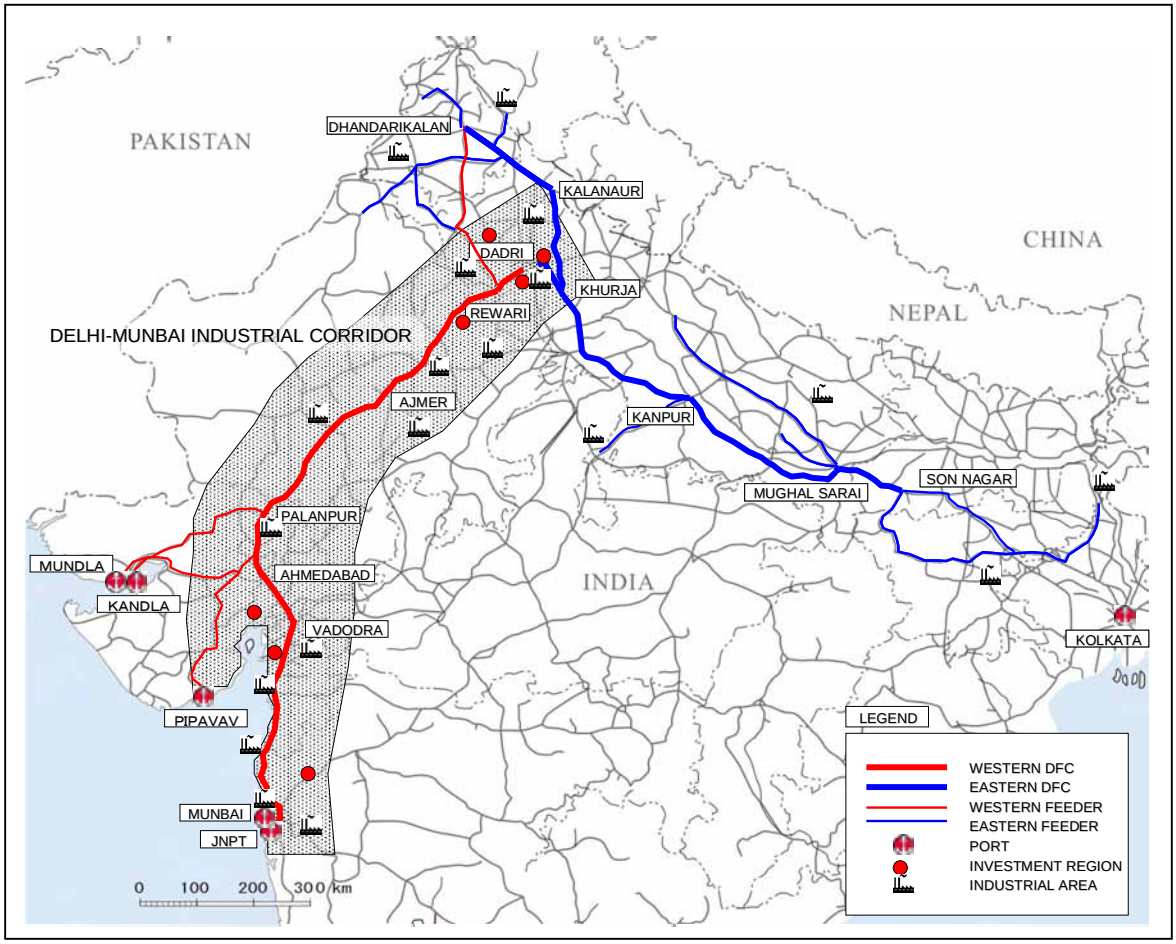


Figure 12-10 Promotion of Industry

Promotion of Agriculture, Forestry and Fisheries

The development of the DFC will cut down the time required for delivering products to the markets as well as to food processing plants. This will make it possible to grow and cultivate such products in other places. This will no doubt contribute substantially to promote a new agro-industry. Moreover, because the traveling time from the coastal area to the inland is shortened, more marine products can be expected to circulate. Therefore, it plays an important role in the promotion of the primary industry that is one of the important sectors in the country.

Improvement in Living Conditions

The improvement of transportation conditions with the DFC will greatly help people in local areas to utilize and gain access to social service facilities such as hospitals, schools, government offices, among others. Therefore, it plays a major role in improving people's living conditions and providing a stable life.

CHAPTER 13
STRATEGIC BUILDING BLOCKS IN BUSINESS PLAN FOR DFC

CHAPTER 13 STRATEGIC BUILDING BLOCKS IN BUSINESS PLAN FOR DFC

13.1 MEASURES FOR SOUND MANAGEMENT

13.1.1 Subjects for Business Plan

The management of the DFC proposed by the Government of India is a vertical separated model, because the owner of the railway infrastructure is DFCCIL and IR is the exclusive operator for DFC. But we should consider it as an integrated model by Indian Railway (IR), because more than 51% (actually 100%) of DFCCIL equity is held by IR, resulting that IR holds the corporate governance of DFCCIL.

The Task Force under the Central Government Committee on Infrastructure recommended an integrated model by the SPV with open access to the DFC lines by other operators besides the SPV. MOR has been improving its business performance in terms of productivity and profitability, resulting in posting of a net profit of Rs. 149.2billion in 2006-07, 6.3 times higher than that in 2001-02. This can be attributed to its business efforts in cooperation with World Bank and ADB. MOR has begun to create organization and management of DFC based on the integrated model concept by DFCCIL which was originally the rail track owner only.

Furthermore, free competition would be expected on the DFC rail based on the given right of non-discriminatory access by 15 authorized "Container (Bulk) train operators on IR networks".

The scheme wherein MOR collects fare charge from customers and distributes Track Access Charge (TAC) to DFCCIL remains. MOR has also showed confidence in the past 30-year track-record of accounting separation between Zonal Railways.

We should give it first priority that inefficiency in DFC operation, which would be the weak point of an integrated model, must be drastically improved by promoting current "IR's railway reform". (The objective)

It should be prioritized that making Track Access Charge formula, ample enough to cover not only initial capital expenditure and working capital expenditure but sound additional investments for future freight demand growth.

For this purpose, cash flow analysis of DFC Project and DFCCIL business operations, risk analysis of cash flow assumptions and planning on risk hedge are essential.

Main issues requiring considerations are as follows:

1) Increase Feasibility of Project
2) Separation of Accounting from Indian Railway Accounting
3) Organizational separation from existing Zonal Railways
4) Formulation of Track Access Charge (TAC)
5) Measures to make DFCCIL accounting sound
6) Timely completion of construction of DFC
7) Management action plans and target for DFCCIL

13.1.2 Increasing Feasibility of Project by Increasing Business Income of DFC and Setting up New Expenditure Norm for DFC Operations and Maintenance

(1) Increase of freight tonne-km by economic growth and restoring of market share of railway sector.

1) Increase of freight tonne-km by economic growth

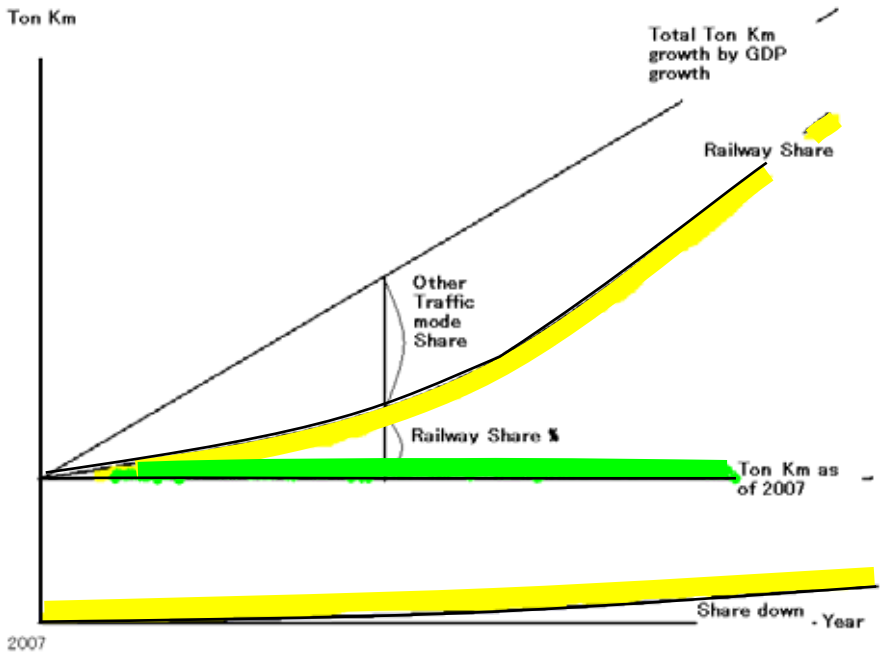
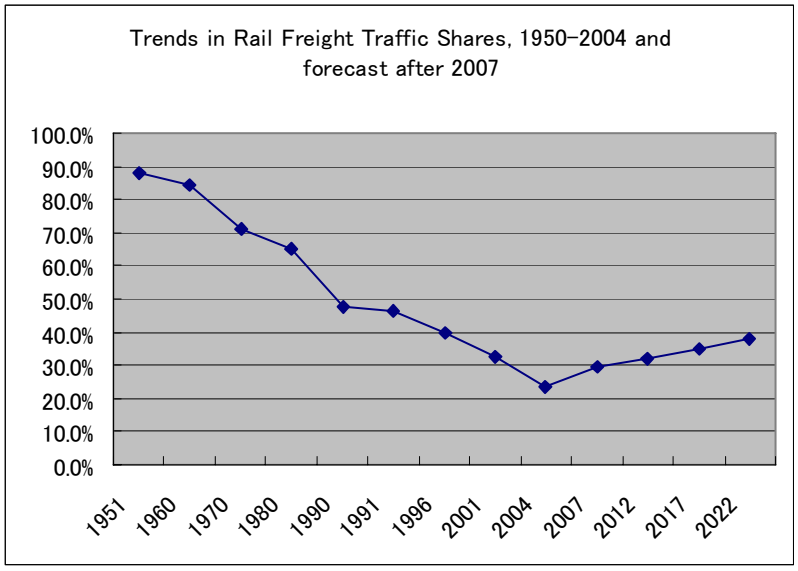


Figure 13-1 Economic Growth and the Railway Market Share

The Above figure shows the relationship between increase of total freight traffic demand by economic growth and IR's market share on the assumption that railway share recovers slowly from 2007. Area above the level line of tonne-km as of 2007 and below the railway share curve shows IR's incremental traffic demand. There will be also falling-off portion from IR's freight traffic shown as "Share down". Area sandwiched by yellow lines represents tonne-km IR can enjoy.

IR and DFCCIL should not be satisfied with the natural demand increase by national economic growth but set up the strategic target of stopping the trend of declining market share and promoting recovery of past IR's market share.

2) Restoring IR's market share



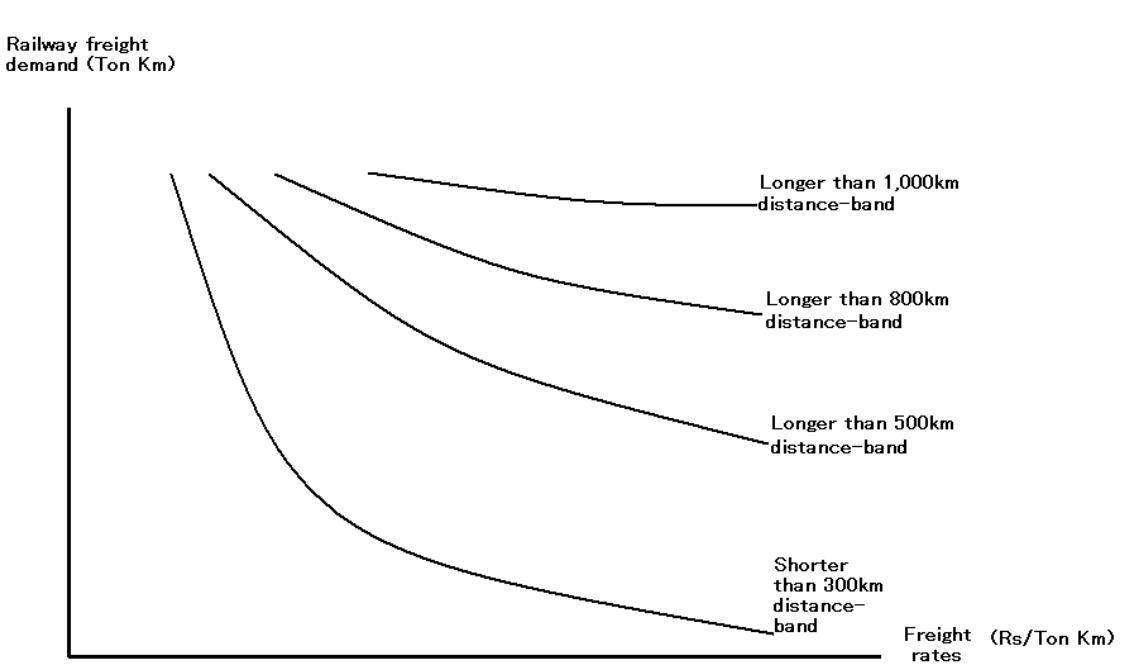
Source: Ministry of Railway, Planning Commission, RITES PETS2 final report
Data from 1951 to 2001sourced by Ministry of Railway and Planning Commission as IR total market share and data after 2004 represent the forecast for DFC market share by RITES

Figure 13-2 Past Trend and Forecast of IR's Freight Traffic Share

IR's share of freight traffic, amounting to 88% (44 billion ton-km) as of 1951, declined steadily to the level of 32% (312 billion ton-km) as of 2001, in proportion to the increase of total transport demand. RITES survey predicts that IR's market share will hit the bottom in 2004 at 23.7% and will grow gradually to the level of 37.7% in 2022 by 14%.

But this forecast could not be achieved without IR's management effort. Especially market share recovery from road transport in short-mid distance-bands, where IR's share has dropped rapidly, needs special management strategy and best sales effort because the recovery scenario is against the current trend of highway development and advance in motorization.

(2) Market share-up by distance-bands



Source: JICA study team

Figure 13-3 Rail Freight Demand Curve by Distance-Bands

As is shown in above figure, railway freight demand curve varies by distance-bands and by commodity classes. In other word, demand depends not only on freight tariff but on other factors like punctuality of arrival date of goods in longer distance-band or with/without pick-up and delivery services.

Accordingly IR has to develop innovative tactics to follow the user's preference other than freight tariff in the non tariff-sensitive distance-bands.

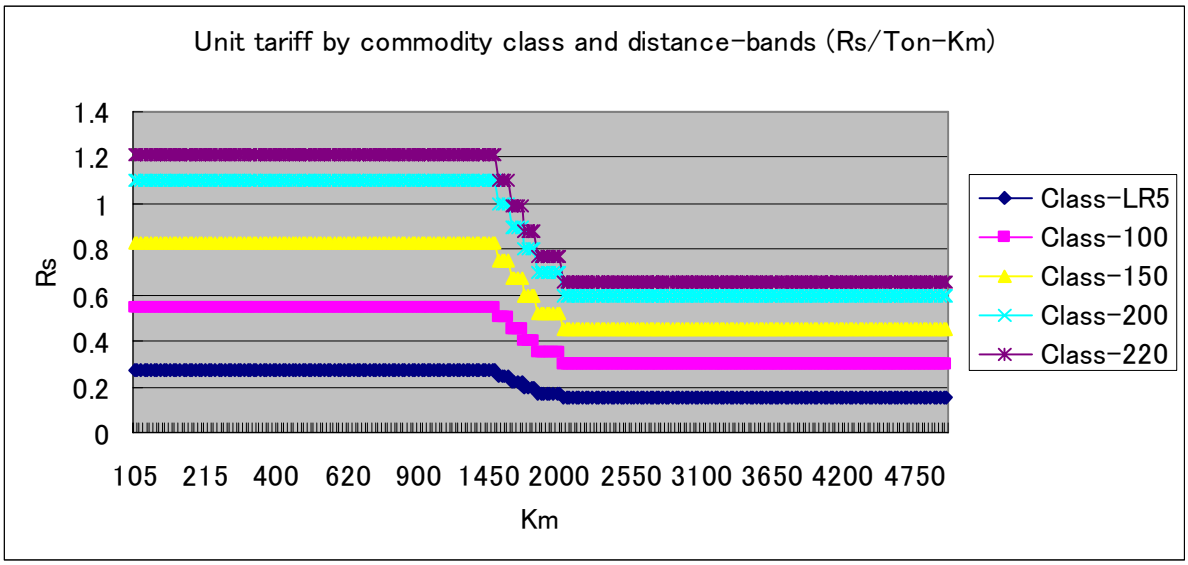
(3) Overview of DFC demand forecast

1) Major commodity of Eastern DFC is would be Coal both in 2013 and 2031 while Container transportation would be the overwhelming majority in Western DFC by 2031.

2) Coal transportation of both 700-1,000Km and 300-700Km distance bands will grow drastically from 2013 to 2031, resulting to increase from almost 0 to 5 billion tkm, and 2 billion tkm respectively. Container transportation of both 1,000-1,500 Km and 300-700 Km distance-bands will also sharply grow from 2013 to 2031, resulting in from 0 to 70 billion tkm, to 20 billion tkm respectively. Demand for distance-band of 700-1,000 Km will double to the level of 20 billion tkm.

3) Demand for both corridors is not well balanced.

(4) Optimum freight tariff by distance- bands



Source: Ministry of Railway
COMMODITY.....CLASS: SALT, FERTILIZERS...100, FOOD GRAINS...110, COAL、CEMENT, ORES…140, LPG…180, POL..220

Figure 13-4 Current Unit Tariff by Commodity Class and Distance

But nobody denies the importance of freight rates by distance bands to recover railway market share. IR takes commodity-oriented stiff unit freight rate in shorter than 1,500km distance-band as is shown in above figure. DFC management should take demand-creative tariff strategy than current freight rate/ton-km. Different tariff system can not work effectively in one organization. (Separate division just like Zonal Railways is needed for DFC operation in Indian Railway in order to make DFC operation and most efficient.)

Rail freight rate in tariff-sensitive mid distance-band because of strong competitors like truck transport should be determined subject to the effective competitor's freight charge including all other charges like Export/Import tariff between States, transit time cost and cost of service frequency on an assumption of the demand curve in Figure 13-3.

Average truck rate is Rs. 1.46/t-km but detailed data by directions and by distance-bands are unknown according to JICA Study Team. Former, Director LRDSS MoR, Dr. Nalin Singhal made generalized cost analysis between road and railway in "Rail-Road Competition in Freight Transportation" and analyzed that generalized cost consists of monetary cost, transit time cost, reliability cost and cost of service frequency. Shippers make mode choice decision not only by monetary cost but also by other factors. He established that while rail services have an advantage over road on a pure transport cost basis over medium to long distances, on a generalized cost basis however, road transport can have an advantage even over long distances.

Railways can maintain the monetary cost advantage over road transport if the railway system can improve transit time, reliability and service frequency or if target market is in the distance-band where shippers do not prefer non-monetary factors to monetary cost.

Railway also can take an additional extreme bargaining tariff tactic as is shown in the following figure in order to get over other disadvantages in the field of transit time cost and cost of service frequency. Risk analysis on the assumption is set out in 13.2.1-(7) "Financial Projection for DFC"

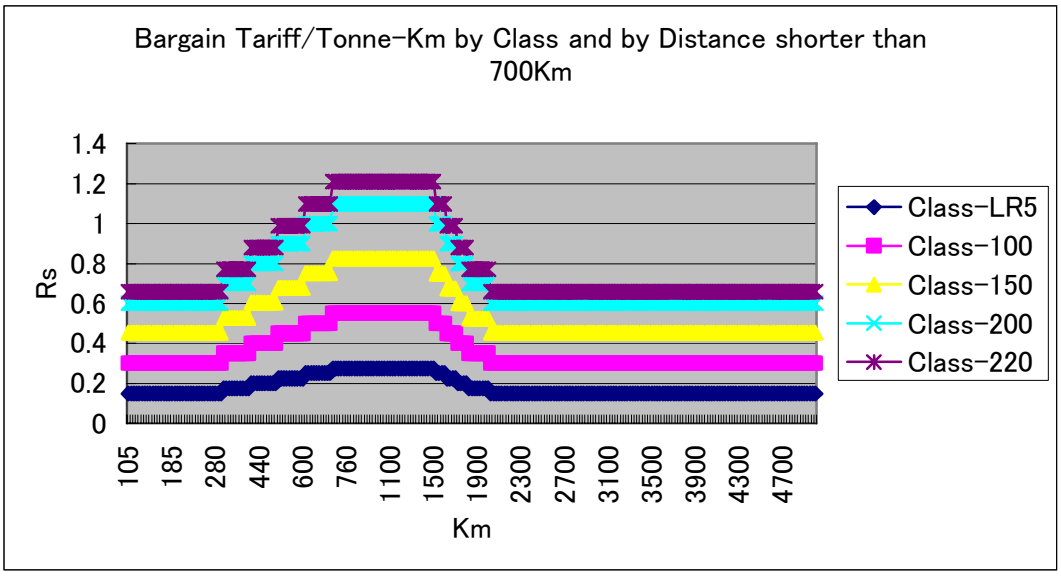
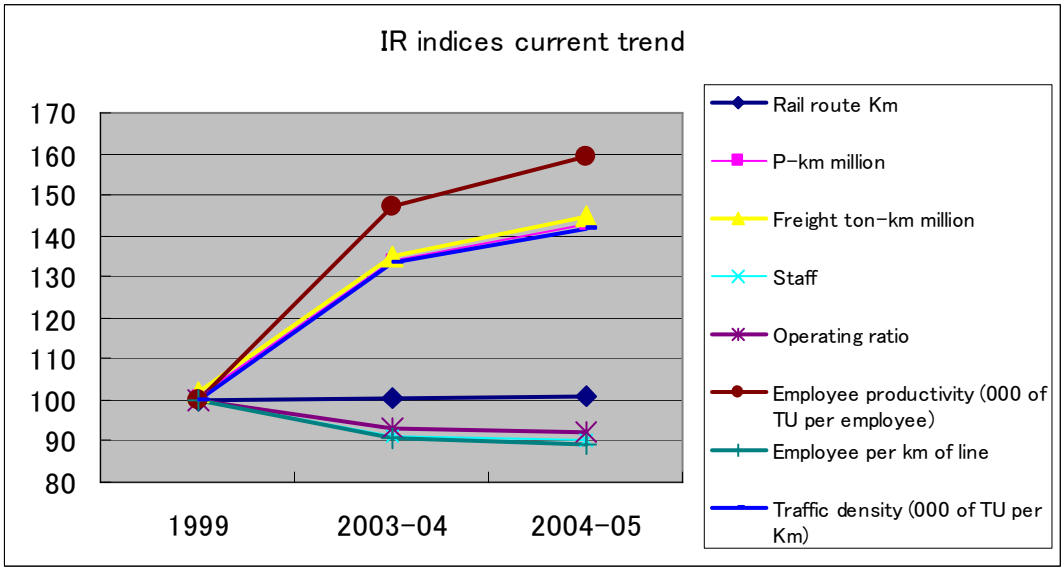


Figure 13-5 Bargain Tariff/Tonne-Km by Distance-bands shorter than 700Km

(5) Improvement of productivity indices and setting up new norms for expenditure in IR

Over the years IR increased TU (Transport Units (tkm + pkm)) by 40%, cut staff by 10%, improved operating ratio from 99% to 84% (2005-06), increased productivity of traffic by 45% and improved employee productivity and productivity of wagon as showed in following figure.



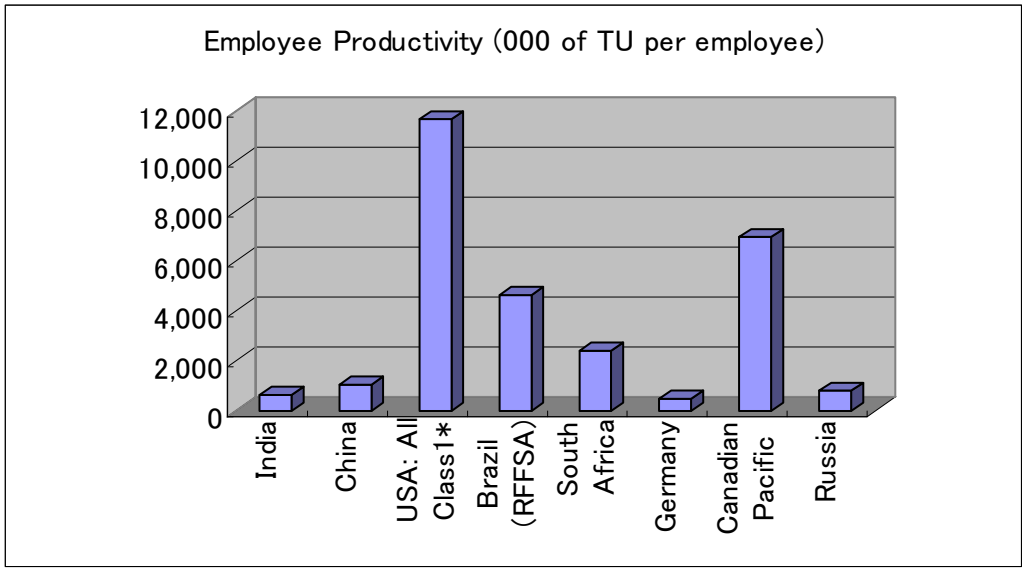
Source: Ministry of Railway、World Bank

Figure 13-6 Trend in productivity indices of IR

But IR has to improve employee productivity continuously because it is still far less than that of the standard of advanced countries as shown in Figure 13-7. Current passenger train operations in Eastern and Western Corridors have priority over freight train operation. Drastic improvement in employee productivity in DFC is likely, because freight train has no more operational limitation in DFC and has most advanced ground facilities.

Actually DFC should target the productivity level of Canada and USA, because DFC has not expensive passengers and will be better equipped by state of the art technology and services compared with USA and Canada. Assumptions regarding to expenses and demand forecast as shown in Table 13-5 and Figure 13-12 respectively prove the same level of productivity as Canada at Year-1 and that of USA at Year-20, exhibited in Figure 13-23

Productivity improvement in DFC hopefully expands firstly to the parallel route of Zonal Railways and then gradually to the railways in the same region.



Source: World Bank Railway data, IR Year Book (1998-99) and Transnet Annual Report 1999

Figure 13-7 Employee productivity

(6) Recommendable tactics

DFCCIL should elaborate on the tactics based on analysis of customer's needs. The following are some suggestions of tactics:

1) Railway freight rates by distance-bands and by commodities.
2) Introducing "Arrival date guarantee system" for long distance-bands customer.
3) Alliance with truck transport industry for providing pick-up and delivery services to mid/short-bands freight customers.
4) Development of Rail-side Warehouse and Logistic Parks.
5) Preferential treatment by core customers/new customers.

13.1.3 How to Separate DFC Accounting from Total IR Accounting

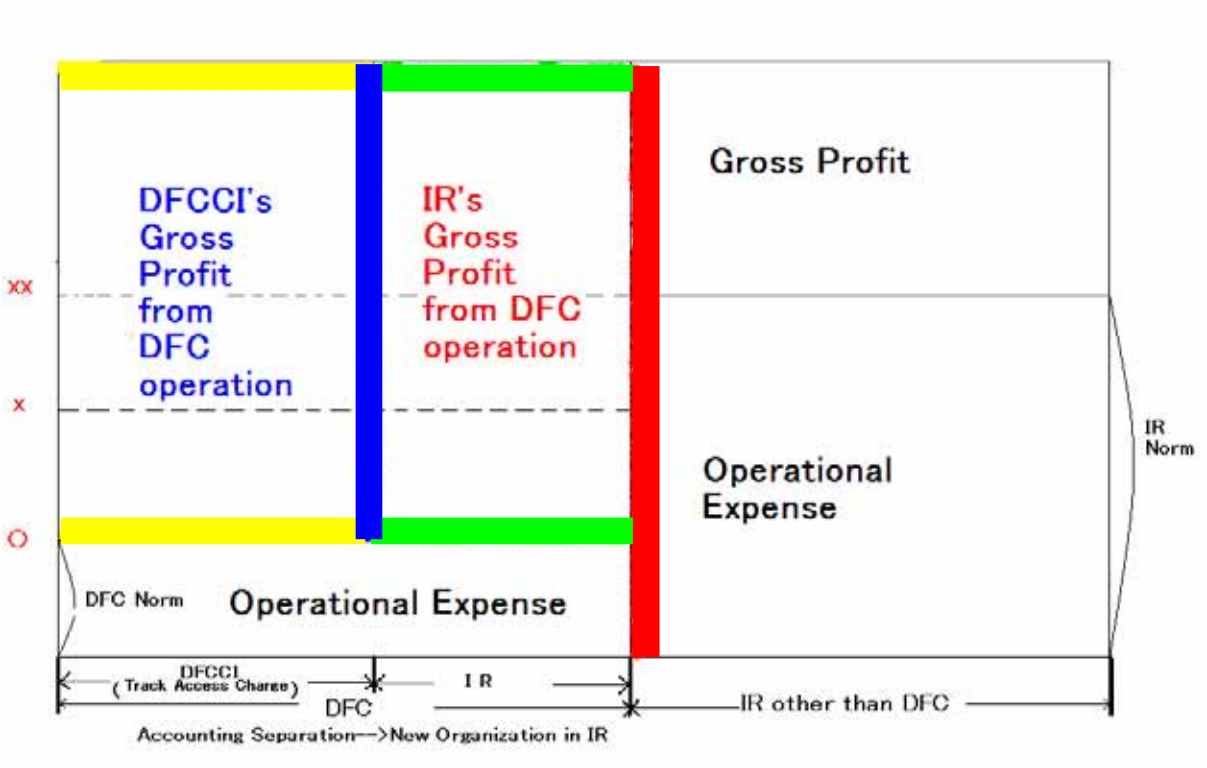
Next figure shows structure of revenue and operational expenditure of both Indian Railway (IR) and DFCCIL.

The figure clearly tells us that accounting separation is absolutely important for DFC/DFCCIL management, because without accounting separation system, we can not recognize DFC income and DFCCIL income.

Accordingly, accounting separation of DFC revenue and expenditure from total IR is indispensable. Accounting separation of DFC makes it possible for the first time that DFC

employees do their best to ensure reduction of their operating costs to the level marked by the circle (○). It is neither the level of the IR Norms (**X**), nor the average level of the DFC Norms and the IR Norms (**XX**). Operating ratio in recent IR posted around 80% but following Cash Flow Projections estimated about 31% of operating ratio in all DFC and about 30% in Western Corridor at the highest. as is shown in Figure 13-24.

Then, we can divide DFC gross profit into DFCCIL and IR by using Track Access Charge formula.



Source: JICA study team

Figure 13-8 Overview of the accounting separation

(1) How to separate DFC income

Total income generated by DFC operation at first flows into IR Zonal Railway account because the shipper is the customer of the Zonal Railways. This raises the issue how to get the DFC income out of the Zonal Railway income. One billing system from start to destination is important for customer's convenience. The accounting system is needed to split the bill into DFC and other IR in terms of tonne-km. Splitting common expenditure into DFC and other IR is also essential.

The accounting computer system must be designed not only for daily booking but for strategic management purposes. All data from business, operation and accounting are assembled into one management information system for analyzing the feature of customers and operating routes. The system could strongly help the restoration of IR's market share to planned levels. Followings are simplified models of apportionment mechanism currently employed among Zonal Railways which could make the DFC apportionment possible with registration of DFC Railway into the system.

1) Relations of customers and branch with different railways:

Customer	A	A	B
Branch	a	b	–
IR (Zonal Railways)	X	Z	**DFC**

2) Payment and receivers of freight fare (Rs)

	Aa	Ab	B
X railway	130		
DFC Railway			40
Z railway		70	
IR total	130	70	40

3) Transportation records

	50Km	20Km	30Km
	X railway	**DFC Railway**	Z railway
Transaction-1	→	→	→
	50Km	20Km	30Km
Transaction-2		←	←
		20Km	30Km
Transaction-3		→	→
		20Km	10Km

4) Apportionment between Zonal Railways (Rs)

	X	**DFC**	Z
Original receipt from customer	130	40	70
Terminal &transhipment charges	(30)	(10)	(20)
X railway	▲ 50	△ 20	△ 30
DFC Railway		▲ 10	△ 10
Z railway		△ 20	▲ 20
OFFSET result	▲ 50	△ 30	△ 20
After OFFSET	△ 80	△ 70	△ 90

5) Customer Management

More than half of DFC Railway revenue comes from customer-A, which is the customer of X Railway as is shown in the table below. It is worthwhile for DFCCIL to solicit customer-Aa and Ab with the help of X Railway.

	B	Aa	Ab	A total
X railway		△ 80		80
DFC Railway	△ 30	△ 20	△ 20	40
Z railway	△ 10	△ 30	△ 50	80
IR total	40	130	70	200

(2) How to separate DFCCIL income

Aforementioned accounting separation requires the accurate management information system of DFC, which would then enable to make DFCCIL income appropriate to recover the huge investment with continuing investments for further growth of demand.

Track Access Charge (TAC) is the major income source for DFCCIL from DFC operation. Formulation of TAC is set out in 13.1.5 in detail but following two points are important for formulating the TAC:

1) The TAC must be increased as DFC income increase. This mechanism is very important for the management of DFCCIL to be always ready for additional investments for the future demand growth.
2) The TAC must at least cover following expenditure:
   - Maintenance personnel cost
   - Facility maintenance cost
   - Depreciation cost
   - Debt repayment and Interest payment
   - Additional Capital Expenditure
   - Dividend payment to equity holders

13.1.4 Organizational separation from existing Zonal Railways for innovative business development of DFC

Originally it was stipulated that DFCCIL takes role of construction and maintenance and IR's role is business, operation and accounting in DFC project. This function sharing made the DFC system complicated. Simplifying its interface with customers is very important for customer's convenience. This is the first reason why the organization handling DFC in all IR should be one. From business point of view customer services in DFC by distance-bands and commodity types are essential as is already mentioned above. This style of business requires integrated and exclusive organizational services to customers over Zonal Railways. From operational and rolling stock point of view one organization (DFC Railway) should handle total DFC line because of the dedicated corridor. Lastly it is clear that organization separation is essential for revenue apportionment.

New organization for DFC in IR should be at least the same level organization as current Zonal Railways considering the expected business volume, profit scale and investment magnitude. IR should give the new organization (DFC Railway) authority to set up other standard of tariff strategy, business rule of conduct, expenditure norm and the like.

MOR is veering towards the direction of making DFCCIL take on roles other than maintaining rolling stocks and drivers. This is proven by the recent public offering of Director positions for **Project Planning and Operations & Business Development**. DFCCIL has GMs not only for Design, Development and maintenance of DFC ground facilities but also for operation and business development.

DFC is an important but a portion of total IR rail network expanded nationwide. IR can select DFC or existing South line of Western DFC between JNPT and Delhi. Accordingly DFCCIL has to work along with other IR network very closely in order to accomplish good result in project planning, business development and sales with the advanced Customer Management Information System.

Nevertheless, setting up DFC Railway in IR is absolutely needed not only for operation and rolling stock purposes but also as the control tower of DFC business as follows: DFC Railway should be responsible for both integrated logistic management including feeder lines and authority to propose aforementioned strategic freight fare in the special distance-band of 300-700 km to Railway Board.

Current discussion on roles of IR and DFCCIL leads to the functional diagram shown in Figure 13-9.

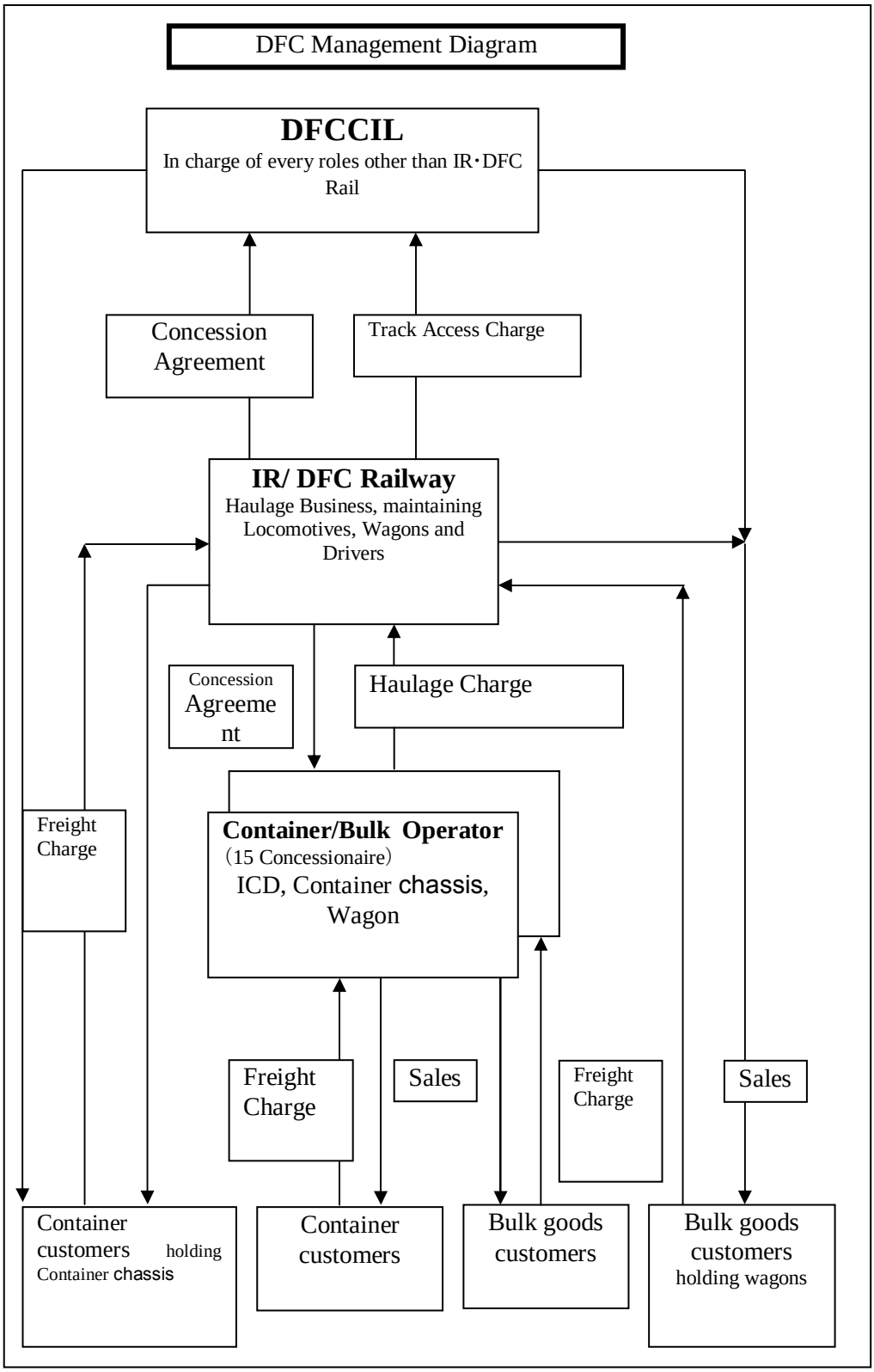


Figure 13-9 DFC Functional Diagram

13.1.5 How to formulate Track Access Charge (TAC)

(1) Categorizing the world TACs for the formulation

Reviewing the formulation of TAC of each country in the world (Europe, North America and Japan) we found the formulas depend upon the way of separation of railway of each country. Accordingly concepts and rules are different from country to country concluding that there is no one best way both theoretically and practically.

But following are trial attempt to extract underlying structure and key factors for formulations in TAC of many countries:

Structure: Railway Operators pay not only operating expenses of DFC Railway but its capital costs and investment return?

There is a business model at one end where no relationship between fare and compensation cost for railway development. On the other hand, there is another business model at the other end where rail operators pay not only operating expenses of DFC Railway but its capital costs and investment return. There is a business model between the two where rail operators pay only operating expenses (or part of operating expenses) as TAC in order to promote new entries of competitive operators or to release/mitigate too much burdens of capital expenditure and construction risks.

Table 13-1 Track Access Charge in other Countries

Countries	Charge Concept	Structure
Sweden	Social marginal cost concept (Air pollution cost, Traffic accident cost, Rail maintenance cost)	No relationship between fare and compensation cost for railway development
Germany	TAC should recover the depreciation cost of the Rail Track Corporation (DB-Netz)	Deferent TAC table is applied by kinds of rail (high speed or normal) and kinds of train (passenger or freight)
England	Rail Track Corporation recovers not only operating expenses but capital expenditure and capital returns. (Costs and returns model)	Deferent TAC table is applied by kinds of train (passenger or freight)
France	Modification by kinds of train and competitiveness should be added to basic cost calculation	TAC consists of base charge, Diagram charge and Distance charge
USA	Rail Track Corporation recovers short term avoidable costs(Operating expense) plus beneficiary's portion of improvement investment plus On-time incentives	
Canada	Rail Track Corporation recovers short term avoidable costs(Operating expense) plus Capital costs plus On-time incentives	
Japan（JR）	JR recovers short term avoidable costs(Operating expenses) plus beneficiary's portion of improvement investments	TAC consists of Track charge and Electric facilities charge
Japan（Narita Airport Express rail）	Rail Track Corporations (JR East and Keisei Railway) recover not only operating expenses but capital expenditure and capital returns. (Costs and returns model)	

Source: Mr. Masamichi Hori, "Separation of Infrastructure and Operation in the Railway System and Rail Access Charge"

(2) What are key factors for the formulation

Following 3 items are key factors to position a TAC formula between the two ends.

1) Project durability to pay TAC

Projects whose cash flow is not sufficient can only afford to support operating expenses of DFC Railway but not afford to support its capital costs and investment return.

In case of worse situation, operators cannot afford to pay full amount of operating expenses of DFC Railway.

2) Relationship between fare and compensation cost for railway development

TAC of England is few times higher than that of Sweden. This is because England operators have to pay full amounts for operation, capital cost and investment return as private company, while in Sweden railway development cost is owed by public sector resulting that TAC has not direct relation with railway capital cost.

3) Degree of Open Access

The higher the TAC is the less entry into the railway operation business. If DFC Railway lowers the TAC level in order to increase new entry, then it can not even pay operational cost.

(3) Trial application of the formulation to DFCCIL

Objective of separation in DFC project is to reduce capital expenditure for ground facilities and operational cost of DFCCIL which could not have realized in case of integration model by IR. Business model of DFC is quite different from Swedish, French and Germany business model.

Approval of new 15 entries into Container/bulk operator business could accelerate the competition. While competition does not depend on level of TAC but on haulage charge because IR is sole TAC-payer to DFCCIL.

From cash flow projection point of view, DFC project is durable to pay not only operating expenses of DFCCIL but its capital costs and investment return thanks to high freight rate level and low operating ratio of 30%.

Accordingly, application of UK business model, “Costs and returns model” is recommended..

Following conditions should be important in developing TAC system:

1) Achievement degree of Operating Ratio should be important part of TAC Equation.

2) Price escalation must be in the formula.

3) TAC should be revised yearly.

4) Rail Regulator’s approval is needed for its instalment and revision.

(4) Simulations for attaining optimum split ratio of profit after tax

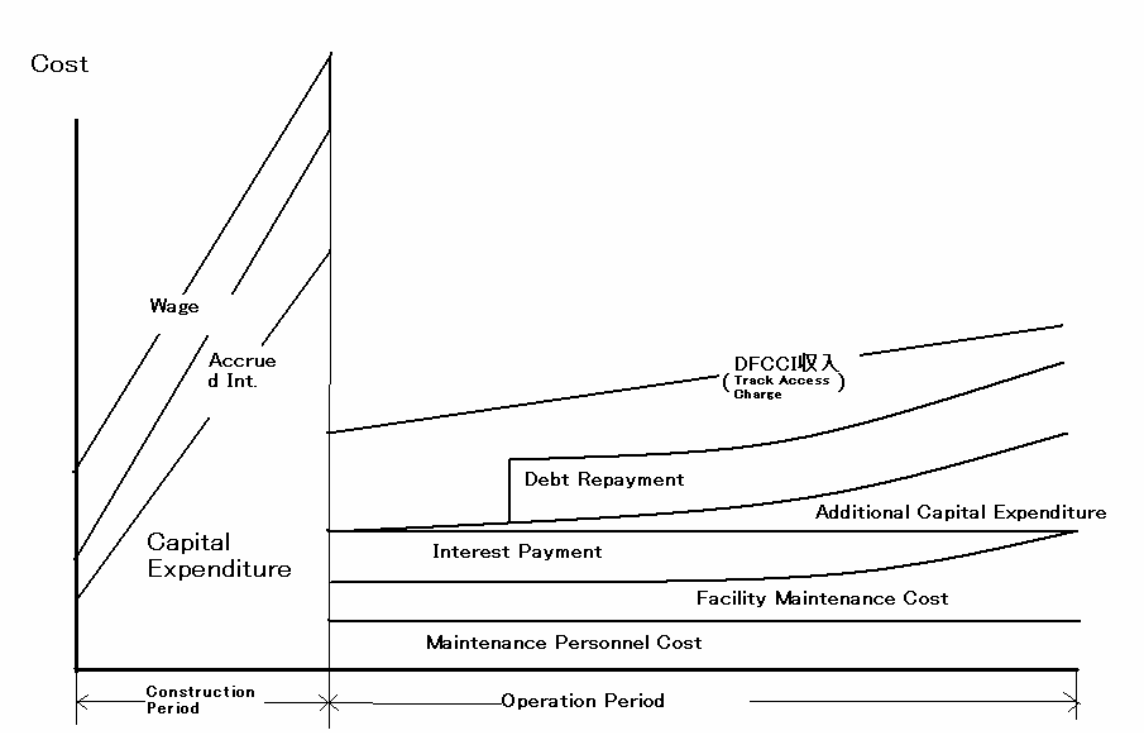
TAC is major income source for DFCCIL. It has to cover all expenditures including repayment of huge amount of debt and operating costs as well as cash surplus for future

investments. A simulation process for the financial analysis was then carried out in 13.2 based on this requirement.

Further analysis regarding Split Rate of profit after tax between MOR and DFCCIL is in 13.2.2.

13.1.6 How to make DFCCIL accounting sound

Following figure illustrate cost structure of DFCCIL both construction period and operation period.



Source: JICA Study Team

Figure 13-10 Cost structure of DFCCIL

Cash flow analysis of DFCCIL, risk analysis of risk assumptions and risk hedge planning will be scrutinized in detail in 13.2.1 but following items must be included:

1) Reduction of initial investment by introducing phasing method of investment, following after demand growth.
2) Balancing of Debt Equity Ratio (Considering dividend rate and interest rate)
3) Maximizing Soft Loan portion (Considering interest rates of Soft Loan and Commercial Loan)
4) Setting up the DFCCIL Norm of maintenance personnel cost.
5) Formulating income-slide TAC system for additional investments.

13.1.7 How to complete construction of DFCCIL as scheduled (No Completion Delay, No Cost Overrun)

As is already stated in *12.5.3.-(1)-4) in the Volume 2 Task0&1* report there are many risks which trigger the completion delay and cost overrun. The DFC project is really a gigantic

project and gigantic scale of construction India never experienced in terms of track length (2,800 km), advanced technology utilized, number of states concerned, number of construction institutions concerned, number of facilities and equipment purchased, number of labours required, number of inhabitants suffered, amounts of construction cost needed (Rs. 267.2 billion), difficulty of funding estimated. Instead of these difficulties this is a challenging project because shorter construction period is required than Konkan Railway (track length: 741 km, construction cost: Rs. 35.5 billion) which caused 2 years of completion delay (40%, original construction period: 5 years) and huge amount of cost overrun (3 times of original cost estimate).

Uncontrollable completion delay and cost overrun would happen in the project if detail risk analysis is not executed and if risk-hedge measures such as phasing of construction process, taking into consideration of long environmental approval process and strong expected resistance against land acquisition and adoption of construction management are not taken.

First of all it is urgently requested that DFCCIL set up specialist team for the construction management.

13.1.8 Management Action Plans and essential Target Figures for successful DFC

Table 13-2 summarizes aforementioned strategies, tactics and recommendations and adds action plans. Picking up practical tactics, target figures are selected for monitoring achievement of tactics.

IR has improved its productivities by gaining big amount of freight volume and by constant reduction of employees for several years and posted huge amount of unparalleled profit as a government owned business in the world. But it is essential for IR to restore the past high market share in the trunk industrial corridors in order to support expected high GDP growth and industrialization. DFC is most expected development project.

DFC has to go through following two reforms to satisfy the expectations and following two target figures are needed for monitoring the degree of the achievement.

(1) Railway Container market share: Western Corridor 35%

This is an index which monitors the development, enhancement and prevalence of “Customer Oriented Business Development” in DFCCIL and IR.

(2) Operating Ratio: DFC (35%), Western Corridor (30%)

This is an index which monitors achievement of high target of productivity of Canada and USA by DFC,

Table 13-2 PP & BD & F/A : Project planning & Business development & Finance & Accounting

	Strategies	Tactics	Recommendation	Action Plan	Target figures
1	**Growth of Tonne-Km**	**Restore of railway market share**	Consensus on "No strategy, no restoration of market share"	MOR,DFCCIL agree	**Railway Container market share : Western Corridor 35%**
			Rcommendation to set up business development & sales in DFCCIL	Director, Operation & Business development (Mr. Shkura), GM, Business development(Neeraj Kumar)	
			Data collection on shipper's shipping record by commodities and by OD	**Setting up Development project of Customer Management System**	
			Data collection on shipper's shipping plan by commodities and by OD		
			Data collection on shipper's strategic truck-transportation plan by commodities and by OD		
			Developing DB with shipper's track record, forecast and planning data and establishing tactics for restoring market share		
2	**Freight fare**	Distance-band Freight fare	Data collection on inter-modal shipping record by commodities and by OD by field survey	**Setting up Research Project of All Transportation Master plan alongside DMIC**	**Reduction of freight fare for 300-700Km distant-band: Figure13.5**
			Analysis on effective freight fare of all transportation modes		
3	**No-Freight fare**	Transit time cost/reliability cost	Door to door service	Multi-User/Multi-Commodity Logistic Park	**Longest days for transportation between major cities: FS8.3 Table8-11**
			Arrival date guarantee system	**System design**	
		Cost of service frequency	Pick-up & Delivery service	**Alliance with truck co.**	
4	**Improve railway productivity**	Energy cost	Promoting electrification in Western Corridor	**Introduction of Electric Locomotive in Western Corridor**	
		Personnel cost	Setting up DFC Norm.	**Ceiling of total number of DFCCIL employee**	**Year-1(8,700), Year-20(14,600)**
		Operating Ratio	Setting up DFC Norm.		**Operating Ratio : DFC(35%), Western Corridor(30%)**
5	**Organization**	Role sharing between MOR and DFCCIL	One window system for DFC customers and Co-working between DFC railways (IR) and DFCCIL in the field of PP & BD & F/A	**Make the new DFC Railways in MOR**	
			Design and Data collection of Integrated MIS system (PP & BD & F/A)	**Development of MIS (Shipper's forecast, Sales, Operation, Accounting,)**	
			Operation (One-man operation)	**Establish one-man operation system**	**Year-1(2,400), Year-20(9,000)**
			Construction (No Completion Delay, No Cost Overrun)	**Phasing of the project and Planning of cost of price escalation on the phased**	
		Profit sharing between MOR and DFCCIL	Track Access Charge (TAC)	**Adoption of Whole cost system like England**	**Split Rate of profit after tax between MOR(70%) and DFCCIL(30%)**
6	**Total Logistic Management**	DFC solution business	Which Organization in MOR group is responsible	**Setting up Control tower in MOR**	

13.2 CASH FLOW PROJECTION FOR DFC/ DFCCIL

13.2.1 Financial Projection for DFC

The following projections were arrived at using the Cash Flow Projection Model developed for simulations and risk analysis.

(1) Base Case

1) Assumption1: Capital Expenditure

Table 13-3 3 Phased Capital Expenditure

Project Start Year	2008	2008	2010	2008
Construction Completion Year	2013	2015	2015	2015
Stage	Phase Ⅰ-a	Phase Ⅰ-b	Phase Ⅱ	Total
Route Km	1,628 Km	905 Km	244 Km	2,777 Km
Civil & Track work Cost	114,066	66,455	25,991	206,512
Electrical Engineering Cost	19,063	8,538	2,866	30,467
Mechanical Engineering Cost	287	135	45	467
Signal & Telecom Engineering Cost	21,405	13,223	3,121	37,749
Sub Total-1 (Construction works):	**154,821**	**88,351**	**32,023**	**275,195**
Electric Locomotives	75,551	0	0	75,551
Sub Total-A (Construction costs):	**230,372**	**88,351**	**32,023**	**350,746**
Engineering Service Cost	4,769	3,473	609	8,851
Price Escalation	11,683	4,176	1,577	17,436
Contingency	21,835	7,805	2,947	32,587
Sub Total-B:	**38,287**	**15,454**	**5,133**	**58,874**
Land acquisition & compensation Cost	31,482	12,830	7,822	52,134
General Administration Cost	10,829	5,407	1,596	17,832
Taxes for Foreign Consultant	1,872	1,348	340	3,560
Accrued Interest during construction	10,820	4,268	1,623	16,711
Sub Total-C:	**55,003**	**23,853**	**11,381**	**90,237**
Grand Total:	**323,662**	**127,658**	**48,537**	**499,857**

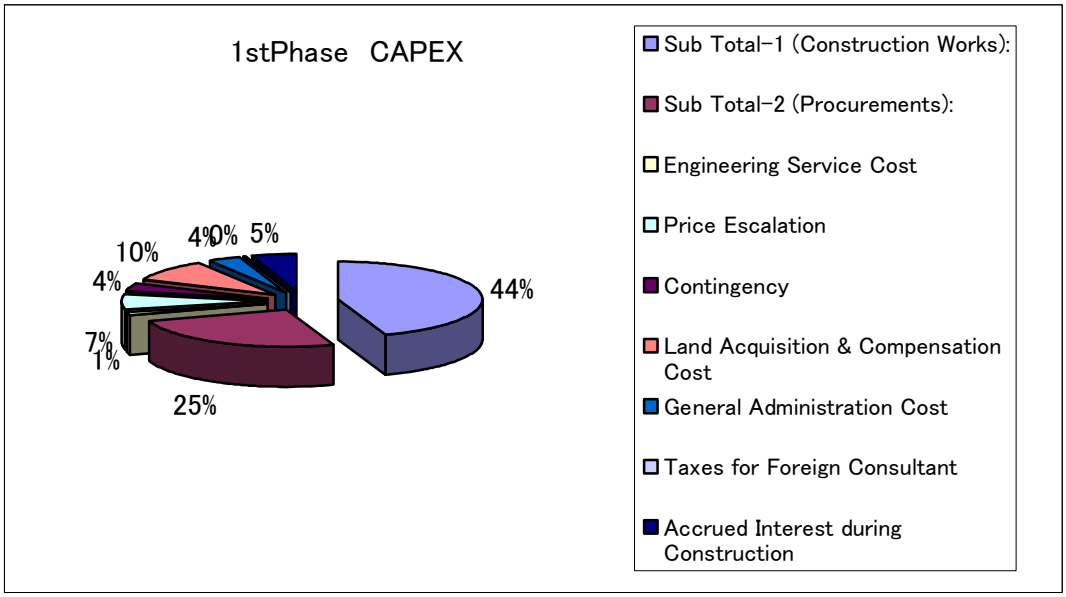


Figure 13-11 1st Phase Capital Expenditure

2) Assumption2: Traffic Demand forecast (Unit: million tonne-Km)

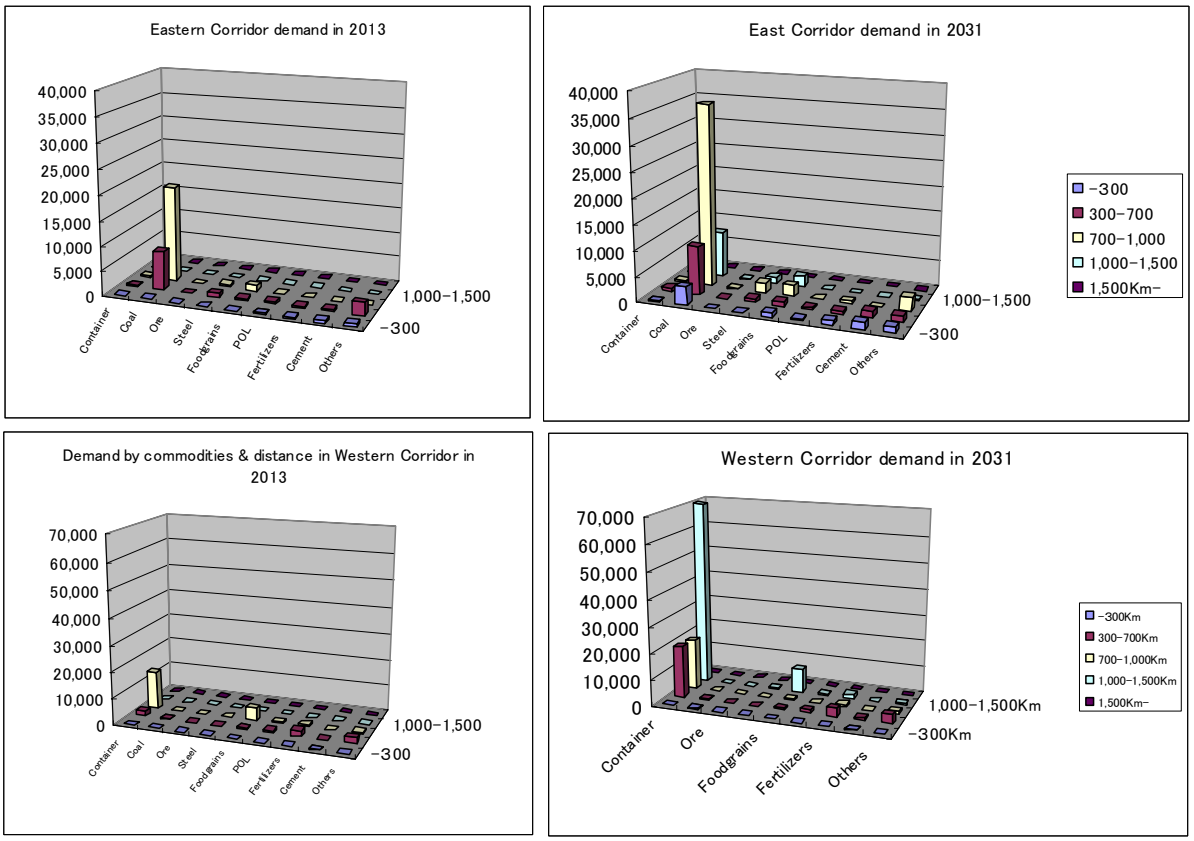


Figure 13-12 Traffic Demand Structure of both Corridors (2013, 2031)

3) Assumption 3: Freight Fare

Table 13-4 Freight Fare by Commodities and by distant-bands

by Commodities		By Distant-bands				
Commodities	Unit	-300Km	300-700Km	700-1,000Km	1,000-1,500Km	1,500Km-
Container	Rs/TEU・Km	10.070	8.264	7.946	7.8	7.478
Coal	Rs/Tonne・Km	1.035	0.850	0.817	0.802	0.769
Ore	Rs/Tonne・Km	1.035	0.850	0.817	0.802	0.769
Steel	Rs/Tonne・Km	1.035	0.850	0.817	0.802	0.769
Food grains	Rs/Tonne・Km	0.813	0.668	0.642	0.63	0.604
POL	Rs/Tonne・Km	1.627	1.335	1.284	1.26	1.208
Fertilizers	Rs/Tonne・Km	0.739	0.607	0.583	0.573	0.549
Cement	Rs/Tonne・Km	1.035	0.850	0.817	0.802	0.769
Others	Rs/Tonne・Km	1.035	0.850	0.817	0.802	0.769
Average	Rs/Tonen・Km	1.044	0.857	0.824	0.809	0.776

4) Assumption 4: Operating Expense

Table 13-5 Unit Costs of Operating Expense

	Unit cost		Variables	Comments
Personnel cost	Overhead	0.52	Route-Km	4fold of JR track record
	Station (Small)	10.5	Number of stations	Station master:1, Signal:1, Others:1
	Station (Big)	35.0	Number of stations	3.5 shift, each 10 staff
	Driver	0.01	Train-Km/day	Apply JR track record
	Facilities	2.60	Route-Km	Apply twofold of track record of Konkan Railway (double track)
	Electric	1.70	Route-Km	Apply JR track record
	Rolling stock	0.0098	Train-Km/day	Apply JR track record
	Unit wage	158,419	Number of employee	Apply IR track record
Material cost	Overhead cost	258,633.6	Route-Km	Apply Konkan Railway track record
	Station	4,644,000	Number of stations	Apply 80% of IR track record
	Driver	2.1	Train-Km	Apply 80% of IR track record
	Fuel (EL)	94.85	Train-Km	Apply IR track record
	Facilities	11.52	Train-Km	Apply 80% of IR track record
	electric	14.16	Train-Km	Apply 80% of IR track record
	Rolling stock	38.32	Train-Km	Apply 80% of IR track record

5) Assumption 5: Train operation and station

Table 13-6 Business-Km Train-Km, Number of stations

		2013	2018	2023	2028	2031
Route-Km	East	697	697	1190	1190	1190
	West	928	1487	1487	1487	1487
Train-Km (million)	East	19.184	24.057	40.741	42.790	43.852
	West	25.248	61.132	85.245	108.404	122.796
Number of small station	East	14	14	52	52	52
	West	22	32	32	32	32
Number of big station	East	8	8	14	14	14
	West	6	12	12	12	12

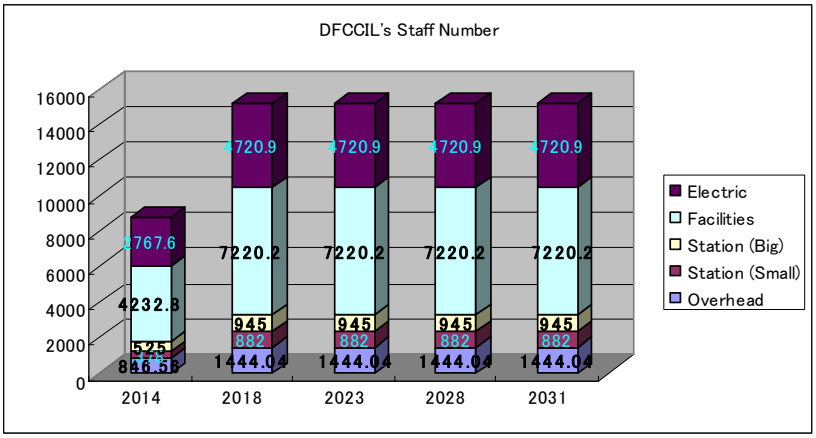


Figure 13-13 Number of DFCCIL's Staff

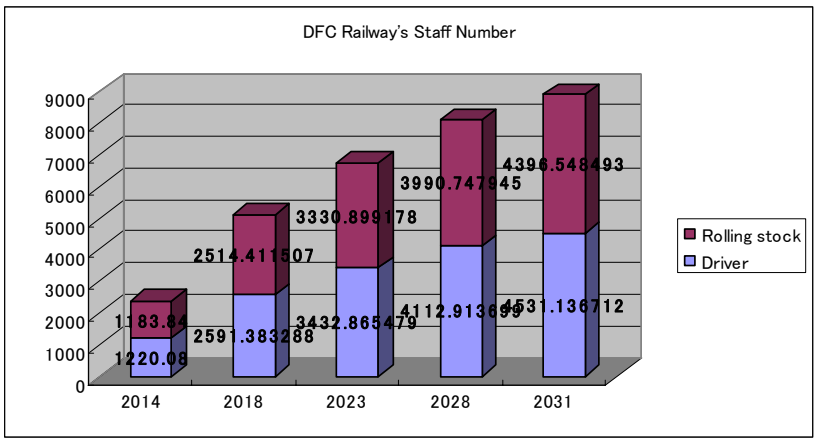


Figure 13-14 Number of DFC Railway's Staff

6) Assumption 6: Financing

a) Financing percentage

- Equity 1/3 of Total finance
- Yen Loan Yen 500billion
- Other Soft Loan 50% of remnant after Equity and Yen Loan
- Commercial Loan 50% of remnant after Equity and Yen Loan

b) Terms and Conditions

- Equity Dividend: 7.0% p.a.
- Commercial Loan 15 years (2 years grace) Interest rate 12%p.a. Soft Loan

	JBIC STEP	ADB	World Bank
Finance amount	Yen 200billion	50% of remnant after Equity and Yen Loan	
Term year (Grace year)	40(10)	30(5)	30(5)
Interest rate	0.40%	6months-LIBOR+0.75%	6months-LIBOR+0.75%

7) Other Assumptions:

a) TAC (Track Access Charge) revenue of DFCCIL from MOR

- DFCCIL receives Expenditure reimbursement (Operation cost, Depreciation, Interest payment, Tax) plus 30% of Profit after tax as TAC.

b) Tax

- Based on domestic corporate tax rate (35%) and added tax (5%) of Income Tax Act 1964. Assume 50% tax exemption for DFCCIL portion upon the suggestion of MOR, taking account other similar projects. MOR portion is not taxable.

c) Depreciation

- Apply SLM (Straight Line Method) rate of depreciation, The Companies Act, 1988 Schedule XIV

d) Capitalize interest payment during Phase I-a construction period (2008-2012).

- Assume interest payment from revenue after operation (2014).

e) Order of disbursement is as follows according to commitment amount:

1. Pro rata disbursement of Equity from MOR and Yen Loan
2. Other Donor Loans
3. Commercial Loan

8) Summary list of the Base-case projection

Table 13-7 Summary of the Projections

	DSCR	ROE	FIRR
Whole DFC project	4.5	47.1%	10.8%
DFCCIL（TAC revenue）	1.8	14.1%	2.8%

Projection results showing ROE of 47.1% and **D**ebt **S**ervice **C**overage **R**atio (DSCR) of 4.5 prove that the whole DFC is an excellent project. The computed FIRR of 10.8% is also high taking into account of the amount of price escalation for 8 years.

9) Projection result-1: Profit & Loss (Unit: Rs. Million)

Profit after tax is posted from Year One. Depreciation and Interest payment begins to decrease about Year-17 resulting to an accumulation of retained earning after that. Average Operating Ratio of less than 30% makes this possible. The reasons for low Operating Ratio are:

a) Three-folds of freight rate compared with other countries

b) Low operating costs assumed as shown in Table 13-6.

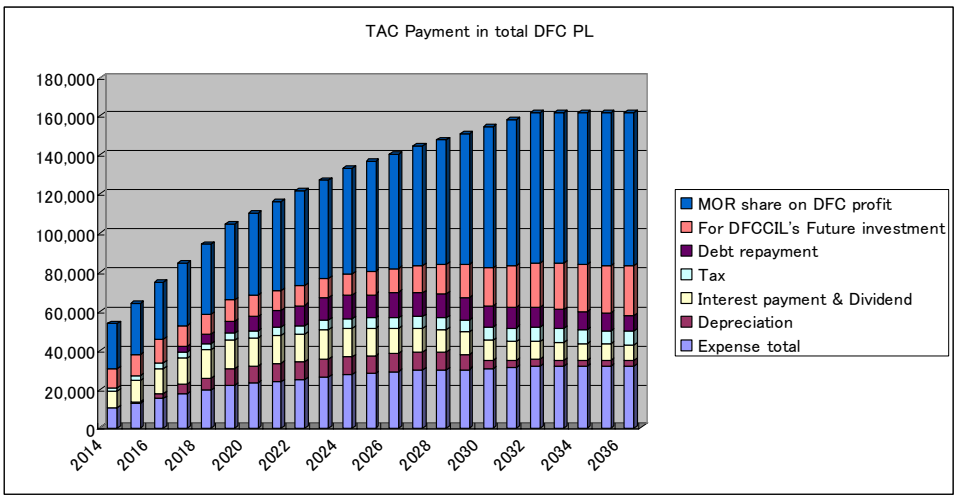


Figure 13-15 DFC Profit & Loss Structure

10) Projection result-2: Debt Service Coverage (Unit: Rs. Million)

Average Debt Service Coverage Ratio (DSCR) of DFCCIL results in 1.8 which shows sufficient repayment ability of debt and interest. In terms of yearly DSCR of DFCCIL, the worst is 1.5 and the best is 2.5 between 2014 and 2036.

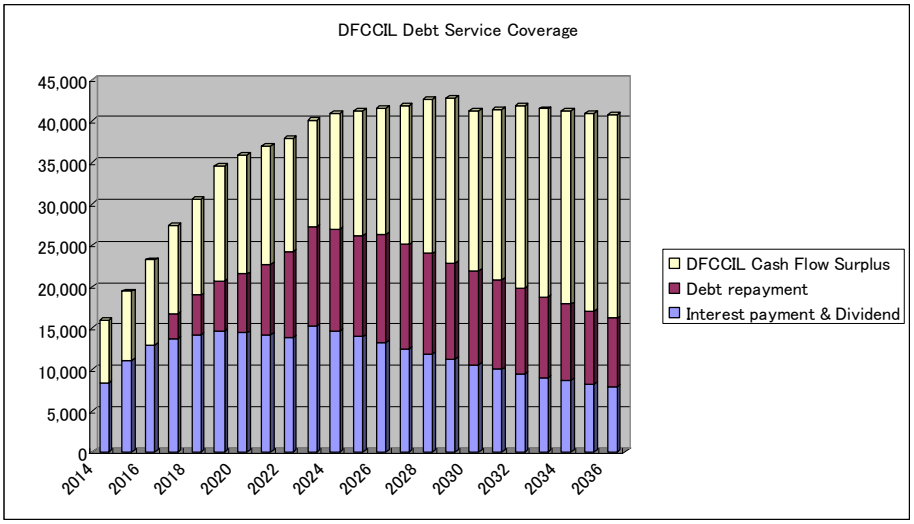


Figure 13-16 DSC Structure of DFCCIL

11) Projection result-3: Equity & Loan Balance of DFCCIL

Equity from MOR begins to be disbursed from 2008. MOR equity and Yen Loan are disbursed on pro rata from 2009. Other Donor loans will be disbursed 2013 and 2014. Commercial loans will be disbursed after 2015. Grace period of each loans are 10years, 5years and 2 years respectively.

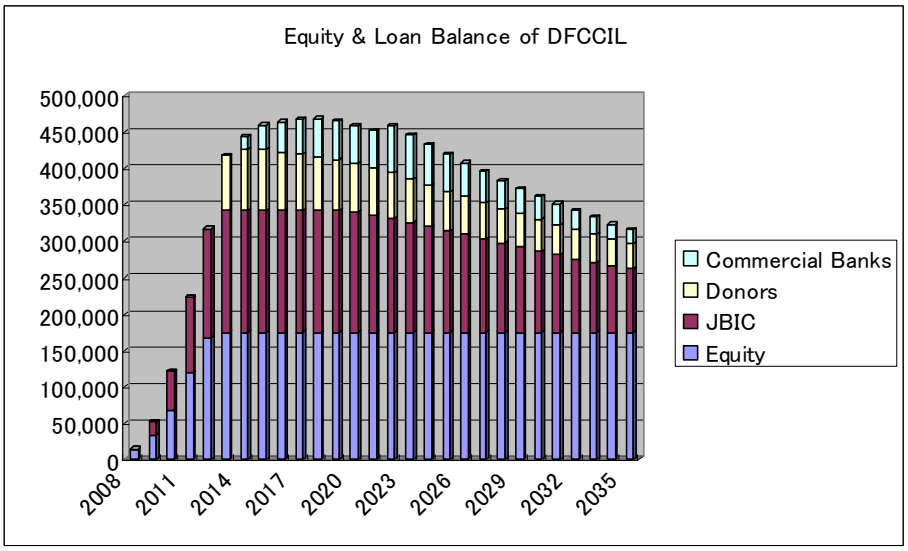


Figure 13-17 Equity & Loan Balance of DFCCIL

12) Projection result-4: Dividend & Interest Payment

Interest-payment-burden of JBIC is extremely light even compared with mandated dividend payment to MOF as to government contribution to IR, by comparison between loan balance in Figure 13-17 and interest payment amount in Figure 13-1.

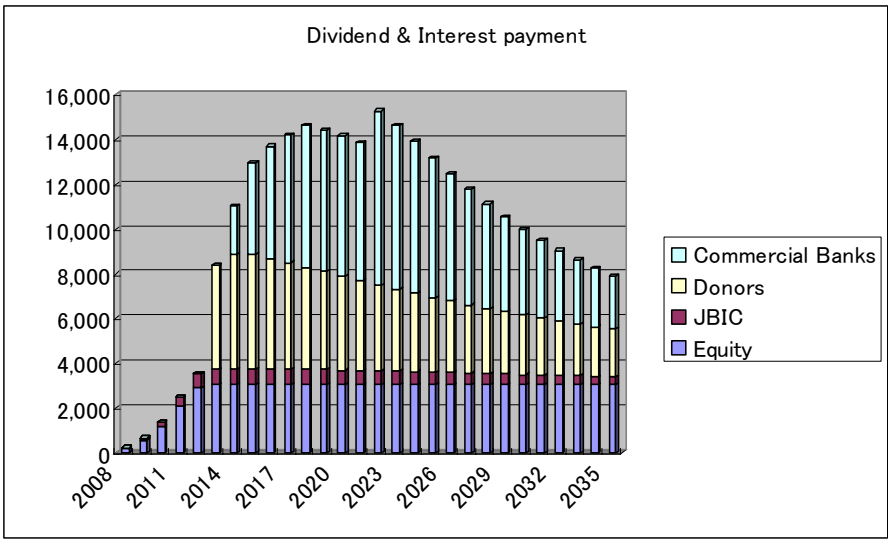


Figure 13-18 Dividend &Interest Payment

13)Projection result-5：TAC simulation (Unit: Rs. Million)

If DFCCIL receives Expenditure Reimbursement (Operation cost, Depreciation, Interest payment, Tax) plus 30% of Profit after tax as TAC, DFCCIL can repay debt and accumulate retained earning for future investment as shown as red in Figure 13-19 The retained earning of DFCCIL seems to be essential and appropriate for additional investments in the future in order to maintain competitiveness and customer satisfaction.

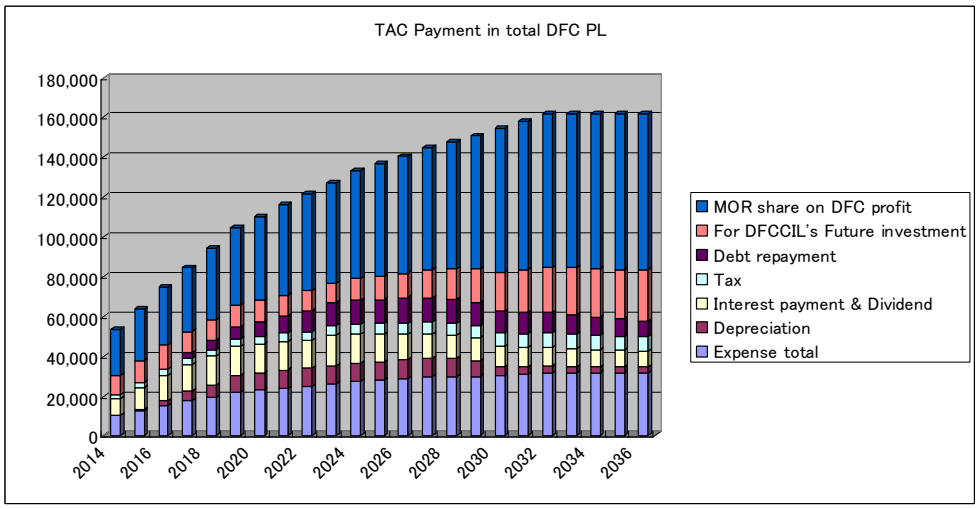


Figure 13-19 TAC Simulation

14) Projection result-6：Retained earnings

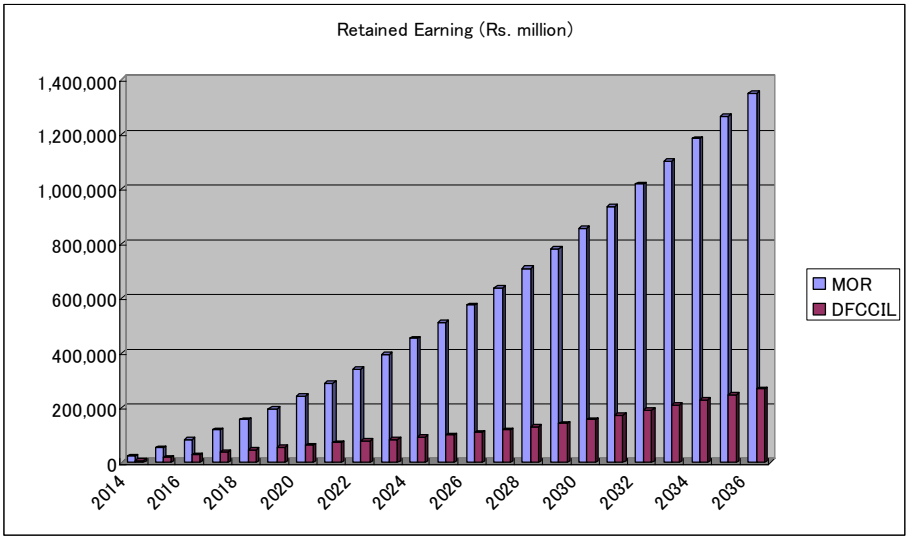


Figure 13-20 Retained earnings

15) Projection result-7：Balance Sheet (B/S) of DFCCIL (Asset)

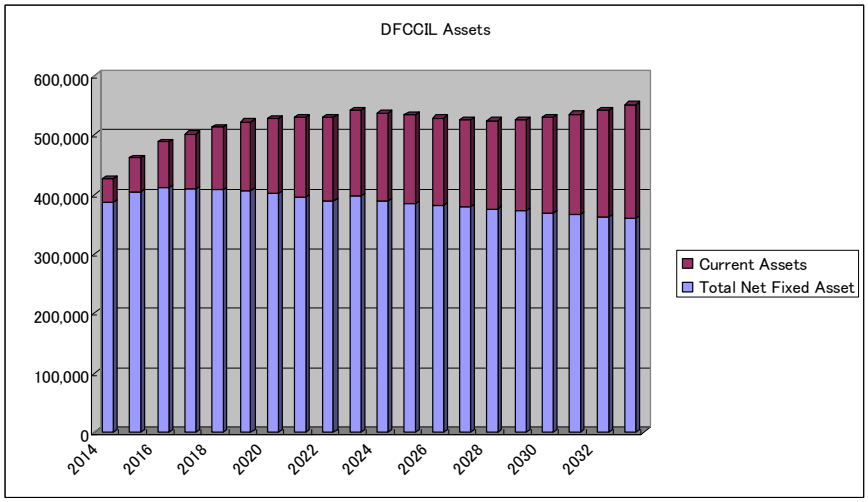


Figure 13-21 Balance Sheet (B/S) of DFCCIL (Asset)

16) Projection result-8：B/S of DFCCIL (Capital & Liability)

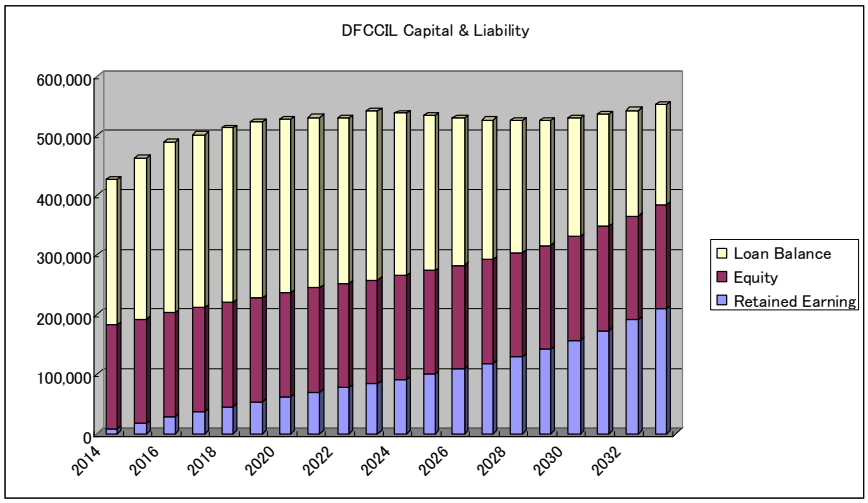


Figure 13-22 B/S of DFCCIL (Capital & Liability)

17) Projection result-9：Employee productivity

As is already stated, Employee productivity in 2014 is as same as Canada and that of 2032 is around the same level of U.S.A. as of 1999.

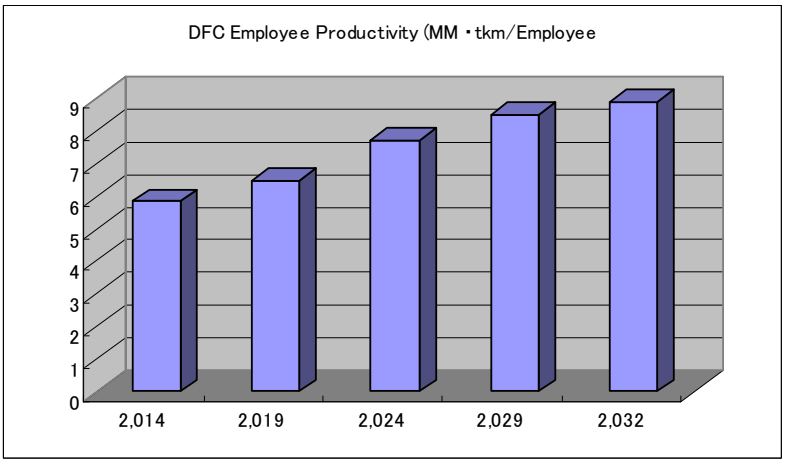


Figure 13-23 Employee productivity

18) Projection result-10：Operating Ratio of DCF project

Main cause of fluctuation as is shown below is fluctuation from depreciation amount.

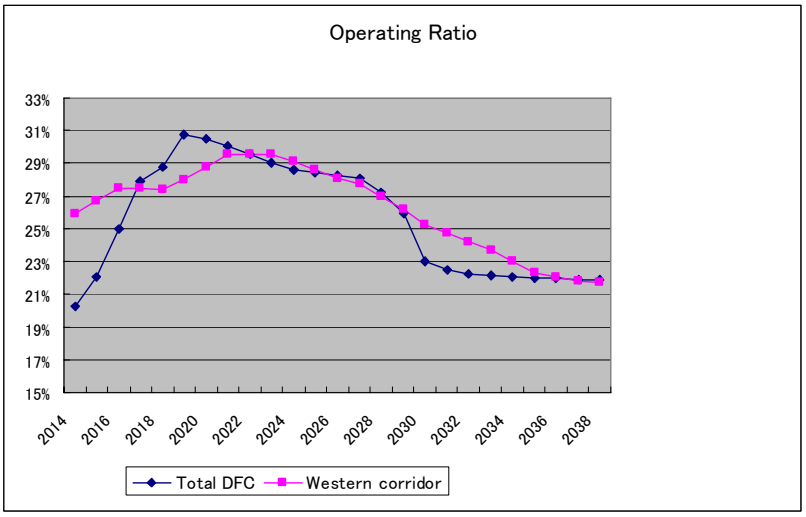


Figure 13-24 Operating Ratio

(2) Business Risk：What if Railway market share is not recovered and GDP growth rate remains 5%.

1) Assumption Change

Base case assumes that IR's market share will hit the bottom in 2004 at 23.7% and will grow gradually to the level of 37.7% in 2022 by 14%. Business Risk-case assumes Railway market share will remain at 23.7% throughout the project period and Western DFC's traffic demand will depend only on natural growth by GDP growth rate of 5%.

2) Summary list of the Business Risk-case projection

Table 13-8 Summary of the Business Risk case Projection

	DSCR	ROE	FIRR
Whole DFC project	3.49	34.7%	8.7%
DFCCIL (TAC revenue)	1.5	10.4%	1.3%

3) Conclusion

Projection result of Whole DFC project (Average DSCR: 3.49 and Average ROE: 34.7%) shows that the Project stands well against the business risk assumption. It is noteworthy that the average ROE of 34.7 is ample enough for the return of capital investment by MOR. DFCCIL's DSCR (1.5) also seems to clear the minimum requirement of 1.2.

(3) Organizational Risk

1) Assumption Change

This scenario assumes that DFC accounting separation will not work well, resulting in 20% of DFC revenue remaining in the zonal railways.

2) Summary list of the Organizational risk-case projection

Table 13-9 Summary of the Organizational risk projection

	DSCR	ROE	FIRR
Whole DFC project	3.4	33.4%	8.0%
DFCCIL (TAC revenue)	1.5	10.0%	-

3) Conclusion

The probability of the organizational risk is not high because of current apportionment system in IR for many years. Even under the very rigid assumption of 20% of revenue reduction, DSCR of DFC and DFCCIL are 3.4 and 1.5 respectively and yearly DSCRs are over 1.2.

(4) Operating-Expenses Risk

1) Assumption Change

This scenario assumes that New Standard of Operating expenses are not set up nor achieved by a strong labor resistance and personnel cost jump up 3 times bigger and material cost is 25% higher than the planed.

2) Summary list of the Operating Expense Risk-case projection

Table 13-10 Summary of the risk projection

	DSCR	ROE	FIRR
Whole DFC project	3.81	43.2%	9.1%
DFCCIL（TAC revenue）	1.3	13.0%	-

3) Conclusion

The result is that Operating Ratio jumps up 40s and DSCR drops to 3, presenting bad effects. This proves that streamlining all expenditure is fundamental for the project. Effect to average DSCR of DFCCIL is worst among all, resulting in 1.3. Yearly DSCR of DFCCIL drops to the level of 1.1, under the safe level of 1.2, in Year-5 and 5 years from Year-9 to Year-13, alarming the needs of cash injection from MOR's portion of DFC retained earning.

(5) Interest Risk

1) Assumption Change

It is assumed that World Bank loan and ADB loan are not applicable to the project and commercial loans take the place and Yen Loan commitment remains Yen400billion.

2) Summary list of the Interest Risk-case projection

Table 13-11 Summary of the Interest risk projection

	DSCR	ROE	FIRR
Whole DFC project	3.64	45.2%	10.9%
DFCCIL（TAC revenue）	1.5	13.6%	3.4%

3) Conclusion

Effects of the interest risk assumption to the total DFC-financials seems to be absorbed. Average DSCR of DFCCIL (1.5) seems to clear the minimum requirement of 1.2 and ROE and FIRR are even improved because the shorter repayment period required by commercial loan lessens the burden of interest payments as long as DFC cash flow is sufficient. But DSCRs of DFCCIL for 2 years from Year-4 to Year-5 after start of operation are under 1.2. This proves that World Bank/ADB Loan should not be ruled out because of big amount of fund requirement.

(6) Project Implementation Risk (Completion Delay, Cost Overrun)

1) Assumption Change

2 year-completion delay occurs in the first phase and 50% Cost Overrun of Civil Engineering Cost is assumed, resulting in total Capital expenditure of Rs.650billion, including swollen accrued interest.

2) Summary list of the Completion-delay & Cost-Overrun Risk-case1 projection

Table 13-12 Summary of the Completion-delay & Cost-Overrun Risk Projection

	DSCR	ROE	FIRR
Whole DFC project	3.15	32.3%	7.9%
DFCCIL（TAC revenue）	1.4	9.7%	1.8%

3) Conclusion

Revised construction schedule is very tight resulting in high possibility of completion delay and cost overrun, because original 15 years, / 3-phased schedule of construction has shortened to 8 years/ actually one-phased schedule. In other words, many unsettled problems such as environmental approval issues, resistance against land acquisition, difficulties on many ROB rebuilding, squatter problem and insufficient traffic demand issues remain to be the sources of Completion delay/ Cost overrun Risk. Accordingly this risk analysis assumes 2 year completion delay and 50% cost overrun in civil engineering cost over the base case and the result of the simulation seems to be serious. Average DSCR of DFCCIL is worsened to 1.4 resulting in yearly DSCR for 6 years from Year-5 to Year-10 under 1.2 of safety standard. Guarantee support from MOR's portion of after tax profit of DFC is needed.

(7) Strategic Freight rate Risk

1) Assumption Change

Discounted freight fares are applied as is shown in Figure 13-5 for reinstatement of railway transportation under 700 km distance-band.

2) Summary list of the strategic freight fare risk-case projection

Table 13-13 Summary of the risk projection

	DSCR	ROE	FIRR
Whole DFC project	4.02	41.2%	9.6%
DFCCIL（TAC revenue）	1.7	12.3%	2.1%

3) Conclusion

The report recommends that railway can take an extreme bargaining tariff tactic in order to get over other disadvantages in the field of transit time cost and cost of service frequency. This risk analysis is to measure the magnitude of the assumption.

The negative effect by the assumption change is slight, resulting that ROE of DFC remains 40s and average DSCR of DFCCIL keeps 1.7. If demand growth by lowering fare is taken into consideration negative impact would be lessen further.

(8) Compound Risk of the business risk and project implementation risk

1) Assumption Change

It assumes that the business risk (no market share recovery and 5% GDP growth rate) and project implementation risk (2 year completion delay and 30% cost overrun) occur simultaneously.

2) Summary list of the compound risk-case projection

Table 13-14 Summary of the risk projection

	DSCR	ROE	FIRR
Whole DFC project	2.68	25.9%	6.8%
DFCCIL (TAC revenue)	1.2	7.8%	-

3) Conclusion

Impact not only to DFCCIL but to DFC is serious, resulting in about 40% shrinking of all ROE, FIRR and DSCR. Above all DSCR of DFCCIL has serious damage, showing yearly DSCR for 7 years from Year-6 to Year-12 1.1. Guarantee support from MOR's portion of after tax profit of DFC is needed.

13.2.2 Simulations for optimum split rate of DFC's profit after tax

A simulation for the optimum TAC-split-rate was carried out, resulting in Figure 13-19 and Figure 13-20 based on the requirement as follows:

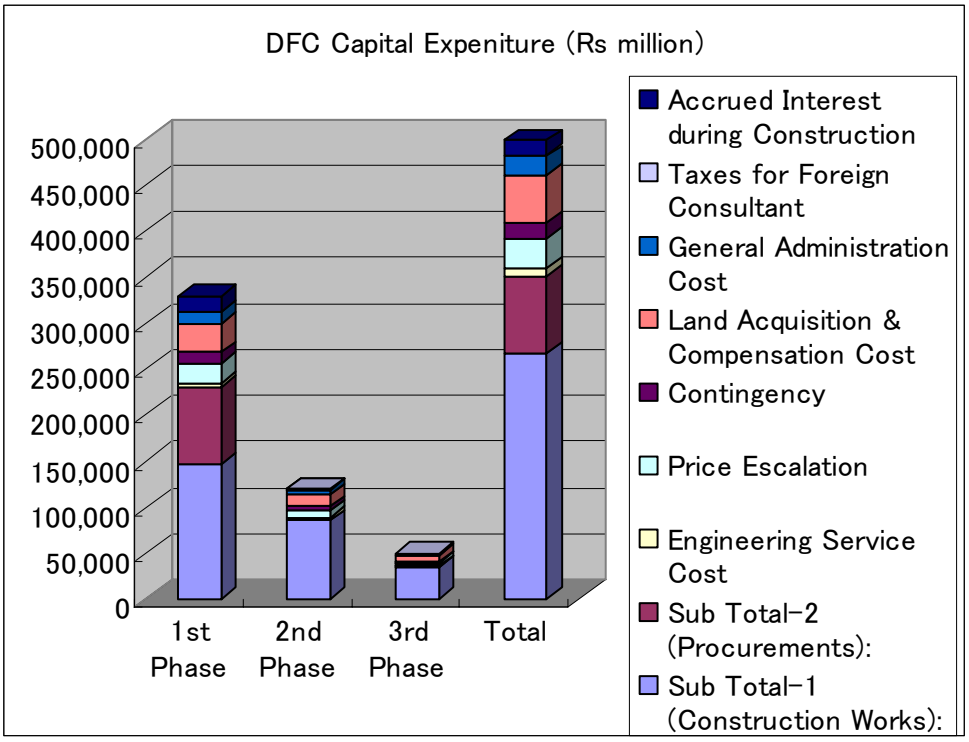
1) Expenditure (Operation cost, Depreciation, Interest & dividend payment, Tax) is deducted from DFC revenue according to operating expenses assumptions for DFCCIL.
2) Then the projection iron out optimal split percentages of profit after tax between MOR and DFCCIL. The DFCCIL portion should cover both Debt repayment and surplus for further investment. MOR portion should cover current and future income of existing freight corridor and investment return.

Risk analysis proves that DFCCIL accumulates Rs. 100 billion retained earnings at Year-20 even under very hash risk assumptions with 30:70 (DFCCIL: MOR) split rate. Please refer to *Volume 4 Technical Working Paper Task2, 13* about the detail result of risk simulation.

30:70 split seems to be appropriate if current assumptions are correct.

13.3 FUNDING PLANS

Capital Expenditure (CAPEX) of the 3 phased project amounts to Rs. 498.8 billion (1st Phase: Rs. 329.2 billion, 2nd Phase: Rs. 119.7 billion, 3rd Phase: Rs. 49.8 billion) according to the results of the JST study shown below.



Source: JICA Study Team

Figure 13-25 Capital Expenditure of DFC project

Rs. 498.8 billion is assumed to be the total amount expected to fund the project. Preliminary research and funding feasibility is shown below based on past track record and the analysis on potential market size because the project is still under F/S and potential financiers have not started their analysis.

13.3.1 Fund sources

Possible fund sources are as follows:

1) Equity finance from MOR
2) Yen Loan
3) Donor finance from international finance institutions like World Bank and ADB
4) Indian domestic commercial finance already financed to Konkan Railway and railway developments by RVNL

13.3.2 Equity finance

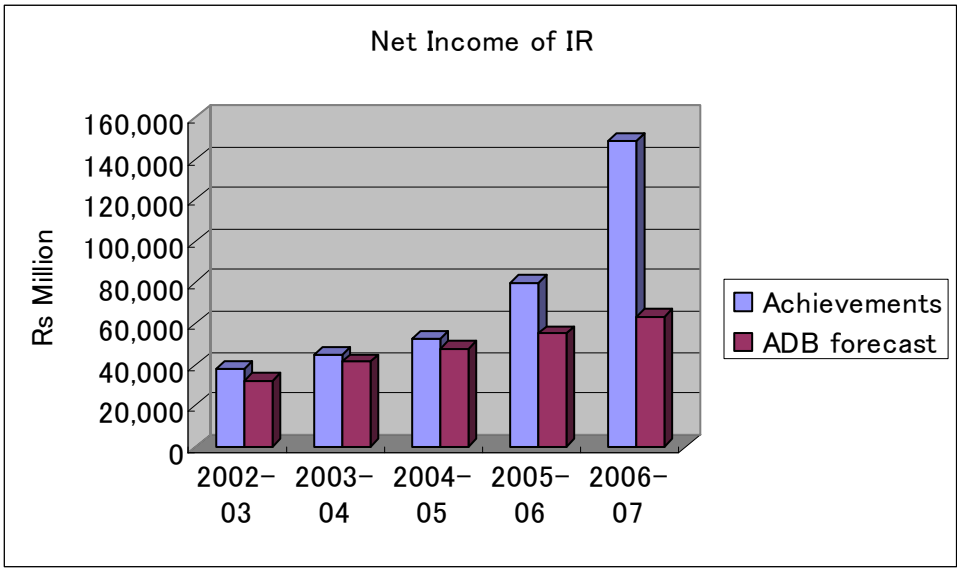
Indian Cabinet decided that Ministry of Railway (MOR) invests 100% of equity to the newly built project company (DFCCIL).

Let's assume MOR invests 1/3 of total required fund amounting to Rs. 166.7 billion.

MOR wants to make the money for the investment from IR's cash flow for first 6 years (Rs. 18.3 billion per year). IR posted Rs. 213 billion of cash flow as of FY 2006 and Rs. 133 billion of total increase in fixed assets. Required fund (Rs. 23 billion per year) is 13% of IR's annual cash flow and 7% of annual total increase in fixed assets. The magnitude is acceptable for the IR's sound financing taking Government Contribution of 25% into consideration.

Detail analysis on PL, cash flow and B/S of IR are as follows. These are the reasons why the above conclusion has come out:

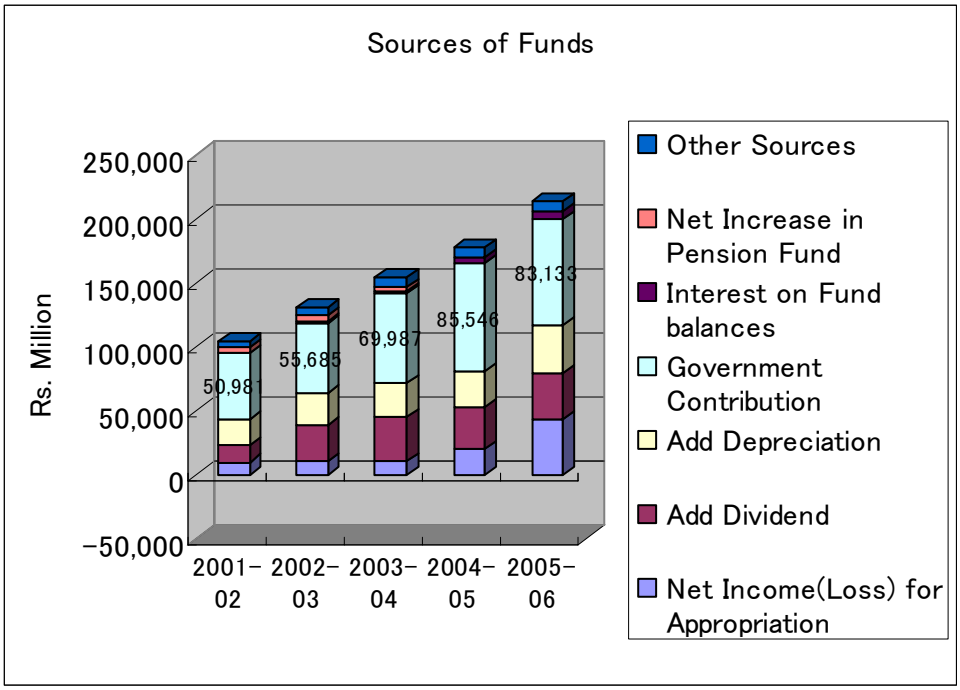
IR's net profit has improved after FY 2002 exceeding ADB forecast. Income increased by both rapid growth of freight traffic while freight rates kept stable. Net Income posted Rs. 149.2billion as of FY2007, 6.3 times larger than as of FY 2002.



Source: Ministry of Railway

Figure 13-26 IR's Net Income Trend

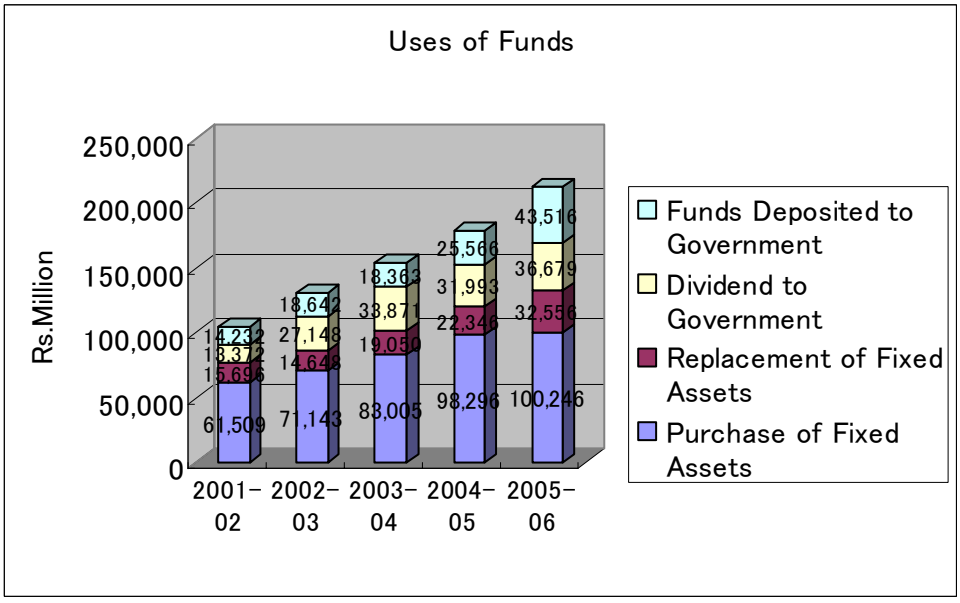
Increase of net profit leads to increase of cash flow (net profit before depreciation) which posted Rs. 117.1 billion as of FY2006, 2.6 times larger than as of FY 2002. Government contribution has increased in line with the growth of cash flow, posted Rs. 83.1 billion as of FY 2005, 1.6 times larger than as of FY2002. Total source of fund as of FY 2005 is Rs. 213 billion.



Source: Ministry of Railway

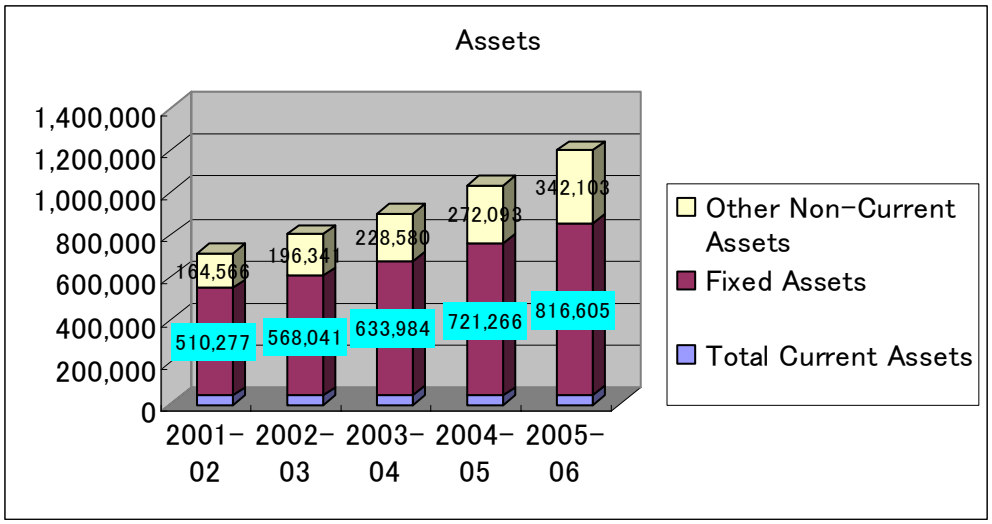
Figure 13-27 IR's Sources of Funds

Looking into the Use of Funds as of FY 2006, 47% (Rs. 100 billion) of source of fund is consumed by purchase of Fixed Assets and 15% (Rs. 32.5 billion) is used for replacement of Fixed Assets. After all, about 62% (Rs. 132.8 billion) of available fund is allotted for Fixed Assets investment. Out of 38% of source of fund, 17% is used for Dividend to the balance of Government Contribution amounted to Rs. 559.5billion. Funds Deposited to Government is mainly for pension fund purpose.



Source: Ministry of Railway

Figure 13-28 IR's Uses of Funds



Source: Ministry of Railway

Figure 13-29 IR's BS

Total Assets as of FY2006 is Rs. 1,200 billion. 68% is Fixed Assets and 28% is Funds Deposits with Government which is mainly for Pension Fund and balance of Depreciation Fund.

As to Liabilities & Equity, 47% is the balance of Government contribution and 49% is Retained Earnings and Deposit-Provident Fund which are the results of corporate activities.

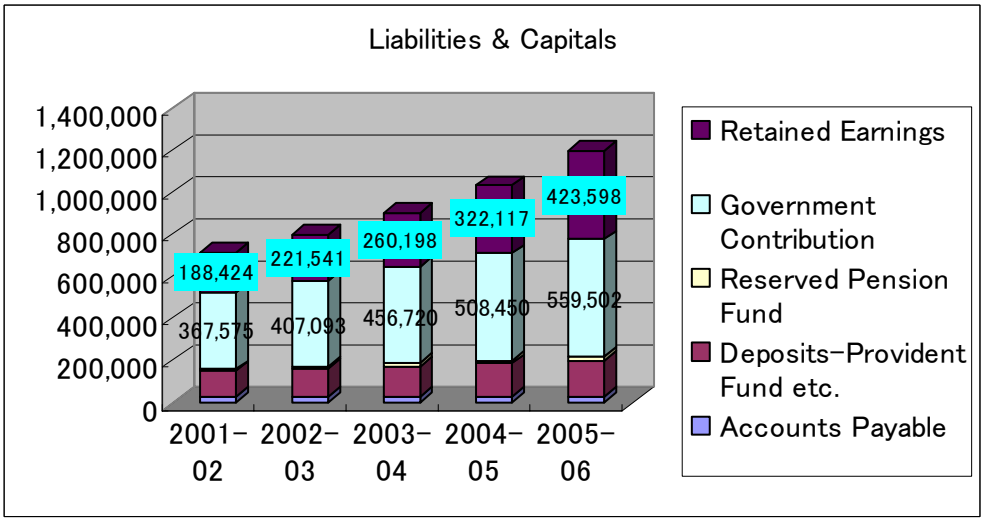


Figure 13-30 IR's BS

13.3.3 Yen Loan

Rs. 27.8 billion per year for 6 years is challenging amount considering current yearly acceptance amount of Yen Loan to India is Rs. 56.5 billion as of FY 2005.

According to "the rule of country of origin", one of the financing rule of Special Terms for Economic Partnership (STEP), it stipulated that more than 30% of agreed STEP loan amount must be procured by facilities & equipment of "Japan Origin" which includes facilities & equipment procured from Japanese companies not only in Japan but from Japanese subsidiaries in the borrower's country* and in other developing countries**.

* Japanese subsidiaries is defined that (1) more than not less than 10% of the equity of the manufacturer are held by Japanese companies and (2) The proportion of the shares held by the Japanese firm mentioned in (1) above is the same as or greater than that of the shares held by any firm of a country or region other than Japan and the country or the territory where the manufacturer is located.

** is defined (1) not less than one-third of the shares of the manufacturer are held by a Japanese firm and (2) the same above.

Assumed Rs.166.7 billion as Yen Loan amount, Yen 150billion, 30% of the loan, could be procured from afore-defined "Japan Origin".

Repayment period (grace period) of STEP is 40 years (10 years) or 30 years (10 years) and interest rate is 0.4% p.a. and 0.3% p.a. respectively.

13.3.4 Other Donors

Assuming that other donors are requested to finance half of the remnant after equity finance and Yen Loan, it is about US$2.2billion. It is possible amount for their subscription because World Bank suggested US$1.5-2billion and ADB are willing to participate the financing with unofficial commitment. But the project is record magnitude in terms of construction scale, tight construction schedule against the construction magnitude and finance amount. Completion delay could destroy the project. Accordingly it is absolutely needed that MOR and other donors get rid of the barriers, which caused troubles in the previous finance. It may be recommendable that Donors clarify their precondition beforehand and find out solutions for it, for example qualified construction bidder because of the importance of other donor portion for total finance scheme.

Followings are terms & conditions of the last financing for MOR's PSU by ADB and World Bank just for information:

Table 13-15 Terms and conditions

	ADB	World Bank
epayment years (Grace period)	30years (5years)	30years (5years)
Interest rate and others	LIBOR-based US$ Lending facility, Int. Margin, front-end fee: 1% pa, Commitment fee: 0.75% pa	LIBOR-based US$ Lending facility, Int. Margin: 0.75%, front-end fee: 1% pa, Commitment fee: 0.75% pa

Source: Ministry of Railway

13.3.5 Domestic Commercial Banks

Let's assume that domestic/foreign Commercial Finance Market takes on the remnant financing amounting to Rs. 83.3 billion.

Domestic Commercial Finance Market has provided following financing both to Konkan Railway and RVNL railway projects. IRFC maintains AAA rating in domestic capital market.

IRFC, the financial arm of MOR, can raise funds from foreign financial/capital markets with a BB+ rating from S&P, Baa3 from Moodys' and BBB from JCR. It has also issued Samurai Bond amounting to Yen 15billion in Tokyo Bond Market in February 2007.

Financing Rs. 83.3 billion for 8 years from the domestic/foreign commercial markets seems to be viable from both funding size and credibility of DFCCIL (100% owned by Central Government) because Konkan Railway raised Rs. 27.6 billion and RVNL (50% owned by Central Government) railway projects is under financing of Rs. 150 billion for 5 years and Rs. 400 billion for 10 years from the domestic Commercial Finance Market.

Current terms and conditions of the domestic Commercial Finance Market are as follows:

1) Commercial Bank Loan

Terms: 10-15 years（incl. 2 year grace period）, Most favourable interest rate: 11.5%

2) Bond

Terms: 3-5 years, Interest rate: around 7.5%

3) Capital Gain Tax Exemption Bond

Terms: 5 years, Interest rate: around 5.5-5.6%

The lending balance of designated commercial banks in Indian financial market is Rs. 7.3 trillion, that of other banks like Indian Industrial development Bank is scaled about Rs. 2.4 trillion and Company Bonds market size is about Rs. 600 billion. Total size of Commercial Finance Market is Rs. 10 trillion as of the end of FY2003.

1) Konkan Railway

Other than 22.5% of equity financing are commercial sources (Debts, Company Bonds, Leases etc.) amounted to Rs. 27.6 billion. Interest rates of Company Bonds are around 10% and term is 5-10 years.

	Amount (Billion Rs.)	Percentage
Equity	8	22.5%
Long term Loan (Bond)	22.5	63.3%
ECB	4.09	11.5%
Lease	0.86	2.4%
Suppliers' Loan	0.1	0.3%
Total	35.55	100%

Borrowing feature: Bond issuing and debt are on project financing basis with support of Letter of Comfort from MOF. Taxable Bond and Tax-free Bond were issued. Bonds are subscribed by Commercial Banks, institutional investor and residents of the railway site.

2) Railway projects under RVNL

RVNL railway projects is under finance amounting to Rs. 150 billion for 5 years. Interestingly 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 with oversubscription

Viability-test is on combination of IRR and other financial indices. Threshold of IRR-test is funding cost + 2%. Commercial financiers are satisfied with the borrower's credibility because projects are 50% owned by RVNL (100% owned by Central Government)

13.4 REVIEWING POSSIBILITY OF PRIVATE/PUBLIC SECTOR PARTICIPATION (PSP) IN DFC

Current PSP activities in MOR as a part of "Railway Sector Reform" are already stated in "MOR's PPP Strategy (Task 0&1)". Possibility of PSP for the DFC project is reviewed hereunder.

13.4.1 PSP to DFCCIL as Equity holders/Major customers

(1) As fund providers:

PSP as equity holders in KRC (Konkan Railway Corporation) and MRVC (Mumbai Rail Vikas Corporation Ltd.) projects is limited to local governments. However equity holders in RVNL (Rail Vikas Nigam) projects extend to port authorities and port trusts. Furthermore if loan and bond funding is considered as PSP much more private sector funds would be involved in KRC and RVNL projects.

Public Sector Undertakings (PSU) such as power generators, steel manufacturers and coal miners have been suggested in the "Report of DFC Task Force" to participate in DFCCIL as equity holders. Equity participation by major shippers might be recommendable and possible, taking into account over Rs.600 billion funding-needs.

(2) As the board members of DFCCIL:

MOR has not placed the main priority in obtaining shipper's needs and taking actions which might lead to a decline in long-term market share. Although MOR has conducted hearing request with major shippers it would be very important for DFCCIL to take in directors from these major shipper and have their opinions on marketing, operation, investment, operating cost reduction and transportation securities during director's meetings.

13.4.2 New entry to container train-operator business with ICD facilities

(1) Promoting PSP in container train-operator business

CONCOR, 100% owned PSU by MOR, used to be the only operator of container (bulk) train with the exception of IR along the IR networks. MOR introduced other 15 operators due to the rapid increase of container demand

The new competitive system of train-operator business with ICD facilities is important for Western DFC where container train will dominate in future. Door to Door strategy of container transportation will be essential in order to realize current demand forecast of Western DFC.

The expected Development Plans of ICD facilities by the 15 operators of container (bulk) train on IR networks will be the key step for successful PSP in railway sector.

13.4.3 Cooperation of Logistic Park/Rail Side Warehousing with ICD/SEZ

(1) Development of a railway-centred integrated transportation business

Road-centred integrated transportation business is prevailing in developed countries where highway network is well developed, motorization is matured and logistic park for truck transportation is well developed nationwide and where railway network is only a part of the total transportation system.

The share of medium ad long-distance railway transportation to the total Indian transportation system is still high while short-distance market share has been dropping. Thus, development of a railway-centred integrated transportation base like a Logistic Park/ Rail side Warehousing is highly recommended in order to block the entry of inefficient truck mode in the medium & long-distance Railway transportation business. PSP in the field is a very important building block for a total PPP. This Logistic Park/ Rail side Warehousing must cooperate with nation wide SEZ/ICD.

CHAPTER 14
EXECUTING AGENCY AND STAKEHOLDERS

CHAPTER 14 PROJECT IMPLEMENTATION PLAN

14.1 EXECUTING AGENCY AND STAKEHOLDERS

DFCCIL is the executing agency of the DFC Project and is positioned in the centre and would manage the communication and interaction of the stakeholders of the Project such as the Ministry of Railways (MOR), relevant Ministries, Zonal Railways, contractors, suppliers, and consultant which will be managing the design and construction supervision.

The following Figure14-1 indicate the assumed organization structure for the DFC Project.

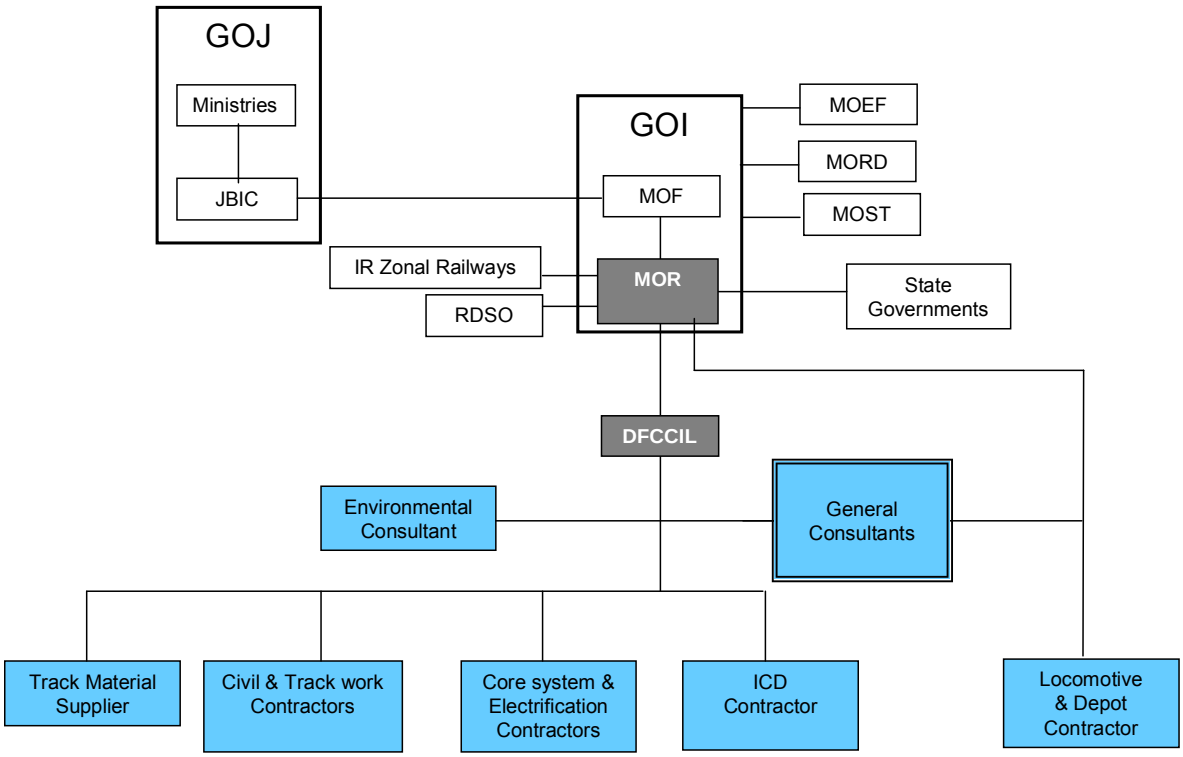


Figure 14-1 Relevant Stakeholders for Implementation of DFC Project

Organisations and role of each of them in the implementation of the DFC Project :is indicated in the following Table 14-1.

Table 14-1 Role of Stakeholders in DFC Project

Abbreviation	Organisation	Role Pertaining to DFC Project
GOJ	Government of Japan	
GOI	Government of India	
JBIC	Japan Bank of International Cooperation	Prime Lending Agency
MOR	Ministry of Railways	Ministry responsible for DFC Project.
MoF	Ministry of Finance	Ministry responsible for budget allocation.
MoST	Ministry of Shipping and Transport	Ministry responsible for development of ports and highways.
MoEF	Ministry of Environment and Forests	Ministry responsible for environment issues, wild life and forests.
MORD	Ministry of Rural Development	Ministry responsible for social environmental issues.
SG	State Governments	Responsible for management of development and maintenance of roads within State, land acquisition, resettlement, and rehabilitation.
IR (Zonal Railways)	Indian Railway	Responsible for management of railway development, maintenance, and operation of feeder lines within respective Zones.
RDSO	Research Design and Standards Organization	Responsible for preparing standards and R&D for railway, approval of new technologies railway technologies applied to DFC.
DFCCIL	Dedicated Freight Corridor Corporation of India Ltd.	SPV for DFC Project responsible for construction maintenance of DFC.

14.2 DFC PROJECT IMPLEMENTATION SCHEDULE

14.2.1 Schedule for the Implementation of DFC Project

(1) Critical Factors of the Implementation

The Project aims to construct a new freight railway line, mainly on embankment structures and the sequence of the works involved can be generalised as: 1) Civil works (earthworks and bridge structures); 2) Track works; 3) Electrification, telecommunication, and signalling works. The implementation of the works is desired to be completed in a short period of time, and JST envisages that the track works and civil works will be carried out simultaneously with a reasonable time between the commencement of each work. Since the civil works being the forerunner of the works, followed by the track works, the critical path of the whole construction schedule lies in these two activities.

The volume of earthworks in Phase I-a Project alone amounts to 107.27 million m3, and assuming the duration of the works of the whole project is five (5) years, the earthworks is required to be completed effectively in two (2) years. Thus the JST assumes that one team for the construction of earthwork is required to be deployed at every 20km along the DFC.

With regard to track works, the procurement of track material such as ballast, sleepers, and rail is largest critical factor which affect the schedule. In Phase I-a alone, 430,000 tons of 60kg rail, 8,400,000m3 of ballast and 6,000,000 pieces of PC sleepers are required to be procured.

With regard to ballast, the DFC lines being planned on three zonal railways i.e. Northern Railway, North Western Railway, and Western Railway, and it is assumed that the total volume of ballast procured by the three Zonal Railways to the extent of 2,000,000m3 per annum will be required for maintenance. JST calculates that it will take four (4) years to procure ballast required for DFC Project even if the suppliers of the ballast doubles their production capacity. The procurement of ballast is envisaged to be a difficult task since the acquisition of approval for the expansion of concession, and expansion of the facility will take time. The situation for the procurement of the sleeper is no different. The expansion of the production facility in a short time frame is perceived to be difficult.

Thus, as a countermeasure, it will be desirable to make a long term material procurement plan, in which the process for the procurement of material is recommended to start in advance of the commencement of the construction.

As an essential consideration, the completion of the land acquisition is absolute prerequisite, in advance of the commencement pf the civil works. If the land acquisition is delayed, the overall schedule will be delayed (time overrun) as well as trigger the increase of Project cost (cost overrun). In recent years there were cases in which a road construction project was delayed, and an industrial park project was terminated due to protest from nearby residents.

The social impact arising from the implementation of mega-scale infrastructure development project such as this DFC Project is substantial, and there is a high possibility that land acquisition issue itself becomes the largest risk factor as well as the critical factor. It is advised that MOR/DFCCIL endeavour with maximum effort for the early acquisition of land required for the Project.

(2) Critical Factors for Financing the Project

The DFC Project is a massive scale project requiring a vast amount of finance. The Government of India is requesting the Government of Japan for Yen Loan since self-financing and borrowing from domestic market alone is not sufficient.

The process for financing from international lending agency such as JBIC, ADB, and World Bank requires some time. In case of financing from these organisations, it is mandatory to comply with the guidelines of the respective organisations stipulating the procurement of consultants and contractors. After the consultants and contractors are procured under competitive bidding procedures of Yen Loan, it requires 2.5 years from the day of the signing of the Loan Agreement (L/A) until the signing of contract for the construction and the commencement of works.

For the case of this Project, in which the application of the Special Terms for Economical Partnership (STEP) will be applied, the procurement of the consultant takes 10 months, and after that the total duration to complete activities such as the detailed design by the consultant, preparation of tender documents, tender assistance, tender evaluation and concurrence by JBIC, negotiation with contractors, signing of contract and concurrence by JBIC of the contractor, and commencement of works, is at least 20 months.

The following Figure 14-2 indicate the duration for the standard procedures for the procurement of consultants and contractors under Yen Loan.

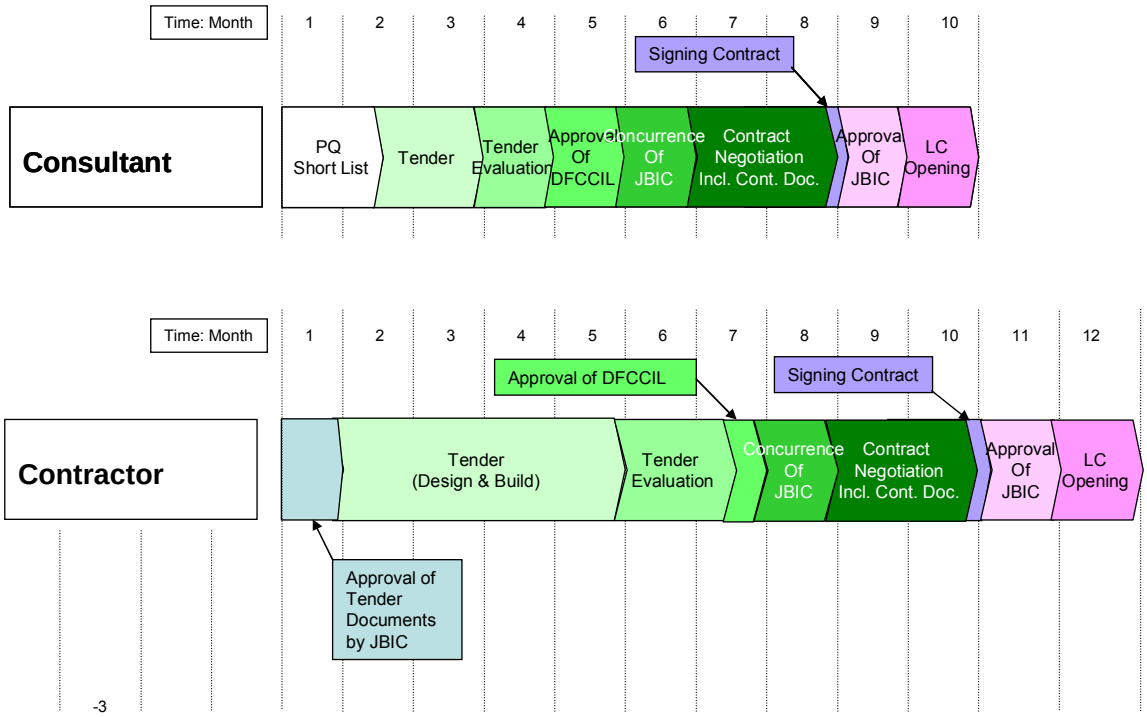


Figure 14-2 Process for Procurement of Consultants and Contractors Under Yen Loan

14.2.2 Implementation Plan for Phased Development

In this section, the implementation plan for the prioritised section covered by Phase I-a, proposed in *Chapter 3*, has deliberated with the assumption that the STEP loan is financed.

The implementation plan is based on the evaluation carried out for each section, taking into consideration the level of seriousness of the traffic situation, the soundness of the design, and level of impact envisaged on the natural and social environment.

The following is the resultant classification of the Project:

For the development scenario, following three phases are considered.

Phase I-a Project : A particular section composed of smaller sections having commonality of stringent traffic situation in the short to mid-term future, and no existence of engineering and environmental issues (category A section) in the near future that would undermine the implementation of the works on the combined sections, and constitutes as an independently viable project that generate viable project effect. The Project is earmarked as a priority project since it was judged to be capable of bearing scrutiny by JBIC and other international lending agencies in the project appraisal process for the financial assistance.

Phase I-b Project : A particular section composed of smaller sections having commonality of stringent traffic situation in the short to mid-term future. However if it is contemplated to get the project financed by international lending agencies, the subject section has serious engineering and environmentally related obstacles, thus the implementation of the

section is judged as not eligible for being taken up by the international lending agencies in the immediate future (category B section). However, even if a category C section can be implemented earlier if it is likely to uplift the overall effect of the implementation, the implementation of such section can be done by self-financing and responsibility of the Government of India. And however if the particular sections are assumed to be financed by international lending agencies, then maximum effort by the Indian Government will be required to eliminate the obstacles and address the issues. The Project 1-B is assumed to be a project that will be implemented by the Indian Government taking immediate action to remove the obstacles, commence with the preparation works on site by self –finance, and seek financial assistance from international lending agencies with approximately a two year lead time.

Phase II Project : A particular section composed of smaller sections having commonality of no serious traffic situation in the short to mid-term future, and is judged that its implementation can be deferred until the traffic demand exceeds its capacity. And sections which require reconsideration of the alignment over the whole stretch, and its immediate implementation is impossible.

Taking into consideration the above condition, the sections to be implemented in each phase have been determined as follows:

Table 14-2 Sections Implemented by Each Phase

Phase	Western Corridor	Eastern Corridor
Phase I-a	Rewari – Ahmedabad – Vadodara (918 Km)	Mughal Sarai – Kanpur – Khurja (710Km)
Phase I-b	Vadodara – Vasai Rd.(339Km) Vasai Rd. – JNPT (Total 433 Km)	Khurja – Dadri (46Km) Khurja – Kalanaur (242km) Kalanaur – Dhandarikalan (184Km) (Total 472 Km)
Phase II	Rewari – Dadri (117 Km)	Sonnagar – Mughal Sarai (127Km)

14.2.3 Implementation Schedule For Phase I-a Project

For the deliberation of the implementation schedule for Phase I-a Project, it is important that the vast 1,600km extensive section is completed as early as possible. For the realisation of this, it is an absolute prerequisite that the Government of India (GOI) promptly resolve problems such as land acquisition, settlement and compensation to habitants, and environmental impact etc. Further more, detailed design works should be accelerated, and after freezing the final alignment, the overall DFC project area be divided into ten (10) to twenty (20) construction segments, and start works on segments having no constraints.

1) For the cases for which Yen Loan is available to implement the works for all sections eligible. (Refer to Table 14-3)

   The procedures for procurement of consultants can commence once the Yen Loan is pledged. Assuming that the L/A for Phase I-a Project is concluded in February 2008,

the selection of the General Consultant will take about 10 months. After that, it is assumed that the General Consultant will take approximately one (1) year and eight (8) months for activities such as: to arrange the procurement of major track materials (such as rail, ballast, and PC sleepers), prepare the detailed design for construction works such as civil, track, electrical, depot for locomotive), prepare tender documents, tendering, tender evaluation, and contract signing with the selected contractor.

In case of ROB construction, coordination activities such as the selection of its route, discussion with road authority, and construction of detour, etc is envisaged to take time. Therefore, JST estimates it will take approximately four (4) years from the conclusion of the L/A to the commencement of the ROB works. Once the civil works completes, the track works and electrical works will follow. Running test of prototype locomotives, and functional tests of the electrical facilities will be carried out, after their arrival. After completion of all works, a comprehensive operational and integrated test would be carried out. After clearance of the operational conditions from the safety point view, the facilities will be handed over to the Indian Railways (IR) who will carry out practical operational and track maintenance trainings for approximately six (6) months. Accordingly, the full commissioning of the DFC of Phase I-a Project becomes a reality, approximately 8 (eight) years after concluding the L/A.

2) For the case that the Government of India commences with all civil works by self-financing. (Refer to Table 14-4)

As a measure to advance the commencement of the works, it is conceived that specific project component be implemented in advance by self-financing from the Government of India (MOR/DFCCIL), later followed by financing by the Government of Japan. Such components are: land acquisition (which is not eligible for Yen Loan), basic design and construction of all civil works (earthworks, bridges, reconstruction of ROBs, construction of RUBs, etc.), determination of site for ICDs and depots.

For this case, JST estimates a duration of fifteen (15) months for the detailed design and preparation of tender document for the civil works. In the whole stretch of Phase I-a (divided into 10 to 20 working sections), construction can commence from in the sections having no constraints, followed by selection of Indian contractors. JST estimates that forty five (45) months is required for the implementation of the civil works. Similarly, JST estimates fifty-four (54) months for the reconstruction of ROBs, and construction of long-span bridges, including the duration from basic design until the completion of its construction.

JST estimate the quantum of main materials necessary for track works of Phase I-a Project as, 8,400,000 m3 of ballast, 5,900,000 pieces of PC sleeper, and about 430,000 tons of head hardened (HH) rail. Ballast and PC sleeper can be procured domestically in India, but due to the limit of manufacturing capacity of existing suppliers, it is recommended that procurement of those materials be planned on a long term basis. Accordingly, JST recommends that GOI procure about 30% of the whole amount of ballast & PC sleeper in the Phase I-a in advance of the commencement of the works funded by Yen Loan, currently estimated to be in the middle of 2009. Regarding procurement of HH rail, it will take Japanese manufacturer three and half (3.5) years from the material order to the delivery of the rails to supply approximately 400,000 tons required for Phase I-a Project. However, rail are also contemplated to be procured by Yen Loan, its delivery can still be made before the commencement of the track works.

Procurement of locomotive is contemplated to be made by Yen Loan. The technical specification for the locomotives are required to be determined by the Indian Railways and approved by Research Design & Standards Organisation (RDSO) before the

commencement of its procurement, which is scheduled in 2009. Based on the approved specification the General Consultant will provide the design documents and tender documents, and will select the contractor through tender. It is envisaged that the awarded contractor (manufacturer) will produce say 10 prototype locomotives. Then the delivered prototype locomotives will be tested on the completed sections of the DFC line for approximately six (6) months in order to confirm its performance. After the test run, the results will be feed backed to the manufacturer who will make necessary improvements, and will start preparation for mass production. After completion of installation of all track facilities including signal, telecommunication, CTC, and electrification system, a comprehensive running test will be executed. The duration for the delivery of the locomotives is expected to take six (6) years from the conclusion of the L/A of the Phase I-a Project to the completion of its delivery.

The provision of at least one inland container depot (ICD) in Phase I-a Project, is required. The determination of its location, basic design, and environmental study (rapid EIA study) of ICD need to be initiated by the GOI, and the tender design, preparation of tender document, procurement of contractor, and the construction of the ICD will be made using Yen Loan. It is estimated that it would take approximately one and a half (1.5) years for the construction of the 50 hectare ICD, for the earthwork, drainage, and pavement works etc. After the completion of the land development works, track works, signalling and telecommunication facility works will follow. Finally, the container company will be selected through tender to install the necessary facilities such as gantry cranes, portal cranes, etc. that are used for loading and unloading containers.

The construction of a locomotive depot, having an area of approximately 50 hectare, is proposed to be covered by Yen Loan. It is estimated to take approximately two (2) years for the completion of the detailed design, selection of contractor, and conclusion of the contract for the construction, and another two (2) years for the construction of the depot. Inside the locomotive depot, a separate repair-maintenance will be built, and machines utilised for repair and rehabilitation is installed in it. Since those machines will be custom-made, JST assumes them to be procured from abroad, which will take 2 and half years for delivery and installation.

Simultaneous to the running test of the locomotives, and integration tests of the electrical facilities, it is envisaged that the Indian Railways will recruit crew, train them for train operation and maintenance, as well as impart training for handling, inspection and maintenance of other facilities. This procedure is estimated to take about six (6) months.

Assuming that the L/A is concluded in March 2008, the procurement of the General Consultant to the commissioning of the DFC operation for Phase I-a, will take approximately 6 years, and commissioning in around January 2014.

The JST concludes that this collaborative implementation of Phase I-a Project, in which procurement of major track material, and advanced commencement of all civil works initiated by the GOI financing, and followed by Yen Loan for the implementation of the remaining works can reduce the project duration by two and half (2.5) years than the schedule implemented by the full Yen Loan, which was presented in 1) above.

Table 14-3 DFC Project Implementation Schedule for Phase I-a

Case Study ---- Option 1: All Eligible Works Fully Covered by Yen Loan

	Description
A. Works Implemented by the Indian Government Budget and Responsibility	
A01	Final Alignment Survey
A02	Basic Design of Facilities and Defining the Technical Specification of the Electric Locomotives
A03	General Plan for new ICD
A04	EIA (Environmental Impact Assessment) for new ICD
A05	Land Acquisition & Resettlement for Track Line, Station & Depot
A06	**Procurement Process of EIA and RRP Consultant/NGO**
A07	**Selection of EIA and RRP Consultant/NGO**
A08	**Implementation of RRP**
A09	**1) Relatively less difficult sections**
A10	**2) Relatively difficult sections**
A11	**3) Implementation of Comprehensive EIA (1 full year survey/monitoring)**
A12	Environmental Baseline Survey
	【ROB Replacement】
A13	General Arrangement Drawing for ROB replacement
A14	Detailed Design / Bid Documents for ROB
A15	Agreement with Road Owner for ROB construction (Design, Permit, Cost Sharing, etc.)
A16	Selection of Contractor for ROB (Replacement)
A17	Construction of ROB (Replacement)
	【Other Works】
A18	Determination of Technical Specification for Locomotive
A19	Approval to the Specification for Locomotive by RDSO
A20	Preparation of Train Operation Manual & Track Maintenance Manual by RDSO
A21	Training for Operation, Training for Maintenance
A22	**Open to Public**
B. Works Implemented Using Yen Loan	
B01	JICA Feasibility Study
B02	EIA based on the guideline-design
B03	Resettlement Action Plan Frame Work based on the Guideline Design
B04	Approval for EIA by the Indian Government
B05	Appraisal to the Project funded by Japanese ODA Loan
B06	Review of EIA & RAP (Resettlement Action Plan) Frame Work by JBIC
B07	Pledge
B08	**Loan Agreement (Japanese ODA Loan)**
B09	Selection of General Consultant (Track Line, Signal, CTC, Telecommunication, Electrification, ICD, Locomotive Depot, EIA, RAP, etc.)
B10	General Consultant Engineering Service
B11	Environmental Management Monitoring Programme
	【Civil and Track Works】
B12	Detailed Design / Bid Documents for Route Alignment, Station & Locomotive Depot by DFCCI
B13	Detailed Design / Bid Documents for Civil Works & Track Works (Earth Works, Bridge, Culvert, Track etc) by DFCCIL
B14	Review of Detailed Design / Bid Documents for Civil and Track Works by GC
B15	Selection of Contractor for Civil Works (Earth Work, Station, Bridge, Culvert, etc.)
B16	Construction of Civil Works (Earth Work, Station, Culvert, etc)
B17	Construction of Long-span Bridge (L=3Km)
B18	Procurement of Ballast
B19	Procurement of PC Sleepers & Fasteners
B20	Procurement of Rail & Turnout
B21	Construction of Track Works
	【Signal and Telecommunication Works】
B22	Tender Design & Bid Document (Signal, Telecommunication, Train Control, Electrification)
B23	Selection of Contractor (Tender) for Electrical Works(Signal, Telecommunication, Train Control, Electrification)
B24	Construction for Electrical Works (Signal, Telecommunication, Train Control, Electrification)
	【Locomotive and Loco. Depot Works】
B25	Tender Design & Documentation for Locomotove and Locomotive Depot
B26	Selection of Contractor for Locomotive Procurement and Maintenance Depot Construction
B26	Procurement of Locomotive (Prototype 10 Rolling Stocks)
B27	Procurement of Locomotive (Feedback of Test Run, Preparation of Series Production & Series Production)
B28	Depot of Locomotive -- Tender, Construction
	【 I C D Works】
B29	Tender Design & Document for ICD (Inland Container Depot)
B30	Reviewing Basic Design & EIA for ICD & Locomotive Depot
B31	Approval by the Provincial Government
B32	Inland Container Depot (ICD) --- Tender, Construction)
B33	Depot of Locomotive -- Tender, Construction
	【Running Test】
B34	Running & Integration Test (Locomotive, Signal, Telecommunication, Electrification & Train Operation)

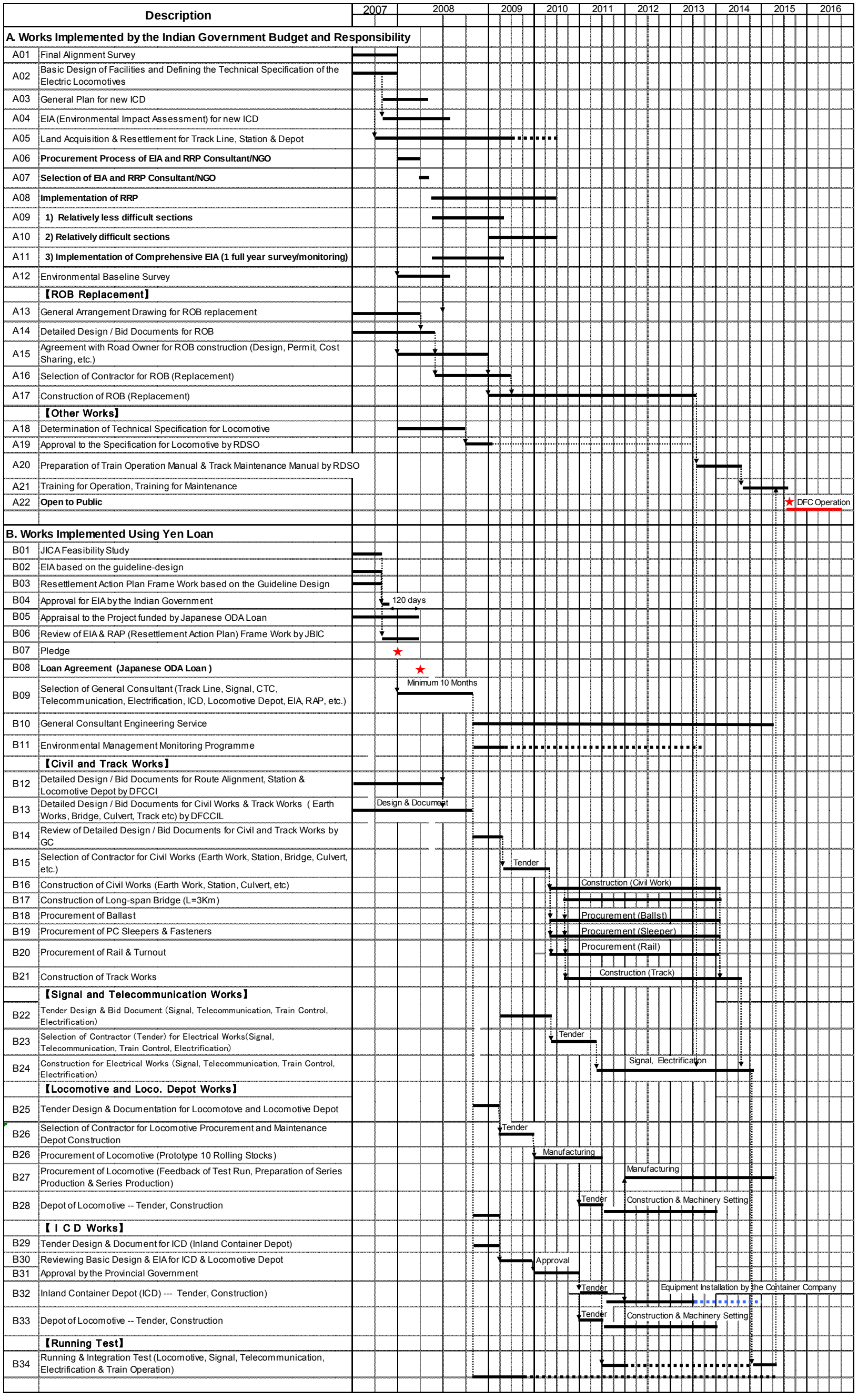


Table 14-4 DFC Project Implementation Schedule for Phase I-a

Case Study ---- Option 2: All Civil Works Advanced by GOI's prior to other Works Covered by Yen Loan

	Description	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
A. Works Implemented by the Indian Government Budget and Responsibility											
A01	Final Alignment Survey										
A02	Basic Design of Facilities										
A03	General Plan for new ICD										
A04	EIA (Environmental Impact Assessment) for new ICD										
A05	Land Acquisition & Resettlement for Track Line, Station & Depot										
A06	**Procurement Process of EIA and RRP Consultant/NGO**										
A07	**Selection of EIA and RRP Consultant/NGO**										
A08	**Implementation of RRP**										
A09	**1) Relatively less difficult sections**										
A10	**2) Relatively difficult sections**										
A11	**3) Implementation of Comprehensive EIA (1 full year survey/monitoring)**										
A12	Environmental Baseline Survey										
	【ROB Replacement】										
A13	General Arrangement Drawing for ROB replacement										
A14	Detailed Design / Bid Documents for ROB										
A15	Agreement with Road Owner for ROB construction (Design, Permit, Cost Sharing, etc.)										
A16	Selection of Contractor for ROB (Replacement)										
A17	Construction of ROB (Replacement)										
	【Civil Works】										
A18	Detailed Design / Bid Documents for Route Alignment, Station & Locomotive Depot										
A19	Detailed Design / Bid Documents for Overall Civil Works (Earth Works, Bridge, Culvert, etc)		Design & Document								
A19	Selection of Contractor for Overall Civil Works (Earth Work, Station, Bridge, Culvert, etc.)		Tender								
A20	Construction of Civil Works (Earth Work, Station, Culvert, etc)			Construction (Civil Work)							
A21	Construction of Long-span Bridge (L=3Km)										
	【Procurement of Track Materials】										
A22	Procurement of Ballast by DFCCIL										
A23	Procurement of PC Sleepers & Fasteners by DFCCIL										
	【Other Works】										
A24	Determination of Technical Specification for Locomotive										
A25	Approval to the Specification for Locomotive by RDSO										
A26	Preparation of Train Operation Manual & Track Maintenance Manual by RDSO										
A27	Training for Operation, Training for Maintenance										
A28	**Open to Public**								★ DFC Operation		
B. Works Implemented Using Yen Loan											
B01	JICA Feasibility Study										
B02	EIA based on the guideline-design										
B03	Resettlement Action Plan Frame Work based on the Guideline Design										
B04	Approval for EIA by the Indian Government		120 days								
B05	Appraisal to the Project funded by Japanese ODA Loan										
B06	Review of EIA & RAP (Resettlement Action Plan) Frame Work by JBIC										
B07	Pledge		★								
B08	**Loan Agreement (Japanese ODA Loan)**		★								
B09	Selection of General Consultant (Track Line, Signal, CTC, Telecommunication, Electrification, ICD, Locomotive Depot, EIA, RAP, etc.)		Minimum 10 Months								
B10	General Consultant Engineering Service										
B11	Environmental Management Monitoring Programme										
B12	Preparation of Tender Design & Bid Document for Track Works										
	【Track Works】										
B13	Selection of Contractor for Track Works			Tender							
B14	Procurement of Rail & Turnout				Rail = 388,000 ton						
B15	Construction of Track Works				Track						
	【Signal and Telecommunication Works】										
B16	Tender Design & Bid Document (Signal, Telecommunication, Train Control, Electrification)										
B17	Selection of Contractor (Tender) for Electrical Works(Signal, Telecommunication, Train Control, Electrification)			Tender							
B18	Construction for Electrical Works (Signal, Telecommunication, Train Control, Electrification)				Signal, Electrification						
	【Locomotive and Loco. Depot Works】										
B19	Tender Design & Documentation for Locomotive and Locomotive Depot										
B20	Selection of Contractor for Locomotive Procurement and Maintenance Depot Construction			Tender							
B21	Procurement of Locomotive (Prototype 10 Rolling Stocks)				Manufacturing						
B22	Procurement of Locomotive (Feedback of Test Run, Preparation of Series Production & Series Production)						Manufacturing				
B23	Depot of Locomotive -- Construction							Construction & Machinery Setting			
	【 I C D Works】										
B24	Tender Design & Document for ICD (Inland Container Depot)										
B25	Reviewing Basic Design & EIA for ICD				Approval						
B26	Approval by the Provincial Government										
B27	Inland Container Depot (ICD) --- Tender, Construction)				Tender	Construction	ICD Track		Equipment Installation by the Container Company		
	【Running Test】										
B28	Running & Integration Test (Locomotive, Signal, Telecommunication, Electrification & Train Operation)										

14.2.4 Implementation Schedule For Phase I-b Project

The length of the section covered in Phase I-b is 905 km which is approximately a little more than that of Phase I-a. However, since the route of Project Phase I-b passes through more built-up areas than that of Project Phase I-a where the land acquisition, resettlement, and compensation is considered to be extremely difficult, JST envisages that the resolution of these issues and the determination of the basic alignment will take time. The largest obstacle that hinders the implementation of the works in this section is the reconstruction of the existing ROBs, particularly a large number of ROBs which are concentrated on sections between Surat to Vasai Rd. and Vasai Rd. to JNP of the Western Corridor. Under the current plan, in which the DFC is planned parallel and adjacent to the existing lines, the existing ROBs need to be demolished and reconstructed. The ROBs located in urbanised are a integral part of the trunk road having a significant traffic volume, thus if its reconstruction is contemplated, discussions and coordination with the road authorities regarding the reconstruction plan is required for engineering and consideration of social environmental aspects. JST concludes that for those sections having concentration of existing ROBs, deliberation for carrying out a comparative study for a detour route in addition to the parallel route plan is necessary.

The implementation of the Phase I-b Project has engineering challenges, and JST considers that financial assistance from international lending agency is essential. For the foreseeable future, JST assumes that the construction works that can be implemented within the right of way can be implemented by self-finance of the Indian Government. For the implementation of other works of which financing from international lending agency is contemplated, the Government of India need to address the conditions for the realisation of the phased development scenario, which is presented in Chapter 3. In consideration of the aspiration of MOR for the early commencement of the DFC works and its completion, JST estimates that it will take eight (8) years for the overall duration of the Project considering a two year lead time required to refine the Project plan to a level which bear scrutiny of international lending agency. (refer to Figure 14-3). It is crucial that the Government of India fully understand that maximum effort is required for the resolution of the aforementioned issues within the short time frame. The following summarises the prerequisites for the realisation of the Project.

[Prerequisites for the realisation of Phase I-b Project]

1) The Phase I-b Project extends to more than 900km, having engineering challenges as well as environmental issues that complicate the implementation. The cost for land acquisition and construction is estimated to be large. It is advised that the Government of India urgently deliberate the necessity of requesting financing from international lending agencies such as ADB and World Bank.

2) Immediate securing of self-financing required for land acquisition and the cost of the works determined to be implemented by the Indian Government.

3) Urgent commencement of detailed site survey and careful study of engineering feasibility of the existing ROBs which are subject to reconstruction.

4) It is envisaged that the land acquisition of the subject section will be difficult since it is situated in a heavily built-up area. The review of plan and the preliminary design of the station need to be prepared to minimise the scale of land acquisition and resettlement.

5) In view of the above, a comparative study is urgently required between the DFC planned in parallel to the existing line and that of an alternative route established that avoids those

sections, having many ROBs, and area where it is extremely built-up or populated. For this purpose the topographical survey is required to be carried out immediately.

6) This section mainly passes through the suburbs and fertile agricultural land, and the residents have voiced dissent in the stakeholder meetings. Since it is envisaged that it would not be easy to build consensus among the residents, thus continuous effort initiated by MOR/DFCCIL is required for the materialisation of the consensus building.

7) In order to acquire fund for international lending agencies, MOR/DFCCIL need to take initiative to carry out a ESIMMS of JICA Study (a rapid EIA level study) in a timely manner that would withstand the appraisal.

14.2.5 Implementation Schedule For Phase II Project

The extent of the section covered in Phase II is approximately 200km which is approximately 10% of the combined section of Phase I-a and Phase I-b. The traffic situation of the freight transport in this section is not serious compared to that of Phase I-a and 1-B, and the line capacity has some margin. The requirement for the reinforcement of containerised freight is low. Since there is possibility of alteration of the whole route of those sections designated as implemented in Phase II on both corridors, the commencement of the works on these sections is not possible in the near future. It is assumed that two (2) years is necessary to determine the route.

The route between Mughal Sarai and Son Nagar cannot be fixed until the track layout of the massive Mughal Sarai Junction Station is determined. There are no prominent constraints on this section other than the issue of this junction station.

A four (4) km tunnel is perceived to be necessary due to the existing gap of the terrain between the Rewari and Dadri section on the Western Corridor. JST has conducted a preliminary study on possible detour routes avoiding this gap, but could not determine a feasible detour route due to difficulty to locate land within the heavily built-up condition of the area. The tunnel option bears environmental impact issues of dewatering of ground water currently utilised for agricultural purposes. Thus, JST judges that a thorough engineering study and planning of the route and structures is required.

JST estimates that two (2) years are necessary to carry out the additional engineering studies (refer to Figure 14-3) which include topographical survey, geological survey, and environmental survey, which require immediate execution. Besides this, discussions with local residents are necessary. The following summarises the prerequisites for the realisation of the Project.

[Prerequisites for the realisation of Phase II Project]

1) The urgent reconsideration of the detour route for the tunnel section between Rewari and Dadri is advised. Also, the urgent execution of engineering survey and preliminary design for the tunnel section is advised.

2) There is a high possibility that the construction of the tunnel section between Rewari and Dadri will cause lowering of the water level, and thus site survey and thorough evaluation is required to assess its impact. The urgent execution of the natural environment survey is advised.

3) The Mughal Sarai Junction Station is the origin of the Mughal Sarai-Son Nagar section and has been proposed to have vast facilities which would require time to determine the design and discussion with the residents. Thus, the urgent commencement of the design work and coordination with the residents is advised.

4) The timely execution and completion of the ESIMMS (rapid EIA level study) that withstand the appraisal need to be initiated by MOR/DFCCIL if financing from international lending agencies is being contemplated for the implementation of the Project.

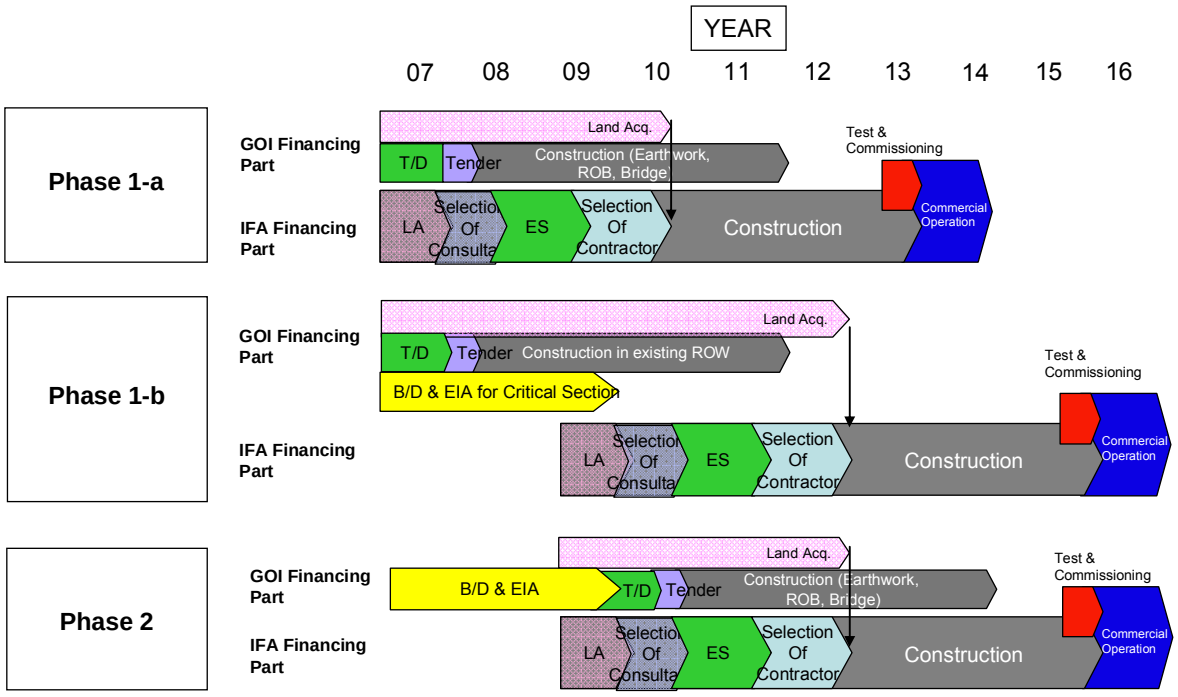


Figure 14-3 Overall Implementation Schedule of DFC Project

14.3 PROJECT IMPLEMENTATION STRUCTURE

14.3.1 Project Approval Process

It is mandatory that Detailed Project Report (DPR) of all Railway development projects costing more than Rs. 100 Cr is approved by the Planning Commission, the Expanded Board which is chaired by the Chairman of the Railway Board of MOR, and the Cabinet Committee on Economic Affairs (CCEA).

The discussions with MOR confirmed that the Project is already approved by the Cabinet, and the financing plan for its implementation is the only pending issue that require approval from the Government. The Government of India has requested the Government of Japan for financial assistance (Yen Loan), and is scheduled to clear internal procedures after establishing the overall Project financing plan based on the results of the discussions with the Japanese Government.

Figure 14-4 presents the flow for project appraisal process of DFC Project.

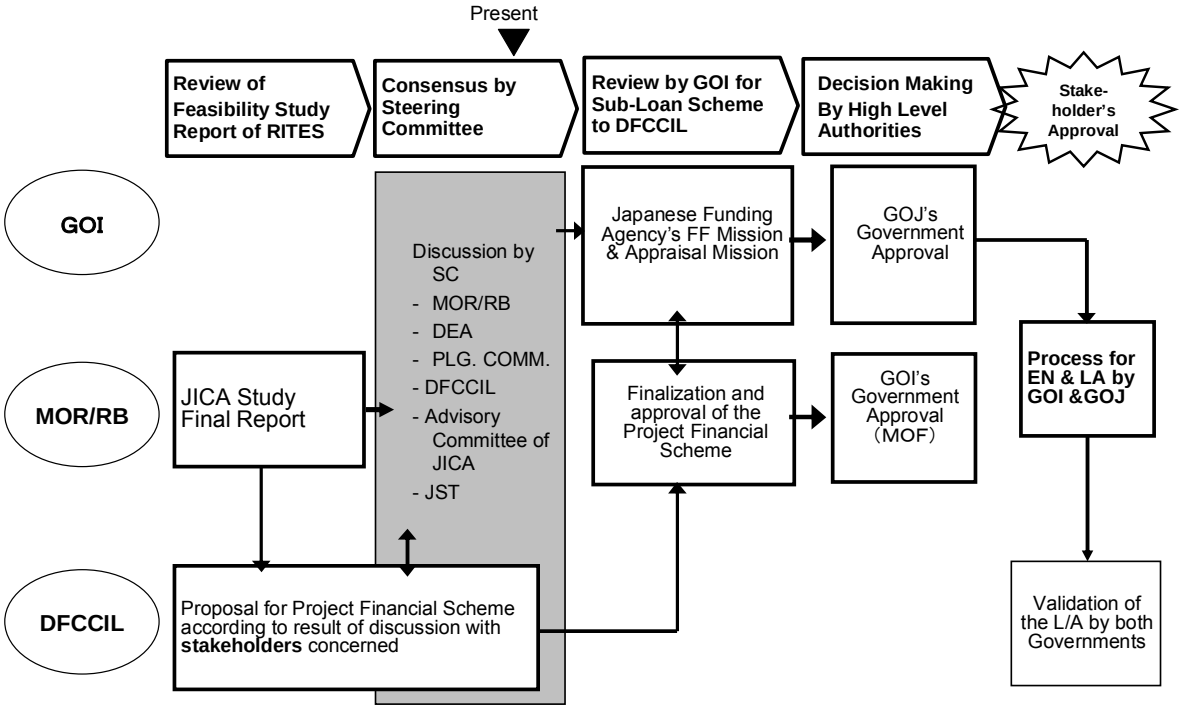


Figure 14-4 Project Appraisal Process for DFC Project

14.3.2 Project Executing Organisation

The executing organisation for the DFC Project is as follows:

1) DFCCIL: An infrastructure management company (SPV) responsible for the construction of the railway infrastructure, train operation control, and the maintenance. JST proposes that DFCCIL be responsible for the construction of the ICD required in Phase I-a Project.

2) MOR: Responsible for the procurement of the rolling stock (locomotives and wagons), train operation, and the maintenance of the rolling stock.

DFCCIL was incorporated on November 03, 2006 and provisional senior Executives consisted of three Boards of Directors and four Officers for the Project Commencement Group. However, DFCCIL is to be managed by a Board of Directors consisting of one Managing Director and four Directors who have been/ are being selected through open applications. The current position is that the Managing Director and Director Finance have already assumed charge of their posts. Besides the Director (Operation & Business Development) is also expected to join soon. However the incumbents for the post of Director (Infrastructure) and Director (Projects & Planning) are under process of finalization.

The Board of Directors of DFCCIL will be supported by the Senior Officers and other supporting staff. As per the information available with JST, the following Senior Officers have already joined their Duty in DFCCIL:

Officer on Special Duty	1 officer
General Manager (S&T)	1 officer
General Manager (Electrical)	1 officer
General Manager (Operation)	1 officer
General Manager (Business Development)	1 officer
General Manager (Finance)	1 officer
General Manager (Mechanical)	1 officer
General Managers (Civil)	3 officers

General Managers of following Regional Offices have also assumed charge:

[Western DFC]
General Manager, DFCCIL Mumbai
General Manager, DFCCIL Vadodara
General Manager, DFCCIL Ahmedabad
General Manager, DFCCIL Jaipur

[Eastern DFC]
General Manager, DFCCIL Allahabad
General Manager, DFCCIL Kanpur
General Manager, DFCCIL Ludhiana

5) Schedule in the Future

DFCCIL will continue to proceed with the expansion of the organisation in accordance to the developments in the Project..

The JST has proposed the establishment of a dedicated Section within the DFCCIL organisation that will handle environmental and social consideration issues, which was accepted in principle by MOR/DFCCIL. The Section Chief is scheduled to be assigned.

14.3.3 Project Management Structure

The MOR nor DFCCIL have experience implementing railway development projects using Yen Loan. In order for DFCCIL, as an executing organisation, to implement and complete the Project as per schedule complying to JBIC Guidelines, it is imperative to hire a Consultant who is well versed with the tasks of design, tender assistance, construction supervision.

Figure 14-5 and 14-6 presents the project management structure during design and tender assistance stage, and project management structure during construction supervision stage, respectively.

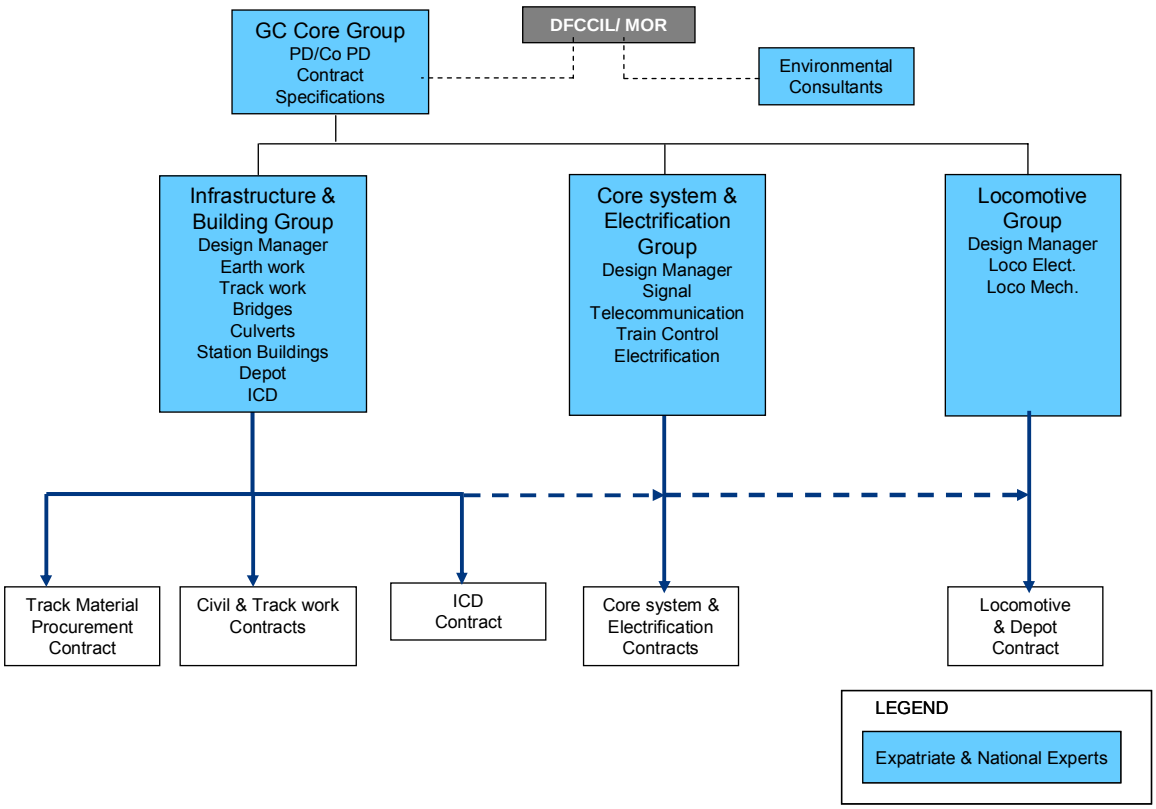


Figure 14-5 Project Management Structure during Design and Tender Assistance Stage

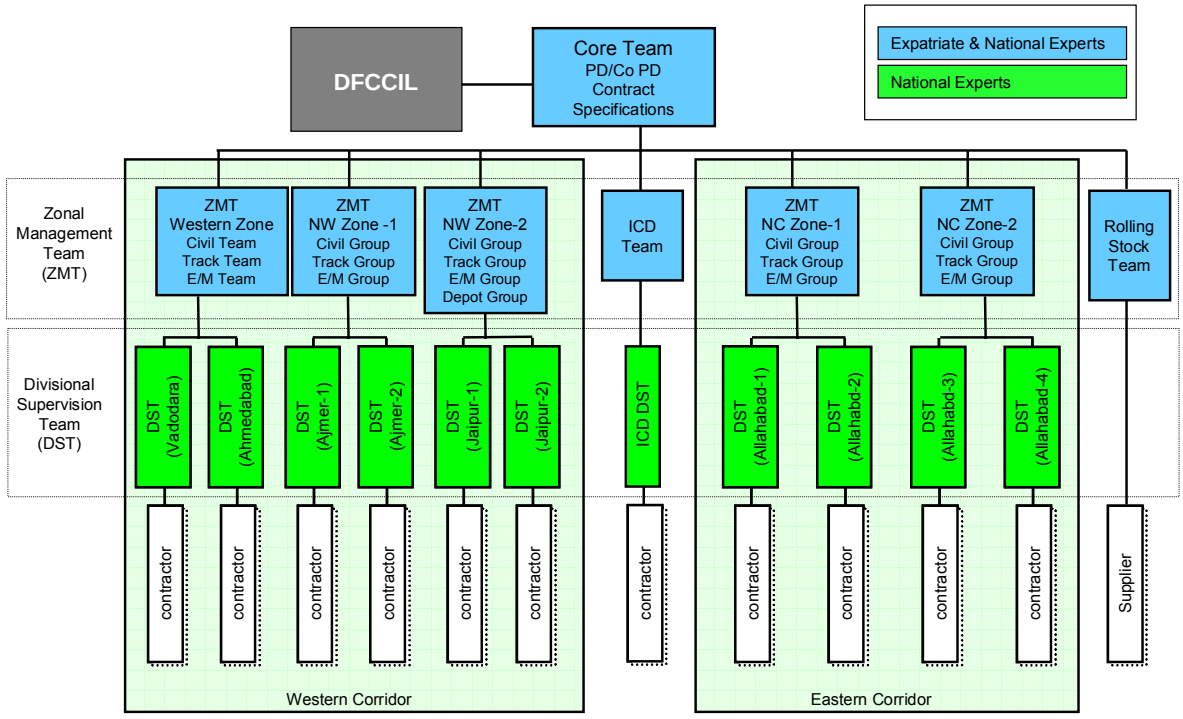


Figure 14-6 Project Management Structure during Construction Supervision Stage

The construction supervision is proposed to be executed by the tri-layered organization. The first layer is the Core Group of General Consultant which has its head office stationed in the DFCCIL Headquarters, and takes on responsibilities for the overall management of schedule and control of Project cost by close communication with DFCCIL.

The Zonal Management Team (ZMT) is placed at the second layer which is expected to make day to day communication with the Zonal Railways, and be responsible for the overall project management of the works of the respective sections within each Zonal Railways, and report the progress to the Core Team. The ZMT is considered to be part of the General Consultant, and international experts will be deployed.

The third layer, the Divisional Supervision Team (DST), will coordinate with the Divisional Office, which is responsible of maintenance of the existing railway facility of the Zonal Railways, and manage the day to day construction activities of the DFC. The DST is proposed to have a site office and under the directions of the ZMT and carry out the day to day construction supervision activities, and report the management record to ZMT.

The DST is required to be established before the hiring of the General Consultants and in place from the beginning of the construction the DFC. Thus it is proposed that the DST is established by the DFCCIL.

The CPM & Experts Groups and Resident Engineer (Site Management) teams that manage and supervise the earthworks, the construction of station facilities, will be deployed according to requirements at site offices.

14.4 DISCUSSIONS REGARDING CONTRACT PACKAGES OF PHASE I-A PROJECT AND CONSTRUCTION SEGMENTS

The following are the preconditions considered for the division of the contract packages and the construction segments.

i) The General Consultant is deployed to manage the overall implementation of the Project.

ii) Implementation of the works and procurement of the rolling stock be made through self-financing from Government of India, and Yen Loan as well as from other international lending agencies.

iii) The Special Terms on Economic Partnership (STEP) conditions is applied for the portion of Yen Loan, and the prime contractor is limited to Japanese firms.

iv) The executing organisation responsible for the construction of the infrastructure and its maintenance is DFCCIL, and the executing organisation responsible for the procurement of rolling stock and its maintenance is MOR.

The division of the contract packages were made considering the following factors:

Factors considered for contract packaging	Clarification
1. Packaging of the same Project component not allowed under different executing organisation.	- Components of construction of infrastructure is to be included in contract of DFCCIL Project, and procurement of rolling stock and construction of the depot to be included in the contract with MOR.

2. For project component(s) which are implemented on different period, packages that is (are) have critical activity are isolated and its implementation be advanced.	- Isolation of the civil/track, works which are implemented in the early stage of the overall schedule, and the electric/signal/telecommunication works, which are implemented in later.
3. Consolidation of Project components that have commonality and mutually relevant	- Consolidation of electric/ signal /telecommunication works into a single package.
4. Consolidation of Project components into a single package that are considered to realise efficient construction.	- Material required for track works need to be procured in advance of the track works. The procurement of track material done in advance together with the procurement of the material required by civil works.
5. The size of one package is required to be small as possible and be able to manage the project efficiently.	- Separate the infrastructure works into two packages, one for each corridor. - The signal/telecommunication system is required to be a unified system by each corridor. Each corridor to have a single package.
6. Since prime contractor are limited to Japanese contractor(s), Project components that are difficult to divide are proposed to be integrated into other Project components.	- The integration of electrification works with signalling/telecommunication works. - The integration of the package for the construction of the depot with the package of procurement of rolling stock.
7. In principle, one main contract package is concluded for each Zonal Railways and site activities managed by ZMT and works carried out by main contractor. However, for Zonal Railways where long sections of DFC is planned, the main contract will be separated into secondary contract packages which will be managed by DST, and its works carried out by a subcontractor.	- [Western Corridor] Phase I-a Project: 2 sub contract packages for North Western Railway between Rewari and Palanpur section; 1 contract package for Western Railway between Palanpur and Vadodara section - [Eastern Corridor] Phase I-a Project: 2 contract packages for North Central Railway between Mughal Sarai and Khurja.

Table 14-5 Contract Packages Assumed for Phase I-a Project

No.	Item	Package	Estimated Contract Amount *) (million Rs.)
Western DFC			
A.	Civil and track works		
	Rewari-Madar (Ajmer) / 290km	Package W-A2a	16,402
	Madar (Ajmer) – Palanpur / 368km	Package W-A2b	23,566
	Palanpur- Vododara / 260km	Package W-A3 & W-B1	20,188
B.	Electric, signal, telecommunication, machinery	Package W-B	25,805
C.	Operation and Maintenance Equipment	Package W-C	2,041
D.	Construction of ICD	Package W-D	3,000
Eastern DFC			
A.	Civil and track works		
	Khurja-Kanpur / 388 km	Package E-A2	21,937
	Kanpur-Mugar Sarai / 322km	Package E-A1	17,628
B.	Electric, signal, telecommunication, machinery	Package E-B	20,197
C.	Operation and Maintenance Equipment	Package E-C	1,495
Common items on both DFC			
	Procurement of Locomotives and construction of depot	Package F	78,335

Note: *) Amount excludes price escalation and physical contingency.

In order to complete the earthworks within two (2) years, the deployment of one construction team at every 20km interval, which is the minimum unit for the construction section. Hence, there will be 12 to 18 construction sections working on civil and track works for each contract package. Each construction section is perceived to be managed by one prime contractor and several subcontractor positioned under the prime contractor. For the tender of the prime contractor, the prime contractor will be asked to provide information of the subcontractor that will be deployed in each section, and technical evaluation be made on the experience and capability of those subcontractor.

CHAPTER 15
COMPREHENSIVE EVALUATION OF THE PROJECT

CHAPTER 15 COMPREHENSIVE EVALUATION OF THE PROJECT

This chapter summarises the Study results, and presents the overall evaluation based on the aspects of technical, environmental, project implementation structure, economical and financial and project implementation plan.

(1) Evaluation of Technical Feasibility

The phased development scenario was established in Task 2 considering the technical adequacy of each section. The scope of the proposed Phase I-a Project and the technologies applicable were evaluated to be adequate.

However, the following technical elements proposed in the PETS-II were judged by JICA Study Team (JST) to be lacking in technical feasibility.

1) Double Stack Container (DSC) transport with flat-type wagons on the Western Corridor

   The PETS-II proposed the application of the DSC transport with flat-type wagons on the Western Corridor. However, this transport system is not proven on any commercial lines and the JST views that the operational safety, particularly with regard to the stability against wind load, need to be verified. The JST has carried out a comparative evaluation of the transport system and concludes that the proven system of DSC transport utilising well-type wagons is feasible for application on the Western Corridor.

2) The existing ROBs in urban areas

   The reconstruction of the existing ROBs in urban areas, included in Phase I-b project and Phase II project, are considered to inflict negative social impact to the residents residing of the area. The reconstruction work is envisaged to be an extreme engineering challenge. Therefore, technical feasibility of the reconstruction of the ROBs requires further examination.

(2) Evaluation of Feasibility on Social and Environmental Considerations

With regard to the Phase I-a project, the JST concludes that serious negative impacts to natural and social environment can be avoided and/or minimized, if careful design works for the track alignment, stations and bridges are conducted by the Indian side, as per the Guideline Design proposed by the JST. However, it is imperative that simultaneous efforts are made by the MOR/DFCCIL to build sufficient consensus among the residents regarding land acquisition, resettlement, and compensation through public disclosure of information and public consultation.

A large scale relocation program, reconstruction of urban ROBs and construction of a new tunnel are envisaged in Phase I-b project and Phase II project. The occurrence of serious negative impact to social environment in the planned areas is likely if the DFC project is implemented without due consideration. The JST concludes that careful and further examination of the plan should be carried out.

On the other hand, it was expected that the implementation of DFC Project will have a gradual effect in inducing road transport users to shift to railways, as well as the tremendous improvement on social and natural environment, such as reducing energy consumption, and green house gas.

(3) Evaluation of Feasibility on Organizational Aspect

The DFCCIL was established in November 2006, as a Public Sector Undertaking under Ministry of Railways. It will be responsible for the construction of the two corridors as also for maintenance of their infrastructure. Since the organisation has been set up recently, it is expected that the staffing at various levels will be strengthen and take full shape in due course of time. The DFCCIL will have a branch for Marketing function and Business Development. JST has confirmed through interviews with concerned personnel that DFCCIL is expected to adopt a completely different approach from that of IR in terms of tangible and intangible aspects and from the success of the DFC project which will be achieved by this approach, they expect that it will result in rationalisation and innovation of the existing Freight Transport System of IR. This innovative willingness of the Indian side will certainly contribute to the realisation of the DFC, although feasibility of the innovation in organizational/institutional aspects cannot be evaluated at the moment.

(4) Evaluation of Feasibility on Economic/Financial Aspect

Economic analysis confirmed the feasibility of the DFC project for both the Western and Eastern Corridor. The financial viability of the Eastern Corridor was proved as well. However, the financial internal rate of return (FIRR) of the Western Corridor resulting at approximately 9%, concluded that low interest loans are essential to secure the financial viability.

The economic and financial analysis of the priority section of the Phase I-a Project concluded a figure slightly lower, but a close internal rate of return, than that of the overall Project. This confirms that the implementation of the Phase I-a Project alone is capable of generating sufficient impact, and the economic impact analyses carried out by the JST in this Study proved huge impacts such as inducing increase in production, increase of gross added value, increase of tax revenue, increase of household income, and increase of employment. Even if there is delay or suspension for the implementation of projects other than Phase I-a, the implementation of Phase I-a Project is independently viable.

Thus, the Study confirmed that the DFC project would have a significant investment value to the national economy of India with direct and indirect economic impact.

(5) Evaluation of Feasibility of Project Implementation Plan

The JST proposes the commencement of works of Phase I-a Project in 2008/09 and complete its construction within 6 years period.

Yen Loan is assumed to be available for the implementation of the Project. However JST proposes that the implementation plan should include the provision for procurement of material required for civil and track works in advance using self-financing from the Government of India. JST also proposes that MOR and DFCCIL take necessary action for timely land acquisition.

The construction period of the Phase I-b project is estimated to be 8 years considering the lead time to resolve the technical issues mentioned in para (1) of this chapter. Phase II project is also assumed to take a 2-year lead time to examine and solve the technical issues of the tunnel section

The JST estimated that eight years is required to complete the overall Project, which is longer than the policy made by the Government of India. It is not a easy task to maintain the project implementation schedule. For the timely progress of the overall project depends on the

extraneous effort by the Government of India for land acquisition and resolving technical issues.

(6) Evaluation of Feasibility on Definition of Project Scope

The project scope of the Study defined the scope of the DFC Project as construction of railway infrastructure for DFC, reconstruction of the existing ROBs accompanied by the activity mentioned in the preceding paras, and the construction of a new ICD required for the Project which will be taken up by DFCCIL as also the procurement of electric locomotives and construction of locomotive depot which will be taken up by the IR. This definition of the project scope is considered to be appropriate when JBIC loan is being contemplated since it suffices the conditions that the Project is sustainable, the Project is characterized as highly public service oriented, and that Project provides exclusive use by DFC.

The PETS-II proposes the construction of ROBs at all level crossings along the DFC. However, the implementation of such project component cannot be justified in terms of technical feasibility, economic and social/environmental sustainability and economic viability as well as the condition for exclusive utilisation for DFC not being met. Therefore, JST proposes that the construction of the ROBs be excluded from the scope of the Project and its implementation taken up separately by MOR as a independent project.

It should be noted that land acquisition, compensation for relocation and consultancy services are included in the Project scope.

As for the branch line section between Asaoti and Tuglakabad ICD of the Western Corridor, JST concludes that this section be excluded from the project scope, since the reconstruction of existing ROB is prohibitive considering the site condition and the limited capacity expansion of TKD ICD yard and the difficulty of land acquisition. The transport of containers on this section can be managed by strengthening the transport capacity by improvement of existing lines.

CHAPTER 16
CONCLUSION AND RECOMMENDATIONS

CHAPTER 16 CONCLUSION AND RECOMMENDATION

16.1 CONCLUSION OF THE STUDY

The DFC Project is concluded as a comprehensively high investment value project including the aspects of economic and financial evaluations.

(1) Phased Development Scenario

The implementation of Phase I-a Project is judged to be reasonable in engineering terms, and in terms of environmental aspects as well - when appropriate measures proposed in the report are executed, the impact on the environment and society can be minimised. Also, the necessity of the Project is justified by the projected demand, hence urgent implementation of the Project is strongly recommended.

With regard to Phase I-b Project, its implementation is inevitable due to the serious traffic situation. However there are sections in which technical and environmental issues need to be solved which require maximum effort by the Government of India for its resolution prior to the start of construction.

With regard to the implementation of Phase II Project, the traffic situation of the relevant sections are not serious at current, but the plan of the tunnel section would require careful investigation and examination in the technical and environmental aspect which require continuous and maximum effort by the Government India.

(2) Optimal Technical Option

After careful and detailed study of various options, the following technical options were judged as optimum for the DFC development:

- The traction system shall be electrified on both western and eastern corridor.
- Container transport system for the Western Corridor shall be the Double Stack Container (DSC) with the “Well Type”;
- Container transport system for the Eastern Corridor shall be the Single Stack Container (SSC);
- Access to the TKD shall be through an improved existing railway line, not through the DFC;
- Clear standing room (CSR) at stations shall be 750m (Land acquisition shall be 1,500m preparing for future traffic demand); and,
- Construction of Road Over Bridges (ROBs) along the existing railway lines was not included in the Project. This shall be developed by the Indian side.

(3) Environmental and Social Considerations

Out of all the Project sections, some sections were deemed to have significant impact on social environment. In addition, some dissenting opinions against the Project were raised by the local residents at the Stakeholder meetings. Thus the JICA Study Team (JST) emphasises in the conclusion and recommendation of the Study that it is crucial for DFCCIL and MOR to make maximum effort to build consensus with the local residents for the implementation of the Project. It was also judged indispensable for the smooth implementation of the Project that appropriate land price is fixed for necessary land acquisition, earlier completion of the relocation plans and prompt procedures for the land acquisition and the relocation.

(4) Railway Management Plan

It was confirmed that an institutional set up of a totally independent management is necessary for a rapid and an independent decision making. In addition to this, introduction of modernized railway technologies and system is a must for the sound railway operation. The Dedicated Freight Corridor Project is merely a part of the whole freight transport system. Throughout the course of the Study, it was confirmed that the relevant intermodal facilities and service of the system need to be developed in order for the Project investment to be effectively utilised and for the expected various effects of the Project. It was concluded that MOR/DFCCIL need to take initiative in approaching the relevant authorities for the realisation of the total transport system development.

16.2 ACTIONS NEED TO BE TAKEN BY THE GOVERNMENT OF INDIA

The following actions need to be taken by the Government of India for the smooth implementation of the Project:

1) Immediate decision should be made by the MOR on the technical options proposed in the JICA Study Report.

2) The approval of the EIA-level report by the Government is a prerequisite to obtain funds from international lending agencies, including Yen Loan, for the implementation of the Project. Particularly, approval of the Government of India, is positively required by November 2007 on the EIA-level report for the sections to be implemented in Phase I-a by Yen Loan.

3) It is imperative that the fund raising for the Project is be arranged at favourable terms for the success of the whole Project. It is advised that the Government of India deliberate on the necessity of funds from international lending agencies such as ADB and World Bank in addition to the funds from Japan, for the implementation of the Project including the implementation of Phase I-a Project and start consultation with them.

4) Necessary funds to cover the cost for land acquisition and advanced implementation of work are arranged immediately by the Government of India.

5) The completion of the preliminary engineering design and Final Location Survey of the facilities covered in Phase I-a should be made by December 2007.

6) With regard to the existing ROBs, which are major obstacles of the Project, immediate execution of engineering survey and preliminary engineering design of the existing ROB subject to reconstruction should be made. Prior to the work, discussions with the road authorities should be commenced as soon as possible.

7) In view of dissenting opinion against the Project received in the Stakeholder Meetings, continuous effort for consensus building of the residents residing along alignment is required through public consultation meetings initiated by MOR/DFCCIL.

8) With regard to the construction of the new ICD between Rewari - Delhi, which is necessary for the Western Corridor Phase I-a Project, immediate decision making should be done considering the proposal made in the JICA Study.

9) Actions for improvement towards the intermodal transport is necessary regardless of the DFC Project. It is imperative that MOR/DFCCIL take initiative in making immediate actions in establishing the Intermodal Transport Improvement Taskforce as was proposed in the Report.