Chapter 5

Modal Costs of Transportation:
Railways, Highways, Airways & Coastal Shipping

5.1 INTRODUCTION

Comparative modal transport cost estimates provide planners with the tools for identifying cost effective range of operations for transport of men and material by various modes with the objective of deciding investment allocations aimed at achieving an optimal modal mix for integrated development of the transport sector. To meet this objective, the cost estimates have to be comprehensive enough to include not only the costs related to modal operations but also other costs associated with freight and passenger transport. Accordingly, modal transport costs have two components viz. costs incurred by the operator or the service provider and costs incurred by the user i.e. consignor/consignee of goods for freight movement and passengers in the case of passenger travel.

Cost to the operator comprises cost of operation of the service, repair and maintenance of infrastructure and moving units, overheads, replacement costs and investments in up-gradation of the system. User cost structure varies with mode. User cost in the case of goods transport by Rail relates to packing of goods, cartage (local transit) from consignor's godown to loading terminal at origin and from unloading terminal to consignee's godown at destination, handling of goods at either end, transit losses, rail siding and transit inventory costs. Cost elements are similar in the case of Coastal Shipping and Airways except that rail siding cost gets excluded. In the case of Road Transport which provides door to door service, both railway siding costs and local transit costs are not relevant. For passengers, user cost includes cost of ingress and egress in the nature of local travel and porterage at the terminals at either end. Sum of the two cost components i.e operator and user cost reflects the total cost of transport of a tonne of goods or a passenger by a particular mode for an identified distance slab.

Further, costs are conceived in terms of financial costs and economic or resource costs. Financial costs include total expenditure actually incurred by an operator or user, inclusive of taxes, duties and other elements reflecting market imperfections. There are also modal variations in cost inputs like the cost of way. While Railways provide for rail tracks, in the case of Highways, it is the Central and State Governments who bear the cost of maintenance of the roads so also for Coastal Shipping and Airways where sea-side facilities and airports are funded and maintained by the Government.

While converting financial costs into economic/resource costs, transfer payments in terms of subsidies, taxes and duties are excluded. Unlike financial costs, economic/resource costs incorporate element of social costs in terms of pollution and accidents. The economic/resource costs are thus worked out as under:

$$Resource\ Cost = Financial\ Cost * Shadow\ Price\ Factor + Social\ Cost$$

In the context of long term planning for the transport sector, long run marginal costs are relevant. For assessing long run marginal cost, it is assumed that all the costs incurred are variable.

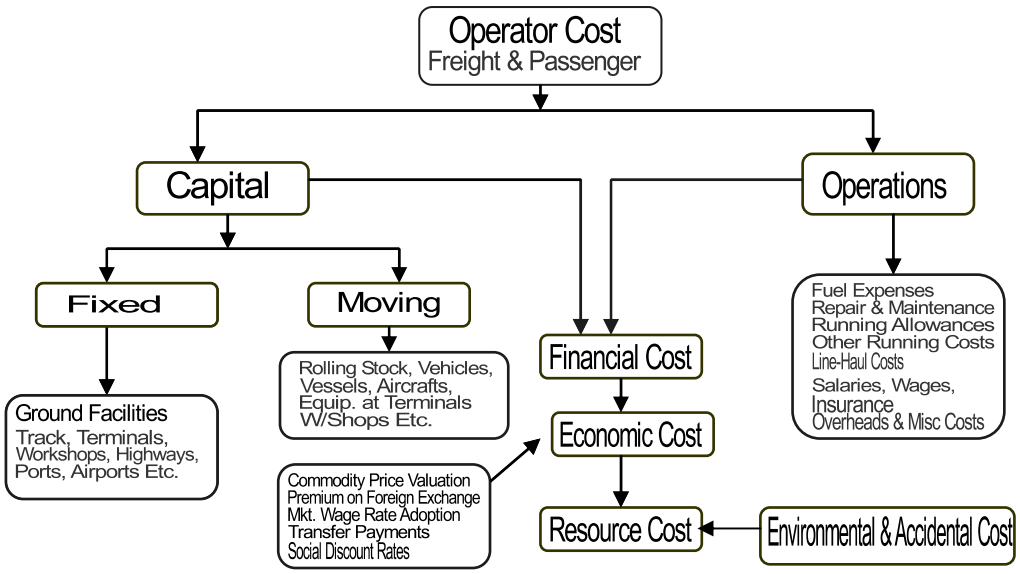
Broadly, operator cost data have been obtained from the operators. Detailed source identification appears in relevant sections on modal cost inputs. For collection of user cost data, specially designed survey instruments were canvassed in respect of all the four modes. Formats of goods & passenger user cost survey instrument are given at **Annexure 1.10 and 1.11**, respectively (contained in Annexure Volume-1).

This chapter presents a broad overview of the costing methodology followed by enunciation of detailed process adopted for estimation of transport costs and resultant financial and economic/resource cost estimates in respect of each of the four modes viz. Railways, Highways, Coastal Shipping and Airways, separately.

5.2 OVERVIEW OF MODAL COSTING METHODOLOGY

In movement of men and material costs are incurred by different mode of transport. As the costs assessed have to be comparable between modes a common base is needed for assessing cost of services by different modes. The flow chart at Figure-5.1 provides the common platform for assessment of cost of different modes of transport.

FIGURE-5.1: FLOW CHART FOR ESTIMATING MODAL COST



The chart gives steps for arriving at costs involved in various stages. Operational costs and Capital costs were estimated for each of the modes of transport. Elements in financial cost are converted to economic cost. To the economic cost, environmental and accident costs were added to assess the resource costs.

5.3 MODAL COST: RAILWAYS

5.3.1 Introduction

Rail transport costs, unlike road, are characterised by high fixed cost of rail, locomotives and rolling stock, and buildings, but lower per unit fuel and operating costs, as rail can carry large

volumes. Moreover, these fixed (mostly infrastructure and some manpower) costs and variable operating costs are joint costs that have to be allocated between several kinds of products and services to arrive at the total cost of each service or product.

In order to facilitate dynamic decision making regarding investment in transport infrastructure, as well as rail operations and pricing, the system of costing should be able to record fixed and variable elements of train operations separately, thereby enabling an evaluation of whether it is profitable to continue or start different services, and also how much to charge for them. It may not be necessary, for instance to charge all the costs for a particular service, if all the fixed costs are being recovered from some other high value traffic. On the other hand, some services may justify recovery of a profit element over and above the fully distributed cost as well. The present costing procedure in use on the Indian Railways, for instance, only works out the fully distributed costs for each service, an approach that does not facilitate determining of marginal cost for providing additional services which is necessary for comparison of cost of service by different modes of transport.

Costing of railway systems has been in vogue since its inception, drawing attention of practitioners, academicians and policy makers. Though the tools used are also varied and changed with purpose on hand, rail costing has defied any standardisation owing to many difficulties. The main difficulties in rail costing are joint nature of costs incurred in different operations, huge sunk costs and non-linearity of growth expenditure to outputs. Keeping this in view the procedures adapted for rail costing have to address the needs of terms of reference while keeping the data availability in view.

The terms of reference for costing are as follows:

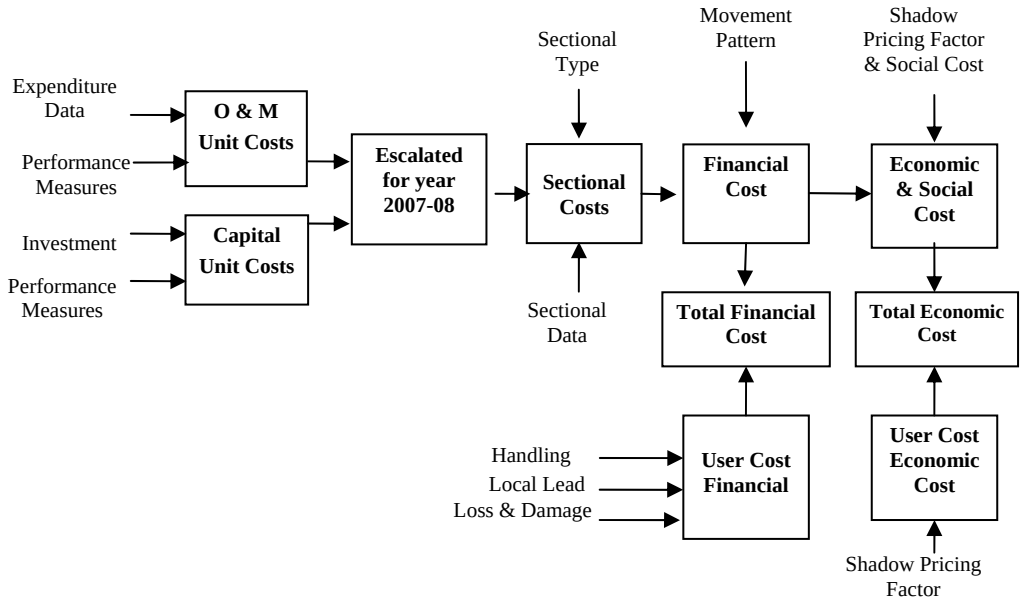
- Determination and analysis of **modal transport costs** in terms of both resource cost and financial cost for each of the above modes of transport, incorporating existing as well as future transport technological advancements.
- Indicate the **desirable share of mode of transport** on the basis of cost consideration.

The study thus has to estimate the financial, economic and social costs both for the operations and maintenance activity and capital costs for the Railways. The financial and economic costs incurred by the user of rail services are also to be included to estimate the total cost of services. The costs should be related to the rail network so that differences in the costs in moving cargo on different types of sections are brought out clearly.

The present costing exercise has as its central objective, calculation of fixed cost, and variable cost for each category of service, i.e. Goods and Passenger, for Broad Gauge Railway lines comprising 89.4 % of total rail network. Fixed costs include both Capital costs of track, locomotives, rolling stock, and signalling and fixed element of maintenance of infrastructure and some manpower element of operating costs. Variable costs that vary with output consist of maintenance and operating costs that may be directly attributed to the service or which may be joint costs for several services, which have to be divided between goods and passenger services.

A basic schematic of various steps involved in the costing process are brought shown in the flow chart given in Figure-5.2. Step 1 is the estimation of unit operations and maintenance costs and capital based on 2006-07 expenses and performance data. Step 2 is the escalation of unit costs to 2007-08. The escalated costs form the basis for sectional costs in the next step. The sectional costs further provide basis to calculate the financial cost of transport of 10 different commodities. These financial costs are modified with shadow pricing factors to evaluate the economic costs. To the economic costs, social costs are added to evaluate the resource costs. Similar procedure is followed for estimating the passenger costs.

FIGURE-5.2: FLOW CHART FOR ESTIMATING RAILWAY COSTS



5.3.2 Review of Extant Methodologies and Limitations

Indian Railways had an elaborate costing exercise in early 70's to develop fully distributed costs of different services. The system generated unit costs by segregating the costs into suburban, goods and coaching activities and then assigning the costs based on pre-assigned ratios. The method, while robust and well established on IR, has the following limitations in applying to the current study:

- It is unable to segregate the variable and fixed costs of operations
- It is difficult to segregate the sectional costs especially to bring in effects of gradients

Other landmark studies are by RITES Ltd. in 1978 and 1986 for the Total Transport System Studies of Planning Commission. The RITES studies estimated the costs at the sectional level by collecting data from sample sections. The approach was able to relate the sectional costs to the railway operations and estimate the cost of movement for different sectional types. A major limitation of the study was the ability to collect data from representative sections. A total of 21 sections were studied in detail, 14 in Broad Gauge and 7 in Metre Gauge, to estimate the costs. List of sections is given in **Annexure- 5.1.1** in Annexure Volume-2.

As the sample size was limited and variability on IR is very high, the assumption that costs would represent the complete section becomes difficult to sustain. More importantly, as explained below, the sectional data was used to supplement the cost analysis undertaken at the divisional level.

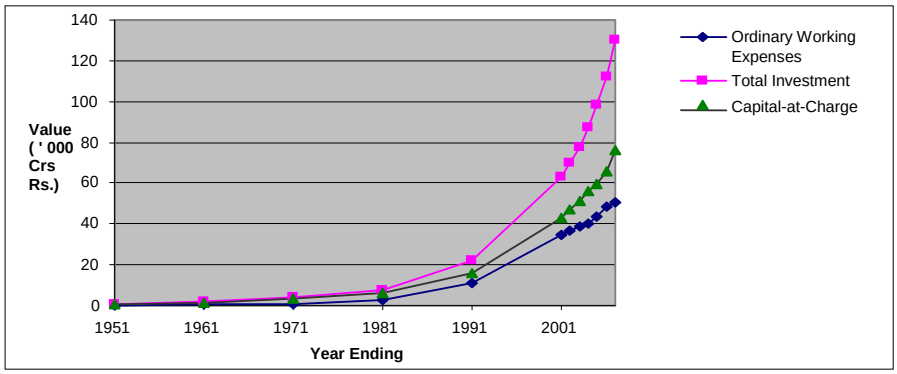
5.3.3 Overview of the Current Approach

Overview of IR expenditure and investment pattern

Like most organisations the cash outflows for IR are accounted mainly for operational activities and capital investment. Trend of past expenditure is presented in Figure-5.3.

FIGURE-5.3

TREND OF ORDINARY WORKING EXPENSES, TOTAL INVESTMENT & CAPITAL-AT-CHARGE



Ordinary working expenses are categorised into 11 different categories called demands 3 to 13. A break of expenditure for the thirteen demands is given in Table-5.1. The table shows that while some demands reflect expenditure of a particular department; in most cases the expenditure is of various departments. Investment in IR varies from year to year depending on the budgetary support, internal accruals, and market borrowings. Investment trends since 1951 are shown in Figure 5.3. The investments are meant to acquire or renew operational assets, new lines, doubling, conversion to Broad Gauge, and computerisation. Figure-5.3 shows a steady increasing investment and capital-at-charge. The outlay over different broad heads, in 2006-07, is presented in Table-5.2. As can be expected major investment is on railway tracks, followed by rolling stock.

TABLE-5.1: IR EXPENDITURE PATTERN FOR 2006-07

DESCRIPTION	DEMAND NO	EXPENDITURE (RS. CRORES)	SHARE%	CUMULATIVE SHARE %
Fuel Expenses	10/H	9733	27.5	27.5
Station Staff	9/G	5754	16.3	43.8
R&M (Coach/Wagon)	6/D	3977	11.2	55.0
R&M (P-Way/Works)	4/B	3358	9.5	64.5
Optg. Exp (R.Staff/Equip)	8/F	2790	7.9	72.4
R&M (Plant & Equip)	7/E	1972	5.6	78.0
Gen. Superintendence	3/A	1916	5.4	83.4
R&M Of Motive Power	5/C	1835	5.2	88.6
Staff Welfare	11/J	1542	4.4	93.0
PF/Retirement Benefits	13/L	1328	3.8	96.7
Misc. Working Exp.	12/K	1161	3.3	**100**
	TOTAL	**35367**	**100**	

TABLE-5.2: IR CAPITAL OUTLAY PATTERN DURING & CUM. UP TO 2006-07

HEAD	DURING 2006-07 (Rs. Crore)	CUM. EXP. SINCE 1951 (Rs. Crore)
Works/Prelim. Exp*	3718	35516
Rolling Stock	483	9622
Gen. Misc. Exp.	365	3829
Floating Asset	287	3368
Other Assets etc	737	5458
TOTAL	**5591**	**57794**

* Including Land, etc.

The foregoing indicates the importance of accounting both the operational expenditure and the capital investment.

Current Approach to Estimate O&M Costs

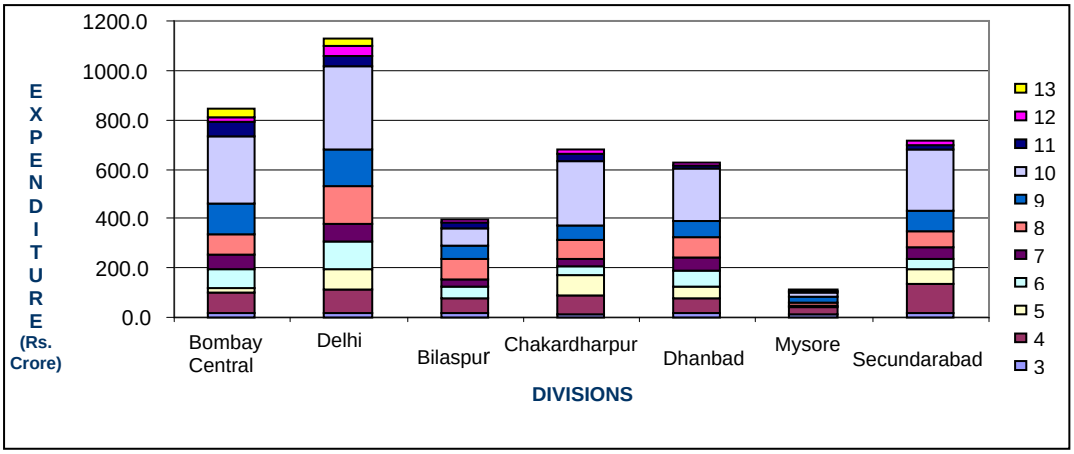
A major problem in railway costing is to segregate joint costs incurred for moving goods and passengers. Resolution of this issue is critical to estimate unit costs of operations of any multi-product industry. To estimate these costs two methods are popular; first is the cost accountants approach and the second is the statistical approach. The cost accountants approach depends primarily on surveys of typical situations and assigns predefined ratios to allocate the expenditure incurred for various common services. IR's existing costing approach and the

RITES previous studies used this method, and it is beset with the problems described earlier for these methods.

Statistical approach collects data from various units and uses statistical tools to assign costs to different services. The method was pioneered for American railroads by Meyer and his team[1] . It has some inherent advantages compared to the first approach. It uses all the available data to bring out the variations in costs for different types of outputs. It also brings into play inherent process much more explicitly without leaving it to the judgement of individual surveyors. A prime requirement to apply statistical tools to costing approach is availability of data across a large number of sampling units. The greater the variability of the inputs and outputs more robust the methodology would be. Indian Railways, owing to its size, geographical diversity, and historical development does provide such a basis. IR has 16 zones, 67 divisions and 46 workshops as administrative centres of expenditure.

A Division is the lowest independently functioning unit where the expenditure and output (or performance factors) is recorded. The divisions show wide variability in the expenditure pattern and outputs. To appreciate the variability of expenditure patterns, data for seven divisions is presented in the Figure 5.4. The divisions vary in the quantum of expenditure and the relative proportions of the different expenditure heads depending on the outputs. However, in areas where the data are sparse or have less amenability for statistical methods the existing survey approach is used for the study.

FIGURE-5.4: EXPENDITURE PATTERN IN DIVISIONS



5.3.4 Data Sources

To estimate the costs, data on expenditure and output parameters are required at the divisional level. The expenditure data are maintained by the accounts department and is recorded in Revenue Allocation Register (RAR). RAR data are kept at the 16 zonal headquarters but data are recorded for 162 accounting units; consisting of 16 zones, 67 divisions and 46 workshops and some miscellaneous accounting units. Equally comprehensive are the details of expenditure recorded. The data on expenditure are hierarchically arranged in order of demand, minor head, sub-head and detailed heads. After compilation of data for all 16 zones, it was observed that data is recorded for 2149 detailed heads. While a more comprehensive description of the RAR data are given in **Annexure-5.1.2** (in Annexure Volume-2) a few comments on data structure of RAR noticed by the Consultants would be in order. RAR data recording mechanism, a process

[1] The economics of competition in the transportation industries (1959) by John Robert Meyer, Merton J. Peck, Charles Zwick

evolved over a large number of years, is very meticulous and comprehensive at the zonal level. However, the data structure for RAR is not made uniform over the Indian Railways. As a consequence the Consultants had to face lot of problems to compare data across different zones. It is necessary to make the data structure uniform across all the zones. This would enable comparison of costs across the zones and divisions simpler and purposeful. It is also necessary to add more accounting units; especially the diesel and electric loco sheds, which spend considerable amount of money. Unlike the expense data, performance data are not maintained at one source and are needed to be pulled from a number of sources.

The data were collected from published and primary sources. A complete list of data sources is given in **Annexure-5.1.3** in Annexure Volume-2.

5.3.5 Estimation of Unit Costs: O&M

After analysing the expenditure pattern and availability of data unit costs were estimated for 7 expense categories. The expense categories and related performance units are given in Table-5.3.

TABLE-5.3: EXPENSE CATEGORIES AND THE PERFORMANCE UNITS

SN	ELEMENTS OF COSTS	UNIT
1	**Operating & Maintenance Cost:**	
	Diesel Loco: R&M,POH,	Per 000' GTKMs
	Fuel/Fuel Related Operating Expenses	Per 000' GTKMs
	Operating Exp. Other than Fuel	Per 000' GTKMs
	Electrical Loco: R&M, POH, Over Head Equipments	Per 000' GTKMs
	Fuel/Fuel Related Operating Expenses	Per 000' GTKMs
	Operating Exp. Other than Fuel	Per 000' GTKMs
2	Permanent Way-Track	Per 000' GTKMs
3	Signal & Telecommunications.	Per Train KM
4	Cost of Other Transportation	Per 000' GTKMs
5	**Cost of Carrying Units:** Wagons	Per Wagon Day
	Vehicles	Per Vehicle Day
6	Terminal Expenses	Per Tonne
7	Overhead Expenditure	Per Tonne

The basic approach is to use linear regression tools to estimate and link expenditure to output. Regression analysis expresses the relationship between an explanatory or independent variable and a response or dependent variable. In this case, the dependent variable comprises the expenditure whereas the independent variables are the units of output. A detailed explanation of the methodology, with expenditure on repair and maintenance of diesel loco as an illustration, is discussed in **Annexure-5.1.4** in Annexure Volume-2.

The linear regression output would be:

*Expense = Constant + coefficient 1 * (output 1) + coefficient 2 * (output 2) + ... + error*

The constant would represent the fixed expenditure to be incurred for production. It is therefore referred also as sunk cost or threshold cost. Coefficient 1, multiplying the output in the equation, gives the marginal cost or variable cost incurred to produce an additional unit of output 1. Thus, the equation represents the marginal or variable cost of production. The equations have a variety of tests to check their validity, and these are discussed in **Annexure-5.1.4** in Annexure Volume-2. Regression estimates for different outputs with performance factor are given in the Table-5.4.

TABLE-5.4: REGRESSION ESTIMATES (CONSTANT & COEFFICIENTS) USED IN UNIT COSTS

SN	ACTIVITY	RESPONSE FACTOR	CONSTANT (INTERCEPT)	PERFORMANCE COEFFICIENTS	
1	Diesel Loco Repair and Maintenance	Divisional Expenses	6.5 (0.00)	Loco Goods	Mail Loco
				0.18 (0.00)	0.22 (0.00)
2	Electric loco Repair and Maintenance	Divisional Expenses	11.38 (0.07)	Loco Goods	Mail Loco
				0.23 (0.05)	0.14 (0.01)
3	Diesel POH	Diesel W/Shop Exp	14.3 (0.36)	Loco POH	
				0.56 (0.05)	
4	Electric POH	Electric W/Shop Exp	13.8 (0.22)	Loco POH	
				0.27 (0.08)	
5	Coach POH	Coach W/Shop Exp	9.4 (0.57)	Non AC	AC
				0.008 (0.75)	0.56 (0.00)
6	Coach R&M	Divisional Expenses	4.96 (0.10)	Coach Holding	
				0.034 (0.0)	
7	Wagon R&M	Divisional Expenses	6.5 (0.00)	Total Outtun	
				0.02 (0.00)	
8	Other Transportation	Divisional Expenses	53.6 (0.13)	Total Ttain KM	
				0.002 (0.00)	
9	Track maintenance	Zonal Expenses	3.19 (0.64)	Equated Track kms	
				0.019 (0.00)	
10	S&T maintenance	Divisional Expenses	12.99 (0.24)	TKM (Goods)	TKM (Passenger)
				0.001 (0.06)	0.005 (0.10)
11	Operating Cost Fuel (Diesel)	Zonal Expenses	103.2 (0.12)	Goods GTKM	Pass. GTKM
				0.005 (0.130)	0.011 (0.0)
12	Operating Cost Other Than Fuel (Diesel)	Zonal Expenses	6.165 (0.00)	Goods GTKM	Pass. GTKM
				0.002 (0.67)	0.013 (0.07)
13	Operating Cost Fuel (Electric)	Zonal Expenses	103.6 (0.15)	Goods GTKM	Pass. GTKM
				25.79 (0.29)	79.23 (0.11)
14	Operating Cost Other Than Fuel (Electric)	Zonal Expenses	7.8 (0.29)	Goods GTKM	Pass. GTKM
				4.8 (0.07)	9.9 (0.06)
15	Wagon POH	Wagon W/Shop Exp		Workshop Outturn	
				Data is inconsistent	
16	Terminal Expenditure	Divisional Exp.		Originating Passengers and Goods	

Note: Regression coefficient is given in brackets adjacent to the estimate.

Proportions of fixed and variable expenditure are presented in Table-5.5.

TABLE-5.5: PROPORTION OF FIXED & VARIABLE EXPENDITURE

SN	ELEMENTS OF COSTS	UNITS IN Rs. CRORE			
		FIXED EXPENDITURE	VARIABLE EXPENDITURE	TOTAL EXPENDITURE	% OF FIXED EXPENDITURE
1	Operating & Maintenance Cost:				
	Diesel Loco: R&M,POH,	374	1050	1424	0.26
	Fuel/Fuel Related Operating Expenses	1238	4285	5523	0.22
	Operating Exp. Other than Fuel	99	1216	1315	0.08
	Electrical Loco: R&M, POH, OH Equipments	392	1581	1973	0.20
	Fuel/Fuel Related Operating Expenses	1243	4343	5586	0.22
	Operating Exp. Other than Fuel	92	694	786	0.12
2	Permanent Way-Track	239	2117	2356	0.10
3	Signal & Telecommunications.	208	731	939	0.22
4	Cost of Other Transportation	804	2506	3310	0.24
5	**Cost of Carrying Units:** Wagons	470	2218	2688	0.18
	Vehicles	332	1685	2017	0.16
6	Terminal Expenses	671	2863	3534	0.19
7	Overhead Expenditure	724	3088	3812	0.19
	Total Expenditure	**6888**	**28377**	**35265**	**0.20**

Complete details of these estimates, including t values, adjusted R-squared and values of test statistics are given in **Annexure-5.1.5** in Annexure Volume-2.

The various elements of O&M cost estimates per unit of performance are given in the Table-5.6.

TABLE-5.6: ELEMENTS OF O&M COST ESTIMATES

FIGURES IN RUPEES

SN	ELEMENTS OF COSTS	UNITS OF OUTPUT	FREIGHT	PASSENGER
1	**Operating & Maintenance Cost:**			
	Diesel Loco: R&M,POH,	1000 GTKMs	20	22
	Fuel/Fuel Related Operating Expenses	1000 GTKMs	107	124
	Operating Exp. Other than Fuel	1000 GTKMs	23	26
	Electrical Loco: R&M, POH, OH Equipments	1000 GTKMs	13	17
	Fuel/Fuel Related Operating Expenses	1000 GTKMs	54	76
	Operating Exp. Other than Fuel	1000 GTKMs	7	10
2	Permanent Way-Track	1000 GTKMs	31	23
3	Signal & Telecommunications.	Train KMs	17	9
4	Cost of Other Transportation	1000 GTKMs	38	39
5	**Cost of Carrying Units:** Wagons/Vehicles	Wagon/Vehicle	153	1224
6	Terminal Cost – Documentation	Tons/Passr. Originated	3	9
	Terminal Cost - Other Terminal Expenses	Tons/Passr. Originated	14	
7	Overhead Expenditure	Tons/Passr. Originated	29	7

5.3.6 Estimation of Unit Costs: Capital

Assets are acquired and used on a continual basis and estimating the cost of capital for a particular year becomes difficult. The issue is further complicated as the study has to adapt uniform method for capital costs for all the modes under study. Keeping the data availability in different modes of transport the study team decided to estimate capital costs assuming all assets are acquired or built in 2007-08. Annual cost of using the capital assets is assessed by three different methods. First the annual depreciation of the asset, arrived at by dividing by asset life assuming straight line method of depreciation, is assumed as the annual cost of capital. This approach de-links the financing of the capital assets from their utilisation, an issue relevant for policy perspective. In the second approach the annual deprecation is increased by adding interest to the capital. The third method uses capital recovery factor approach where interest on capital and depreciation are simultaneously considered to arrive at a fixed annual value. Details of capital expenditure are estimated for 7 assets and they are presented in Table-5.7. The details of estimation are given in **Annexure-5.1.6.1 to Annexure 5.1.6.7** in Annexure Volume-2.

TABLE-5.7: ASSET-WISE CAPITAL EXPENDITURE

SN	ITEM OF CAPITAL	DEPRECIATION	INTEREST	TOTAL	UNIT OF MEASUREMENT	COST PER UNIT
I	**Rolling Stock:**	Rs	Rs	Rs		Rs
	1. Loco – Diesel	4944178	11569376000	11574320178	1000 gtkms	27.04
	2. Loco - Electrical	5711714	12994150000	12999861714	1000 gtkms	24.17
	3. Wagons	12659677	28800766055	28813425732	Wagon day	243
	4. Coaches	8984470	17519715980	17528700450	Vehicle day	975
II	**Track**	346570	2292366	2638936	1000 gtkms	140
III	**Overhead Equip**	114900	298740	413640	1000 gtkms	17.97
IV	**S & T (Per TKM)**	88850	144382	233232	1000 gtkms	12.39

5.3.7 Sectional Costs

As the primary objective of the study is to simulate cargo flow on the transport network it is imperative to relate the unit costs arrived to different types of sections for movement of cargo. The selection of sectional types is driven by the Railway operations and the Inception Report. Both capital and operations costs firstly vary based on the number of lines in the section; hence single line and double line or multiple lines are taken as two categories.

Similarly, the electric and diesel sections have different characteristics and they drive the operational and capital costs totally. Gradient of a section is a critical element in deciding capital and operations costs because speed of movement, tractive effort required and detention hours vary with the gradient. Based on this criterion sections were divided into two categories; plain sections with gradients less steep than 1 in 100 and ghat sections with steeper gradients. The three criteria have two sub-categories giving rise to 8 (2*2*2) different combinations to identify variations in sectional costs. Section types for which O&M costs can be differentiated are the following:

1	SINGLE LINE-DIESEL-PLAIN	2	DOUBLE LINE-DIESEL-PLAIN
3	SINGLE LINE-ELEC-PLAIN	4	DOUBLE LINE-ELEC-PLAIN
5	SINGLE LINE-DIESEL-GHAT	6	DOUBLE LINE-DIESEL-GHAT
7	SINGLE LINE-ELEC-GHAT	8	DOUBLE LINE-ELEC-GHAT

The sectional costs vary due to sectional speeds, requirement of additional locomotives for movement and additional time spent for safety examination. All these factors were considered in estimating the sectional costs. Sectional speed and detention data were obtained from freight operating information systems (FOIS), train running data base for large sample of sections. A summary of sections used in this estimation is given in Table-5.8.

TABLE-5.8: SUMMARY OF SECTIONAL DATA FOR ESTIMATING SPEEDS

SN	CAPACITY	DIESEL				ELECTRIC				TOTAL
		PLAIN		GRADIENT		PLAIN		GRADIENT		
		SL	DL	SL	DL	SL	DL	SL	DL	
1	A	11	7	4	--	12	7	--	2	53
2	B	5	4	2	--	--	6	--	--	17
3	C	9	2		--	4	6	--	1	22
4	D	17	4	5	--	5	11	1	--	43
	Total	**42**	**17**	**11**	--	**21**	**30**	**1**	**3**	**125**

The data on requirement of additional locomotives and additional train examinations is obtained from working time tables, FOIS information and discussions with the zonal operating teams.

Using the above criteria average Sectional Unit Costs are estimated for Indian Railways. The unit costs are then converted to cost per tonne-km (tkm) for freight services and cost per passenger-km (pkm) in the case of coaching services by developing appropriate factors. The converted sectional cost per tkm and per pkm is given in Table-5.9.

TABLE–5.9(a): SECTIONAL TKM COSTS FOR MOVEMENT OF CARGO

Units: Rs. per TKM

SN	ELEMENTS OF COSTS	PLAIN SECTION				GHAT SECTION			
		UNIT COST FOR DIESEL		UNIT COST FOR ELECT.		UNIT COST FOR DIESEL		UNIT COST FOR ELECT.	
		SL	DL	SL	DL	SL	DL	SL	DL
A	**FINANCIAL COSTS:**								
1	Line-haul/Operational Costs	0.34	0.30	0.23	0.21	0.62	0.54	0.37	0.32
2	Terminal Cost	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
3	Overhead Cost	0.045	0.045	0.045	0.045	0.04	0.04	0.04	0.04
4	Total of O&M Costs	0.41	0.37	0.30	0.28	0.69	0.61	0.44	0.39
5	Capital Costs	0.26	0.27	0.28	0.29	0.29	0.30	0.31	0.32
6	Total Fully-distributed Costs	**0.66**	**0.63**	**0.57**	**0.54**	**0.97**	**0.91**	**0.75**	**0.71**
B	**ECONOMIC COSTS:**								
1	Line-haul/Operational Costs	0.28	0.25	0.19	0.17	0.51	0.45	0.30	0.26
2	Terminal Cost	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
3	Overhead Cost	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
4	Total of O&M Costs	0.35	0.32	0.26	0.24	0.58	0.52	0.37	0.33
5	Capital Costs.	0.21	0.22	0.22	0.23	0.25	0.26	0.27	0.28
6	Total Fully-distributed Costs	**0.56**	**0.54**	**0.48**	**0.45**	**0.83**	**0.78**	**0.64**	**0.61**

TABLE-5.9(b): SECTIONAL PKM COSTS FOR MOVEMENT OF PASSENGERS

(UNITS: RS. PER PKM)

DESCRIPTION	OCCU-PANCY	PLAIN SECTION								GRADIENT SECTION			
		MAIL/EXPRES				ORDINARY SERVICES				MAIL/EXP.		ORDINARY SERVICES	
		DSL-SL	DSL-DL	ELC-SL	ELC-DL	DSL-SL	DSL-DL	ELC-SL	ELC-DL	DSL-SL	ELC-DL	DSL-SL	ELC-DL
(A) FINANCIAL COST													
ONE METRO CITY TO A METRO CITY	100%	0.38	0.36	0.33	0.33	0.31	0.30	0.28	0.27	0.43	0.38	0.35	0.32
	76%	0.48	0.46	0.42	0.41	0.40	0.38	0.35	0.34	0.54	0.48	0.45	0.41
	Actual	0.46	0.44	0.40	0.40	0.35	0.34	0.44	0.31	0.52	0.46	0.40	0.37
ONE METRO CITY TO A MOFUSSIL CITY	100%	0.36	0.34	0.32	0.31	0.30	0.28	0.27	0.26	0.40	0.36	0.34	0.31
	76%	0.46	0.44	0.40	0.39	0.38	0.36	0.34	0.33	0.52	0.46	0.43	0.39
	Actual	0.44	0.42	0.39	0.38	0.34	0.32	0.30	0.29	0.49	0.44	0.38	0.35
ONE MOFUSSIL CITY TO A MOFUSSIL CITY	100%	0.31	0.30	0.28	0.27	0.33	0.31	0.29	0.28	0.35	0.32	0.37	0.34
	76%	0.40	0.38	0.35	0.34	0.42	0.40	0.36	0.35	0.44	0.40	0.47	0.42
	Actual	0.38	0.36	0.33	0.33	0.37	0.36	0.33	0.32	0.42	0.38	0.42	0.38
(B) ECONOMIC COST													
ONE METRO CITY TO A METRO CITY	100%	0.32	0.31	0.28	0.28	0.26	0.25	0.23	0.23	0.36	0.32	0.30	0.27
	76%	0.41	0.39	0.36	0.35	0.34	0.32	0.30	0.29	0.46	0.41	0.38	0.34
	Actual	0.39	0.37	0.34	0.34	0.30	0.29	0.37	0.26	0.44	0.39	0.33	0.31
ONE METRO CITY TO A MOFUSSIL CITY	100%	0.31	0.29	0.27	0.27	0.25	0.24	0.22	0.22	0.34	0.31	0.28	0.26
	76%	0.39	0.37	0.34	0.33	0.32	0.31	0.28	0.28	0.43	0.39	0.36	0.33
	Actual	0.37	0.35	0.33	0.32	0.29	0.27	0.25	0.25	0.41	0.37	0.32	0.29
ONE MOFUSSIL CITY TO A MOFUSSIL CITY	100%	0.27	0.26	0.24	0.23	0.28	0.26	0.24	0.24	0.30	0.27	0.31	0.28
	76%	0.34	0.32	0.29	0.29	0.35	0.34	0.30	0.30	0.38	0.34	0.40	0.35
	Actual	0.32	0.31	0.28	0.28	0.31	0.30	0.28	0.27	0.36	0.32	0.35	0.32

Actual Occupancy Ratio Formulae = (Passenger KMs/Vehicle KMs) X (2/Coach Capacity)
Actual Occupancy Ratio for M/E trains = 79%
Actual Occupancy Ratio for Ordinary Services = 86%%

5.3.8 Costing of Commodities

The Inception Report specifies costing to be carried out for 10 representative commodity groups as listed in Table-5.10.

TABLE-5.10: LIST OF REPRESENTATIVE COMMODITIES

1	FOOD GRAINS	6	POL
2	FRUITS & VEGETABLES	7	CEMENT
3	COAL	8	LIVESTOCKS
4	FERTILISERS	9	IRON & STEEL PRODUCTS
5	SUGAR	10	CONTAINER

Commodity wise costs were identified to be varying by three important cost drivers; percentage of distance the trains run empty after unloading or to load a cargo (referred as empty return ratio), average quantity loaded in a wagon, and average lead for the cargo. The empty return ratio for different types of wagons and average quantity loaded in a wagon was collected from the Railway Board published records. The average lead data were based on the Annual Statistical Statements. These parameters are shown in **Annexure-5.1.7.1 & Annexure 5.1.7.2** in Annexure Volume-2. Using these parameters cost for moving a commodity per tkm is estimated. The results are summarised in the Table-5.11. Detailed financial cost of operations and maintenance and capital costs for the 10 commodities are given in **Annexure-5.1.8.1** to **5.1.8.10** for Ghat Section and **Annexure 5.1.9.1** to **5.1.9.10** for Plain Section in Annexure Volume-2.

TABLE-5.11: OPERATOR COST

FINANCIAL COST		UNIT: RS. PER TKM							
		PLAIN SECTION				GHAT SECTION			
SN	ELEMENTS OF COSTS	UNIT COST FOR DIESEL		UNIT COST FOR ELECT		UNIT COST FOR DIESEL		UNIT COST FOR ELECT	
		SL	DL	SL	DL	SL	DL	SL	DL
1	Wheat	0.77	0.73	0.65	0.63	1.17	1.08	0.89	0.82
2	Onions	0.79	0.75	0.67	0.65	1.20	1.11	0.91	0.85
3	Coal	0.82	0.77	0.69	0.67	1.24	1.14	0.94	0.86
4	Fertilisers	0.79	0.75	0.67	0.66	1.19	1.10	0.91	0.84
5	Sugar	0.76	0.72	0.64	0.63	1.17	1.08	0.88	0.81
6	POL	0.90	0.85	0.75	0.73	1.38	1.27	1.03	0.95
7	Cement	0.81	0.77	0.69	0.68	1.21	1.12	0.93	0.86
8	Livestock	1.92	1.80	1.61	1.56	2.94	2.71	2.21	2.04
9	Steel Products	0.84	0.79	0.70	0.68	1.30	1.19	0.97	0.89
10	Container heavy wt.	0.98	0.92	0.83	0.80	1.48	1.37	1.12	1.04

5.3.9 Economic and Social Costing

Taxes and subsidies are parts of any transport industry; more importantly so rail movement. To assess the economic costs taxes and subsidies of the system are corrected and shadow pricing factors worked out using the Planning Commission Project Appraisal and Monitoring Division (PAMD) guidelines. The shadow pricing factors are listed out in Table-5.12 for operational and capital expenditure.

TABLE-5.12: ECONOMIC COST FACTORS FOR RAILWAYS

OPERATION & MAINTENANCE (O&M)		
HEADS	COST FACTOR	
	DSL	ELEC
Documentation	0.94	0.94
Other Terminal	0.91	0.91
Provision & Maint. of Wagons	0.82	0.82
Traction	0.81	0.78
Track Maintenance	0.87	0.87
Signalling	0.82	0.82
Other Transportation Services	0.92	0.92
Overheads Cost	0.93	0.93
AGGREGATE O&M	0.89	0.90

ROLLING STOCK (RS)		
HEADS	COST FACTOR	
	DSL	ELEC
Wagon (Excl. Taxes)	0.81	
Locomotives		
WDG3	0.82	
WDG4	0.81	
WAG7		0.84

COSTRUCTION COST	
HEADS	COST FACTOR
Civil	0.85
S & T	0.81
General Electrification	0.79
Electrification	0.79

The economic costs for the 10 commodities are listed out in Table-5.13.

TABLE-5.13: UNIT ECONOMIC COSTS FOR THE 10 COMMODITIES

Unit: Rs./TKM

SN	ELEMENTS	PLAIN SECTION				GHAT SECTION			
		DSL		ELEC		DSL		ELEC	
		SL	DL	SL	DL	SL	DL	SL	DL
1	Food grains	0.63	0.59	0.53	0.52	0.98	0.91	0.80	0.74
2	Fruits & vegetables	0.65	0.61	0.55	0.53	1.00	0.93	0.83	0.76
3	Coal	0.68	0.64	0.57	0.55	1.04	0.96	0.85	0.78
4	Fertilisers	0.65	0.62	0.55	0.54	1.00	0.93	0.82	0.76
5	Sugar	0.63	0.59	0.52	0.51	0.97	0.90	0.80	0.74
6	POL	0.74	0.70	0.62	0.60	1.15	1.06	0.94	0.86
7	Cement	0.67	0.64	0.57	0.56	1.02	0.95	0.84	0.78
8	Livestock	1.56	1.47	1.30	1.27	2.44	2.26	2.00	1.84
9	Iron & Steel Products	0.69	0.65	0.57	0.55	1.08	1.00	0.88	0.80
10	Container	0.80	0.76	0.67	0.66	1.23	1.15	1.02	0.94

Another important component of the study is to assess the externalities involved in rail transport. The Inception Report mandated assessment of environmental cost and accident cost as part of the social cost. To assess the environmental cost, abatement costs worked out by Central Pollution Control Board (CPCB) to reduce carbon dioxide emissions were considered. The cost of abatement of green house gases worked out to Rs 0.05/tkm for diesel traction and Rs 0.01/tkm for electric traction. The accident cost assessed by Asian Institute of Transport Development (AITD) were adopted for the study and updated to 2007-08. Accident cost works out to Rs 0.001/tkm. Total resource cost for transport by rail is obtained by adding the economic costs and the social costs.

5.3.10 Comparison with Railways Unit Cost Estimates

Table-5.14 compares the costs estimates from this study and the unit costs estimates of Indian Railways (IR). Out of the six elements, costs of five elements differ from railway estimates by less than 10 %. However, wide differences are noted in S&T estimate. This could have arisen either due to data limitation or that assumed performance factors do not explain the expenditure pattern. The later is plausible as S&T expenditure is mainly driven by signal and telecom units and not by the train and track-kilometres. However, as data on signal and telecom unit could not be gathered, the analysis had to be based on train-kilometres.

TABLE-5.14: UNIT COST COMPARISON OF RITES AND IR

SN	ELEMENTS OF COSTS	FREIGHT UNIT COSTS		PERCENTAGE OF DIFFERENCE
		RITES	IR	
1	**Operational Costs**			
	Diesel Loco-R&M, POH Operating Cost Other than Fuel per 1000 gtkms	41.34	39.56	
	Fuel and fuel related Operating exp. cost per 1000gtkms	102.40	93.81	
	Total Working expenditure of Diesel Loco	**143.74**	**133.37**	**-0.08**
2	Electrical Loco-R&M, POH, OHE and Operating other than Energy.	19.34	23.92	
	Energy cost per 1000 gtkms	51.45	52.25	
	Total Working expenditure of Electrical Loco	**70.79**	**76.17**	**0.07**
3	**O&M Cost of Track Per 1000 gtkms**	**29.94**	**30.23**	**0.01**
4	**O&M Cost of Other transportation per 1000 gtkms**	**36.72**	**35.80**	**-0.03**
5	**O&M Cost of S&T per Train-km**	**16.59**	**10.91**	**-0.52**
6	**O&M Cost of Wagons.**	**146.22**	**146.97**	**0.01**

5.4 MODAL COST: HIGHWAYS

5.4.1 Introduction

The unit cost of transportation for various modes plays an important role in defining the importance of each mode and thus affecting the inter-modal choice of the users. Unit cost comprises both noticeable (quantifiable costs) and concealed (non-quantifiable) costs. While the quantifiable costs are worked out by using element-wise ongoing market prices, the non-quantifiable costs are estimated on normative basis, where the norms are developed not as a part of the same exercise but after going through a detailed analysis of limited data/information.

In the case of Highways (road transport), unit operating costs of carrying goods and/or passengers can be divided in two categories - vehicle operating costs and the user costs. While the vehicle operating costs are directly borne by the service providers or the vehicle owners, the user costs are incurred by the users of the service before the actual start of the modal transportation as well as after the completion of the transport service and are thus in addition to

the vehicle operating costs. The later element of cost relates mainly to packaging, handling, local cartage, inventory, etc. in the case of goods transport sector. For passenger transport it relates to the distance travelled by the passenger from his actual place of start (stay) to the bus terminal at origin and similar leg of journey at destination to reach his final destination. Under goods transport local cartage of cargo is considered only in the case of parcels, which involve consolidation of goods by the booking agents to form a full vehicle-load for a particular destination.

The requisite cost structure has been developed by collecting item-wise cost incurred by various agencies in financial terms. All the costs have been collected to represent the base year 2007-08, to complement goods and passenger flows data estimated based on detailed surveys. Financial costs for different components have been converted into economic terms by adopting relevant norms prescribed by the Planning Commission, Govt. of India.

Almost all the cost elements remain unchanged both in financial and economic cost structures, except highways cost, accidents, environment and other social costs. While the highway (road) cost is considered as a part of the vehicle operating costs under the economic costing, in financial costing various taxes payable by the vehicle owner (such as road tax, goods or passenger tax, etc) are considered in lieu of this. Similar remarks hold good for costs relating to accidents, environment and other social costs which are considered in addition to the vehicle operating costs under economic costing.

The entire cost structure has been divided into three categories, i.e. vehicle operating costs, highway cost and the users costs.

5.4.2 Vehicle Operating Costs

In spite of the fact that both goods and passenger transport use similar type of vehicles and perform on the same infrastructure, their operations are not similar. Moreover, in the goods sector where private operators play a significant role, public sector is more effective in the passenger transport sector, because of various reasons. In the light of this, while estimating vehicle operating cost norms, goods and passenger sectors are considered independently.

Vehicle operating costs have been estimated to reflect the entire spectrum of costs borne by the vehicle owners/operators as service providers. Since these costs vary under different operating conditions such as terrain, highway quality, commodity handled, etc., an attempt has been made to distinguish costs structure to reflect all these operating conditions. Further, with a view to ascertain cost discrimination arising on account of varying vehicle operating conditions, both due to ownership as well as operating conditions in different parts of the country, the sample frame for collecting information has been drawn from all over India.

In order to estimate the relative vehicle operating costs under different operating conditions the requisite information has been collected by canvassing specially designed questionnaires. Keeping in view the predominance of single-truck owners/operators in goods transport sector and the method of their maintaining records/information on vehicle performance and cost particulars, separate questionnaires have been used for single-truck operators and multi-vehicle operators. While for the multi-vehicle operators, the information has been culled out from their records, for the single-vehicle operators personal interview method was adopted for collection of the required information from the crew. Reverse holds good in the case of passenger transport sector, where main emphasis was given to collect information from the State Road Transport Undertakings.

In view of the fact that details of certain goods vehicle operating costs as well as operating behaviour can be elicited more accurately from the vehicle crew, the required information was

collected by canvassing a specially designed questionnaire on 'Vehicle Performance and Cost Behaviour' survey along with the goods O-D survey conducted at more than 1000 check-posts all over the country. On the other hand, for the more organized passenger transport operations, similar information could be collected on the basis of sample interviews with the crew working on various routes.

Since the load-ability of trucks varies from commodity to commodity, in order to assess the actual load of different commodities carried by various types of vehicles on different routes, at all-India level, Weigh-bridge surveys were conducted at selected locations. Requisite information on trip particulars, commodity particulars, weight of empty vehicle (un-laden weight of the vehicle) and the gross weight of the vehicle including the weight of commodity, has been collected just at the start or at the end of a trip, at the existing private weigh-bridges. The process involved recording of two weigh-ments in each case. For the terminating trips, particulars of vehicle (vehicle registration No., ULW, RLW, carrying capacity, etc.), trip particulars (origin-destination), commodity carried, gross weight the vehicle were recorded and the weight of the un-laden vehicle was recorded after the vehicle was emptied at the final destination. On the other hand for originating trips, all information other than the gross vehicle weight (GVM) was recorded when the empty vehicle is weighed before start of the trip. This information was used to determine the extent of overloading on various road section characteristics.

With a view to correlate the data collected through the goods origin-destination surveys with the road network and vehicle characteristics, operating costs have been estimated under different scenarios. In order to accommodate highway characteristics in the cost estimates, separate costs have been estimated to represent terrain (Plain, Hilly/Rolling), highway type (NH, SH, MDR/ODR) and road width (Single-lane, Double-lane, Four-lane and above 4-lane). Similarly, keeping in view the carrying capacity of different types of goods vehicles separate costs have been estimated to represent tempos (Light & Medium Commercial Vehicles), trucks (Heavy Commercial Vehicles - 2 axle), trucks (Heavy Commercial Vehicles - 3 axle) and multi-axle trailers (Heavy Commercial Vehicles - 4 axle and above).

It was established from the goods O-D survey results that vehicle composition on road changes with the trip length. In order to appropriately account for the impact of each category of vehicle, the O-D survey data have accordingly been grouped into number of sub-categories. In total 1.51 million goods vehicle trips intercepted in the first round of goods O-D have been used and summarized in Table-5.15.

TABLE-5.15: NO. OF TRIPS ON DIFFERENT DISTANCE SLABS

SN	Distance Slab (Km)	2 Axle 4/6 Tyres		3 Axle (10 Tyres)	4 Axle & Above (14 Tyre & Above)	Grand Total
		Tempo	Truck			
1	0-200	176816	367909	126485	24855	696065
2	201-400	29448	117788	75686	12279	235201
3	401-600	9625	56847	43114	7626	117212
4	601-800	3308	42780	38135	7250	91473
5	801-1000	879	35047	31278	5841	73045
6	1001-1500	1649	66719	70752	12820	151940
7	>1500	2212	66020	68834	11092	148158
TOTAL		223937	753110	454284	81763	1513094

Results of Weigh-bridge surveys have revealed that different commodities have different load-ability, hence commodity-specific transportation costs have been worked out.

To develop vehicle operating cost (VOC) norms for representing each category of vehicles, item/element wise data have been collected through the surveys and interviews in respect of 10941 goods vehicles. Element wise cost details have been collected from the field in financial terms. Although efforts have been made to collect the required information from a representative sample of goods vehicles under each sub-category, data were interpolated to bridge the data gaps, if any.

VOC has been divided into time-related and running costs. Time-related costs include, expenditure such as capital, crew salary, insurance, taxes (Goods & Road), overheads, etc. which are to be incurred by the operator irrespective of the vehicle movement. Similarly, the costs borne by the operator relating to vehicle movement are considered as running costs, i.e. fuel, mobil oil, repairs and maintenance (all types), tyre & tubes, toll charges, trip allowances or 'Bhatta' to the crew and other wayside expenses.

5.4.3 Time Related Costs

Capital Costs: In view of the fact that capital investment is a one-time cost and needs to be recovered on the entire performance of the vehicle, annualized costs have been estimated using cost recovery factor (CRF) technique. All the information on capital cost was used to represent a new vehicle.

Vehicle Taxation: Regarding the existing vehicle taxation system, information on vehicles with different tax options has been collected. Since it was not feasible to segregate the sample on the basis of tax options, an overall tax for various categories of vehicles operating on different distance ranges has been estimated to work out the modal costs.

Crew Cost: To estimate the cost on vehicle crew relating to different types of vehicles, information collected from the sample crew (private sector only) has been adopted, keeping in view their overall share in the road transport market. Monthly allowances such as uniform allowance, festival allowance, dearness allowance, if any, are also included under the crew costs. Details on these cost elements have been collected through the sample drivers during Cost & Performance Behaviour Survey.

Vehicle Insurance: It is obligatory to get the vehicle insured before it is put on road. The insurance charges vary from vehicle to vehicle depending upon various factors. In the current study, insurance paid by the operator (as obtained from his records) has been considered and an overall insurance figure has been worked out for different categories of vehicle.

Overhead Costs: Although the goods road transport sector has preponderance of single-vehicle operators, the overhead charges may or may not be applicable in their case. However, in this study, the overhead expenditure reported by the multi-vehicle operators as well as the single-vehicle operators, on staff which is not working as vehicle crew members but are providing necessary services for vehicle operations, the cost indicated to meet such services has been included in the time-related cost estimates.

5.4.4 Running Costs

Fuel Costs: Expenditure on fuel is one of the major cost elements of vehicle operations and predominantly diesel is the main fuel used in the goods vehicles. Although the unit price of diesel is fully controlled by the central government, cost per unit is charged differently in different states after adding the local state taxes. In this exercise, the actual cost incurred by the operator

has been collected and incorporated to arrive at per unit transport cost. Efforts have also been made to independently estimate the fuel cost norms for each road terrain condition as well as to reflect the cost variations arising on account of the road conditions.

Mobil Oil & Lubricants Cost: In order to reflect their impact on different road and vehicle conditions, the mobil oil & lubricant costs are considered independent of the repair & maintenance costs.

Vehicle Repair & Maintenance Cost (R&M): Repair and maintenance cost is another major head of expenditure incurred by the vehicle operator on regular basis. In view of the fact that newer vehicles require lesser repair & maintenance expenditure, more so, the periodical overhaul, which involves sizeable expenditure and is undertaken once after 2 or 3 years (above the performance recommended by the vehicle manufacturer), the overall sample was drawn covering all category of vehicles. All the costs, on scheduled (at headquarter) and responsive (en-route/wayside and at terminals) repairs have been estimated.

Tyres & Tubes Cost: Like repair & maintenance, expenditure on tyres and tubes is another important head. Nowadays with a growing number of multi-axle vehicles on road the expenditure on tyres and tubes is more than the repair & maintenance cost. While estimating overall costs on tyres & tubes, re-soling costs as well as the resale value obtained by the operator, if reported, has also been considered and included under this head of cost.

Trip-allowance to crew: In addition to salary, crew is given daily allowance (Bhatta) to meet their day to day expenditure (towards food, etc). In majority of the cases, such an amount is authorized by the owner of the vehicle to crew on daily basis as a part of the en-route expenditure. In certain cases to attract better performance, some of the operators have attached it to the round trip, which may be different for different O-D pairs. It is pertinent to note that the days when the vehicle is laid-off due to major repairs or non-availability of loads, the operator continues to the pay daily allowance to vehicle crew. In this exercise the daily allowance (as reported) has been used as a part of the VOC.

Other Operating Costs: Costs such as en-route toll and octroi charges, weigh-bridge charges, commission paid to middle agency for arranging loads (cargo), minor repair charges, parking fees and other incidental charges (fines, penalties, Police expenditure, etc) are included under this head. These costs are incurred by driver and are different on different routes. Item wise expenditure for each type of vehicle to represent each category has been tabulated in the format described below. Wherever, the cost for any item was reported for the period other than base year, costs of the base year have been used particularly in case of purchase price of vehicle chassis and body fabrication, because of sample mix, representing different vehicle age.

For estimating the desired level of cost disaggregation, many field surveys have also been conducted to elicit information on average loading & unloading time for each commodity, average load carried by various type of vehicles, number of vehicle running hours, actual running speed (through test journey surveys) on different types of road sections. Element-wise cost estimates format is given in Table-5.16.

TABLE-5.16: ELEMENT-WISE COST ESTIMATES – A FORMAT

SN	COST ELEMENT			
1	Capital Cost (2007-08)			
2	Payload (Tonnes)			
3	Extent of Overloading			
4	Annual Performance			

SN	COST ELEMENT			
5	Working Hrs./Year			
6	Average Age of Vehicle (Years.)			
7	Life (Years)			
8	Loading/Unloading Time (Hr per handling)			
9	Average Running Speed (Km/Hr)			
A.	**TIME RELATED COSTS**	ANNUAL COST (RS)	COST / WORKING HR (RS.)	COST / TONNE-KM (PAISE)
i)	Annualized Cost of Vehicle			
iii)	Crew Salary & Allowances			
iv)	Motor Vehicle Taxes			
v)	Insurance			
vi)	Overheads			
	Sub-Total			
	Excl. Cap. Cost			
	Incl. Cap. Cost			
B.	**RUNNING COSTS:**			
i)	Diesel			
ii)	Mobil oil			
iii)	Crew Running Allowance			
iv)	Repair & Maintenance			
v)	Battery			
vi)	Tyres & Tubes			
vii)	Others			
	Sub-Total			
	TOTAL COST:			
	Excl. Capital Cost			
	Incl. Capital Cost			

All the time related (annualized) costs have been distributed on the estimated number of vehicle running-hours per year, whereas the running costs have been directly assigned on the basis of actual running of vehicle. Based on the foregoing discussions, all the results are grouped into a number of combinations, to reflect highway type (NH, SH, MDR), highway terrain (plain, rolling and hilly), and width (number of lanes). Under each category, VOC of each type of vehicle such as tempo, 2-Axle truck, 3-Axle truck and multi-axle trailor has separately been estimated. Various combinations considered under the Plain terrain are given in Table-5.17. Similar set of VOC has also been worked out for goods vehicle operating under Rolling and Hilly terrain conditions.

TABLE-5.17: HIGHWAY COMBINATIONS UNDER PLAIN TERRAIN

SN	HIGHWAY TERRAIN	HIGHWAY TYPE	NO. OF LANES	SECTION CODE	VEHICLE TYPE
1	Plain	NH	2 Lane	112	Tempo
2	Plain	NH	2 Lane	112	2 Axle Truck
3	Plain	NH	2 Lane	112	3 Axle Truck
4	Plain	NH	2 Lane	112	Multi-Axle Trailor
5	Plain	NH	4 Lane	114	Tempo
6	Plain	NH	4 Lane	114	2 Axle Truck
7	Plain	NH	4 Lane	114	3 Axle Truck
8	Plain	NH	4 Lane	114	Multi-Axle Trailor
9	Plain	NH	4 Lane Exp.	115	Tempo
10	Plain	NH	4 Lane Exp.	115	2 Axle Truck
11	Plain	NH	4 Lane Exp.	115	3 Axle Truck
12	Plain	NH	4 Lane Exp.	115	Multi-Axle Trailor
13	Plain	SH	2 Lane	122	Tempo
14	Plain	SH	2 Lane	122	2 Axle Truck
15	Plain	SH	2 Lane	122	3 Axle Truck
16	Plain	SH	2 Lane	122	Multi-Axle Trailor
17	Plain	SH	4 Lane	124	Tempo
18	Plain	SH	4 Lane	124	2 Axle Truck
19	Plain	SH	4 Lane	124	3 Axle Truck
20	Plain	SH	4 Lane	124	Multi-Axle Trailor
21	Plain	SH	4 Lane Exp.	125	Tempo
22	Plain	SH	4 Lane Exp.	125	2 Axle Truck
23	Plain	SH	4 Lane Exp.	125	3 Axle Truck

SN	HIGHWAY TERRAIN	HIGHWAY TYPE	NO. OF LANES	SECTION CODE	VEHICLE TYPE
24	Plain	SH	4 Lane Exp.	125	Multi-Axle Trailor
25	Plain	MDR	Single Lane	131	Tempo
26	Plain	MDR	Single Lane	131	2 Axle Truck
27	Plain	MDR	Single Lane	131	3 Axle Truck
28	Plain	MDR	Single Lane	131	Multi-Axle Trailor
29	Plain	MDR	2 Lane	132	Tempo
30	Plain	MDR	2 Lane	132	2 Axle Truck
31	Plain	MDR	2 Lane	132	3 Axle Truck
32	Plain	MDR	2 Lane	132	Multi-Axle Trailor
33	Plain	MDR	Intermediate Lane	136	Tempo
34	Plain	MDR	Intermediate Lane	136	2 Axle Truck
35	Plain	MDR	Intermediate Lane	136	3 Axle Truck
36	Plain	MDR	Intermediate Lane	136	Multi-Axle Trailor

Road Category Codes

- **Terrain:** Plain =1, Rolling =2, Hilly =3,
- **Road Type:** NH =1, SH =2, MDR =3,
- **No. of Lanes:** Single Lane =1, Two Lane = 2, Four Lane = 4, Four Lane Expressway = 5, Intermediate Lane = 6

As discussed above, VOC has been estimated to represent each category and sub-category. Depending upon the actual load being carried in the case of each commodity, all the commodities have been grouped into three broad categories i.e. heavy, light and normal commodities. While the heavy commodities have a greater tendency of overloading such as iron ore, other ores, coal, cement, iron & steel, etc., the light commodities on the other hand represent those commodities that have either low or no over loading tendency i.e. wood, fruits and vegetables, tea, POL products, fodder, jute, cotton, etc. Most of the commodities falling in this category are voluminous in nature and cannot be loaded beyond the carrying capacity of the vehicle.

The commodities under the normal group are generally carried in standard bags, and as a result, the operator is able to decide the extent of load to be carried by him, which is not the case for most of the heavy commodities. The extent of overloading registered in the case of normal commodities was much lower than that of the heavy commodities. Further, the average load-ability of commodities varied under different terrain conditions. For each commodity category, average terminal time for loading and unloading of cargo, has been worked out on the basis of field surveys. Since the terminal time remains unchanged irrespective of the trip length, an overall average time has been worked out.

Average annual working hours have been estimated to distribute the overall time-related costs on the basis of vehicle composition observed at each distance range. Similarly, the composite running speed has been estimated separately to reflect the terrain, highway type and width of highway (number of lanes). Annual time related and running costs have been estimated separately to arrive at the overall VOC per tonne-km (the final output). As discussed earlier, while the time related costs are distributed over the total vehicle running hours, which are attributed to the trip on the basis of overall distance involved and the average speed observed on the corridor, the running costs are distributed over the total performance of the vehicles to arrive at per vehicle-km cost. Both the time related and running costs are further distributed over the average load carried by the vehicle to arrive at per tonne-km cost. Broad format used to represent each category in the Plain terrain is given in Format-5.1.

Relevant set of costs has been used to arrive at the total transport systems cost. The actual trip distance and commodity formed the basis for the cost assignment. Wherever the O-D pair has involved more than one set of cost inputs, the relevant inputs have been assigned to arrive at the total transportation costs. For example, in case an O-D pair involves more than one terrain

conditions, the relevant costs have been assigned to the corresponding distances. Similar remarks hold good for other differentiating factors involved in the cost module.

FORMAT-5.1: COMMODITY GROUP HEAVY/LIGHT/NORMAL COMMODITIES TRIP LENGTH RANGE UP-TO 200 KM

SN	Section Code	Avg. Loading/ Un-loading Time Hr	Avg load carried	No. of Working Hr/Yr.	Avg. Running Speed KMPH	Financial							
						Time Related Costs			Running Costs			Total Costs	
						Annual Cost (Rs.)	Per Working Hr (Rs.)	Per Ton-km (Paise)	Annual Cost (Rs.)	Per Km. (Rs.)	Per Ton-km (Paise)	Annual Cost (Rs.)	Per Ton-km (Paise)
1	111												
2	112												
3	114												
4	115												
5	122												
6	124												
7	125												
8	131												
9	136												
10	132												

In order to estimate the total transport system economic cost, all the cost elements have been independently considered for conversion from financial to economic terms due to their different multiplying factors. Under economic systems costs, highway costs have been used in lieu of road, goods and passenger taxes, which are termed as transfer payments in the case of economic costing. Various cost inputs helped us to match different road and vehicle categories to arrive at an overall inter-regional road transport costs at national level. Summary of commodity-wise vehicle operating cost are given as **Annexure 5.2.1** for the base year, **Annexure 5.2.2** for the year 2011-12 and **Annexure 5.2.3** (contained in Annexure Volume-2) for the year 2017-18. Distance-slab and commodity-wise VOC are given in **Annexure 5.2.4** for the Base Year, **Annexure 5.2.5** for the year 2011-12 and **Annexure 5.2.6** for the year 2017-18.

Similar approach has been adopted to estimate vehicle operating cost of passenger buses. Keeping in view the predominance of ordinary buses in the total bus population, exercise is limited to this category only. The entire set of passenger movement has been divided into three categories, i.e. from Metro City/State Capital to Metro City/State Capital, Metro City/State Capital to Moffusil Town and from Moffusil Town to Moffusil Town. Based on data collected from sample operators, relevant norms have been worked out. Like goods sectors, item wise costs have been estimated, except periodical taxes. In the case of passenger transport, passenger tax that is not paid periodically like goods tax, do not form part of passenger bus VOC. Passenger tax is charged by the conductor as a part of fare and transferred to the government revenue on completion of the trip. Based on the capacity utilization of the bus, average cost per passenger has been estimated.

Unlike goods sector where the VOC is directly applicable to O-D flows, in the case of passenger transport, normative costs for different distance slabs have been estimated up to the distance range of 650 km. Detailed approach and methodology adopted to estimate Highway cost is described in the following section.

5.4.5 Highways Cost (Road)

The entire road network of the country is under the direct control of government agencies. Based on the funding or controlling agencies the road network is categorised as National Highways (NH) including Border Roads, State Highways (SH), Major District Roads (MDRs), Other District Roads (ODRs), Village Roads (VR) or Projects Roads (PR). In the current study, which covers the entire country except the Andaman & Nicobar and Lakshdweep islands, a limited network that provides inter-connection to all the 623 regions identified in the study area has

been used. The study network has been extended up-to MDRs. Table-5.18 brings out the proportionate share of various categories of roads covered in the study.

TABLE-5.18: LENGTH OF DIFFERENT TYPES OF ROADS

SN	HIGHWAY TYPE	ROAD NETWORK*	STUDY NETWORK**	% COVERAGE
1	Expressways	200	200	100
2	National Highways	66590	52297	78.54
3	State Highways	131899	93402	70.81
SUB TOTAL		198689	145899	73.43
4	Major District Road	467763	8169	1.746
5	Village and Other Roads	2650000	0	0
	TOTAL	3316452	154068	4.65

* As per NHAI websites

** Road Distances as collected from "Road Map of India', Sixth Edition, Survey of India Publications

In view of the fact that the road network under study comprises not only the two lane and above capacity road sections, the highway costs have been estimated separately to match the entire road network composition. Where the National Highway and State Highway sections comprised single-lane, two-lane, four-lane, and 4 to 6-lane Expressway sections, Major District Roads covered single-lane, intermediate-lane and two-lane sections only. Although length of 4-lane and 4-lane Expressway is very much limited in the rolling and hilly terrain, comparative costs have also been estimated keeping the future transport demand in view.

Highway cost is borne directly by the government. Since it is not feasible to develop historic Highway systems cost, for the purpose of the current study, a new set of costs have been estimated based on the current market price (base year costs). Relevant information has been collected through various Highway Projects/studies conducted by RITES Ltd on behalf of National Highway Authority of India (NHAI) and other government agencies. In addition, to account for annual repair & maintenance of road sections, the requisite information has been collected from the concerned government site offices.

In order to estimate base year costs of each type of road section, item wise quantities of work and the related costs have been worked out. Since in majority of the cases the land has already been available with the government for construction of new road section or up-gradation of the existing section, land cost is considered as sunk. The entire set of activities towards construction of a new road link has been classified under the following sub-heads:

- Site clearance
- Earthworks
- Sub-Base and Base Courses
- Bituminous Courses
- Cross Drainage Works (Culverts)
- New Bridges, Underpasses, Grade Separators and
- Drainage and Protective works
- Miscellaneous

Efforts have been made to select road sections spread all over the country to develop homogeneous cost norms. Based on the estimated quantities of work under each item, total input costs have been estimated by using 2007-08 price structure applicable in that region. To arrive at the total capital cost of the road section under study, Environmental Cost, Resettlement and Rehabilitation Cost, Relocation of Utilities Cost, etc. wherever applicable, have also been considered in addition to expenditure towards other contingencies, construction supervision, etc.

Item-wise financial costs were converted into economic terms by using appropriate conversion factors developed on the basis of detailed studies of limited sample road sections, as the highway costs are relevant only for economic costing.

Similarly, to arrive at the total highway cost, data on annual repair & maintenance of selected road sections have been collected from the concerned agencies.

Annual capital cost of the respective road sections, keeping in view the life of 100 years (relevant for bridges & culverts), has been worked out using cost recovery factor by deploying a economic discount rate of 8% per annum. Total annual costs (capital and repair & maintenance) are further brought to daily units. Since different sections have different designed capacity (PCUs/Day, as per IRC Norms), and the utilization, corresponding total costs have been assigned to arrive at cost per PCU. Since goods vehicle-mix comprises vehicles with different PCUs equivalents and loads carried, weighted average has been estimated at national level to appropriately apportion the cost to arrive at per tkm highway cost.

Distance slab and commodity-wise VOC in Economic terms and Financial terms are given in **Annexure 5.2.7** and **Annexure 5.2.8** for base year,**Annexure 5.2.9** and **5.2.10** for the year 2011-12 and **Annexure 5.2.11** and **5.2.12** (in Annexure Volume-2) for the year 2017-18, respectively. The comparative impact of highway cost is the highest under low traffic road sections as observed in the case of hilly sections that involves comparatively higher capital cost for construction, higher annual R&M and has a lower capacity vis-à-vis plain or rolling sections. To appropriately account for highways costs applicable for passenger transport, cost per PCU arrived at, as discussed in earlier paragraphs, has been used to work out cost per passenger on different distance slabs.

5.4.6 Users Costs

Users cost in the case of passengers relates to the cost of local movement of passenger from place of stay at origin to place of final destination. Using the methodology adopted to estimate bus operating costs, vehicle operating costs of various modes of local transport have been estimated. Based on the data collected at select Metro cities and Moffusil towns on various modes used and the average distance travelled, appropriate costs to represent Metro city and Moffusil towns have been worked out. Depending on the passenger movement between various combinations, the relevant costs have been worked out. Total passenger transport costs estimated for various combinations are given in Table-5.19.

TABLE-5.19: PASSENGER MOVEMENT COST – HIGHWAYS

MOVEMENT TYPE	TRIP LENGTH (KM) (RS./PASSENGER)											
	100	150	200	250	300	350	400	450	500	550	600	650
FINANCIAL												
Metro City to Metro City	64.00	83.93	103.87	123.81	143.75	163.69	183.63	203.57	223.51	243.45	263.39	283.33
Metro City to Moffusil Town	57.99	78.34	98.69	119.04	139.40	159.75	180.10	200.46	220.81	241.16	261.52	281.87
Moffusil Town to Moffusil Town	60.03	84.83	109.62	134.42	159.21	184.01	208.80	233.60	258.40	283.19	307.99	332.78
ECONOMIC												
Metro City to Metro City	55.46	71.89	88.31	104.74	121.17	137.60	154.03	170.46	186.88	203.31	219.74	236.17
Metro City to Moffusil Town	50.24	67.15	84.06	100.97	117.87	134.78	151.69	168.59	185.50	202.41	219.32	236.22
Moffusil Town to Moffusil Town	51.79	72.55	93.32	114.08	134.85	155.62	176.38	197.15	217.91	238.68	259.44	280.21

5.5 MODAL COST: AIRWAYS

5.5.1 Introduction

Air Transport is a relatively new and evolving mode of transportation compared to rail and surface transport and is often termed as the 'Sunrise Sector'. Air traffic, till recently, had only a marginal presence in the overall transport scenario of the country. However, recent additions of

air fleet and countrywide linkages have led to a high rate of growth, making the presence of airways visible particularly in the passenger segment.

It is pertinent to mention that collection of reliable data for the assessment of transportation cost in Airways sector is a formidable task. Most importantly, the relevant information is not easily available because the airlines have strong reservations in sharing data related to costing. The published data is often available in a gross aggregate form, making it rather difficult to assess the unit cost. The extant exercise therefore, had to primarily depend on data sourced from the DGCA (Directorate General of Civil Aviation), which maintains both operational as well as financial data related to domestic air operators in terms of the following:

- Data for individual airlines (submitted to DGCA as per ICAO guidelines)
- Form A- Monthly flow summary
- Form B- O-D Flow for Domestic Sector
- Form D- Fleet & Personnel data
- Form EF – (P&L A/C, Balance Sheet, Physical Parameters, Statement of Retained Earnings)
- Publications of DGCA & AAI

Details of the above mentioned Forms are enclosed in **Annexure 5.3.**

In addition, a large amount of data was also collected from information available over the websites of various aircraft manufacturers and operators.

It may, however, be mentioned that data for costing exercise were available only up to the year 2006-07, which was suitably inflated to the current prices (2007-2008) as per index of Central Statistics Organization (CSO). Further, during the compilation, a lot of inconsistency was noticed in the data furnished by various airlines. However, since time series data for all the airlines were available, it was possible to remove the out layers through Trend Analysis and weighted average of the clubbed data.

5.5.2 Overview of Costing in Airways Sector

Cost economics of airline operations around the world follow a reasonably similar structure, albeit with minor variations driven by the local environment. By and large, various costs incurred by the airlines can be summarised in the following broad heads:

- Repair & Maintenance
- Fuel Cost
- Passenger Service
- Ticketing & Sales
- Crew Cost
- Landing & Navigation and
- Residual Expenses.

Further, the above costs are divided into two distinct categories viz. 'Fixed' and 'Variable' as per the following:

(A) Variable Costs

- Fuel and oil
- Variable flight crew

- Crew Allowances
- Cabin Crew Allowances
- Airport and en-route charges:
  (Landing, parking and housing/En-route navigation/Terminal navigation and landing charges)
- Passenger service cost:
  (Meal cost / hotel expenses, handling charges (ground landing)

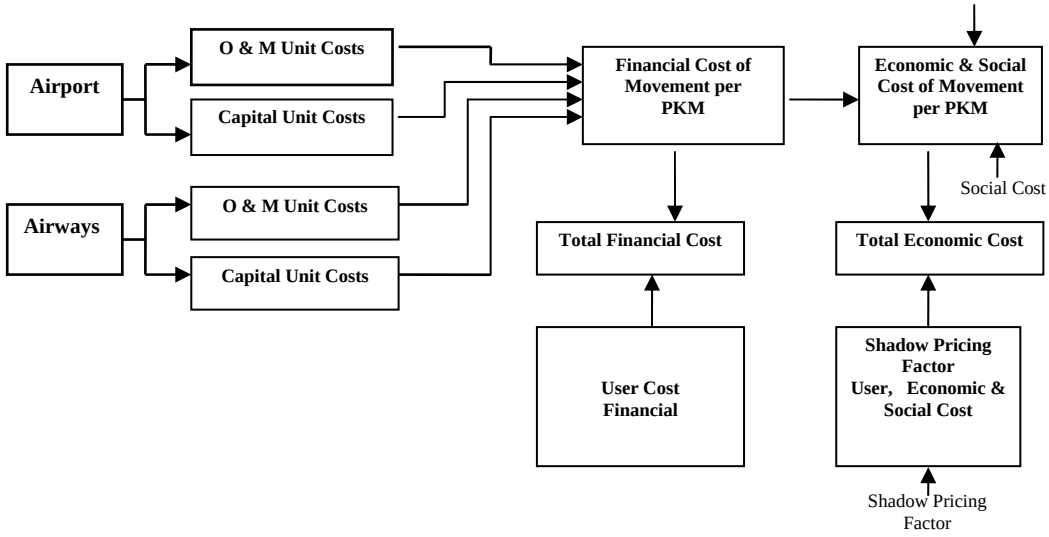
(B) Fixed Costs

- Salaries and expenses unrelated to flying done (Flying crew, cabin crew)
- Aircraft depreciation
- Lease rentals
- Aircraft insurance

5.5.3 Costing Methodology

A schematic diagram of the basic methodology adopted for assessment of modal costs in Airways sector is depicted in Figure-5.5:

FIGURE-5.5: FLOW CHART OF AIRWAYS COSTING



5.5.4 Operation and Maintenance Cost:

Keeping in view the specialised relevance of various components of operation and maintenance cost, unique parameters were adopted to assess the unit cost of operation for each group of cost components as detailed below:

Cost Component	Parameter Adopted for Unit Cost Calculation
Repair & Maintenance	Available Seat Kilometres **(ASKM)**
Landing & Navigation	
Crew	
Fuel Cost	

Cost Component	Parameter Adopted for Unit Cost Calculation
Ticketing & Sales	Passenger Kilometres **(PKM)**
Passenger Services	
Residual Services	

The total O&M cost derived was subsequently segregated into fixed and variable cost by assigning relative percentage of fixed and variable quotient of cost in-built into each of the cost components as per Table-5.20.

TABLE-5.20: PERCENTAGES OF FIXED & VARIABLE COST COMPONENTS

SN	COMPONENTS	VARIABLE COST	FIXED COST
1	Repair & Maintenance	0.8	0.2
2	Landing & Navigation	0.85	0.15
3	Ticketing & Sales	0.8	0.2
4	Crew Cost	0.4	0.6
5	Passenger Service	0.7	0.3
6	Fuel Expenses	0.9	0.1
7	Residual Expenses	0.7	0.3

The results of the unitary method exercise to arrive at the O&M cost was further validated through regression analysis of the dependent and independent variables as depicted in Table-5.21.

TABLE-5.21: DEPENDENT & INDEPENDENT VARIABLES OF COST

COMPONENT (DEPENDENT VARIABLE)	RELATIVE COMPONENTS (INDEPENDENT VARIABLE)
Repair & Maintenance	Machinery & Spares Cost
	R&M Staff Salary Cost
	Miscellaneous Expenses
Landing & Navigation	Landing Charges
	Navigation Charges
	Miscellaneous Expenses
Ticketing & Sales	T&S Staff Cost
	Commissions to Agents
	Miscellaneous Expenses
Crew Cost	Crew Salary Cost
	Crew Allowances
	Miscellaneous Expenses
Passenger Services	Catering Expense
	Inflight Amenities Expense
	Miscellaneous Expenses
Fuel Expenses	Aviation Fuel Expense
	Lubricants Expense
	Miscellaneous Expenses
Residual Expenses	General Staff Salary Expense
	Staff Perquisites Expense
	Rent & Maintenance Expense
	Staff Travel Expense
	Publicity & Corporate

For assessment of O&M cost for freight traffic an exercise similar to the passenger traffic was carried out to arrive at a tkm figure. However, while calculating the cost of freight traffic, two components i.e., Passenger Service and Ticketing & Sales were assumed to surrogate the booking costs of goods, as data for the same was not available.

5.5.5 Capital Cost

To estimate the per unit capital cost, the cost of Aircraft and that of Terminal Handling were computed separately and these were then related to the passengers and tonne-kms performed.

5.5.6 Terminal Cost

Like other modes of transport under study, Airways also lacks historical costs for various infrastructure facilities required to operate an airport. The existing airports are the outcome of decades of airways development and growth in the country. Moreover, unlike other modes which possess the entire infrastructure at their own control, in the case of Airways, a number of airports are jointly operated by the Civil Aviation Authority and the Defense, as a result segregation of costs are not feasible.

In the light of this, to estimate comparative costs of Airways vis-a-vis other modes of transport under study, such as; Railways and Highways, entire infrastructure costs have been estimated at the current market price (base year price). Keeping in view the level of traffic handled at various airports and the types of aircrafts deployed, all airports are classified under three categories i.e. Airports at Metropolitan cities, Major Towns/Cities and Other Towns/Cities. Airports at Metropolitan Cities represents all the important airports in the country which form the backbone of the Indian Air Transport and each airport has all the modern facilities to accommodate latest generation aircrafts to handle passenger and goods traffic. All these airports act as a hub in their respective region.

Similarly, the second category represents other major towns/cities most of them state capitals or other metro cities in states spread all over the country. The third category covers all the remaining functional airports of the country which are provided not merely on financial or economic considerations but are suited to offer air connectivity at all-India level keeping other national and international aspects in view.

In the current exercise, costs of infrastructure facilities are estimated based on certain assumptions. At Metro cities terminal costs to offer domestic services to accommodate aircraft up to Boeing 747 has been considered whereas airports at Major Cities and Other Cities, Air Bus 320 and ATR (up to 72 Seats), respectively have been considered. Keeping in view the existing passenger traffic demand at Metro Airports, daily number of flights have been assumed and accordingly facilities designed, whereas for airports at the Major Cities and Other Cities designed capacity reflects the minimum number of flights and number of passengers that can be accommodated with the given infrastructure facility. International traffic is considered only at Metro Airports. Since Metro Airports would offer both domestic and international services as well as cater to higher number of daily scheduled flights, two Runways have been considered. Certain facilities which are exclusively required for international passengers are segregated while arriving at cost unit of out put. Similarly, certain facilities which involve huge cost and are not required to be provided at all the airports, are considered only at Metro Airports, such as; Night Landing Facility, R&M Workshops for Aircraft, Night Parking Facility, Cargo Sheds, separate bays for cargo aircrafts, etc.

To estimate overall cost of each airport, item wise costs have been worked out. Sample airports have been divided into following four parts keeping in view their functionality:

- Runway and Allied Facilities
- Terminal Buildings
- Navigational Facilities
- Outer Circulating, Parking and Connecting Area of the Airport.

Length and width of Runway is considered based on the type of aircrafts likely to be operated. Similarly, all other facilities are assumed keeping in view the quantum of traffic likely to be handled at each airport. Costs for various activities have been developed based on various studies conducted by RITES within India and abroad as well as inputs collected from other similar studies.

Capacity of different airports is not alike. Metro cities are designed to operate about 120 flights each way and handle daily passenger traffic to the extent of 39000 (each way), whereas at Major cities and other cities the number of daily flights considered are 20 and 10, respectively. The terminals at Major Cities and Other Cities are designed to handled 5300 and 1120 passengers daily, respectively.

Infrastructure costs estimated for each category of airport is summarized in Table-5.22:

TABLE-5.22: AIRPORT TERMINAL COSTS (FINANCIAL)

SN	COST ELEMENT/UNIT	AIRPORT CATEGORY		
		OTHER CITIES	MAJOR CITIES	METROS
1	Infrastructure Capital Cost (Rs.)	1,081,200,616	3,297,490,390	10,334,238,379
2	Life of Infrastructure (years)	50	50	50
3	Annual Share of Capital Cost (Rs)	88,380,429	269,546,289	844,750,182
4	Annual Operating, R& M Costs (Rs.)	19,440,000	60,827,517	182,482,552
5	Total Annual Cost (Rs.)	107,820,429	330,373,807	1,027,232,734
6	No. of Runway Provided	1	1	2
7	Types of Navigational Facilities Offered	Day	Day +Night	Day +Night
8	Open for Traffic (Domestic/International or Both)	Dom	Dom	Dom+International
9	Types of Aircrafts permitted	ATR (Up to 72 Seats)	Up to A320	Up to Boeing 747
10	Weighted Average Capacity in terms of No. of Passengers Carried Per Flight	56	110	136.45
11	Average No. of Daily Flights (Incoming + Out going)	10+10	20+20	120+120
12	Designed Capacity to handle No. of Passengers/Day	1120	5300	78000
13	Designed Capacity Assigned to Handle Domestic Passengers (No. of Pass. Both ways)	1120	5300	46800

The above table shows that the overall infrastructural cost for creating a new airport at Metro Cities works out to about Rs. 1033.42 crore (excluding land cost which is considered as sunk for all the modes in the current study), as against Rs 329.75 crore at Major Cities and Rs. 108.12 crore at Other Cities. Life of infrastructure is considered as 50 years. Assets which have life less than 50 year are considered for replacement under repair & maintenance costs. To annually apportion capital cost of the infrastructure, cost recovery technique has been adopted, wherein the rate of interest (discount) is considered as 8 % p.a. keeping 50 years life of the assets. Similarly, capital infrastructure costs of the airports in economic terms, arrived at by applying appropriate conversion factors to the financial costs, are summarized in Table 5.23.

TABLE-5.23: AIRPORT TERMINAL COSTS (ECONOMIC)

SN	COST ELEMENT/UNIT	AIRPORT CATEGORY		
		OTHER CITIES	MAJOR CITIES	METROS
1	Infrastructure Capital Cost (Rs.)	846,445,391	2,688,704,179	8,474,361,551
2	Life of Infrastructure (years)	50	50	50
3	Annual Share of Capital Cost (Rs.)	69,190,866	219,782,364	692,718,534
4	Annual Operating, R&M Costs (Rs.)	19,440,000	60,827,517	182,482,552
5	Total Annual Cost (Rs.)	88,630,866	280,609,882	875,201,086
6	No. of Run way Provided	1	1	2
7	Types of Navigational Facilities Offered	Day	Day +Night	Day +Night
8	Open for Traffic (Dom/Inter or Both)	Dom	Dom	Dom+International
9	Types of Aircrafts permitted	ATR (Up to 72 Seats)	Up to A320	Up to Boeing 747
10	Weighted Average Capacity in terms of No. of	56	110	136.45

SN	COST ELEMENT/UNIT	AIRPORT CATEGORY		
		OTHER CITIES	MAJOR CITIES	METROS
	Passengers Carried Per Flight			
11	Average No. of Daily Flights (Incoming +Out going)	10+10	20+20	120+120
12	Designed Capacity to handle No. of Passengers/Day	1120	5300	78000
13	Designed Capacity Assigned to Handle Domestic Passengers (No. of Pass. Both ways)	1120	5300	46800

Pie chart depicting Annual Terminal Cost of various categories of Airports is shown in Figure 5.6.

FIGURE -5.6

Total Annual Cost (Rs.) Financial / Economic

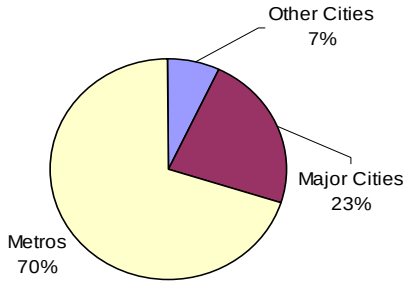


Table 5.23 above shows that the overall infrastructural economic cost of a new airport at Metro Cities works out to about Rs. 843.44 crore (excluding land cost), as against Rs 268.87 crore at Major Cities and Rs. 84.64 crore at Other Cities.

In view of the fact that a large number of Indian airports operate much below their designed capacity, accordingly, terminal cost has been estimated under various capacity utilization options, ranging from 5 % to 80 %. The terminal cost is inversely proportional to the capacity utilization. The cost per passenger is the highest in the case of the lowest capacity utilization level and the reverse holds good for highly utilized airports. Cost per passenger worked out to Rs. 43268.13 in the case of airports at Other Cities as against Rs. 5935.98 estimated for Metro Cities assuming utilization to the extent of 5 % only. The costs are in favour of Metro Cities, because of their higher designed capacity, as explained earlier.

Thus, with 80 % utilization of airport terminals at Metro Cities, cost per passenger (each way) is estimated as Rs. 371.00. Table 5.24 brings out the terminal costs in financial terms, under varying capacity utilization scenarios.

TABLE 5.24: TERMINAL COST PER PASSENGER UNDER VARYING CAPACITY UTILISATION NORMS (one side) – FINANCIAL

Rs. per Passenger

SN	CAPACITY UTILISATION	AIRPORT CATEGORY		
		OTHER CITIES	MAJOR CITIES	METROS
1	5.00%	5274.97	3415.60	721.62
2	10.00%	2637.49	1707.80	360.81
3	20.00%	1318.74	853.90	180.41
4	30.0%	879.16	569.27	120.27
5	40.0%	659.37	426.95	90.20
6	50.0%	527.50	341.56	72.16
7	60.0%	439.58	284.63	60.14
8	70.0%	376.78	243.97	51.54
9	80.0%	329.69	213.47	45.10

Economic terminal costs estimated under different capacity utilization options is summarized in Table 5.25.

TABLE-5.25: TERMINAL COST PER PASSENGER UNDER VARYING CAPACITY UTILISATION NORMS (one side) - ECONOMIC

Rs. per Passenger

SN	CAPACITY UTILISATION	AIRPORT CATEGORY		
		OTHER CITIES	MAJOR CITIES	METROS
1	5.00%	4336.15	2901.11	614.82
2	10.00%	2168.07	1450.56	307.41
3	20.00%	1084.04	725.28	153.71
4	30.0%	722.69	483.52	102.47
5	40.0%	542.02	362.64	76.85
6	50.0%	433.61	290.11	61.48
7	60.0%	361.35	241.76	51.24
8	70.0%	309.72	207.22	43.92
9	80.0%	271.01	181.32	38.43

5.5.7 Economic Cost

The Economic Cost of the Operation and Maintenance was derived by adopting the shadow pricing factors (adjustments of transfer payments, taxes or subsidies) as indicated in Table 5.26.

TABLE-5.26: SHADOW PRICING FACTORS FOR AIRWAYS

AIRWAYS O&M EXPENSES	
Repair & Maintenance	0.84
Landing & Navigation	0.74
Ticketing & Sales	0.86
Crew Cost	0.98
Passenger Services	0.87
Fuel Expenses	0.77
Residual Expenses	0.93
Rental Flight Equipment	1
AIRPORT CONSTRUCTION COST	
Pavement Works	0.83
Building Works	0.84
Development Works	0.85
Equipments	0.79

5.5.8 Resource Cost

Resource cost is the sum total of Social and Economic costs (Financial cost * shadow price factors). To derive the social cost, environment and the accidental costs were the two negative externalities that were considered.

5.5.9 Final Results of Economic & Resource Costs

Table 5.27 brings out details of Economic and Resource Costs of Airways.

TABLE-5.27: ECONOMIC AND RESOURCE COSTS OF AIRWAYS

UNIT		ECONOMIC COST	RESOURCE COST
Rs per PKM	Operation	2.65	3.13
	Terminal	0.45	0.45
	Total	**3.1**	**3.58**
Rs per TKM	Operation	32.79	39.65
	Terminal	6.63	6.63
	Total	**39.42**	**46.28**

The graphical representation of the above analysis is given in Figures 5.6 and 5.7.

FIGURE 5.6: OPERATION AND TERMINAL COST RS PER PKM

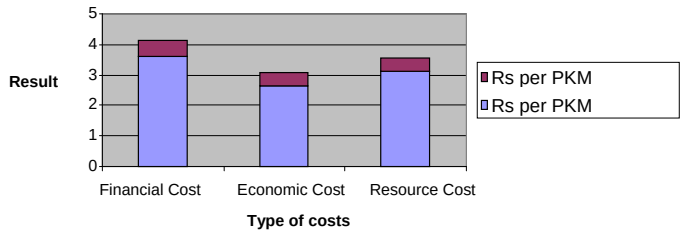
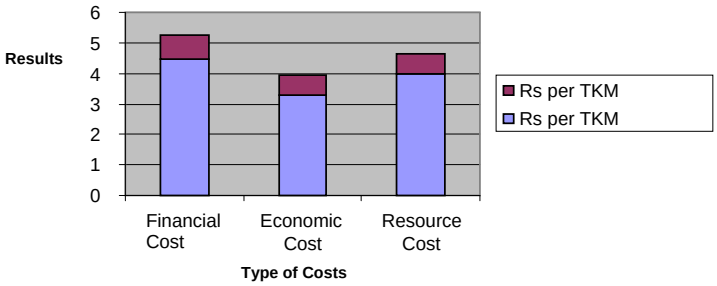


FIGURE-5.7: OPERATION AND TERMINAL COST RS PER TKM



5.5.10 User Cost

User cost in the case of Airways passengers relates to the movement cost of passengers at either end of the journey i.e., at origin: from actual place of start to the airport and at destination between airport and final place of stay. Using the methodology adopted to estimate the cost, vehicle operating cost of various local modes of transport has been estimated. Based on the data collected at select, Metro Cities, Major Cities and Other Cities, on various modes used and the average distance travelled, appropriate costs to represent movement between Metro city–Major city, Metro city-Other city and Major city-Other city have been worked out. Depending upon the various passenger movement combinations relevant costs have been estimated. The total passenger user costs estimated for various combinations are tabulated in Table 5.28.

TABLE-5.28: USER COST PER PASSENGER

AIRPORTS AT METRO CITIES (FINANCIAL)

INDEX	DISTRIBUTION OF PASSENGERS BASED ON MODE USED				TOTAL
	AUTO	BUS	MINI BUS	TAXI/OWNED VEHICLES	
No. of Passenger	42	29	23	417	511
Model Share in Total	8.22%	5.68%	4.50%	81.60%	100.00%
Average Distance Travelled Km	11	13	7	19	17.5
Cost per Passenger Trip (Rs.)	47.07	5.9	4.65	87.02	75.42

AIRPORTS AT METRO CITIES (ECONOMIC)

INDEX	DISTRIBUTION OF PASSENGERS BASED ON MODE USED				TOTAL
	AUTO	BUS	MINI BUS	TAXI/OWNED VEHICLES	
No. of Passengers	42	29	23	417	511
Model Share in Total	8.22%	5.68%	4.50%	81.60%	1.00
Average Distance Travelled Km	11	13	7	19	17.5
Cost per Passenger Trip (Rs.)	42.59	5.2	3.57	76.05	66.02

AIRPORTS AT MAJOR CITIES (FINANCIAL)

INDEX	DISTRIBUTION OF PASSENGERS BASED ON MODE USED				TOTAL
	AUTO	BUS	MINI BUS	TAXI/OWNED VEHICLES	
No. of Passengers	54	17	9	83	163
Model Share in Total	33.13%	10.43%	5.52%	50.92%	100.00%
Average Distance Travelled Km	9	13	5	14	11.7
Cost per Passenger Trip (Rs.)	38.51	4.13	2.38	71.66	49.81

AIRPORTS AT MAJOR CITIES (ECONOMIC)

INDEX	DISTRIBUTION OF PASSENGERS BASED ON MODE USED				TOTAL
	AUTO	BUS	MINI BUS	TAXI/OWNED VEHICLES	
No. of Passengers	54	17	9	83	163
Model Share in Total	33.13% 9	10.43% 13	5.52% 5	50.92% 14	100.00% 11.7
Average Distance Travelled Km	34.85	3.64	2.09	56.04	40.58
Cost per Passenger Trip (Rs.)	54	17	9	83	163

AIRPORTS AT OTHER CITIES (FINANCIAL)

INDEX	DISTRIBUTION OF PASSENGERS BASED ON MODE USED				TOTAL
	AUTO	BUS	MINI BUS	TAXI/OWNED VEHICLES	
No. of Passengers	87	17	5	111	220
Model Share in Total	39.55%	7.73%	2.27%	50.45%	100.00%
Average Distance Travelled Km	6	11	12	16	11.6
Cost per Passenger Trip (Rs.)	25.67	3.08	4.5	64.04	42.80

AIRPORTS AT OTHER CITIES (ECONOMIC)

INDEX	DISTRIBUTION OF PASSENGERS BASED ON MODE USED				TOTAL
	AUTO	BUS	MINI BUS	TAXI/OWNED VEHICLES	
No. of Passengers	87	17	5	111	220
Model Share in Total	39.55%	7.73%	2.27%	50.45%	100.00%
Average Distance Travelled Km	6	7	4	9	7.5
Cost per Passenger Trip (Rs.)	23.23	1.96	1.55	36.02	27.55

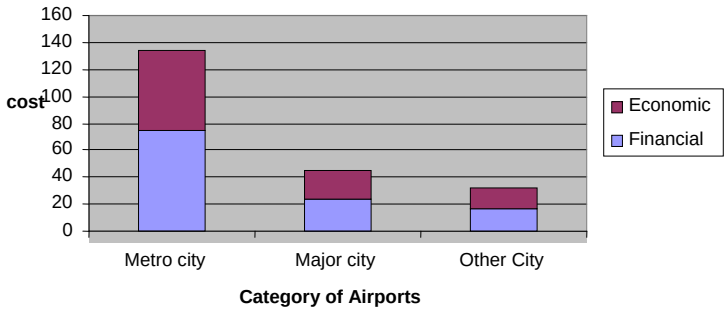
Sample size captured for various modes of transport in working out User Cost is given in Table 5.29.

TABLE 5.29: SAMPLE SIZE

AIRPORT TYPE	SAMPLE DISTRIBUTION: BASED ON MODE USED				TOTAL
	AUTO	BUS	MINI BUS	TAXI/OWNED VEHICLES	
Metro Cities	42	29	23	417	511
Major Cities	54	17	9	83	163
Other Cities	87	17	5	111	220
Total	183	63	37	611	894
% Distribution	20.47%	7.05%	4.14%	68.34%	100.00%

Bar chart in Figure-5.9 depicts the user cost per passenger in different categories of Airport.

FIGURE-5.8: USER COST PER PASSENGER



5.6 MODAL COST: COASTAL SHIPPING

5.6.1 Introduction

Coastal Shipping is characterized, like rail, by high fixed capital costs due to the cost of port infrastructure and coastal vessels, and low variable cost owing to low operations and maintenance costs accompanied by higher volumes carried. It is thus more fuel efficient

compared to rail or road. However, unlike rail and similar to road, the costs of vehicle movement are easily separable from the fixed infrastructure costs. As most often ships carry same type of commodities from point to point, joint costs are minimal. Hence it becomes easy to differentiate the fixed and moving infrastructure costs of service at commodity level.

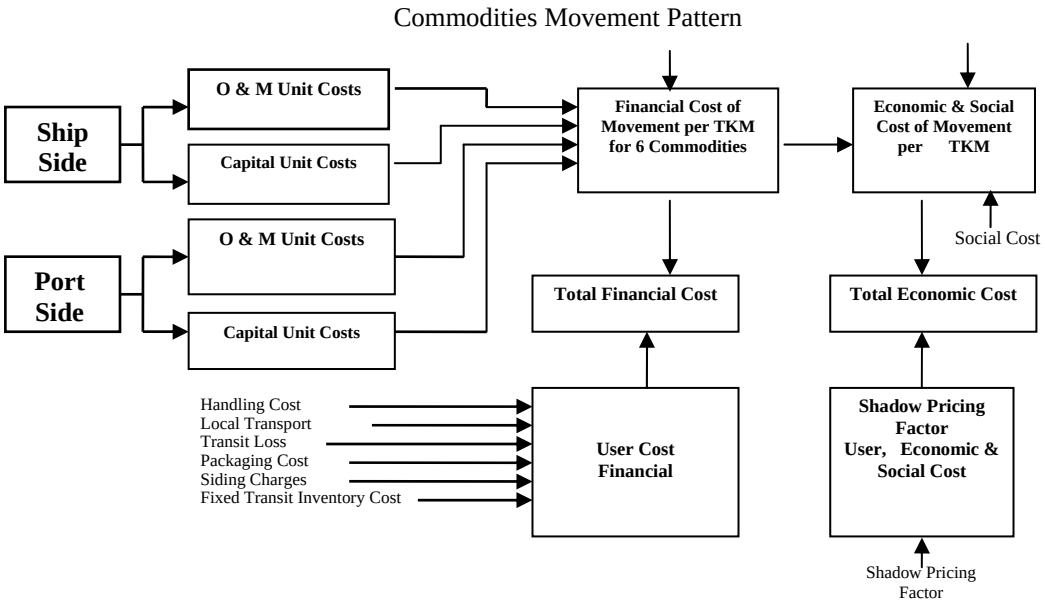
The terms of reference for costing are as follows:

- Determination and analysis of modal transport costs in terms of both resource cost and financial cost for each mode of transport, incorporating existing as well as future transport technological advancements.
- Indicate the desirable share of mode of transport on the basis of cost consideration.

The study thus has to estimate the financial, economic and social costs both for the operations and maintenance activity and capital costs for Coastal Shipping. The financial and economic costs incurred by the user of Coastal Shipping are also to be included to estimate the total cost of services.

A basic schematic of the method for calculation of costs involved in Coastal Shipping are presented in Figure-5.9.

FIGURE-5.9: FLOW CHART OF COASTAL SHIPPING COSTING



Shipping industry, being well established for a long time, has various cost classification systems in vogue. Two important classifications are fixed and variable, and standing and running costs. Fixed costs are invariant to the output while variable costs are directly proportional to the output. However, the classification is time dependent. As time horizon increases, most costs considered fixed change to semi-variable and finally would become variable. Standing costs refer to the expenses incurred on a ship whether it is running or otherwise. Running costs are expenses when the ship is on the run. Broad classification of the costs and examples for each case are given in Table-5.30.

TABLE-5.30: THE CLASSIFICATION OF COSTS

TYPE OF COST	STANDING COST	RUNNING COST
Fixed Cost	1.Capital Cost - Port & Vessel, 2.Depreciation of Vessel 3.Salary, Bonus & contribution of PF of Floating staff 4.Insurance fee for vessel, 5.Overheads of the shipping company, salary & allowances to shore staff, & repair & maintenance of building, etc 6.Dry-docking expenses	1. Fuel Cost port days, 2. Dry-docking 3. Steamer Sundry Costs.& fee 4.Port
Variable Cost	1.Salary including bonus to floating staff/on board 2.Survey, Repairs & maintenance of vessel	1. Stores, 2. Victualling, 3. Cost of Running Staff incl allowances to engine crew, 4.Fresh Water Charges, 5. Fuel Cost

A more detailed classification of the costs is given at **Annexure-5.4.1** in Annexure Volume-2.

5.6.2 Coastal Shipping Costs

The costs of shipping operations, inter alia, are dependent on the size of the ship and cargo carried, lead kilometres, empty-haulage of ship and type of cargo. In principle the unit cost of transport reduces for heavier ships, for longer leads, lesser empty-haulage and for bulk type of cargo. Thus, the costs vary from commodity to commodity, from voyage to voyage and needs to be estimated for each of the commodities separately.

5.6.3 Profile of Coastal Vessels and Operations

As per Directorate General of Shipping (DGS), as on 30.06.08, a total of 879 vessels are registered under Indian shipping registry for overseas and coastal movement, consisting of wide variety of vessels. A summary of various vessels is given in **Annexure-5.4.2** in Annexure Volume-2. Out of these, cargo carriers are 319 and are classified as; dry cargo liners, dry cargo bulk carriers, tankers (crude and product), ethylene carriers and cellular containers.

A break up of vessels in each of the categories is summarised in Table-5.31. A complete list of the coastal vessels and the companies owning them can be seen from **Annexure-5.4.2** in Annexure Volume-2.

TABLE-5.31: COMPOSITION OF COASTAL AND OVERSEAS FLEET REGISTERED IN INDIA

TYPE OF VESSELS	COASTAL			OVERSEAS		
	NUMBER	G.R.T.	D.W.T.	NUMBER	G.R.T.	D.W.T.
Dry Cargo Liner	73	127444	186250	8	31842	40743
Dry Cargo (Bulk Carriers)	11	234285	362923	95	2643193	4512539
Tankers (Crude Oil & Product Carriers)	15	109386	155587	97	4396157	7862453
Ethylene Gas Carriers	3	8727	658	0	0	0
Cellular Container *	0	0	0	17	213202	270044
TOTAL	102	479842	705418	217	7284394	12685779

Note* Main cellular container vessels are classified as overseas; some of them are used for coastal movement.
D.W.T. = Dead Weight Tonnage
G.R.T. = Gross Registered Tonnage

The ranges of dead weight tonnage (DWT) and gross registered tonnage (GRT) of coastal vessels is summarised in Table-5.32 and Table-5.33, respectively. Vessel sizes of coastal fleet are smaller compared to the overseas counterparts. The size, however, is driven by the quantities moved on coastal leg.

TABLE-5.32: CLASSIFICATION OF COASTAL VESSELS BY DEAD WEIGHT TONNAGE (DWT)

TYPE OF VESSELS	RANGE OF DEAD WEIGHT TONNAGE (DWT)				
	NUMBER OF VESSELS				
Dry Cargo Liner	0-2000	2000-4000	4000-6000	6000-8000	8000>
	24	43	2	2	2
Dry Cargo (Bulk Carriers)	0-16000	16000-32000	32000-48000	48000-64000	64000-80000
	2	3	4	0	2
Tankers (Crude & Product)	0-8500	8500-17000	17000-25500	25500-34100	34100-42600
	11	0	1	1	2
Ethylene Gas Carriers	0-540	540-1080	1080-1620	1620-2160	2160-2700
	0	0	1	0	2
Cellular Container	0-6000	6000-12000	12000-18000	18000-24000	24000-30000
	1	5	5	3	3
Total	38	51	13	6	11

TABLE 5.33: CLASSIFICATION OF COASTAL VESSELS BY GROSS REGISTERED TONNAGE (GRT)

TYPE OF VESSELS	RANGE OF GROSS REGISTERED TONNAGE (GRT)				
	NUMBER OF VESSELS				
Dry Cargo Liner	0-1000	1000-2000	2000-3000	3000-4000	4000>
	19	43	6	1	4
Dry Cargo (Bulk Carriers)	0-10000	10000-20000	20000-30000	30000-40000	40000-50000
	2	3	4	1	1
Tankers (Crude & Product)	0-6000	6000-12000	12000-18000	18000-24000	24000-30000
	11	0	1	0	3
Ethylene Gas Carriers	0-700	700-1400	1400-2100	2100-2800	2800-3500
	0	0	0	1	2
Cellular Container	0-4500	4500-9000	9000-13500	13500-18000	18000-22500
	0	6	5	2	4
Total	32	52	16	5	14

Age profile of vessels shows that while 15 per cent of the vessels are 16 to 20 years old and 44 per cent are more than 20 years old. Thus, vessels deployed on coastal routes are usually old.

TABLE- 5.34: AGE PROFILE OF VESSELS

VESSELS AGE GROUP	DRY CARGO LINER	DRY CARGO BULK CARRIER	TANKERS	ETHYLENE GAS	CELLULAR CONTAINER	TOTAL
5 years & below	2	0	0	0	0	2
5 -10 years	10	1	2	0	0	13
11-15 years	17	0	0	0	4	17
16-20 years	14	0	1	3	4	18
20 years & above	30	10	12	-	9	52
TOTAL	73	11	15	3	17	119

The age reduces the operational efficiency of the vessel and increases the operational costs. However, as older vessels are cheaper, their capital cost is lower.

5.6.4 Data Sources

Unlike Railways and Airways, and similar to road, data on cost of shipping operations is not collated by a centralised agency and the Consultants had to collect them from ship owners and operators directly. To enable data collection, a survey schedule was prepared to cover data on expenses and the related cost drivers. However, the shipping industry being a close knit and highly competitive one, keeps cost of operations under wraps and it is not shared to outside agencies easily. To enable data collection the Consultants sought help from Directorate General of Shipping, Indian Coastal Conference (ICC) - trade body of coastal ship operators, and Indian National Ship-owners Association (INSA). A copy of the letter addressed to Ship Operators by the ICC is placed at **Annexure 5.4.3** in Annexure Volume-2.

The schedule was modified and finalised for data collection. The final schedule is provided at **Annexure-5.4.4** in Annexure Volume-2. The schedule has Parts A and B. Part-A deals with data about the company and the ship for the year 2007-08. Part-B deals with the voyage details of the ships in 2007-08. Information sought is summarized in Table-5.35.

TABLE-5.35: SUMMARY OF INFORMATION COLLECTED IN THE SCHEDULE

SN	ITEM	AREA OF COVERAGE
1	Operation Identification	Identified the company and the commodity carried, Vessel size & type of ship which generally operated.
2	Sample Vessel Identification	Type of operation like coastal/overseas, Vessel details like capacity, Year of build & acquisition and price & taxes incurred on the vessel, Type of vessel: Private/Private
3	Voyage Details	Selected O-D pair of ports, length of ballast run, distance for ballast & loaded run, loading/unloading time in port, fuel consumption in sea & port days, port charges, quantity for selected commodities.
4	Yearly abstract of expenditure on the sample vessel	Collected data for the yearly expenditure on the vessel for the distance covered in nautical miles, fuel consumption ; Heavy (HO) & Diesel oil (DO), Fresh water, Victualling ,Store, Wages to running staffs, Insurance fee, life of vessel, Depreciation of the vessel, Steamer sundry expenses, Voyage duration, charted/own vessel, waiting for freight, survey & repair and dry docking period and Cost .
5	Other administrative overhead charges of the company	Collected the Annual report & balance sheet of the company and also got the feed back from the concerned person.

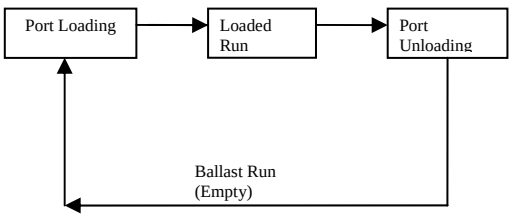
5.6.5 Operating Costs

The operation and maintenance expenses of vessel are categorised into 9 heads given as below:

- Salary including bonus to floating staff/on board
- Overhead Costs of Company
- Survey & Repair of the vessel & dry-docking
- Insurance Fee of the vessel
- Steamer Sundry Costs & Fee
- Interest Cost on the Capital Asset
- Water Charges
- Fuel Cost steaming days
- Fuel Cost port days

The expenses depend on the nature of operations and commodity carried. The commodities have two patterns of movement. First is a round trip voyage or fixed route voyage and its movement pattern is shown in Figure-5.10. Here the vessels move on a round trip; where they start from a loading point, move to the unloading point and return to the loading point. This pattern of operation is seen in iron ore, coal, containers and cement. In such cases average expenses based on a single voyage would suffice.

FIGURE-5.10: FIXED ROUTE VOYAGES (ROUND-TRIP VOYAGES)



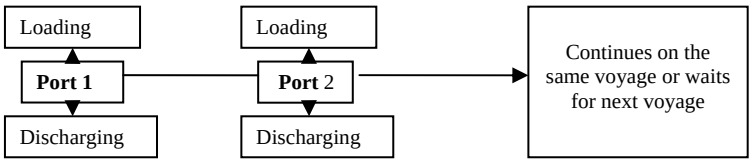
Voyage features: Loading and unloading quantities and route usually remain the same.

Commodities: Coal, Iron Ore, Cement and Clinker, Container

In the case of POL crude and POL products movements the vessels move from a loading point to unloading point. After discharge of cargo the vessels move to a different loading point or are laid-

up waiting for cargo **(Figure 5.11)**. As the pattern of operations is not fixed, data on a representative sample of voyages is necessary for estimating the costs. Accordingly, data is collected for 62 voyages for POL products and on 8 voyages for POL crude movement.

FIGURE-5.11: VARYING ROUTE VOYAGES (AS PER CARGO REQUIREMENTS)



Voyage Features: Loading and unloading routes and quantities vary in different voyages.

Commodities: POL Product and Crude Oil. Brief summary of the nature of operations, summarised in Table-5.36, shows the variability in leads, ship sizes and type of voyages.

TABLE-5.36: SUMMARY OF OPERATIONS DATA

SN	COMMODITIES	VESSEL SIZE (DWT) & TYPE	AVERAGE LEAD (KM)	TYPE OF MOVEMENT
1	POL Crude oil	67161, Tankers	940	Varying route
2	POL Product	33000, Tankers	1355	Varying route
3	Thermal Coal	45234, Bulk carriers	1271	Fixed route
4	Cement/Clinkers	4000, Bulk carriers	552	Fixed route
5	Containers	15000, Containers	664	Fixed route
6	Iron Ore & Pellets	131987, Bulk carriers-loose	2965	Fixed route

The expenses were related to the performance measures of tonnes carried, tonne-km and stay in the port. Using these data costs were estimated.

Financial Cost of Operations per tonne-km is presented in Table-5.37. The cost varies from commodity to commodity due to the differences in operational patterns.

TABLE- 5.37: FINANCIAL COST OF OPERATION PER TKM

COMMODITIES	FINANCIAL- COST RS./TKM
Iron Ore	0.08979
POL Product	0.56540
POL Crude	0.22662
Container	0.37352
Cement/Clinker	0.34245
Coal	0.26134

Detailed break-up of costs of 6 commodities are given in **Annexure-5.4.5** in Annexure Volume-2.

5.6.6 Capital Costs

As a ship is the most important asset for coastal cargo operations, it is considered exclusively to estimate capital costs. The capital costs have two components; annual asset depreciation and financing cost of asset acquisition. Both the parameters are driven by asset prices. To maintain uniformity with other modes of transport purchase price of 2007-08 for different types of vessels was considered. Indicative price of different types of vessels, available from published sources, is given at **Annexure-5.4.6** in Annexure Volume-2. Based on the data prices of vessels in use were estimated and are given in Table-5.38.

TABLE- 5.38

INDICATIVE PRICES OF VESSELS IN 2007- 08

COMMODITIES	SAMPLE VESSEL SIZE (DWT)	PRICE OF VESSELS (Rs. CR.)
Iron ore	125000	269
POL product	33000	169.3
POL crude	67000	226.9
Container	15000	64.8
Cement/clinker	4000	10
Coal	45000	150

Vessel prices were divided by asset life, assumed 30 years, to arrive at the annual depreciation costs. This method was adapted for all modes of transport to maintain uniformity.

The financing costs were assessed for three scenarios. First case assumes that the financing options are not linked to the cost of the vessels and no financing costs are considered. This will be of interest to the policy makers in evaluating different modes of transport to generate long-term options for transport development. Another option would be to charge fixed interest cost on the cost of the vessels annually. This method was used in the current evaluation. Another approach was to use the capital recovery factor method, a method which would evaluate the depreciation and interest components together. The depreciation and financing costs are presented in Table-5.39.

TABLE-5.39: DEPRECIATION AND VESSEL INTEREST COSTS PER TONNE

COMMODITY	DEPRECIATION COSTS (RS./TKM)	INTEREST COSTS (RS./TKM)	TOTAL COSTS (RS./TKM)
POL Product	0.03	0.10	0.13
Crude Oil	0.03	0.06	0.09
Iron Ore	0.01	0.02	0.03
Coal	0.03	0.06	0.09
Container	0.03	0.05	0.08
Cement	0.02	0.03	0.05

5.6.7 Economic and Social Costs

Financial costs assessed above were converted into economic costs using the shadow pricing norms of the Planning Commission. Shadow pricing norms are discussed in **Annexure-5.4.7** in Annexure Volume-2. The corresponding economic costs of transport are given in Table-5.40.

To the economic costs the value of environmental and social costs were added. The environmental costs were evaluated by assessing the cost of carbon abatement. This cost works out to Rs 0.03 per tonne-kilometre. The costs of accident are taken as zero as deaths reported due to coastal operations is insignificant. The financial and Economic costs per tonne-km are presented in Table 5.41.

TABLE-5.41: FINANCIAL AND ECONOMIC COST

COMMODITY	FINANCIAL RS./TKM	ECONOMIC RS./TKM
Iron ore	0.06162183	0.05238
POL Product	0.40637487	0.34542
POL Crude	0.13357406	0.11354
Container	0.16216436	0.13784
Cement	0.29461923	0.25043
Coal	0.29268684	0.24878

TABLE-5.40: ECONOMIC COSTS OF TRANSPORT BY COASTAL SHIPPING

COMMODITY	ECONOMIC COSTS RS./TKM
Iron ore	0.05238
POL Product	0.34542
POL Crude	0.11354
Container	0.13784
Cement	0.25043
Coal	0.24878

5.6.8 Port Costs

The port and other land side operation costs are independent of the coastal service and can be assessed independently. Like ship cost, port costs are also assessed for operations and capital separately.

5.6.9 Data Sources

Unlike shipping operations, port operations, barring a few forays by private sector in recent years, are in public sector. In addition Government of India has appointed a regulatory body called Tariff Authority for Major Ports (TAMP) to regulate the tariff for all major ports. TAMP fixes the tariff for the major ports by following cost plus return formula and these were used to estimate the operations and maintenance costs of ports. Data on capital costs for port infrastructure have been collected from recent work estimates for berths and other facilities from project reports and from the 11th Plan Working Group Report.

5.6.10 Operating Costs

For a vessel to berth in a port area the basic charges paid to port are:

- Entry fee,
- Berthing fee,
- Pilotage fee and
- Miscellaneous fee, if any.

The fees for major ports are fixed by TAMP and for non-major ports by state governments bodies. The charges vary on vessel type, duration of berthing and from port to port. TAMP publishes tariffs, called the scale of rates, to be charged by major ports. These rates for one port are given in **Annexure-5.4.8** in Annexure Volume-2 for illustrative purpose. It is comprehensive and covers all commercial activities of the port.

For non-major ports tariffs fixed by Gujarat Maritime Board are used as the basis since it handles about 86% of coastal traffic. In fact, availability of this data was a distinct advantage over earlier attempts at costing port activities, which had to necessarily depend on work studies.

Port tariffs used by all the ports for moving a commodity were factored in and weighted in direct proportion to the quantity of traffic to assess the cargo. The weighted average gives the tariff charged per tonne. Complete estimation procedure is shown in **Annexure-5.4.9** in Annexure Volume-2. The estimated tariff was converted to cost by adjusting with the profit margin as provided by IPA. The details of profit margin for the ports are given in **Annexure-5.4.10** in Annexure Volume-2. Port charges for different commodities are given in Table 5.42.

TABLE-5.42: PORT CHARGES FOR DIFFERENT COMMODITIES

SN	COMMODITIES	VESSEL RELATED CHARGES (RS/TKM)
1	Iron ore	0.0019
2	Cement / clinker	0.005
3	Coal	0.005
4	POL Product	0.008
5	Containers	0.004
6	Crude	0.005

5.6.11 Capital Costs: Financial and Economic

The capital costs were based on the estimated cost of construction data available with the Planning Commission and the figures furnished by the 11th Plan Working Group. As explained earlier in the case of vessel depreciation, capital investment is converted to annual depreciation by dividing value of investment by asset life of 50 years. Similar to vessel financing costs, interest costs assessed by assuming zero interest cost and interest cost of 6 per cent. The combined costs of deprecation and interest were also assessed through capital recovery factor approach.

Detailed calculations for evaluating the capital costs are shown in **Annexure-5.4.11** in Annexure Volume-2. and summary is given in Table-5.43. The financial costs are converted into economic costs by using shadow pricing factors presented in **Annexure-5.4.7** in Annexure Volume-2. The economic costs are also given in the table.

TABLE-5.43 CAPITAL COSTS OF PORTS- FINANCIAL AND ECONOMIC

COMMODITIES	FINANCIAL COSTS RS/TKM	ECONOMIC COSTS (RS/TKM)
Iron ore	0.0224	0.0197
POL Product	0.0496	0.0436
POL Crude	0.0979	0.0862
Coal	0.0835	0.0735
Cement	0.0946	0.0833
Container	0.033	0.029

Total Costs

The financial, economic and resource costs incurred in moving cargo by Coastal Shipping are given in Table 5.44. The costs include the capital and maintenance costs of ports and the vessels.

TABLE-5.44: TOTAL OPERATING COST – FINANCIAL, ECONOMIC AND RESOURCE

COMMODITIES	FINANCIAL COST RS/TKM	ECONOMIC COST RS/TKM	RESOURCE COST RS/TKM
Iron ore	0.112	0.096	0.126
POL Product	0.598	0.509	0.539
POL Crude	0.325	0.277	0.307
Coal	0.345	0.294	0.324
Cement	0.437	0.372	0.402
Container	0.407	0.346	0.376
Others	0.345	0.294	0.324

5.6.12 Social Cost

Though social cost is multi-dimensional, the study is limited to two significant components i.e. environment and accident.

Environment Cost

The transport sector is dependent on petroleum fuel which contributes significantly to greenhouse gases emissions leading to air pollution and contributing to phenomenon of Global Warming. In view of the hazardous effects of environment pollution and gaseous emissions which vary significantly under different modes, assessment of social cost plays an important role.

Assessment of Environment Cost was based on the study, "Estimating Cost of Air Pollution Abatement for Road Transport in India: Case Studies of Andhra Pradesh and Himachal Pradesh" conducted by Institute of Economic Growth in 2005. In this study cost to the environment was arrived on the abatement approach. Under this approach the cost for abatement which is treated as synonymous to the environment cost for different type of road vehicles comprises:

- Cost of upgrading the vehicular technology to make it compatible with Euro III standards
- Cost of improving the fuel quality

This study in turn had based its emission level by different modes on the data collected by Central Pollution Control Board (CPCB), the nodal agency for monitoring the pollution levels across the country. CPCB executes a nation-wide programme of ambient air quality monitoring known as National Air Quality Monitoring Programme (NAMP).

Under this programme four air pollutants *viz*., Sulphur Dioxide (SO_2), Oxides of Nitrogen as NO_2, Suspended Particulate Matter (SPM) and Respirable Suspended Particulate Matter (RSPM / PM10) have been identified for regular monitoring at various locations. Based on the above, various pollutants for the movement of freight traffic through road were arrived at in the study conducted by IEG under references which are brought out in Table-5.45:

TABLE-5.45: VARIOUS POLLUTANTS FOR MOVEMENT OF FREIGHT TRAFFIC THROUGH ROAD

TYPE OF VEHICLES	EMISSION (kgs / km)							
	PRE EURO (1996-00)				EURO 3			
	CO	HC	NOX	PM	CO	HC	NOX	PM
TW	0.0040	0.0033	0.0001	0.0001	0.0014	0.0013	0.0000	0.0000
CAR	0.0026	0.0006	0.0009	0.0002	0.0010	0.0001	0.0003	0.0000
BUS	0.0045	0.0012	0.0168	0.0016	0.0028	0.0008	0.0100	0.0002
Truck	0.0050	0.0010	0.0080	0.0008	0.0028	0.0008	0.0050	0.0001
Others	0.0069	0.0003	0.0025	0.0005	0.0006	0.0001	0.0005	0.0001

The cost of improvement of fuel quality is taken from the Report of Expert Committee on Auto Fuel Policy popularly known as Mashelkar Committee, 2002 which provides estimates of incremental costs for production of improved fuel quality of petrol and diesel compatible with Euro norms. Incremental cost of production of one litre diesel for BIS -2000 standards to BIS III as received from various refineries varies from Rs 0.25 to Rs. 3.35. Hence an average incremental cost of improvement of fuel has been taken as Rs 1.80. Annualized incremental cost of up-gradation of vehicular technology for conversion of same standards has been taken from the referred study at Rs 17212.50.

On the basis of above, the environment cost per tonne-km for road freight sector was arrived at. The cost for rail and coastal sector was arrived at in proportion to fuel consumption under these sectors. A fuel consumption norm of 2.54 litres/'000 GTKM under rail, 0.00216 litres/tkm under coastal sector and 4.8 litre/100 kms for Airways was adopted. The environment cost adopted in the study under different modes is shown in Table-5.46.

TABLE-5.46: ENVIRONMENT COST PER TONNE-KM

(Units: In Rs)

MODE	COST
Road (Freight)	0.202
Rail (Diesel Traction)	0.051
Rail (Electric Traction)	0.015
Airways	0.690
Coastal Shipping	0.030

Accident Cost

Safety has always been an important consideration in transport sector. An accident leads to fatalities, injuries to people and damage to property resulting in economic loss to society. Accident cost varies significantly amongst different modes of transport and plays a significant role in modal choice. Therefore, a proper assessment of this component This side of social cost in today's world has assumed great significance. The accident cost under different modes was based on the study conducted by Asian Institute of Transport Development in 2002 namely "Environmental and Social Sustainability of Transport - Comparative Study of Rail and Road". Different approaches are available for monetary evaluation of accidents, but under the study in reference Gross Output Approach was adopted.

This approach takes into consideration the cost of a road accident as the sum of real resource costs, such as vehicle damage, medical expenditure, police costs and the discounted value of the victim's future output. However, to capture for human considerations as reflected in the other approach (willingness to pay) to estimate accident costs the values as derived by following the

Gross Output Approach were further augmented to account for pain, grief and suffering of those involved in road accidents were also duly accounted for in study under reference.

The accident cost based on the above estimation and further inflated to 2007-08 price level works out to:

Road - Rs. 0.062 / tkm
Rail - Rs. 0.001 / tkm

5.6.13 User Cost

Introduction

For moving cargo between any two points, the total costs would include the costs incurred by a mode operator (like rail, road and coastal shipping) and the costs incurred by a consignor or consignee so as to be able to use a mode of transport. The economic and financial costs incurred by each mode of transport are estimated earlier. However, a user (consignor or consignee) incurs additional costs to move cargo by different modes of transport.

To be able to move cargo by a mode of transport the cargo needs to be packed, loaded or unloaded, and moved from originating point to the nearest point where the mode is available or vice versa. However, different modes of transport call for different levels of expenses for each of the elements. Table 5.47 shows the user elements involved for each mode of transport.

TABLE-5.47: USER COST ELEMENTS INVOLVED FOR EACH MODE OF TRANSPORT

SN	ELEMENT	RAIL	ROAD	COASTAL
1	Packing	✓	✓	✓
2	Handling	✓	✓	✓
3	Local Transport	✓		✓
4	Transit Loss	✓	✓	✓
5	Siding Charges	✓		✓
6	Inventory Holding Cost	✓	✓	✓

While costs relating to Packing (excluding Coal, POL, Iron & Steel and Livestock which need no packing), handling and transit inventory are relevant to transport of goods by Railways, Coastal Shipping and Highways, and local transport which is relevant generally in the case of Railways and Coastal Shipping. The siding cost is relevant for rail transport and Coastal Shipping only and that too for specific commodities viz. Cement, Fertilizer, Coal, Steel, POL, Wheat and Sugar. Incidentals i.e. cost of transmittal of freight receipt is relevant mainly in the case of Railways and Coastal Shipping, as in the case of Highways, the freight receipts in most cases are sent through truck drivers. Octroi is taken into consideration in terms of financial costing only for each of the modes.

Data Sources

For collection of requisite user cost data, a commodity related sample frame of consignors and consignees was drawn up and a comprehensive schedule/questionnaire was designed for the purpose. To get a clear picture how the data was collected refer **Annexure 5.5.1** in Annexure Volume-2.

In collecting the data, both approaches i.e. mailing the schedules to sample consignor/consignee firms and personal canvassing by the RITES study team were adopted. Though, in some cases, particularly for sugar the mailed schedules did bring in response, in most other cases data had to be collected through personal interviews with the concerned parties. The major difficulties faced during the field surveys were (i) reluctance of the respondents, mainly private agencies, to part with the data and (ii) the differentials between the manner of data maintenance by the firms and

the manner in which the data were demanded by project requirements. The approach adopted to overcome these constraints envisaged using the good offices of the associated Government Departments, Trade Associations and persistent interaction with individual parties. Government organizations helped a lot to acquire reasonable level of sample data. A listing of commodity related sample firms is placed at **Annexure 5.5.2** in Annexure Volume-2.

Estimation Procedure (Financial Cost)

Packing

The estimation of packing cost is based on average of the cost data relating to labour charges and material inputs furnished by the sample firms in respect of different commodities except coal, POL and livestock (horn cattle) which need no packing. For the packed commodities the cost of the empty bag/carton and the labour incurred (mechanical/physical) is considered as the input. The packing costs in respect of all the commodities covered in the study are not mode-variant and accordingly have same values both in the case of Railways and Highways.

In the case of steel, though some products like billets, blooms/slabs, ingots, do not have packing element, CR/HR coils and sheets, do have a specific packing material and labour input to the extent of Rs. 80.42 per tonne as estimated. In addition, there is the cost of providing bracings to secure the consignments in the wagon/truck. This cost has, however, been taken as part of handling and accounted for accordingly for the remaining commodities excluding livestock, coal and POL which need packing. Table 5.48 shows the packing cost of sample commodities taken for the study.

TABLE-5.48: PACKING COST OF COMMODITIES

COMMODITY	RAILWAYS	HIGHWAYS	COASTAL SHIPPING
Food grains	24.47	24.47	
Fruits & Vegetables	60.00	60.00	
Coal & loose minerals	0.00	0.00	0.00
Fertilizers (Urea)	160.00	160.00	
Sugar	58.87	58.87	
Petroleum products	0.00	0.00	0.00
Cement	70.00	70.00	70.71
Livestock	0.00	0.00	
Iron & Steel	41.00	41.00	
Container	329.90	329.90	342.07
Others	329.90	329.90	342.07

Handling

Handling Scenarios

Handling charges plays a major role in user cost. The handling cost is mode variant. The commodity which is produced or manufactured shall reach the user by various modes of transport. The handling charges scenario changes from commodity to commodity. A product which has to be moved by Railways shall be first handled at the warehouse to load in to the truck/lorry and it has to be unloaded in railway yard and then it shall be loaded into railway wagons. Again at destination point it shall be unloaded and then loaded to truck/lorry and moved up to the warehouse. The number of handlings changes not only as per the commodity but also as per the mode of transport.

Handling cost changes the complete break-even distances of the commodities depending on number of handlings taken place while moving the commodity from the consignor to consignee.

Handling Situations

Handling (loading/unloading) costs are derived by averaging the sample cost data in terms of actual expense in the case of commodities where only manual labour is involved at either end viz. Wheat, Onion, Sugar, Livestock (horn cattle). In the case of remaining commodities viz. Coal, POL, Fertilizers, Cement and Steel, both manual and mechanical inputs are relevant in handling. In respect of these commodities, while the labour input is treated in similar manner as above, the cost of mechanical input is based on the interest and depreciation in relation to its historical value, using straight line method of depreciation at an average rate of interest of 12.5 percent taking into account extant sources of funding and their relative importance i.e. banks and other financial institutions, the cost of operation and maintenance in terms of manpower, material and power/fuel. The costs so worked out are average over sample units.

In the case of Railways, three handlings each are involved at origin and destination ends in respect of commodities which are loaded and unloaded at the railway goods sheds i.e. commodities listed in the first set above except livestock where only one handling at either end is involved. Even at destination, it is 3 handlings generally although for receipts at FCI sidings, the incidence is reduced to 1.

Steel and POL

In the case of Steel and POL, as the movement takes place between the siding at the origin and siding at destination (stock-yard siding in the case of steel), accordingly only one handling at either end is taken. For fertilizer (urea) and cement, one handling at origin and three handlings at destination are involved.

Coal

For Coal one handling at origin and one or three handlings at destination have been considered depending on the real world situation revealed by our study on whether the consignment is unloaded at a siding (e.g. at power house, cement plants) or at a railway goods shed or, alternatively, in relation to block-load movement.

The handling costs in the case of Highways are computed in a similar manner as indicated earlier and are comparatively low because only one handling is involved at either end.

Livestock (Horn Cattle)

In the case of livestock (horn cattle), both in transport by rail or road, the nature of user cost inputs does not permit the normal categorization. The costs relate to provision of breast bars to secure the animals during transit, spreading of earth on the wagon/truck floor to make the journey comfortable and provisions such as rope, twine, water can, kerosene oil and buckets for use enroute by the accompanying attendants. In the case of Railways, two attendants are carried free and the additional attendants are required to pay second class passenger fare. On return journey they have to spend on their travel. In the Highways, both attendants are carried free on outward journey and pay for their return trip. The cattle are walked into and out of the wagon/truck by the two attendants within the amount of TA/DA paid to them and the effort is part of the overall responsibility entrusted to them. The costs are really in terms of labour and material and as such not distinguishable in terms of either packing or handling. The costs can, however, be grouped only under 'handling' in the existing format.

TABLE-5.49: HANDLING COST OF COMMODITIES

Units: Rs per tonne

COMMODITY	RAILWAYS	HIGHWAYS	COASTAL SHIPPING
Food grains	58.89	35.91	
Fruits & Vegetables	80.10	36.00	
Coal & other loose minerals	157.18	116.00	231.34
Fertilizers (Urea)	47.58	35.91	
Sugar	107.83	40.68	
Petroleum products	70.00	70.00	67.28
Cement	111.84	55.92	153.70
Livestock	34.09	34.09	
Iron & Steel	211.82	105.91	
Containers	150.00	150.00	170.45
Others	150.00	150.00	170.45

Local Transport

Transport Distance Scenarios

For the transport of goods through Railways and Coastal Shipping, except in the cases where sidings or berths are provided in consignor or consignee premises, local transport of cargo is involved. Local transport is predominantly done through trucks. The distance between the goods sheds and warehouses among all the consignees/consignors are not the same for any given commodity.

Likely Situation

Local Transport in the case of Railways and Coastal Shipping is valid both at origin and destination except for Fertilizers (Urea) and Cement where local cartage is relevant at destination only, loading at origin being done at the siding. For POL where no Local Transport is indicated owing to availability of siding facility at either end.

In the case of Highways, however, where door to door movement is involved, local cartage is not relevant. The local transport cost in respect of these modes is based on the sample data collected and fare lists published by lorry owners association of the concerned states/districts.

Table 5.50 shows the Local Transport cost of sample commodities taken for the study.

TABLE-5.50: LOCAL TRANSPORT COST OF COMMODITIES

COMMODITY	RAILWAYS	HIGHWAYS	COASTAL SHIPPING
Food grains	83.00	0.00	
Fruits & Vegetables	59.16	0.00	
Coal & other loose minerals	55.28	0.00	106.00
Fertilizers (Urea)	24.75	0.00	
Sugar	38.50	0.00	
Petroleum products	0.00	0.00	0.00
Cement	73.00	0.00	81.11
Livestock	0.00	0.00	
Iron & Steel	65.00	0.00	
Container	168.76	0.00	187.78
Others	168.76	0.00	187.78

Transit Loss

Transit loss is also an important factor to be considered during movement of the commodities from one destination to another. The transit loss varies from 0.5 % to 2 % depending on the commodity handled. The commodities like wheat, cement which are having multiple handlings are susceptible to more transit losses. In the case of perishable goods the transit loss will be more due to delay in transit. During transhipment of consignment from one mode to another mode or in the same mode the wastage percentage will increase heavily. While calculating the

losses all these factors are taken into consideration since handling of consignment is a major factor affecting them. Commodity-wise transit losses estimated for each mode are given in Table 5.51.

TABLE-5.51: TRANSIT LOSS OF COMMODITIES

COMMODITY	RAILWAYS	HIGHWAYS	COASTAL SHIPPING
Food grains	84.00	0.00	
Fruits & Vegetables	24.00	0.00	
Coal & other loose mineral	8.00	0.00	24.00
Fertilizer (Urea)	45.00	0.00	
Sugar	53.10	0.00	
Petroleum products	46.78	0.00	0.00
Cement	14.40	0.00	14.40
Livestock	22.00	0.00	
Iron & Steel	0.00	0.00	
Container	0.00	0.00	0.00
Others	0.00	0.00	0.00

Siding Costs

The Railway Siding costs have been estimated by averaging the data collected from sample consignors/consignees in respect of capital cost, repair and maintenance cost, shunting cost and the Railway staff cost debitable to consignor/consignee, if any. The process of calculating interest and depreciation is same as in the case of mechanical handling equipment as already described.

For clear understanding the calculation of Railway Siding Costs refer to **Annexure-5.5.3** in Annexure Volume-2 (Calculation of Siding Cost).

Table 5.52 shows the Siding Cost of sample commodities taken for the study.

TABLE-5.52: SIDING COST OF COMMODITIES

Units: Rs per tonne

COMMODITY	RAILWAYS	HIGHWAYS	COASTAL SHIPPING
Food grains	5.26	0.00	
Fruits & Vegetables	5.26	0.00	
Coal & Other loose minerals	3.25	0.00	3.25
Fertilizers (Urea)	5.26	0.00	
Sugar	5.26	0.00	
Petroleum products	52.57	0.00	52.57
Cement	7.27	0.00	7.27
Livestock	3.25	0.00	
Iron & Steel	5.25	0.00	
Container	0.00	0.00	0.00
Others	0.00	0.00	0.00

Transit Inventory Cost

In estimation of transit inventory cost, the commodity value is based on its wholesale price. The business rate of interest at 15 percent per annum as prevalent during 2007–2008 has been applied to the value of the commodity over the estimated distance-slab based transit times for working out the transit inventory cost.

Annexure 5.5.4 in Annexure Volume-2 explains how the Transit Inventory Cost has been calculated. Table 5.53 brings out details of Transit Inventory Costs for Railways, Highways and Coastal Shipping.

TABLE 5.53: TRANSIT INVENTORY COST OF COMMODITIES

COMMODITY	RAILWAYS	HIGHWAYS	COASTAL SHIPPING
Food grains	4.32	2.78	
Fruits & Vegetables	1.23	0.79	
Coal & other loose minerals	0.16	0.16	0.99
Fertilizers (Urea)	4.62	2.97	
Sugar	5.46	3.51	
Petroleum products	16.20	10.42	64.81
Cement	1.23	0.95	3.95
Livestock	3.39	1.53	
Iron & Steel	1.64	1.59	
Container	0.00	19.82	0.00
Others	0.00	19.82	0.00

5.6.14 Summary of Goods User Cost - Financial

As discussed above the user cost refers to the cost incurred by either consignor or consignee for movement of consignment from its originating point to point of consumption. The financial user cost of all the commodities as discussed above are presented in Table 5.54.

TABLE5.54: FINANCIAL USER COST OF COMMODITIES

COMMODITY	RAILWAYS	HIGHWAYS	COASTAL SHIPPING
Food grains	259.94	63.15	
Fruits & Vegetables	229.75	96.79	
Coal & other loose minerals	218.39	116.16	365.58
Fertilizers (Urea)	287.21	198.88	
Sugar	269.01	103.06	
Petroleum products	185.55	80.42	184.66
Cement	277.74	126.87	331.14
Livestock	62.73	35.62	
Iron & Steel	324.71	148.50	
Container	648.66	499.72	700.30
Others	648.66	499.72	700.30

5.6.15 Economic Costs

The compatible economic costs have been worked out from the financial cost estimates, using the guidelines provided by the Project Appraisal Division of the Planning Commission.

For working out the economic cost of packing of commodities carried in gunny/polythene bags (cement, wheat, sugar, fertilizers and onions), the 2007–2008 financial cost of packing materials, net of retrievable value, has been multiplied by a factor derived by dividing f.o.b. price of jute, adjusted for foreign exchange premium of 25 percent net of handling cost, trade and transport margin, by the domestic (wholesale) price of the material. In the case of steel (CR & HR coils and sheets), the conversion of packing cost from financial to economic is again based on c.i.f. prices duly adjusted as indicated earlier. In working out cost of bracings, the cost share of wood and nails/other like materials and manpower have been taken as 93.22 percent, 3.44 percent and 3.34 percent, respectively. For the manpower input for packing in respect of all the commodities, the financial cost as such has been taken into account. Packing cost is not relevant in the case of coal, POL and livestock (horn cattle).

In respect of handling, for commodities where manual handling is relevant either at both ends or at one end, viz. wheat, onions, coal, fertilizer, sugar, cement, livestock and containers, etc., the handling cost is based on the actual expense at the relevant end/ends. In the case of commodities like coal, steel, POL, cement, fertilizer and containers which have mechanical input also, either at one end or at both ends, the cost shares of the mechanical equipment/materials

and labour have been considered as 70 percent and 30 percent, respectively. The accounting ratio for machine/materials is based on duly adjusted c.i.f. price. Capital costs are worked out on current i.e. 2007–2008 replacement cost approach, duly allowing for the spent up period of the total economic life of the asset. The labour part of the cost is considered on the basis of actual expense both in relation to operation and maintenance of machine, material and power/fuel being duly adjusted to arrive at their economic value.

The local transport cost by truck, where relevant, has been worked out by duly adjusting the financial cost of truck operations for a lead of less than 50 kilometres using relevant adjustment factors computed for the Highway operator economic cost estimates.

In the case of railway siding cost, a composite adjustment factor in respect of railway track, repair and maintenance, shunting and railway staff has been worked out based on the rail operator cost constituent relating to marshalling yard components such as land, structures, ballast, sleepers, rails, fastenings, etc.

5.6.16 Summary of Goods User Cost - Economic

As discussed above, financial user costs were converted into economic user cost, using shadow price factors. Summary of commodity wise economic user cost is presented in Table 5.55.

TABLE-5.55: ECONOMIC USER COST OF COMMODITIES

COMMODITY	RAILWAYS	HIGHWAYS	COASTAL SHIPPING
Food grains	243.70	57.98	
Fruits & Vegetables	204.42	90.67	
Coal & other loose mineral	199.53	102.24	327.22
Fertilizer (Urea)	274.23	189.77	
Sugar	250.45	96.41	
Petroleum products	177.15	72.02	176.59
Cement	256.32	119.46	303.88
Livestock	58.64	31.53	
Iron & Steel	292.79	135.79	
Container	602.04	469.98	648.90
Others	602.04	469.98	648.90