

## Chapter 11

### ECONOMIC ANALYSIS

#### 11.1 INTRODUCTION

The purpose of the undertaking an economic evaluation is to provide an overall picture of the contributions of the MRT system to broadly defined social goals thereby justifying its implementation. The economic viability is commonly expressed in terms of Economic Internal Rate of Return (EIRR).

#### 11.2 ECONOMIC ANALYSIS APPROACH

The economic appraisal of the MRT has been carried out within the broad framework of Social Cost –Benefit Analysis Technique. It is based on the incremental costs and benefits and involves comparison of project costs and benefits in economic terms under the “with” and “without” project scenario. In the analysis, the cost and benefit streams arising under the above project scenarios have been estimated in terms of market prices and economic values have been computed by converting the former using appropriate shadow prices. This has been done to iron out distortions due to externalities and anomalies arising in real world pricing systems. The annual streams of project costs and benefit have been compared over the analysis period of 30 years to estimate the net cost/ benefit and to calculate the economic viability of the project in terms of EIRR.

The Economic Internal Rate of Return (EIRR) for the project has then been arrived using Discounted Cash Flow technique to the net benefit stream at economic prices.

#### 11.3 EVALUATION ASSUMPTIONS

The key evaluation assumptions used in the economic evaluation are listed in **Table 11.1**

**Table 11.1 KEY EVALUATION ASSUMPTIONS**

PARAMETER	ASSUMPTION
Price Level	June'2004
First year of operation	2010
Last year of operation	2042
Construction period	3 years (2006-2010)
Daily to annual factor	340

#### 11.4 ESTIMATION OF COSTS

The project cost comprises capital cost, operation and maintenance cost.

Cost components considered for the purpose of this exercise include:

- Capital cost of infrastructure (civil engineering, land, track, power supply, traction system, signaling and telecommunications, etc.) and rolling stock.
- Operating cost of Metro

**Table 11.2** summarizes the estimated cost (Rs. in Crores) to economy. For Ahmedabad Metro, it is estimated as 4295 Crores assuming escalation factor of 5%.

**TABLE 11.2**  
**ESTIMATED COST TO ECONOMY FOR AHMEDABAD METRO**  
**CORRIDOR IN YEAR 2010**

SYSTEM	COST	Rs. In Crores
Ahmedabad Metro	Completion Cost	4295 Cr
	Operating Cost	276 Cr.

### 11.5 ESTIMATION OF BENEFITS

The Ahmedabad Metro will yield tangible and non-tangible savings due to equivalent reduction in road traffic and certain socio-economic benefits. Introduction of Metro will result in reduction in number of buses, usage of private vehicles, air pollution and increase the speed of road-based vehicles. This, in turn, will result in significant social benefits due to reduction in fuel consumption, vehicle operating cost and travel time of passengers. Reduction in accidents, pollution and road maintenance costs are the other benefits to the society in general.

The benefit stream that has been evaluated and quantified includes:

- Capital and operating cost (on present congestion norms) of carrying the total volume of passenger traffic by existing bus system and private vehicles in case Metro project is not taken up.
- Savings in operating costs of all buses and other vehicles due to de-congestion including those that would continue to use the existing transport network even after the Metro is introduced.
- Savings in time of commuters using the Metro over the existing transport modes because of faster speed of Metro.
- Savings in time of those passengers continuing on existing modes, because of reduced congestion on roads.
- Savings on account of prevention of accidents and pollution with introduction of Metro.

- Savings in road infrastructure and development costs that would be required to cater to increase in traffic, in case Metro is not introduced.
- Savings in fuel consumption on account of less number of vehicles on road and decongestion effect with introduction of Metro are included in those of vehicle operating cost.

The values used for various parameters used for the analysis are given in Appendix –1.

Quantification of some of the social benefits has not been attempted because universally acceptable norms do not exist to facilitate such an exercise. However, it has been considered appropriate to highlight the same, as given below:

- Reduced road stress
- Better accessibility to facilities in the influence area
- Economic stimulation in the micro region of the infrastructure
- Increased business opportunities
- Overall increased mobility
- Facilitating better planning and up-gradation of influence area.
- Improving the image of the city.

## 11.6 TRANSPORT DEMAND ON MRT CORRIDOR

Existing mass transport system of Ahmedabad consists of buses operated by AMTS, shared auto rickshaws by private operators. The transport scenario in year 2010 with and without Metro is presented in **Table 11.3**

**TABLE 11.3  
TRANSPORT DEMAND FORECAST ON AHMEDABAD METRO**

ITEM	2010(Lakh)
Total Trips	61.10
Trips on Metro	6.75
Trips on Regional Rail System	4.55
Trips by Buses including Shared Autos	25.36
Trips by other private modes	24.44

In 2010, total trips on Ahmedabad Metro network would be 6.75Lakh and 4.55 Lakh trips would be catered by Regional Rail network.

## 11.7 SAVING IN CAPITAL & OPERATING COST OF BUSES

It is estimated that with Ahmedabad Metro, there would be savings of 250 buses, which would result in savings of Rs. 56 Crs. in 2010 towards capital and operating cost of buses. The saving in respect of private vehicles will be approx. Rs.506 Crores.

## 11.8 REDUCTION IN TRAFFIC CONGESTION

Metro will contribute towards reducing the congestion and journey time on roads because of diversion of some traffic to Metro. Reduction in traffic congestion will save the necessary capital investment and vehicle operating cost as well as increase in time saved per vehicle. With the implementation Ahemdabad Metro corridor, the savings from operating costs due to decongestion effect of Metro has been estimated to be Rs 95 Crores in the year 2010.

## 11.9 REDUCTION IN FUEL CONSUMPTION

Savings in fuel consumption with the introduction of Metro corridors have already been included in savings of vehicle operating cost. The effect of Metro on fuel savings alone has been calculated separately as follows. The main fuels used in vehicles are CNG and petrol. The saving because of fuel alone from the savings in vehicle operating costs and savings due to decongestion effect for the year 2010 works out to Rs 332 Crore for Ahemdabad Metro. (Table 11.3)

**TABLE 11.3**  
**SAVINGS IN FUEL ALONE WITH THE PROJECT SCENARIO IN YEAR 2010**

MRT CORRIDOR	PARAMETERS	SAVINGS
		(Rs. in Crores)
Ahemdabad MRT	Savings in Diesel due to	
	- Less number of vehicles	14
	- Decongestion effect	6
	Savings in Petrol due to	
- Less number of vehicles	226	
- Decongestion effect	86	
	TOTAL	332

## 11.10 PASSENGER TIME SAVING

With the introduction of Metro, there will be reduction in traffic congestion on the roads and correspondingly, there will be saving in time of commuters travelling by various modes of road transport. Similarly, Metro System itself being faster than conventional road transport modes, will also lead to considerable saving in time of commuters travelling on Metro. With the implementation Ahemdabad Metro the passenger time saving would be 289 Crores.

## 11.11 SAFETY

The reduction in traffic volumes on roads brought about by modal transfer to Metro is expected to reduce number of accidents. Any reduction in number of

accidents will involve savings from damage to vehicles and savings towards medical and insurance expenses to persons involved in accidents. The benefits because of accidents prevented with the introduction of Ahmedabad Metro corridors works out to Rs8 Crores.

### 11.12 REDUCED AIR POLLUTION

The benefits because of saving in cost of prevention of vehicular pollution, with the implementation of Ahmedabad Metro Corridors in the year 2010 is expected to be Rs 132 Crores.

### 11.13 SAVINGS IN ROAD INFRASTRUCTURE

The MRT corridor may bring savings in investment in road infrastructure because shifting of passengers to MRT and withdrawal of vehicles in the project area. Since no such data is available for Ahmedabad, this benefit for with project scenario has not been considered.

### 11.14 SHADOW PRICING

The value of Project cost and benefits have been expressed in terms of market prices. These prices, however, do not reflect the real resource cost and value of benefits derived from the project to the economy. The market prices are distorted due to variety of factors. These factors could be controlled/administered prices of inputs, monopolistic market of inputs, tax structure etc. The factors used for converting project inputs and output to economic costs are given in following **Table 11.4**

S.NO	ITEM	FACTOR
1	CAPITAL COST	0.85
2	OPERATIONS & MAINTENANCE COST	0.80
3	SAVINGS IN CAPITAL & OPERATING COST OF BUSES	0.89
4	SAVINGS IN CAPITAL & OPERATING COST OF PRIVATE VEHICLES	0.8
5	SAVINGS IN PASSENGER TIME	1.0
6	SAVINGS IN VOC	1.1
7	SAVINGS IN ACCIDENT COSTS	1.0
8	SAVINGS IN POLLUTION COSTS	1.0

### 11.15 RESULT OF ECONOMIC ANALYSIS

The cost and benefit streams for 30-year period in the economic prices have been worked out and presented in **Tables 11.5**. The residual value of Metro facilities (e.g. Metro and Rail corridors, equipment for power supply and tele-communication, rolling stock, etc.) in last year has not been taken into account as benefit in these tables. The total cost worked out on the above basis is then subtracted from the total benefits to estimate the net benefit of

the project. This flow is then subjected to the process of discounting to work out the internal rate of return on the project, to examine the viability of the Project in Economic terms. Thereafter, the Project EIRR in economic terms has been arrived by using shadow prices.

The EIRR in economic terms works out to for Ahemdabad Metro network EIRR works out to 26.95%.

### 11.16 SENSITIVITY ANALYSIS

A sensitivity analysis of the EIRR with 10% cost overrun and 10% reduction in traffic materialization (separately) has been carried out. The EIRRs under these scenarios are given in **Table 11.6**.

**TABLE 11.6**  
**EIRRs - SENSITIVITY ANALYSIS**

<b>SENSITIVITY</b>	<b>EIRR (%)</b>
	<b>AHEMDABAD METRO</b>
Basic EIRR	26.95
With increase in cost by 10%	25.53
With reduction in traffic materialization by 10%	26.75
With 10% reduction in traffic and increase in cost by 10%	25.35

It can be seen from above table that 10% reduction in traffic materialization affect economic viability as much as cost overrun of the project. Accordingly, it is recommended that controls should be exercised required for realization of the projected traffic and to keep the cost of construction under control.

Table 11.5

Cost and Benefit Stream for Ahmedabad MRTS: ECONOMIC PRICES										
										Units: Rs in Crores
YEAR	CAPITAL	RUNNING EXPENSE	TOTAL COSTS	SAVINGS BUSES	FROM OTHERS	SAVINGS FROM TIME	VOC	ACC/POL	TOTAL SAVINGS	NET CASH FLOW
		OF MRTS			VEHICLES					Rs. IN Cr.
2006	176	0	176	0	0	0	0	0	0	-176
2007	864	0	864	0	0	0	0	0	0	-864
2008	1262	0	1262	0	0	0	0	0	0	-1262
2009	749	0	749	0	0	0	0	0	0	-749
2010	393	220	613	52	472	270	89	131	1015	401
2011	206	234	440	57	514	294	96	142	1103	663
2012	0	248	248	62	558	320	105	155	1199	950
2013	0	264	264	67	607	347	114	168	1303	1039
2014	0	280	280	73	660	378	124	183	1416	1136
2015	0	298	298	79	717	410	134	199	1540	1242
2016	0	316	316	86	779	446	146	216	1674	1357
2017	0	336	336	94	847	485	159	235	1819	1483
2018	0	358	358	102	921	527	173	255	1977	1620
2019	0	380	380	111	1001	573	188	277	2149	1769
2020	0	405	405	121	1088	623	204	301	2336	1931
2021	0	489	489	131	1182	677	222	328	2539	2050
2022	273	520	793	142	1285	736	241	356	2760	1967
2023	0	553	553	155	1397	800	262	387	3000	2447
2024	0	588	588	168	1518	869	285	421	3261	2673
2025	0	626	626	180	2368	1052	262	598	4459	3834
2026	0	666	666	196	2574	1143	284	650	4847	4181
2027	0	709	709	213	2797	1242	309	706	5268	4559
2028	0	755	755	232	3041	1350	336	768	5726	4971

2029	0	804	804	252	3305	1468	365	834	6224	5420
2030	0	857	857	274	3592	1595	397	907	6765	5908
2031	445	1029	1474	298	3905	1734	432	986	7354	5880
2032	696	1095	1792	323	4244	1885	469	1071	7993	6201
2033	731	1167	1898	352	4613	2049	510	1165	8688	6790
2034	0	1243	1243	376	4941	2194	546	1247	9305	8062
2035	0	1324	1324	537	5174	2466	533	1269	9979	8654
2036	0	1412	1412	575	5541	2641	571	1360	10687	9276
2037	0	1506	1506	616	5935	2829	611	1456	11446	9941
2038	0	1606	1606	659	6356	3029	654	1560	12259	10653
2039	0	1714	1714	706	6807	3245	701	1670	13129	11415
2040	0	1830	1830	756	7291	3475	751	1789	14062	12232
2041	0	1954	1954	810	7808	3722	804	1916	15060	13106
2042	5687	2087	7774	868	8363	3986	861	2052	16129	8355
									IRR(%)	26.95



## APPENDIX I

## Assumption made in carrying out Economic Analysis

Various assumptions have been made, while assessing the economic benefits to the society on account of various factors after introduction of MRTS system. Following are the assumptions made for each of the factors:

## Assumption for Inflation rate

**The prices for various calculations made are at June 2004 level. The inflation rate calculated for each year have been calculated from wholesale price index for various years as given in Economic Survey 2002-2003. The years for which WPI figures are not available, inflation rate from inter net have been obtained.**

YEAR	WPI	GROWTH
1997-98	132.8	
1998-99	140.7	1.059488
1999-2000	145.3	1.032694
2000-01*	155.7	1.071576
2001-02*	161.3	1.035967
2002-03*	165.8	1.027898
2003-04**	174.9	1.0549
2004-05**	184.2	1.0532
*(SOURCE ECONOMIC SURVEY: 2001-02,2002-03)		
** inflation figures of the yr taken from net		
***ASSUMED keeping in view the last 2 yr fig		

## Assumption for modal characteristics

Mode	Average speed (Km.) 2010		Daily vehicle utilisatio n (Km.)	Occupancy/ Vehicle	Trips/ Day
	Without MRTS	With MRTS			
Bus	13	15	207	66	-
Car	22	25	20	3	2
2 Wheeler	22	25	20	1.2	2
Shared Auto	16	18	100	5	15

Mode	Avg. lead	VOC/ Km.* (Rs.)	VOC/hour** (Rs.)	Value of Time (Passenger)/*** Hour (Rs.)
Bus	7	27.58	413.67	10.23
Car	8.59	6.11	152.69	35.81
2 Wheeler	6.85	2.70	49.79	67.48
3 Wheeler	6.33	5.04	90.72	10.23
MRTS	9.29			10.23

#### Assumptions For Fuel Consumption & Emission\*

Mode	Fuel consumption (Litre/Km.)	Pollution Emission (Kg./1000 Litres)
Bus	0.270	96.50
Car	0.067	447.60
2 Wheelers	0.033	447.60

- Damage cost of Pollution                      Rs. 38.40/- per Kg.
- Price of Fuel
  - Petrol    Rs. 42.25/- per litre
  - CNG    Rs. 29.85/- per litre

**Assumptions for Bus characteristics**

- Fleet Utilization                                81%
- Load Factor                                    85%
- Carrying Capacity                            66 passengers
- Daily Utilisation                               207 km.

**Assumptions for road accidents**

- Cost of a Fatal Accident                      Rs. 6,02,508\*
- Cost of an Injury Accident                   Rs. 1,74,110\*

*\*Source: Road Cost Evaluation study conducted by M/S Tata Consultancy Services*

**• Cost of damage to Vehicles due to an Accident.\***

- Car    Rs. 21,565
- Bus    Rs. 62,698
- Truck    Rs. 64,828
- 2 Wheelers                                        Rs. 5,458

*\*Source: : Road Cost Evaluation study conducted by M/S Tata Consultancy Services*

- Data on number of accidents has been obtained net.