FINANCIAL ANALYSIS
Western Freeway Sea Link

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BANDRA
MAHIM
JUNCTION
R. C. F.
JUNCTIO
SB MARG
CONNECT TO WE
WADALA
DADAR KHODADAD C
SIDDHI VINAYAK
DADAR
SB MARG
ELPHISTONE
SB MARG
N.M. JOSHI
WORLI NAKA
SB MARG
FERGUSSON
HAJI ALI
JJ HOSPITAL-
BHENDI BAZAR
CROWFORD MARKET
WFSL
PROPOSED

Salient Features

- Total length 14.77 Km
- Alignment about 200m away from Shore line
- Starting from interchange at Worli
- Eight lane bridge from Worli to HajiAli interchange
- Six lane beyond Haji Ali to Nariman Point
- A major cable stayed bridge across link between Malabar Hill Point and Nariman point
- Modern Traffic Monitoring Control
- State-of-the-Art toll collection system proposed
- Superstructure proposed with precast units over RCC substructures supported on large diameter piles
- Landmark in the city

Benefits of Western Freeway Sea Link

- Significant savings in travel time
  - •increased speed
  - •reduced delays at intersections
- Savings in Vehicle Operating Cost (VOC)
  - • reduction in congestion on the existing roads
  - • lower vehicle operating cost on the bridge
- Ease in driving with reduced mental tension

Benefits of Western Freeway Sea Link

- Reduced accidents
- Air and noise pollution reduced
- No land acquisition hence no R & R issue

Financial Analysis

Financial analysis:

rate of return for investors under realistic conditions.

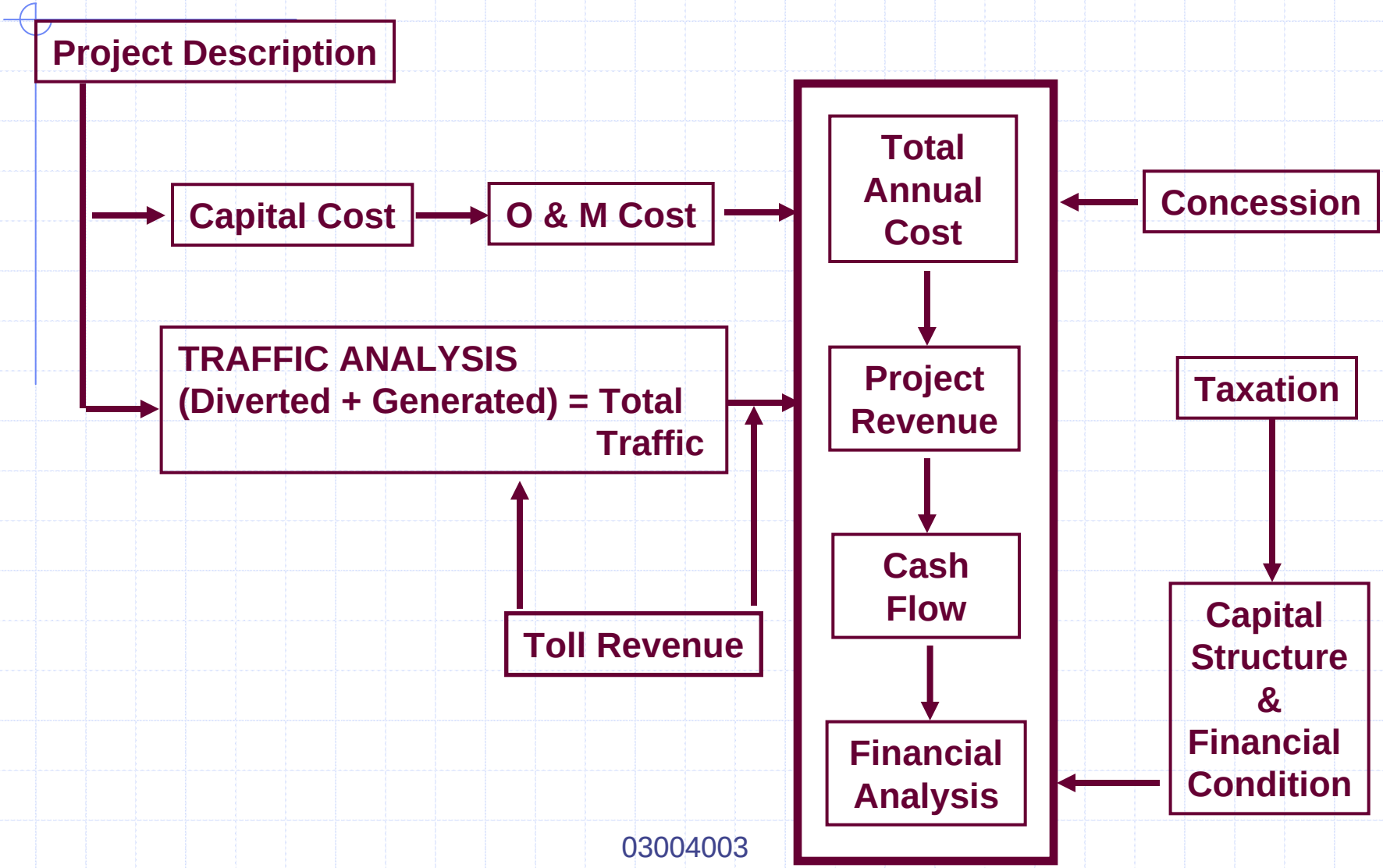
Financial evaluation:

adequate cash to meet all its operating expenditure

service and repay the debt

attractive return on equity to shareholders.

FLOW CHART FOR FINANCIAL ANALYSIS



Debt Finance:

Describes loans from banks or other financial institutions such as commercial banks, investment banks, developing agencies etc.

Sources:

- Rupee debt from financial institutions and banks
  - IDBI, DFC,
- International funding agencies
  - World Bank, IFC,ADB
- Foreign banks and Institutions
- Infrastructure bonds
- Foreign currency debit

Equity Capital

Provision of risk capital by investors to an investment opportunity and results in issuance of shares to those investors.

Sources

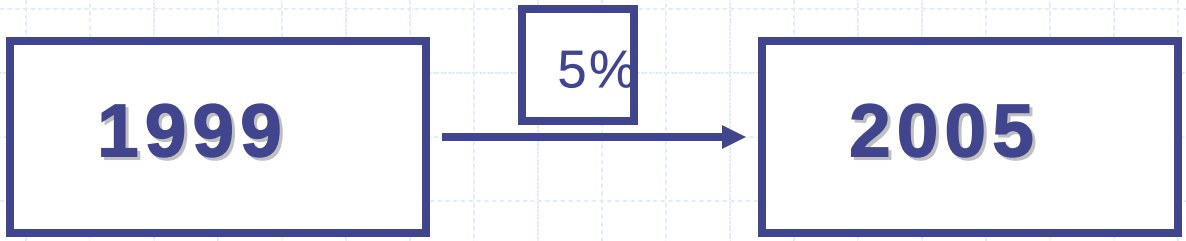
Contribution from Govt. of Maharashtra/ MMRDA/ MSRDC

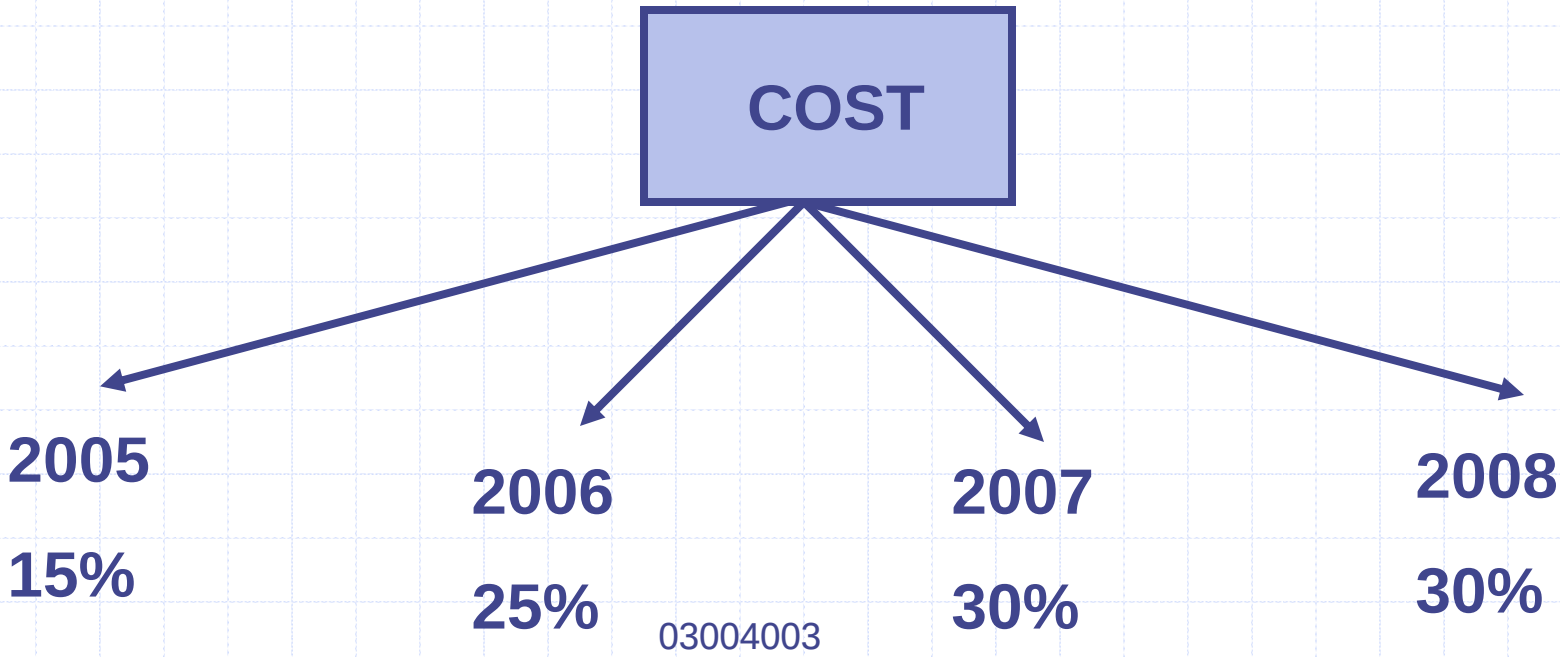
Domestic and foreign construction companies

Financial investors
IDBI, IDFC, Insurance companies

Private placement of equity

Project cost





Capital Cost & Phasing

Project Cost	1999	15% 2005	25% 2006	30% 2007	30% 2008	2005
Construction Cost	13208	2529	4214	5057	5057	17700
Engineering Cost (7%)	925	177	295	354	354	1328
Contingencies	991	190	316	379	379	1240
R & R Cost	0	0	0	0	0	0
Other Charges	726	139	232	278	278	975
Total Cost	15850	2895.19	4825.32	5790.38	5790.38	21243
Cost after inflation (6% /annum)		173.71	289.52	347.42	347.42	1158.08

O & M Cost

is assumed to go up in tandem with inflation i.e. @ 6% p.a.

Operation & Maintenance Cost

Period	Maintenance		Operation of Toll Plazas	Total Cost
	Routine	Periodic		
2008 - 2012	41	-	27	67
2013 - 2017	55	206	35	296
2018 - 2022	73	276	47	396
2023 - 2027	98	369	64	530
2028 - 2032	131	493	85	709
2033 - 2037	175	660	114	949

Operation and Maintenance Cost (2004- Price Level)

Toll Tax

Methods

- Occupancy of the vehicle
- Hindrance caused to other vehicles
- Willingness to pay survey

Toll

- Toll of Rs. 5.00 / km for Car, Taxi and LCV and
- Rs. 8.50/ km for BUS & TRUCK

	Car/ Taxi	Bus	Truck
Link 1	20	30	30
Link 2	10	20	20
Link 3	30	50	50

Toll Tax Revenue

Mode	Toll (Rs.)		Revenue	Toll (Rs.)		Revenue	Toll (Rs.)		Revenue	Revenue
	2003	2008	Link - 1	2003	2008	Link - 2	2003	2008	Link - 3	(Rs.)/Day
Car+Taxi	20	27	2181187	10	13	478262	30	40	754433	3413883
LCV	20	27	36353	10	13	7971	30	40	12574	56898
HCV	30	40	14893	20	27	4354	50	67	5723	24970
BUS	30	40	37804	20	27	11052	50	67	14529	63385
						Total Rev./Day (Rs. million)				3.56
						Total Rev./Year (Rs. million)				1299.08

Advertisement Revenue

Possible Avenues

- Elevated portions of the Toll plazas
- Bill boards on the street lights polls
- Advertisement on the toll tickets

5% → 10%

6%

Financial Viability Analysis

Assumptions and Parameters.

Debt Equity Ratio	-	2:1
Rate of inflation	-	6% p.a.
Rate of interest	-	10%
Concession period	-	30 years
Project cost	-	2124.3 crore
Annual O & M Cost	-	68 million
Toll revenue	-	1299.2 million
Advertisement Revenue	-	77.94 million

Financial Analysis

IRR VALUE

Toll tax collection only 12.27%

Toll tax collections

+ Advertisement revenue 12.74%.

Sensitivity Analysis

Increase in capital cost by 10 %

Decrease in revenue by 10 %

Increase capital cost by 10 % & decrease in revenue by 10%

IRR VALUES

Scenario	30 Years		20 Years	
	Toll + Advmt	Only Toll	Toll + Advmt	Only Toll
Base Case	12.74	12.27	6.5	7.88
Sensitivity Analysis				
10% Increse in Cost	12	11.54	7.55	6.94
10% Decrease in Revenue	11.89	11.47	7.38	6.78
Combined Scenario	11.71	10.67	6.46	5.87

Conclusion from Financial4/3/2007 Analysis

FIRR = 12.74% < (16 – 17%)

Thus Project it Financially Weak.

Project can be made Acceptable by:

Development rights in the new areas around the freeway.

Support from state govt./MMRDA/BMC in the initial stages

Public-Private Partnership(PPP)

Additional features like Viewers Gallery, Commercial centre at Toll Plaza.

Thank You

Financial Analysis of Chennai MRTS

By: TAPISH MEHTA (03004008)

Chennai City prior to MRTS

- 4.2 million (city) population in 2003, 7.5 million (metropolitan area)
- Port city, major industrial and commercial center
- Population growth in the 1990s: 0.9% per annum;
- Density in Chennai City: 250 people/hectare, double in sub-areas
- Transport system: road-based but with strong commuter rail network

The MRTS

PHASE 1

- Approved by the Planning Commission and the Railway Board in 1983-84
- To be implemented and operated by the Southern Railway department of Indian Railways
- 8.6 km in long, 1,676 mm gauge, double-track line
- Completed in 1997, 20 years after its conception, the total cost came to Rs 2,690 million
- Government of Tamil Nadu contributed about 20 hectares of land, including 0.5 ha of private land

- About 3,500 families were affected by the project and received a total Rs 60 million in compensation
- It was designed for a maximum load of 600,000 passengers per day, but carried only about 9,000

PHASE 2

- It will be elevated along 7.9 km, out of its 11.2 km total length and have 7 elevated and 2 at-grade stations
- Construction costs are forecast at Rs 6.05 billion rupees
- The Government of India will contribute one-third and Tamil Nadu for two-thirds of the investment
- Tamil Nadu will also contribute 100 ha of state-owned land and about 9 ha of private

- Expected to involve about 2,500 households, will be about Rs 250 million
- Expectations are that the complete Phase I and II sections will carry 29,600 passengers per hour per direction in 122 trains

PHASE 3

- It is just 5 km long, would connect the MRTS with the south-west commuter rail line at St. Thomas Mount station.
- This is expected to cost Rs 3.78 billion (US$78.8 million)

Fare Affordability

- Bus fares were onerous for monthly household incomes of less than Rs 1,000 (roughly 10-13% of passengers)
- Commuter rail monthly passes were significantly more affordable. At Rs 2,500 a month per household, a monthly bus pass for one person would be under 10% for most distances, and rail passes were half of that
- The conclusion is that fares are set at levels acceptable for a majority of passengers

Significance of the Project

- Urban transport effects in reduction of poverty indirectly as a stimulator of poverty reducing growth and directly effects on the quality of life of people
- In past few years transport system has been unable to keep up with the growing number of firms moving into Chennai

- A 2003 Confederation of Indian Industry survey of urban populations in Southern India showed 90% passengers dissatisfied with roads, and 58% dissatisfied with public transport services
- The same survey showed that 89% were willing to pay for good-quality toll roads and 65% are willing to pay higher public transport fares to get more comfort and frequency

Tools for Financial Analysis

The following tools were used for the financial analysis of the project:

- Benefit-Cost Ratio
- Net Present Value (or Discounted Cash Flow)
- Internal Rate of Return

Assumptions

- Discount rate is 10 %

Traffic,

- From 1997 to 2010 traffic growth rate is 5%.
- From 2011 to 2020 traffic growth rate is 4%.
- From 2021 to 2026 traffic growth rate is 3%.

Construction Cost

- Phase 1: 269 crore Rupees.
- Phase 2: 733.39 crore Rupees(estimated)
- Phase 3: 3428 crore Rupees(estimated)

Operation and maintenance cost

- Regular maintenance cost was 27.5 crore for 1997.
- 3% Increase in maintenance cost per annum.

Revenue

- 5 % increase in toll revenue per annum and implemented after every three years

Average Daily Trip Length

- Assuming no change in daily trip length10.2 km estimated from road transport.

Analysis Results

The following results were obtained from the financial analysis of the project:

- B/C Ratio **0.161**
- IRR **-1.45%**
- NPV **-1902.78 Crore Rupees**

Sensitivity Analysis

Sensitivity Analysis is done for following three cases :

- Case I: Increase in project cost by 10 %.
- Case II: Decrease in revenues by 10 %.
- Case III: Increase in project cost and decrease in revenue by 10%.

The results of the Sensitivity Analysis are as follows:

	CASE 1	CASE 2	CASE 3
B/C Ratio	0.146	0.145	0.132
IRR	-1.77%	-1.80%	-2.11%
NPV	-2129.45 Crore Rupees	-1939.17 Crore Rupees	-2165.84 Crore Rupees

Conclusions

- The benefit cost ratio is about 0.161 and internal rate of return is -1.45% from which it can be concluded that the project is **financially unviable**
- The perception of the people should also be considered as to whether they are willing to travel on this proposed MRTS as per the fare structure proposed
- The project is less sensitive to the increase in cost and decrease in benefits as seen from Sensitivity Analysis

- Since the FIRR of this project is much less than minimum attractive rate of return 15%, Therefore the project needs government contribution for making it financially attractive

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THANK YOU

Financial Evaluation of BOT Highway Projects Case Study: MPEW and NH 4

Guided by:
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Presented by:
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Outline

- Introduction
- BOT Scheme
- Financial Evaluation
- Acceptance Criteria of BOT Projects
- Risk Analysis
- Case Study: MPEW and NH 4
- Conclusion

Introduction

- An efficient transport system is a pre-requisite for economic development.
- Project appraisal is essential for infrastructure projects.
- The role of private sector in the provision of infrastructure is currently receiving a great deal of attention.
- Financial evaluation identifies the lean period and is critical for project sustainability.
- Risk analysis is essential for dealing with the problem of uncertainty of the project.

BOT Scheme

- One of the promising methods of privatization.
- Jointly carried by public and private sector.
- Development of infrastructure with financing from outside the budget allocation.
- Risk transfer to private sector and better risk management, by exploiting the innovativeness and efficiency of private sector.
- Creation of new equity by stimulation of investor interest in BOT infrastructure projects.

Financial Evaluation

- Ensures that there are sufficient funds to cover the cost of implementing the project.
- Focuses only on the costs and revenues of the enterprise responsible for the project.
- Market prices and valuations are used in assessing benefits and costs, instead of measures like willingness to pay and opportunity cost.

Evaluation Techniques

- **Net Present Value (NPV)**
  - Estimation of the net benefit over the lifetime of a project.
  - NPV > 0 => project is acceptable.

$$NPV = \sum_{t=0}^{N} C_t /(1+i)^t$$

Where: C_t is the net cash flow in year t,

i is the discount rate,

N is the life time of the project.

Evaluation Techniques (Contd.)

- **Internal Rate of Return (IRR)**
  - Rate at which the present value of a series of investments is equal to the present value of the returns on those investments, i.e. NPV = 0.
  - Alternate having higher IRR is preferred.

$$NPV = \sum_{t=0}^{N} C_t/(1+IRR)^t = 0$$

Where: C_t is the net cash flow in year t,

IRR is the discount rate at which NPV = 0,

N is the life time of the project.

Evaluation Techniques (Contd.)

- **Benefit Cost Ratio (BCR)**
  - Identifies the relationship between the cost and benefits of a proposed project.
  - BCR > 1 => project is acceptable.

$$B/C = PVB/PVC$$

Where: PVB is the present value of benefits,

PVC is the present value of costs.

Acceptance Criteria of BOT Projects

- NPV for the project should be positive.
- IRR should have a value greater than the discount rate.
- Cash flow situation in each year of the concession period should be satisfactory.
- BCR for the project should be greater than one.

Risk Analysis

- Risk analysis is essentially a method of dealing with the problem of uncertainty.
- In reality, many critical variables of a transport infrastructure project such as construction cost, operation cost, maintenance cost, traffic volume and toll revenue cannot be predicted precisely.
- For a realistic and meaningful financial analysis of BOT projects, the consideration of risk and uncertainty should be explicitly incorporated.

Risk Analysis Techniques (Contd.)

- **Sensitivity Analysis**
  - Non probabilistic technique used for the evaluation of risk variables.
  - The value of an input variable is changed while all others are held constant, and the amount of change in analysis results is noted.
  - The process is repeated for all other input variables.
  - Sensitivity analysis allows the analyst to get a feel for the impact of the variability of individual inputs on overall economic results.

Risk Analysis Techniques (Contd.)

- **Scenario Analysis**
  - Several parameters are varied simultaneously and their combined effect on the overall economic results can be examined.
  - It helps in determining which combination of input variables gives the best possible results.

Case Study: MPEW and NH 44

- **Existing Scenario**
  - The project had initially been budgeted at around Rs. 1,600 crores; finally Rs. 2,136 crores was spent on it.
  - With an average initial debt repayment interest of 13%, the total liability is now Rs. 3,000 crores.
  - The projected traffic was nearly 50,000 PCUs (by 2004) but the actual number of vehicles using the expressway daily is only 16,000.

Proposal

- Bids were invited for tolling, operation and maintenance of the MPEW and widening, tolling, operation and maintenance of NH 4.
- Ideal Road Builders took the project against an upfront payment of 900 crores.
- The company also immediately started collecting the toll from the Expressway.
- The IRB, in turn, have to ensure the up gradation of the NH4 to a four-laned at a cost of Rs 400 crores.

Project Details
Cost and Finance Structure

Mumbai-Pune Expressway (MPEW)	
Initial Cost (2004)	900 crores
Periodic Maintenance and Operational Cost - 5 yearly	210 crores
Periodic Maintenance and Operational Cost - annually	63 crores
Growth of Maintenance Annually	3%
Project life in years	15 (2005 to 2019)
Length	94 Km
NH 4	
Construction Cost (2004 -2005)	400 crores
Periodic Maintenance and Operational Cost - 5 yearly	40 crores
Periodic Maintenance and Operational Cost - annually	12 crores
Growth of Maintenance Annually	3%
Project life in years	14 (2006 to 2019)
Discount Rate	15%
Length	111 Km

Revenues and Returns of MPEW

FY	Cap. Cost	PMC	RMC	Total Costs	Total Rev.	Dis. Costs	Dis. Ben.	Dis. Cash Flows
2004	900			900.00	60.05	900.00	60.05	-839.95
2005		243.45	70.91	314.36	191.13	273.35	166.20	-107.16
2006			73.04	73.04	202.77	55.23	153.32	98.09
2007			75.23	75.23	215.12	49.46	141.44	91.98
2008			77.49	77.49	228.22	44.30	130.48	86.18
2009			79.81	79.81	242.12	39.68	120.37	80.69
2010		282.22	82.20	364.43	256.86	157.55	111.05	-46.50
2011			84.67	84.67	272.50	31.83	102.44	70.61
2012			87.21	87.21	289.10	28.51	94.51	66.00
2013			89.83	89.83	306.70	25.53	87.18	61.65
2014			92.52	92.52	325.38	22.87	80.43	57.56
2015		327.17	95.30	422.47	345.20	90.81	74.20	-16.61
2016			98.16	98.16	366.22	18.35	68.45	50.10
2017			101.10	101.10	388.52	16.43	63.15	46.71
2018			104.13	104.13	412.18	14.72	58.25	43.54
2019			107.26	107.26	437.29	13.18	53.74	40.56

NPV = -216.535 crores **IRR** = 11.09% **BCR** = 0.88

Revenues and Returns of NH 4

FY	Cap. Cost	PMC	RMC	Total Costs	Total Rev.	Dis. Costs	Dis. Ben.	Dis. Cash Flows
2004	150			150.00	0	150.00	0	-150.00
2005	250			250.00	51.80	217.39	45.04	-172.35
2006			12.00	12.00	164.85	9.07	124.65	115.58
2007			12.36	12.36	174.89	8.13	114.99	106.87
2008			12.73	12.73	185.54	7.28	106.09	98.81
2009			13.11	13.11	196.84	6.52	97.87	91.35
2010		46.37	13.51	59.88	208.83	25.89	90.28	64.40
2011			13.91	13.91	221.55	5.23	83.29	78.06
2012			14.33	14.33	235.04	4.68	76.84	72.15
2013			14.76	14.76	249.35	4.20	70.88	66.69
2014			15.20	15.20	264.54	3.76	65.39	61.63
2015		53.76	15.66	69.41	280.65	14.92	60.32	45.40
2016			16.13	16.13	297.74	3.01	55.65	52.64
2017			16.61	16.61	315.88	2.70	51.34	48.64
2018			17.11	17.11	335.11	2.42	47.36	44.94
2019			17.62	17.62	355.52	2.17	43.69	41.53

NPV = 666.322 crores **IRR** = 42.00 % **BCR** = 2.43

Cumulative Performance

	MPEW		NH 4					
FY	Costs	Benefits	Costs	Benefits	Total Costs	Total Ben.	Cash Flows	Dis. Cash flows
2004	900.00	60.05	150.00	0.00	1050.00	60.05	-989.95	-989.95
2005	314.36	191.13	250.00	51.80	564.36	242.92	-321.43	-279.51
2006	73.04	202.77	12.00	164.85	85.04	367.62	282.58	213.67
2007	75.23	215.12	12.36	174.89	87.59	390.01	302.42	198.85
2008	77.49	228.22	12.73	185.54	90.22	413.76	323.54	184.99
2009	79.81	242.12	13.11	196.84	92.92	438.96	346.04	172.04
2010	364.43	256.86	59.88	208.83	424.30	465.69	41.39	17.89
2011	84.67	272.50	13.91	221.55	98.58	494.05	395.47	148.67
2012	87.21	289.10	14.33	235.04	101.54	524.14	422.60	138.15
2013	89.83	306.70	14.76	249.35	104.59	556.06	451.47	128.34
2014	92.52	325.38	15.20	264.54	107.72	589.92	482.20	119.19
2015	422.47	345.20	69.41	280.65	491.88	625.85	133.97	28.79
2016	98.16	366.22	16.13	297.74	114.28	663.96	549.68	102.74
2017	101.10	388.52	16.61	315.88	117.71	704.40	586.69	95.35
2018	104.13	412.18	17.11	335.11	121.24	747.30	626.05	88.48
2019	107.26	437.29	17.62	355.52	124.88	792.81	667.93	82.08

NPV = 449.786 crores **IRR** = 20.34 % **BCR** = 1.20

Sensitivity Analysis

Sensitivity Analysis

Construction Cost						
	MPEW		NH 4		Cumulative	
% Change	NPV	IRR	NPV	IRR	NPV	IRR
10%	-216.53	11.09%	631.54	38.93%	415.00	19.85%
30%	-216.53	11.09%	555.45	32.97%	338.92	18.80%
Operational and Maintenance Cost						
	MPEW		NH 4		Cumulative	
% Change	NPV	IRR	NPV	IRR	NPV	IRR
10%	-304.69	9.50%	656.32	41.67%	351.63	19.17%
30%	-481.05	6.28%	636.33	41.01%	155.28	16.83%
Volume of Traffic						
	MPEW		NH 4		Cumulative	
% Change	NPV	IRR	NPV	IRR	NPV	IRR
-10%	-373.06	8.05%	552.95	37.83%	179.89	17.19%
-20%	-529.59	4.72%	485.20	35.21%	-44.39	14.45%
Toll Rates						
	MPEW		NH 4		Cumulative	
% Change	NPV	IRR	NPV	IRR	NPV	IRR
-10%	-374.38	8.02%	554.15	37.87%	337.62	19.07%
-20%	-530.04	4.71%	437.75	33.49%	-92.30	13.84%

Scenario Analysis
Scenario Analysis

Original Scenario							
Change		**MPEW**		**NH 4**		**Cumulative**	
Const. Cost	0%						
Op. Cost	0%	**NPV**	-216.53	**NPV**	666.32	**NPV**	449.79
Traffic	0%	**IRR**	11.09 %	**IRR**	42.00 %	**IRR**	20.34 %
Toll	0%						

Scenario 1							
Change		**MPEW**		**NH 4**		**Cumulative**	
Const. Cost	10%						
Op. Cost	10%	**NPV**	-308.61	**NPV**	618.71	**NPV**	310.10
Traffic	-5%	**IRR**	9.42 %	**IRR**	38.52 %	**IRR**	18.62 %
Toll	5%						

Scenario Analysis

Scenario 2							
Change		**MPEW**		**NH 4**		**Cumulative**	
Const. Cost	10 %						
Op. Cost	10 %	**NPV**	-429.91	**NPV**	530.85	**NPV**	100.93
Traffic	-8 %	**IRR**	7.02 %	**IRR**	35.47 %	**IRR**	16.20 %
Toll	0 %						

Scenario 3							
Change		**MPEW**		**NH 4**		**Cumulative**	
Const. Cost	10 %						
Op. Cost	10 %	**NPV**	-531.66	**NPV**	457.16	**NPV**	-74.50
Traffic	-10 %	**IRR**	4.87 %	**IRR**	32.87 %	**IRR**	14.10 %
Toll	-5 %						

Conclusions

- Privatization provides with risk mitigation and financing from outside budgetary allocation.
- BOT scheme is very instrumental in achieving privatization objectives.
- MPEW and NH 4, together was found to be financially strong with NPV of 449.786 crores and IRR of 20.34%
- Sensitivity analysis shows that traffic volume and toll rates are more sensitive to the project.

Thank You

Thank You

Course Project Seminar

Economic Evaluation of Mass Rapid Transit System for Chennai

By
Manish Goyal
03004020

Economic Viability Analysis

- The Economic Viability analysis of the Chennai MRTS assessed within the broad framework of Cost-Benefit Analysis
- The Economic costs and benefits over life of project have been identified under with and without the project conditions
- Analysis identifies and quantifies the social benefits in terms of the effects of the projects on fundamental objectives of the whole economy

Objectives of the evaluation of Chennai MRTS

- To assess the Economic viability of a project and its ability to meet its debt service requirements.
- To assess the sensitivity of the MRTS Chennai project for the assumptions made in the analysis.

Steps Followed in the Economic Evaluation

- Estimation of economic costs of the project both, capital, as well as annual operating costs, for the assumed economic life of 30 years after the commencement of the project
- Estimation of annual recurring operation & maintenance costs at the current market price & its conversion into economic costs
- Identification and quantification direct and indirect economic benefits to users, Non-users, Community
- Based on traffic forecast for the project annual stream of benefits will be estimated and compared with the stream of annual costs

Evaluation of Economic Costs

Measurement of Economic Costs and Benefits:

- The measure of a project's benefit to the economy is not the difference in output or cost levels before and after constructing the project. The proper measure is difference between what the level of output services would be with the project and what they would have been without it

- In the case of Chennai MRTS project, the without situation will not mean continuation of the present situation but will include others measures that could be undertaken to meet the growth in demand for transport

Evaluation of Economic Costs

- The annual stream of project costs and benefits in economic terms will be computed over the analysis period of 30 years in the present project
- These cost and benefit for every year will be compared to estimate the net cost / benefit and calculation of economic viability with the help of Discounted Cash Flow Technique
- The results will be presented in terms of Economic Internal Rate of Return (EIRR) and Net Present Value (NPV)

Phase I

Length	8.55 km.	
Estimated cost	Rs 53.46 crores.	
Cost of completion	260 crores.	
Government land	9.68 hectare	
Private land	0.54 hectare	
Cost of the land	Rs. 60 crore	
Cost of 3500 tenements affected	Rs.6.00 crores	
Surface length	2.75 km	
Elevated length	5.80 km	
No. of elevated stations	5	
Carrying capacity	10-12000 commuters/day	
No. of ground stations	3	

PHASE II: THIRUMYLAI - VELACHERY

Length	11.165 km
Estimated cost	Rs. 733.39 crores.
Expenditures(upto October 2006)	Rs 665.53 crores
Government land	34.50 hec.
Private land	33.93 hec.
Cost of the land	Rs. 60 crore
Gauge (1676 mm)	Broad Gauge
Surface length	2.75 km
Elevated length	7.848 km
No. of elevated stations	7
Carrying capacity	4.25 Lakh trips per day
No. of ground stations	2

Benefits of Chennai MRTS

- Savings in Foreign Exchange due to reduced Fuel Consumption
- Reduction in Pollution
- Savings in Time for all passengers using Metro and Roads
- Savings in Accidents
- Savings in Vehicle Operating Cost (VOC) due to decongestion for residual traffic
- Savings in Capital and Operating cost of diverted vehicles
- Savings in the cost of Road Infrastructure

User of the MRTS

- (i) Reduction in travel time due to higher speeds.
- (ii) Savings in travel cost.
- (iii) Greater comfort and convenience enjoyed by commuters

Social / Community benefit

- (i) Reduction in pollution levels.
- (ii) Increase in opportunity cost of land in the catchments area.
- (iii) Change in land values and higher tax base to local authority.
- (iv) Savings in land area for “Transport” use and overall ratio at city level due to high density of development

Estimation of Economic Costs

- **Capital cost**
- **Maintenance cost**
- **Road User Cost**

Capital cost

- Outlays for construction works for:
  - Proposed MRTS,
  - Track as well as rolling stocks stations
  - Other commuter walkways
  - Traffic junctions
- Environmental and social mitigating measures
- Relocation of utilities
- Land acquisition and construction supervision

Capital Cost

Basic Project Cost : 269 Crores
(Phase I)

773 Crores
(Phase II)

Rs 3545 crores
(phase III + IV)

Operating and Maintenance (O&M) Cost

- The main items of routine maintenance cost are:
  - Cost of operation
  - Regular maintenance of track, rolling stock, stations, signaling & ticketing system, etc.
- The annual cost of O&M has been estimated at Rs 27.50 crores in the first year of operation.
- Based on rider ship and capacity augmentation the O&M costs have been envisaged to increase

Operating and Maintenance Cost

Department	Year					
	1998	2003	2008	2013	2018	2023
System Operation (A)	23.91	27.5	77.75	90.47	197.9	228.5
Admn. + General charges @ 12% of (A)	2.87	3.3	9.3	10.86	23.75	27.41
Contingency @ 3.5% of (A)	0.72	0.7	2.75	2.77	5.95	8.0
Total	27.5	31.8	89.8	104.1	227.6	263.9

Economic Cost

Year	Economic Cost of O&M
1998	89.08
2003	92.735
2008	367.71
2013	500.9
2018	193.46
2023	263.9

Benefits

Category of Benefit	1998	2007	2017
Saving in VOC & VOT	30.6	36.57	234.21
Saving in alternative transport system	194.4	324	810
Environment Benefits	7.02	11.4	42.12

Analysis

Sensitivity analysis of the projects economic viability has carried out to take into consideration uncertainties pertaining to traffic forecast and critical parameters relating to cost and benefits. The analysis reveals the impact of changes in the following main variables

1. Increase in capital cost by 10%.

2. Decrease in revenue or benefits by 10%.

3. Combined effect of increase in project cost by 10% and decrease in revenue or benefits by 10%.

Results of Economic Analysis

	Base Case	Sensitivity 1	Sensitivity 2	Sensitivity 3
EIRR	12.08%	11.24%	10.14%	9.31%
B/C Ratio	1.6	1.52	1.44	1.37
NPV (Rs crores)	611.65	478.31	357.74	225.48

- The EIRR of 12.08% for the base case.
- The sensitivity analysis estimates the lowest EIRR at 9.31%.
- The B/C ratio is 1.6

This indicates that the project is unviable under the worst condition of increase in project cost by 10% and decrease in benefits by 10%

Facts

- MRTS runs 90 trains per day, with 15 min headways in the peak and 30 min off peak.
- It was designed for a maximum load of 600,000 passengers per day, but carries only about 9,000.
- Poor location relative to sources and destinations of passengers, especially the low-density area between the line and the Bay, the proximity of parallel and fare-competitive bus lines, and poor feeder/interchange facilities
  These are 2002-2003 data obtained directly from the Southern Railway.
- Other sources cited 7,000 passengers per day in 2001, with subsequent increases of as much as 50% on monthly basis, in late 2002, due to bus strikes and fare hikes, reflecting a high price elasticity of demand.

Thank You

Course Project Presentation

Economic Evaluation of Konkan Railway

Under the guidance of

Prof. S.L.Dhingra

Sriram Emani (03004023)

Economic Evaluation

- The objective of economic evaluation is to determine the feasibility of the proposed project in terms of the benefits likely to accrue to the economy as a whole, thereby justifying its implementation based on profit to the nation/ economy.

- Need for Economic evaluation
  - Cost-Effective Design and Construction
  - Best Return on Investment
  - Understanding Complex Projects
  - Documentation of Decision Process

Process of Economic Evaluation

- Main Step Followed in the Economic Evaluation are as Follows:
- Estimation of economic costs of the project both, capital, as well as annual operating costs, for the assumed economic life after the commencement of the project.
- Estimation of annual recurring operation & maintenance costs at the current market price & its conversion into economic costs.
- Identification and quantification of economic benefits to users, Non-users, Community.
- Based on traffic forecast for the project annual stream of benefits will be estimated and compared with the stream of annual costs.

Konkan Railway – Project Proceedings

Information	**Time**
Construction Starting	1991
Construction Ending	1998
Commercial Operation	1994
Discount Rate	10%

Economic Costs

- **Capital cost**
  - Construction costs
  - Environmental and social mitigating measures
  - Relocation of utilities
  - Land acquisition and construction supervision.
- Costs are computed first in financial terms based on market prices.
- market prices are often distorted due to market imperfections, govt. policies and regulations.
- The financial cost therefore will be converted into economic cost by applying conversion factor of 0.85 as recommended by international funding agencies
- Capital cost = Rs. 3300 crores

Maintenance Costs

- Maintenance Cost:
  - Regular Maintenance Cost = Rs. 200 crores per year and increases by 10% annually.

  Assumption:

  - Periodic Maintenance Cost = 25% of Construction cost

  (0.25 * 3300 = Rs. 825 crores)

Year	Financial O&M Cost	Economic Cost
1994	1.1	0.935
1995	2.9	2.465
1996	18.6	15.81
1997	26.4	22.44
1998	161	136.85
1999	479.5	407.575
2000	513	436.05
2001	548	465.8
2002	551	468.35
2003	146	124.1
2004	196	166.6
2005	217	184.45
2006	241	204.85
2007	297.22	252.637
2008	297.22	252.637
2009	297.22	252.637
2010	297.22	252.637
2011	297.22	252.637
2012	326.942	277.9007
2013	326.942	277.9007
2014	326.942	277.9007
2015	326.942	277.9007
2016	326.942	277.9007
2017	359.636	305.6906
2018	359.636	305.6906
2019	359.636	305.6906
2020	359.636	305.6906

Periodic Maintenance Cost

Year	Financial costs (Rs in crores)	Economic costs (Rs in crores)
2008	800	680
2018	800	680

Economic Benefits

- The benefits of a transportation investment are typically estimated by comparing the amount of travel time, vehicle miles traveled and expected number of crashes for the Alternative to the Base Case.

- The second step is translating these physical benefits into monetary values.

- The major economic benefits are
  - Saving in Vehicle operating time (VOT)
  - Savings in Vehicle operating cost (VOC)

Savings in VOC and VOT
2.560
8.560
14.670
22.870
34.670
78.000
95.000
109.250
125.638
144.483
166.156
191.079
219.741
252.702
290.607
334.198
384.328
441.977
508.274
584.515
672.192
773.021
888.974
1022.320
1175.668
1352.018

Economic Appraisal

- The annual stream of economic costs and benefits has been computed over the analysis period.
- **Net Present Value**
- All costs and benefits in future years are discounted to the year of analysis using the adopted discount rate. The future stream of discounted costs is subtracted from the future stream of discounted benefits. This can be represented by the following formula:
- ***NPV = PV(Benefits) – PV(Costs)***
- If the sum of the discounted benefits is greater than the sum of the discounted costs, the net present value is positive and the infrastructure improvement is deemed to be economically justified

Economic Viability

- The project's economic viability is assessed in terms of Economic Internal Rate of Return (EIRR) and Net Present Value (NPV) by applying the Discounted Cash Flow (DCF) technique to the annual stream of the net benefits of the project

Sensitivity Analysis

- Sensitivity analysis of the project's economic viability has been carried out to take into consideration uncertainties pertaining to traffic forecast and critical parameters relating to cost and revenue/ benefit.

- The analysis reveals the impact of changes in the following main variables

  - Increase in capital cost by 10%
  - Decrease in revenue or benefits by 10%
  - Combined effect of increase in project cost by 10% and decrease in revenue or benefits by 10%

Results of Economic Analysis

	Base Case	Sensitivity 1	Sensitivity 2	Sensitivity 3
EIRR	15.4%	17.8%	17.4%	16.9%
B/C Ratio	0.726	0.714	0.653	0.642
NPV (Rs crores)	-3846	-4081	-4006	-4240

Conclusions

- Economical analysis of the project gave the EIRR to be **15.4%** which is greater than the discount rate of 10%, but the B/C ratio came out to be less than 1
- According to the acceptance criteria of a BOT, the project is deemed to be financially non viable.
- As per sensitivity analysis results the increase in costs by 10%, decrease in benefits by 10 %, and both these cases the IRR is nearly about **17 %.** So project is very less sensitive to the increase in cost and decrease in benefits.

THANK YOU

FINANCIAL ANALYSIS OF DELHI – GURGAON EXPRESSWAY

By

SAURABH JAIN

03004025

Finacial Analysis

- Method used to evaluate the financial viability of a proposed project by assessing the value of net cash flows that result from its implementation.

- Includes calculation of
  - Costs
  - Benefits

- Costs can be divided into
  - Total Tranportation Costs
    - Construction cost
    - Maintenance Cost
    - Road User Cost
  - Economic and Financial Costs

- Benefits can be divided into
  - Tangible Benefits
  - Intangible Benefits

Methods of Financial Analysis

- Net Present Value Method
- Internal Rate of Return Method
- Benefit Cost Ratio Method

Acceptance Criteria for BOT Projects

- The NPV for the project should be positive.
- The financial IRR should have a value greater than the discount rate.
- The BCR for the project should be greater than one.

Delhi – Gurgaon Expressway

- Project Details
  1. Cost: Rs 755 Crore .
  2. Length: 27.70 Km.
  3. Number of lanes: 8/6
  4. 8-lane portion: 22.33 Km.
  5. 6-lane portion: 5.37 Km.
  6. Number of fly-overs: 7
  7. Number of underpasses: 5
  8. Length of service road: 46.84 Km.
  9. Median strip width: 4.0 meters
  10. Paved shoulder width: 1.70 meter
  11. Completion month: July, 2007

Financial Costs

- Capital Costs
  - Construction Costs
  - Maintenance Costs
- Costs are computed first in financial terms based on market prices.
- Market prices are often distorted due to market imperfections, govt. policies and regulations.

- The predicted construction costs of the project was 550 crores but due to delays in the project it rose to around 750 crores.

- Maintenance cost
  - Periodic Maintenace Cost = Rs. 150 crores every 5 years
  - Regular Maintenance Cost = Rs. 50 crores anually

Cost Structure of DGEW

Delhi-Gurgaon Expressway	
Initial Cost (2004)	750 crores
Periodic Maintenance and Operational Cost - 5 yearly	150 crores
Periodic Maintenance and Operational Cost - annually	50 crores
Growth of Maintenance Annually	3%
Project life in years	15 (2005 to 2019)
Length	28 Km

CONSTRUCTION AND MAINTENANCE COST

YEAR	CONSTRUCTION COST	OPERATION AND MAINTENACE COST	TOTAL COSTS
2004	1500000000		1500000000
2005	2250000000		2250000000
2006	2250000000		2250000000
2007	1500000000		1500000000
2008		150000000	150000000
2009		154500000	154500000
2010		159135000	159135000
2011		163909050	163909050
2012		168826322	168826322
2013		173891111	173891111
2014		179107844	179107844
2015		184481080	184481080
2016		190015512	190015512
2017		195715978	195715978
2018		201587457	201587457

2019		207635081	207635081
2020		213864133	213864133
2021		220280057	220280057
2022		226888459	226888459
2023		233695112	233695112
2024		240705966	240705966
2025		247927145	247927145
2026		255364959	255364959
2027		263025908	263025908
2028		270916685	270916685
2029		279044186	279044186
2030		287415511	287415511
2031		296037977	296037977
2032		304919116	304919116
2033		314066689	314066689
2034		323488690	323488690
2035		333193351	333193351
2036		343189151	343189151
2037		353484826	353484826
2038		360125451	360125451
2039		365421569	365421569

Periodic Maintenance Cost

Year	GPEW (Rs in crores)	Financial costs (Rs in crores)
2010	173	345
2015	224	542
2020	298	764

Financial Benefits

REVENUE WITH MAXIMUM TOLL

YEAR	TOLL			TOTAL REVENUE	DISCOUNTED REVENUE
	TRUCK	BUS	CAR		
2006					
2007					
2008	804000	341700	1742100	176449500	105869700
2009	844200	358700	1829200	185264500	111158700
2010	886500	376720	1920600	194538700	116723220
2011	930750	395590	2016700	204266400	122559840
2012	977400	415310	2117500	214481350	128688810
2013	1026150	436050	2223400	225195500	135117300
2014	1077450	457810	2334500	236447600	141868560
2015	1131450	480760	2451300	248288350	148973010
2016	1176600	499970	2549300	258207450	154924470
2017	1223700	520030	2651300	268545050	161127030
2018	1272600	540770	2757300	279275450	167565270

2018	1272600	540770	2757300	279275450	167565270
2019	1323600	562360	2867600	290450600	174270360
2020	1376550	584970	2982300	302078700	181247220
2021	1431600	608260	3101600	314152100	188491260
2022	1488750	632740	3225700	326724150	196034490
2023	1548450	657900	3354700	339790250	203874150
2024	1610250	684250	3488900	353375000	212025000
2025	1674750	711620	3628500	367518950	220511370
2026	1725000	733040	3737300	378548400	227129040
2027	1776750	754970	3849400	389898700	233939220
2028	1830000	777580	3964900	401589300	240953580
2029	1884900	801040	4083900	413650900	248190540
2030	1941450	825010	4206400	426054600	255632760
2031	1999650	849830	4332600	438839300	263303580
2032	2059650	875330	4462500	452001800	271201080
2033	2121450	901510	4596400	465557100	279334260
2034	2185200	928540	4734300	479530900	287718540
2035	2250750	956420	4876300	493916950	296350170
2036	2257050	959140	4890000	495305650	297183390
2037	2310000	981580	5004800	506924300	304154580
2038	2362950	1004190	5119600	518557400	311134440
2039	2415900	1026630	5234300	530171050	318102630

Financial Appraisal

- The annual stream of financial costs and benefits has been computed over the analysis period.
- **Net Present Value**

  All costs and benefits in future years are discounted to the year of analysis using the adopted discount rate. The future stream of discounted costs is subtracted from the future stream of discounted benefits. This can be represented by the following formula:

  NPV = PV(Benefits) – PV(Costs)

If NPV > 0 then the project is deemed to be financially justified.

Financial Viability

- The financial viability of a project is assessed in terms of Financial Internal Rate of Return (FIRR) and the Net Present Value (NPV).

- For the Delhi Gurgaon Expressway:
  - FIRR = 8.26%
  - NPV = -224.56 crores
  - B/C = -0.74

Sensitivity Analysis

- **Sensitivity Analysis is done for following three cases**
  - Case I: Increase in project cost by 10 %.
  - Case II: Decrease in revenues by 10 %.
  - Case III: Increase in project cost and decrease in revenue by 10%.
- **Results of three cases are as follow:**
  - Case I: FIRR=9.48%
  - Case II: FIRR =8.94%.
  - Case III: FIRR=8.83%

Conclusions

- Financial analysis of the project gave the FIRR to be 8.26% which is less than the discount rate of 10%, and also the B/C ratio came out to be less than 1
- According to the acceptance criteria of a BOT, the project is deemed to be financially non viable.
- As per sensitivity analysis results the increase in costs by 10%, decrease in benefits by 10 %, and both these cases the IRR is nearly about 9 %. So project is very less sensitive to the increase in cost and decrease in benefits.

THANK YOU

ECONOMIC EVALUATION OF BANGALORE METRO

BY
SAURABH PARETA
ROLL NO.- 03004026

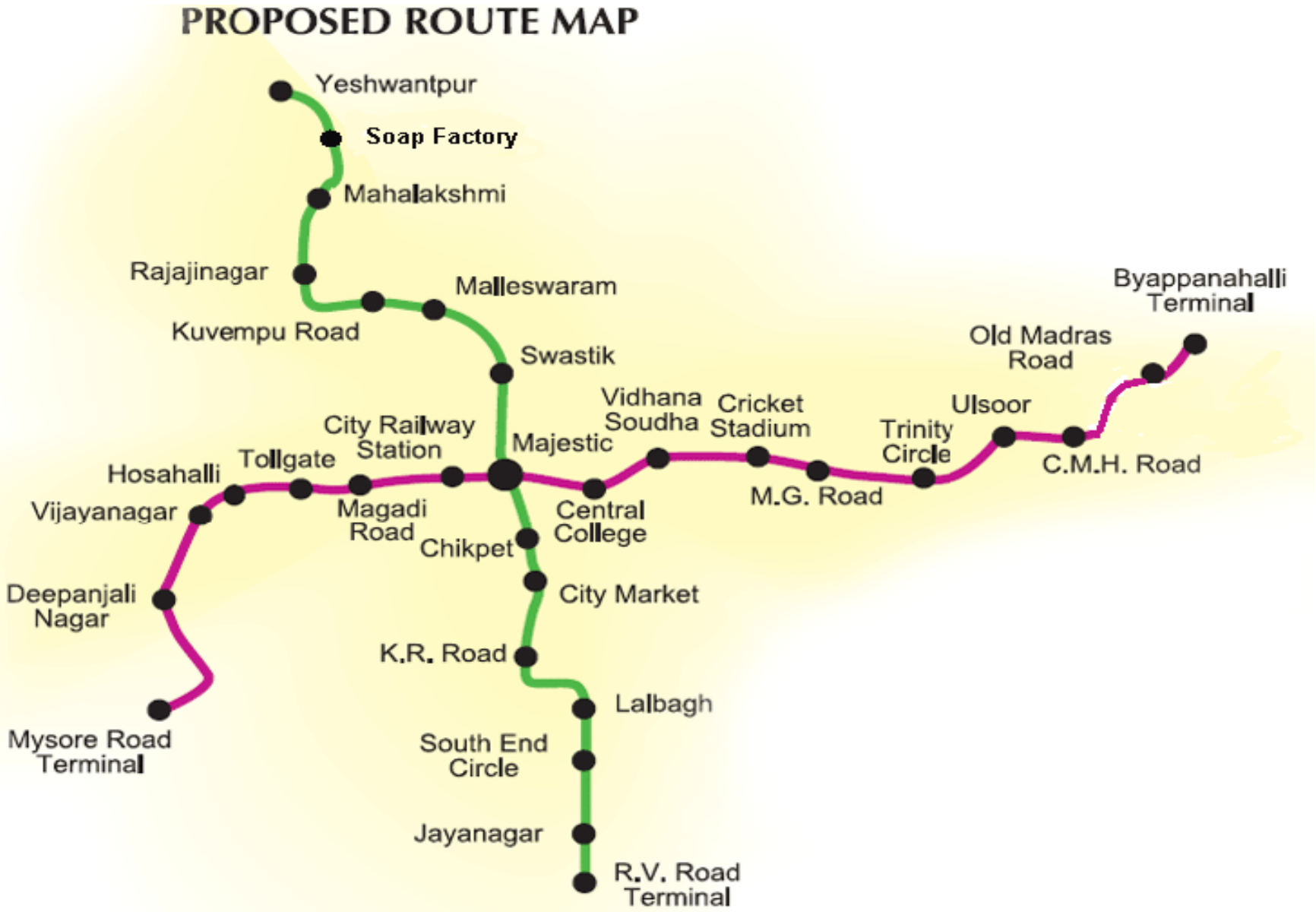
Project Background

- Bangalore Metro

It offers:

- Comprehensive connectivity
- Convenience
- Comfort
- Affordability
- Frequency
- Reliability
- Safety

The Route Map



Corridor	**East West** (Byappanhalli- Mysore Road) Baiyappanahalli - Indira Nagar – CMH Road – Swami Vivekanand Road – MG Road – Ambedkar Road – Post Office Road – K G Road – Majestic – KSRTC Bus Stand – Bangalore City Railway Station – Magadi Road – Toll Gate Junction – Chord Road – Vijay Nagar – Mysore Road upto Ring Road Junction.		**North South** (Yeshwantpur Rly. Stn. – Jayanagar) Yeshwantpur – Chord Road – Mahakavi Kuvempu Road – Swastik – Platform Road – KSRTC Bus Stand – Chikpet – City Market – K R Road – Vanivilas Road – Lal Bagh – Southend circle – R V Road upto Jayanagar	
	Length (Km.)	Stations	Length (Km.)	Stations
Elevated	14.35	13	11.30	10
Underground	3.40	4	3.30	3
Surface	0.35	1	0.30	1
Total	18.1 KM	18	14.9 KM	14

Some informations regarding Bangalore Metro

- **Cost of the project**

(in Rs. Crore)

Construction cost	5080 (5912)*
Interest during construction	348 (449)*
Financing charges and preoperative expenses	25 (29)*
TOTAL Current Cost	**5453 (6395)***

* Figures in bracket refer to completion cost which is the current cost plus an annual escalation of 5% per year for the likely duration of the project.

Economic Viability Analysis

- Broad framework of Cost-Benefit Analysis.
- The Economic costs and benefits over life of project have been identified under with and without the project conditions.
- Analysis identifies and quantifies the social benefits in terms of the effects of the projects on fundamental objectives of the whole economy.

Benefits of Bangalore Metro

- Reduction in the travel times.
- Reductions in travel costs, and as a result of savings in accidents.
- Increased employment opportunities both directly as a result of the construction and operation of the system.
- Environment benefit such as the reduction of air pollution.
- Economic benefits to the overall regional development policies.

The disbenefit can include

- Adverse socio-economic effects resulting from displacement of residents and businesses to make way for the system.
- State subsidies to construct or operate the system.
- Diversion of resources from other activities, so-called opportunity costs.

Cost Benefit Analysis

- The main objective of the analysis is to identify all the direct and indirect benefits and to compare them over the economic life of the project so as to justify its implementation based on benefits/ profits to the economy/ nation.

- This necessitates consideration of different streams of costs and benefits over time.

Steps Followed in the Economic Evaluation

- Estimation of economic costs of the project both, capital, as well as annual operating costs, for the assumed economic life of 25 years after the commencement of the project.

- Estimation of annual recurring operation & maintenance costs at the current market price & its conversion into economic costs.

- Identification and quantification of direct and indirect economic benefits to users, non-users and community.

Evaluation of Economic Costs

Measurement of Economic Costs and Benefits:

- The measure of a project's benefit to the economy is not the difference in output or cost levels before and after constructing the project.
- The proper measure is difference between what the level of output services would be with the project and what they would have been without it.

Evaluation of Economic Costs contd.

- The annual stream of project costs and benefits in economic terms is computed over the analysis period of 25 years in the present project.
- These cost and benefit for every year will be compared to estimate the net cost / benefit and calculation of economic viability.
- The results will be presented in terms of Economic Internal Rate of Return (EIRR) and Net Present Value (NPV).

Estimation of Economic Costs contd.

- **Capital cost**
- **Maintenance cost**
- **Road User Cost**

Capital cost

- Outlays for construction works for:
  - Proposed Metro
  - Track as well as stations
- Environmental and social mitigating measures
- Relocation of utilities
- Land acquisition and construction supervision.

Capital Cost contd.

The capital cost of the Bangalore Metro System is estimated at Rs 5912 crores. In addition, the project will require additional cost of Rs 478 crores to cover pre-construction planning and design cost, proof checking & supervising consultancy, legal and financial charges.

- The financial and economic cost of the project are as follows :
  - Financial cost including other charges Rs 6395 crores.
  - Economic cost with conversion factor of 0.85, i.e., Rs 5435.75 crores.

Operating and Maintenance (O&M) Cost

- The main items of routine maintenance cost are:
  - Cost of operation.
  - Regular maintenance of track, stations, etc.
- The annual cost of O&M has been estimated at Rs 320 crores in the first year of operation.
- Based on capacity augmentation the O&M costs have been envisaged to increase.

Operating and Maintenance Cost contd.

Year	Economic Cost of O&M
2007	272
2012	386.8
2017	498.1
2022	571.2
2027	620.5

Cost of replacement

- In addition to O & M cost, fund will be required for replacement of old equipment. The cost of replacement has been estimated as
  - Rs. 262.3 crores in 2020
  - Rs. 693.7 crores in 2025
  - Rs. 130 crores in 2030.

Categories of Benefits

A. User benefits of the Metro

- Reduction in travel time due to higher speeds.
- Savings in travel cost.
- Greater comfort and convenience enjoyed by commuters.

Categories of Benefits contd.

B. Non-user benefits to users of rail based transport

- Savings in vehicle operating costs due to reduced congestion as a result of Metro.
- Savings in travel time cost due to reduced congestion.
- Savings in energy cost as a result of reduction in fuel consumption.
- Savings in cost to Transport System Management.

Categories of Benefits contd.

C. Social / Community benefit

- Reduction in pollution levels.
- Change in land values and higher tax base to local authority.
- Savings in land area for “Transport” use and overall ratio at city level due to high density of development.

Estimated benefits

(all units in Rs. Crores)

Category of Benefit	**Year**					
	2012	**2017**	**2022**	**2027**	**2030**	
Saving in VOC	678	748.6	826.5	912.5	968.4	
Saving in alternative transport system	417	283.9	294.3	510.6	501	
Environment Benefits	60	75.7	81.3	89.03	89.03	

Land Appreciation

- Land requirement met by the State Govt.
- Total 138 acres of central govt. land acquired.
- Total land appreciation cost estimated to be Rs. 600 crores.

Distribution of various benefits

Sl. No.	Externalities	Rs. (in crores per annum)
1.	Traffic decongestion (Avoidance of new buses and private vehicles)	347
2.	Reduced fuel consumption (Existing vehicles)	253
3.	Less strain on roads	128
4.	Savings in travelling time	289
5.	Reduction in number of accidents	78
6.	Reduction in pollution	60
	TOTAL	**1155**

Sensitivity Analysis

Sensitivity analysis takes into consideration uncertainties pertaining to forecast and critical parameters relating to cost and benefits. The analysis reveals the impact of changes in the following main variables.

1. Increase in capital cost by 10%.

2. Decrease in revenue or benefits by 10%.

3. Combined effect of increase in project cost by 10% and decrease in revenue or benefits by 10%.

Results of Economic Analysis

	Base Case	Sensitivity 1	Sensitivity 2	Sensitivity 3
EIRR	11.29%	10.1%	10.02%	8.90%
NPV (Rs crores)	589.5	45.88	10.53	-550
B/C ratios	1.7	1.65	1.53	1.49

Conclusion

- The EIRR of 11.29% for the base case.
- The sensitivity analysis estimates the lowest EIRR at 8.90%.
- The B/C ratio is 1.70.

This indicates that the project is viable for all cases except the case under the worst condition of increase in project cost by 10% and decrease in revenue by 10%.

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Thank You

Course Project Presentation

Financial Analysis of Konkan Railway

Under the guidance of

Prof. S.L.Dhingra

Sameer Gupta (03004029)

Financial Analysis

- Evaluates the financial viability of a proposed project
- Assess the value of net cash flows that result from its implementation
- Includes calculation of
  - Costs
  - Benefits

Financial Analysis

- Costs have the following components
  - Total Tranportation Costs
    - Construction cost
    - Maintenance Cost
    - Road User Cost
  - Economic and Financial Costs

- Benefits can be divided into
  - Tangible Benefits
  - Intangible Benefits

Methods of Financial Analysis

- Net Present Value Method
- Internal Rate of Return Method
- Benefit Cost Ratio Method

Acceptance Criteria for BOT projects

- The NPV for the project should be positive
- The financial IRR should have a value greater than the discount rate
- The BCR for the project should be greater than one

Financial Costs

- Capital Costs
  - Construction Costs
  - Maintenance Costs
- Costs are computed first in financial terms based on market prices.
- Market prices are often distorted due to market imperfections, govt. policies and regulations.

Costs

- Capital cost = Rs. 3300 crores
- Maintenance Cost:
  - Regular Maintenance Cost = Rs. 200 crores per year and increases by 10% annually.

  Assumption:

  - Periodic Maintenance Cost = 25% of Construction cost

  (0.25 * 3300 = Rs. 825 crores)

Year	Project Cost	O&M Cost	Depreciation and financial charges	Periodic Maintenance Cost	Total Cost
1991	108				108
1992	266				266
1993	388				388
1994	506	1.1			507.1
1995	823	2.9			825.9
1996	445	18.6			463.6
1997	510	26.4			536.4
1998	327	161			488
1999		479.5			479.5
2000		513			513
2001		548			548
2002		551			551
2003		146	405		551
2004		196	413		609
2005		217	377		594
2007		297.22	400		697.22

2008		297.22	400	800	1497.22
2009		297.22	400		697.22
2010		297.22	400		697.22
2011		297.22	400		697.22
2012		326.942	400		726.94
2013		326.942	400		726.94
2014		326.942	400		726.94
2015		326.942	400		726.94
2016		326.942	400		726.94
2017		359.636	400		759.64
2018		359.636	400	800	1559.64
2019		359.636	400		759.64
2020		359.636	400		759.64
					19801.85

Year	Earnings		Total Earnings
	Passengers	Others	
1991			0
1992			0
1993			0
1994	0.06		0.06
1995	0.22		0.22
1996	0.92		0.92
1997	5.3		5.3
1998	18.4	0.55	18.95
1999	80.4	18.1	98.5
2000	118	12	130
2001	152	16	168
2002	179	9.5	188.5
2003	212	16	228
2004	235	15.5	250.5
2005	272	17	289
2006	341	31.45	372.45
2007	395.56	37.11	432.67

2008	458.85	43.79	502.64
2009	532.27	51.67	583.94
2010	617.43	60.97	678.40
2011	716.22	71.95	788.17
2012	830.81	84.90	915.71
2013	963.74	100.18	1063.92
2014	1117.94	118.22	1236.16
2015	1296.81	139.50	1436.30
2016	1504.30	164.60	1668.90
2017	1744.99	194.23	1939.22
2018	2024.19	229.19	2253.38
2019	2348.05	270.45	2618.50
2020	2723.74	319.13	3042.87
			20911.19896

Financial Appraisal

- The annual stream of financial costs and benefits has been computed over the analysis period.
- **Net Present Value**
- All costs and benefits in future years are discounted to the year of analysis using the adopted discount rate. The future stream of discounted costs is subtracted from the future stream of discounted benefits. This can be represented by the following formula:
- ***NPV = PV(Benefits) – PV(Costs)***
- If the sum of the discounted benefits is greater than the sum of the discounted costs, the net present value is positive and the infrastructure improvement is deemed to be economically justified

Financial Viability

- The project's financial viability is assessed in terms of Internal Rate of Return (IRR) and Net Present Value (NPV) by applying the Discounted Cash Flow (DCF) technique to the annual stream of the net benefits of the project

Sensitivity Analysis

- Sensitivity analysis of the project's financial viability has been carried out to take into consideration uncertainties pertaining to traffic forecast and critical parameters relating to cost and revenue/ benefit.

- The analysis reveals the impact of changes in the following main variables

  - Increase in capital cost by 10%
  - Decrease in revenue or benefits by 10%
  - Combined effect of increase in project cost by 10% and decrease in revenue or benefits by 10%

Results of Financial Analysis

	Base Case	Sensitivity 1	Sensitivity 2	Sensitivity 3
IRR	8.41%	9.21%	9.14%	9.09%
B/C Ratio	1.056	1.038	0.950	0.935
NPV (Rs crores)	-3000	-3190	-3226	-3440

Conclusions

- Financial analysis of the project gave the IRR to be **8.41%** which is less than the discount rate of 10%, and also the B/C ratio came out to be less than 1
- According to the acceptance criteria of a BOT, the project is deemed to be financially non viable.
- As per sensitivity analysis results the increase in costs by 10%, decrease in benefits by 10 %, and both these cases the IRR is nearly about **9 %.** So project is very less sensitive to the increase in cost and decrease in benefits.

THANK YOU

Economic Evaluation of Delhi-Gurgaon Expressway

Under the supervision of

Prof. S.L Dhingra

Department of Civil Engineering

IIT Bombay

By

Vipul Modi

(03004030)

April 2007

An Outline

- Salient Features of Expressway
- Benefits
- Technical Details
- BOT Scheme
- Cost Structure & Analysis
- Sensitivity Analysis
- Conclusion

Introduction

- The expressway is built on one of the busiest link in the country connecting Delhi and Haryana State on National Highway 8
- It will reduce the travel time from an hour to 20 mins
- PCU count for the link was estimated as over 120,000 per day
- It consists of an 8 lane road (82%) and 6 lane road (18%) for congestion reasons
- Toll Structure taken into account will be at concessional rate for local traffic.

Salient Features of Expressway

- Use of Modern Technology and Equipments
- Project is on Build-Operate-Transfer (BOT) basis
- Construction being done as in International Standards
- Speedy Completion of Work
- Cranes provided to lift and remove vehicles

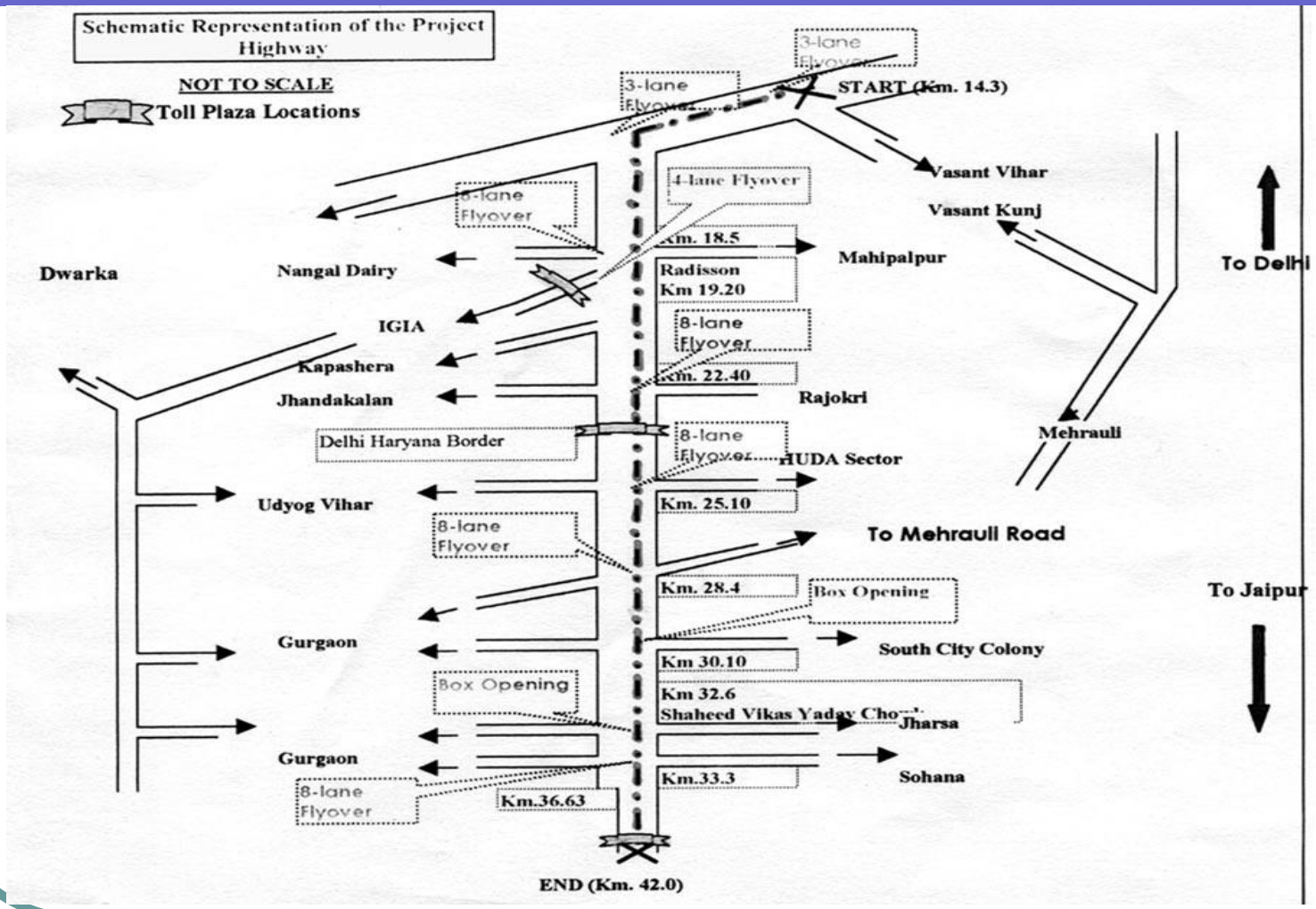
Benefits

- Travel Time reduced from 65 mins to 20 mins
- Saving fuel worth Rs 8000 crores per annum
- Less Pollution
- Faster and Comfortable journey
- Easily accessibility to the Delhi International Airport
- No Intersections
- Highway Patrolling
- Less Road-Mishaps

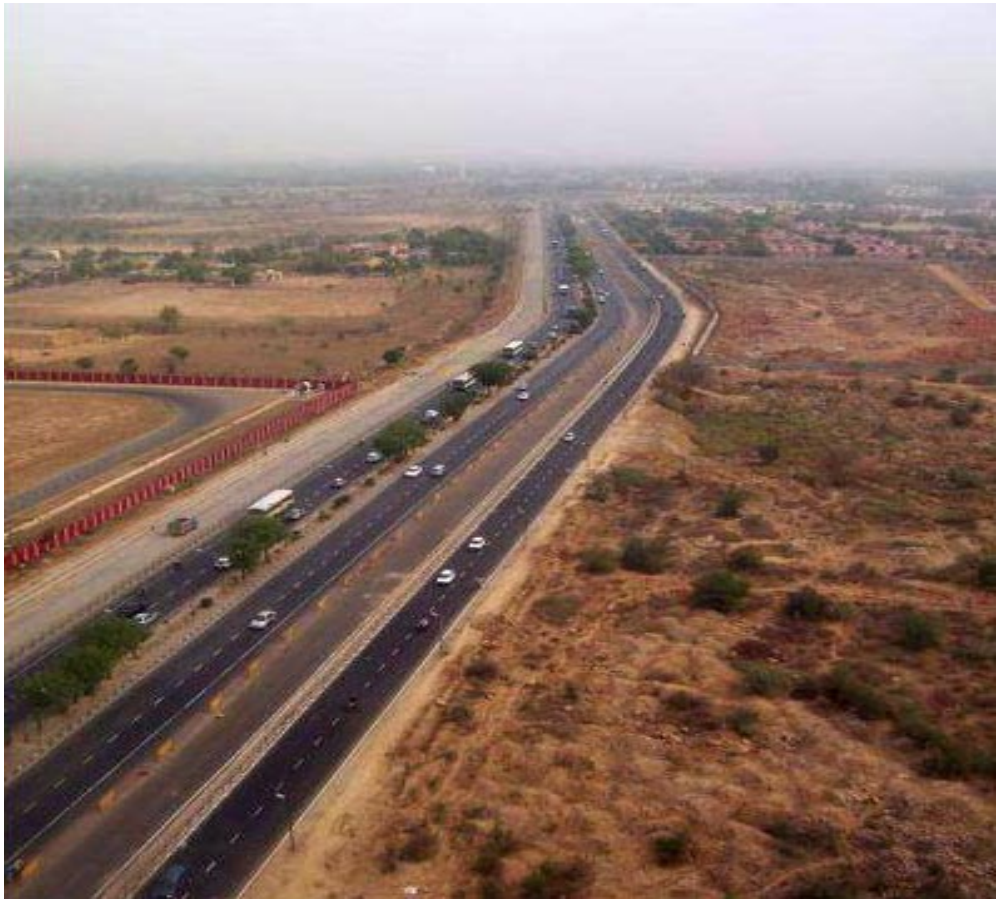
Technical Details

- 8 / 6 Lane expressway with 22.33 kms and 5.37 kms respectively
- Length of service road: 46.84 Km.
- Median strip width: 4.0 meters
- Paved shoulder width: 1.70 meter
- No. of Flyovers: 7
- No. of Underpasses: 5

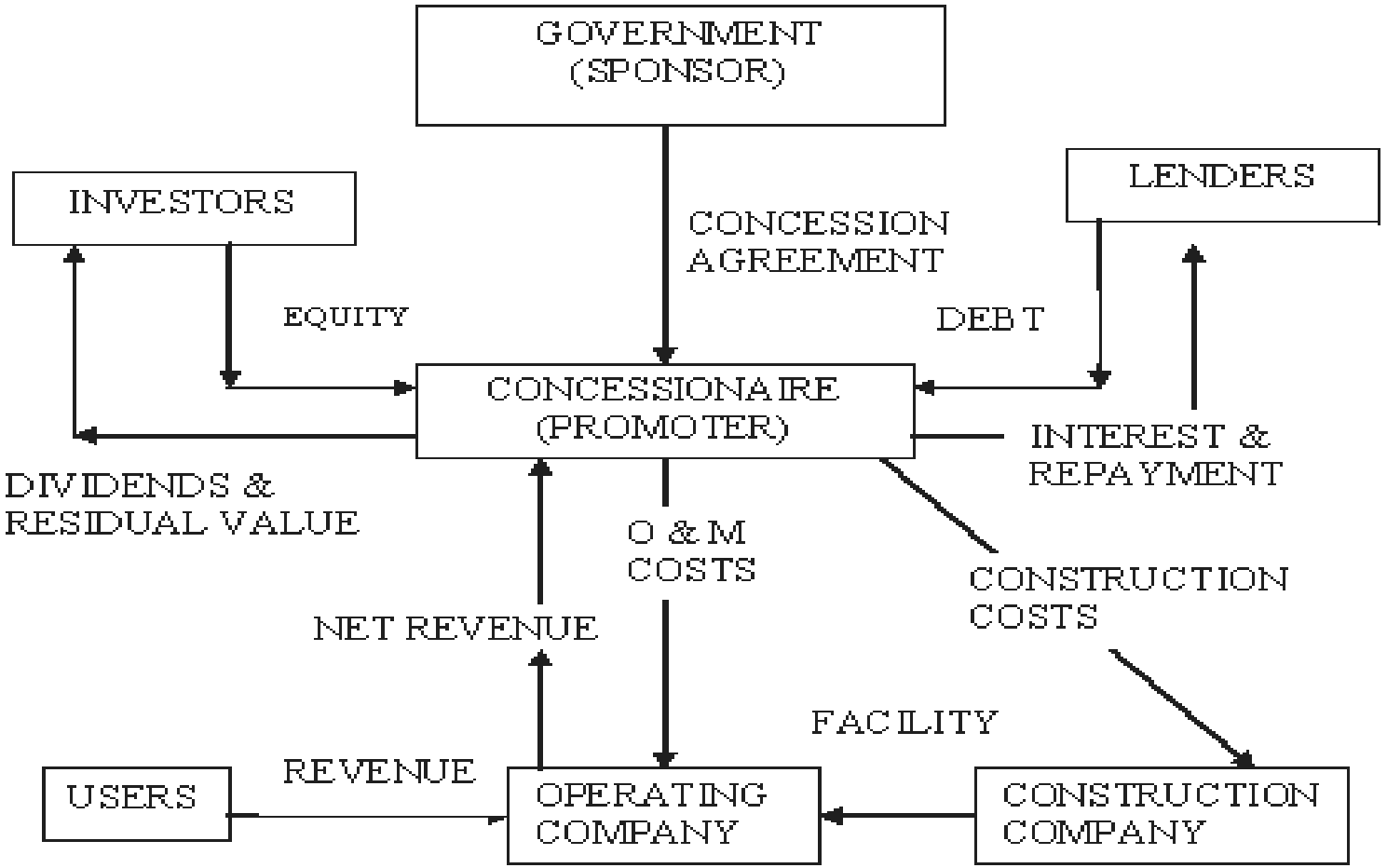
Plan of Delhi-Gurgaon Expressway



View of Delhi-Gurgaon Expressway



The BOT Scheme



Principles of Economic Evaluation

- Complete objectivity is required in the estimation of estimating, forecasting and selecting the factors and their magnitude.
- Economic Analysis is not the decision process, though it aids in decision making.
- All the alternatives should be considered, so the best one is selected.
- The analysis is done based upon all the net costs and net consequences.
- All factors in the analysis should be discounted to the same time, using an appropriate time discount factor.
- Economic evaluation is independent of method of analysis.
- The inputs (costs) and outputs (benefits & adverse affects) must be considered for the exact period of time.

Steps in Economic Evaluation Analysis

1. Identification of definition of the project.
2. Collection of economic base data.
3. Traffic surveys on existing facility.
4. Selection of policy variables for analysis and decision criteria.
5. Inventory of existing road.
6. Traffic projections.
7. Engineering design of proposed alternative schemes.
8. Estimation of cost of new facility as per all alternatives considered.
9. Traffic analysis on existing road and new facility.
10. Estimation of road user benefits.
11. Economic analysis.

Methods of Economic Evaluation

- Equivalent Uniform Annual Cost Method (EUAC)
- Present Worth of Costs Method (PWOC).
- Equivalent Uniform Annual Net Return Method (EUANR).
- Net Present Value Method (NPV).
- Benefit-Cost ratio (B/C) method.
- Internal Rate of Return Method (IRR).

Total Transportation Costs

1. Construction cost
2. Maintenance cost
3. Operation cost
4. Road user cost

Under the Road user cost the following costs will come

- Vehicle operation cost.
- Travel time cost.
- Accident cost.

Vehicle Operation Cost Components

- **Distance- related components**
- Fuel
- Lubricants
- Tyres
- Spare parts
- Labour cost of repairs and maintenance

- **Time-related components**
- Depreciation
- Fixed costs
- Wages of crew

Assumptions

- Rise and Fall for the Expressway is taken as 30m per Km and 10m per Km respectively.
- Roughness values assumed to be 2000mm per Km
- Effect of congestion in both distance and time related components.
- Capacity is taken as 150,000 PCU per day used to determine the distance and time related congestion factors.
- M & O Costs taken together and are going to start after 4 years of opening of the Expressway with an annual increase of 3%.

Cost Structure

Delhi-Gurgaon Expressway	
Initial Cost (2005)	750 crores
Periodic Maintenance and Operational Cost - 5 yearly	210 crores
Growth of Maintenance Annually	3%
Project life in years(2005 to 2019)	15
Length	28Kms

Cost Structure

- Assumed that the overall cost has been divided in a 20 – 30 – 30 – 20 ratio in percentages over 4 years

- Total Traffic when open to Public is assumed according to

Mode	HCV	LCV	Buses	Cars
No.	5680	9724	3646	31602

Value of Travel Time and Savings from it

Mode	Travel time savings (min)	Unit value of travel time	Value of travel time saved
HCV	70	75 Rs/hr	87.5 Rs
LCV	50	60 Rs / hr	50 Rs
Buses	60	350 Rs /hr	350 Rs
Cars	75	130 Rs / hr	162.5 Rs

VOC Equations for Cars

S No	VOC COMPONENT	EQUATION (on 2 lane exiting road, NH4)	COST Rs/Km
1	Fuel cost	$FC=21.85+\frac{504.15}{V}+0.004957*V^2+0.000652*RG+1.0684*RS-0.3684*FL$	2.8
2	Spare parts Cost (including taxes)	$SP=NP*0.0018*(RG-2000)*10^{-5}$	0.8
3	Maintenance Labour	$LC=0.5498*SP$	0.439
4	Tyre Life	$TL=68771-147.9*RF-26.72*\frac{RG}{W}$	0.07
5	Engine Oil	$EOL=1.7048+0.03319*RF+0.0005241*\frac{RG}{W}$	0.378
6	Other Oil	$OL=1.631+0.05167*RF+0.0001867*\frac{RG}{W}$	0.57
7	Grease	$G=2.816+0.2007*RF$	1.301
8	Fixed costs	$Fx=\frac{292.53}{UPD}$	2.19
9	Depreciation	$DC=\frac{56.76}{UPD}$	0.428
			Total: Rs 8.976

Source: Road User Cost Data (Volume-1) By CRRI New Delhi

VOC Equations for Buses

S No	VOC COMPONENT	EQUATION (on 2 lane exiting road, NH4)	COST Rs/Km
1	Fuel cost	$FC=32.97+(3904/v)+0.0207*V^2+0.0012*RG+3.3281*RF-0.7769*FL$	6.385
2	Spare parts Cost	$\frac{SP}{NP} = e^{[-10.44+.0073RT+0.0000723*RG+1.925*W}$	1.127
3	Maintenance Labour	$LC = 0.5498*SP$	0.754
4	Tyre Life	$TL = 38519-389.52*RF-1.32*RG+983.829*W$	0.677
5	Engine Oil	$EOL = 1.146+0.00398*RF+0.0005952*\frac{RG}{W}$	0.8
6	Other Oil	$OL = 3.3201+0.002889*RF+0.00008217*RG-0.3295*W$	0.662
7	Grease	$G = 2.816+0.2007*RF$	0.453
8	Fixed costs	$Fx = \frac{727.39}{UPD}$	1.4682
9	Depreciation	$DC = \frac{182.84}{UPD}$	0.2667
10	Crew Wages	$CW = \frac{752}{UDP}$	1.1415

Total: Rs 13.43

Source: Road User Cost Data (Volume-1) By CRRI New Delhi

Study of Accident Rate and Cost

Cost of a fatal accident

Item	Cost, Rs
Gross loss of future output	130240
National value of pain, grief and suffering	28365
Hospital expenditure	800
Expenditure by court& lawyer fee	6800
Administrative expenses of police, Injury companies, Visits by relatives, funeral expenses etc	5000
	Total Rs 1,71,205

Cost of a serious accident

Item	Cost, Rs
Hospitalization Charges	28000
OPD visits and hospital expenditure	1800
Cost of accessories like artificial limbs	3400
Cost of establishment of police, court, lawyer fee etc.	1600
Monetary value of loss of future output due to permanent disability	105,430
	Total Rs 1,40,230

Assume number of accidents reduced due to new facility is 10 per year

Benefit due to decrease in accidents=10*171205= Rs 1712050

So Rs 17,12,050 we can add to benefits.

Savings from VOC in Rs per Km

Mode	HCV	LCV	Buses	Cars
Savings	9.56	6.43	7.68	3.1

Sensitivity Analysis

Cases	With Travel Time Savings	Without Travel Time Savings
Base Case	15.35%	12%
10% increase in initial investment	14.13%	11.9%
10% decrease in Revenue	13.96%	11.74%
10% increase in investment and 10% decrease in revenue	14.81%	12.74%

Conclusions

- From Sensitivity analysis results we concluded that the Delhi – Gurgaon Expressway Project is economically feasible as the value of IRR is coming out to be 15.35% with travel time savings.
- Benefits to Cost ratio is coming out to be 1.126
- Important thing we have to consider is whether the traffic projection as given in this report will come on to this proposed Expressway or not. And also the coming traffic will very much depend on the Toll structure.
- We have to take the perception of the people whether they are willing to come on this proposed Expressway for the toll structure given.
- Also depends upon the future developments around the expressway i.e Delhi Metro and other State peripheral expressways.

Thank You

Course Project Presentation

Economic Evaluation of Mumbai Pune Expressway and NH4

Guide

Prof S.L.Dinghra

Jyothsna Pannala

03004035

Economic Evaluation

- The objective of economic evaluation is to determine the feasibility of the proposed project in terms of the benefits likely to accrue to the economy as a whole, thereby justifying its implementation based on profit to the nation/ economy.

- Need for Economic evaluation
  - Cost-Effective Design and Construction
  - Best Return on Investment
  - Understanding Complex Projects
  - Documentation of Decision Process

Economic Evaluation Process

- Main Step Followed in the Economic Evaluation are as Follows:
- Estimation of economic costs of the project both, capital, as well as annual operating costs, for the assumed economic life after the commencement of the project.
- Estimation of annual recurring operation & maintenance costs at the current market price & its conversion into economic costs.
- Identification and quantification of economic benefits to users, Non-users, Community.
- Based on traffic forecast for the project annual stream of benefits will be estimated and compared with the stream of annual costs.

MPEW and NH4

- Mumbai Pune Expressway
  - India's first expressway
  - reduced the travel time between Mumbai and Pune to approximately two hours
  - construction entrusted to MSRDC by the Govt. of Maharashtra in March 1997 on Built, Operate and Transfer (BOT) basis with the permission to collect the toll for 30 years.
  - Initially budgeted around Rs. 1600 crores
  - Final cost around Rs. 2,136 crores
  - cost escalation of about 30 per cent
  - With an average initial debt repayment interest of 13 per cent, the total liability is now Rs. 3,000 crores.

- March 1, 2004, NH-4 and the Expressway were handed over to Ideal Road Builders (IRB), a Mumbai-based company.

Project Details

- capital cost –
  - Mumbai Pune Expressway - Rs. 900 crores
  - widening of the parallel NH 4 from two lanes to four lanes - Rs. 400 crores

- construction period for NH4 is 1 year
- life period
  - MPEW is 15 years (2005 to 2019)
  - NH 4 is 14 years (2006 to 2019).

Project Proceedings

	Time
Information	May-04
Construction Starting	Sep-04
Construction Ending	Aug-05
Commercial Operation	Sep-05
Concession Ending	Dec-19
Discount Rate	15%

Economic Costs

- **Capital cost**
  - Construction costs
  - Environmental and social mitigating measures
  - Relocation of utilities
  - Land acquisition and construction supervision.

- Costs are computed first in financial terms based on market prices.

- market prices are often distorted due to market imperfections, govt. policies and regulations.

- The financial cost therefore will be converted into economic cost by applying conversion factor of 0.85 as recommended by international funding agencies

Capital Costs

MPEW (Rs in crores)	NH4 (Rs in crores)	Total financial Cost (Rs in crores)	Total Economic Cost (Rs in crores)
900	400	1300	1105

Table Capital Costs of MPEW and NH4

Maintenance Costs

- MPEW:
  - Regular Maintenance Cost = 70.91 crores per year and increases by 3% annually.
  - Periodic Maintenance Cost = 210 crores @ every 5th year

- NH4
- Assumptions:
  - Regular Maintenance Cost on NH4 = 3% of construction cost
    = 0.03 x 400 = 12 crore per year and increases by 3% annually.
  - Periodic Maintenance Cost on NH4 = 10% of construction cost
    = 0.1 x 400 = 40 crore @ every 5th year

Year	MPEW (Rs in crores)	NH4 (Rs in crores)	Financial Cost (Rs in crores)	Economic Cost (Rs in crores)
2004	0.00	0.00	0.00	0
2005	70.91	0.00	70.91	60.27
2006	73.04	12.00	85.04	72.28
2007	75.23	12.36	87.59	74.45
2008	77.49	12.73	90.22	76.68
2009	79.81	13.11	92.92	78.98
2010	82.20	13.51	95.71	81.35
2011	84.67	13.91	98.58	83.79
2012	87.21	14.33	101.54	86.30
2013	89.83	14.76	104.59	88.89
2014	92.52	15.20	107.72	91.56
2015	95.30	15.66	110.95	94.31
2016	98.16	16.13	114.28	97.14
2017	101.10	16.61	117.71	100.05
2018	104.13	17.11	121.24	103.05
2019	107.26	17.62	124.88	106.14

Periodic Maintenance Costs

Year	MPEW (Rs in crores)	NH4 (Rs in crores)	Financial costs (Rs in crores)	Economic costs (Rs in crores)
2005	243	0	243	206
2010	282	46	728	619
2015	387	54	941	800

Economic Benefits

- The benefits of a transportation investment are typically estimated by comparing the amount of travel time, vehicle miles traveled and expected number of crashes for the Alternative to the Base Case.

- The second step is translating these physical benefits into monetary values.

- The major economic benefits are
  - Saving in Vehicle operating time (VOT)
  - Savings in Vehicle operating cost (VOC)

Savings in VOT

- Travel-time savings typically generate the greatest amount of benefit
- These savings are calculated based on the difference in travel time between the Base Case and an Alternative.
- Savings in Travel Time will increase in 3% rate as traffic is increasing at a rate of 3%
- Savings in VOT
  - HCV : 87.5 Rs per day
  - LCV : 50 Rs per day
  - Buses : 350 Rs per day
  - Cars : 162.5 Rs per day
- From 2005 september onwards, Savings in Travel Time on MPEW will be reduced to half because of widening of NH4 to four lanes.

Year	MPEW (Rs in crores)	NH4 (Rs in crores)	Total Savings (Rs in crores)
2004	43.94	0	43.94
2005 - Jan to Aug	104.87	0	104.87
2005 - Sep to Dec	17.48	28.43	45.91
2006	74.17	90.49	164.67
2007	78.69	96.00	174.70
2008	83.48	101.85	185.33
2009	88.57	108.05	196.62
2010	93.96	114.63	208.60
2011	99.68	121.61	221.30
2012	105.75	129.02	234.78
2013	112.20	136.88	249.07
2014	119.03	145.21	264.24
2015	126.28	154.06	280.33
2016	133.97	163.44	297.41
2017	142.13	173.39	315.52

Savings in VOC

- When transportation improvements are made, the cost of operating vehicles along a particular facility or set of facilities can change.
- Operating costs can change because the number of miles driven changes, as in the case of a shorter bypass or a reduction in circuity or diversion of trips, or it can change because of changes in the number of stops.
- The number of vehicle-miles traveled (VMT) is the most common variable that affects vehicle operating costs.
- Savings in VOC
  - HCV : 9.56 Rs per day
  - LCV : 6.43 Rs per day
  - Buses : 7.68 Rs per day
  - Cars : 3.1 Rs per day

Year	MPEW (Rs in crores)	NH4 (Rs in crores)	Total Savings (Rs in crores)
2004	1.68	0.00	1.68
2005 -Jan to Aug	4.01	0.00	4.01
2005 - Sep to Dec	0.67	1.09	1.75
2006	2.83	3.46	6.29
2007	3.01	3.67	6.68
2008	3.19	3.89	7.08
2009	3.38	4.13	7.51
2010	3.59	4.38	7.97
2011	3.81	4.65	8.46
2012	4.04	4.93	8.97
2013	4.29	5.23	9.52
2014	4.55	5.55	10.10
2015	4.83	5.89	10.71
2016	5.12	6.25	11.37
2017	5.43	6.63	12.06

Economic Appraisal

- The annual stream of economic costs and benefits has been computed over the analysis period.
- **Net Present Value**
- All costs and benefits in future years are discounted to the year of analysis using the adopted discount rate. The future stream of discounted costs is subtracted from the future stream of discounted benefits. This can be represented by the following formula:
- ***NPV = PV(Benefits) – PV(Costs)***
- If the sum of the discounted benefits is greater than the sum of the discounted costs, the net present value is positive and the infrastructure improvement is deemed to be economically justified

Economic Viability

- The project's economic viability is assessed in terms of Economic Internal Rate of Return (EIRR) and Net Present Value (NPV) by applying the Discounted Cash Flow (DCF) technique to the annual stream of the net benefits of the project

	EIRR	**NPV (Rs in crores)**
MPEW	29.71%	715.35
NH4	75.66%	1382.51
Total	42.92%	2097.87

Sensitivity Analysis

- Sensitivity analysis of the project's economic viability has been carried out to take into consideration uncertainties pertaining to traffic forecast and critical parameters relating to cost and revenue/ benefit.

- The analysis reveals the impact of changes in the following main variables
  - Increase in Capital costs
  - Decrease in volume of traffic
  - Increase in discount rate
  - Increase in O&M costs
  - Decrease in toll rates
  - Decrease in VOC savings
  - Decrease in VOT savings

Increase in Capital Costs

Construction Cost						
	MPEW		NH 4		Cumulative	
% Change	NPV	EIRR	NPV	EIRR	NPV	EIRR
10%	274.27	20.75%	1031.32	61.41%	1305.59	32.68%
30%	485.85	22.98%	1288.83	59.64%	1774.69	33.83%

Decrease in Traffic Volume

Volume of Traffic						
	MPEW		**NH 4**		**Cumulative**	
% Change	**NPV**	**EIRR**	**NPV**	**EIRR**	**NPV**	**EIRR**
-10%	492.36571	25.19%	1204.5	68.47%	1696.9	37.73%
-20%	269.38	20.65%	1026.56	61.22%	1295.94	32.55%

Change in Discount Rate

Discount Rate						
	MPEW		NH 4		Cumulative	
% Change	NPV	EIRR	NPV	EIRR	NPV	EIRR
18%	493.39	29.71%	1116.60	75.66%	2097.87	42.92%
22%	273.28	29.71%	852.82	75.66%	1126.10	42.92%

Increase in O&M Costs

Operational and Maintenance Cost						
	MPEW		NH 4		Cumulative	
% Change	NPV	EIRR	NPV	EIRR	NPV	EIRR
10%	640.40	28.06%	1374.02	75.40%	2014.42	41.61%
30%	490.49	24.85%	1357.03	74.87%	1847.52	39.06%

Toll Rates						
	MPEW		NH 4		Cumulative	
% Change	NPV	EIRR	NPV	EIRR	NPV	EIRR
-10%	558.83	26.59%	1269.15	71.08%	1827.98	39.48%
-20%	402.30	23.45%	1155.78	66.49%	1558.08	36.05%

VOC Savings						
	MPEW		NH 4		Cumulative	
% Change	NPV	EIRR	NPV	EIRR	NPV	EIRR
-10%	399.85	23.39%	1153.40	66.39%	1553.26	35.98%
-20%	397.41	23.34%	1151.03	66.30%	1548.43	35.92%

Decrease in VOT Savings

VOT Savings						
	MPEW		NH 4		Cumulative	
% Change	NPV	EIRR	NPV	EIRR	NPV	EIRR
-10%	338.28	22.09%	1093.55	63.96%	1431.84	34.36%
-20%	274.27	20.75%	1031.32	61.41%	1305.59	32.68%

Scenario Analysis

- Scenario 1: Increase in capital cost by 10%.
- Scenario 2: Decrease in benefits by 10%.
- Scenario 3: Combined effect of increase in project cost by 10% and decrease in revenue or benefits by 10%.

	Base Case	Sensitivity 1	Sensitivity 2	Sensitivity 3
EIRR	42.92%	28.89%	28.51%	25.04%
NPV (Rs Crores)	2709	1114.41	983.85	792.67
B/C ratios	2.97	2.7	2.68	2.43

Conclusions

- Economic analysis of MPEW project alone gave an EIRR of 29.71% and NPV of 715.35 crores. Though the base project MPEW project is economically viable, any variation in project parameters can result in a lower value of EIRR.

- Economic analysis of NH4 project alone gave an EIRR of 75.65% and NPV of 1382.51 crores. NH4 project is very much economically viable.

- The cummulative performance of MPEW and NH4 is found to be good with project EIRR of 42.92%, NPV of 2709 crores and BCR of 2.97. The cut off rate for the economically viable project at present is 15%. The project gives the EIRR of 42.92% for the base case. The combined project is economically viable.

Conclusion

- The sensitivity analysis was carried out on the project parameters
- The sensitivity analysis estimates the lowest EIRR at 25.04%. This indicates that the project is viable even under the worst condition of increase in project cost by 10% and decrease in revenue by 10%.
- A 20% decrease in VOT savings showed a 45% decrease in NPV. This indicates that the project is very sensitive to VOT savings.

Thank You

CE 754 Course Project

Economic Evaluation of BOT Scheme for Highway Projects

Instructor
Prof. S.L. Dhingra

Presented by
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Introduction

- Transport economic analysis is an important phase of the transport project appraisal.
- It is a technique where the costs and benefits from a scheme are quantified over a selected time horizon.
- Economic analysis is done for national point of view.

Methods of Economical Analysis

- Benefit Cost Analysis

$$B_{pv} = \sum_{i=1}^{n} \frac{B_i}{(1+r)^i} \qquad C_{pv} = \sum_{i=1}^{n} \frac{C_i}{(1+r)^i}$$

  - Benefit Cost Ratio Method (BCR)
  - Net Present Value Method (NPV)

Case Study

- National Highway 8 which connects the Jaipur city to Delhi is provided with a bypass road, which passes through the Transport Nagar intersection – where NH 8 meets the other national highway no 11 (Jaipur – Agra road) and passes via Karbala T-junction and Y junction with old Amer road.

- Being at the boundary of the Jaipur city, this section of the road caters for all type of traffic – light, medium and heavy vehicles including buses and trucks.

- This bypass road is also accessed from the important Amer road via the busy and congested Karbala link road. It is necessary to upgrade this package road section for traffic worthiness in conformity with the Delhi road.

- Keeping in view the requirement of future widening in due course, decision has been taken by the authorities to keep this road for future 6 lane decided configuration and wherever space is available without constraint, to also provide for 2X1.5 m further widening over and above 6 laning and to provide, for the present, 4-lane divided carriageways for the time being, to ease congestion.

- Two stretches of this bypass road from Transport Nagar crossing up to Karbala T junction have already been taken up under package no. JAI/ST/01 and JAI/ST/03.

- It is therefore proposed to take up improvement of this portion of the bypass road from Karbala T junction up to bottom of hilly stretch by construction of a new retaining wall on the RHS(Jaipur-Delhi) from Karbala up to the hillock opposite to mosque and further from existing road up to bottom of Ghati portion including cutting of the hill, for the future 6-laning including widening, providing for only 4-laned configuration for the present throughout the package length, besides improvement of intersections en-route and wayside development like service roads in the commercial stretch ensuing after the Ghati. After the package length, the Delhi road is already 4 lane.

Justification for road widening:

- This section of road connects heavily populated commercial, agricultural area.
- At present, the carriageway is only 2 lane wide, with paved shoulders of widths varying from 0.6m to 8 m.
- Due to inadequate carriageway width, the road becomes congested resulting into low speeds and to possibility of accidents, whereby the traffic passing through this stretch suffers the most.

- Widening and strengthening as per requirement of this 8.85 km length of the bypass is, therefore, absolutely necessary

  - to ease traffic situation near Jaipur city

  - to provide relief and time savings to through traffic

  - to reduce accidents, congestion and operating expenses of the vehicles

- This will also improve the environment of Jaipur city.

Assumptions

- Initial investment and residual value of the project is zero.
- Moratorium period is 6 years for this project i.e. construction period plus one operational year consider as moratorium period.
- Discount rate is constant throughout the concession period.
- Operation and maintenance cost are assumed to increase at the rate of inflation rate.
- All toll rates for any mode at any time are kept in full rupees

Traffic Survey

- Peak hour traffic survey was conducted in June 2004 on the Delhi bypass road. Total ADT in both directions of various categories of vehicles is given in the table below. Keeping in view the future construction of a new bypass, the initial design period for stage construction of this arterial road has been taken as 5 years. In accordance with IRC: 37 – 2001, a growth factor of 7.5% per annum has been used to predict the future traffic.

Types of vehicles	Abbr.	Traffic in Base Period
Trucks,Containers,Trailers, Buses	TCTB	3960
LCVs,Tempos,Agri Tractors	LCTA	290
Cars, Jeeps, Vans	CJV	518
Two wheelers, Autorickshaws	TWAR	2660

Maintenance strategy

- The maintenance of the pavement can be of two types
  - Routine maintenance
  - Periodical maintenance
- Routine maintenance includes the regular crack sealing due to shrinkage of asphalt layer, repair pot holes, bitumen heaves near the bus stops or approach road which are caused due to acceleration and deceleration of the vehicles. The periodical maintenance is related to the roughness index of the pavement. Whenever the roughness index of the pavement goes beyond the specified value, profile corrective course in the form of bituminous overlay has to be provided. Generally the interval of periodical maintenance is 5 years.

Operation and Maintenance cost

- The estimated O&M cost (at 2010 prices) are summarized in the following table.

Operation cost per year	2.5 crore
Routine maintenance per year	2 crore
Periodic maintenance per 5 years	10 crore

Operation and Maintenance Cost

Useful Parameters

Debt equity ratio	2:1
Rate of inflation	6%
Rate of interest	12%
Discount rate	12%
Concession period	11 yrs
Government grant	20%
Moratorium period	6 yrs
Length of the road	8.85 km

Conclusion

- After simulating the data of this project in Highway Design and Maintenance Standards Model (HDM), IRR was 18.14% and NPV was Rs 3.97 crore at the discount rate of 12%.

THANK YOU

CE 754 Course Project

Financial Evaluation of BOT Scheme for Highway Projects

Instructor
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(03004040)

Introduction

- The financial viability of a project built by a private sector means that the project must generate revenue that will be sufficient
  - To payoff principal and interest payments in respect of the project debt over the term of the various loans and
  - To provide a return of and on equity which is commensurate with whatever development and long term project risk the equity investors are being asked to take.

- Financial costs represent the actual amounts one has to pay to get a road constructed and maintained. They are the engineer's estimates to get the project sanctioned and they are shown in the accounts and budgets.

- In financial analysis, one is concerned with the ways and means of financing a project (through taxes or toll) and the financial profitability of the project.

Case Study: Statistics of the Project

- **Construction cost**
  - The project cost has been estimated based on 2005 prices
  - Project implementation is spread over the years 2005-2010.
  - Cost estimates have been adjusted for inflation @ 6% p.a.
  - Interest during the construction period (IDC) has been considered on the debt component @ 12% p.a and has been funded till the year, 2010. Hence the repayment of interest and principal starts from 2011 after moratorium period ends.

- The project is planned for completion within five years. The investment phasing schedule of construction has been given in the following table.

Year (Qtrs)	Construction cost (crore Rs)	Construction cost after inflation and IDC (crore Rs)
2005 (9)	2.4027726	2.48533
2006 (12)	2.3378332	2.68359
2007 (12)	2.3378332	3.03058
2008 (12)	2.3378332	3.42619
2009 (12)	2.3378332	3.87977
2010 (3)	0.5844583	1.04865
Total	12.3385637	16.55411

Phasing of Construction Cost

Traffic and Toll

- The average daily traffic (ADT) and toll rates for base year (2004) of different category of vehicles are given below in the following table. The annual growth rate for daily traffic is taken as 7.5% and toll rates are assumed to go up in tandem with inflation i.e., @ 6% p.a.

Category	ADT	Toll (Rs)
Trucks, Containers, Trailers, Buses	3960	20
LCVs, Tempos, Agri Tractors	290	15
Cars, Jeeps, Vans	5180	10

Note: Two wheelers and auto rickshaws are considered as toll free.

Table: Traffic and Toll rates for base year 2004

Advertisement Revenue:

The share of advertisement revenue for such projects in the total operating revenue has been ranged between 5-10%. The possible avenues where advertisement billboards can be targeted are:

- Advertisements from hoardings on the sides of the highway.
- Advertisements on the toll tickets.

For this project, the share of the advertisement revenue has been assumed at 5% of the tolls revenue.

Cost and Finance Structure

Cost		Rs crore
Construction cost		13.6799
IDC		3.2388
Total		16.9187
Debt : Equity Ratio		2
Financing		
Government Grant	20%	3.3837
Own Equity		4.5117
Debt from financial institution		9.2033
	Total	16.9187

Conclusion

- After simulating the data of this project in model IRR and NPV was calculated as 20.91% and Rs 5.85 crore respectively with ad revenue and without ad revenue, IRR was 18.14% and NPV was Rs 3.97 crore at the discount rate of 12%.

- According to the acceptance criteria, the project is found to be financially viable.

THANK YOU