COST BENEFIT ANALYSIS OF CHENNAI PERIPHERAL ROAD

1 Introduction

The objective of the cost benefit economic analysis is to identify and quantify the benefits and costs associated with the project. This analysis will help in identification of the optimum solution along with economic viability in terms of its likely investment return potential. This is carried out in order to test the economic feasibility of the project road and to assist the Government to take decision.

The Chennai Peripheral Road project is examined for implementation with respect to its economic viability. However, since the project of this nature involves certain social costs in terms of utilization of scarce resources and public investment, to have significant benefits flowing to the society, it becomes imperative to undertake an economic analysis to examine whether such projects are significantly beneficial to the society or the economy.

The economic feasibility study is carried out using the overall guidelines stipulated by the Indian Road Congress (IRC:SP:30-2009) and the World Bank in their manuals and Manual for HDM-4. These manuals are accepted by the Ministry of Road Transport & Highways (MORT&H), National Highways Authority of India (NHAI) and World Bank for highway projects in India.

Construction of peripheral road for a length of 133.381 km (of which 35.40 km is existing road) brings about a reduction of vehicle operating costs, travel time, accidents, environmental pollution, etc. In the present analysis, the cost stream comprises of the civil cost whereas the benefits are accrued from saving in vehicle operating costs (VOC) and travel time costs for passengers and goods. Social development and the quality of life will prove to be a significant benefit for the project and the same has been separately quantified based on earlier studies.

The cost-benefit analysis is carried out by using the discounted cash flow (DCF) technique to obtain the economic internal rate of return (EIRR) and economic net present value (ENPV) for the proposed investments linked with the project. This is followed by a sensitive analysis carried out by increasing or decreasing the critical factors affecting the cost and benefit streams of the proposed project, in order to ascertain their effect on the economic feasibility indicators i.e. EIRR, ENPV.

2 Project Details

Length of project road in Section-wise is given in Table 1.

Table 1: Details of Project Road

Section	Project Stretch	Existing Road Length (km)	New Alignment Length (km)	Total (km)
Section – 1	Ennore Port to Thatchur on NH-5 incl. Link Road to TPP Road	0	25.11	25.11
Section – 2	Thatchur on NH-5 to Start of Thiruvallur Bypass	0	26.40	26.40
Section – 3	Start of Thiruvallur Bypass to Sriperumbudur on NH-4	9.60	21.00	30.60
Section – 4	Sriperumbudur on NH-4 to Singaperumalkoil on NH-45	23.80	0	23.80
Section – 5	Singaperumalkoil on NH-45 to Mahabalipuram	2.00	25.471	27.471
Total Length		**35.40**	**97.981**	**133.381**

The detailed feasibility report for Section 1 (Ennore Port to Thatchur incl. Link Road to TPP Road) was originally done by consultants for the NHAI and TNRDC has updated the feasibility study. Hence for present economic analysis, rest of the sections i.e. Sections 2 to 5 have been considered.

Approved configuration of project road in Section-wise is given in Table 2.

Table 2: Configuration of Project Road

Sl. No.	Description	Section - 1	Section - 2	Section - 3	Section - 4	Section - 5
1	Right of way (RoW)	100m	60m	60m	40-60m	60m
2	Number of lanes in Main Carriageway	2 X 2-lane with paved shoulder	2 X 3-lane with paved shoulder	2 X 3-lane with paved shoulder	2 X 3-lane with paved shoulder	2 X 2-lane with paved shoulder
3	Central Median	4.00m	4.00m	4.00m	1.0m	4.00m
4	Service Road	2 X 2-lane	2 X 2-lane	2 X 2-lane	2 X 2-lane	2 X 2-lane
5	Footpath/Drain/ Utility Corridor	2 X 2m & 2 X 3m	2 X 3m	2 X 3m	2 X 2.5m	2 X 3m

3 Traffic Assignment

The traffic assignment on the proposed peripheral road has been carried out based on the traffic volume survey and origin-destination surveys conducted on the project area. Data on traffic movement between various radial roads has been sorted out to assess the likely traffic assignment. It is expected that, with the proposed peripheral road, the traffic movement pattern will undergo significant change. Considering the population, socio-economic characteristics and economic activities of abutting land use, the likely traffic along the link in the base year (2013) along with the weighted average has been presented in Table 3.

Table 3: AADT along Project Road Sections

Sec	Length (Km)	Year	Goods Vehicles				Passenger Vehicles				**Total No.**
			LCV	2-Ax Truck	3-Ax Truck	MAV	Car/ Jeep	T/W	Pass. Auto	Bus	
2	26.25	2013	830	1,957	1,544	924	1,34	2,36	89	245	**9,296**
3	29.55	2013	1,56	3,181	2,077	1,13	5,04	8,09	222	902	**22,221**
4	24.85	2013	2,12	5,186	2,260	1,24	6,52	9,67	198	1,07	**28,297**
5	27.50	2013	602	1,031	494	210	2,15	3,42	87	86	**8,093**

4 Traffic Forecast

The growth rates for various categories of traffic are based on various assumptions and general growth trends in number of registered vehicles of the State. It is estimated that the benefits will start accruing from 2019, after the construction is completed. Further, the generated traffic is estimated as 5% for each category of vehicle for first 5 years. The estimated growth rates and the projected traffic are presented in Table 4 and Table 5.

Table 4: Estimated Traffic Growth Rates (% per annum)

Slab Year	**Two Wheeler**	**Passenger Auto**	**Car/Jeep**	**Bus**	**LCV**	**2 / 3 Axle Truck**	**MAV**
2013-2018	9.37%	5.34%	9.14%	5.55%	13.10%	7.33%	6.22%
2018-2023	8.43%	5.00%	8.22%	5.00%	11.79%	6.59%	5.60%
2023-2028	7.59%	5.00%	7.40%	5.00%	10.61%	5.93%	5.04%
2028-2033	6.83%	3.89%	6.66%	4.05%	9.55%	5.34%	4.53%
2033-2038	6.15%	3.50%	5.99%	3.64%	8.59%	4.81%	4.08%
2038-2043	5.53%	3.15%	5.39%	3.28%	7.73%	4.33%	3.67%

Table 5: Traffic Projection in PCU (AADT)

Year	Sections			
	2	3	4	5
2013	19669	39554	49263	11924
2014	21163	42576	53091	12884
2015	22776	45843	57234	13926
2016	24518	49376	61718	15057
2017	26401	53198	66573	16286
2018	28436	57334	71833	17621
2019	31838	64229	80552	19807
2020	35655	71971	90352	22270
2021	39939	80668	101369	25047
2022	44748	90438	113759	28177
2023	50149	101419	127695	31706
2024	53364	108041	136134	33881
2025	56799	115122	145163	36212
2026	60468	122694	154825	38714
2027	64389	130795	165170	41398
2028	68581	139464	176246	44279
2029	72688	147982	187093	47098
2030	77055	157047	198642	50105
2031	81700	166697	210943	53315
2032	86641	176973	224047	56741
2033	91899	187916	238010	60398
2034	96835	198114	251117	63851
2035	102056	208907	264996	67513
2036	107580	220331	279697	71400
2037	113424	232426	295271	75526
2038	119611	245236	311775	79905
2039	125505	257447	327519	84091
2040	131713	270312	344115	88511
2041	138252	283869	361613	93179
2042	145141	298158	380066	98109
2043	152400	313222	399530	103318

5 Approach to Economic Analysis

The economic analysis of the project road has been carried out through HDM 4-Version 1.3. It allows accessing the physical, functional and economic feasibility of the specified project alternative by comparing against a base case or a 'without project' alternative. The analysis covers the following;

- Life cycle costing of pavement structural performance.
- Prediction of road deterioration.
- Estimation of road user costs (vehicle operating costs, travel time and accidents).
- Modeling of road works effects and costs associated to the road administration.
- Calculation of economic and financial benefits by comparing project alternatives.
- Maintenance of existing roads.
- Improvement of existing roads.

The various steps followed are;

- Creating a project - Project title, road network, vehicle fleet.
- General information - Description, start year of analysis, duration of analysis period, output currency, conversion rate.
- Network – Section selection based on pavement, speed-flow type, traffic volume, geometry.
- Vehicle types and traffic characteristics – AADT and year, composition, growth rate and year of growth period.
- Selection of alternatives – Description, maintenance and/or improvement standards, generated traffic, exogenous benefits and costs.
- Running the economic analysis – Base case project alternative, discount rate, road accident analysis, etc.
- HDM outputs – Input data, deterioration/works effects, road user effects, environmental effects, energy use, cost streams, economic comparison summaries/ indicators.

6 Assumptions and Inputs

The analysis for the project road is being carried out considering the following assumptions;

1. The total length of the project road is 133.38 Kms which consists of 34.4 km existing road and remaining is new alignment. The existing route followed at present is around 20 km more than the proposed alignment, with no definite routing pattern. For simplicity the length has been kept at 133 km, with the assumption that an existing two lane road is available along the proposed alignment, which needs up-gradation and lane addition.
2. Analysis period is taken as 30 years starting from 2016.
3. Rise and Fall – 3 m/Km for all sections
4. No. of Rise and Falls – 2 / Km for all sections
5. Average curvature – 12 to 26 deg./ Km
6. Altitude – Varies between 8m to 60m from MSL
7. Speed Limit – 30 to 40 Km/hr
8. Sub grade CBR – 8%
9. Roughness (IRI) – 4 to 4.5
10. Total cracking area – 10% to 20%
11. Ravelled area – 5% to 10%
12. Edge break – 10 sqm/ Km for all sections
13. Rut depth – 10 mm
14. Surface thickness – 25 mm
15. No non –motorized vehicle has been considered in the analysis.
16. The economic analysis is based mainly on the saving in vehicle operating costs and travel time, which is directly related to the condition and performance of the main carriageway. Hence the service road component has been excluded from the analysis and costing part.
17. The economic cost for all the items has been assumed as 90% of the financial cost.
18. Discount rate – 12%.

7 Alternatives

Based on the above discussions the alternatives considered are;

- Without Project (Do Nothing) – Existing road and assumed 2-lane alignment with maintenance of the same.
- With Project - Construction of 6-lane divided carriageway (service road on either side ignored as it will be used for local access) and maintenance of the same for the total life span.

8 Project Cost and Inputs

For the purpose of carrying out the economic analysis, the cost estimate of the road has been prepared considering road, structures and other amenities and facilities separately. Land acquisition costs have been added to arrive at the total cost estimate of the project. Though some of the activities may start in 2016, the construction is expected to start in 2017 and be completed in the year 2019, construction period being estimated as 36 months. The total financial cost of the project road (Section 2 to 5) has been worked out as Rs 8010 Crores at current financial prices (cost of 2-lane service road – Rs 1.6 crores/km). However, like other studies in the state land acquisition cost has not been considered for the analysis. The distribution of cost has been estimated as 20% in first year, 40% in second year and 40% in third year.

Further, it may be noted that the benefits of the economic analysis is from the saving in VOC and travel time cost, which is mainly dependant on the performance of the main carriageway (not service road). The function of the service road may be considered as means of controlling access to the main carriageway. The facility is to be maintained in good condition to ensure that the level of service provided to the users is not below their expectation. It normally consists of different maintenance packages provided in the program and its periodicity. The maintenance work has been made as,

- Reconstruction at IRI between 6 and 8 with responsive intervention
- Overlay at IRI 4 with responsive intervention
- Patching and crack seal as routine with periodicity of 1 year
- Cost considered/ sqm – Overlay 40mm – Rs 440, Overlay 25mm – Rs 290, Patching – Rs 200, Edge repair – Rs 150.
- Lane addition of average 4 lanes for the entire section (except for Section 4, where two additional lanes are to be constructed for main carriageway).

9 Project Benefits

Road user benefits will be from vehicle operating cost (VOC) savings, travel time saving and saving in maintenance costs. Social benefits will accrue from improvements in quality of life and environmental condition and appreciation of abutting land value. The generated traffic, accident reduction and exogenous benefits have been excluded from the analysis.

The cost of the project seems to be quite high in comparison to the benefits; hence an attempt has been made to include the social benefits. As social benefit forms a major part of the benefit stream, in absence of any clear guideline, attempts have been made utilizing the result from Bhutan Rural Road Investment (Credit was approved by IDA Board in December 1999). In that study it was established that 29% of project benefits were derived from quantifiable social benefits – 27% from education and 2% from health benefits.

10 Economic Internal Rate of Return (EIRR)

The values of the economic indicator are as under;

- Net Present Value (NPV) : Rs. 6,191.98 million
- EIRR : 13.90 %

11 Sensitivity Analysis

The sensitivity analysis is required to be done through three different situations as;

Case –I : Cost increased by 15%

Case –II : Benefit decreased by 15%

As the base case EIRR is on lower side Case –III (Cost increased by 15% and Benefit decreased by 15%) has not been tried.

It has been observed that for Case-I and Case-II, the EIRR values work out to be 12.14% and 11.86% respectively, indicating more sensitivity towards reduction in benefits

12 Conclusion

The proposed peripheral road will provide improved connectivity with radial roads while acting as a bypass for Chennai city. Further with construction of the road, development of educational, health and commercial/ industrial activities around the corridor is anticipated. Moreover, new port development at Kattupalli, Petro-Chem Park, Greenfield Airport and Mahindra City will act as an impetus for full development of the peripheral road. Though the

EIRR value reaches only 13.90%, considering the above and other social and development benefits, the project may be considered to be viable.