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Worthiness of the Bus Rapid Transit System in Ahmedabad, India: Economic Cost Benefit Analysis Perspective

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Abstract

This paper analyses whether the Bus Rapid Transit System (BRTS) project in the city of Ahmedabad in the state of Gujarat in India is worth the investments (more than ten thousand million Indian rupees) it swallowed. The viability of transportation project being a public good has to be assessed using the economic cost benefit analysis method. Hence, in this paper, the variant of Kaldor-Hicks compensation criterion is taken for performing the economic cost benefit analysis of the project. The economic costs are derived by using the shadow pricing concept. The conversion factor of 0.90 is used to convert the project cost at market prices to the economic project cost. The vehicle operating costs, the monetary worth of the passenger commuting time, and the monetary worth of the air pollution are calculated for 'with project' case and 'without project' case. These are further used to evaluate the economic benefits. In the said project the economic benefits exceed the economic costs and using the discounted cash flow technique it is found that there is an economic IRR of 20.42 percent which is above the hurdle rate of 12 percent that is used by multilateral agencies for developing countries like India. The economic NPV of 7981.9 million INR and the economic Benefit Cost Ratio of 3.27 as well conveys the sound status of the project. The project also withstand the sensitivity test for the cases (i) increasing the capital expenditure by 25 percent, (ii) decreasing the benefits by 25 percent, and (iii) simultaneously increasing the capital expenditure and decreasing the benefits each by 25 percent.

*Keywords:*Economic Cost Benefit Analysis; Discounted Cash flow; Economic Viability; Urban Transport; Bus Rapid Transit System.

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1. Introduction

Generally, public investment decisions are to be made based on two types of analysis. Firstly, the economic cost benefit analysis which estimates the benefits and costs to the society, and secondly, the financial analysis which is carried out to assess the financial return on investment. It is observed that urban transport projects are capital intensive in

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nature and more often than not the financial viability of such projects remain elusive. However, one cannot undermine the significance of such huge investments on the grounds of financial un-viability as these projects provide a plethora of economic benefits to the society. Hence, such infrastructure projects essentially need to be analyzed from the lens of economic cost benefit analysis perspective.

The Bus Rapid Transit System (BRTS) project that got implemented in the city of Ahmedabad, Gujarat in India is one such public transport project which involved huge spending. BRTS is an integrated system of facilities, equipment, services and amenities that improves the speed, reliability and identity of bus transit. It comprises of the components such as dedicatedrunning ways for BRTS buses i.e. dedicated bus corridor, bus stations, depot, vehicles, Intelligent Transit Management System (ITMS). The project is operational since October 2009 under the aegis of Ahmedabad Municipal Corporation (AMC). The AMC is operating this service through the special purpose vehicle known as *Ahmedabad Janmarg Ltd* (AJL). The word *Janmarg* translates to 'Peoples' Way'. AJL is wholly owned subsidiary of AMC. BRTS project was implemented to reap the benefits of the efficient, faster, safe, and reliable intra city transport in the city of Ahmedabad. After the completion of all the phases, it has around 250 buses, 153 bus stations, and a total of 88 kilometer network.

In this paper an attempt is made to find whether the project can withstand the economic cost benefit analysis test. I.e. whether the economic benefits outweigh the economic costs this project imposes on the public. The economic cost benefit analysis is performed and the economic net present value (ENPV), economic internal rate of return (EIRR), and economic benefit cost ratio (EBCR) of the project free cash-flows are calculated to judge the health of the project. The subsequent sections shall elaborate the material and methods, review of literature, analysis, results, and conclusion pertaining to this study.

2. Material and methods

The economic viability of the project has been carried out by using the economic cost benefit analysis approach and Discounted Cash Flow (DCF) technique. The financial project cost has been determined using the market prices. The economic project cost has been computed by applying appropriate conversion factor to the financial project cost. This has been done to remove distortion due to externalities and anomalies in market pricing system so as to arrive at true cost to economy. The detailed discussion pertaining to economic project cost is specified in economic cost section of section 4 of this paper.

The project benefits have been computed through comparison of costs arising out of **'with project'** and **'without project'** scenario. For instance, in 'without project' scenario, the economic costs incurred by the economy in carrying the diverted traffic to proposed BRTS project by the alternative mode of transport viz., two wheeler, three wheeler, cars, and existing bus systems (AMTS) has been computed. Therefore, the economic benefits would arise due to savings in cost that would accrue to the economy by moving the project traffic over the alternate mode of transport. In addition, other social benefits that would accrue to the economy due to savings of direct/indirect costs namely, vehicle operation cost (VOC) savings, fuel savings, environmental pollution, maintenance cost, passenger time savings, etc. These have been computed using 'with project' and 'without project' scenario. These savings in social costs have also been considered to the extent that they are quantifiable. These social benefits have been computed based on economic prices instead of market prices. Shadow prices have been used to arrive at the economic costs/benefits. To arrive at the shadow prices, appropriate conversion factors of 0.90 (for converting market prices to economic cost) have been applied(Martin, 2004).

The pictorial representation of methodology of Economic analysis is specified in Figure 1. The CBA approach used is the one widely accepted and used by multilateral agencies and governments across the globe.

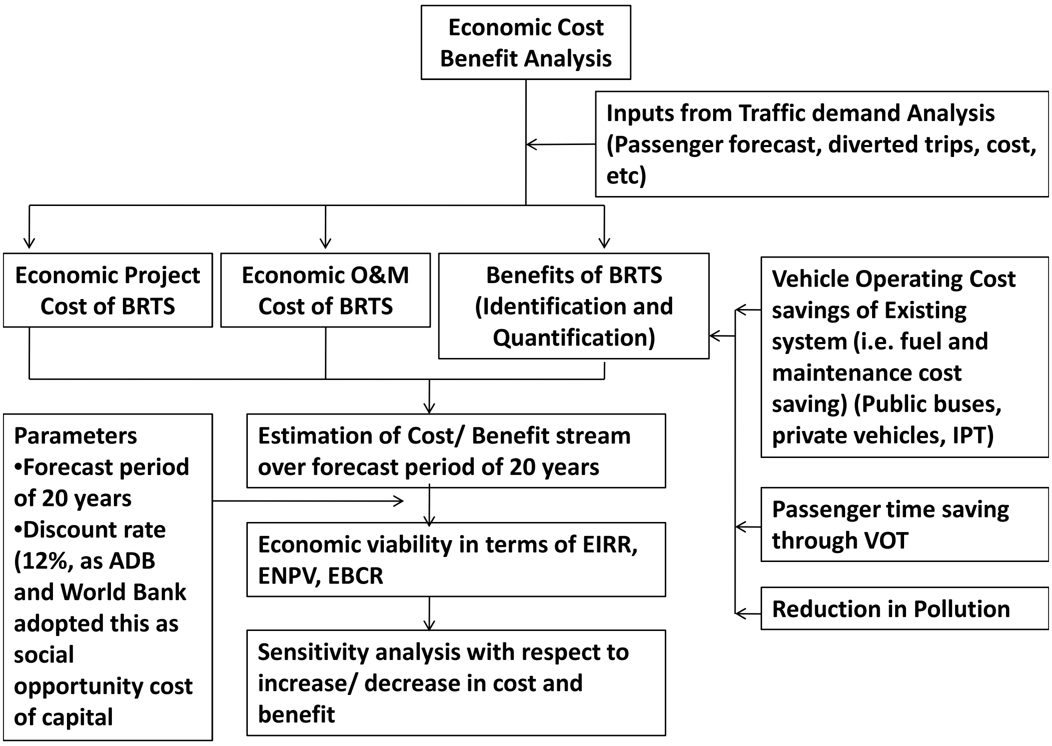

Figure 1: Flow Chart Depicting Approach and Methodology for Economic Cost Benefit Analysis Technique.

Source: Author

The annual stream of economic costs and benefits has been computed for analysis period of 20 years because system life is 20-25 years after which major maintenance/re-construction can be carried out. Further, uncertainty for making projection beyond 20 years is high and degree of predictability is lower beyond 20 years.

Economic viability has been undertaken using the Discounted Cash Flow (DCF) technique to obtain the economic internal rate of return (EIRR %), economic net present value (ENPV), and economic benefit to cost ratio (EBCR) for the proposed project. This is followed by a ‘sensitivity analysis’ 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. ENPV, EIRR, EBCR.

3. Literature review:

Cost benefit analysis (CBA) is an established technique that is widely used in both governments and international organizations like World Bank, International Monetary Fund, and OECD etc. Historically, it originated from Europe in the 1840s while appraising infrastructure projects in France (Mishan & Quah, 2007; OECD, 2006). CBA is one of the widely used ex-ante evaluation tool used to support the decision making process in transport sector too (Grant-Muller, Mackie, Nellthorp, & Pearman, 2001; Hayashi & Morisugi, 2000; Odgaard, Kelly, & Laird, 2005; Vickerman, 2007; cited in Mouter, 2014). Acccording to Mackie *et al.* (2014), "the CBA is a framework within which all impacts of a scheme or project can be brought together and compared using the money metric".

The roots of CBA are grounded in moral theories of 'Consequentialism'and 'Utilitarianism'. The former refers to the family of moral theories which hold that the consequences of a particular action decides for any valid moral judgment about that action. From the 'utilitarianism' viewpoint, the moral worth of an action is purely determined by its contribution to overall utility or for that matter to the social welfare. Hence, the projects with positive social welfare effect are to be implemented (Hansson, 2007; cited in Mouter, 2014).

When it comes to measuring changes in social welfare, two approaches namely- Pareto criterion and the Kaldor-Hicks compensation test criterion were the initial developments (Mouter, 2014). The Pareto criterion involves that the social welfare impact of a project is positive if it makes someone better off without making anyone worse off. On the other hand, Kaldor-Hicks compensation test criterion entails that the social welfare effect of a project is positive when the size of benefits is such that the gainers could compensate the losers, even though the compensation does not actually have to be carried out (Nyborg, 2012). However, both the approaches are bound with certain shortfalls. Pareto criterion never takes a stand when different people's interests conflict, irrespective of the matter how small or unimportant the conflict is. For instance, if one single person suffers an almost imperceptibly small cost, the Pareto criterion will classify the project as 'social welfare diminishing', even if it improves everyone else's situation dramatically. On the other hand, Kaldor-Hick compensation test is referred as the overcompensation test because the gainers can compensate the losers and have something positive left over (Nyborg, 2012; cited in Mouter, 2014). However, in today's world, across globe, a variant of Kaldor-Hicks test is applied in practice. This variant entails that the social welfare effect of a project is positive when the gains for the gainers exceed the losses for the losers. This approach eliminates the need to verfiy whether the gainers are potentially able to compensate the losers (Romijin & Renes, 2013; Kanemoto, 2011). In the present case as well the author has adopted a variant of Kaldor-Hicks test.

After World War II, the pressure for 'efficiency in government' necessitated in finding out the ways to ensure that public funds were efficiently utilized in all major public investments. This subsequetly paved the path for fusion of the new welfare economics, which was essentially CBA, and practical decision making (OECD, 2006). CBA found its acceptance not only among the governments but also among various international organizations- the OECD in 1969, the UN in 1975, and the World Bank in 1975 (Squire & Van der Tak, 1975). It was at the Earth Summit in Rio de Janeiro in 1992 that a call was taken that all countries looking for financial assistance for their public sector projects should be subjected to passing the CBA test as far as possible and this was applauded by many nations and wherever the funding came from multilateral agencies like the World Bank, International Monetray Fund, etc they ensured that CBA was conducted religiously.

Cost-benefit analysis, used in the evaluation of any project, studies the total effects on the state of the economy by involving a comparison of the economy 'with' the project and 'without' the project. *"CBA in transport can be seen as a way of civilising the process of handling conflicts inherent in deciding the level of funding at programme level, how scarce funding should be allocated within the programme and whether particular projects should proceed. Hence, the CBA framework and the values within it are important not just in their own right but also because they confer legitimacy to contested decisions"* (Mackie*et al.*, 2014).

CBA aims to encompass all effects that accrue from a transport project and aggregate all the information analyzed in the study in one final indicator namely; net present value, benefit-cost ratio and internal rate of return (Annema, et al., 2015). The strength of CBA lies in its unambiguity (Mackie*et al.*, 2014; Macharis & Bernardini, 2015; Beria*et al.*, 2012). This unambiguity made Beria *et al* (2012, p.148) and Brown and Ryan (2011, p. 230) to conclude that *'CBA is a common language known and used worldwide'* and *'CBA is widely used, firmly embedded in project project appraisal'* respectively. A very significant advantage of CBA is that it is a way to overcome cognitive, structural and process-related limitations and biases in decision making. In other words, CBA inculcates objectivity in decision making. CBA ensures that relevant information for stakeholders- different levels of government, infrastructure providers, operators, transport users, environmentalists and planners is brought together in one place and in one way which is specified in advance in the rulebook. Additing to it, use of CBA stems from the fact that it is not always politically rational to strive for the greatest common good (Mackie *et al.*, 2014).

4. Economic cost benefit analysis of the BRTS project

This section shall aim to find the economic costs and the economic benefits derived out of the BRTS project in the city of Ahmedabad.

4.1 Analysis period

In Ahmedabad, a total of 88.8 km of BRT corridor corresponding to 271 km length of routes, as reflected in Table 1, has been operational. The route length is greater than the length of the BRTS corridor due to the fact that common corridor up to certain points can be used for different routes. For instance, Route 1 - Chandkheda to Iskon and Route 2 - Chadkheda to Nehrunagar share common corridor from Chandkheda to Shivaranjani.

Table 1: Route kilometers for different BRTS routes

Sr No	Routes	Length in kms
1	Bopal to Maninagar	19.3
2	Science City Approach to Odhav	20.8
3	RTO to Maninagar	21.3
4	Zundal to Commerce 6 Road	20.9
5	Vasna to Naroda Gaam	21.9
6	Narol to Naroda Gaam	15.4
7	IIT to Narol	21.5
8	Iskcon to Naroda Gaam	20

9	Sola Civil to Maninagar	22.4
10	Cirular West - anti circular	25.6
11	Cirular West - circular	25.6
12	Town Hall to Odhav GIDC	13.1
13	RTO to Hatkeshwar (via CTM)	23.3
Total length of all routes		271.1

Source: Ahmedabad Janmarg Limited.

The approval schedule of BRTS project is presented in Table 2.The construction started in 2006 and the Pilot phase was made operational in October 2009. The stretches of phase 1 and phase 2 were added to the system thereafter and complete Phase 1 and Phase 2 was made operational since 2014. The actual traffic since beginning of the operation is presented in Table 3 below.

Table 2: Approval schedule for BRTS project

Phase	Length (in km)	Date of approval
Pilot	12.3	Aug 11,2006
Phase 1	46	Oct 6, 2006
Phase 2	30.5	Sep 5, 2008
All phases	88.8	

Source: Ahmedabad Janmarg Limited.

As observed, from Table 3, the system started operation in October 2009 and complete system was made operational in 2013-14. The analysis of BRTS project is carried out from the Construction period of Pilot stage (starting 2006) and Operational period of 20 years (starting 2009-10 and ending in 2028-29). The costs and benefits are estimated for this period.

Table 3: Implementation schedule and daily passenger traffic

	2009-10	2010-11	2011-12	2012-13	2013-14
Operational KM (length)	18.5	40.5	45	61	86
No of Bus Stations	25	60	67	93	127
BRT Buses under Operation	23	77	105	130	143
Average Daily Passenger Trips	28513	76785	114270	110000	135000

Source: Ahmedabad Janmarg Limited.

4.2 Ridership estimates

The ridership of the BRTS corridor has increased as new corridors have been added to the system. Total of 1,35,000 of passengers from buses, two wheelers, three wheelers have been shifted to BRTS in 2013-14. As per the AJL sources and industry experts opinion, this is owing to safety, speed and comfort (AC buses) benefits that the high quality BRT system would offer. A minor slump in passenger trips per day is observed for the years 2012-13 and 2014-15 due to significant higher BRTS fares compared to IPT players. Along with addition in BRTS corridor and a moderate growth in passenger traffic owing to increases in population and economic activity, the ridership demand in BRTS service is expected to increase to 0.281million trips per day in 2028-29. Ridership potential of around 0.25 to 0.26million trips per day is expected to be achieved with increased modal shifts from private modes by 2021 which is about 12 years after launch, beyond which ridership growth on a year on year basis should taper down and stabilize to about 1 per cent per annum. Table 4 specifies the ridership projection over an operation period of 20 years.

Table 4: Year wise daily BRTS passenger trips and its growth rate

Year	Daily BRTS Passenger Trips	% Growth in Passenger Trips	Year	Daily BRTS Passenger Trips	% Growth in Passenger Trips
2009-10	28513	-	2019-20	242053	7
2010-11	76785	169	2020-21	252899	4
2011-12	114270	49	2021-22	263826	4
2012-13	110000	-4	2022-23	265963	1
2013-14	135000	23	2023-24	268032	1
2014-15	128571	-5	2024-25	270034	1
2015-16	148515	16	2025-26	272892	1
2016-17*	176453	19	2026-27	275667	1
2017-18	203658	15	2027-28	278360	1
2018-19	227011	11	2028-29	280973	1

Source: Ahmedabad Janmarg Limited and Study estimates.
*Note: Year Wise Daily Passenger Trips estimated from 2016-17 year onward.

It is to be noted that Table 4 specifies potential ridership of the BRTS System in Ahmedabad City. However, many factors such as marketing, proper implementation, better services etc. impact ridership. The underlying assumptions such as in time project implementation; better services and effective marketing have been considered in estimation of ridership potential.

4.3 Rolling Stocks Requirement

The total fleet of 254 buses of different types is deployed for providing high speed bus services on dedicated corridor for the year 2015-16. This is specified in Table 5.

Table 5: Categories of buses run by AJL

Category of Bus (Rolling Stock)	Number
Non AC Diesel	65
AC Diesel	31
Non AC CNG Buses	35
High Quality AC Buses*	123
Total	254

Source: Ahmedabad Janmarg Limited.
*High Quality AC buses are AJL owned Buses and given to Operator for O&M in 2014-15 whereas rest are Operator owned Buses.

It is expected that AJL being a premier service, with an aim to provide better experience and comfort to its commuters, shall procure the 900 mm Low floor High Quality AC (Air Conditioned) Buses in future to meet the ridership demand and provide fast and comfortable experience to passengers.

Key inputs/assumptions, based on the past trends of Ahmedabad BRTS as well as similar systems world over, for estimating the rolling stock requirements are specified below.

- The present estimate is that each bus would be able to do around 200 km per day (Vehicle Utilizations). Vehicle Utilization is higher than that observed in city bus experience in the country owing to high speed dedicated BRT corridor.

- The present shorted average trip length of 8 km per passenger trip which would rise marginally over the years (1percent per annum) as proportion of commuters travelling longer distance shall increase.

- Speed of BRT Buses of around 28 km/hr and seat capacity of 60 per Bus (i.e Seating and Standing) is considered.

- Average daily load factor of 50 percent in year 2014-15 which is expected to stabilize at 60 percent from year 2021. This is slightly conservative estimates given the trends observed in public transit services.

- Total of 13 routes of 271 km with headway of 5 minutes and layover time of 5 minutes is considered.

Based on above mentioned points, the gross rolling stock requirement (including that of spare) of 254 buses are estimated in year of 2015-16 for BRT Service. The fleet requirement is expected to increase to approximate 300 in year 2023 due to requirement to cater to increased ridership. Beyond this period the growth in fleet requirement shall slower down. Table 6, indicates the fleet requirement for BRTS services.

Table 6: Gross fleet requirement during the operation period

Year	Passengers Trips per day	Gross Fleet (Including stand-by fleet)
Actual *(Source: Ahmedabad Janmarg Limited)*		
2009-10	28513	23
2010-11	76785	77
2011-12	114270	105
2012-13	110000	130
2013-14	135000	143
2014-15*	129000	254
Projection *(Source: Study estimates)*		
2015-16	148515	254
2016-17	176453	263
2017-18	203658	268
2018-19	227011	274
2019-20	242053	279
2020-21	252899	284
2021-22	263826	289
2022-23	265963	295
2023-24	268032	300
2024-25	270034	305
2025-26	272892	312
2026-27	275667	318
2027-28	278360	324

2028-29	280973	331

Source: Ahemdabad Janmarg Ltd for the years 2009-10 to 2014-15 and study estimates for the years 2015-16 to 2028-29.

*Additional Buses were deployed towards the end of the Financial Year

4.4 Financial project cost and expenditure

The project expenditure framework is conceptualized as follows.

1. *BRTS infrastructure development cost*: This Includes capital cost attached with development of BRTS Corridor, BRTS Bus Shelters, Depot, Sliding Doors, Terminal, Hardware/ Software for Intelligent Transport System.
2. *BRTS infrastructure maintenance cost*: This includes costs with regard to maintenance of BRT Infrastructure over operation period.
3. *Fleet purchase cost:* This includes capital costs for Rolling Stocks during the operation period.
4. *Existing financial situation of AJL*
5. *Projection of system running expenditure:* This includes rolling stock operation and maintenance cost, ticketing cost, control center operation cost, administration and salary cost. This also includes security, junction management and housekeeping expense.

4.4.1 BRTS infrastructure / asset development cost

The capital cost attached with development of BRT infrastructure is summarized in Table 7. The per kilometer infrastructure development cost comes around Rs 121 million.

Table 7: BRTS infrastructure development cost

Phase	Length (in km)	Financial Project Cost (Actual) (Rs million)*
Pilot	12.3	901.4
Phase 1	46	4961.9
Phase 2	30.5	4881.3
All phases	88.8	10744.6

Source: Ahmedabad Janmarg Limited.

*Project Cost includes corridor, Bus Stations, Depot, ITS, Sliding Doors

The phasing of the infrastructure development cost is shown in Table 8. It could be deduced that all the phases of the project got implemented in 2013-14 with a total infrastructure development cost of Rs 10740million for all the three phases. Pilot phase, Phase 1 and Phase 2 got completed in the years 2008-09, 2011-12, and 2013-14 respectively.

Table 8: Phasing of infrastructure development cost

Year				Rs in million
	Pilot	Phase 1	Phase 2	Total Financial Project Cost
2006-07	90			90
2007-08	360	500		860
2008-09	450	990		1440
2009-10		1240	490	1730

2010-11		1240	1220	2460
2011-12		990	1220	2210
2012-13			980	980
2013-14			980	980
Total	900	4960	4880	10740

Source: Ahmedabad Janmarg Limited.

4.4.2 Infrastructure maintenance cost

The BRT infrastructure needs to be maintained during the operation period. Thus costs with respect to maintenance need to be accounted for in financial and economic analysis. Key inputs/assumption for BRT Infrastructure cost is specified below.

Maintenance of civil components of BRTS: It is adopted as per industry standard. Annual maintenance at 1 per cent of construction cost for regular interval of five years. Above costs are escalated at average WPI of 5.4 per cent per annum[1].

Table 9: BRTS infrastructure maintenance cost

Year	BRT Corridor, Bus Stations and Depot Maintenance Cost (Rs in million)	Year	BRT Corridor, Bus Stations and Depot Maintenance Cost (Rs in million)
2014-15	107	2022-23	164
2015-16	113	2023-24	172
2016-17	119	2024-25	182
2017-18	126	2025-26	192
2018-19	133	2026-27	202
2019-20	140	2027-28	213
2020-21	147	2028-29	224
2021-22	155		

Source: Study analysis

Based on above assumptions/inputs infrastructure maintenance costs have been estimated and presented in Table 9. It covers civil works maintenance costs for the infrastructure components mentioned in the Table 9. There shall not be any infrastructure maintenance cost from the year 2009-10 to 2013-14 for the reason that the infrastructure developed is new one.

4.4.3 ITMS equipment replacement cost

The life of ITMS has been considered 7 years. This implies that ITMS system could be replaced at regular interval of 7 years.

Table 10: ITMS equipment replacement cost (Rs in million)

	2016-17	2023-24
Hardware	396	572
Software	134	193

[1] CAGR of WPI from 2005 to 2015

Fiber Optics Electronics	61	88
Total	591	853

Source: Study analysis

The present cost as specified in DPR is escalated at 5.4 percent to estimate the cost of ITMS. The seven year time span is calculated from the year 2009-10. The ITMS equipment replacement cost is shown in Table 10.

4.4.4 Fleet purchase cost

AJL adopted two models namely; Operator owned Buses, and AJL owned Buses for running Bus Services for BRTS Project. Prior to 2015-16, operator owned buses were deployed on Gross Cost Contract basis for providing bus services; whereas in 2015-16 AJL purchased High Quality AC Buses and gave to selected operator for its operation and maintenance on Gross Cost Contract basis. It is expected that the cost of the buses shall be financed by the AJL during the analysis period from 2015-16 onward. Prior to that the fleet procurement cost was not borne by AJL as the bus operators had procured the required bus fleet on their own. The fleet procurement cost is shown in the Table 11. A standard 900 mm AC bus costing Rs 5.5 million at present prices is expected to be used for BRT services. The BRT bus costs higher owing to the fact that it is a high quality bus characterized by the following features:

1. Higher quality buses would possess a higher engine capacity. Against standard practice of engines of 100-120 HP being used in the current services, the BRT Bus would use *more than* 200 HP for AC services. A higher engine capacity will give better acceleration versus a modest acceleration, resulting in faster average speeds. This leads to time saving for the passengers. However, due to a higher engine capacity, fuel efficiency (FE) in higher quality buses is often lower. Owing to the higher engine capacity, the fuel efficiency is expected to be lower at around at 3 km/ litre.
2. The bus will be 900 mm in terms of floor height. Lower floors give better stability to the standing passenger.
3. The buses have smoother rides due to better suspension. They also have better seats and better hand grips. This leads to lower impacts on riders and increases comfort level.
4. The buses are equipped with good quality IT systems such as GPS and passenger information systems. This allows for more effective passenger awareness of the system’s services, increasing the efficiency and comfort for the entire process.
5. The buses have more robust structural built quality, more precisely tuned mechanics, and better instrumentation level. This allows greater safety and a longer life. It is to be noted that life of a bus depends on a variety of factors such as maintenance, drive quality, extent of refurbishment etc. Considering that standard maintenance and refurbishment practice would be followed, the lives of the buses are considered as 12 years.

Escalation of 5.4 per cent per annum (as per CAGR of WPI for last ten years) is assumed in the price of buses during the operation period.

Table 11: Fleet procurement cost

Year	Additional Rolling Stocks Required during Projection Period	Replacement of Fleet at every 12 Years (no.)	Total Fleet to be Procured (no.)	Total Fleet Procurement Cost (Rs. in million)
2015-16	123	0	123	676.5
2016-17	0	25	25	145
2017-18	0	60	60	367
2018-19	1	67	68	374
2019-20	5	93	98	539
2020-21	5	127	132	726
2021-22	5	150	155	852.5
2022-23	6	0	6	33
2023-24	5	25	30	165
2024-25	5	183	188	1034
2025-26	7	67	74	407
2026-27	6	93	99	544.5
2027-28	6	125	133	731.5
2028-29	7	150	157	863.5

Source: Study analysis

4.4.5 Existing financial situation

In the case of Ahmedabad, the BRT System has been currently operating since 2009. The situation on operational income and expenditure during 2009-10 to 2013-14 is available from AJL's annual report and is summarized in Table 12. From the same table, it can be seen that the operational losses increased. This may be due to the account of absence of fare revision that effected for higher fuel prices. However, the deficit is expected to decline as the time passes on account of increased efficiency and future fare revision.

Table 12: Financial performance of AJL from 2009-10 to 2013-14

	2009-10	2010-11	2011-12	2012-13	2013-14
Operational KM	18.5	40.5	45	61	86
No of Bus Stations	25	60	67	93	127
No of Buses	23	77	105	130	143
Income (Rs in million)					
Fare Income	23.9	16.12	29.13	35.38	47.91
Advertisement Income	0	0.49	1.00	1.80	2.67
Other Income	1.9	1.07	1.46	6.92	2.5.2
Total Income	25.7	17.68	31.59	44.10	53.10

Expenses (Rs in million)					
Bus Hire Charges	38.4	170.5	288.4	408.7	524.0
ITMS and Fare Collection	13.6	52.4	32.9	42.8	56.5
Passenger Tax	0.3	1.6	2.9	3.5	4.0
Station House Keeping	0.6	2.5	3.8	5.8	9.1
Corridor Sweeping	0	0	0	1.2	2.8
Engineering Repairing	0	0	5.8	9.6	8.7
Tree Plantation	0	0.3	1.9	4.5	5.7
Admin and legal charges	7.3	10.0	16.0	13.8	24.4
Security and Junction Management Exp	11.3	31.9	31.1	40.2	49.8
Total Expenditure	71.5	269.2	382.8	530.1	685.0
Surplus /Deficit (Rs in million)	-45.7	-92.4	-66.9	-89.1	-154.0
Revenue per Bus Km (Rs.)	32.09	40.74	44.13	55.32	51.18
Cost per Bus Km (Rs.)	89.3	62.02	53.47	66.49	66.01
Difference (Rs)	57.21	21.28	9.34	11.17	14.83
Deficit (in %)	177.82	52.26	21.18	20.20	28.98

Source: Annual Reports of Ahmedabad Janmarg Limited. The audited financialstatements for the Financial Years 2014-15 and 2015-16 were not made public till date.

4.4.6 System running expenditure

The primary expenditure in running the BRTS would be bus related costs and other costs such as ITMS O&M and fare collection cost, Control center operation costs, administration and legal cost, housekeeping and junction management costs have been estimated using previous experiences in other BRT Systems.

Bus related costs:

The bus related costs are calculated through cost models for operation and maintenance of the buses by a private sector on a Gross Cost Contract basis. The bus related costs include operations and maintenance costs. It does not include capital investment cost as fleet requirement for later years including fleet replacement is expected to be financed by SPV.

The Bus O&M costs include fuel, staffing, insurance and accident claims, spares and consumables, motor vehicle tax, registration charges and office related expenditure. Presently AJL uses five different models for bus hire as shown in Table 13. Considering the deployment in Table 13, the blended rate for different kind of buses is found using the weighted mean as reflected in Table 14.

Table 13: Existing per kilometer rate for bus operations

Bus Type	Rate (Rs/Km) as on 2014	Deployed as on 2014
Existing Operator Owned Buses		
Non AC Diesel	47.51	50
Non AC Diesel	43.51	15
Diesel AC old	49.70	11
Diesel AC new	53.03	20
CNG	51.07	35
New High Quality Buses		
High Quality AC Buses	52.5	123
Total		254

Source: Ahmedabad Janmarg Limited

Table 14: Calculation of Blended Rate for Bus Operation (Rs/ Km)

Bus Type	Rate (Rs/Km) as on 2014	Deployed as on 2014	Proportion of deployed Buses	Rate (Rs per KM)
Existing Operator Owned Buses				
Non AC Diesel	47.51	50	20%	9.4
Non AC Diesel	43.51	15	6%	2.6
Diesel AC old	49.70	11	4%	2.2
Diesel AC new	53.03	20	8%	4.2
CNG	51.07	35	14%	7.0
New High Quality Buses				
High Quality AC Buses	52.5	123	48%	25.4
Total		254	100%	51.3

Source: Study analysis

It can be seen that the blended rate for different types of buses is evaluated as Rs 51.3 per km. This blended rate has been adopted for projection of Bus Operation Cost. Further, it has been observed that Fuel index has increased at 4.6 per cent whereas WPI for all commodities has increased at a rate of 5.35 per cent during 2005-2015. Same hasbeen adopted for projections and are reflected in Table 15.

Table 15: Projections of Bus Operations Cost

Year	No of Buses	No of Km (million Km)	Bus hire charge (Rs/ Km)	Total Bus Hire Charges (Rs million)
2014-15	150	1020.0	51.33	523.6
2015-16	250	1700.0	53.88	916.0
2016-17	250	1700.0	56.57	961.6
2017-18	255	1734.0	59.38	1029.7
2018-19	260	1768.0	62.34	1102.2
2019-20	265	1802.0	65.45	1179.4
2020-21	270	1836.0	68.71	1261.5
2021-22	275	1870.0	72.14	1348.9
2022-23	280	1904.0	75.73	1442.0
2023-24	285	1938.0	79.51	1540.9

2024-25	290	1972.0	83.48	1646.2
2025-26	296	2012.8	87.65	1764.2
2026-27	302	2053.6	92.03	1889.8
2027-28	308	2094.4	96.62	2023.7
2028-29	314	2135.2	101.45	2166.2

Source: Study analysis

ITMS and fare collection cost

ITMS and Fare Collection costs are estimated based on following inputs/assumptions.

- Existing ITMS Contract is expiring in 2016 and hence entire hardware and software needs to be replaced and re-installed.
- Hardware and Software maintenance cost is taken at a cost of 2 per cent of capital expenditure (capex) which can be escalated 4 per cent as per the prevailing contract documents for the ITMS Project.
- Further, Fare Collection Agency shall have to deploy manpower for fare collection in around 192 ticketing counters. For this purpose we have considered two shifts, minimum wages of Rs 11000 per month, service charges of 10 per cent and administration cost of 5 per cent.

Based on above consideration, ITMS and fare collection cost is determined in Table 16.

Table 16: Fare collection and ITMS operation cost

Year	Rs in million			
	Fare Collection Cost at BRT Bus Stations (A)	ITMS Hardware and Software Maintenance Cost (B)	Control Center Operation Cost (C)	ITMS O&M and Fare Collection Cost D=A+B+C
2016-17	78	23.6	30	132
2017-18	82	24.1	32	138
2018-19	87	24.6	33	144
2019-20	91	25.1	34	151
2020-21	96	25.6	36	157
2021-22	101	26.1	37	165
2022-23	107	26.6	39	172
2023-24	113	27.1	40	180
2024-25	119	27.7	42	188
2025-26	125	28.2	43	197
2026-27	132	28.8	45	206
2027-28	139	29.4	47	215
2028-29	147	30.0	49	225

Source: Study analysis

Housekeeping , security related cost, administration and other cost

The present cost of housekeeping, security and administration costs have been escalated of WPI of 5.4 per cent for analysis period. Based on above inputs/assumptions system running cost have been estimated and presented in Table 17.

Table 17: Projection of other costs

Year	A	B	C	D	E	F	Total (A+B+C+D+E+F)
	Rs in million						
2014-15	10	3	9	6	26	52	106
2015-16	10	3	10	6	27	55	112
2016-17	11	3	10	7	29	58	118
2017-18	11	3	11	7	30	61	124
2018-19	12	4	11	7	32	65	131
2019-20	12	4	12	8	33	68	138
2020-21	13	4	13	8	35	72	145
2021-22	14	4	13	9	37	76	153
2022-23	15	4	14	9	39	80	161
2023-24	15	5	15	10	41	84	170
2024-25	16	5	16	10	43	89	179
2025-26	17	5	16	11	46	94	189
2026-27	18	6	17	11	48	99	199
2027-28	19	6	18	12	51	104	210
2028-29	20	6	19	13	54	110	221

Source: Study analysis

Footnote: A=Station House Keeping Expenses, B= Corridor Sweeping Expenses, C= Engineering Repairing Expenses, D= Tree Plantation Expenses, E= Admin & Legal charges, F= Security and Junction Management Expenses.

It can be seen that bus hiring cost is the significant contributor (80 to 90 per cent) to system running costs followed by ticketing and control center operation expenses and housekeeping, junction management and security costs.

4.5 Economic project cost and expenditure

Here we shall derive the economic cost of various components described in the above section.The Economic project cost (i.e. capital cost) of the BRTS is calculated from the financial project cost on the following basis.

- Tax components are excluded from the financial project cost as it represents transfer payments.

- Interest during Construction (IDC) has been excluded from the financial cost.

On capital cost sides subsidies and market distortion including foreign exchange distortions are very difficult to evaluate. Therefore, the practice is to apply an overall conversion factor (CF) to cost figures to eliminate all possible distortions including foreign exchange distortions if applicable. ADB projects in the past have used in India a conversion factor (CF) equal to 0.90. Hence to eliminate all possible distortion owing to subsidies, wages of laborers and foreign exchange distortion, conversion factor equal to 0.90 have been used to arrive at Economic project cost. In similar fashion the CF of 0.90 is used to calculate economic costs for ITMS replacement and rolling stocks, and infrastructure maintenance and system running cost. These economic costs are reflected in the Table 18.

Table 18: Economic cost of various components of the project

Year	Economic Cost (Rs in million)						
	Project Cost	Rolling stock Cost	ITMS Replacement Cost	Infrastructure Maintenance Cost	System Running Cost		
					Bus Hiring Cost	ITMS Operation and Fare Collection Cost	Other O&M Cost
2006-07	80	0	0	0	0	0	0
2007-08	770	0	0	0	0	0	0
2008-09	1300	0	0	0	0	0	0
2009-10	1560	0	0	0	30	10	20
2010-11	2210	0	0	0	150	50	40
2011-12	1990	0	0	0	260	30	50
2012-13	880	0	0	0	370	40	70
2013-14	880	0	0	0	470	50	90
2014-15	0	0	0	96.7	471.2	53.6	95.3
2015-16	0	609	0	101.9	824.4	56.5	100.5
2016-17	0	130	532	107.4	865.5	125.7	105.9
2017-18	0	330	0	113.2	926.7	132.5	111.6
2018-19	0	337	0	119.3	992	139.6	117.6
2019-20	0	485	0	125.8	1061.4	147.2	124.0
2020-21	0	653	0	132.5	1135.4	155.1	130.7
2021-22	0	767	0	139.7	1214.0	163.5	137.7
2022-23	0	30	0	147.2	1297.8	172.3	145.1
2023-24	0	149	768	155.2	1386.8	171.7	153.0
2024-25	0	931	0	163.5	1481.6	181.0	161.2
2025-26	0	366	0	172.4	1587.8	190.7	169.9
2026-27	0	490	0	181.7	1700.9	201.0	179.1
2027-28	0	658	0	191.4	1821.3	211.8	188.7
2028-29	0	777	0	201.8	1949.6	223.3	198.9
Total	967	6712	1300	2149.7	19996.4	2505.5	2389.2

Source: Study Analysis

4.6 Estimation of economic benefits of BRTS project

As discussed, in the Material and Method section above in this study, the BRTS project will accrue tangible and non-tangible benefits due to diversion of passenger trips from alternate modes of transport like auto rickshaws, 2-wheelers, cars, and AMTS to the BRTS system. As a result, there will be reduction in number of passenger vehicles with introduction of BRTS and this in turn will reduce congestion. This will also lead to savings in Vehicle Operating Cost due to modal shift of vehicles and savings in indirect cost such as passenger time savings, accident reduction benefits and pollution reduction benefits. The introduction of BRTS project could result in numerous direct and indirect benefits such as lower vehicle operating costs, passenger time saving in commuting, reduction in air pollution, reduction in accidents, better access to workplace due to transit oriented development (TOD), economic impetus to micro region, overall increased mobility, better urban planning, benefits due to betterment of city image, etc.

While impacts can be quantified using proxies and estimates when necessary, we need to bear in mind that certain impacts could be difficult to capture due to the fact that there is absence of universally accepted methods. The crucial three benefits namely; benefits due to savings in vehicle operating cost, benefits due to savings in passenger commuting time, and benefits due to reduction in pollution are taken into account for this paper and are elaborated hereafter at length. In fact, the benefits out of these impacts are the major ones in any urban transport project.

Introduction of BRTS results in reduction in usage of private vehicles, reduction in air pollution, and increase the speed of road-based vehicles. This, in turn, will result in significant economic benefits due to reduction in fuel consumption, vehicle operating cost and travel time of passengers. Reduction in accidents, pollution and road maintenance costs are the other benefits to the society in general.

4.6.1 Benefits due to saving in vehicle operating cost

The vehicle operating cost for mixed traffic have been computed for ‘with project’ and ‘without project’ option to derive benefits due to saving in vehicle operating cost for mixed traffic. VOC benefit of mixed traffic (B_{VOCMT}) is represented as shown below.

$B_{VOCMT} = VOC_{MTWithout\ Project} - VOC_{MT\ With\ Project.}$

Here,

$VOC_{MTWithout\ Project}$ = VOC of mixed lane traffic ‘without project’ case (i.e. Base case).

$VOC_{MT\ With\ Project}$ = VOC of mixed traffic ‘with project’ case.

VOC is a function of speed, road roughness, carriageway, and width/ capacity, and rise and fall of the road. VOC per kilometer for various modes of transport at different speed of vehicles are given in Road User Cost Study (RUCS)- 2001 by Central Road Research Institute (CRRI). VOC per kilometer for different modes of the commutation are multiplied by the mode wise total vehicle kilometers run in a year to get the mode wise VOC per year. The speed of different modes of vehicle ‘without project’ case are lower than the speed of the different modes of vehicle ‘with project’ case. Hence, there shall be benefits due to saving in VOC of mixed traffic as $VOC_{MTWithout\ Project}$ is greater than $VOC_{MT\ With\ Project.}$

Similarly, benefits due to savings in VOC of modal shift due to the diverted trips from various modes of commutation to the BRTS are shown here under. Here, VOC_{MS} is calculated as explained in the above paragraph. BRTS bus Operation and Maintenance (O&M) cost is derived from the financial O&M cost. As per the prevailing practice, only real prices have been considered in computation of economic bus O&M estimates. The conversion factor equal to 0.9 is applied on financial O&M cost to arrive at economic bus O&M estimates.

$B_{VOCMS} = VOC_{MS} - VOC_{BRTS}$

Here,

VOC_{MS} = VOC of various modes of commutation like shared auto rickshaw, AMTS, 2-wheelers, and AMTS from which the trips got shifted to BRTS project.

VOC_{BRTS} = VOC of BRTS ‘with project’ case.

The total benefits due to saving in VOC shall be
$B_{VOC} = B_{VOCMT} + B_{VOCMS}$

4.6.2 Benefits due to saving in passenger commuting time

The passenger commuting time for ‘without project’ and ‘with project’ cases are calculated for mixed lane traffic and the modal shift. The vehicles plying on the mixed lane in ‘without project’ case will witness lower speed compared to ‘with project’ case. This is so because, ‘without project’ case the speed of the vehicles plying on mixed lane deteriorates faster than the one witnessed in ‘with project’ case.
The monetary worth of the passenger commuting time is the product of vehicle operating time, vehicle occupancy factor and value of passenger time. The monetary worth of the benefits due to reduction in passenger commuting time (B_{PCTMT}) for the commuters travelling on the mixed lane are as follows.

$B_{PCTMT} = PCT_{MT\ Without\ Project} – PCT_{MT\ With\ Project}$
Here,
$PCT_{MT\ Without\ Project}$ = the monetary worth of the passenger commuting time while they commute on mixed lane in ‘without project’ case.
$PCT_{MT\ With\ Project}$ = the monetary worth of the passenger commuting time while they commute on mixed lane in ‘with project’ case.

Here, $PCT_{MT\ With\ Project}$ smaller than $PCT_{MT\ Without\ Project}$ indicates that the passenger saves time in commuting on mixed lane ‘with project case’.
Similarly, time savings to passengers shifting from other modes to the BRTS owing to better speeds in BRTS case as compared to speeds of other vehicles in base case. (i.e two wheelers, three wheelers, cars, AMTS bus) is calculated for deriving benefits due to saving in passenger commuting time for the modal shift case.

$B_{PCTMS} = PCT_{MS\ Without\ Project} – PCT_{BRTS}$
Here,
$PCT_{MS\ Without\ Project}$ = the monetary worth of the passenger commuting time for the passengers which shifted to the BRTS, if they were to commute in other modes of commutation if BRTS was not there.
$PCT_{MS\ With\ Project}$ = the monetary worth of the passenger commuting time for the passengers commuting on BRTS.

The time value of passenger travelling by different modes is taken as an average of Rs 140 per hour for working trips and Rs 42 per hour for non-working trips. Here the hourly rate for work related trips is calculated from the primary survey conducted and the non work related hourly rates are taken as 30 percent of the hourly rate for work related trips. This is essentially the practice adopted by the World Bank as well.

The total benefits due to savings in passenger commuting time is as mentioned below.
$B_{PCT} = B_{PCTMT} + B_{PCTMS}$

4.6.3 Benefits due to reduction in air pollution

Implementation of project leads to reduction in vehicles plying on mixed lane owing to modal shift. This leads to improvement in fuel efficiency and reduction in congestion and therefore savings in carbon emission. Modal shift also leads to reduction in vehicle kilometers by other modes.

Vehicle wise per kilometer emission norms specified in India Infrastructure Report, 2010," "Infrastructure Development in Low Carbon Economy" is adopted to calculate the carbon emission.

The price of per ton of CO_2 is considered as €4.70 which was carbon trading price in spot market in European Energy Exchange as on 27th August, 2016. The rate can be converted to Rs. 353.29/ ton with exchange rate of €1=Rs. 75.17 as on the above date. Refer Table 19 and Table 20 for further understanding.

A benefit due to reduction in air pollution due to modal shift is calculated as below.

$B_{RAPMS} = AP_{MS\ Without\ Project} - AP_{BRTS}$

Here,

$AP_{MS\ Without\ Project}$ = Monetary worth of the air pollution by different modes of the vehicle for the modal shift 'without project' case. If BRTS was not there, how many different vehicles would have been required and what amount of pollution they would have created.

AP_{BRTS} = Monetary worth of the air pollution by BRTS for the 'with project' case.

Here there shall be benefits accrued only when the AP_{BRTS} is lower than the $AP_{MSWithout\ Project}$.

Here, the study has not taken the benefits due to reduction in air pollution in mixed lane traffic with the project case because the total kilometer on mixed lane for 'with project' and 'without project' are same and the air pollution figures based on the speed of vehicles is not known.

Table 19: Emission factor per vehicle kilometer based on the mode of commutation

Mode	Carbon emissions in grams / Vehicle km	Carbon Emission in Tonnes/ vehicle km
Sc/Mc	25.8	0.0000258
Auto Rickshaw/Tempo	173.9	0.0001739
Car/Jeep/Van (Taxi)	155.7	0.0001557
Car/Jeep/Van (Private)	131.9	0.0001319
Std Bus	950	0.00095

Source: India Infrastructure Report 2010

Table 20 Value of carbon emission per tone

Value of 1 tonne of CO_2 in euro traded at European Energy Exchange (As on 27th August, 2016)	4.7
Exchange Rate Euro to INR (As on 27th August, 2016)	75.17

Value of 1 tonne of CO2 - Total in INR	353.299

Source:www.eex.com

4.6.4 Summarizing the Economic Benefits

The summary of the benefits derived out of the savings in vehicle operating cost, passenger commuting time, and air pollution are reflected in the Table 21.

Table 21: Summary of Economic Benefits

Year	Benefits (*Rs in million)*		
	VOT Savings B_{VOT}	PCT Saving B_{PCT}	Savings due to Pollution Reduction $B_{RAP} = B_{RAPMS}$
2009-10	157	83	1
2010-11	375	164	2
2011-12	698	308	4
2012-13	598	137	3
2013-14	1004	270	4
2014-15	1038	158	3
2015-16	1418	-87	2
2016-17	2004	207	3
2017-18	2739	413	4
2018-19	3619	766	5
2019-20	4558	732	6
2020-21	5515	990	6
2021-22	6666	1171	6
2022-23	8744	1368	7
2023-24	9868	1998	6
2024-25	11289	1935	6
2025-26	12868	2021	6
2026-27	14665	2734	6
2027-28	16699	2852	6
2028-29	19056	4209	6
Group Total	123575	22426	91
Grand Total of Benefits		146092	

Source: Study Analysis

5. Result of Economic Cost Benefit Analysis

To sum it up, the benefits accrued due to saving in VOC, PCT, and air pollution is shown in the Table 21. It could be deduced that 84.59 percent of total benefits are accrued out of savings in PCT and 15.35 percent of the benefits are contributed by savings in VOC. A meager 0.06 percent contribution toward benefits is attributed to pollution reduction saving.

As discussed in the section 4.5 and 4.6 above, the costs and benefits streams for the twenty three years period in economic prices have been estimated. Further, the Discounted Cash Flow (DCF) technique has been used. Discount rate of 12 per cent has been used to determine present value of economic costs and benefits. The present value of economic cost and benefits are specified in Table 22 for BRTS project option. The largest benefits accrue out of saving in passenger commuting time due to lower passenger commuting time 'with BRTS' case.

Table 22: Present Value of Economic Costs and Benefits

Particular	Amount (Rs million)
Economic Cost of Project	
Capital Cost	6936.8
Maintenance & System Running Cost	4810.3
Total Cost (A)	**11747.1**
Economic Benefits	
Savings in Vehicle Operating Cost	3056.2
Savings in Passenger Commuting Time	16653.5
Benefits due to Pollution Reduction	19.2
Total Benefits (B)	**19729.0**
NPV (B-A)	**7981.9**

Source: Study analysis

The outcomes of the economic cost benefit analysis for BRTS Project using the assumptions discussed and calculations computed in previous sections is presented below:

Description	Economic IRR for Analysis Period
Economic IRR (EIRR) Considering all economic benefits and Costs.	**20.42%**
Economic Benefit to Cost Ration (EBCR)	**3.27**

Thus the project as a whole is found to be economically viable with positive net present values and EIRR greater than 12 percent. The hurdle rate (i.e. the social opportunity cost of capital) considered for social projects in India is 12 per cent. The BCR too is very sound in this case. The project banks upon high ridership level and savings of travel time of the commuters.

5.1 Outcome of economic cost benefit analysis under sensitivity test

The outcome of the economic appraisal specified above is based on estimated values of project cost and benefits. The economic viability of the project to a large extent depends on realization of these estimated values. Thus it is prudent to ascertain the effect of increase/decrease of certain critical factors such traffic and fuel cost on economic viability of the project. Thus sensitivities test has been carried out. The outcome of the economic viability under various sensitivity tests are presented in Table 23.

It can be depicted from the Table 23 that under the different sensitivity tests, EIRR is determined more than 12 per cent; indicating sound condition of the project. The project is relatively more sensitive to reduction in the total benefits which are mainly dependent on the ridership than to increase in project and operation and maintenance costs. The likelihood of Scenario 3 may be very negligible. However, even in such scenario the EIRR is higher than the hurdle rate of 12 per cent and ENPV and EBCR both are favourable.

Table 23: Economic viability of project under different sensitivity tests

Scenario	Sensitivity Parameters	Economic IRR	Net present value (ENPV) @ 12% discount rate (Rs in million)	Economic Benefit -Cost Ratio
1	Increase in Project Cost and O&M cost by 25%.	16.76%	5045.1	2.61
2	Reduction in Benefits by 25%.	15.71%	3049.6	2.45
3	Reduction in Benefits by 25% and Increase in cost by 25%	12.12%	112.8	1.96

Source: Study analysis

6. Conclusion

Although the BRTS project does not withstand the financial viability, the rational for such capital intensive projects cannot just be eliminated on the grounds that the project is financially unviable. Such project which is meant to provide the public goods (urban public transport services) has to be evaluated for the larger social and economic benefits that it renders to the society. Hence, the economic cost benefit that is being performed upholds the viability of the project from the socio-economic view point. The EIRR of 20.42 percent is above the hurdle rate of 12 percent that is used by multilateral agencies for developing countries. The Economic Net Present Value of Rs 7981.9 million and the Economic Benefit Cost Ratio of 3.27 as well conveys the sound status of the project. The project also withstands on all this parameters for the sensitivity analysis that is conducted with the scenario ‘increase in project cost and O&M cost by 25 percent’, ‘reduction in benefits by 25 percent’, and ‘increase in project cost and O&M cost by 25 percent and reduction in benefits by 25 percent simultaneously’. In all the scenarios, the ENPV, EIRR, and EBCR have not been on the danger zone. This essentially reflects that the project is viable from the socio-economic view point.

Also, adding the benefits of accident reduction, benefits of reduced ailments due to reduction in air pollution, and the other benefits like improved mobility due to TOD development, increased tax revenues due to enhancement of the market values of commercial and residential properties in the catchment area of BRTS corridor, improved city’s image, etc will even strengthen the case in support of such project.

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