ECONOMIC ANALYSIS

A. Introduction

1. Greater Dhaka is one of the fastest growing megacities in the world. Its population has more than doubled from 2000 to 2010 and it is projected to grow from 17 million in 2012 to 25 million in 2025. It is also one of the most densely populated city in the world, with 45,508 people per square kilometer in the core area. The project area's current traffic is characterized by the following modal split: (i) 22% of trips are made by private modes; (ii) 40% are made by public transport, i.e., buses; and (iii) 38% are non-motorized, made on foot or by cycle-rickshaws. The high level of congestion and pollution result from (i) rapid motorization; (ii) the weak road network accounting for only 10% of the urban area when the required ratio is 25%; (iii) weak traffic management to organize the dense and anarchical mix of many competing modes; (iv) lack of transport demand management; and (v) inefficient public transport services. Car ownership and usage are still low but with annual growth of 8%, there could be up to half a million cars in 2025.

2. Public transport in Dhaka is inadequate and of poor quality. An estimated 4,858 large and mini buses run through the project corridor, 25% of which do not have a proper permit. Those buses are shared between 38 intercity routes and 61 licensed city routes. The city routes are operated by 45 companies, mostly private. The bus fleet is in a critical condition, bus stops are rudimentary and do not provide passengers with information on schedule, itinerary or connections, the ticketing system is not developed, and operators compete for passengers, worsening congestion and impairing safety. The situation in road-based traffic collisions is deteriorating, mostly affecting pedestrians (thus the poorest) who represent more than half of road accident fatalities in Dhaka North City Corporation (DNCC) and Gazipur City Corporation's (GCC) streets.

B. Rationale

3. The rationale for intervention is based both on the failure of (i) the market to adequately provide what passengers require, and (ii) public institutions to deliver public services efficiently and economically.[1]

4. The basic project assumptions are as follows:
   (i) corridor total length is 20.15 kilometers (km);
   (ii) system includes 31 stations and two terminals;
   (iii) 312 average working days in a year, essentially six days per week;
   (iv) daily operation schedule lasts 16 hours; and
   (v) peak hours cover 9% of total daily demand.

C. Demand Analysis

5. The passenger demand was estimated using a transport model taking into account the
   (i) origin and destination matrix,
   (ii) traffic counts,
   (iii) population growth estimated at 1.7% per annum,
   (iv) real gross domestic product (GDP) growth estimated at 5% per annum, and
   (v) passenger demand growth at 3.0% per annum.

[1] Bus service monitoring by the regulators, BRTA (Bangladesh Road Transport Corporation) and DMRTC (Dhaka Metropolitan Regional Transport Committee), is notably ineffective.

6. Table 1 shows passenger volumes by bus type in the project area.

Table 1: 2011 Passenger Volume (number of persons)

Site	From Dhaka				To Dhaka			
	LB	MB	A-R	Total	LB	MB	A-R	Total
Chowrasta–Joydevpur Road east of Gazipur Chowrasta	6,790	33,531	3,488	43,809	6,591	31,085	4,555	42,231
Dhaka–Mymensingh Road (N3) south of Gazipur Chowrasta	50,947	58,260	4,975	114,182	52,236	59,008	1,500	112,744
Dhaka–Mymensingh Road (N3) south of National University	50,155	51,578	676	102,409	57,319	56,805	384	114,508
Dhaka–Mymensingh Road (N3) south of Cherag Ali Market	49,653	64,889	424	114,966	60,337	70,103	124	130,564
Dhaka–Mymensingh Road (N3) at Tongi Bridge	73,883	72,832	3,300	150,015	72,491	78,891	2,136	153,518
Dhaka–Mymensingh Road (N3) at international airport	78,692	88,708	0	167,400	99,937	100,632	134	200,703
Dhaka–Mymensingh Road (N3) north of National University	42,127	50,695	494	93,316	44,203	45,629	466	90,298
Dhaka–Mymensingh Road (N3) south of National University	42,395	44,894	255	87,544	47,380	49,787	115	97,282

LB = large bus, MB = medium-sized bus, A-R = Auto-Rickshaw.
Source: Project preparatory technical assistance and Asian Development Bank fact-finding mission estimates, 2011.

7. Table 2 shows the projected passenger demand for public transport (or estimated ridership) along the project corridor.

Table 2: Projected Passenger Demand (number of persons)

Item	2014	2019	2024	2034
Bus rapid transit	114,300	257,145	325,730	525,987
Conventional buses	392,644	430,022	469,345	372,591
Total Demand	**506,944**	**687,167**	**795,075**	**898,578**

Source: Project preparatory technical assistance and Asian Development Bank fact-finding mission estimates, 2011.

D. Project Alternatives

8. At project initiation, the Government of Bangladesh requested the Asian Development Bank (ADB) to analyze six main traffic corridors and select the most appropriate corridor to accommodate the implementation of a pilot mass transit system. Because of ongoing construction, the analysis did not include one of the corridors. The analysis was carried out based on five criteria—operational practicability, immediate implementation, urban and environmental impact, social benefits, and stakeholder support. The highest scoring corridor was the Gazipur–Tongi–Uttara.

9. On this corridor, four route service scenarios were identified. Through a preliminary cost–benefit analysis, the route connecting Gazipur to the airport, meeting the highest demand volume in terms of demand per kilometer and coverage, was selected for about 8 km out of the 20 km corridor. Further to long-term demand horizon considerations linked to other bus rapid transit (BRT) projects, a design for two dedicated BRT lanes in each direction was elected. Finally, to avoid significant destruction on the existing urban environment surrounding the corridor and the ensuing social and implementation issues, the corresponding section of BRT lanes will be elevated although higher construction costs are incurred. By choosing the elevated option, additional resettlement costs estimated at $16 million are avoided, but more importantly, the project becomes socially and politically acceptable to local authorities and the population.

E. Costs and Benefits

10. The economic internal rate of return and net present value were estimated with the following assumptions: (i) the project implementation period is 5 years from 2012, (ii) the evaluation period is 30 years from commission, (iii) the discount rate is 12.0%.

11. Economic costs include (i) investment costs, (ii) recurrent annual maintenance cost at 2.5% of the investment cost, and (iii) BRT buses operating costs. Economic costs were converted from the financial costs based on (i) a shadow exchange rate factor of 1.09 applied to tradable inputs, (ii) a shadow wage rate conversion factor of 0.7 for local unskilled labor, and (iii) a shadow wage rate conversion factor of 0.9 for local skilled labor.

12. Three different assumptions for the investment costs were applied in the analysis: (i) direct BRT costs, meaning costs strictly necessary for the construction and future operation of the BRT; (ii) BRT costs and ancillary costs, which comprise the drainage works, sidewalk improvements, and other works along the BRT corridor; and (iii) the full project cost, which breaks down into BRT costs, ancillary costs, and the widening of the Tongi bridge (which was to be carried out without the project, but is now included in its scope).

13. Economic benefits include (i) savings in vehicle operating costs, (ii) journey time savings, and (iii) increase in land value.

14. Table 3 shows the economic benefits expected from the project.

Table 3: Economic Benefits

Benefit	Assumptions
Savings in vehicle operating costs	Seven bus routes eliminated and four bus routes shortened
	Vehicle operating cost: $0.38 per vehicle-kilometer
Journey time savings	Current traffic speed is 12 kilometers per hour
	BRT commercial speed is 25 kilometers per hour
	Reduced waiting time: 5 minutes per passenger
	Value of time:[a] Tk21 per hour
Increase in land value[b]	Bandwidth considered along corridor: 500 meters
	Average land value: $237 per square meter
	Project-related land value increase: 1% per annum over 2 years

BRT= bus rapid transit, Tk = taka.

[a] Different sources were used to estimate the value of time: (i) Valuation of Travel Time Savings: I.T. Transport Ltd. 2005. *Empirical Studies in Bangladesh, Ghana, and Tanzania and a practical model for developing countries*. Washington. Funded by the Department for International Development of the United Kingdom; (ii) Bangladesh Institute of Development Studies. 2009. *An Analysis of Real Wage in Bangladesh and Its Implications for Underemployment and Poverty*. Dhaka. ; and (iii) value of time used in recent transport projects in Bangladesh.

[b] The rationale for including the increase in land value in the economic analysis is based on the opportunity to create both business and residential development nodes through urban densification along BRT corridors. Scottish Executive. 2004. *Developing a Methodology to Capture Land Value Uplift around Transport Facilities*. Edinburgh. The document examines empirical evidence of investments in transport and increased land values. The report finds that (i) the expected effect on both the residential and commercial property markets is positive, but the range of impacts is very variable, from marginal to over 100% in the commercial sector from the North American evidence; (ii) changes will take place in land and property values in advance of the completion of the transport investment as developers and house builders will invest in the expectation of improvements in the transport infrastructure; effects might also be expected immediately after the transport investment is opened, and in the future as the full benefits are recognized; (iii) depending on the investment, extension of residential impacts could be of 1,000 meters, while those for commercial developments are likely to be concentrated in an 800 meter radius; (iv) rapid transit tends to accentuate existing trends—if an area is undergoing an expansion or boom period, rapid transit can accentuate the expansion; and (v) the "land use–transport feedback" cycle is more notable where accessibility is scarce, particularly in big congested, traditional cities.

Source: Project preparatory technical assistance and Asian Development Bank fact-finding mission estimates, 2011.

15. Table 4 shows the Economic Cost-Benefit Analysis for the project.

Table 4: Economic Cost–Benefit Analysis

	Net Benefits		
Item	**BRT**	**BRT and Ancillary Facilities**	**Full Project**
Net present value ($ million)	69.08	59.94	35.06
Economic internal rate of return (%)	18.40	17.20	15.10

BRT = bus rapid transit.
Source: Project preparatory technical assistance and ADB fact-finding mission estimates, 2011.

16. The high economic internal rate of return (EIRR) is mainly due to the significant time savings brought about by a dedicated corridor in a highly congested city as well as the relatively limited infrastructure cost.

F. Sensitivity and Risk Analysis

17. Sensitivity analysis was undertaken for each investment assumption (Tables 5–7).

Table 5: Sensitivity Analysis Results for Bus Rapid Transit Only

Item	**EIRR** (%)	**NPV** ($ million)	**Switching Value** (%)
Base case	18.40	69.08	
10% increase in capital costs	16.50	53.90	44.70
10% increase in O&M expenses	17.90	64.22	142.10
10% decrease in benefits	15.90	42.13	25.70
1-year delay in project completion	15.10	39.82	

EIRR = economic internal rate of return, NPV = net present value, O&M = operation and maintenance.
Source: Project preparatory technical assistance and Asian Development Bank fact-finding mission estimates, 2011.

Table 6: Sensitivity Analysis Results for Bus Rapid Transit and Ancillary Facilities

Item	**EIRR** (%)	**NPV** ($ million)	**Switching Value** (%)
Base case	17.20	59.94	
10% increase in capital costs	15.50	43.84	37.00
10% increase in O&M expenses	16.80	55.08	123.40
10% decrease in benefits	14.90	32.99	22.30
1-year delay in project completion	14.20	30.67	

EIRR = economic internal rate of return, NPV = net present value, O&M = operation and maintenance.
Source: Project preparatory technical assistance and Asian Development Bank fact-finding mission estimates, 2011.

Table 7: Sensitivity Analysis Results for Full Project

Item	**EIRR** (%)	**NPV** ($ million)	**Switching Value** (%)
Base case	15.10	35.60	
10% increase in capital costs	13.50	18.71	21.40
10% increase in O&M expenses	14.60	30.20	72.20
10% decrease in benefits	12.90	10.34	14.20
1-year delay in project completion	12.50	6.94	

EIRR = economic internal rate of return, NPV = net present value, O&M = operations and maintenance.
Source: Project preparatory technical assistance and Asian Development Bank fact-finding mission estimates, 2011.

18. The most sensitive risk factor is the 1-year delay in project completion. Advanced measures have been initiated to improve project readiness and prevent any slippage in the planned project implementation schedule.

19. The EIRR was also calculated without including the increase in land value as an economic benefit. The result shows that the EIRR remains solid without this benefit (Table 8).

Table 8: Economic Cost–Benefit Analysis Without Increased Land Value

	Net Benefits		
Item	**BRT**	**BRT and Ancillary Facilities**	**Full Project**
Net present value ($ million)	36.74	27.60	2.73
Economic internal rate of return (%)	14.80	14.00	12.20

BRT = bus rapid transit.
Source: Project preparatory technical assistance and Asian Development Bank fact-finding mission estimates, 2011.

G. Other Benefits

20. A valuation of the health benefits resulting from a decrease in pollutant emissions has been undertaken under the project preparatory technical assistance, and the results have been incorporated in the economic analysis. The quantification of the health benefits have been carried out using the following methodology: (i) measuring changes in emissions (including greenhouse gases); (ii) measuring changes in fine particulate matter air quality; (iii) estimating changes in health outcomes; and (iv) valuing the avoided cases of morbidity and mortality, specifically avoided incidents in chronic bronchitis and avoided deaths for population under 5 years old and above 30 years old.

21. The health benefits in terms of avoided deaths could not be captured for people aged 5–30 because of the unavailability of information (concentration-response functions) for that age range. In Bangladesh, this represents about 53% of the population.

22. Table 9 shows the results of the economic cost-benefit analysis, including health benefits.

Table 9: Economic Cost–Benefit Analysis with Health Benefits

	Net Benefits		
Item	**BRT**	**BRT and Ancillary Facilities**	**Full Project**
Net present value ($ million)	80.52	71.37	46.50
Economic internal rate of return (%)	19.20	18.00	15.90

BRT = bus rapid transit.
Source: Project preparatory technical assistance and Asian Development Bank fact-finding mission estimates, 2011.

23. Several other benefits have not been quantified in this analysis because of the unavailability of reliable information such as (i) reduced congestion on the project corridor as bus routes will be gradually eliminated from the existing road; and (ii) a decrease in vehicle and pedestrian accidents caused by improved road infrastructure (sidewalks and underpasses, dedicated bus lanes) as well as improved bus driving discipline.

24. Additionally, an extension of the proposed BRT to Dhaka is being considered by the World Bank, which is currently preparing the feasibility study. The combined benefits of the full corridor will be very significant and have only been partly taken into account in the analysis through the passenger demand. Meanwhile, costs that will cover the needs of the BRT extension are included in the project. For instance, the 5-year operational cost of the special project organization during construction is covered under this project. This support is required as the establishment of this new entity will involve substantial work. However, when the BRT extension will be commissioned, the same special project organization will operate the complete BRT corridor with little incremental cost.