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Ministry of Communications
Roads and Highways Department

INSTITUTIONAL DEVELOPMENT COMPONENT
for Ministry of Communications (RHD RRD and BRTA)

RHD ROAD USER COST ANNUAL REPORT For 2000 - 2001

Economics Circle
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1 INTRODUCTION

1.1 Background

Road user costs (RUC) are the costs borne by the people through use of the road network facility. A road infrastructure project involves three types of cost in its useful life; they are construction cost, maintenance cost and road user cost. While construction and maintenance costs are incurred by the concerned road development agency, road user costs are borne by the users of road output. Of these three components of life-cycle cost, road user cost occupies the major proportion depending on the volume of traffic.

According to an empirical study carried out by the Organisation for Economic Cooperation and Development (OECD) in 1994 on cost-shares under optimal maintenance of road infrastructure, the proportion of RUC is about 38% on a road with 50 vehicles per day, about 75% on a road with 300 vehicles per day and above 90% on a road with 5000 vehicles per day.

This huge road user costs can be reduced substantially through proper maintenance of the road network. With this understanding, Economics Circle of RHD in collaboration with the IDC Transport Economists developed a methodology to carry out road user cost study during 1995 through 1997. Three Economic Working Papers on three RUC components such as Vehicle Operating Cost (VOC), Travel Time Cost (TTC) and Accident Cost (ACC) were published. The first RUC study report was published in 1998-99 which was updated in 1999-2000 through application of VOCM4, a stand alone sub-model of HDM III. The present report contains the updated study of road user costs for the year 2000-2001 using HDM4 model.

The input for these studies had to be collected mainly through field surveys conducted in various regions of the country which include among others vehicle operator's survey and passenger and freight time cost survey, while other essential data like vehicle registration, vehicle price, vehicle make and model, tax structure, fuel and tyre price, and accident related data had to be collected from concerned public and private agencies.

1.2 RUC Components

RUC consists of following three components:

- Vehicle operating costs (VOC), that is, the physical costs of operating a vehicle such as fuel, spare parts, depreciation, crew costs, etc;
- Travel time costs (TTC), that is, the value of time spent in travelling that could be used in other activities;
- Accident costs (ACC), that is, the physical costs of an accident and the value of injuries and fatalities.

The importance of controlling road user costs becomes evident just when it is understood that the Bangladesh transport sector consumes some 1.5 million tonnes of petroleum products annually. And this is only one component of vehicle operating costs which include among others cost of the vehicle itself, its maintenance parts and tyres. Costs involved in all such major components of VOC are a huge burden to the economy as well as a severe drain on the scarce foreign exchange, which could largely be reduced through proper management and upkeep of the road network.

Bangladesh is developing a process to allocate to its highways maintenance and development budgets according to an economic appraisal system HDM as well as RBEMS (Road and Bridge Economic Appraisal System) aimed at minimising costs to road users. This system is now in a functional stage of development in Roads and Highways Department (RHD). The Institutional Development Component (IDC) Project funded by the Department for International Development (DFID, UK) has been helping build this system since 1994 and is likely to continue to provide support until it is fully established.

A vital part of this system is to provide an accurate and up-to-date estimate of Road User Costs. The Economics Circle of the Network Management Wing under RHD undertakes this task. This is the third annual road user cost report published by the Economics Circle. It contains vehicle operating and travel time costs updated on the basis of data collected through conducting field surveys during July through September 2000 of road users, transport owners/operators and transport businesses.

The accident costs report has been updated mainly in respect of number of accidents (fatal, grievous and simple), lost output, medical costs, property damage costs and lost earnings, and other related costs. The statistics of road accident has been collected from the recent publications of Bangladesh Police captioned as Road Traffic Accidents National Report 1999. The estimation of costs relating to lost output, property damage, lost earnings etc have been based on the data collected through VOC and TTC field surveys, while costs involved in other relevant components have been estimated on the basis of secondary data through using other publications.

Every vehicle on the road, whether it is motorised or non-motorised, incurs road user costs. The analysis systems applied so far have concentrated on quantifying the motorised RUC. This is the first time that the VOC of the non motorised transport (NMT) have also been included in the road user costs report. The World Bank's up-dated economic appraisal model HDM-4 has incorporated the provision of modelling the cost of non-motorised vehicles. Currently RHD has been using HDM-4 for planning and management of road maintenance system under the department.

It may be mentioned that data on non-motorised vehicles was obtained from the IDC funded PhD research completed by Mr. M Bari in 2000. These were based on 6537 roadside interview surveys conducted in 1997-98.

1.3 Financial and Economic Costs

All costs in the report are given in financial and economic prices. The financial price is the retail market price to the consumer of the product. The economic price reflects the true value (that is, the real worth) as well as the scarcity value of the resource to the economy. In the economic jargon, this is teemed as a "shadow" or "accounting" price of the resource in the economy. The shadow price of unskilled labour, for instance, may well be lower than the wage to reflect its abundant supply, while that of a skilled professional may be higher than the salary given to him, if his opportunity cost is considered. The economic price of a factor or a product also excludes all tax elements as they reflect mostly a transfer of resources from one sector of the economy to another. On the other hand, subsidy elements if any is included with the economic price. Furthermore, market distortion or imperfection and government regulations or interventions are also taken into consideration while shadowpricing a factor or a product. In case of imported inputs, economic costs were based on the border prices plus port handling, transport, assembly and retail cost (profit margin) duly shadow priced. Local

inputs of labour and materials were shadow priced using the RHD Standard Conversion Factor of 0.8 (see Economics Working Paper E9 for details on shadow pricing.)

1.4 Structure of this Report

The report starts by examining the current composition of the Bangladesh vehicle fleet in Section 2 as this data is common to all the components of road user costs. These three components such as vehicle operating costs, travel time costs and accident costs are then described in turn in Sections 3, 4 and 5 respectively.

A more detailed account of the work on each component is contained in the following IDC Economics Working Papers:

- E6 Vehicle Operating Costs
- E7 Travel Time Costs
- E8 Accident Costs

2 THE BANGLADESH VEHICLE FLEET

2.1 Vehicles Registered

Information on the Bangladesh vehicle fleet was collected from BRTA, which is responsible for motorised vehicle registrations and renewals in Bangladesh. The organisation does not publish an annual report on registrations but provides data to the Bangladesh Bureau of Statistics (BBS) which is published annually in the Statistical Yearbook of Bangladesh.

BRTA is not responsible for non-motorised traffic registrations, which are left to the local authorities to regulate. Non-registration is common and the actual number of NMTs is unknown. However, this report has dealt with the operating costs of both motorised vehicles as well as NMTs.

Table 2.1 shows BRTA figures for vehicles registered in Bangladesh for 1989, 1998 and 1999. Motorcycles and autorickshaws account for nearly 59 per cent of the total motorised fleet. Cars and Jeeps account for 25 per cent of registrations and trucks/buses 13 per cent.

The BRTA figures indicate that to date some 522,000 motorised vehicles have been registered in Bangladesh, equivalent to some four vehicles per 1000 capita, a very low level compared to other Asian Countries. The number of registered vehicles shows a slight fall in its growth. As against 7.7% of AAGR over a period of 10 years upto 1998, total vehicle registrations have grown at an average rate of 7.6 per cent per annum taking 1999 into account. Of all the vehicles listed in the table 2.1, the fastest growing category has been auto-rickshaws as before.

This means that though there was a lot of change in the number of vehicle types over the last one year period, no significant change has taken place in the percentage composition of the vehicles during the same period.

Table 2.1 Number of Registered Vehicles

Type	1989	1998	1999	AAGR (%)
Car/Taxi	43,222	88840	94042	8.08
Jeep/Microbus	18,090	36479	38748	7.91
Bus	11,734	13672	13939	1.74
Minibus	7,542	12520	12999	5.59
Truck	23,978	38900	41008	5.51
Autorickshaw	19,796	73497	75637	14.34
Motorcycle	120,301	215274	231785	6.78
Other	7,102	11534	14151	7.14
Total	**251,765**	**490806**	**522309**	**7.57**

Source: Bangladesh Road Transport Authority
Note: AAGR= Annual average growth rate

2.2 Representative Vehicles

The Bangladesh vehicle fleet is characterised by a large number of different vehicle types spanning up to three decades in age. RHD has derived a classification of motorised vehicles and non-motorised vehicles for traffic counting which categorises vehicles into two broad groups: one for ten standard motorised vehicles and the other for three standard non-motorised vehicles, as set out in Table 2.2. No data is published on

the makes and models of vehicle registrations by BRTA. It was, therefore, necessary to examine BRTA registration records to derive this information. This was a time consuming exercise as all records prior to 1995 are on paper. Registrations following this date are computerised which makes the task a lot easier. This advantage will be utilised in future study as it was mentioned in the previous report also.

It may be mentioned that a detailed exercise to select the representative make for each type of vehicle had been done previously in 1995 for VOC 1997-98 Report. The results of 1995 survey for representative vehicle are being used so long including this report. This sort of exercise is required to carry out generally at 5 years interval due to the fact that the vehicle market does not show considerable changes in make and model during a very short span of time of mere one or two years. On this consideration, a new exercise to select representative make of vehicles on road will be required on the eve of the next RUC study.

A summary of the results for the two most popular makes of vehicle in each category is shown in Table 2.3. This demonstrates that in all categories over half the vehicles consist of two makes and models. In many categories the fleet is dominated by one make of vehicle. Toyota in the car group is an example. A brief comparison of costs and characteristics for the principal models demonstrated little variation and it was therefore decided to adopt the leading model in each group as the representative vehicle.

Table 2.2 RHD Vehicle Categories

RHD Category	Description
Articulated Truck	All articulated trucks and trucks with trailers
Medium Truck	Two or three axle rigid > three tonne payload
Small Truck	Two axle rigid < three tonne payload
Large Bus	>40 seats and >36 feet chassis
Mini Bus	16-39 seats and <36 feet chassis
Micro Bus	<16 seats
Utility	Four wheel drive jeeps and pick-ups
Car	All saloon cars and taxis
Motor Cycle	All two wheeled motorised vehicles
Auto Rickshaw	All three wheeled motorised vehicles
Cycle Rickshaw	All three wheeled passenger and van NMT
Cart	All animal carts and human drawn/push carts
Bicycle	All two wheeled non-motorised vehicles

Source: MCC Traffic Guide (RHD), December 1997
Note: The previous Heavy Truck category had been re-named as Articulated Truck.

Table 2.3 Summary of Representative Vehicle by Category and Model (Per Cent of Registered Vehicle Fleet)

RHD Category	Most Popular Make/Model	%	Second Popular Make/Model	%	Total Two Makes %
Articulated Truck	Tata	No data available			
Medium Truck	Tata SE 1612	28%	Bedford England	27%	55%
Small Truck	Isuzu NKR55L	46%	Toyota	13%	59%
Large Bus	Hino AK series	56%	Tata	32%	82%
Mini Bus	Tata LP909	44%	Mitsubishi	19%	63%
Micro Bus	Toyota Liteace	81%	Mitsubishi	13%	94%
Utility	Mitsubishi Pajero	25%	Toyota	23%	48%
Car	Toyota Corolla	74%	Nissan	7%	81%
Motor Cycle	Honda 125	58%	Yamaha	14%	72%
Auto Rickshaw	Bajaj Baby Taxi	97%	Other	3%	100%
Cycle Rickshaw	NA	-	NA	-	-
Cart	NA	-	NA	-	-
Bicycle	NC	-	NC	-	-

Source: BRTA
Note: NA = Not Applicable and NC = Not Collected

As Bangladesh has no vehicle manufacturing plant, all vehicles are imported either completely built up (CBU) or completely knocked down (CKD). Most trucks, buses and auto-rickshaws are imported knocked down in the form of chassis and engine, whereas cars, microbuses, motor cycles and utilities are imported whole. The vehicle market is dominated by Japanese and Indian manufacturers and in particular:

- Toyota (Japan) - Microbuses, four wheel drives and saloon cars
- Honda (Japan) - Motorcycle
- Hino (Japan) - Buses
- Tata (India) - Trucks and buses
- Bajaj (India) - Autorickshaws/motorcycles

The following section gives a brief description of the vehicles in each of the RHD categories.

Articulated Truck (previously called heavy truck)

It was not possible to identify the number of articulated trucks from BRTA records, which define Articulated Trucks as those carrying more than 7 tonnes of cargo, which includes the RHD articulated and medium categories. Of those multi-axle trucks that could be identified the majority were Tata tractor units and trailers. As there are still very few multi-axle vehicles in Bangladesh, further works were not carried out on articulated trucks.

Medium Truck

The medium truck market is dominated by three makes: Bedford England, Bedford Hindustan and Tata, which account for some 75 per cent of the market. However, the number of Bedford's has been declining in recent years and the Tata is becoming increasingly popular. During 1994-95 truck imports were dominated by Tata who's most popular model is the 15.6 tonne GVW SE1612.

Small Truck

It is evident that the small truck market is increasing in importance. Previous studies have not identified this as an important category but the 1995/1996 traffic census identified significant volumes on the RHD road network. This increasing trend has been steadily prevailing since then. This increase is symptomatic of the development of the economy and commercial liberalisation. At present the small truck market is dominated by second hand vehicles, and most especially converted ex-military Willy's Jeeps and old model Toyota Land Cruisers which have had a locally made flat bed added. It is not possible to identify the proportions of these vehicles from the BRTA registration statistics, which only show the number of new registrations. However, new vehicles are being imported mostly from Japan and Isuzu, Toyota and Mitsubishi dominate this small but growing market. The Isuzu NKR55L was selected as the representative model.

Large Bus

Large buses can be divided into luxury (Air Conditioned and Chair Class) and ordinary categories. Hino of Japan and Tata of India dominate the large bus market, with some 90 per cent of the total market share. Of these the Hino AK series is by far the most popular and is expected to increase its market share with the introduction of more luxury air conditioned inter-urban services as the road network improves. In the category of large bus, the chair class bus still dominate and as such has been selected as the representative vehicle for modelling.

Minibus

The major brands of minibus are Isuzu, Mitsubishi, Hindustan, Tata, Nissan, Toyota and Eicher. The Japanese makes were popular till the last half of the 1980's but the Indian makes have been steadily increasing their share and now the Tata LP909 is dominating new purchases. For the last three years its share of the total market was over 70%.

Micro Bus

Microbuses are usually privately owned and small numbers are operated by public transport. Toyota dominates this category with its Hyace and Lightace models and has an 81% share of the market. The Mitsubishi L300 accounts for most of the remainder.

Car

Toyota also dominates the car fleet with 74% of the market. Most imports now consist of the highly popular Corolla Sedan 5 door saloon which comes in several variants. A mid range variant (1300 GL) was chosen for the representative model. Some cars are imported as re-conditioned second hand vehicles.

Utility (4WD)

The utility vehicle market is dominated by Japanese luxury four wheel drive models, usually referred to as Jeeps. The Mitsubishi Pajero and the Toyota Land Cruiser account for over half this market. The utility category also includes pick ups. But as these vehicles account only for a small proportion of the whole utility market they are not considered for separate modelling. In 1999 a joint venture between Mitsubishi and Progati Industries Ltd Bangladesh started to import Pajeros in knocked down form and manufacture their bodywork locally. The cost of these vehicles is significantly less than the completely built up versions. The proportion of these vehicles in the market is

increasing significantly. At the same time the Rangs Limited has been importing Pajero GL V31 VHNDR category of vehicles. These types of middle range Pajeros are dominating the present market share. So, the Pajero GL V31 VHNDR has been chosen for modelling.

Auto-Rickshaw

The auto-rickshaw market is divided into three categories which are defined by their respective manufacturers: Mishuk (Atlas), Babytaxi (Bajaj), Tempo (Vespa). In addition auto-vans are built on various chassis. The Mishuk is a locally developed three wheeled vehicle based on a motor cycle engine, manufactured in Bangladesh by Atlas Ltd. which is a part of the Bangladesh Steel and Engineering Corporation. However, only a small number of this variety were constructed so far and the market is now dominated by the Bajaj Babytaxi. The usually Vespa based Tempo is a larger passenger carrying vehicle (up to 15) which has a small but growing share of the auto rickshaw market.

Motor Cycle

Honda dominates the motor cycle market with 58 per cent of the fleet, most of which are 125cc variants. Yamaha, Bajaj and Suzuki account for 14 per cent, 6 per cent and 4 per cent of the remaining market respectively.

Bicycle

Under this category, all two wheeled NMT are considered. India and China made bicycles largely dominate in the market. A small proportion of this category are assembled by the vendors combining local and imported parts and accessories. In this study, modelling of bicycles for VOCs are based on a composite of the available models in Bangladesh.

Rickshaw/Van

All three wheeled non-motorised transports are considered under this group. Rickshaw is a very common mode of transport throughout Bangladesh. The vans are more popular in rural areas. The frames and bodies of this type of vehicle are made locally using both local and imported parts. Rims and chains are generally imported from adjacent areas of the neighbouring country, while tyres and bearing are locally manufactured.

Animal/Push Carts

All animal drawn/pushed carts are categorised here. Animal carts are mainly rural vehicles, while push carts exist both in rural and urban areas. All of this type of vehicles are locally made with no imported parts used. Wheels are made by wood covered with iron and rubber rims.

2.3 Characteristics of Representative Vehicles

Table 2.4A and 2.4B set out the physical characteristics of the representative vehicle types identified in the previous section.

Table 2.4A Vehicle Characteristics :Engine and Tyres

Category	Make	Imported as	Fuel	CC	Cylin-ders	Metric HP	No. Tyres	Type of Tyres
Motorised								
Medium Truck	Tata SE 1612/42	CKD	Diesel	5675	6	120	6	10.00x20-16PR
Small Truck	Isuzu NKR55L	CKD	Diesel	2771	4	72	4	7.50x20-12PR
Large Bus	Hino AK3HMKA	CKD	Diesel	6443	6	195	6	9.00x20-14PR
Mini Bus	Tata LP909/36	CKD	Diesel	4788	6	112	6	7.50x20-12PR
Micro Bus	Toyota Liteace	CBU	Petrol	1800	4	79	4	5.50x13-8PRLT
Utility (Jeep)	Mitsubishi Pajero	CBU	Petrol	2400	4	132	4	205 - R16
Car	Toyota Corolla Sedan 1300GL	CBU	Petrol	1300	4	110	4	155 - SR13
Auto Rickshaw	Bajaj Baby Taxi	CKD	Petrol/ 5%Oil	145	1	5.52	3	4.0x8-6PR
Motor Cycle	Honda CG125	CBU	Petrol	125	1	11	2	Front 2.5 - 4PR Rear 3.0 -4PR
Non-motorised								
Bicycle	nc	CKD	na	na	na	na	2	na
Rickshaw/van	na	Local	na	na	na	na	3	na
Animal Cart	na	Local	na	na	na	na	2	na

Note: (1) nc = Not collected
(2) na = Not applicable

Table 2.4B Vehicle Characteristics: Weights and Dimensions

Category	Make	Axles No.	TARE kg	GVW kg	Length mm	Width mm	Height mm
Medium Truck	Tata SE 1612/42	2	4,015	15,660	6,970	2,434	3,625
Small Truck	Isuzu NKR55L	2	2,750	5,200	6,025	1,880	2,220
Large Bus	Hino AK3HMKA	2	4,145	12,500	10,005	2,430	1,995
Mini Bus	Tata LP909/36	2	3,300	9,000	5,970	2,159	1,900
Micro Bus	Toyota Liteace	2	1,180	2,150	4,453	1,695	1,870
Utility (Jeep)	Mitsubishi Pajero	2	1,930	2,800	4,645	1,695	1,865
Car	Toyota Corolla Sedan 1300GL	2	998	1,510	4,270	1,685	1,380
Auto Rickshaw	Bajaj Baby Taxi	2	200	580	1,900	745	1,020
Motor Cycle	Honda CG125	2	96	N	1900	745	1020
Bicycle	nc	2	nc	90	nc	nc	nc
Rickshaw/van	na	2	nc	304	nc	nc	nc
Animal Cart	na	1	nc	1800	nc	nc	nc

Source: Vehicle retailers in Dhaka

Notes:
N = no manufacturers data
TARE = unloaded weight, GVW = gross vehicle weight
CKD = completely knocked down, CBU = completely built unit

3 VEHICLE OPERATING COSTS (VOC)

3.1 Introduction

The prediction of VOCs is a complex procedure as costs of all relevant components of the vehicle are needed for the entire Bangladesh vehicle fleet consisting of a plethora of vehicle types. Moreover, the variation of these costs under different operating conditions must also be understood. These operating conditions are normally categorised as:

- Horizontal curvature;
- Vertical curvature;
- Road Surface Condition;
- Traffic Congestion.

The starting point in using the RUE (Road User Effect) sub-model of the HDM-4 is to configure the model for Bangladesh. This involves selecting the representative vehicle types to be modelled and the units of currency used. All costs were input in Taka. The method used for deriving the costs is set out in Economics Working Papers E6, E7 and E8.

The HDM-4 Calibration manual (Volume 5) recommends three levels of calibration, as set out in Table 3.1. The model was calibrated to Level 1 fully and level 2 partially. Speed Capacity and PCSE (Passenger Car Space Equivalence) calibrations were carried out by the HDM Circle and are described in their calibration report.

Given that a stand alone VOC model for HDM-4 is not yet available, unit VOCs were derived for this study by running a project analysis on an 1 km representative section of road and recording the predicted unit VOCs at different roughness levels. These were compared with fare and tariff data to match them with a global calibration of the model predictions.

Table 3.1 Calibration of HDM-4 Road User Effects Model

	Required	**Priority 1**	**Priority 2**	**Assume Defaults**
Level 1	Unit Costs	Mass Capacity Speed Service Life Utilisation	Power Tyre Parameters Depreciation Parameters	All Others
Level 2		Speed Capacity PCSE	Fuel Power Service Life Utilisation	All Others
Level 3		Priorities Depend on Resources and Objectives		

3.2 Selection of Representative Vehicle Types

3.2.1 General

The RHD vehicle types were selected in 1995 as a balance between having too many categories that it would be difficult for the traffic survey enumerator to classify and getting sufficient vehicle types to accurately model RUC's and traffic effects. This means that some "sub-categories" of vehicles are not recorded (see Table 3.2) especially in the Large Bus, Auto Rickshaw, Cycle Rickshaw and Cart categories. The last column of Table 3.2 shows which vehicle belonging to the respective sub category is currently modelled. In each case the most prevalent vehicle is modelled according to current knowledge. The exception is the cart category where human carts may outnumber animal carts. But since there is no applicable HDM relationship with regards to human carts, animal cart had to be chosen.

The modelling could be improved by estimating a weighted average relationship for the vehicles with sub categories. This would have to be based on additional research to identify the proportions of vehicles in each category and to collect the VOC information needed to model them. Alternatively, the sub-categories could be included in an expanded traffic count form and new relationships established. But this is not possible to take into consideration until the current problems with the traffic counting programme are addressed as enumerators already face a lot of troubles classifying the 13 existing categories.

Table 3.2 RHD Vehicle Categories

RHD Category	Sub Category	Modelled
Articulated Truck		
Medium Truck		
Small Truck		
Large Bus	Ordinary, Chair, Luxury	Chair
Mini Bus		
Micro Bus		
Utility		
Car		
Auto Rickshaw	Baby Taxi, Tempo	Baby Taxi
Motor Cycle		
Cycle Rickshaw	Passenger and Van	Passenger
Cart	Animal and Human	Animal
Bicycle		

The data inputs for the model were collected through field survey during July-August 2000. A total of 40 operators for each type of vehicles were chosen in Dhaka (20 operators), Chittagong (10 operators) and Rajshahi (10 operators) areas. The data was entered onto a computer database and stored in the Economics Circle. It is understandable that in order to arrive at more realistic results for the country as a whole, field surveys covering more areas and operators are necessary, which calls for more financial and personnel resources.

3.3 Utilisation

3.3.1 Existing Characteristics

The way in which a vehicle is utilised is a key parameter in estimating VOC. In Bangladesh commercial vehicles are often intensively utilised. Buses, in particular, are operated around the clock with different sets of crews on day time and night time schedules. Table 3.3 shows utilisation rates for the operators surveyed in 2000. Large buses operating on the intercity routes are utilised for up to 80 per cent of the time available. Most of other vehicles average either around 60 per cent utilisation or more.

For modelling VOC's it is necessary to estimate how many kilometres on average a vehicle is driven for in a year and how many hours the vehicle is operated for. The data on vehicle utilisation collected through 2000 survey by Economics Circle are set out in Table 3.3. This shows that distances travelled by large buses are very high reflecting their higher utilisation ratios, while the smaller vehicles are driven much less as would be expected.

Table 3.3 Average Utilisation of Vehicles

Category	Annual Km Driven	Annual Hours In Work	Annual Hours Driven	Utilisation Ratio (1)
Medium Truck	55,000	2600	1,640	64%
Small truck	36,000	2100	1,320	64%
Large Bus	120,000	3350	2,680	80%
Mini Bus	56,000	3000	2,100	68%
Micro Bus	37,000	2340	1,500	64%
Utility (Jeep)	42,000	2700	1,460	53%
Car	32,000	2240	1,410	63%
Baby Taxi	34,000	3380	2,400	71%
Tempo	27,000	3100	2,118	68%
Motor Cycle	15,000	1490	820	55%
Bicycle	3,835	256	nc	nc
Richshaw	13,796	1,003	nc	nc
Animal Cart	4,796	1,599	nc	nc

Source: Vehicle operators survey 2000
Note: (1) Hours driven as % of hours available

Another important aspect of utilisation is the length of time vehicles are operated before they are scrapped or sold on, known as the service life. This is a vital component in estimating the depreciation charges attributable to each vehicle. The survey established the average age of vehicles belonging to the operators interviewed and also to what age operators normally keep the vehicles under their possession (Table 3.4). The results show quite long service lives with a minimum of seven years and maximum of thirteen years. On average the current ages of vehicles are half the service life. Table 3.4 also sets out the percentage of vehicles in the sample that were purchased second-hand. This shows that nineteen percent trucks were purchased second hand. Most buses were purchased new such as microbuses, utilities and motorcycles. A thirty three percent of cars was purchased second hand.

Table 3.4 Age and Operational Life of Vehicles

Category	Average Age (Years)	Normal Service Life (Years)	Second Hand Purchases %
Medium Truck	9	11	19
Small Truck	9	8	13
Large Bus	4	10	0
Mini Bus	4	12	0
Micro Bus	4	10	16
Utility (Jeep)	5	13	0
Car	3	10	33
Baby Taxi	6	8	3
Tempo	7	7	12
Motor Cycle	4	8	9
Bicycle	nc	18	nc
Richshaw	nc	12	nc
Animal Cart	nc	8	nc

Source: Vehicle operators survey 2000

3.3.2 Response of Operators to Road and Bridge Improvements

As part of the survey, operators were asked what benefits they had experienced from road and bridge projects. The purpose of this was to establish an idea of the impact of the road programme in general terms and to find out how operators respond to improved conditions of a road. This determines how depreciation is modelled in the economic appraisal system.

The results showed that all operators interviewed had benefited from road and bridge improvements (Table 3.5). All the large bus, mini bus and ninety percent of truck operators had changed operations, mostly by increasing the number of trips and truck by longer trip. Utility, car and tempo operators generally made more trips with improved condition of roads.

Table 3.5 Operator's Responses to Road Improvements (Percent)

Response	Med Truck	Small Truck	Large Bus	Mini Bus	Utility	Car	Tempo	Baby Taxi	Motor Cycle
Benefitted	100	83	100	97	100	100	91	85	87
Change operation	96	96	100	100	75	96	83	95	67
More trips	32	74	79	81	60	85	96	92	56
Longer trips	41	15	21	19	40	15	4	8	44
Increased load	27	11	0	0	0	0	0	0	0

Source: Vehicle operators survey 2000

The operators were also asked what specific projects they had benefited from. The two most beneficial general projects are set out in Table 3.6. These are all general road improvement & maintenance and improvement of main roads (national and regional) & bridges, which hence gave substantial savings, especially in terms of travel time saved. Through improvement of main roads (national and regional) & bridges operators saved

on the average about 19 per cent of the travel time and ten percent of the vehicle operating costs.

Table 3.6 Savings in Travel Time and VOC to Operators for Specific Projects (Per cent saving compared with trip before improvement)

Project	Saving	Med Truck	Small Truck	Large Bus	Mini Bus	Utility	Average
Road improvement & maintenance (network in general)	Time	30	14	26	18	0	21
	VOC	10	5	8	7	0	7
Improvement of main roads & bridges	Time	33	17	24	10	17	19
	VOC	20	7	18	7	9	10

Source: Vehicle operators survey 2000

3.4 Vehicle Purchase Costs

Vehicle purchase costs were derived from a survey of established motor vehicle outlets in Dhaka. In order to derive economic costs the final retail price (actual cost to the purchaser) are required to be broken down into its constituent parts to identify taxation and foreign currency elements.

Duties and taxes are charged on the "Assessable Value (AV)" of the import which means the Cost, Insurance & Freight (CIF) value in foreign currency converted to Taka at the prevailing exchange rate set by the Bangladesh Bank. If the Cost & Freight (C&F) value only is given, then an insurance and a landing fee of one per cent each is applied to the C&F cost to give the assessable value. A number of duties and taxes are charged on CIF value, which are set out in Bangladesh Operative Tariff Schedule issued by the National Board of Revenue. The following five duties and taxes are payable on the AV:

- **Customs Duty (CD)**: Charged at a percentage rate on the AV. These vary between 5.0 and 37.5 per cent for vehicle imports. Duty on trucks and buses has been reduced from 7.5 to 5 per cent since 1997/98 and increased from 15 to 25.5 per cent for baby taxis.
- **Development Surcharge (DS):** Charged at a uniform rate of 2.5 per cent of AV to directly fund development works;
- **Supplementary Duty (SD)**: Additional charge under the VAT Act, charged as a percentage rate on AV;
- **Value Added Tax (VAT)**: Charged at a uniform rate of 15 per cent on the AV inclusive of customs duty and Supplementary Duty, i.e, VAT on (CIF+CD+SD);
- **Advance Income Tax (AIT)**: Charged at a flat rate of 3 per cent on AV, except for Government imports;
- **Landing Permit Fee (LPF)**: Charged at a flat rate of 2.5 per cent of AV on imports in excess of Taka 100,000, except for Government imports.

Tariffs charged on the representative vehicle categories are set out in Table 3.7. The CIF prices of the vehicle at Chittagong port are paid either in US dollar or Japanese Yen. Other costs include port dues, transportation, assemblying (for knocked down units) and dealers' overheads and margins. The economic cost is taken as the CIF cost plus all port, transport and assembly costs incurred in getting to the retail price of the vehicle which are shadow priced according to the SCF. Table 3.8 sets out breakdown of tariff values.

Table 3.7 Tariffs Applicable to Representative Vehicles and Tyres

Category	DS	AIT	LPF	CD	SD	VAT
Medium Truck	2.5%	3%	2.5%	5%	-	15%
Small Truck	2.5%	3%	2.5%	9.35%	-	15%
Large Bus	2.5%	3%	2.5%	5%	-	15%
Mini Bus	2.5%	3%	2.5%	5%	-	15%
Micro Bus	2.5%	3%	2.5%	37.5%	-	15%
Utility (Jeep)	2.5%	3%	2.5%	37.5%	120%	15%
Car	2.5%	3%	2.5%	37.5%	45%	15%
Baby Taxi	2.5%	3%	2.5%	25.5%	32%	15%
Motor Cycle	2.5%	3%	2.5%	15%	-	15%
All tyres	2.5%	3%	2.5%	30%	-	15%

Source: National Board of Revenue and Dealer's Survey November 2000

Table 3.8 New Vehicle Purchase Costs (Taka in 2000 Prices)

Category	CIF	Tariffs	Assembly & Other Costs	Total Financial	Total Economic
Medium Truck	604,955	195,712	608,748	1,409,415	1,091,953
Small Truck	548,525	179,725	396,750	1,125,000	865,925
Large Bus	1,602,840	460,817	1,136,343	3,200,000	2,511,915
Mini Bus	516,289	166,755	618,748	1,301,792	1,011,287
Micro Bus	557,890	368,905	348,205	1,275,000	836,455
Utility (Jeep)	1,034,398	1,925,273	440,329	3,400,000	1,376,661
Car	631,690	744,605	673,705	2,050,000	1,170,654
Baby Taxi	57,413	51,870	101,217	210,500	138,387
Motor Cycle	78,691	31,984	15,325	126,000	90,951

Source: Dealer's Survey November 2000

3.5 Consumable Costs

3.5.1 Tyre Costs

Tyres are imported from India, Japan, Malaysia and Taiwan with Indian tyres dominating the market mainly because they are relatively cheaper. The use of re-treaded tyres is not common, as is shown in Table 3.9. Table 3.10 sets out a breakdown of new tyre prices for each of the representative vehicle types. Tyres are subject to 53 per cent duties and taxes (Table 3.10).

Table 3.9 Use of Re-treaded Tyres

Item	Med Truck	Large Bus	Mini Bus	Utility	Car	Tempo	Baby Taxi
Operators Using	24%	8%	31%	0%	3%	21%	46%
Cost Tk per Tyre	4,300	2,700	2,300	-	750	280	290

Source: Vehicle operators survey 2000

Table 3.10 Cost of New Tyres (Taka 2000)

Category	Tyre Size	Make	CIF Cost	Tariffs	Other Costs	Financial Cost	Economic Cost
Medium Truck	10.00x20-16PR	Dunlop	4,237	3,259	3,367	10,863	6,931
Large Bus	9.00x20-14PR	Dunlop	3,399	2,505	3,042	8,946	5,833
Mini bus/small truck	7.50x20-12PR	Dunlop	2,132	1,612	1,456	5,200	3,297
Micro Bus	5.50x13-6PR	Dunlop	584	448	915	1,947	1,316
Utility (Jeep)	205-R16	Dunlop	2,858	2,123	3,186	8,167	5,407
Car	155-SR13	Dunlop	898	681	1,143	2,722	1,812
Auto Rick	4.00x8-6PR	Falcon	270	202	371	843	567
Motor Cycle	Front 2.5-18 4PR	Dunlop	405	211	194	810	560
	Rear 3.0 -17 4PR	Dunlop	494	257	236	987	683

Source: Vehicle operators survey 2000

3.5.2 Fuel and Lubricants

Detailed information on fuel and lubricant cost were collected from Bangladesh Petroleum Corporation (BPC). Analysis of data so collected resulted in the breakdown of unit costs of fuel and lubricants as set out in Table 3.11.

Table 3.11 Economic and Financial Costs of Fuel (Taka per litre in 2000)

Item	Petrol		Diesel		Lubricating Oil	
	Financial	Economic	Financial	Economic	Financial	Economic
CIF Chittagong	8.64	8.64	8.64	8.64	19.05	19.05
Tariffs	7.49	0.00	7.49	0.00	8.19	0.00
Service charges	0.55	0.44	0.55	0.44	10.79*	8.63
Estimated implicit tax	6.32	0.00	-0.63	0.63	30.97	0.00
Total	**23.00**	**9.08**	**15.50**	**9.71**	**69.00****	**27.68**

Source: Bangladesh Petroleum Corporation 2000
Note: $1=Taka 54
* Includes Tk 10.00 for packaging
** Assuming 25% GTX and 75% other LO being used

3.6 Vehicle Maintenance Policies and Costs

The majority of the operators interviewed maintained their own vehicles as shown in Table 3.12. Most operators serviced vehicles on a time related basis, with the exception of large buses which required distance related maintenance due to very high utilisation.

Table 3.12 Vehicle Maintenance Policies

Policy	Med Truck	Small Truck	Large Bus	Mini Bus	Utility	Car	Baby Taxi
Maintained by owners	90%	90%	90%	90%	60%	90%	75%
Maintained in garage	10%	10%	10%	10%	40%	10%	25%
Time related servicing	78%	97%	92%	97%	75%	77%	100%
Distance related servicing	22%	3%	8%	3%	25%	23%	0

Source: Vehicle operators survey 2000

The annual costs of maintaining the representative vehicles were estimated from the operators' surveys and is set out in Table 3.13. Costs were highest for large buses, which appears to be realistic from the point of view of their high utilisation. The average maintenance labour cost per hour was about 55 Taka. SCF 0.8 is applicable to find the economic values of the financial figures shown in the following table.

Table 3.13 Annual Financial Cost of Vehicle Maintenance (Taka)

Cost Parameters	Medium Truck	Small Truck	Large Bus	Mini Bus	Micro Bus	Utility	Car	Baby Taxi
Spare parts	48,889	13,847	64,567	37,606	23,012	28,550	17,171	10,394
Maintenance labour	14,532	7,620	17,304	13,272	8,928	9,168	7,320	5,328
Total	**63,421**	**21,467**	**81,871**	**50,878**	**31,940**	**37,718**	**24,491**	**15,722**

Source: Vehicle operators survey 2000

3.7 Crew Costs

Driver and helper costs are set out in Table 3.14. Nearly all trucks and buses have a permanent helper in addition to the driver. The costs of drivers and helpers for buses are based on two crews per vehicle. Driver's wages for buses, trucks and cars average around Taka 5,000 per month which is double the national average monthly wage of Taka 2,000 -2,500 for skilled labour as found on the basis of survey data. However, the wages for babytaxi drivers are lower.

Table 3.14 Crew Wage Costs (Taka 2000 prices)

Cost Parameters	Med Truck	Small Truck	Large Bus	Mini Bus	Micro Bus	Utility	Car	Baby Taxi
Driver per month	5074	4086	13188	5981	3988	4769	3390	3261
Helper per month	2058	1824	5882	4483	None	None	None	None
Driver per hour	25	20	46	25	22	24	20	16
Helper per hour	9	9	18	13	-	-	-	-
Total financial/hour	**34**	**29**	**64**	**38**	**22**	**24**	**20**	**16**
Total economic/hour	**27**	**23**	**51**	**31**	**18**	**19**	**16**	**13**

Source: Vehicle operators survey 2000

3.11 Overhead Costs

Overhead costs are set out in Table 3.15. These consist of office administration and rental charge, garaging, insurance, vehicle excise duty/VAT and tolls/route permit fees. Overhead costs are high in Bangladesh, in part due to ferry and bridge tolls that account for over half of overheads in case of medium truck and significant proportions in respect of buses and other trucks.

Table 3.15 Overhead Costs (Taka per annum)

Item	Med Truck	Small Truck	Large Bus	Mini Bus	Micro Bus	Utility	Car	Baby Taxi	Motor Cycle
Insurance	3,967	906	27,188	4,742	3,227	5,578	636	476	197
Taxes	5,188	3,950	6,120	5,490	4,730	3,389	3,510	918	1,000
Tolls	98,480	13,016	215,183	18,528	5,183	24,000	24,583	-	3,100
Office	21,913	6,412	45,083	24,286	8,171	2,750	7,725	3,580	-
Other	24,298	12,046	23,452	12,525	9,667	8,870	7,568	4,431	-
Total fin	153,846	36,330	317,026	65,571	30,978	44,587	44,022	9,404	4,297
Total fin less taxes	**148,658**	**32,380**	**310,906**	**60,081**	**26,248**	**38,822**	**40,512**	**8,486**	**3,297**
Total Econ	**118,926**	**25,904**	**248,725**	**48,065**	**20,998**	**31,058**	**32,410**	**6,789**	**2,638**

Source: Vehicle operators survey 2000

3.9 VOC Inputs

The summary of VOC inputs required to run the HDM model arrived at through the analysis of relevant parameters are presented in table 3.16

Table 3.16 VOC Inputs

Item Cost	Unit	Medium Truck		Small Truck		Large Bus		Mini Bus		Micro Bus		Utility		Car		Auto Ricksaw		Motor Cycle	
Unit Costs		Fin	Econ	Fin	Econ	Fin	Econ	Fin	Econ	Fin	Econ	Fin	Econ	Fin	Econ	Fin	Econ	Fin	Econ
Purchase cos of vehicles	Tk'000 per vehicle	1,409	1,092	1,125	866	3,200	2,512	1,302	1,011	1,275	836	3,400	1,377	2,050	1,171	211	138	126	91
Cost of new tyre	Tk per tyre	10,863	6,931	5,200	3,297	8,946	5,833	5,200	3,297	1,947	1,316	8,167	5,407	2,722	1,812	843	567	899	622
Maintenance labour cost	Tk per hour	55	44	55	44	55	44	55	44	55	44	55	44	55	44	55	44	55	44
Overhead cost	Tk '000 per annum	154	119	36	26	317	249	66	48	31	21	45	31	44	32	9	7	4	3
Crew cost	Tk per hourr	34	27	29	23	64	51	38	31	22	18	24	19	20	16	16	13	Not applicable	
Fuel cost	Tk per litre	15.50	9.71	15.50	9.71	15.50	9.71	15.50	9.71	23.00	9.08	23.00	9.08	23.00	9.08	23.00	9.08	23.00	9.08
Lubricant cost	Tk per litre	69.00	27.68	69.00	27.68	69.00	27.68	69.00	27.68	69.00	27.68	69.00	27.68	69.00	27.68	69.00	27.68	69.00	27.68
Utilisation																			
Annual km driven	Kms per annum	55,000		36,000		120,000		56,000		37,000		42,000		32,000		34,000		15,000	
Annual hours driven	Hrs per annum	1,640		1,320		2,680		2,100		1,500		1,460		1,410		2,400		820	
Average service life	Years	11		8		10		12		10		13		10		8		8	
Physical Characteristics																			
Manufacturers GVW	Kg	15,660		5,200		12,500		9,000		2,150		2,800		1,510		580		Not available	
TARE weight	Kg	4,015		2,750		4,145		3,300		1,180		1,930		998		200		96	
Axles	Number	2		2		2		2		2		2		2		2		2	
Tyres	Number	6		6		6		6		4		4		4		3		2	
Fuel type	Type	Diesel		Diesel		Diesel		Diesel		Petrol		Petrol		Petrol		Petrol/Oil		Petrol	
HDM Parameters																			
HDM- 4 vehicle type	Code	10		8		15		14		12		7		4		1		1	
MaintenanceModel	Rotation Coefficient	0.85		1.00		0.85		1.00		1.00		0.85		1.00		1.00		1.00	
Life Model	Type	Constant		Constant		Constant		Constant		Constant		Constant		Constant		Constant		Constant	

3.10 Unit Vehicle Operating Costs

It means VOC per kilometre at different roughness levels

3.10.1 Assignment of HDM-4 Vehicle Categories

HDM-4 representative vehicle types were assigned to each of the 10 motorised vehicle types and 3 non-motorised vehicle types on the basis of the vehicle characteristics like number of axles, tyres, type of fuel, GVW, vehicle dimension among others (Table 3.17).

This is the first time that the two and three wheeled vehicles have been modelled. Since HDM-3 did not contain appropriate relationships these vehicles could not be modelled in the previous Road User Cost studies, although unit costs in terms of inputs had been prepared. HDM-4 does not have a three-wheeled motorised vehicle type. That's why the motorcycle relationship was used as the representative vehicle for the auto rickshaw with some modifications in respect of relevant characteristics. It should be noted that the auto rickshaw modelled represents a Baby Taxi and that the larger Tempo will have higher operating costs.

It is also for the first time that Non Motorised Transport costs have been incorporated in the modelling system of Road User Cost study. The HDM-4 cart is an animal cart. In case of economic appraisal this vehicle could be used only when it is confirmed through traffic count survey that the vehicle in question is animal cart. It means that the man drawn cart will not be used in the name of animal cart. In respect of cycle rickshaw only passenger cycle rickshaws are modelled, although it is acknowledged that rickshaw vans are an important component of this market. If it is desired to model the van separately then further research will have to be conducted.

Table 3.17 Assignment of Representative Vehicle Types

RHD Category	HDM Representative Vehicles	HDM Vehicle Code
Articulated Truck	Articulated Truck	11
Medium Truck	Heavy Truck	10
Small Truck	Light Truck	8
Large Bus	Heavy Bus	15
Mini Bus	Medium Bus	14
Micro Bus	Mini Bus	12
Utility	Four Wheel Drive	7
Car	Large Car	4
Auto Rickshaw	Motorcycle	1
Motor Cycle	Motorcycle	1
Cycle Rickshaw	Rickshaw	NMT 2
Cart	Cart	NMT 3
Bicycle	Bicycle	NMT 1

3.10.2 VOC Modelling

The modelled predictions were validated against fare and tariff data collected during the Vehicle Operating Cost survey. This demonstrated a reasonable correlation.

It was considered that the maintenance parts model was over-estimating in the high roughness range for medium trucks, large buses and utilities. The maintenance model rotation factor was therefore adjusted from 1 to 0.85, which reduced total VOC by 15-20 per cent.

The Optimal Life method was over-estimating depreciation costs by 5-10 per cent and the constant life model was therefore adopted for all vehicle types.

The economic VOC per km resulted through HDM run at different roughness levels are presented according to vehicle type (motorised and non-motorised) in Table 3.17 and 3.19 respectively.

Table 3.17 Sensitivity of VOC to Road Roughness (motorised)

International Roughness Index (IRI)	Medium truck	Small Truck	Large Bus	Minibus	Microbus	Utility	Car	Auto Rickshaw	Motor Cycle
2	8.58	5.02	9.13	5.42	4.52	6.08	7.50	0.83	0.80
3	8.65	5.07	9.22	5.47	4.55	6.15	7.54	0.84	0.80
4	8.98	5.32	9.81	5.73	4.76	6.62	7.81	0.88	0.82
5	9.32	5.58	10.46	5.99	4.98	7.14	8.09	0.92	0.84
6	9.62	5.87	11.14	6.24	5.20	7.71	8.41	0.95	0.85
7	9.91	6.17	11.90	6.47	5.45	8.34	8.73	0.98	0.86
8	10.30	6.52	12.79	6.76	5.75	9.05	9.09	1.00	0.87
9	10.80	6.90	13.79	7.12	6.09	9.81	9.48	1.02	0.89
10	11.39	7.32	14.86	7.55	6.47	10.61	9.89	1.06	0.92
11	12.03	7.77	15.99	8.01	6.87	11.43	10.31	1.10	0.96
12	12.71	8.24	17.14	8.41	7.28	12.28	10.74	1.14	1.00
13	13.42	8.73	18.31	9.00	7.71	13.13	11.18	1.19	1.05
14	14.16	9.23	19.50	9.52	8.15	14.00	11.62	1.25	1.11
15	14.90	9.75	20.70	10.05	8.59	14.87	12.06	1.30	1.16

This year information on vehicle ownership tax like registration fee, road tax, route permit fee, vehicle fitness fee etc have been collected from BRTA which show somewhat lower values than those collected from vehicle operators for the previous studies. Besides, in case of the previous studies price of only GTX brand of lubricating oil was considered while in this study 25% of GTX and 75% of other brands of the same are taken into consideration. GTX is more expensive than other brands. These two changes resulted in VOC slightly lower than those yielded in the previous year's study.

Table 3.18 Comparison of Tariffs and Economic VOC (Taka/km)

Tariff & Economic VOC	Medium Truck	Large Bus	Mini Bus
*Average Tariff & Fare	10.66	16.48	12.27
Average of VOC at IRI=4,5&6	9.31	10.47	5.91

Source: Vehicle operators survey 2000

*Due to increase in fuel price about 20% bus owners/operators alongwith transport workers and union raised the fare by a range between 30-50 per cent.

Table 3.19 Sensitivity of VOC to Road Roughness (non-motorised)

International Roughness Index (IRI)	Bicycle	Rickshaw	Animal Cart
2	0.37	0.78	3.44
3	0.41	0.90	3.79
4	0.45	1.02	4.15
5	0.49	1.14	4.51
6	0.53	1.27	4.89
7	0.57	1.39	5.25
8	0.61	1.51	5.63
9	0.65	1.64	6.02
10	0.70	1.76	6.43
11	0.74	1.89	6.83
12	0.79	2.01	7.25
13	0.83	2.14	7.69
14	0.88	2.27	8.15
15	0.93	2.40	8.63

Cost of energy item i.e fodder for the bullock as well as food for cyclist/ricksaw puller have not been taken into account. No overhead cost is generally involved for this type of vehicles. Parameters like repair and maintenance of NMT, depreciation, interest and crew costs have been taken into consideration for estimation of VOC as produced through HDM run. It may be mentioned that the VOC for the animal cart is relatively more sensitive to roughness mainly due to its typical operating characteristics.

The economic VOC per km for motorised and non-motorised vehicles are presented according to vehicle type in Figures 3.1 and 3.2 respectively.

FIGURE 3.1 SENSITIVITY OF MOTORISED VOC TO ROUGHNESS

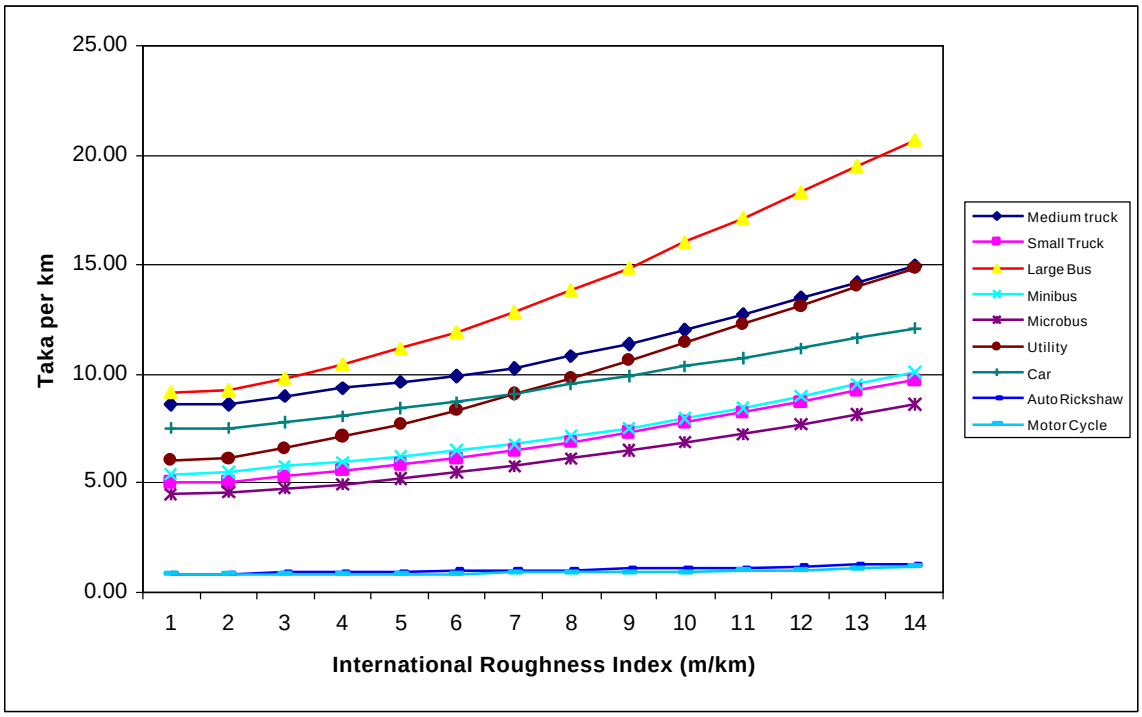
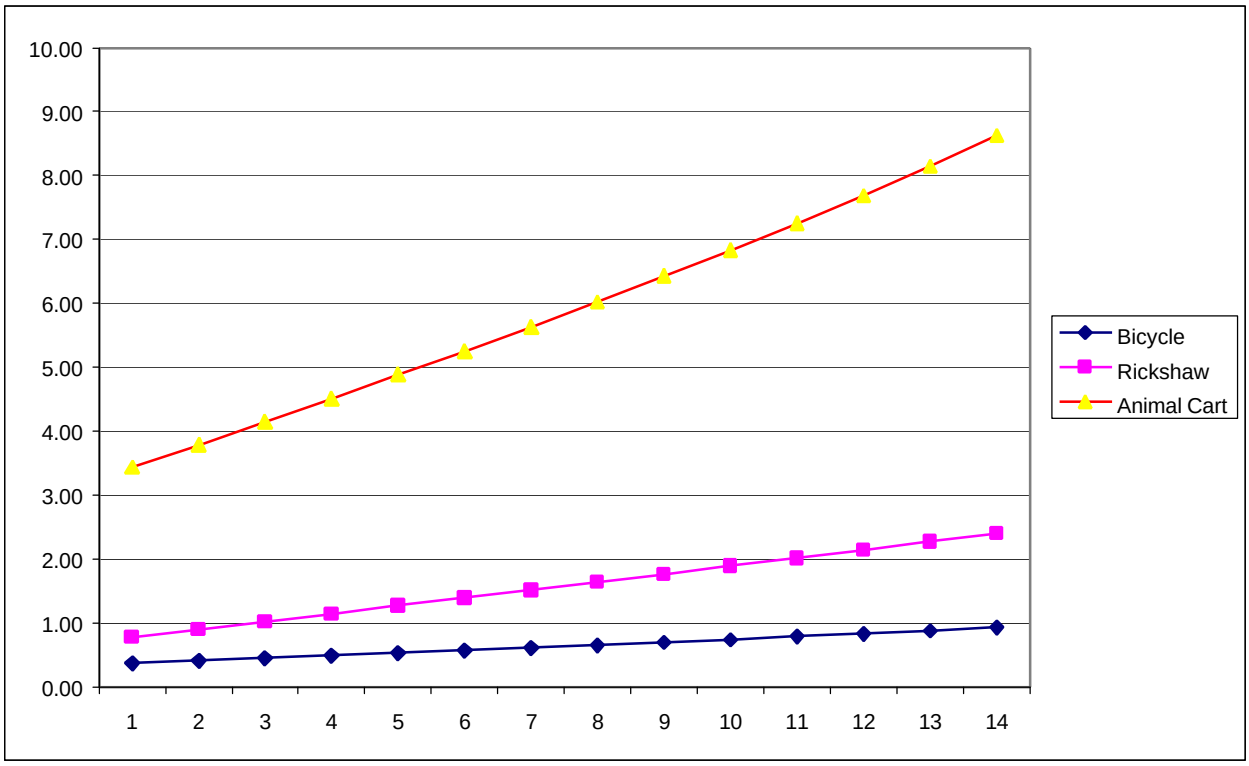


FIGURE 3.2 SENSITIVITY OF NON-MOTORISED VOC TO ROUGHNESS



4 TRAVEL TIME COSTS

4.1 General

Travel Time Costs (TTC) also referred to as Values of Time (VOT) are an important component of road user costs. The concept of travel time costs is based around the premise that time spent in travelling has an "opportunity cost" and could be used in an alternative activity which also produce or may produce some significant utility (benefit). If the alternative activity can have a monetary value assigned to it this can be used as a part of RUC in the economic appraisal of projects, particularly of the transport projects having relation with consumption of time.

TTC may vary from country to country, even from project to project in the same country. This can vary in size from 20 per cent of total RUC to over 80 per cent of the same in the economic and/or financial appraisal of schemes depending on the extent of time delays involved in case of the project under study as well as the income pattern of the road users. In case of the construction of a major new bridge to replace a ferry for example, TTC will be very significant compared to a road improvement project without any change in its alignment. Again, value of time will be much higher in a more developed country like the USA or Britain than that in a less developed country like Bangladesh or Afganistan. Similarly this variation in value of time may exist between a more developed region or society of a country and a relatively less developed part or habitation of the same country.

Time costs can be estimated for road users and for freight consignments. Costs may be broken down into "in vehicle time" and "out of vehicle time". The latter may be important to bus passengers waiting for a vehicle, but is specialised in its application and is not considered in the RHD approach which focuses on "in vehicle" time values only.

Time costs will vary between different vehicle types according to the socio-economic characteristics of the occupants, their trip purpose and the type of freight carried. For analysis purposes TTC are expressed as hourly values per vehicle by assuming average occupancies and loading factors for each vehicle type.

Although every vehicle or category of vehicles will have its own total TTC it is sometimes considered appropriate to apply a uniform TTC across all vehicle types to avoid biasing investment towards roads with a dominance of one type of user over another (i.e. a road with many high income car users will generate much higher time savings than a road with many low value rickshaw users: a scenario typically prevailing in Bangladesh). In this case of uniform application the TTC is referred to as an "equity" value. This approach is appropriate mainly for the developed country as income distribution in such country is more or less smooth and even. Users of cars and bicycles may belong to the same economic class as most of them own and use both of the vehicles to suit the convenience of their movement. In a country like Bangladesh on the contrary, the income pattern between the users of highly expensive motorised vehicles such as cars and jeeps and those of slow moving non-motorised transport such as rickshaws and bicycles is substantially different and these two categories of road users belong to two completely different economic classes in the society. That's why the approach of uniform TTC has not been adopted in Bangladesh to date. In this study TTC has been estimated according to separate vehicle type.

As TTC varies geographically according to the socio-economic characteristics of the region, it would be expected, for instance, that road users in Dhaka city will value their time more than those in a remote Thana in Dinajpur. It is usual practice, in this case, to

adopt a set of nationally averaged TTC applicable to all analyses to avoid the sort of geographical biases in road investment. This approach will continue to be used in Bangladesh in line with current methodology.

4.2 Previous Work

Until the IDC initiative taken since the later part of 1990's TTC were estimated in feasibility studies according to the requirements of specific projects. Costs were often based on small surveys or updated from previous studies. Table 4.0 sets out the principal transport studies to date that have did some original work on TTC. An average wage base approach was used by the first four studies. This basis was changed in case of the Dhaka City Eastern Bypass Study which used a Stated Preference interview technique producing very high TTC.

Table 4.0
Previous Works on TTC in Bangladesh

Study	Author	Year
Jamuna Bridge Feasibility Study	Rendel Palmer & Tritton et al	1989
Road Master Plan Project	Transroute et al	1992
Road Materials & Standards Study	Howard Humphreys et al	1994
Dhaka Urban Transport Study Phase 2	Mott MacDonald et al	1996
Dhaka Eastern Bypass	Halcrow Fox et al	1997

Findings of the previous studies including those of the RHD Economics Circle are presented in the following table.

Table 4.1
Findings of Previous Works on TTC in Bangladesh
(Values per vehicle occupant in Taka, not adjusted for inflation)

Study	Year	Bus	Car
Jamuna Bridge Feasibility Study	1989	7.84	-
Road Master Plan Project	1992	8.00	20.00
Road Materials & Standards Study	1994	9.00	23.00
Dhaka Urban Transport Study Phase 2	1996	5.52	19.17
Dhaka Eastern Bypass	1997	28.8-35.6	74.40
RHD Economics Circle	1999-2000	13.90	31.20

4.3 Methodology

The Dhaka Eastern Bypass Study (DEBS) derived TTC higher than the ones estimated by other previous studies. As the reasons for the unduly higher values are not completely clear through the study report, they were not used in the economic appraisal of the bypass study. It was considered that the results might have been biased by the high incomes in the Dhaka area and/or the previously unused “Stated Preference” interview technique. The Economics Circle therefore started to undertake annually TTC surveys in some greater details in four major divisional cities since 1997 both on main and feeder roads in order to develop a greater understanding of the issues involved, and to estimate a common national set of TTC according to vehicle types.

The survey was based on the Average Wage approach whereby the wage rates of vehicle occupants are assessed and then their average rates have been estimated to

reflect the value of time of occupants in different vehicles. An assessment of the number of travellers in work time (WT) and non-work time (NWT) is made for each vehicle type. The TTC for WT is then taken as the estimated wage rate (net of tax but including employers costs directly associated with the employment) and the value for NWT as a proportion of the wage rate (35 per cent according to advice from the United Kingdom's Transport Research Laboratory).

The Economics Circle has been undertaking TTC survey every year as a part of RHD RUC Annual Report. The circle has already published two RUC reports for the years 1998/99 and 1999/2000. As a part of this study report, TTC survey was conducted by the Economics Circle during mid 2000.

4.4 Summary of Survey Results

This section sets out a summary of the main and feeder road travel time surveys conducted in 2000. Details of TTC methodology can be found in Economics Working Paper E7. Tables 4.2 and 4.3 set out the distribution of trip purpose for main road and feeder roads respectively.

Table 4.2
Percentage Sample Distribution of Vehicle Occupants by Trip Purpose (Main Road)

Trip Purpose/ Vehicle Type	A/C Bus	C/C Bus	O/C Bus	Mini Bus	Micro Bus	Car	Auto Rick	Tempo	Motor Cycle
Journey to Work	17	16	37	20	33	26	41	27	36
Employers Business	13	22	23	20	7	16	14	30	14
Own Business	22	13	30	12	27	5	24	20	36
Family and Social	39	39	3	32	33	32	14	7	9
Other	9	10	7	16	0	21	7	16	5
Total	100	100	100	100	100	100	100	100	100

Note: A/C =Air Conditioned, C/C= Chair Class, O/C= Ordinary Class.

Table 4.3
Percentage Sample Distribution of Vehicle Occupants by Trip Purpose (Feeder Road)

Trip Purpose/ Vehicle Type	O/C Bus	Mini Bus	Micro Bus	Car	Auto Rick	Tempo	Motor Cycle
Journey to/from Work	43	63	14	0	50	48	33
Employers Business	5	13	14	0	20	16	26
Own Business	22	7	0	60	5	12	22
Family and Social	9	14	72	40	25	20	15
Other	21	3	0	0	0	4	4
Total	100	100	100	100	100	100	100

Tables 4.4 and 4.5 show the distribution of occupations according to main road and feeder road users respectively.

Table 4.4
Percentage Sample Distribution of Vehicle Occupants by Occupation (Main Road)

Occupations/ Vehicle Type	A/C Bus	C/C Bus	O/C Bus	Mini Bus	Micro Bus	Car	Auto Rick	Tempo	Motor Cycle
Businessman	43	16	37	40	53	37	24	30	45
Officer	30	48	13	16	27	53	20	7	27
Salesman	0	0	0	0	0	0	0	10	5
Clerical	0	10	10	0	13	5	14	23	9
Farmer	0	3	10	4	0	0	7	0	0
Student	9	10	7	16	0	0	17	17	5
Domestic Staff	0	0	0	0	0	0	0	3	0
Housewife	9	3	0	0	0	5	4	0	0
Unemployed	0	0	0	0	0	0	4	0	0
Other	9	10	23	24	7	0	10	10	9
Total	100	100	100	100	100	100	100	100	100

Table 4.5
Percentage Sample Distribution of Vehicle Occupants by Occupation (Feeder Road)

Occupations/ Vehicle Type	O/C Bus	Mini Bus	Micro Bus	Car	Auto Rick	Tempo	Motor Cycle
Businessman	22	27	43	100	30	20	37
Officer	13	0	29	0	15	4	37
Salesman	0	7	0	0	10	8	0
Clerical	26	10	0	0	25	8	11
Farmer	9	17	14	0	5	20	4
Student	17	13	0	0	10	16	7
Domestic Staff	0	0	0	0	0	0	0
Housewife	0	10	14	0	5	12	0
Unemployed	0	0	0	0	0	0	0
Other	13	16	0	0	0	12	4
Total	100	100	100	100	100	100	100

Tables 4.6 and 4.7 shows the reported monthly household income of the respondents (gross of tax) by vehicle type. The results accord with last years surveys and show the significant differences between main road and feeder road incomes and between different bus and vehicle types.

Table 4.6
Percentage Sample Distribution by Monthly Income (Main Road)

Income/ Vehicle Type	A/C Bus	C/C Bus	O/C Bus	Mini Bus	Micro Bus	Car	Tempo	Auto Rick	Motor Cycle
<1000	0	0	0	0	0	0	0	0	0
1001-2000	0	0	7	4	0	0	7	0	0
2001-5000	0	13	13	28	13	0	43	31	0
5001-10000	39	42	53	52	20	21	33	28	50
10001-20000	44	32	20	12	40	58	17	38	41
20001-30000	13	13	4	4	27	11	0	3	9
30000+	4	0	3	0	0	10	0	0	0
Total	100	100	100	100	100	100	100	100	100

Source: Travel Time Cost Survey 2000.

Table 4.7
Percentage Sample Distribution by Monthly Income (Feeder Road)

Income/ Vehicle Type	O/C Bus	Mini Bus	Micro Bus	Car	Tempo	Auto Rick	Motor Cycle
<1000	0	3	0	0	0	0	0
1001-2000	0	3	0	0	8	0	0
2001-5000	57	57	14	0	52	10	4
5001-10000	39	30	72	20	40	70	78
10001-20000	4	7	14	80	0	15	18
20001-30000	0	0	0	0	0	5	0
30000+	0	0	0	0	0	0	0
Total	100	100	100	100	100	100	100

Source: Travel Time Cost Survey 2000.

4.5 Unit Travel Time Costs

The 2000-01 TTC are set out in Table 4.8. The bus value is an average of all bus types weighted by annual bus passenger km. The values for all other passenger vehicles have been averaged typically taking category-wise length of network and density of road use into consideration. The unit results worked out are more or less consistent with those of the previous year. However the occupancy number for the category of buses has decreased by about 10% resulting in a similar fall of TTC per bus, though the TTC per passenger remains slightly above. TTC value for tempo has increased by 34%, while that for motor cycle has decreased by 10.6% compared to last year value.

Table 4.8
Recommended Financial and Economic TTC For 2000-01(National Average)

		Financial		Economic	
Vehicle Category	**Occupancy Number**	**TTC per pass Taka/hr**	**TTC per vehicle Taka/hr**	**TTC per pass Taka/hr**	**TTC per vehicle Taka/hr**
All Buses	42.2	17.5	740.3	14.0	592.2
Micro Bus	7	30.4	212.5	24.3	170.0
Car/Utility	3.2	40.5	129.7	32.4	103.7
Tempo	9	14.9	133.7	11.9	107.0
Auto Rickshaw	2	23.7	47.4	19.0	38.0
Motor Cycle	1.5	28.2	42.3	22.6	33.8

Observations:

- The unit TTC values are more or less consistent with the values of the previous study
- The large differences between the feeder road and main road transport markets identified in the previous report are confirmed in the 2000 surveys
- TTC for non-motorised vehicles are not included in this report

The information through which the above unit TTC values have been arrived at are furnished in the following tables.

Table 4.9
Summary of Financial TTC per Hour in Taka for Passengers by Vehicle Category and Road Type

Category of Vehicles	Main Road	Feeder Road
Air Conditioned Large Bus	34.8	-
Chair Class Large Bus	33.1	-
Ordinary Large Bus	26.9	12.0
Mini Bus	21.2	13.5
Microbus	32.9	20.2
Car	43.9	27.0
Tempo	20.6	12.4
Auto Rickshaw	22.9	25.0
Motor Cycle	30.5	25.9

Table 4.10
Calculation of Weighted Average Global Bus Travel Time Cost

Total Buses Registered in Bangladesh (BRTA 1999)

Minibus	12999
Largebus	13939
Total	26938

Annulisation factor (working days/annum) 312

Bus Category	Average Occupancy	Avg daily km per bus	Buses Registered	% of Total Fleet	Daily bus km (mln)	Daily pass km (million)	Annual Pass km (million)	TTC per Pass (Tk/hr)	TTC per Bus (Tk/hr)	Annual TTC per Pass (Tk/hr)	Annual TTC per Bus (Tk/hr)
1	2	3	4	5	6	7	8	9	10	11	12
	TTC Survey	VOC Survey	Estimate	Estimate	(3*4)	(6*2)	(7*Anl optg days)	Table 4.2	(8*2)	(8*7)	(9*7)
Inter-urban											
A/C Large	28	361	348	3%	0.13	3.52	1099	34.8	974.4	38245	1070850
Chair	33	391	3067	22%	1.20	39.57	12345	33.1	1092.3	408627	13484707
Large Other	47	230	3624	26%	0.83	39.18	12223	13.5	634.5	165013	7755626
Large Minibus	35	180	5200	40%	0.94	32.76	10220	21.2	742.0	216671	7583488
Rural											
Large	64	180	6830	49%	1.23	78.68	24549	12.0	768.0	294589	18853674
Mini	36	180	7799	60%	1.40	50.54	15769	13.5	486.0	212875	7663498
Totals			26868.3		5.73	244.25	76205			1336020	56411844

Travel Time Costs	Financial	Economic
Weighted Average TTC per Passenger Hour (Tk)*	17.5	14.0
Weighted Average TTC per Vehicle Hour (Tk)*	740.3	592.2

* Weighted average is based on operating km according to bus type

National Average Occupancy All Buses (Persons)	42.2

In case of general use the nationally weighted average TTC is recommended. However for a particular project relating to either main or feeder road or even particular bus type, the methodology applied in the above table can be followed.

Table 4.11
Calculation of Global TTC per Hour for Non-Bus Vehicle Passenger

Category of Vehicles	TTC (Main Road)	Weight Factor	TTC (Feeder Road)	Weight Factor	Average TTC (financial)	Average TTC (economic)
Microbus	32.9	80%	20.2	20%	30.4	24.3
Car	43.9	80%	27.0	20%	40.5	32.4
Tempo	20.6	30%	12.4	70%	14.9	11.9
Auto Rickshaw	22.9	60%	25.0	40%	23.7	19.0
Motor Cycle	30.5	50%	25.9	50%	28.2	22.6

5 ACCIDENT COSTS

5.1 Introduction

Accident costs here refer to the costs borne by the economy due to occurrence of a road accident. Research carried out so far has shown that the economic value of road accident costs can easily be equivalent to one per cent of a country's Gross Domestic Product (GDP), a significant drain on any country's resources. In addition to the overall impact of Road Traffic Accidents (RTA) on the national economy, estimates of accident costs are also needed to measure the safety impacts of road schemes. The main objective of most road improvement works is to reduce vehicle operating costs and journey time costs, which is most often achieved by increasing vehicle speeds. Increased speeds may increase the number and severity of accidents. It is therefore vital to include the cost of accidents in road project appraisals as the failure to do so may result in increased loss of life and economic output.

The two basic methodologies of costing accidents are the Lost Output (or "human capital") and the Willingness to Pay (WTP) approach. Lost Output focuses on the economical consequences of road accidents but also includes a component for the pain, grief and suffering (PGS) caused by road accidents. The WTP method, on the other hand, considers the value of preventing an accident, i.e. how much people would pay to avoid an accident altogether. This approach produces much higher cost estimates than the Lost Output Method. WTP has only been used in motorised countries, while the Lost Output method has traditionally been recommended for motorising countries whose primary objective is maximisation of national economic growth.

Our approach is based on the Lost Output method. The methodology follows an established procedure. A conservative approach was adopted as several of the parameters require additional research which is hoped to be accomplished in future studies.

5.2 Estimating the Number of Road Traffic Accidents (RTA)

As most injury RTA include more than one casualty and loss of many other dimensions, RTA costing is traditionally divided into casualty related costs like lost output, medical costs, pain, grief and suffering, etc and event related costs such as property damage and administration costs. RTA casualties are classified in three basic categories:

- **Fatalities** are limited to deaths that take place from and within 30 days of the occurrence of RTA
- **Grievous/Serious injuries** include injuries which require hospitalisation i.e. an overnight admission and stay in a hospital to those RTA related deaths taking place after the first 30 days from RTA occurrence.
- **Simple/Slight injuries** are those which require medical treatment but not hospitalisation.

The number of RTA as recorded in the Microcomputer Accident Analysis Package (MAAP) edited by Bangladesh Police in 1999 has been presented in table 5.0 and 5.1 according to severity and area.

Table 5.0
Nationwide Casualties According to Severity and by Police Range as well as Metropolitan Area in 1999

Metropolitan Area /Police Range	Casualties			Total	Percentage
	Fatal	Grievous	Simple		
DMP	314	512	253	1079	16.6
CMP	104	92	26	222	3.4
KMP	22	12	28	62	1.0
RMP	36	23	15	74	1.1
Dhaka Range	810	486	194	1490	23.0
Chittagong Range	510	418	297	1225	18.9
Sylhet Range	272	191	150	613	9.4
Khulna Range	167	118	117	402	6.2
Barisal Range	41	46	15	102	1.6
Rajshahi Range	675	913	224	1218	18.8
Total	2,951	2,217	1,319	6,487	100

Source: Bangladesh Police, Road Traffic Accidents, National Report 1999

Table 5.1
Casualties According to Severity and by Status of Area in 1999

Area status	Casualties			Total	Percentage
	Fatal	Grievous	Simple		
Urban	753	862	444	2,059	31.8
Rural	2,190	1,350	872	4,412	68.2
Total	2,943	2,212	1,316	6,471	100
Actual Total*	2,951	2,217	1,319	6,487	

*Note: 16 casualties was unknown by status of area that is either urban or rural.
Source: Bangladesh Police, Road Traffic Accidents, National Report 1999

Estimation of total cost for road accidents should not be limited to only those which are officially reported; it should include both reported and unreported accidents as all accidents incur costs borne by the economy. It is largely admitted that there is widescale under-reporting of simple RTA, while the concerned agencies including the Bangladesh Police believe that fatal and grievous RTA are well reported.

But this has not been found to be the case. An IDC assessment in 1995/1996 found that only 20% of casualty RTA were included in the official accident statistics of Dhaka Metropolitan Police (DMP). In reality, this statistics of accident recording appears to be on the higher side. It is possible that the actual accident figure is twice as large which means that only 10% casualty RTA are really being officially recorded. It should be pointed out that the severity ratio i.e. the ratio of RTA injuries to fatality in Bangladesh is less than 8:1 vis-a-vis the recommendations of two recent study in Indonesia with the ratio of 25:1 and 52:1. (Downing, 1997). So again, injuries could be much higher in Bangladesh than is estimated.

The severity ratio will greatly depend upon the extent to which accidents are consistently reported. The percentages used in this accident costing exercise are shown in Table 5.2. Fatal accidents are assumed to be the best reported that is almost half the number of accidents really occurred, while only one out of every 15 simple RTA is believed reported to the police.

Table 5.2
Estimated RTA on the basis of Reporting

Type	MAAP 1999	Percentage of Reporting	Estimate of 100% Accidents in 1999-2000
Fatal	2,951	49%	6,022
Grievous	2,217	19%	11,668
Simple	1,319	7%	18,843
Total	6,487	20%	32,435

MAAP = Microcomputer Accident Analysis Package
Source: Bangladesh Police

It has traditionally been assumed that fatal RTA have been the most well reported as this is the case in motorised countries. However in Bangladesh problems of compensation reduce the reporting of fatal accidents. Further research into the extent of under-reporting is required before an accurate assessment of the accident occurrence can be made. Accidents causing Property Damage Only (PDO) have also been estimated as they too incur costs. Conservative figures have been used with three PDO RTA being estimated for every casualty RTA. This is lower than that used at any time in the UK (early costings assumed a 6:1 ratio) and lower than that currently estimated for Nepal. Total RTA are set out in Table 5.3.

Table 5.3
Estimated Nationwide Total RTA (Casualty Plus PDO)

Casualty RTA	PDO multiplier	Estimated PDO	Total RTA
32,435	3	97,305	129,740

5.3 Valuing Cost of Road Traffic Accident Components

5.3.1 Lost Output

Lost output refers to the loss to the economy of productive capacity of the persons victimised by a road accident. While most accident surveys rely on accident victim surveys or average wage rate to estimate lost output, average incomes for motorised transport users have been determined by the TTC surveys undertaken by the Economics Circle. Only the average income of a pedestrian had to be calculated additionally using an average per capita income of Taka 1,598 per month. Table 5.4 shows the average incomes estimated for the different road user types and the relative casualty share estimated.

Table 5.4
Average Income and RTA Casualty Share by Road User Type (Taka -2000)

Item	Truck	Bus	Car	Rickshaw	Pedestrian
Average monthly income*	6,154	7,740	17,000	5,300	1,598
Average annual income*	73,848	92,880	204,000	63,600	19,176
RTA casualty share**	5%	25%	5%	15%	50%

* Source:TTC survey, 2000 & BBS
** Source: As estimated by Accident Costs Specialist IDC 1998

It is necessary to calculate the average age of accident victim in order to estimate the net average lifetime income lost by a road user due to an accident. The casualty statistics by

age in 1999 as available from MAAP, Bangladesh Police has been presented in the following table.

Table 5.5
Casualties by Severity and Age Group in 1999

Age Group	Casualties			Total	Percentage
	Fatal	Grievous	Simple		
0 - 5	74	27	11	112	2.3
6 - 10	226	56	22	304	6.3
11 - 15	153	74	34	261	5.4
16 - 20	190	129	78	397	8.3
21 - 25	244	252	160	656	13.6
26 - 30	328	309	188	825	17.2
31 - 35	298	277	155	730	15.2
36 - 40	180	169	124	473	9.9
41 - 45	153	111	80	344	7.1
46 - 50	125	78	24	227	4.7
51 - 55	93	31	17	141	2.9
56 - 60	91	31	12	134	2.8
61 - 65	57	19	9	85	1.8
66 - 70	59	16	2	77	1.6
70 - 75	14	2	0	16	0.3
> 75	26	2	2	30	0.6
Total	2,311	1,583	918	4,812	100
Actual Total*	2,951	2,217	1,319	6,487	

*Note: 6487-4812=1675 casualties was unknown by age.

The net lost output for a RTA fatality was based on the following assumptions:

- Average lost working years = 27 (average retirement age 57 years - average age of RTA fatality 30 years as calculated on the basis of above table)
- Annual discount rate of 12% and average GDP per capita growth rate 3.1% (average of the different growth rates over the analysis period considered)
- 30% of per capita is taken to be personal consumption.

The present values of lost output for each user category are set out in Table 5.6. The average lost output is Taka 1036,076.

Table 5.6
Lost Output by Road User Type (Taka in 2000)

Lost Output Parameters	Truck	Bus	Car	Rickshaw	Pedestrian	Average
Present Value of Lost Output	843,566	1060,969	2330,293	726,503	219,048	1036,076
RTA casualty Share in percent	5	25	5	15	50	100
RTA casualty Share in amount	42,178	262,242	116,515	108,975	109,524	639,434

Injuries and Recovery time

The lost output for RTA injuries was the daily income multiplied by the number of recovery days. Based on studies in India and Indonesia, a 30 day recovery period was used for grievous injuries while 2 days was used as the estimated average recovering time required for simple injuries. As a 25 day working month has been used in previous

RHD economic analyses, the lost output for grievous injuries will be 25 days to be valued at 100% and the remaining 5 days at 25%, i.e. non-working/leisure time. Both days spent recuperating with simple injuries have been assumed to be working days.

Cost per RTA is definitely higher than that per casualty. Therefore RTA multipliers as assumed on the basis of the economics working paper E8 relating to accident costs prepared by IDC consultant are applied to the casualty cost in order to arrive at the RTA cost.

Table 5.7
Lost Output Casualty Costs (Taka in 2000)

Category	Per casualty Cost	Fatal RTA		Grievous RTA		Simple RTA	
		Number	Cost	Number	Cost	Number	Cost
Fatality	457,074	1.7	777,025	0	0	0	0
Grievous	4,921	1.4	6,889	1.7	8,366	0	0
Simple	375	1.4	525	2.2	825	1.5	562
Total			**784,439**		**9,191**		**562**

5.3.2 Medical Costs

The standard cost components of medical services received by RTA casualties include: first aid and rescue services (ambulance), hospital costs (food and bed, operations, x-rays, medicines, doctors services), and subsequent rehabilitation costs (treatment, prosthetics).

Rescue services

In Bangladesh, very few of RTA casualties are transported by ambulance services or receive first aid treatment as roadside first aid posts do not exist. Yet RTA casualties are still transported to medical centres or homes (the police usually transport the bodies of those who died at the scene) and these trips involve a cost. Given the lack of data on hospital transport costs, a token amount of Taka 500 is assigned to each RTA casualty to reflect transport cost.

Hospital care

Hospital costs are difficult to calculate and an average in-patient per day cost and average out-patient visit cost are the best working estimates believed possible. The Centre for the Rehabilitation of the Paralysed (CRP) estimates its monthly in-patient cost at Taka 13,572/month (up from 8000/month when costs first began being monitored in 1990). Using the CRP's figure, an average in-patient per day cost of Taka 452 will be used. Average in-patient length of stay is not known for RTA casualties only. However an average in-patient stay of 10 days is assumed, while an average out-patient length of stay of 2 days is assumed with 50% cost of in-patient stay per day. Outpatient visit costs are estimated at 25% of the in-patient per day and outpatient visits will refer to all casualty treatment services, whether hospital or private clinic administered.

Table 5.8
Medical Costs per RTA Casualty (Taka-1997)

Category	Per casualty Cost	Fatal RTA		Grievous RTA		Simple RTA	
		Number	Cost	Number	Cost	Number	Cost
Fatality	300	1.7	510	0	0	0	0
Grievous	45,692	1.4	63,969	1.7	77,677	0	0
Simple	113	1.4	158	2.2	249	1.5	170
Total			**64,638**		**77,926**		**170**

5.3.3 Human Costs: Pain, Grief and Suffering (PGS)

The Road User Cost Study conducted in India in the early 1980's estimated PGS at 20 per cent of total lost output. This percentage has been maintained in subsequent Indian costings and was also adopted for the 1995 Nepal accident costing exercise. It has been used in this analysis as a default value pending further research.

As explained under Lost Output, the amount estimated for personal consumption (30% of gross lost output) has been transferred to the traditional PGS Component. This is added to the 30 per cent proportion of lost output taken as the PGS component to give the cost set out in Table 5.9. The term "human costs" is used to refer to this expanded component.

Table 5.9
Human Costs (Taka 2000-01)

Category	Per casualty Cost	Fatal RTA		Grievous RTA		Simple RTA	
		Number	Cost	Number	Cost	Number	Cost
Fatality	274,244	1.7	466,215	0	0	0	0
Grievous	2,953	1.4	4,134	1.7	5,019	0	0
Simple	225	1.4	315	2.2	495	1.5	337
Total			**470,664**		**5,514**		**337**

5.3.4 Vehicle Damage Costs

One further area of RTA costs is the vehicle and other property damage. This component should also include some costs due to any loss caused to the businesses because of the vehicle being out of commission. This may be referred to as the lost earnings to the vehicle owners. Vehicle damage was known to be a major cost component and data was collected during the 2000 survey of operators conducted by the Economics Circle. This data is summarised in Table 5.10.

Table 5.10
Average Vehicle Damage Costs from 2000 Operators Survey
(Taka per vehicle-2000-01)

Cost component	Medium Truck	Small Truck	Large Bus	Mini Bus	Utility	Car	Tempo	Auto Rick
Damage	65,563	3,140	94,583	14,444	4,000	14,000	5,791	2,875
Lost earnings	58,733	6,600	54,042	13,444	3,250	5,025	4,688	2,844
Total Costs	**124,296**	**9,740**	**148,625**	**27,888**	**7,250**	**19,025**	**10,479**	**5,719**
Number of Accidents	28	5	23	11	2	5	9	12
Grand Total	**3480,288**	**48,700**	**3418,375**	**30,6768**	**14,500**	**95,125**	**94,311**	**68,628**

In addition, vehicle claim data was provided by one large private insurance company which found that the 1997 average vehicle damage claim cost was Taka 43,500 (265 claims). It needs updating which could not be done during this study. As such estimation of vehicle damage costs was made on the basis of vehicle operators' survey 2000 irrespective of the insurance claim. Given the uncertainty regarding the proportion of vehicle damage involved in an average accident it was decided to adopt a cost which might be incurred due to vehicle damage and lost earnings facing a simple average accident. A value of Taka 79218 per simple accident was therefore adopted which accords with the weighted average values from the operators' survey. Then factors 1.5 and 2.0 were applied to arrive at the grievous and fatal accidents cost respectively. Table 5.11 sets out the resultant costs.

Table 5.11
Average Vehicle Related Costs per Accident (Taka 2000)

Severity	Unit costs
Fatal	158,436
Grievous	118,827
Simple	79,218
PDO	3,961

Source: Economics Circle Estimates

5.3.5 Administrative Costs

Administrative costs include the "handling costs" incurred by police, insurance companies and courts in investigation of road accidents as well as prosecution and the settlement of insurance claims. Related police activity includes at the scene efforts as well as the initial reporting and any subsequent investigation and prosecution. This could include the officer in charge, the accident investigator, the vehicle examiner, and the Coroner's office.

- Given the level of under-reporting, the relatively few vehicle insurance claims, and the small number believed to go through the legal system, administrative costs are not assumed to be worth surveying in Bangladesh. However, as it is believed that many if not most of accidents are settled privately and these negotiations do take time, a token amount of Tk 1000 is suggested for general administrative costs.

5.4 Total Road Accident Cost Estimates

5.4.1 Costs Not Included

RTA cost calculations are almost exclusively focused on the losses to society related to the victim himself and not those of others close to the victim. Some of the other costs not commonly factored in accident costings include:

1. loss of earnings of carer (i.e. family member must give up work to provide home care);
2. work replacement cost, i.e. training to the replacer;
3. travel time delay from accidents, including that from road blockades occasionally created after accidents;
4. clearing up of accident spot/scene;
5. leisure time lost in the post working years;
6. life expectancy reduced of RTA casualties.

Moreover, this accident costing exercise was limited to the three main casualty types, fatal, grievous and simple. It did not factor those grievously injured who are left disabled and with reduced earning capability.

5.4.2 Average Accident Cost by Severity

Table 5.12 shows the total cost of each RTA by severity and according to various cost components.

Table 5.12
Total Accident Costs By Severity Type And Cost Component
(Taka '000)

Component	Fatal	Grievous	Simple	PDO
Lost output	784.44	9.19	0.56	0.00
Medical costs	64.64	77.93	0.17	0.00
Human costs	470.66	5.51	0.34	0.00
Vehicle damage	158.44	118.83	79.22	3.96
Administration	1.00	1.00	1.00	1.00
Total	**1479.18**	**212.46**	**81.29**	**4.96**

According to the above cost estimates, a fatal RTA costs 7 times that of a grievous RTA and 18 times than that of a simple RTA. Property damage only accidents have been estimated at only 6% of a simple accident. The cost of a grievous RTA is estimated at a value 2.6 times higher than that of a simple RTA.

5.4.3 National Road Traffic Accident Costs

Table 5.13 sets out the sum of all accident cost components for the total number of estimated accidents in 1997. The total cost of all road accidents, including PDO, has been conservatively estimated at Tk 7,495 million (Tk 750 Crore or US$153 million). The vast majority of the costs are due to casualty accidents with property damage only accidents accounting for less than 2.5 per cent of total costs.

Table 5.13
Annual National RTA Costs For 2000-01 (Taka)

Item	Number of Accidents	Average Cost per accident ('000 Tk)	Total Cost (million Tk)
Fatal RTA	6,022	1,479	8,907
Grievous RTA	11,668	212	2,474
Simple RTA	18,843	81	1,526
Total casualty RTA	**32,435**	**-**	**12,907**
PDO RTA	97,305	5	487
Total RTA	**129,740**	**-**	**13,394**
Average Casualty RTA Cost	-	-	0.40

The average casualty RTA is estimated to cost Tk 400,000 (US$ 7407), while the total annual RTA costs amount to Taka 13394 million (US$248 million). It means that the total annual national accident cost is equal to 0.6 per cent of Gross National Product in 1997 (see Table 5.14.) This is less than the previously assumed global amount of 1 per cent. However, when it is considered that the whole analysis was based on conservative assumptions this amount is almost certainly the minimum cost to society. The true cost is probably much closer to the one per cent estimate and represents a totally unacceptable waste of life and Bangladesh's scarce resources.

Table 5.14
Total Annual Accident Costs as Proportion of GDP

Item	Taka Million	US$ Million
Estimated Total Annual Accident Costs	13,394	248
Gross Domestic Product at 1998-99 current market prices	2,196,954	40,684
Accident Costs %GDP	0.6%	0.6%

Note: US$1=54 Taka

5.5 Conclusions and Recommendations

5.5.1 Significance of this findings

Accident cost analysis in Bangladesh is still in its premature stage. A good many assumptions had to be made in carrying out the exercise. However efforts are always active to reduce the number of such assumptions and to make the analysis more fact-based.

The analysis has proved that accident costs are quite significant in Bangladesh and represent a substantial drain on its resources. As traffic volume and the population increase these costs will increase more than proportionately. Immediate action is required to address the accident problem in Bangladesh if the scale of the losses is not to hold back the wheel of development and if there is an intention to reduce the loss of human life.

5.5.2 Areas for Further Research

A main area of work in this accident costing business was the estimation of the actual number of road accidents. Some progress could however be made in respect of knowing

the number of accidents according severity, though further research is required on this fundamental problem as an accurate assessment of the overall accident situation has not yet been possible. More research is also required on the weightage to be given to a fatal RTA vis-a-vis a grievous RTA or a simple RTA. The size of the sample survey has also to be increased in respect of vehicle damage costs and loss of earnings.

5.5.3 Application of Accident Costs

A great deal of work is needed on researching the relationships between accident rates as well as fatality of accidents and road design as well as road improvement or development. Without this knowledge it will not be possible to apply the results of accident costs analysis in the economic appraisal of road maintenance and development projects. It is hoped that the accident reporting system introduced under IDC using the MAAP5 accident analysis software will provide the data to derive these relationships. This will be a longer-term exercise as a reliable time series of data will have to be recorded before realistic relationships can be established.