Government of the People's Republic of Bangladesh
Ministry of Communications
Roads and Highways Department

RHD ROAD USER COST ANNUAL REPORT For 2004 - 2005

Economics Circle
Sarak Bhaban Ramna Dhaka
June 2005

Foreward

It is a great pleasure for me to see that the Economics Circle under Roads and Highways Department has published the annual Road User Costs (RUC) Report 2004-2005. The Report contains as usual three components of basic works like Vehicle Operating Costs (VOC), Travel Time Costs (TTC) and Accident Costs (ACC).

As is known to all professionals in the transport realm, RUC occupies a dominantly major proportion of the total life-cycle costs of a road project which may increase even up to ninety percent depending on the volume of traffic on a road segment. RUC is such a vital issue that it is terribly uneconomic to ignore it in any extent. This huge road user costs can be substantially reduced through timely and proper maintenance of the road network.

The materials contained in the RUC report are principally used as the basic inputs in carrying out annual maintenance planning of road projects under RHD through application of HDM model. Besides, they are also largely used as significant inputs in conducting economic feasibility study of road and bridge projects. I hope the RUC study carried out by the RHD Economics Circle with its limited resources will go a long way to achieve the cherished goal for which it is intended.

In fine, I cordially thank the officers and staff of the Economics Circle engaged in doing this important task and hope that their efforts will continue to do the same in future as well.

(AKM Faizur Rahman)
Chief Engineer
Roads and Highways Department
Sarak Bhaban Ramna Dhaka

Preface

RHD has been pursuing a policy of following a planning system to allocate its budget to its highway maintenance and development programs according to socio-economic merits. An integral part of this system is the estimation of accurate Road User Costs (RUC) annually. The Economics Circle under RHD has been doing the job to update the RUC report on regular basis.

RUC report 2004-05 is the fifth annual/biennial update of this type. It contains vehicle operating, travel time and accident costs analysed on the basis of data collected through conducting field surveys in four divisional headquarters in Bangladesh as well as collection of relevant data from various concerned agencies and organisations.

The field surveys were conducted in various regions of the country which included 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.

Preparation of this report is the outcome of a combined effort of the officers and staff working in the Economics Circle on various levels in such form as data collection, data entry to the computer, data analysis, model run and report writing. Although care was taken to enrich the report as much as possible, there is still scope of some errors which could kindly be treated as inadvertent.

It is understandable that the effect of RUC on the economy of the country is colossal. It is as such desirable that the outcome of the study should be as much accurate as possible and closest to the reality. But in doing this job Economics Circle has been facing some methodical problems which need to be addressed properly. One area of such issue is the requirement of some expert training program arranged in home or abroad on the understanding of the relevant aspects of HDM-4 model as well as on some key areas of RUC analysis to be essentially imparted to the officers doing the job. RUC analysis of non-motorised vehicles is also a vital area in this respect. Besides in order to carry out the RUC studies with solemn reliability, we need to have some more personnel and financial resources than before.

(Marufa Ismat)
Executive Transport Economist RHD
Economic Feasibility Study Division
Sarak Bhaban Ramna Dhaka.

(Syed Faizul Islam)
Chief Transport Economist RHD
Economics Circle
Sarak Bhaban Ramna Dhaka.

CONTENTS

Page

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 plying on road.

According to an empirical study carried out by the Organisation for Economic Cooperation and Development (OECD) in 1994 on cost-shares under optimal maintenance situation 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 and timely 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. Economic Working Papers on three RUC components such as Vehicle Operating Cost (VOC), Travel Time Cost (TTC) and Accident Cost (ACC) were worked out. The first RUC study report was published in 1998-99 and had been updated annually/biannually since then. The present report is the fifth update of road user costs for the year 2004-2005.

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 travel 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 measuring 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.

Roads and Highways Department is developing systems to allocate its highway maintenance and development budgets according to economic criteria since 1994. 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 Planning and Maintenance Wing under RHD undertakes this important task. It contains vehicle operating, travel time and accident costs updated on the basis of data collected through conducting field surveys of road users, transport owners as well as operators and transport businesses. The statistics on the number and nature of road accidents are however taken from the National Road Traffic Accident Report 2003 prepared by the Road Safety Cell under BRTA.

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 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. It is important to mention here that in order to carry out a comprehensive ACC study, we need to have the accurate data on the number of road accidents and to undertake a detailed survey of medical costs in the representative hospitals of the country both government and private, urban and rural.

The report considers both motorised and non-motorised transport costs. The latter were included in the report in line with their inclusion in the HDM-4 appraisal model which is the basis for road maintenance planning under the Department. It may be mentioned that VOC and TTC for NMT were not done afresh for the current report but taken from the previous report exactly as they were. The NMT study of the previous report was based on the IDC funded PhD research completed by Mr. M Bari in 2000 and some sample surveys conducted by Economics Circle. In order to do this part in complete form, we need to have some training support from the CIDC3 or any other competent institution home or abroad. We also need to have more personnel as well as financial resources for this purpose.

1.3 Annual RUC in Bangladesh

It transpires from the study that the size of RUC in terms of monetary value is astoundingly stupendous. The annual RUC is Taka 389 billion in economic term during the year 2004 of which VOC at IRI 4 amounts to Taka 220 billion and TTC to Taka 169 billion. In financial value, on the other hand, the annual RUC is Taka 512 billion for the same period comprising Taka 298 billion as VOC at IRI 4 and Taka 214 billion as TTC. The financial RUC thus constitutes about 15 per cent of our GDP at current market price for the year 2003-04. But if the VOC is calculated at IRI 10, it comes to an amount of Taka 263 billion and Taka 373 billion respectively in economic and financial values. Now added to the TTC to arrive at annual RUC, these two figures stand at Taka 433 billion and Taka 587 billion respectively. One can easily imagine the huge implications of not maintaining the road network properly and timely.

It may be mentioned here that the RUC figure has been calculated on the basis of the number of registered motorised vehicles in 2003 and their average rate of utilisation in terms of kilometer and hour. If the RUC of non-motorised vehicles plying on road all over the country is also taken into account the amount of annual usrers' costs will be much higher than the one estimated here.

Calculated on the same basis, the total passenger-kilometer run during the year 2004 is 287 billion and the total ton-kilometer carried is 32 billion.

1.4 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 premium of the resource to the economy. In the economic jargon, this is termed 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 or from one agency to another within the economy. 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 shadow-pricing a factor or a product. In case of imported inputs, economic costs were based on the border prices plus port handling, transportation, assembling and retail cost (profit margin) duly shadow priced. Local inputs of labour and materials were also shadow priced using the RHD Standard Conversion Factor of 0.8 (ref: Economics Working Paper E9 for details on shadow pricing.)

Some transport economists opine that this standard conversion factor could now be 0.9 considering the relatively higher opportunity cost of a factor or a product with the increased job opportunity created in the economy. This opinion may be taken into consideration in future studies, if thought realistic.

1.5 Structure of this Report

The report starts by taking care of 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.

Detailed accounts of the work on each component are contained in the following Economics Working Papers:

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

2 THE BANGLADESH VEHICLE FLEET

2.1 Registered Vehicles

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 NMV is unknown. However, this report has dealt with the operating costs of both motorised vehicles as well as non-motorised.

Table 2.1 shows BRTA figures for vehicles registered in Bangladesh from 1995 to 2003. The BRTA figures indicate that to date some 737,000 motorised vehicles have been registered in the country.

Table 2.1 Number of Registered Vehicles in Bangladesh

Type	1995*	1997	1999	2001	2003	AAGR (%)
Car/Taxi	61962	82867	94048	106073	127128	9
Jeep/Microbus	29911	33778	38752	43337	49364	6
Bus	27724*	27972	28525	29456	30617	1
Minibus	25092*	26753	27834	29456	33364	4
Truck	31706	36152	40903	46203	51375	6
A Rick/Tempo	50539	69069	75612	79144	98479	9
Motorcycle	175088	201145	232181	271204	321347	8
Other	7255	10281	14146	18402	25726	17
Total	409277	488017	552001	623275	737400	8

AAGR= annual average growth rate from 1995 to 2003
*Note: Data regarding the number of buses and minibuses as shown for the year 1995 in BRTA report were wrongly shown much less and has later on been corrected.

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 eleven standard motorised vehicles and the other for four standard non-motorised vehicles, as set out in Table 2.2.

No data is published on the makes and models of vehicle registered by BRTA. A detailed examination of BRTA registration records was undertaken in 1995 to derive this information. This was supposed to be reviewed for application in the current RUC report in view of the fact that by the time of about 10 years since 1995 there was a lot of change in the pattern of vehicle fleet in Bangladesh. But due to resource constraint at the disposal of the Economics Circle it could not be done. However the idea of reviewing the makes and models of the registered vehicle fleet to adapt the changes in the exercise of selecting the updated representative vehicles category has not been given up. It is

expected that the task will be taken up immediately after the current RUC report is published.

Meanwhile a summary of the results of 1995 analysis for the two most popular makes of motorised 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. But in case of a number of vehicle categories the fleet is dominated by one make only. 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	Three wheeled motorised vehicles
Tempo	Large passenger & cargo carrying 3 wheelers
Cycle Rickshaw	Three wheeled passenger NMV
Rickshaw Van	Three wheeled cargo NMV
Cart	All animal carts and human drawn/push carts
Bicycle	All two wheeled non-motorised vehicles

Source: MCC Traffic Guide (RHD), October 2001

Table 2.3 Summary of Representative Vehicles 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%

Source: Bangladesh Road Transport Authority 1995

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

It was not possible to identify the number of articulated trucks (previously called as heavy truck) 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. 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. However, only a small number of this variety were constructed so far and the market is still 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.

It should be noted that an important development in 2002 was the introduction of CNG (Concentrated Natural Gas) powered auto-rickshaws in Dhaka. The VOC's for this new category will be assessed in the next RUC studies.

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

Source: Vehicle retailers in Dhaka

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	50	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

3.1 Introduction

The prediction of vehicle operation cost (VOC) 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 are 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. The personnel of Economics circle need more training on HDM-4 model. It is also required to have at least two weak input from one foreign expert who has knowledge on economics of HDM-4 to finalise the report in the light of global experience.

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

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 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 15 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 2004. A total of 40 operators for each type of vehicles were chosen with 10 operators in Dhaka, Chittagong, Rajshahi and Khulna areas each. The data were entered into 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 as well as time span.

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 2004. Large buses operating on the intercity routes are utilised for up to 83 per cent of the time available. Medium truck and mini bus are utilised more than 65 per cent. While light vehicles like micro bus, jeep, car and motor cycle are less utilised.

For modelling VOC 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 2004 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 except baby taxi are driven much less as would be normally expected.

Table 3.3 Average Annual Utilisation of Vehicles

Category	Annual Km Driven	Annual Hours in Work	Annual Hours Driven	Utilisation Ratio (1)
Medium Truck	80,700	3,100	2,036	66%
Small Truck	74,000	3,600	1,748	49%
Large Bus	129,800	3,450	2,864	83%
Mini Bus	66,700	3,060	2,121	69%
Micro Bus	56,800	3,200	1,171	37%
Utility (Jeep)	22,000	4,700	863	18%
Car	50,000	2,850	1,276	45%
Baby Taxi	46,000	1,950	1,695	87%
Tempo	44,000	3,850	2,126	55%
Motor Cycle	13,000	3,950	588	15%
Bicycle *	4,000	2,60	nc	nc
Rickshaw *	14,000	1,000	nc	nc
Animal Cart *	5,000	1,600	nc	nc

Source: Vehicle Operators Survey 2004 & (*) Vehicle Operators Survey 2002
Note: (1) Hours driven as % of hours in work

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). Table 3.4 also sets out the percentage of vehicles in the sample that were purchased second-hand.

Table 3.4 Age and Operational Life of Vehicles in Years

Category	Average Age	Normal Service Life	Second Hand Purchases %
Medium Truck	9	9	12
Small Truck	10	8	43
Large Bus	7	5	11
Mini Bus	10	5	17
Micro Bus	9	6	42
Utility (Jeep)	8	7	9
Car	8	5	31
Baby Taxi	4	5	7
Tempo	8	6	16
Motor Cycle	8	5	0
Bicycle*	nc	18	nc
Rickshaw*	nc	12	nc
Animal Cart*	nc	8	nc

Source: Vehicle Operators Survey 2004 & (*) Vehicle Operators Survey 2002

3.3.2 Response of Operators to Road and Bridge Improvements

As part of the survey, operators were asked what benefits they had experienced through implementation of road and bridge projects. The purpose of this was to establish an idea of the impact of the road improvement 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).

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

Response	Med Truck	Small Truck	Large Bus	Mini Bus	Micro Bus	Utility	Car	Tempo	Baby Taxi	Motor Cycle
Benefited	80	43	48	33	38	23	13	25	25	5
Change in operation	63	40	34	30	23	10	20	28	23	3
More trips	36	38	46	62	73	67	50	75	63	100
Longer trips	21	25	54	38	27	33	50	25	37	0
Increased load	43	37	0	0	0	0	0	0	0	0

Source: Vehicle Operators Survey 2004

The operators were also asked what specific projects they had benefited from. The three most beneficial projects are set out in Table 3.6

Table 3.6 Average Saving in Time and Operation Cost to Operators for Specific Road & Bridge Projects (% saving compared with trip before improvement)

Project	M Tuck	S Truck	AC Bus	CC Bus	OC Bus	Mini Bus	Micro Bus	Utility	Car	2/3 Wheel MT	Average
Nalka-Hatikamrul-Bonpara Road											
Time Saving	13	20	24	23	25	21	48	19	80	-	24
VOC Saving	16	24	15	22	17	14	17	18	-	-	19
Katchpur-Daudkandi Road											
Time Saving	18	28	10	14	20	20	24	-	22	-	19
VOC Saving	14	15	5	9	10	12	13	-	12	-	11
Dhaka City Roads											
Time Saving	-	15	-	-	-	-	-	12	16	-	16
VOC Saving	-	9	-	-	-	-	-	12	12	-	12

Source: Vehicle Operators Survey 2004

Table 3.7 Average Saving in Travel Time and Operation Cost to Operators for Improvement of Network in General (% saving compared with trip before improvement)

Saving	M Truck	S Truck	Large Bus	Mini Bus	Micro	Utility	Car	M Cycle	Tempo	Auto Rickshaw	Average
Time Saving	17	19	20	19	32	20	26	13	27	23	21
VOC Saving	13	19	13	12	17	12	24	11	9	18	14

Source: Vehicle Operators Survey 2004

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 prices (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 assessable value (AV):

- **Customs Duty (CD)**: Charged at a percentage rate on the AV. These vary between 14 and 40 per cent for vehicle imports. Duty on micro and car have been reduced from 40 to 25 and 35 to 25 per cent since 2000. On the other hand duty on medium truck, large bus, mini bus, baby taxi and motor cycle have been increased.

- **Development Surcharge (DS):** Charged at a uniform rate of 4 per cent of AV on all types of motorised vehicle to directly fund development works;

- **Supplementary Duty (SD)**: Additional charge under the VAT Act on jeep, car, baby taxi and motor cycle charged as a percentage rate on AV;

- **Value Added Tax (VAT)**: Charged almost at a uniform rate of 15 per cent (except mini bus whereon 19 per cent and motor cycle 18 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 1.5 per cent of AV on imports in excess of Taka 100,000, except for Government imports mainly applicable for large bus type.

Tariffs charged on the representative vehicle categories are set out in Table 3.8. The CIF prices of the vehicle at Chittagong Port are paid either in US dollar or Japanese Yen. Other costs include port dues, transportation, assembling (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 Standard Conversion Factor (SCF). Table 3.9 sets out breakdown of vehicle purchase costs.

Table 3.8 Tariffs Applicable to Representative Vehicles and Tyres

Category	DS	AIT	CD	SD	VAT	Total Duty
Medium Truck	4%	-	16%	-	15%	35%
Small Truck	4%	3%	17%	-	15%	39%
Large Bus	4%	3%	15%	-		23%
Mini Bus	4%	-	14%	-	19%	37%
Micro Bus	4%	3%	25%	-	12%	44%
Utility (Jeep)	4.6%	3%	40%	62%	16%	126%
Car	4%	3%	25%	30%	10%	72%
Baby Taxi	4%	3%	20%	22%	15%	64%
Motor Cycle	4%	-	25%	19%	18%	66%
All vehicle average	4%	3%	22%	33%	15%	56%
All tyres	4%	3%	24%	-	18%	57%

Source: National Board of Revenue and Dealer's Survey 2004

Notes: (1) 1.5% Landing Permit Fee is only applicable for large bus type.
(2) 2% Commercial Tax and 6% Clearing Charge & PSI is applicable for all tyres.

Table 3.9 New Vehicle Purchase Costs (Taka in 2004 Prices)

Category	CIF	Tariffs	Assembly & Other	Total Financial	Total Economic
Medium Truck	736,334	244,215	716,451	1,697,000	1,309,495
Small Truck	564,000	215,212	480,788	1,260,000	948,630
Large Bus	1,452,000	261,360	1,536,640	3,250,000	2,681,312
Mini Bus	586,608	209,823	688,569	1,485,000	1,137,463
Micro Bus	1,450,000	623,500	72,500	2,146,000	1,508,000
Utility (Jeep)	1,047,834	1,174,278	859,698	3,081,810	1,735,592
Car	98,600	719,780	79,300	1,785,080	1,049,440
Baby Taxi	79,632	53,391	106,051	239,073	164,472
Motor Cycle	42,573	29,701	11,477	83,750	51,754

Source: Dealer's Survey 2004

3.5 Consumable Costs

3.5.1 Tyre Costs

Tyres are imported from India, Japan, Malaysia, Indonesia 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 3.10. Although the usage has significantly been increased from 20 to 57 per cent in case of medium truck with an associate fall in prices. Table 3.11 sets out a breakdown of new tyre prices for each of the representative vehicle types.

Table 3.10 Use of Re-treaded Tyres

Item	Med Truck	Small Truck	Large Bus	Mini Bus	Micro Bus	Utility	Car	Tempo	Baby Taxi
% Of RT usage	57	9	30	33	50	-	20	59	19
Cost Tk per RT tyre	1067	1450	2333	2,233	1200	-	575	1019	774

Source: Vehicle Operators Survey 2004

Table 3.11 Cost of New Tyre (Taka 2004 Prices)

Category	Tyre Size	Make	CIF Cost	Tariffs	Other Costs	Financial Cost	Economic Cost
Medium Truck	10.00x20-16PR	Dunlop	6394	3027	1413	10834	7524
Small Truck	7.50x20-12PR	Dunlop	2468	1168	964	4600	3239
Large Bus	9.00x20-14PR	Dunlop	5825	2758	1467	10050	6999
Mini Bus	7.50x20-12PR	Dunlop	2468	1168	964	4600	3239
Micro Bus	5.50x13-6PR	Dunlop	1114	527	380	2219	1576
Utility (Jeep)	205-R16	Dunlop	3941	1866	2178	7985	5683
Car	155-SR13	Dunlop	1328	630	594	2552	1803
Auto Rick	4.00x8-6PR	Falcon	493	222	110	825	581
Motor Cycle	Front 2.5-18 4PR	Dunlop	368	167	155	690	492
	Rear 3.0 –17 4PR	Dunlop	488	221	179	888	631

Source: Vehicle Operators Survey 2004

3.5.2 Fuel and Lubricants

Detailed information on fuel and lubricant cost is collected from Bangladesh Petroleum Corporation (BPC). The breakdown of unit costs of fuel and lubricants is set out in the following table.

Table 3.12 Economic and Financial Costs of Fuel (Taka per litre in 2004)

Item	Petrol		Diesel		Lubricating Oil	
	Financial	Economic	Financial	Economic	Financial	Economic
C&F	19.30	19.30	20.48	20.48	20.47	20.47
Tariffs	6.58	0.00	6.58	0.00	9.57	0.00
Agent/ other cost at port area	0.12	0.09	0.13	0.10	15.64	12.51
Transportation cost and loss	0.44	0.35	0.44	0.35	0.44	0.35
Dealer/ agent commission	0.85	0.68	0.54	0.43	0.85	0.68
Other cost (including profit margin)	5.72	4.58	3.00	2.40	18.29	14.63
Subsidy				11.16		
Total	33.00	25.00	31.16	34.93	65.25	48.64

Source: Bangladesh Petroleum Corporation 2004
Notes: (1) US$1=Taka 59 as applied by BPC
(2) Pump price Taka /litre 33.00 for Petrol & Taka /litre 20.00 for Diesel

It may be mentioned here that the high increase in economic cost of fuel compared to those of the previous report is due to the apparently deflated C&F costs as supplied by the concerned agency earlier. Moreover price of fuel in international market has been increased almost by 20 per cent.

3.6 Vehicle Maintenance Policies and Costs

The majority of the operators interviewed maintained their own vehicles as shown in Table 3.13. But the trend to maintain the vehicle in garage is increasing. Most operators usually prefer to service their vehicles on a time related basis, with some exception in case of small & medium truck and jeep.

Table 3.13 Vehicle Maintenance Policy

Policy	Med Truck	Small Truck	Large Bus	Mini Bus	Micro Bus	Utility	Car	Motor Cycle	Temp	Baby Taxi
Maintained by owners %	92	90	74	78	73	65	68	80	92	95
Maintained in garage %	8	10	26	23	28	35	32	20	8	5
Time related %	80	75	83	88	83	68	90	85	95	78
Use related %	20	25	8	13	18	33	10	15	5	22

Source: Vehicle Operators Survey 2004

The annual costs of maintaining the representative vehicles were estimated from the operators' surveys and is set out in Table 3.14. Costs are highest for large buses, which appears to be realistic from the point of view of their high utilisation. The average maintenance labour cost per month is around Taka 14,000 for all vehicles, assuming a 200 working hours per month, the average financial cost per hour stands for Taka 70 and economic Taka 56.

Table 3.14 Annual Financial Cost of Vehicle Maintenance (Taka 2004 prices)

Item	Medium Truck	Small Truck	Large Bus	Mini Bus	Micro Bus	Utility	Car	Motor Cycle	Tempo	Baby Taxi	Average
Spare parts	43,840	36,523	61,248	34,055	27,030	22,083	27,250	5,650	18,765	7,525	32,446
Maint. Labour	19,295	15,162	25,227	13,096	13,709	10,795	10,018	3,058	6,839	6,755	14,029
Total	63,135	51,685	86,475	47,151	40,739	32,878	37,268	8,708	25,604	14,280	46,475

Source: Vehicle Operators Survey 2004

3.7 Crew Costs

Driver and helper costs are set out in Table 3.15. 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.

Table 3.15 Crew Wage Costs (Taka 2004 prices)

Cost Parameters	Med Truck	Small Truck	Large Bus	Mini Bus	Micro Bus	Utility	Car	Tem poo	Baby Taxi
Driver per month	5980	4123	8872	5648	4523	5704	4079	5031	3994
Helper per month	2412	1892	4729	3081	2118	0	2000	2034	1267
Driver per hour	23	14	31	22	17	15	17	16	12
Helper per hour	7	5	12	9	6	0	8	5	4
Total financial/hour	30	19	44	31	23	15	25	21	16
Total economic/hour	24	25	35	25	19	12	20	17	13

Source: Vehicle Operators Survey 2004

3.8 Overhead Costs

Overhead costs are set out in Table 3.16. These consist of office administration and rental charge, garaging, insurance, vehicle excise duty/VAT and tolls/route permit fees. For calculation of economic costs, tax elements and 70 per cent of toll money being treated as transfer payments are eliminated from the financial values. Overhead costs are high in Bangladesh, in part due to ferry and bridge tolls that account for 60 per cent of financial overheads in case of medium trucks and large buses and significant proportions (45%) in respect of small trucks and mini buses.

Table 3.16 Annual Overhead Costs (Taka 2004)

Item	Medium Truck	Small Truck	Large Bus	Mini Bus	Micro Bus	Utility	Car	Motor Cycle	Tempo	Baby Taxi
Insurance*	4,000	1,000	9,000	5,000	3,000	5,500	1,000	200	400	500
Taxes*	5,000	4,000	2,000	5,500	5,000	3,500	3,500	1,000	-	1,000
Tolls	105,000	36,000	225,667	99,000	21,000	2,000	41,000	1,800	8,000	6,500
Office	18,000	13,000	65,000	48,000	82,000	-	44,000	-	8,000	5,000
Garage	9,000	6,000	18,000	15,000	10,000	9,000	7,000	2,000	2,500	6,800
Other	34,000	21,000	57,667	37,000	21,000	5,000	10,000	3,700	11,000	8,800
Total Finan	175,000	81,000	377,333	209,500	142,000	25,000	106,500	8,700	29,900	28,600
Total Econ	96,500	51,800	217,367	134,700	122,300	20,100	74,300	6,440	24,300	23,050

Source: Vehicle Operators Survey 2004 and (*) Road User Cost Report 2002

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 3.17.

Table 3.17 Summary of VOC Inputs 2004/05

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 cost of vehicle	Tk'000 per vehicle	1697	1309	1260	949	3250	2681	1485	1137	2146	1508	3082	1736	1785	1049	239	164	84	52
Cost of new tyre	Tk per tyre	10834	7524	4600	3239	10050	6999	4600	3239	2219	1576	7985	5683	2552	1803	825	581	789	562
Maintenance labour cost	Tk per hour	70	56	70	56	70	56	70	56	70	56	70	56	70	56	70	56	70	56
Overhead cost	Tk '000 per annum	175	97	81	52	377	217	210	135	142	122	25	20	107	74	29	24	9	6
Crew cost	Tk per hour	30	24	31	15	44	35	31	25	23	19	15	12	25	20	16	13	Not applicable	
Fuel cost	Tk per litre	31	35	31	35	31	35	31	35	33	25	33	25	33	25	33	25	33	25
Lubricant cost	Tk per litre	65	48	65	48	65	48	65	48	65	48	65	48	65	48	65	48	65	48
Utilisation																			
Annual km driven	Kms per annum	80,700		74,000		129,800		66,700		56,800		22,800		50,000		46,000		13,000	
Annual hours driven	Hrs per annum	2,036		1,748		2,864		2,131		1,171		863		1,276		1,695		588	
Average service life	Years	9		8		5		5		6		7		5		5		5	
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	9		8		15		14		12		7		4		1		1	
Maintenance Model	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 Estimation of Unit Vehicle Operating Cost

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 3.18).

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.

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 3.18 Assignment of Representative Vehicle Types

RHD Category	HDM Representative Vehicles	HDM Vehicle Type	HDM Vehicle Code
Articulated Truck	Articulated Truck	MT	11
Medium Truck	Heavy Truck	MT	9
Small Truck	Light Truck	MT	8
Large Bus	Heavy Bus	MT	15
Mini Bus	Medium Bus	MT	14
Micro Bus	Mini Bus	MT	12
Utility	Four Wheel Drive	MT	7
Car	Large Car	MT	4
Auto Rickshaw	Motorcycle	MT	1
Motor Cycle	Motorcycle	MT	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 financial VOC per km resulted through HDM run at different roughness levels are presented according to different type of motorised vehicle in Table 3.19.

Table 3.19 Sensitivity of Financial VOC of Motorised Vehicle to Road Roughness (Taka/km)

International Roughness Index (IRI)	Medium Truck	Small Truck	Large Bus	Minibus	Microbus	Utility	Car	Auto Rickshaw	Motor Cycle
2	13.70	10.20	17.68	12.14	14.98	14.35	14.30	2.99	1.78
3	13.85	10.30	17.84	12.25	15.07	14.47	14.38	3.01	1.79
4	14.46	10.79	18.54	12.60	15.64	15.04	14.80	3.08	1.82
5	15.10	11.30	19.27	12.97	16.25	15.67	15.25	3.17	1.84
6	15.75	11.82	20.01	13.35	16.92	16.44	15.75	3.25	1.87
7	16.40	12.33	20.76	13.74	17.64	17.35	16.24	3.35	1.89
8	17.06	12.86	21.59	14.16	18.44	18.47	16.75	3.45	1.91
9	17.76	13.40	22.63	14.62	19.37	19.79	17.29	3.55	1.92
10	18.54	14.00	23.87	15.16	20.43	21.27	17.89	3.67	1.94
11	19.39	14.64	25.27	15.78	21.60	22.88	18.53	3.79	1.97
12	20.32	15.34	26.79	16.47	22.88	24.57	19.20	3.92	2.01
13	21.30	16.08	28.38	17.22	24.23	26.32	19.90	4.06	2.08
14	22.31	16.86	30.04	18.02	25.63	28.12	20.61	4.20	2.15
15	23.36	17.67	31.74	18.85	27.08	29.95	21.34	4.35	2.23

The economic VOC per km of motorised vehicle resulted through HDM run at different roughness levels are presented in Table 3.20.

Table 3.20 Sensitivity of Economic VOC of Motorised Vehicle to Road Roughness (Taka/km)

International Roughness Index (IRI)	Medium Truck	Small Truck	Large Bus	Minibus	Microbus	Utility	Car	Auto Rickshaw	Motor Cycle
2	12.25	9.08	13.04	11.00	10.90	8.85	9.02	2.25	1.28
3	12.40	9.18	13.16	11.11	10.96	8.93	9.06	2.26	1.28
4	12.90	9.56	13.72	11.40	11.36	9.26	9.32	2.32	1.30
5	13.43	9.95	14.32	11.70	11.79	9.62	9.59	2.38	1.32
6	13.98	10.34	14.92	12.00	12.27	10.05	9.88	2.44	1.34
7	14.55	10.71	15.54	12.29	12.78	10.56	10.16	2.51	1.35
8	15.13	11.07	16.23	12.58	13.35	11.18	10.44	2.58	1.36
9	15.74	11.44	17.06	12.89	14.00	11.92	10.76	2.66	1.36
10	16.38	11.85	18.05	13.25	14.76	12.76	11.11	2.74	1.37
11	17.06	12.30	19.15	13.68	15.60	13.68	11.49	2.83	1.38
12	17.77	12.79	20.34	14.18	16.51	14.65	11.89	2.93	1.41
13	18.50	13.33	21.58	14.74	17.48	15.66	12.32	3.03	1.45
14	19.27	13.90	22.87	15.34	18.49	16.70	12.75	3.13	1.49
15	20.05	14.50	24.18	15.98	19.52	17.76	13.20	3.25	1.54

Unit operating costs for all types of motorised vehicle are higher than those of the previous year except motor cycle. The main reason for this is the higher vehicle,

particularly the CIF price of medium truck, micro bus, utility and car. Besides, there is some increase in the overhead, maintenance labour and particularly in fuel costs. This is because of the fact that in the last year study report there was some under estimation in the C&F cost of fuel as provided by the BPC. The utilisation of vehicle is increased, on the contrary normal service life is decreased.

It may be mentioned that though the unit operating costs are generally higher this year, they are still below the fare in the transport market for buses and trucks as set out in the following table.

Table 3.21 Comparison of Tariffs and VOC 2004 (Taka/km)

Tariff & Economic VOC	Medium Truck	Small Truck	Large Bus	Mini Bus
Average Tariff / Fare	17	15	31	17
Average of Financial VOC at IRI=4 to 10	16	12	21	14
Average of Economic VOC at IRI=4 to 10	15	11	16	12

Source: Vehicle Operators Survey 2004

The average operating speed in kilometre per hour of motorised vehicle resulted through HDM run at different roughness levels are presented in Table 3.22. It may be mentioned that the average level of speed of the vehicular traffic is found slightly higher than that of the previous RUC studies. Mention should also be made that this year HDM-4 version has been used, while the earlier studies were based on HDM-III version. However, the relevant speed model factors particularly VDES2 for desired speed factor for this study is used as calibrated for Bangladesh in the year 2000. In most cases HDM-4 default values (ARVMAX, SPEED_SIG, SPEED_BETA etc) are used. Perceivable reason for the slight increase in the speed level of the current study may be the general improvement in the mechanical efficiency of the vehicle fleet accompanied with the overall improvement and strengthening of the road network.

Table 3.22 Sensitivity of MT Average Operating Speed to Road Roughness (km/hr)

International Roughness Index (IRI)	Medium Truck	Small Truck	Large Bus	Minibus	Microbus	Utility	Car	Auto Rickshaw	Motor Cycle	Average Traffic Speed
2	63	69	74	71	70	86	84	51	70	71
3	62	69	74	71	70	86	84	51	70	71
4	62	69	74	71	70	85	84	50	70	70
5	60	68	74	70	70	84	83	49	69	70
6	59	67	73	69	69	82	81	48	69	69
7	57	65	70	68	68	77	77	47	67	66
8	55	63	65	65	66	71	72	45	65	63
9	52	59	59	62	62	65	66	44	62	59
10	50	56	54	58	58	60	60	42	58	55
11	47	52	49	53	54	55	55	40	54	51
12	45	49	45	50	50	50	51	39	50	48
13	42	45	42	46	47	46	47	37	47	44
14	40	43	39	43	44	43	44	36	44	42
15	38	40	36	40	41	40	41	34	41	39

The economic VOC per km of non-motorised vehicle resulted through HDM run at different roughness levels are presented in Table 3.23.

Table 3.23 Sensitivity of NMT VOC to Road Roughness (Taka/km)

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. Share of various components of motorised voc in respect of two different levels of road roughness are presented in figure 3.3 and 3.4.

FIGURE 3.1 SENSITIVITY OF MOTORISED VOC (ECONOMIC) TO ROAD ROUGHNESS

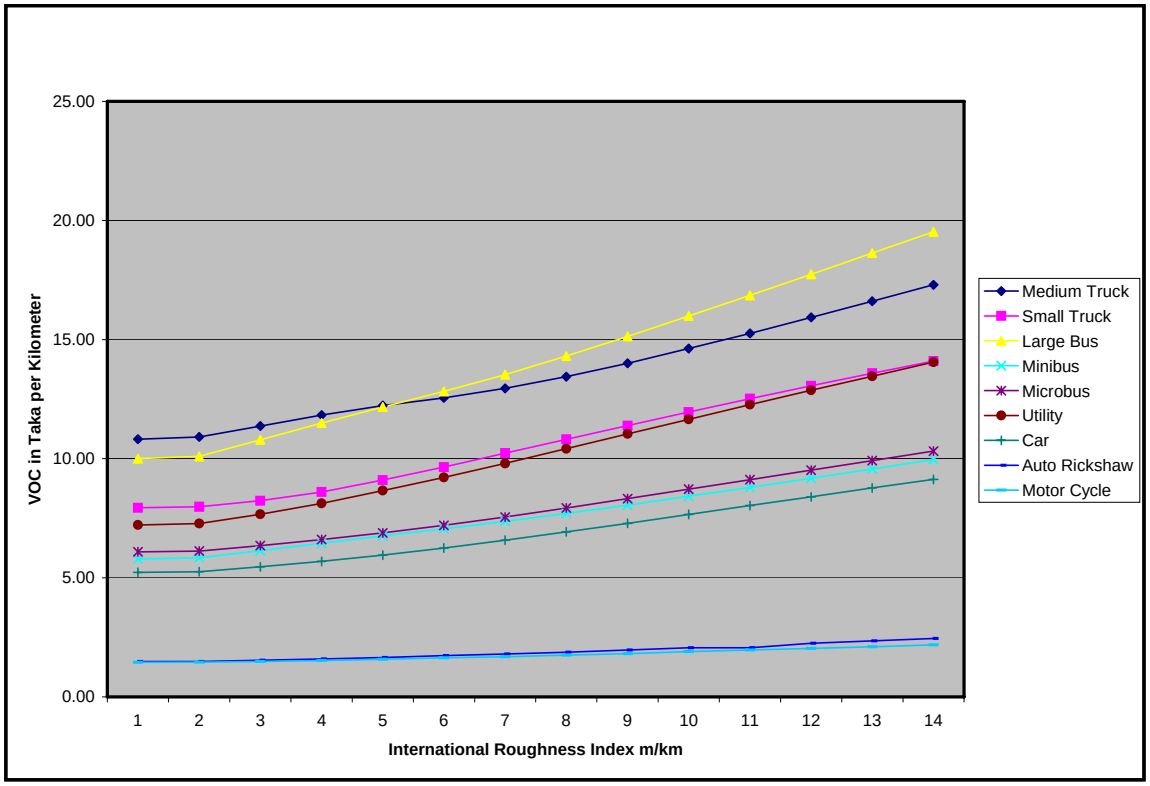


FIGURE 3.2 SENSITIVITY OF NON-MOTORISED VOC (ECONOMIC) TO ROAD ROUGHNESS

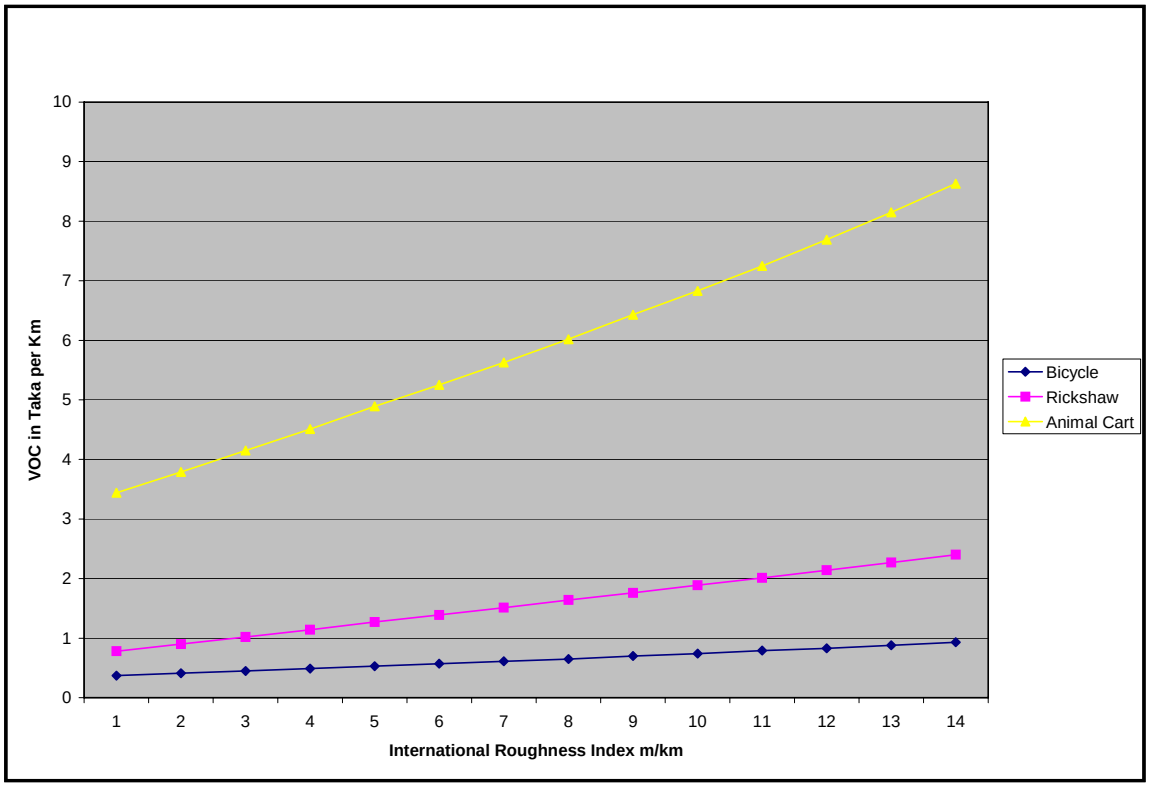


FIGURE 3.3 BREAKDOWN OF MOTORISED VOC COMPONENTS at IRI 4

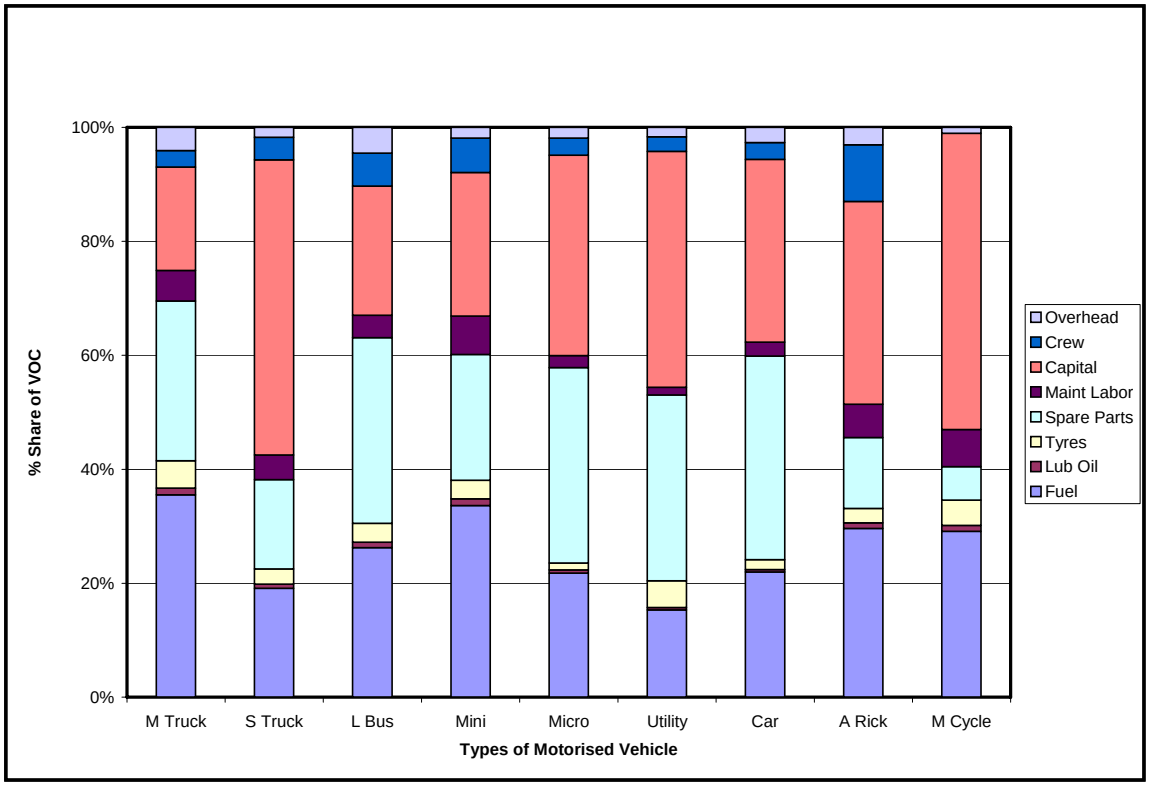
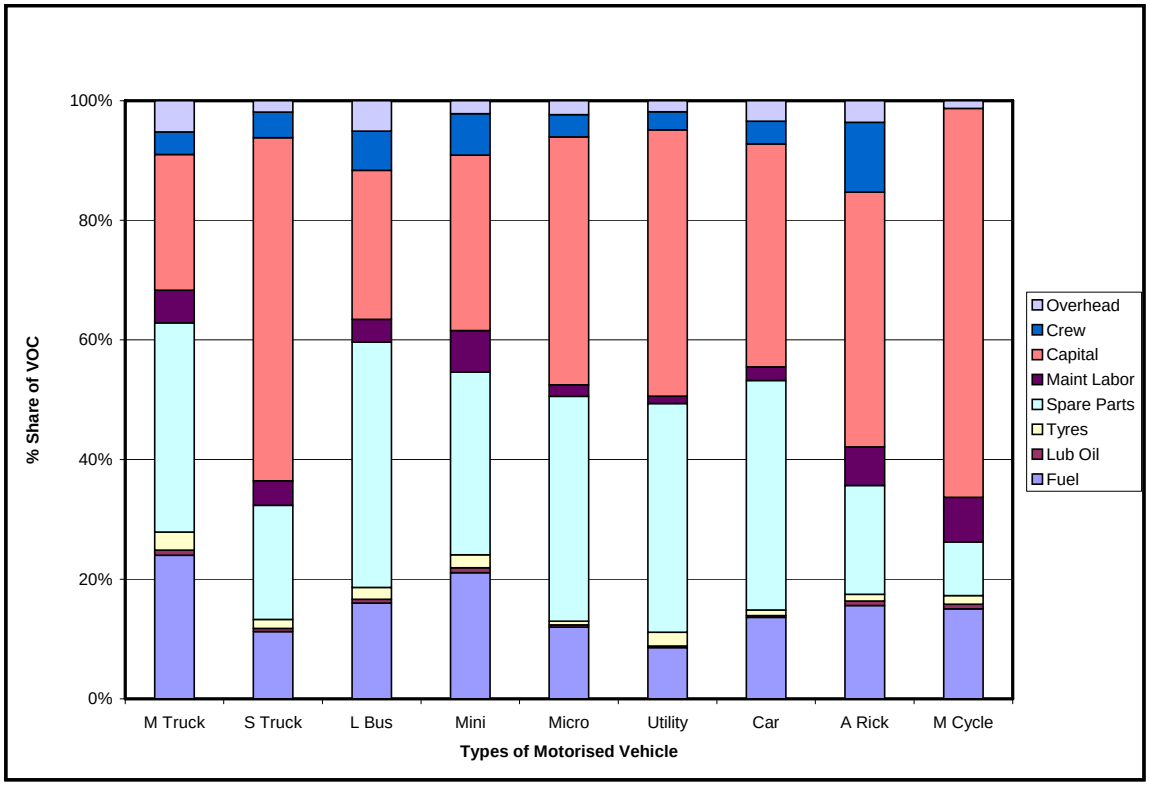


FIGURE 3.4 BREAK DOWN OF MOTORISED VOC COMPONENTS at IRI 10



4 TRAVEL TIME COSTS

4.1 General

Travel Time Costs (TTC) also referred to as Values of Time 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 popularly known as 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 in the use of their output.

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 users of the project output. In case of the construction of a major new bridge to replace a ferry for example, TTC will be immensely significant compared to a road improvement project without any change in its alignment or pavement and/or shoulder capacity. 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 Methodology

The Economics Circle of RHD has been conducting annual TTC surveys 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 almost every year as a part of RUC Annual Report. The circle has already published four RUC reports for the years 1998/99, 1999/2000, 2000/01 and 2002/03. As a part of this study report, that is RUC 2004-05, TTC survey was conducted by the Economics Circle during middle of the 2004.

4.3 Summary of Survey Results

This section sets out a summary of the main and feeder road travel time surveys conducted in 2004. Details of TTC methodology can be found in Economics Working Paper E7. Tables 4.0 and 4.1 set out the distribution of trip purpose for main road and feeder roads respectively.

Table 4.0 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	Tempo	Auto Rick	Motor Cycle
Journey to Work	13	24	10	23	9	32	35	23	30
Employers Business	24	10	14	12	16	11	10	11	20
Own Business	13	7	8	11	18	19	14	18	23
Family and Social	44	43	60	37	43	30	19	33	16
Other	6	16	9	18	15	8	23	15	11
Total	100	100	101	101	101	100	101	100	100

Source: Travel Time Cost Survey 2004.

Table 4.1 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	13	20	7	11	17	15	31
Employers Business	17	14	10	11	8	10	23
Own Business	17	11	16	19	14	19	23
Family and Social	33	44	54	47	43	40	19
Other	20	11	13	13	17	17	3
Total	100	100	100	101	99	101	99

Source: Travel Time Cost Survey 2004 .

Tables 4.2 and 4.3 show the distribution of occupations according to main road and feeder road users respectively.

Table 4.2 Percentage Sample Distribution of Vehicle Occupant 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
Labor	0	1	2	2	0	0	4	1	0
Farming/ Fishing	0	1	7	7	0	0	0	6	0
Shop Employee	0	1	3	1	2	0	10	4	0
Peon	0	0	1	1	0	0	1	1	0
Salesman	0	2	2	6	0	0	10	7	0
Mechanic/ Driver	0	1	5	6	0	0	5	5	0
Office Worker	9	15	12	16	2	12	23	12	26
Student	14	16	14	12	12	5	12	12	8
Professional	3	6	5	4	5	11	6	7	4
Officer	25	21	11	8	26	20	3	9	19
Unemployed	1	1	0	1	2	2	2	2	4
Housewife	9	8	11	9	7	12	2	7	0
Guard	0	0	1	0	0	0	1	0	0
Domestic Servant	0	0	0	0	0	0	1	0	0
Businessman	34	25	20	23	42	35	16	24	38
Other	5	2	6	4	2	3	3	3	0
Grand Total	100	100	100	100	100	100	100	100	100

Source: Travel Time Cost Survey 2004.

Table 4.3 Percentage Sample Distribution of Vehicle Occupant by Occupation (Feeder Road)

Occupations/ Vehicle Type	O/C Bus	Mini Bus	Micro Bus	Car	Auto Rick	Tempo	Motor Cycle
Labor	7	5	3	6	7	10	0
Farming/ Fishing	7	11	2	0	12	7	3
Shop Employee	2	2	3	0	1	2	0
Peon	0	1	2	0	0	0	0
Salesman	2	2	5	0	2	1	3
Mechanic/Driver	0	0	5	4	8	6	3
Office Worker	5	19	11	0	13	11	21
Student	3	10	11	6	6	9	1
Professional	12	7	8	6	4	6	10
Officer	10	6	8	23	7	4	23
Unemployed	2	0	0	0	0	0	0
Housewife	3	4	15	17	6	9	0
Businessman	47	28	23	36	23	28	29
Other	2	4	3	0	10	6	8
Grand Total	100	100	100	100	100	100	101

Source: Travel Time Cost Survey 2004

Tables 4.4 and 4.5 show the reported monthly household income of the respondents (gross of tax) by vehicle type. The results more or less accord with last years surveys in most cases but show some differences between different buses and between different vehicle types, and as usual, there are differences in income between main road and feeder road.

Table 4.4 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	1	1	0	1	3	0
1001-2000	0	4	9	7	4	0	19	3	0
2001-5000	0	19	26	35	14	3	28	22	19
5001-10000	23	34	33	30	28	27	37	32	40
10001-20000	37	18	16	18	28	32	12	25	29
20001-30000	26	10	6	2	18	25	2	9	10
30000+	8	10	6	4	6	10	0	4	3
Total	94	95	96	97	99	97	99	98	101

Source: Travel Time Cost Survey 2004.

Table 4.5 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	4	0	0	4	4	0
1001-2000	7	4	2	0	17	16	0
2001-5000	37	36	33	19	41	34	22
5001-10000	32	36	46	30	30	24	47
10001-20000	17	11	16	15	5	13	22
20001-30000	3	0	3	28	1	4	3
30000+	0	4	0	4	1	1	4
Total	100	100	100	100	100	100	100

Source: Travel Time Cost Survey 2004

Table 4.6 is derived on the basis of Table 4.0 & 4.1 and 4.4 & 4.5, where the average wage rates of vehicle occupants are assessed to reflect the value of time of occupants while travelling 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 from trip purpose tables under different road environment. Accordingly an average time value of travelling passenger irrespective of in work or non-work times is assessed by category of vehicle and road class in Table 4.6. On the other hand average passenger occupancy by category of vehicle and road class is set out in the same table for convenience.

Table 4.6 Travel Time Costs (Financial) of Passengers by Category of Vehicle & Road Class

Category of Vehicles	Main Road		Feeder Road	
	Average Occupancy	TTC (Taka /Passenger hour)	Average Occupancy	TTC (Taka /Passenger hour)
AC Large Bus	35	49.34	-	-
Chair Class Large Bus	38	27.64	-	-
Ordinary Large Bus	44	24.21	40	19.0
Mini Bus	32	19.94	30	17.5
Microbus	6	34.29	10	18.7
Car	3	39.94	4	33.5
Tempo	10	15.44	10	12.8
Auto Rickshaw	3	25.72	4	15.4
Motor Cycle	1	30.77	1.1	27.2

Source: Travel Time Cost Survey 2004

4.4 Unit Travel Time Costs for Motorised Vehicle

The 2004-05 TTC are set out in Table 4.7. 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 all 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 per cent, while that for motor cycle has decreased by 11 per cent compared to last year value.

Table 4.7 Recommended Financial and Economic TTC For FY 2004-05 (National Average)

Vehicle Category	Occupancy Number	Financial		Economic	
		TTC per Pass Taka/hr	TTC per Vehicle Taka/hr	TTC per Pass Taka/hr	TTC per Vehicle Taka/hr
All Buses	36.4	22.0	816.6	17.6	653.3
Micro Bus	8	31.2	249.0	24.9	199.2
Car/Utility	3	38.6	123.3	30.9	98.6
Tempo	10	13.6	137.6	10.9	110.1
Auto Rickshaw	4	20.6	76.5	16.4	61.2
Motor Cycle	1	28.6	30.2	22.9	24.1

Observations:

- The unit TTC values are more or less in conformity with the values of the previous study
- The large differences between the feeder road and main road transport markets as identified in the previous reports have considerably reduced in 2004 surveys
- Average occupancy for bus and car/utility have slightly dropped
- TTC per passenger has reasonably increased for bus, micro & car and slightly increased for other vehicles except for motor cycle exhibiting some reduction
- TTC per vehicle for all vehicles has increased except for motor cycle and tempo showing some reduction

4.5 Unit Travel Time Costs for Non-Motorised Vehicle

Time values for non-motorised vehicle has been derived from the thesis "Quantification of the Effects of Non-motorised Transport and Roadside Activities" M Bari, November 1999. These are quantified as work time values. Non-work time values are estimated on assuming standard RHD 35%. The average value per person and per vehicle are estimated using the NMV journey characteristics data from the field survey carried out in 2002 by Economics Circle.

Table 4.8 Travel Time Costs for Non Motorised Vehicles

Vehicle Category	**Journey Characteristics**		**Travel Time Cost Taka per hour**			
	Occupancy	Journey in work time	Work time value	Non-work time value	Average per person	Average per vehicle
Rickshaw	2	9%	10	3.5	4.1	8.2
Bi-Cycle	1	23%	21	7.4	10.5	10.5

Source: (1)"Quantification of the Effects of Non-motorised Transport and Roadside Activities" M Bari, 1999
(2) Economics Circle TTC Survey 2002

5 ACCIDENT COSTS

5.1 Introduction

In this analysis, accident means road accident and accident costs 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 around 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 and bridge schemes. The main objective of most road improvement works is to reduce vehicle operating costs and journey time costs, which is achieved by reducing road surface roughness and most often 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.

There are two basic methodologies of costing accidents. They are the Lost Output (or "human capital") approach 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 parameters require additional research to arrive at more accurate values. This additional research is time taking and resource consuming. If necessary time and resources are available further action will be taken in future studies to accomplish this task.

5.2 Estimating the Number of Road Traffic Accidents (RTA)

5.2.1 Official Reporting by Bangladesh Police

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 and those RTA related deaths that take 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 by Bangladesh Police and published in the National Road Traffic Accident Report 2003, Road Safety Cell under BRTA has been presented in table 5.0 and 5.1 according to severity and area.

Table 5.0
Nation-wide Recorded Casualties According to Severity and by Division and Metropolitan Area in 2003

Metropolitan Area /Division (excluding Metropolitan Area)	Number of Casualties			Total	Percentage
	Fatal	Grievous	Simple		
DMP	402	460	61	923	13
CMP	82	48	48	178	3
KMP	18	10	10	38	1
RMP	46	29	27	102	1
Dhaka	1001	834	442	2277	32
Chittagong	613	298	279	1190	17
Sylhet	225	154	102	481	7
Khulna	236	186	30	452	6
Barisal	97	47	48	192	3
Rajshahi	614	355	272	1241	18
Total	3334	2421	1319	7074	100

Source: National Road Traffic Accidents Report 2003

Table 5.1
RTA According to Severity and by Road Environment in 2003

Road Environment	No. of RTA		Total	Percentage
	Fatal	Grievous & Simple		
Urban	763	509	1272	33
Rural	1989	651	2640	67
Total	2752	1160	3912	100

Source: National Road Traffic Accidents Report 2003

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 wide scale under-reporting of simple RTA, while the concerned agencies including the Bangladesh Police believe that fatal and grievous RTA are well reported.

5.2.2 IDC Assessment of Under-Reporting

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 (20%) 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. 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.

5.2.3 Update of Bangladesh Road Traffic Casualty Under-Reporting

A survey of 80,000 households throughout Bangladesh was conducted in 2000. The research study was funded by DFID and conducted jointly by TRL, Institute of Child and Mother health (ICMH) and the Bangladesh Transport Foundation to update the road crash costing guidelines for low income countries. According to the study results there was a 95% probability that at least 8,000 road death occurred in 2000 but the best estimate was of over 12,000 i.e. more than the total number that being reported by the police. Under reporting of injuries is even worse with almost 75 times more serious injuries estimated than that reported by the police for that year. The study also showed that 13-15 serious injuries for every road death identified. This is consistent with WHO's report on Road Traffic Injury which estimates an average of 15 serious injuries for every road death (WHO 2004). The percentage of under reporting is applied to 2003 accident data for costing exercise as shown in Table 5.2.

Table 5.2 Estimated RTA on the Basis of Reporting

Type	**BRTA 2003**	**Percentage of Reporting***		**Estimate of 100% Accidents in 2003**	
		Conservative Assumption	Best Assumption	Conservative Assumption	Best Assumption
Fatal	2752	38%	24%	7242	11467
Grievous	921	2%	1%	46050	92100
Simple	239	1%	<1%	23900	79664
Total	3912			77,192	183,233

Source: * Aeron-Thomas (2003), Bangladesh Road Crash Costing Discussion Document, TRL.

In 2003 an even larger household survey was conducted jointly by the Directorate of Health Services, ICMH, UNICEF and The Alliance for Safe Children. The study report published in 2005 is "Bangladesh Health and Injury Survey: Report on Children and Call for Action" shows that over 3400 children were killed and 110,000 seriously injured in road crashes in 2003. This figure is greater than the number of total fatal deaths and 15 times greater than the total injuries for all ages reported in the RTA 2003 Annual Report.

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. The number of estimated total RTA are set out in Table 5.3.

Table 5.3 Estimated Nationwide Total RTA (Casualty Plus PDO)

Basis	**Casualty RTA**	**PDO multiplier**	**Estimated PDO**	**Total RTA**
Conservative Assumption	77,192	3	231,576	308,768
Best Assumption	183,233	3	549,700	732,933

5.3 Valuation of Cost of Various RTA 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 analysis 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 in 2004 by the Economics Circle. Only the average income of a pedestrian had to be calculated additionally using an average per capita income of Taka 2,162 per month (BBS 2004). Table 5.4 shows the average incomes estimated for the different road user types and the relative casualty share.

Table 5.4 Average Income and RTA Casualty Share by Road User Type (Tk. 2004)

Item	Truck	Bus	Car	Rickshaw	Pedestrian[1]
Average monthly income[2]	7,200	10,232	15,225	8,250	2,162
Average annual income	86,400	122,784	182,700	99,000	25,944
RTA casualty share[3]	15%	20%	6%	11%	48%

Source: [1] BBS 2004 [2] TTC survey 2004 & [3] BRTA 2004

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 fatal casualty statistics by age in 2003 as available from Bangladesh Police has been presented in the following table.

Table 5.5 Fatal Casualties by Age Group in 2003

Age Group	Number of Fatalities			Total
	Driver	Passenger	Pedestrian	
0 - 5	0	13	55	68
6 - 10	0	21	195	216
11 - 15	5	33	73	111
16 - 20	18	72	58	148
21 - 25	39	111	102	252
26 - 30	55	134	85	274
31 - 35	60	123	85	268
36 - 40	24	82	57	163
41 - 45	27	77	58	162
46 - 50	9	40	62	111
51 - 55	7	27	35	69
56 - 60	1	17	55	73
61 - 65	2	8	26	36
66 - 70	0	12	41	53
70 - 75	0	2	13	15
> 75	0	5	16	21
Unknown	252	466	576	1294
Total	499	1243	1592	3334
%	15%	37%	48%	100%

Source: National Road Traffic Accidents Report 2003

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

- Average age of RTA fatality = 31 years as calculated on the basis of above table
- Average lost working years = 26 (average retirement age 57 years minus the average age of RTA fatality 31 years)

- Annual discount rate of 12% and average GDP per capita growth rate 3.1% (average of the different growth rates over 26 years as calculated lost output period)
- 30% of per capita income 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 812,795*.*

Table 5.6 Lost Output by Road User Type (Taka 2004)

Lost Output Parameters	Truck	Bus	Car	Rickshaw	Pedestrian	Average
Present Value of Lost Output	977,773	1,389,524	2,067,582	1,120,364	293,603	1,169,769
RTA casualty Share in percent	15	20	6	11	48	100
RTA casualty Share in amount	146,666	277,905	1,124,055	123,240	140,930	812,795

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. On the other hand both days spent recuperating with simple injuries has 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 are applied to the casualty cost in order to arrive at the RTA cost.

Table 5.7 Lost Output Casualty Costs (Taka 2004)

Category	Per casualty Cost	Fatal RTA		Grievous RTA		Simple RTA	
		Number	Cost	Number	Cost	Number	Cost
Fatality	568,957	1.2	682,748	0	0	0	0
Grievous	6,284	1.0	6,284	1.6	10,055	0	0
Simple	479	1.4	670	2.2	1,053	1.9	910
Total	575,720		689,703		11,108		910

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 600 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 outpatient 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 17,280/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 576 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 outpatient 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 2004)

Category	Per casualty Cost	Fatal RTA		Grievous RTA		Simple RTA	
		Number	Cost	Number	Cost	Number	Cost
Fatality	600	1.2	720	0	0	0	0
Grievous	6,048	1.0	6,048	1.6	9,677	0	0
Simple	744	1.4	1,042	2.2	1,637	1.9	1,414
Total	7,392		7,810		11,314		1,414

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 costing 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 2004)

Category	Per casualty Cost	Fatal RTA		Grievous RTA		Simple RTA	
		Number	Cost	Number	Cost	Number	Cost
Fatality	341,374	1.2	409,649	0	0	0	0
Grievous	3,771	1.0	3,771	1.6	6,033	0	0
Simple	287	1.4	402	2.2	632	1.9	546
Total	345,432		546,745		6,665		546

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 2004 survey of operators conducted by the Economics Circle. This data is summarised in Table 5.10.

Table 5.10 Average Per Vehicle Damage Costs (Taka 2004)

Cost component	Medium Truck	Small Truck	Large Bus	Mini Bus	Utility	Car	Tempo	Auto Rick
Damage	47,438	30,500	55,800	40,000	26,250	90,000	800	1,000
Lost earnings	56,857	25,000	224,000	20,000	5,500	15,000	818	1,000
Total Costs	104,295	55,500	279,800	60,000	31,750	21,500	1,618	2,000

Source: Vehicle Operators' Survey 2004

In addition, vehicle claim data was provided by one large private insurance company that 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 2004 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 around of Taka 97,500 per simple accident was therefore adopted which accords with the weighted average values from the operators' survey 2004. Then factors 0.05, 1.5 and 2.0 were applied to arrive at the property damage only (pdo), grievous and fatal accidents cost respectively. Table 5.11 sets out the resultant costs.

Table 5.11
Average Vehicle Related Costs per Accident (Taka 2004)

Severity	Factor	Unit costs
Fatal	2.0	195,053
Grievous	1.5	146,289
Simple	1.0	97,526
PDO	0.05	4,876

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 1,500 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 costing 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 replacement;
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.
7. 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

As the RTA cost calculation analysis is almost exclusively focused on the losses to society related to the victim himself hence 5 basic components including human cost are considered in this report to quantify. 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
(In '000 Taka)

Component	Fatal	Grievous	Simple	PDO
Lost output	689.7	11.1	0.9	0.0
Medical costs	7.8	11.3	1.4	0.0
Human costs	413.8	6.7	0.5	0.0
Vehicle damage	195.1	146.3	97.5	4.9
Administration	1.5	1.5	1.5	1.5
Total	1307.9	176.9	101.9	6.4

According to the above cost estimates, a fatal RTA costs 7 times that of a grievous RTA and 13 times than that of a simple RTA. Property damage only accidents have been estimated at only 16 per cent of a simple accident. The cost of a grievous RTA is estimated at a value around 2 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 cost components for the total number of estimated accidents in 2004. The total cost of all road accidents, including PDO, has been conservatively estimated at Taka 21,529 million or US$ 365 million. The major portion of the costs are due to casualty accidents along with property damage only accidents accounting for 7 per cent of total costs. On the other hand, the total cost of accident stands at Taka 42,910 million or US$ 727 million according to the best estimate of under-reporting.

Table 5.13 Annual National RTA Costs in 2004 (Taka)

Item	Average Cost per accident ('000 Tk)	Number of Accidents	Total Cost (million Tk)	Number of Accidents	Total Cost (million Tk)
		Conservative Estimate		Best Estimate	
Fatal RTA	1,308	7,242	9,472	11,467	14,997
Grievous RTA	177	46,050	8,145	92,100	16,290
Simple RTA	102	23,900	2,435	79,667	8,118
Total casualty RTA		77,192	20,052	183,233	39,405
PDO RTA	6	231,576	1,477	549,700	3,505
Total RTA		308,768	21,529	732,933	42,910
Average Casualty RTA Cost			0.279		0.234

According to the conservative estimate the average casualty RTA is estimated to cost Tk 279,000 (US$ 4,729), while the total annual RTA costs amount to Taka 21,529 million (US$ 365 million). It means that the total annual accident cost borne by the country is equal to 0.6 per cent of Gross National Product in 2004-05 (Table 5.14).

According to the best estimate the average casualty RTA is estimated to cost Tk 234,000 (US$ 3,966), while the total annual RTA costs amount to Taka 42,910 million (US$ 727 million). It means that the total annual accident cost of the country is equal to 1.3 per cent of Gross National Product in 2004-05 (Table 5.14). Thus road accident causes an huge unacceptable waste of life as well as scarce resources of Bangladesh.

Table 5.14 Total Annual Accident Costs as Proportion of GDP

Item	Taka Million	US$ Million	Taka Million	US$ Million
	Conservative Estimate		Best Estimate	
Estimated Total Annual Accident Costs 2004	21,529	365	42,910	727
Gross Domestic Product at 2003-04 current market prices	3,325,670	56,367	3,325,670	56,367
Accident Costs %GDP	0.6%	0.6%	1.3%	1.3%

Note: US$1=60 Taka

5.5 Conclusions and Recommendations

5.5.1 Significance of these 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 cause 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 persist beyond tolerance 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 to severity, though further research is required on this fundamental problem as an accurate assessment of the various dimension of RTA has not yet been possible. More research is also required on the weight age 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. Another important component of research is the estimation of RTA related medical costs based on hospital survey both public and private and also household survey of the victim.

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.