ADB-ASEAN Regional Road Safety Program

Accident Costing Report: AC 1

The Cost of Road Traffic Accidents in Brunei Darussalam

ADB

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Asian Development Bank–Association of Southeast Asian Nations Regional Road Safety Program

Accident Costing Report AC 1: Brunei Darussalam

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ABBREVIATION

ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
RIPAS	Raja Isteri Pengiran Anak Saleha

NOTE

In this report, "$" refers to US dollars.

CONTENTS

1 INTRODUCTION

1.1 General

It is now well established that many developing countries, including Brunei Darussalam, have a serious road accident problem. In 2003, there were 2,625 accidents. Even though this amount is 7.53% less than the 2002 total, the annual accumulative losses of road accidents in Brunei Darussalam are not well appreciated, and these have large-scale economic and social impacts. Further, it is important to realize that road accidents are one of the 10 leading causes of deaths in Brunei Darussalam (Appendix 1).

According to a joint report on road traffic injury prevention by the World Bank and the World Health Organization, road accidents are the second leading cause of death among people between the ages of 5 and 29, and road traffic injuries cost between 1% and 2% of gross national product, which is about $518 billion every year worldwide. The report also stated that the cost of road traffic injuries in low- and middle-income countries is estimated at $65 billion, which exceeds the total amount of aid received by these countries. Many families are driven into poverty by the cost of prolonged medical care, loss of a family breadwinner, or extra funds needed to care for people with disabilities. Road accident survivors, and their families, friends, and other caregivers, often suffer adverse social, physical, and psychological effects. Thus, road safety problems demand a greater share of funding and other resources.

The report also noted that one of the main factors contributing to the increase in road accident injuries worldwide is the growing number of motor vehicles. Therefore, there is a need to determine the cost of road accidents and the value of preventing these based on the notion that the cost of preventing accidents is generally much less than the economic cost of casualties and damage caused by accidents.[1] In other words, prevention is better than a cure.

An estimate of the total national cost of road accidents will help the Government realize the heavy economic losses incurred. This will encourage officials to invest more in road safety improvements, to reduce these losses, and regard expenditure on road safety as an investment and not as a cost.

Road safety precaution in Brunei Darussalam tends to receive less attention, since not all road accidents and casualties are reported or recorded at the scene, and no system of estimating road accident costs has yet been established. Thus, this report is hoped to act as a catalyst to encourage a more efficient road safety program in the near future.

1.2 Objectives and Scope of Study

This study is based on the premise that accidents involve large social and economic costs. Thus, the objectives of this report are three–pronged. The report will

(i) find out the total national cost of traffic road accidents that caused fatalities, injuries, and property damage;

(ii) encourage responsible agencies to take certain actions or approaches that can help minimize the costs of road accidents; and

(iii) contribute and support the National Road Safety Council of Brunei Darussalam in analyzing the accident and casualty trends and costs of road accident in Negara Brunei Darussalam.

The scope of this study covers the computation of road accident costs and underreported data for 2003 from several

[1] http://europa.eu.int/

agencies, especially, police, hospitals, and insurance companies.

1.3 Source of Data

There are many different methods and approaches to estimating costs of road accidents. Whatever method is used, it will need a considerable amount of data to be collected. Data are mainly focusing on the costs that are related to road accidents. These costs can be divided into the following five categories:

(i) costs of medical treatment, including hospital treatment and the use of ambulance services, which can be obtained from the Ministry of Health;

(ii) cost of vehicle damage and damage to government property, where these data can be collected from insurance companies under the General Insurance Association of Brunei and all Islamic insurance companies, namely Islamic Bank of Brunei (IBB); Islamic Development Bank of Brunei (IDBB); and Tabung Amanah Islam Brunei (TAIB), as well as selected car repair workshops in the Brunei Muara district;

(iii) police and administration costs. Due to the difficulty of attaching monetary values to these costs, this report adopted the method used by the United Kingdom when estimating these costs;

(iv) costs of lost output; road accidents lead to a loss of output in the year when accidents occur and, in the case of fatal and very serious accidents, in future years also; and

(v) costs of pain, grief, and suffering; there are rather subjective and include the physical and mental suffering of victims and families. The difficulty in placing an appropriate value is overcome by making use of benchmark values established elsewhere. In this study, the benchmark values used by the United Kingdom are applied.

Information was collected from hospital records, police records, and Transport Department and Department of Public Work and Services records.

1.4 Outline of Report

This report is divided into five chapters. Chapter 1 provides a brief introduction of the economic costs of road accidents. It also gives the rationale for this study and outlines the methodology used. Chapter 2 provides a detailed explanation of the types of approaches used in this report. It reviews earlier literature reflecting some of the approaches used. Chapter 3 computes the estimate in the Brunei Darussalam context. This is followed by a presentation on the cost computation at the national level in Chapter 4. Finally, Chapter 5 summarizes the discussion on the implication of the findings. The appendixes supplement and support the findings.

2 METHODOLOGY

2.1 Introduction

Estimating costs of road accidents is crucial in assisting the decision making process of investing in road improvements and national road safety programs. There are various methods that can be used to estimate road accident costs, but no single method is without its own limitations. A considerable amount of data needs to be collected regardless of the method used. The choice of costing method depends very much on the objectives set by a country's policy planners and economists.

It is very important to emphasize that before estimating costs due to road accidents, a country must have consistent classification on the type of accidents and the extent of personal injury accidents; no injury (damage only to vehicles and property), slight injury (minor cuts, sprains, or bruises), serious injury (hospitalized and sustained injuries, such as fractures, concussions, internal injuries, crushing, severe cuts and lacerations, or general shock that require medical treatment) or fatality (deaths that occur within 30 days) (Transport Research Laboratory 1995).

2.2 Available Methods

Hills and Jones-Lee (1981 and 1983) identified six different methods that can be used to estimate costs on road accidents. These are the gross output (or human capital) approach, the net output approach, the life-insurance approach, the court award approach, the implicit public sector valuation approach, and the value of risk change or willingness-to-pay approach. They made the point that the appropriate method to use in any particular context may depend upon the objectives and priorities of those who intend to use the costs and values concerned. The reasons for costing road accidents are most likely to be either the maximization of national output or the pursuit of social welfare objectives, such as the minimization of injury accidents or fatalities on roads.

The gross output (or human capital) method estimates costs due to a loss of current resources, such as cost of vehicle damage and medical treatment, police/administration costs, and costs resulting from a loss of future output in terms of wages that could be earned in future years if deaths did not occur. The net output method estimates costs by subtracting the discounted value of victims' future consumption from gross output figures. The life insurance method estimates costs based on individuals' willingness to insure their own lives. The court award method estimates the costs based on the sums awarded by the courts to the surviving dependants of those killed or injured as a result of either crime or negligence, and these sums are regarded as an indication of the cost that society associates with road accidents or the value that it would have placed on its prevention. The implicit public sector valuation method estimates costs based on values that are implicitly placed on accident prevention in safety legislation or in public sector decisions taken either in favor of or against investment programs that affect safety.

The willingness-to-pay method estimates costs based on the decisions made in the public sector concerning the allocation of scarce resources that should reflect the preferences and wishes of those individual citizens who will be affected by the decisions (e.g., the amount that people are prepared to pay for an improvement in road safety).

2.3 The Gross Output Method

A very widely used approach is the gross output or human capital approach, which is also the method recommended by the Asian Development Bank (ADB) for Association of Southeast Asian Nations

(ASEAN) countries. This method encompasses direct and indirect costs to individuals and society as a whole from the decline in the general health status of road accident victims. During their lifetime, individuals function as producers and consumers of economic output. In this approach, costs will be divided into two. First, costs due to loss of current resources, such as medical treatment, vehicle damage, damage to government property, and police and administration costs, and second, costs due to loss of future output of people killed in road accidents. Among the reasons why this approach is selected for estimating costs of road accidents in Brunei Darussalam follow

(i) Compared to other costing methods, data needed to estimate costs using the gross output method are more easily available and obtained from various private and government agencies.

(ii) Considerations on the basis of humanity can be easily incorporated into the gross output costing method by taking into account pain, grief, and suffering of accident victims.

This method is rather conservative, but it is recommended because it ensures an indisputable minimum value obtained for road accident costs in a country. The argument is that if the investment can be justified on such a minimum value, it will certainly be justified on any other value (ADB 1997).

The analysis in this report is based on the data and information collected for 2003.

The costs of an accident are composed of casualty-related costs and accident-related costs. Casualty-related costs include costs of lost output; costs of medical treatment; and value of pain, grief, and suffering. Accident-related costs include property damage and administration costs. The total cost of road accidents in a country is the number of accidents by severity multiplied by their respective accident cost.

It is standard practice for these accidents to be classified as being fatal, serious, or slight. The definitions most commonly used are as follows.

A fatal accident is one in which one or more people are killed as a result of an accident, provided death occurs within 30 days.

A serious accident is one in which there are no deaths but one or more people are seriously injured. The people are normally hospitalized due to injuries sustained, including fractures, concussions, internal injuries, crushing, severe lacerations, or severe general shock requiring medical treatment.

A slight accident involves no deaths or serious injuries. The people have cuts, sprains, or bruises.

A no-injury accident is a damage-only accident in which no one is injured but damage to vehicles and or property is sustained.

3 COST COMPONENTS

3.1 Introduction

This section describes the assessment of the estimated costs of road accidents in Brunei Darussalam for 2003. The cost estimate is used by employing the gross output or human capital method.

3.2 Damage to Property

Costs of vehicle damage can be obtained from insurance companies and workshops based on property damage claims and costs of repair of damaged vehicles, respectively. Since the costs of vehicles damaged in accidents can vary depending on the degree of damage sustained, it is only possible to obtain estimates based on accident severity. It is not always the case that the severity of injuries sustained by accident victims correlates with the degree of damage done to vehicles. For instance, in the case of a pedestrian accident that is categorized as a fatal accident, the vehicle may have little or no damage. When getting information from insurance companies, it is possible to get a sample of cases of accident claims based on accident severity. The process of estimating costs will be possible, but it will not be accurate. This is because the comprehensive process of collecting information is not an easy task. Several things need to be considered when dealing with information from insurance companies. These include uninsured commercial and public service vehicles and vehicle damage costs not fully paid by the insurance company.

Another way of getting estimates of vehicle damage costs is to gather information from automobile repair workshops, but this can be time consuming and often does not get the expected cooperation from workshops, due to varieties of damage to the vehicles involved in accidents. The average repair cost for vehicle damage and the average number of vehicles involved in each severity of accident are obtained. Finally, the cost of damage to government property, such as streetlights, railroads, and other street furniture can usually be obtained from the Public Workx and Services Department and the police.

Brunei Darussalam Estimates. Using information from the General Insurance Association of Brunei and insurance companies for total motor vehicle claims from road traffic accidents and damage costs to street furniture obtained from the Public Work Services Department in Brunei Darussalam, the total compensation for property damage from traffic accidents for 2003 amounted to $23 million. This works out to an average claim of $8,564 per accident for property damage. While the damage is somewhat correlated with the injury severity, it is not possible with the available data to compute the property damage by severity categories. Nevertheless, using the information on cost estimates given by insurance personnel and vehicle repair workshop managers and mechanics, the average cost of property damage for a fatal accident was estimated to be around $15,000, while the costs of serious and slight injury accidents were $13,000 and $5,000, respectively. Where no injuries were involved, the average cost was estimated to be $3,000.

3.3 Administrative Costs

Administrative costs involve the costs of court proceedings, insurance claim processing, and time spent by police dealing with or investigating accidents. It is particularly very difficult to attach monetary value to these services. Some countries choose to ignore police and administration costs because apportioning costs can be difficult, unless detailed records are maintained in which such records are not yet likely to be established by most countries. Further, such effort may not be necessary since the contribution of administration costs to the overall accident costs is considerably low. One suggestion is to adopt the method

used by the United Kingdom and developing countries when estimating these costs, that is police and administration costs valued at 0.2% of total resource cost, due to loss of resources in fatal accidents; 4.0% in serious accidents; 14.0% for accidents involving slight injury; and 10.0% for no–injury accidents (property damage only accidents).

Brunei Darussalam Estimates. Administration costs are considerably low when compared with other cost components of road traffic accidents. This is because it is probably not worth spending much time and effort in producing detailed estimates and these costs are particularly not easy to determine unless proper recording systems are done by the parties involved in dealing administratively with road traffic accidents. This is why some countries choose to just ignore police and administration costs.

In this study, administration cost is calculated based on the information given by insurance companies. Thus, police costs in dealing with or investigating accidents, costs of court proceedings, and other related costs are not included. It was assumed that 10.0% of the total cost of all insurance costs was set against administration expenses, which is what most developing countries did, adopting the ratios determined by research in the United Kingdom and assume administration costs to represent 0.2% of the total resource costs or $1,740 in a fatal accident, 4.0% of the total resource costs or $1,017 in a serious accident, 14% of total resource costs or $947 in a slight accident, and 10% of the total resource costs or $300 in damage-only accidents.

3.4 Medical Costs

Costs on medical treatment include hospital treatment and the use of ambulance services. Hospital treatment refers to both inpatients and outpatients. For accident victims who are hospitalized (inpatient), the total costs would involve the average length of hospitalization; average cost of treatment per day; ambulance services (if sent by ambulance); and, after released, additional costs of medical treatment that need to be taken into account. For outpatients (usually those with slight injury) only the average number and average costs per outpatient visit are considered. In the case of fatalities, we can ignore costs arising from outpatient treatment.

Some information needed to estimate costs of medical treatment can be obtained from hospitals. Data on costs of hospital treatment per day are usually not published. However, estimating costs of treatment per day is still possible by making use of information on available treatment costs. Since medical services and facilities in Brunei Darussalam are heavily subsidized by the Government, records of costs of medical treatment from road accidents are not likely to be available. Nevertheless, the cost figures can still be obtained from fee-paying patients.

Brunei Darussalam Estimates. Medical costs are a difficult area in which to collect data. Neither the Ministry of Health nor individual hospitals are able to estimate the cost of an inpatient stay per night or an outpatient visit. This is because medical costs vary widely, but injuries from road accidents are classified into fatal, serious, and slight.

For the purpose of the analysis, statistics on the number of casualties from road accidents by severity were collected for all public hospitals in Brunei Darussalam, and these statistics were published by RIPAS hospital, the biggest hospital in Brunei Darussalam (Appendix 2). Since public hospitals in Brunei Darussalam apply the same guidelines of scheme of charges authorized by the Ministry of Health, observation of different types of costs involved in treating road accident patients was done in RIPAS hospital only.

In this limited study, many assumptions need to be used to get the estimated figure of medical costs. Because medical services for locals are heavily subsidized, an estimate of the average cost of treatment for road accident casualties was mostly derived from fee-paying casualties. From here, estimates of cost could possibly be derived for local casualties, but the task would not be easy because individual medical records have to be observed and analyzed, which was time-consuming.

Although there are different classes of bed charges specified in the scheme of charges, the common bed charges used in this study are $20 per night for the ordinary wards and $150 per night for surgical and medical intensive care wards. The ward charges refer to food and accommodation only. But, as mentioned earlier, bed charges do not reflect the true cost incurred. Other costs are for X-rays, tests, CT scans, surgeries, medicines, and rehabilitation services and facilities (physiotherapy, etc.).

Based on the consolidated computations and from the analysis of medical records of traffic accidents in 2003, costs of medical treatment for road accident casualties by severity were as follows.

For fatal cases, the average number of days in a hospital before death was assumed to be 3. (Some fatal cases died immediately, while some were hospitalized for a few days before death.) The costs involved were the bed charge ($150 for surgical and medical intensive care wards); other estimated average overhead charges, such as costs of ambulances, surgeries, and medicines ($4,330, based on the receipts given to the fee-paying patients who were involved in accidents), plus the funeral cost ($2,000). Thus, the total cost per fatal casualty was estimated at $6,780.

In the case of seriously injured victims, the average number of days in a hospital was assumed to be 30, and the average number of outpatient visits was assumed to be 30. The costs involved were the bed charges ($20); other estimated average overhead charges, such as ambulance, surgery, and medicine costs ($7,770); plus outpatients visits ($90). Thus, the total cost of a seriously injured casualty was $8,460.

In the case of slightly injured victims, the average number of outpatient visits was assumed to be seven. The average cost involved was estimated to be $840.

3.5 Lost Output

When an accident involves a fatality, it will cause a loss of future output for the country because a resource, in this case labor (one of the economy's factors of production), is lost. Loss of output is estimated by first calculating the number of days or years lost. This is obtained by subtracting the average age of accident fatalities from the retirement age. If the accidents involve serious injury, the number of days of hospitalization and any recovery time required should be taken into account. For accidents resulting in slight injuries, the number of days absent from work each time an outpatient visit is made is considered to be the number of days lost. The number of days or years lost is then multiplied by the national wage rate, to estimate the cost of lost output in the case of accidents involving serious and slight injury. For fatality cases, a discount rate would have to be used to discount the loss in future years to a present value.

Information on number of days lost can be obtained from hospital records, employers, or the victims themselves. The average age of accident fatalities is available from police, transport department, and hospital records, whereas the source for information on wage rate would be from the *Brunei Darussalam Statistical Yearbook*.

Brunei Darussalam Estimates. To compute the economic rate of productivity for fatalities, no weight is given to the different types of individuals involved, except for the consideration of their age. An average value is assumed (i.e., all victims are assumed to be average workers capable of an economic production measured by the per capita gross domestic product obtained from the *Brunei Darussalam Statistical Yearbook*). For injured victims, lost output is computed based on the average wage rate of patients, and, in this case, a single average national wage rate is used to calculate lost output. Future lost output is then expressed in present values by applying a discount rate, which in Brunei Darussalam's case is 5.5% and taken from the yearbook.

From the age distribution of fatal accident victims in 2003 (Table 1), the average age of fatal accident victims is 27 years (Table 2). The average loss of productive years is computed based on a retirement age of 65 years. The age of 65 is chosen because at this age there are still a significant number of people who are economically active and employable. The average number of years forgone by fatal casualties is 38 years.

Table 1: Age Distribution of Fatalities

Age	Distribution of Fatalities (%)
5–14	17.8
15–24	42.8
25–34	14.2
35–44	7.1
45–54	14.2
55–64	3.5

Source: Brunei Darussalam Statistical Yearbook, 2003.

Table 2: Average Age of Fatalities in Brunei Darussalam
(2003)

Age Groups	Average Age	Number	Total Years
5–14	9.5	5	47.5
15–24	19.5	12	253.5
25–34	29.5	4	118
35–44	39.5	2	79
45–54	49.5	4	198
55–64	59.5	1	59.5
Total		**28**	**755.5**
Weighted Average		(27 years)	

Source: Brunei Darussalam Statistical Yearbook, 2003.

The average number of years of lost output following a fatal road accident was thus 38 years. In 2003, the gross domestic product per capita per annum was $23,615. This value was applied to the 38 years lost due to road accidents and discounted at 5.5%. The total discounted lost output was estimated to be $848,015.

An analysis of the medical records of 2003 road traffic accident cases at RIPAS hospital showed that for road accident patients involved in serious accidents the average length of hospitalization could be longer (i.e., 30 days). Based on information gathered from some interviews on the phone of the previous victims as well as information gathered from a medical officer, a further 30 days, on average, were spent recovering at home from a serious road accident. Thus, the average lost output for a serious road accident casualty was estimated to be 60 days. With an average daily wage rate of $66 per day, the cost of lost output for serious accidents was $3,960 per casualty. In the case of slight injury accidents, no inpatient treatment is required, only outpatient treatment or recovery at home. It was assumed that for slight injury accidents an average of 7 days were lost. Thus, the lost output from slight injury accidents was estimated to be $462.

3.6 Costs of Pain, Grief, and Suffering

When accidents involve serious injuries and fatalities, victims (seriously injured), relatives, and friends might suffer mentally and physically. Thus, it is deemed humane to attach costs for pain, grief, and suffering. There is no way to attach specific values to pain, grief, and suffering associated with road accidents. An alternative would be to adopt the weights used by the United Kingdom: 38% of total costs for fatal accidents, 100% of total costs for accidents involving serious injury, and 8% for accidents involving slight injury.

Brunei Darussalam Estimates. Based on the weights from research provided by the United Kingdom and used as benchmarks by most developing countries, estimates of costs for pain, grief, and suffering from road traffic accidents in Brunei Darussalam are $331,183 for each fatality, $36,347 for each seriously injured victim, and $771 for each slightly injured victim.

The individual cost components in each accident and casualty category are summarized in Table 3. If the crude estimates of pain, grief, and suffering are included in the computation, the human costs total about $1,185,978 for a fatal casualty, $38,857 for a seriously injured casualty, and about $2,535 for a slightly injured casualty.

Computed based on accident occurrence, the total noninjury costs will be about $16,740 for a fatal accident, $14,017 per accident involving serious injuries, $5,947 per accident involving slight injury, and $3,300 per accident involving property damage only.

Table 3: Summary of Costs per Casualty or Per Accident (BND)

Item	Fatal	Serious Injury	Slight Injury	Property Damage Only
Per Casualty				
Lost Output	848,015	3,960	462	
Medical Costs	6,780	8,460	840	
Pain, Grief, and Suffering	331,183	26,347	771	
Total	**1,185,978**	**38,857**	**2,073**	
Per Accident				
Administration Cost	1,740	1,017	947	300
Property Damage	15,000	13,000	5,000	3,000
Total	**16,740**	**14,017**	**5,947**	**3,300**

Source: Brunei Darussalam data.

4 NATIONAL ROAD ACCIDENT COSTS

4.1 Introduction

Once the costs of individual accidents and casualties are established, it is possible to determine the total national cost of accidents by aggregating all the individual accident costs. While this may appear straightforward, there are several difficulties that relate to the accuracy and quality of the accident data.

4.2 Computation of National Costs

The overall national accident costs can be computed by using the unit cost value of the individual components shown in Table 3 and the number of accidents that have occurred.

Since most accidents involve multiple casualties, the casualty rates per accident must be established when computing the cost on a per accident basis. Table 4 gives the 2003 casualty rates for each class of accident.

Table 4: Casualty Rates per Accident (2003)

Accident Severity	Number of Casualties per Accident		
	Fatal	Serious Injury	Slight Injury
Fatal Accident	1.17	0.38	0.26
Serious Injury	—	1.43	0.30
Slight Injury	—	—	1.53

Source: Brunei Darussalam data.

Taking into account multiple casualties in an injury accident, the average cost was $1,419,639 per fatal accident, $70,205 per serious injury accident, $9,119 per slight injury accident, and $3,300 per property damage accident only.

In 2003, there were 24 cases of fatal accidents resulting in 28 fatalities. There were also 65 cases of accidents involving serious injuries, 580 cases involving slight injuries and 1,952 cases involving damage-only accidents. From table 5, it is shown that the total cost of traffic accidents that occurred in 2003, was BND84 million.

Table 5: National Cost of Road Accidents in Brunei Darussalam (2003)

Types of Casualties	Number of Casualties	Average Cost ($)	Total Cost ($)
Fatal	28	1,419,639	39,749,892
Serious	349	70,205	24,501,545
Slight	1,469	9,119	13,395,811
All Casualties	1,834	—	77,647,248
Property Damage Only	1,952	3,300	6,441,600
Total			**$84,088,848**

Source: Brunei Darussalam data.

Based on a gross domestic product value for 2003, which is $8,236.9 million, the accident cost is about 1.02% of gross domestic product. However, if estimates of underreported cases of fatalities, serious injury, slight injury, and no-injury accidents are incorporated, the total cost of traffic accidents would increase. The estimates investigated (Table 6) show the percentage of underreported cases.

Table 6: Estimates of Underreporting of Fatalities, Serious and Slight Injuries, and Damage Only Accidents (2003/2004)

Accident Severity	Estimates of Underreporting
Fatality	2–5% of deaths
Serious Injury	17–26% of serious injuries
Slight Injury	36–42% of slight injuries
Property Damage Only	50–100% of all property damage only accidents

Source: Brunei Darussalam data.

thus, taking the minimum percentage of underreported cases, the total estimated cost of accidents in Brunei Darussalam has increased to $99,114,972 (Table 7), which is equivalent to 1.2% of Brunei Darussalam's 2003 gross domestic product.

Table 7: National Cost of Road Accidents in Brunei Darussalam (2003)

Types of Casualties	**No. of Casualties**	**Average Cost** ($)	**Total Cost** ($)
Fatal	30	1,419,639	42,589,170
Serious	408	70,205	28,643,640
Slight	1,998	9,119	18,219,762
All Casualties	2,436	—	89,452,572
Property Damage Only	2,928	3,300	9,662,400
Total			**99,114,972**

Source: Brunei Darussalam data.

5 CONCLUSION

Although the number of deaths and injuries relating to road accidents was reduced in 2003, and the estimated annual costs of accidents amounted to nearly BND84 million, representing 1.02% of gross domestic product, it is still imperative that the relevant authorities in Brunei Darussalam invest more in road safety research and programs to better understand and improve the road safety environment, considering private automobile ownership rates in the country have been increasing annually (from 231,656 in 2002 to 244,067 in 2003).

The economic benefits of investing in road safety improvements (in road design and layout, education, training and enforcement) can be greatly appreciated if the national annual cost of road accidents can be properly estimated. To achieve this, resources for developing a better road accident costing database is crucial, so that better and more estimates can be obtained.

It is important for the Government to declare the lack of road safety an urgent problem, if research on the economic and human cost of traffic injuries is conducted, and use modern strategies and tools to raise awareness about this issue.

There must be cooperation across many sectors in Brunei Darussalam, not only in health, but also in education, transport, and law enforcement. A workforce that will tackle injury prevention and control (i.e., in media and communication, economic analysis, and policy development) must be built.

Road traffic accidents can be prevented by taking action, including raising awareness of and enforcing laws governing speed limits, seat belt use, and crash helmets.

APPENDIXES

Table A1: Ten Leading Causes of Death in Brunei Darussalam (2003)

Type of Disease	Male	Female	Total	Percent	Rate per 100,000 Population
Heart Diseases	115	98	**213**	21.1	61.1
Cancer	87	69	**156**	15.4	44.7
Diabetes Mellitus	47	35	**82**	8.1	23.5
Cerebrovascular Diseases	39	38	**77**	7.6	22.1
Bronchitis, Chronic and Unspecified Emphysema, and Asthma	38	30	**68**	6.7	19.5
Influenza and Pneumonia	39	20	**59**	5.8	16.9
Hypertensive Diseases	20	18	**38**	3.8	10.9
Certain Conditions Originating in the Perinatal Period	20	16	**36**	3.6	10.3
Road Transport Accidents	23	5	**28**	2.6	7.5
Congenital Malformations, Deformations, and Chromosomal Abnormalities	10	15	**25**	2.5	7.2
Others	121	109	**230**	22.8	65.9
All Deaths	559	453	**1,037**	100.0	289.6

Source: Ministry of Health.

Table A2: Road Accident Statistics For All Hospitals in Brunei Darussalam (2003)

Hospitals	Accident Severity	Age Group																					
		0		1–4		5–14		15–24		25–34		35–44		45–54		55–64		65–74		75+		Total		
		M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	Total
RIPAS	Fatal	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	2	2	**4**
	Serious Injury	0	1	6	7	26	11	46	35	51	40	27	18	13	10	6	0	5	4	2	0	182	126	**308**
	Slight Injury	0	1	14	8	32	43	125	97	106	51	57	41	17	14	8	5	5	2	0	0	364	262	**626**
Total		0	2	20	15	58	54	173	134	157	91	84	59	30	24	14	5	10	6	2	0	548	390	**938**
SSB	Fatal	0	0	0	0	2	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	4	2	**6**
	Serious Injury	0	0	0	0	1	0	1	0	6	1	2	1	2	1	0	0	0	0	0	0	12	3	**15**
	Slight Injury	0	1	7	5	32	24	60	48	70	33	35	26	14	11	13	6	2	4	5	1	238	159	**397**
Total		0	1	7	5	35	24	63	50	76	34	37	27	16	12	13	6	2	4	5	1	254	164	**418**
TUTONG	Fatal	0	0	0	0	1	0	2	0	1	0	1	0	0	0	0	0	0	0	0	0	5	0	**5**
	Serious Injury	0	0	0	0	2	0	6	1	2	2	1	0	0	1	1	0	1	0	1	0	14	4	**18**
	Slight Injury	0	0	6	12	22	25	55	34	34	23	28	16	10	12	4	2	8	3	0	0	167	127	**294**
Total		0	0	6	12	25	25	63	35	37	25	30	16	10	13	5	2	9	3	1	0	186	131	**317**
PIHM	Fatal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	Serious Injury	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	Slight Injury	0	0	2	2	2	2	7	3	6	2	5	1	2	1	0	0	3	0	0	0	27	11	**38**
Total		0	0	2	2	2	2	7	3	6	2	5	1	2	1	0	0	3	0	0	0	27	11	**38**
PANAGA	Fatal	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	**1**
	Serious Injury	0	0	0	0	1	2	0	0	0	1	0	1	2	0	1	0	0	0	0	0	4	4	**8**
	Slight Injury	2	0	3	2	15	14	16	19	11	8	12	3	4	2	3	0	0	0	0	0	66	48	**114**
Total		2	0	3	2	16	16	16	19	11	9	12	4	7	2	4	0	0	0	0	0	71	52	**123**
All Hospitals	Fatal	0	0	0	0	3	0	6	4	1	0	1	0	1	0	0	0	0	0	0	0	12	4	**16**
	Serious Injury	0	1	6	7	30	13	53	36	59	44	30	20	17	12	8	0	6	4	3	0	212	137	**349**
	Slight Injury	2	2	32	29	103	108	263	201	227	117	137	87	47	40	28	13	18	9	5	1	862	607	**1,469**
Total		2	3	38	36	136	121	322	241	287	161	168	107	65	52	36	13	24	13	8	1	1,086	748	**1,834**

Sources: Division of Statistics, RIPAS Hospital, BSB.

Table A3: General and Transport Statistics of Brunei Darussalam (2003)

Population and Area	
Land Area	5,765 square kilometers
Population	348,800
Population Growth	2.3%
Economic Indicators	
Gross Domestic Product	$8,236.9 million
Per Capita Gross Domestic Product	$23,615
Vehicle Population	
Nongovernment Vehicles	238,061
Government Vehicles	6,671
Total Registered Vehicles	244,732

Source: Brunei Darussalam Statistical Yearbook, 2003.

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ADB-ASEAN Regional Road Safety Program

Accident Costing Report: AC 7

The Cost of Road Traffic Accidents in the Philippines

ADB

asean

Asian Development Bank-Association of Southeast Asian Nations
Regional Road Safety Program

Accident Costing Report AC 7: Philippines

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ABBREVIATIONS

ADB	Asian Development Bank
DPWH	Department of Public Works and Highways
MMARAS	Metro Manila Accident Reporting and Analysis System
MMDA	Metro Manila Development Authority
TARAS	Traffic Accident Reporting and Analysis System
TMG	Traffic Management Group
TRL	Transport Research Laboratory

NOTE

In this report, “$” refers to US dollars.

CONTENTS

1 INTRODUCTION

1.1 General

At this time, traffic accidents worldwide claim approximately two human lives every minute. Even against the backdrop of rampant underreporting, the number of annual traffic-related deaths worldwide has exceeded the 1 million mark, around 70% of which occur in those countries that the World Bank classifies as low- or middle-income (Lamm et al. 1999). Apart from prime loss in human lives, these occurrences are also accompanied by a tremendous amount of waste in finances, property, time, resources, and services. Medical efforts geared toward the treatment and needed rehabilitation of accident victims are obviously huge and tedious. The investigation and litigation processes involved could also be very taxing, not only financially but also emotionally, for bereaved and grieving families. A great amount of labor-related resources is likewise lost when manpower is reduced due to (i) absence from work for medical treatment or insurance claims processing, (ii) absence resulting from injuries with disabilities, and (iii) vacancy due to deaths. In the Philippines, a single traffic accident can be peculiarly costly, because one accident could potentially cause heavy traffic congestion that result from great delays in the investigation and rescue processes. These in turn cause additional losses among all people affected.

While road safety is improving in developed countries, the situation seems to be getting worse in developing countries, where providing transportation infrastructure geared toward improving the mobility of people is prioritized (Sigua 2000). The very high growth rate of vehicles in developing countries has compounded the problem of road safety. In the past 10 years, the volume of vehicles in the Philippines has more than doubled (from 1.88 million in 1992 to 4.19 million in 2002). Once merely a status symbol, owning a car has become a necessity due to the inadequacy of public transportation services and the deterioration of the environment caused by pollution. The lack of driver education and weak enforcement of traffic rules and regulations exacerbate the situation. Higher speeds and a complete disregard for and lax implementation of traffic rules and regulations have contributed to the rise of casualties on the road.

However, apart from freak road accidents sensationalized by media, there seems to be a lackluster response from the Government to road safety issues. Could this be the result of taking these accidents simply as common occurrences or even as natural phenomena? Or, is there no clear understanding of the magnitude of the loss to society incurred by traffic accidents?

Human life is considered most sacred, and there seems to be strong disagreement over whether or not to place a monetary value on it. Some people are uncomfortable or emotionally reluctant to assess in terms of money traffic accidents involving the loss of human life. A reason for this is that property and money can be restored or replaced, but human lives, when lost, are lost forever. Putting a monetary value on a human life or a fatal accident may be a topic for heated debate, but postponing or avoiding this debate leaves many, including decision makers, still groping in the dark.

Estimating the losses attributed to traffic accidents could be very well justified if it would create awareness of the worsening road safety situation in the Philippines. Similar to the growing concern regarding the environment, the time has come for the Government to take action to promote road safety. If realistic estimates of the cost of losses can be made, nothing prevents the Government from taking action to reduce this cost.

An ongoing project at the Department of Public Works and Highways (DPWH)

includes a component on the estimation of the economic cost of traffic accidents. The methodologies of that study and this one are based on the gross output method, which is thoroughly discussed in the United Kingdom's Department for International Development final report entitled *Guidelines for Estimating the Cost of Road Crashes in Developing Countries* (Babtie Ross & Silcock and Transport Research Laboratory [TRL], 2003). With strong support and encouragement from the Asian Development Bank (ADB), there seems to be a strong emphasis on estimating the losses attributed to traffic accidents in Association of Southeast Asian Nations countries.

Estimates must truly reflect the actual worsening condition of our roads in terms of safety. While data gaps exist, reasonable assumptions must be made as an initial attempt. Improving estimates can be done in the future, as data become readily available and collection efforts improve. Most of the assumptions made in this report were made based on DPWH work.

1.2 Objectives

The reason for estimating accident costs may seem obvious, but this is seldom expressed explicitly. Costs are sometimes used for general statements (e.g., accidents in a country cost more than several million dollars per year, or accidents costs are equal to a certain percentage of a country's gross domestic product). For such purposes, general figures are sufficient, so long as they are of the right magnitude (Andreassen 1988). Costs are also required for assessing the value of improving highways, installing traffic signals, enforcing specific traffic laws, putting reflective plates on trucks, implementing various safety countermeasures, and others. When value assessments are considered, a very specific cost is required to determine benefits.

The promotion of traffic safety contributes to improving the welfare of society in two ways (Organisation for Economic Co-operation and Development, 1981).

(i) By avoiding accidents and accident consequences, the losses of resources caused by accidents are avoided as well.

(ii) By avoiding accidents and their social costs, resources can be saved that otherwise would be devoted to the relief of accident consequences.

The first point includes the avoidance of production losses resulting from the incapacity of accident victims and the avoidance of damage to capital goods and production losses caused by congestion that results from accidents.

The second point includes the avoidance of costs of medical treatment of people involved in accidents, repair of property damage, police investigation costs, costs of legal and court procedures, and insurance administrative costs. The resources thus saved can be used elsewhere, to increase welfare.

1.3 Significance

The significance of this report therefore lies in (i) increasing awareness regarding the extent of road safety-related problems in the Philippines (in the hope of promoting a preventive, instead of reactive, approach to the situation) and (ii) establishing a realistic and systematic costing methodology for traffic accidents, rather than the mere estimation of the scale of these accidents.

2 METHODOLOGY

2.1 General Approach

Numerous methodologies to estimate the costs of accidents were introduced in the past. These include the gross output or human capital method, life insurance method, court award method, implicit public sector valuation method, net output method, and value of risk change or willingness-to-pay method. These methods are documented by Alfaro et al (1994), Jacobs (1995), and Babtie Ross & Silcock (2003).

The life insurance method measures the valuation of risk associated with road usage and is determined by the premiums that the driver population is willing to pay. The court award method is based on the actual compensation settlements awarded, which may be influenced by the degree of negligence found. In the implicit public sector valuation method, a set of implicit values are used to value human lives.

However, most of these estimation methods were generally discredited (Babtie Ross & Silcock 2003). To date, the two commonly accepted methods to estimate the economic cost of accidents are the gross output or human capital method and the willingness-to-pay method.

Gross Output or Human Capital Method. This approach focuses on the economic consequences of a road accident and usually also includes a notional sum that reflects the pain, grief, and suffering incurred by the people involved and their families. The method is based on the idea that the value to society of avoiding a death or injury is related to the potentially lost economic output and resources.

Willingness-to-Pay Method. This method is based on the amount that a person is willing to pay to avoid an accident. This is a very subjective measure that reflects individual preferences, values, and perceptions of risk. Reliably estimating these factors is extremely difficult, and estimates will vary significantly from person to person and from place to place.

The willingness-to-pay method has become the preferred costing method in many developed countries, as it has been recognized as the best way to measure the costing of accidents for the purpose of benefit-cost analysis. Recognizing the difficulty of implementing this method in developing countries, due to its data requirements (relies on the completion of a complex questionnaire), ADB's *Road Safety Guidelines for the Asian and Pacific Region, Regional Initiatives in Road Safety* (1997) recommends the gross output method. This document considers the gross output method the appropriate method for use in developing countries because it relates more closely to direct economic impacts and the practical and measurable consequences of road accidents. The gross output method is the approach used in this cost estimation, and the detailed methodology for dealing with data gaps and underreporting is in line with the guidance document provided to the author by ADB.

2.2 Determination of Cost Components

Consistent with the gross output method and ADB's guidelines, the accident cost components can be grouped into the five major cost categories shown in Table 1.

Table 1: Cost Component Categories

Cost Category	Definition
Lost Output	The loss of the value of the work that injured people would have produced during the time they were absent from their jobs.
Pain, Grief, and Suffering	An allowance for the loss of quality of life and the pain, grief, and suffering incurred by injured people and their families and friends.
Medical Costs	The cost of treating people injured in accidents, including the cost of doctor's fees, medicines, and (if required) time spent in hospitals and receiving long-term care.
Property Damage	The cost of repairing vehicles and other property damaged, including the costs paid by people and their insurance companies.
Administrative Costs	The costs incurred by the police and other services in the process of attending to accidents and associated activities and by insurance companies administering insurance claims.

Source: Philippines data.

These cost categories are discussed in greater detail in the following paragraphs.

Lost Output. Lost output is generally considered as the largest resource cost incurred as a result of a traffic accident. Lost output is an expression of the loss to society of productive manpower, be it permanent or temporary. Its value varies widely, ranging from a 1-day loss, for a minor injury incident, to long years of foregone work, for those killed or permanently disabled.

Pain, Grief and Suffering. Strictly, mental suffering, pain, and other emotional factors cannot be assessed. They defy evaluation in terms of money and must therefore be taken as true intangibles. However, in practice, some countries add an assumed lump sum or proportional amount to measured accident costs to allow for emotional losses.

Medical Treatment and Hospital Costs. The treatment and rehabilitation of traffic accident victims require the use of medical resources (i.e., work input of the personnel [ambulance personnel, doctors, nurses, and others]) and provision of rescue equipment, hospital beds, instruments, and other medical aids, such as drugs. If injuries caused by traffic accidents could be avoided, these resources could be made available for other purposes, such as treatment of the sick, or their basic components could be transferred to other uses. The components that can be distinguished include treatment on the spot, transport and treatment on the way, treatment in a hospital, and rehabilitation in a hospital. Outpatient follow-up treatment and general treatment can also be distinguished.

Although considerable parts of medical expenses are paid only to those who provide such medical services, the expenses may still be regarded as losses to the economy, because such services would have been provided elsewhere if the traffic accidents had not occurred. The same applies to the repair charges of damaged vehicles and legal fees.

Property Damage. Property damage necessitates repair or replacement costs of vehicles, goods, and road accessories. In addition, property damage can result in

further welfare losses, when capital goods (e.g., trucks, cars for commercial use, equipment, and others) are damaged or destroyed and their productive services are lost. When private passenger cars are damaged, additional welfare losses may result from the loss of use.

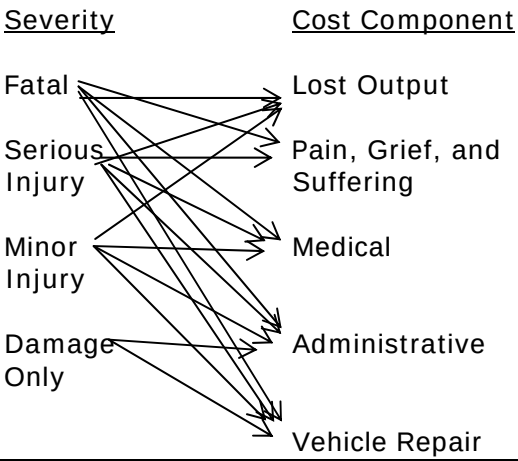
For the determination of property damage only involvement costs, insurance records can be used and the compensation taken as an indicator of social losses. Account has to be taken of the fact that insurance companies generally pay compensation for liability cases only and are liable for accidents brought on by one's own fault only to the extent of a contracted limit. In addition, it should be noted that there may be considerable differences between the cases recorded by the insurance companies and police records.

With respect to property losses, evaluation is relatively easy, because the market prices and repair charges for the property lost or damaged can be regarded as a good expression of the objective values.

Administrative Costs. The police are called to the sites of traffic accidents to control traffic and investigate and record the facts. Total person-hours required for handling traffic accidents have to be considered. A patrol car is dispatched to each traffic accident site to control traffic and deal with the accident. The patrol car is used for other purposes also, and half of its total expenses will be taken up in connection with traffic accidents. In addition, the police headquarters use cameras to photograph accident sites. Some of the other components of administrative costs are judicial costs, and insurance administration costs. The functions of the court dealing with traffic accidents include (i) civil suits for damages, (ii) civil mediation, (iii) criminal suits for negligence, and (iv) summary criminal procedures. Most damage caused by traffic accidents is covered by insurance, and operating expenses required to support this system are also part of the costs and expenses incidental to traffic accidents.

Figure 1 provides a summary of the different cost components that may be involved in each accident severity type.

Figure 1: Different Cost Components of Each Severity Type



Based on the figure, a fatal accident would incur the loss of productive life of the victim; pain, grief, and suffering of loved ones; cost of medical treatment, when the victim was brought to a hospital before dying; costs related to various miscellaneous expenses that would constitute administrative costs; and cost of a totally wrecked vehicle or the cost of the repair of a damaged vehicle. Similar cost components may be incurred when a victim becomes permanently disabled after an accident resulting in serious injury. An accident resulting in minor injury would still incur some medical costs, require some paper work, and require, possibly, minor repair of a slightly damaged vehicle.

Other Assumptions. A range of assumptions underlie the recommended methodology. The major additional assumption is that all accidents are costed as though all steps are taken to restore people, vehicles, and property as closely

as possible to their condition before the accident. This means that

ADB recommends the following.

(i) Administrative costs for fatal accidents should be 0.2% of the total resource cost for all fatal accidents.
(ii) Administrative costs for serious injury accidents should be 4.0% of the total resource cost for all serious injury accidents.
(iii) Administrative costs for minor injury accidents should be 14.0% of the total resource cost for all minor injury accidents.
(iv) Administrative costs for property damage only accidents should be 10.0% of the total resource cost for all property damage only accidents.

Indirect Costs of Accidents. Aside from the major cost components previously discussed, other costs may be attributed to traffic accidents. One is the cost of transportation services for the injured from the accident spot to a hospital. In many cases, a law-abiding offender is the one that brings a victim to the hospital. In some cases, a concerned citizen may offer to bring a victim to a hospital. Seldom does a hospital ambulance come to the aid of a victim. At present, ambulance services may be provided by some rescue teams that go to accident sites when notified by phone.

Losses Caused by Traffic Congestion. Traffic accidents often cause bottlenecks. A few minutes of congestion would easily create gridlock at intersections and many kilometers of vehicle queues in urban areas. The people affected by such bottlenecks waste time and fuel and suffer mental and physical fatigue.

3 ESTIMATION OF COST COMPONENTS

Following ADB's guidelines, the gross output method requires a procedure that is relatively easy to follow. What remains is the problem of collecting pertinent data that will be used as inputs in the step-by-step procedure. While collection of such data does not pose a major problem in developed countries, it proves to be a major task in developing countries. It must be stressed once again that traffic accident data are very valuable and thus require a conscientious effort on the part of the agencies responsible in data collection. Table 2 provides the method of calculating the cost of each component based on the gross output method.

Table 2: Estimation Procedure for Valuing Accidents Based on the Gross Output Method

Cost Component	Estimation
Lost Output	This is calculated as the average daily wage rate of each person involved in an accident, multiplied by the number of days of missed work, and then added for all people involved in an accident. For fatalities and permanent disabilities, the calculation is performed over the rest of the victims' expected working lives and discounted to an equivalent present value.
Pain, Grief, and Suffering	Calculated as a percentage of lost output cost.
Medical Costs Short-Tem	These are calculated as the average length of stay in hospital for each seriously injured person involved in an accident, multiplied by average daily cost of hospital care, then added for all people seriously injured in an accident. For minor injuries, the cost is calculated as the average cost of a visit to a doctor for treatment, multiplied by the average number of visits.
Long-Term	These are calculated as the annual cost of care for people permanently and severely disabled. The calculation is performed over the rest of their expected lifespan and discounted to an equivalent present value.
Vehicle Damage	This is calculated as the average cost of vehicle repairs (sourced from insurance company records), multiplied by the average number of vehicles involved in an accident.
Administrative Costs	These are calculated as a percentage of resource costs in line with Asian Development Bank recommendations (0.2% for fatal accidents, 4.0% for serious injury accidents, 14.0% for minor injury accidents, and 10.0% for property damage only accidents).

Source: Philippines data.

3.1 Underlying Assumptions

The gross output method requires input to a number of variables incorporated in each cost component. Some of these variables require estimation from secondary data that are available at the time of the study. However, some variables cannot be known unless comprehensive primary data collection is conducted. In this case, assumptions based on the experience of other countries are made. Nevertheless, estimation of the cost of accidents has to be updated regularly. At this point, determining those variables that have deficiency in data availability is very important. Determination of these variables can then be incorporated in the research agenda on road safety. The National Center for Transportation Studies of the University of the Philippines has actually initiated the formulation of a research agenda related to traffic safety.

One notable research effort on traffic analysis, focusing on hospital records (Vibal 2003), proves to be very valuable in determining the extent of severity of human damage attributed to road accidents. The result of the research is also used in this paper, in determining the extent of underreporting of traffic accidents.

Several government projects on road safety funded by international organizations are ongoing. One relevant project previously mentioned is DPWH's Sixth Road Project (C08 Road Infrastructure Safety Project). One of the expected outputs of this ADB-funded project is the development of a handbook on accident cost estimation and updating. Almost simultaneously, another ADB-funded project, implemented through the Metro Manila Development Authority, (MMDA) and the Department of Environment and Natural Resources and entitled Metro Manila Air Quality Improvement Project, has a major component on road safety. It is interesting to note that these projects have developed traffic accident database and analysis systems.

The Traffic Accident Reporting and Analysis System (TARAS), is housed at DPWH and is composed of computer software and associated procedures for recording and analyzing road accidents in the Philippines. TARAS focuses on the analysis of traffic accidents occurring along national highways only. However, the Metro Manila Accident Reporting and Analysis System (MMARAS) is the computer software being used by MMDA. MMARAS is intended for recording and analyzing road accidents in Metro Manila. Although the proponents of the two projects may assert that having two separate systems is best, since they have different objectives to meet, in the end, what matters most is whether the two systems can give the overall picture of traffic safety in the Philippines. In the case of MMARAS, only fatal and serious injury accidents are considered for reporting and analysis. This leaves the traffic investigation reports on minor injury accidents and property damage only accidents intact on the shelves of the different police districts in Metro Manila. If integration of the two systems is not possible, at least coordination of tasks between the two agencies concerned is absolutely necessary.

3.2 Values Used for Estimation

Average Age of Seriously Injured People. Based on a recent study (Vibal 2003) examining 617 cases of serious injuries in road accidents (including 44 fatalities), the average age of seriously injured people was 28 years. Most seriously injured people were between the ages of 13 and 39 years.

Average Age of Fatalities. This has been assumed to be the same as the average age of people seriously injured.

Damage to Property. Damage to property can be obtained from insurance companies, based on property damage claims for motor vehicle accidents. Property damage costs can vary considerably, depending on the degree of wreckage sustained. Obtaining estimates based on accidents stratified according to severity may therefore be necessary.

As previously mentioned, the repair costs are calculated as if all vehicles are repaired to manufacturer's specifications, since this represents the resource cost to the community of vehicle damage. Information on average claims was supplied by the Insurance Surety of the Philippines on a confidential basis. The average claim was converted to 2003 figures, then allowance was added for total wrecks and owners cost input and towing. In general, vehicles involved in fatal and serious injury accidents will be damaged more than cars in accidents where nobody is injured. No data are currently available for the relative cost of

damage by injury severity. International experience indicates that the relative repair cost of accident types compared to average cost is as follows.

(i) The repair cost of fatal accidents is 1.55 times average cost.
(ii) The repair costs of serious injury accidents is 1.40 times average cost.
(iii) The repair costs of minor injuryaccidents is 1.25 times average cost.
(iv) The repair cost of damage only accidents is 0.85 times average cost.

These costs translate to ₱46,500 per vehicle for a fatal accident, ₱42,000 per vehicle for a serious injury accident, ₱37,500 per vehicle for minor injury accident, and ₱25,500 per vehicle for a damage only accident.

Administrative Costs. The costs are composed of several components, as many agencies administer services in relation to accidents (traffic police, emergency response services, insurance companies, and law service providers). Computing this cost is therefore very difficult. This is compounded by the problems of underreporting and the lack or complexity of administrative links. ADB's guidelines are followed in estimating administrative costs. ADB recommends that administrative costs be taken as a percentage of total resource costs (sum of lost output and medical and property damage costs).

Similar to property damage, administrative costs associated with an accident are likely to depend on the accident's severity. In a more serious accident, vehicles may remain on the road longer, and more police may be assigned to direct traffic. The process of investigation is also longer and more complicated, as are claims and follow-up procedures and possibly legal proceedings.

ADB recommends the following.

(v) Administrative costs for fatal accidents should be 0.2% of the total resource cost for all fatal accidents.
(vi) Administrative costs for serious injury accidents should be 4.0% of the total resource cost for all serious injury accidents.
(vii) Administrative costs for minor injury accidents should be 14.0% of the total resource cost for all minor injury accidents.
(viii) Administrative costs for property damage only accidents should be 10.0% of the total resource cost for all property damage only accidents.

Medical Costs. Medical costs vary widely depending on the severity of the injury. Serious injury could mean long hospitalization and rehabilitation periods.

The two major factors for serious injuries are hospital stays and recuperation periods.

Hospital Stays. In a recent study of traffic accident hospital records (Vibal 2003), victims stayed in hospitals, depending on the severity of their injuries, for the following number of days: 6–8 days for typical pedestrian accidents, 17 days for more severe pedestrian accidents, 5–6 days for typical motorcycle accidents, and 19 days for more severe motorcycle accidents. For the purpose of this study, an average of 8 days per stay will be used for estimating cost.

During this 8-day hospital stay, the cost incurred due to hospital care must be considered. Based on the rates in a tertiary hospital and the cost of daily visits by a general practitioner, two visits by a specialist, various medicines, one minor surgery, and one ambulance ride to a hospital, the total cost of hospital care is estimated at ₱4,000 per day. This amount

is paid in full by the patient, without subsidy from the Government.

Recuperation Period. While recuperating at home, an injured person may still be using medication. During this period, that person is also off work. As no data exist concerning average recuperation periods, information from experiences in other countries may be used. In Australia, for example, a study showed that on the average a person recuperating from hospital treatment will have an additional 2 days off work for every day in a hospital. This was confirmed with medical practitioners in Manila.

In the case of minor injuries, 2 visits to a doctor can be reasonably assumed. The first visit is for initial assessment of injuries. The second visit is for follow-up treatment.

Costs incurred during each visit may be as follows: ₱250 for consulting services and another ₱250 for medication, bandages, and other necessary items. This equals ₱500 per consultation.

When a seriously injured person becomes permanently disabled, the costs will include medical expenses, special equipment (e.g., a wheelchair or special bed), and in-home nursing costs. Or, if a family member cares for the permanently disabled person, the cost of lost income due to absence from work would be included. In the absence of data on long-term care, an estimate of ₱100 per day is assumed to cover the costs of long-term care for a permanently disabled person.

Based on the limited records[1] so far inputted to the TARAS of DPWH, the following information was obtained.

(i) The average number of vehicles involved in each accident type was 1.4 vehicles per fatal accident, 1.5 vehicles per serious injury accident, 1.5 vehicles per minor injury accident, and 1.8 vehicles per property damage only accident.
(ii) The average number of injuries in a fatal accident was 1.1 fatalities and 0.4 serious injuries.
(iii) The average number of injuries in a serious injury accident was 1.5 serious injuries.
(iv) The average number of injuries in a minor injury accident was 1.1 minor injuries.

3.3 Estimation of Average Cost of Accidents

In this section, the computation of average cost for each type of accident will be shown. The estimates are based on values of the different variables explained earlier (under Cost Components) and follow the calculation procedure given in Table 2.

Estimation of Cost of a Single Fatal Accident. The estimation of the cost of a fatal accident requires the calculation of the five cost components: lost output; pain, grief, and suffering; medical cost; administrative cost; and repair cost of the damaged vehicle. As shown in Table 3, the estimated average cost of a fatal accident is approximately ₱2.3 million.

[1] When more data are collected, better estimates can be obtained.

Table 3: Average Cost of Fatal Accident

Cost Component	Amount (₱)	%
Lost Output:	1,783,540	
• Fatality	32,428	
• Disability and/or Serious Injury	2,893 1,818,861	
• Off Work		
Subtotal		80
Pain, Grief, and Suffering	363,772	16
Medical Cost		
• Short-term	12,800	
• Long-term	8,672	
Subtotal	**21,472**	**0.9**
Vehicle Damage	65,100	2.9
Administrative Cost	3,811	.2
Total	**2,273,017**[a]	**100.0**

[a] ₱2,273,017 = $41,328
Source: Philippines data.

Estimation of Cost of a Single Serious Injury Accident. The same cost components considered when estimating the cost of a single fatal accident are considered when estimating the average cost of a serious injury accident. As shown in Table 4, the estimated average cost is about ₱350,000.

Table 4: Average Cost of Serious Injury Accident

Cost Component	Amount (₱)	%
Lost Output:		
• Disability and/or Serious Injury	121,605 10,849 **132,454**	**37.5**
• Off Work		
Subtotal		
Pain, Grief, and Suffering	66,227	18.7
Medical Cost:		
• Short-term	48,000	
• Long-term	32,521	
Subtotal	**80,521**	**22.8**
Vehicle Damage	63,000	17.8
Administrative Cost	11,039	3.1
Total	**353,242**[a]	**100.0**

[a] ₱353,242 = $6,423.
Source: Philippines data.

Estimation of Cost of a Single Minor Injury Accident. The estimation of the average cost of a minor injury accident requires the calculation of three cost items: medical cost, repair cost of the damaged vehicle, and administrative cost. As shown in Table 5, a single minor injury accident would amount to approximately ₱70,000.

Table 5: Average Cost of Minor Injury Accident

Cost Component	Amount (₱)	%
Lost Output • Off Work	603	0.9
Medical Cost	1,100	1.6
Vehicle Damage	56,250	81
Administrative Cost	11,470	16.5
Total	**69,423**[a]	**100.0**

[a] ₱ 69,423 = $1,262.
Source: Philippines data.

Estimation of Cost of a Single Property Damage Only Accident. Aside from the cost of repair of a damaged vehicle, administrative costs are also incurred when a damage only accident occurs. As shown in Table 6, a damage only accident would cost about ₱55,000. (This excludes costs that may be incurred due to repair or replacement of damaged road signs and other street furniture.)

Table 6: Average Cost of Damage Only Accident

Cost Component	Amount (₱)	%
Vehicle Damage	45,900	83.3
Administrative costs	9,180	16.7
Total	**55,080** [a]	**100.0**

[a] ₱ 55,080 = $1,001.
Source: Philippines data.

Summary of Average Cost of Each Type of Accident. Table 7 shows the summary of the average costs of accidents by type. In terms of property damage only accidents, the cost will be about 40.00 times, 6.00 times, and 1.25 times the cost of fatal, serious injury, and minor injury accidents, respectively.

Table 7: Summary of Cost

Accident Type	Average Cost (₱)
Fatal	2,273,000[a]
Serious Injury	350,000[b]
Minor Injury	69,000[c]
Damage Only	55,000[d]

[a] ₱2,273,000 = $41,330.
[b] ₱350,000 = $6,360.
[c] ₱69,000 = $1,250.
[d] ₱55,000 = $1,000.
Source: Philippines data.

4 ESTIMATION OF NATIONAL COST

Once the average cost of each type of accident is obtained, the total cost of accidents may be estimated by multiplying the total number of accidents of each type by the average cost. The types used in the analysis are fatal accident, serious injury accident, minor injury accident, and property damage only accident.

4.1 Data Availability and Quality

In the Philippines, researchers rely mostly on accident data provided by the police. More specifically, the Traffic Management Group (TMG) is responsible for keeping accident data for the whole country. Most experts agree that a serious problem exists in the reporting of accidents. This results from the following practices.

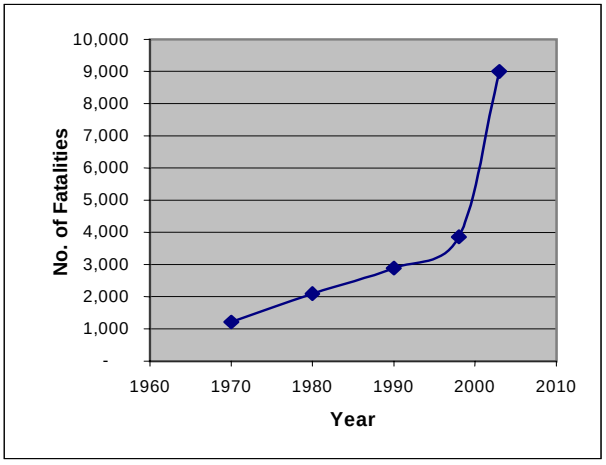
(i) The fatalities count is still based on death at the scene, although the United Nations Office at Geneva definition of a traffic death (i.e., a traffic death is one that occurs within 30 days of the event), is recognized. Even though most countries still use different definitions, their accident statistics are adjusted by applying correction factors to conform to the standard definition. Our current system of accident data keeping makes this practice of applying corrections almost impossible to do.

(ii) A major cause of underestimating traffic accident statistics in the Philippines is the lack of an effective means of updating fatality and injury data. At present, we do not yet have a system in which records from hospitals are transferred to TMG, which is the proper authority for data keeping.

(iii) The process of recording and updating is prone to errors, as these tasks are done manually. Moreover, records can be lost or misplaced.

Most experts (including those from the Philippine National Police) recognize that because of the different agencies involved and different jurisdictions, a serious problem exists regarding police underreporting traffic accidents. An efficient road accident data system is simply not yet available in the Philippines. Moreover, hospital records are not reconciled with those of the police. Figure 2 shows the official statistics from the health sector. Deaths attributed to traffic accidents for 1970, 1980, 1990, and 1998 are available from Philippine Health Statistics. And, in the recently completed *Philippine National Injury Survey* (2003), funded by United Nations Children's Fund, approximately 9,000 fatalities were attributed to road traffic accidents in 2002. This showed a dramatic increase from the number of deaths (3,800) recorded in 1998. Moreover, the police reported only 801 fatalities in 2002. This, alone, implies that a very serious underreporting problem exists.

Figure 2: Traffic Accident Deaths



Source: Philippine Health Statistics and 2003 Philippine National Injury Survey, Quizon et al.

The situation of underreporting for injury cases is far worse than that of fatal cases. Previous studies have highlighted the relationship between the number of crash

deaths and injuries. Barrs et al (1998) quoted a generic ratio of 10–25 injuries to deaths (with half requiring hospitalization), but the only developing country example included was from an urban hospital study in Ethiopia, which reported 16 injuries for every death (Dessie and Lawson 1991). A 3-month study conducted by Malaysia's Public Health Department (Rahman 2002) reported 19,271 casualties receiving treatment at hospitals. Of these, 1.3% were fatal and 79.0% received outpatient treatment. Thus, for every road death, 15 people were hospitalized and another 61 were slightly injured.

Underreporting was believed to be much greater for injuries than deaths (Jacobs et al. 2000). To estimate global road casualties, the study adopted a ratio of 100 injuries for each fatality for high-income countries, while a conservative road 20-30 deaths per injury ratio was used for low-income countries. In the 1st Safe Community Conference on Cost Calculation and Cost-Effectiveness in Injury Prevention and Safety Promotion, a ratio of 70 slight injuries and 15 serious injuries to each death was suggested to apply to most countries (Mohan 2001).

In the case of the Philippines, the three major hospitals having the highest number of inpatients with traffic accident-related cases were studied (Vibal 2003). The study primarily focused on fatal and serious injury cases. Out of the 1,242 cases (with 94 unspecified cases), 67 (5.4%) and 1,081 (87.0%) cases were fatal and seriously injured, respectively. This gives a serious injury to death ratio of 16:1, which is consistent with the results of the studies mentioned. In the absence of data on slight injury cases, a ratio of 70:1 will be adopted.

Estimating the number of property damage only accidents is far more difficult, as underreporting of such accidents is more prevalent. In the absence of data on this, the estimation of the numbers of this type of accident will be based on ADB's guideline of five damage only accidents for each injury accident. Again, as data collection efforts improve, a local value for the Philippines may be estimated more accurately.

In preparation for the estimation of national cost of accidents, determining the number of accidents by type is necessary, since the individual costs are estimated using that same unit. Based on TMG statistics of recorded traffic accidents for 2002, the breakdown for each type is shown in Table 8.

Table 8: Traffic Accident Statistics

Accident Type	Frequency
Fatal	714
Serious Injury	797
Minor Injury	1,672
Damage Only	9,623
Total	**12,806**

Source: Philippines data.

Applying the corrections attributed to underreporting and the other assumptions adopted in the previous section, the number of accidents is adjusted in Table 9.

Table 9: Traffic Accidents Statistics

Accident Type	Frequency (adjusted)
Fatal[a]	8,180
Serious Injury	93,820
Minor Injury	402,150
Damage-Only	469,090
Total	**973,240**

[a] Based on Lim-Quizon data.
Sources: Lim-Quizon, M.C. et al. 2004. Injury Among Children in the Philippines: A Situationer.

The details of estimating the frequency of accidents by type are discussed in Appendix 3.

4.2 Calculation of National Costs

Applying the average cost of each type of accident, the national cost of accidents is calculated as shown in Table 10.

Table 10: Calculation of National Cost

Accident Type	Average Cost (₱)	Number of Accidents		Total Cost (₱ million)	
		As reported	Adjusted for under-reporting	Based on reported accidents	Adjusted for under-reporting
Fatal	2,273,000	714	8,180	1,623	18,593
Serious Injury	353,000	797	93,820	281	33,119
Minor Injury	69,000	1,672	402,150	115	27,748
Damage Only	55,000	9,623	469,090	529	25,800
Total		**12,806**	**973,240**	**2,548**[a]	**105,260**[b]

[a] ₱ 2,548,000,000 = $45,000,000
[b] ₱ 105,260,000,000 = $1,900,000,000
Source: Philippines data.

Without any corrections made to the accident statistics collected by the responsible agency, the cost of traffic accidents is about ₱2.5 billion or $45 million each year. However, this is a gross underestimation, as too much underreporting of accidents was shown to occur. The estimate of the cost, which is based on health sector data, amounts to ₱105 billion (or $1.9 billion), and this may still be on the low end, as many cost components were not accounted for during the application of the gross output method. But this cost is already about 2.6% of the Philippines' gross domestic product. A better estimate of the cost is expected when the data collection system is improved and more accurate statistics are available.

5 CONCLUSION

This report presented a methodology for calculating the average cost of traffic accidents on individual and national levels. Even with the most conservative data used, the figures prove to be alarmingly high.

In lieu of such findings, the need for the Government to prioritize road safety cannot be overemphasized. Knowing the extent of tangible waste, not to mention humanitarian considerations for irreplaceable lives lost, the time has come for national authorities to accord road safety a higher priority in national planning and policy making. The time has also come to give more credence to research on road safety. An improved understanding of this phenomenon will lead us to conclude that most traffic accidents can be prevented, most losses avoided, and most resources better spent.

Appendix 1 Tables of Various Traffic Accident Related Statistics

The information shown in Table A1.1 was obtained from various sources: National Statistics Office Yearbook (population); National Statistics Coordination Board (gross domestic product); Land Transportation Office (vehicle registration); and Traffic Management Group, Philippine National Police (accident data on fatalities and serious injury accidents).

Table A1.1: Population and Gross Domestic Product and Vehicle Registration

Year	Population (million)	Gross Domestic Product (₱ billion)	Vehicle Registration (million)	Fatalities	Seriously Injured
1998	73	888	3.3	1,213	1,844
1999	75	917	3.5	969	1,637
2000	76	973	3.7	866	1,541
2001	78	1,002	3.8	737	1,961
2002	80	1,046	4.0	801	1,145
2003	81	1,135	4.1	774	1,129

Sources: Philippines data.

The following tables A1.2, A1.3, and A1.4 were obtained from the Land Transportation Office.

Table A1.2: Vehicle Registration

Year	Total	Motorcycles
1998	3,316,817	604,746
1999	3,533,732	672,789
2000	3,701,173	725,330
2001	3,865,862	1,337,576
2002	3,979,898	1,470,383
2003	4,054,014	1,616,376

Source: Land Transportation Office.

Table A1.3: Driver Licenses and Permits

Year	Professional	Nonprofessional	Student Permits	Total
2000	1,386,407	586,710	1,001,927	**2,975,044**
2001	1,352,205	580,545	990,031	**2,922,781**
2002	1,351,102	581,333	967,588	**2,900,023**

Source: Land Transportation Office.

Table A1.4: Types of Driver Apprehension

Type	Number
Fined	594,126
Suspended License	345
Revoked License	4,447
Dropped	7,805
Impounded Vehicle	5,771
Others	27,128
Total	**639,622**

Source: Land Transportation Office.

Table A1.5 was obtained from the report of the Traffic Management Group, Philippine National Police.

Table A1.5: Causes and/or Nature of Traffic Accidents (2003)

Cause	Number	Frequency (%)
Driver's Error	4,222	25.72
Drunk Driving	94	0.57
Mechanical Defect	2,003	12.20
Overspeeding	2,908	17.71
Using Cell Phone	47	0.29
Road Defect	783	4.77
Hit and Run	673	4.10
Bad Overtaking	2,042	12.44
Bad Turning	1,543	9.40
Overloading	1,174	7.15
Self Accident	806	4.91
Others	123	0.75
Total	**16,418**	**100.00**

Source: Traffic Management Group, Philippine National Police.

Until 1998, the health sector through the Department of Health used to compile health statistics, including information on casualties due to road traffic accidents. The information was published in *Philippine Health Statistics*. For unknown reasons, this compilation was stopped. The data are listed in Table A1.6

Table A1.6: Road Accident Deaths

Year	Road Accident Deaths
1970	1,212
1980	2,093
1990	2,889
1998	3,865

Source: Philippine Health Statistics.

Tables A1.7 and A1.8 were processed from the database of the 16 hospitals in Metro Manila with the largest number of patients who were victims of road traffic accidents.

Table A1.7: Age Distribution based on Hospital Data (2001)

Age Group	Fatal	Nonfatal	Fatal (%)	Nonfatal (%)
<10	11	626	11	16
10–15	9	421	9	11
16–20	6	427	6	11
21–25	17	512	17	13
26–30	9	381	9	10
31–35	6	427	6	11
36–40	10	228	10	6
41–45	4	251	4	6
46–50	5	142	5	4
51–55	6	142	6	4
56–60	4	63	4	2
61–65	3	91	3	2
>65	9	154	9	4
Total	**99**	**3,866**	**100**	**100**

< = less than, > = greater than
Source: Philippines data.

Table A1.8: Vulnerable Road Users Group

Group	Fatal (%)	Seriously Injured (%)	Fatal	Injured
Cyclists	0	3.7	0	142
Passenger (private)	5.1	5.6	5	216
Passenger (public)	6.1	8.5	6	330
Motorcyclists	9.1	10.2	9	393
Pedestrians	56.6	45.4	56	1,754
Others	23.2	26.7	23	1,031
Total	**100**	**100.0**	**99**	**3866**

Source: Philippines data.

Appendix 2 United Nations Children's Fund Study: Philippine National Injury Survey (2003)

The details of the United Nations Children's Fund study presented here are based on the presentation of Dr. Ma. Consorcia Lim-Quizon during the Road Safety Forum held at Manila in October 2004.

The nationwide study covered about 90,500 households randomly selected from the *barangay* (smallest local government unit) to regional level. The respondents of the interview were any of the household members at least 18 years old, who have a reliable knowledge of the other household members.

In the study, illness was classified into infectious diseases (56%), noncommunicable diseases (14%), injury (15%), and other unknown causes (15%).

Table A2.1 shows that in terms of injury morbidity (illness), vehicular accidents ranked as the leading cause.

Table A2.1: Ten Leading Causes of Injury Morbidity (2003)

Cause of Injury	Percent
1. Vehicular Accident	21.8
2. Fall	14.6
3. Injured by sharp objects	12.4
4. Struck/hit by an object	5.3
5. Animal/Insect bites	5.3
6. Burn	3.8
7. Assault	3.6
8. Machine/Tool Injury	1.4
9. Electrocution	1.4
10. Self-harm	1.0
Others	29.4

Source: Philippines data.

In terms of mortality (deaths), causes were classified as infectious (49%), noncommunicable (17%), injury (11%), and unknown (23%). As far as injury is concerned, road traffic deaths again ranked number one, as shown in Table A2.2.

Table A2.2: Leading Causes of Deaths from Injury

Cause	Percent
1. Road Traffic Accidents	20
2. Gunshot	17
3. Stabbing	14
4. Drowning	12
5. Electrocution	4
6. Fall	4
7. Abortion	2
Others	27

Source: Philippines data.

According to the study, children from 1 to 4 years of age had the highest mortality rate (about 17 deaths per 100,000). This was followed by children under the age of 1 (11 deaths per 100,000) and children from 10 to 14 years of age (10 deaths per 100,000).

Appendix 3 Estimation of Number of Traffic Accidents Based on Health Sector Statistics

Based on the recently completed Philippine National Injury Survey (2003) by the United Nations Children's Fund, the estimated number of deaths caused by road traffic accidents was about 9,500. For the purpose of estimating the cost of accidents for 2002, a value of 9,000 fatalities is used. With a 16:1 ratio for serious injuries over fatalities, the total number of seriously injured victims is estimated as 144,000. Also, with a 70:1 ratio for minor injuries over fatalities, the total number of victims with minor injuries is 630,000.

Estimation of number of fatal accidents.

Since 1 fatal accident causes 1.1 fatalities and 0.4 seriously injured victim, the number of fatal accident is 9,000/1.1 or 8,180. This 8,180 fatal accidents would have also caused 0.4*8,180 or 3,270 seriously injured victims.

Estimation of Number of Serious Injury Accidents. To estimate the number of serious injury accidents, 3,270 seriously injured victims (attributed to fatal accidents) are deducted from the total number of seriously injured (144,000), or 140,730 victims attributed to serious injury accidents alone. With 1.5 seriously injured victims per serious injury accident, the total number of serious injury accidents is 140,730 divided by 1.5, or 93,820 accidents.

Estimation of Number of Minor Injury Accidents. The number of minor injury victims due to serious accidents is 187,640 (assuming 2 minor injury victims for every serious accident). This is then deducted from the total of 630,000, giving 442,360 minor injury victims due to minor injury accidents alone. For every minor injury accident, estimates indicate that there would be 1.1 minor injury victims. This would translate to 402,150 minor injury accidents.

Estimation of Number of Property Damage Only Accidents. This is estimated as five times the number of serious injury accidents, or 469,090 property damage only accidents.

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ADB-ASEAN Regional Road Safety Program

Accident Costing Report: AC 9

The Cost of Road Traffic Accidents in Thailand

ADB

asean

Asian Development Bank-Association of Southeast Asian Nations Regional Road Safety Program

Accident Costing Report AC 9: Thailand

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ABBREVIATIONS

AIS	abbreviated injury scale
EMS	emergency medical service
TRL	Transport Research Laboratory

NOTE

In this report, “$” refers to US dollars.

CONTENTS

1 INTRODUCTION

1.1 General

Road traffic accidents in developing countries tend to be the major cause of fatalities and disabilities. In Thailand, the road traffic accident problem is now also regarded as one of the most serious social problems. According to a study conducted by the Bureau of Health Policy and Plan, Ministry of Public Health, the years of lost life of all 62 million Thais due to road accidents equaled about 600,000, making road accidents the second leading cause of death in 2000, as shown in Table 1. This could cause large-scale annual economic losses for the country.

Table 1: Years of Lost Life from 10 Leading Causes of Death
(all ages, 2000)

Cause of Death	Total	
	Years of Lost Life	Percentage of All Deaths
HIV/AIDS[a]	1,481,685	23.9
Road Accidents	**593,263**	**9.6**
Paralysis	289,517	4.7
Liver Cancer	280,771	4.5
Suicide	210,235	3.4
Injured by Others	202,478	3.3
Other Infections	190,281	3.1
Diabetes	185,904	3.0
Drowning	162,410	2.6
Ischemic Heart	161,893	2.6

[a] HIV/AIDS = human immunodeficiency virus/acquired immunodeficiency syndrome.
Source: Bureau of Health Policy and Plan 2001.

The attempts to reduce the number of fatalities and disabilities resulting from road crashes in Thailand have yet to achieve a satisfactory outcome, as road safety-related problems still remain a threat to the country overall. One way to achieve sustainable solutions for road safety is to examine the costs of road accidents. Transport Research Laboratory (TRL) describes several needs related to estimating road accident costs in developing countries. Accident costs are generally used to justify more resources for promoting and implementing road safety programs, to evaluate the proposed safety regulations and persuade policy makers that road safety schemes are beneficial (Jacobs 1995 and Jacobs et al. 2000).

1.2 Problem Statement

Over the past few decades, little effort has been made in Thailand to assess the costs of road accidents, owing to the lack of systematic accident data and/or information. Various questions often arise when road safety strategies are proposed to address the road accident situation in Thailand (e.g., the necessity of the proposed safety programs). One alternative in dealing with these inquiries is to consider the costs of these accidents.

Therefore, examining the costs of road accidents is important, as is using data as a basis or tool to tackle road accident problems.

1.3 Objectives and Scope of the Study

The objectives of this study are to estimate the costs of road crashes and casualties and assess Thailand's annual economic losses. This study attempts to provide rationalized information on the most current and comprehensive road accident costs, based on reliable and available sources. Information and data on road accident statistics and all associated cost elements in 2002 are employed in this study.

1.4 Outline of Report

This report is organized into five chapters. Chapter 1 provides the background, the problem of present practice, and the objectives and scope of this study. Chapter 2 describes the methodology used to determine the cost of road accidents together with the accident data sources acquired by this study. Chapter 3 discusses the details of cost components. Chapter 4 analyzes and clarifies the national casualties and economic losses resulting from road accidents in Thailand. Chapter 5 offers conclusions.

2 METHODOLOGY

2.1 General

To determine the costs of road traffic accidents, several practical techniques are available. For instance, TRL discussed the gross output or human capital method, net output method, life-insurance method, court award method, implicit public sector valuation method, and value of risk change or willingness to pay method. Nevertheless, no single costing method is believed to be an ideal method to use, and a considerable amount of data still needs to be collected, regardless of the method used (Jacobs 1995).

Actually, one of the most widely known methods used to estimate accident costs in developing countries, which is very well documented in the *Guidelines for Estimating the Cost of Road Crashes in Developing Countries* (Babtie Ross & Silcock 2003) is the human capital method. Thus, this method is employed to estimate accident costs in this study.

2.2 Human Capital Method

The key concept of the conservative human capital or gross output method entails the estimation of direct and indirect costs incurred to individuals and the society as a whole. The costs of a traffic accident are divided into two main categories: (i) the costs due to the loss of current resources, including the costs of vehicle damage, medical treatment, and administrative costs, and (ii) the costs due to the loss of future resources that the victim would have lived to earn, which must be discounted back, to give present values (Jacobs 1995).

According to the human capital method, six cost components, including hospital and medical cost, output lost, property damage cost, insurance administrative cost, emergency medical service cost, and human cost, are all considered to determine economic losses.

Data required for this technique are inputs for the six cost components. The accident costs can be derived by using accident severity data obtained from the Ministry of Public Health and the Royal Thai Police. Accident severity is classified as fatal, seriously injured, slightly injured, or property damage only.

2.3 Data Sources

Two main categories of data exist: road accident data and unit cost data. The following are the sources of these data.

(i) Road accident data, which are classified into four degrees of severity (fatal, serious, slight, and property damage only accidents), were obtained from the Royal Thai Police, while the number of casualties, which are classified into three degrees of severities (fatality, serious injury, and slight injury), were acquired from the Ministry of Public Health.

(ii) Unit cost data consist of six components, as presented in Table 2.

Table 2: Summary of Data Requirements and Sources of Each Cost Component

Cost Components	Data Requirements	Data Sources
Hospital and Medical Costs	▪ Average hospital and medical expenditure (in- and outpatients)	▪ Hospital and medical records from hospital
Loss of Output	▪ For fatal casualties—average fatal age, average age of retirement, and average national income statistics ▪ For serious and slight casualties—time lost for rehabilitation	▪ Ministry of Public Health ▪ Hospital and medical records from hospital ▪ National Statistical Office
Property Damage Cost	▪ Vehicle damage cost ▪ Street furniture damage cost	▪ Royal Thai Police ▪ Department of Highways
Insurance Administrative Cost	▪ Accident investigation and claim overhead	▪ Insurance companies
Emergency Medical Service (EMS) Cost	▪ EMS and rescue team operating and overhead costs	▪ Khon Kaen Regional Hospital's EMS Center
Human Cost	▪ Transport Research Laboratory's estimated proportion of the total costs	▪ Transport Research Laboratory

Source: Thailand data.

3 COST COMPONENTS

3.1 General

This chapter describes how the six cost components employed in the human capital method are estimated in this study.

3.2 Hospital and Medical Costs

Hospital and medical costs resulting from traffic accidents arise from in-hospital patient services (which include the costs of operations, X rays, medicines, doctor services, and food and bed); outpatient services; rehabilitation costs; prosthetic costs; and funeral costs. At-scene care and transport costs for patients, however, are excluded from this cost component, as these costs are covered in the emergency medical service (EMS) cost component.

Total costs of all medical treatment can be separated into those provided by hospitals and those provided by medical centers. In fact, information on the total number of hospital beds or total number of injuries in a country are available in the published statistics, and the average costs per bed or per casualty can be easily determined from such statistics.

3.3 Abbreviated Injury Scale

Several hospitals assess the costs of medical treatment, especially for nonfatal injuries, based on various categories that depend on the level of injury severity according to the abbreviated injury scale (AIS). The AIS is a classification system for assessing crash injury severity. The scale was first developed and published by the American Association for Automotive Medicine in 1969 (TRAUMA.ORG Ltd. 2003 and National Highway Transport Administration 2002).

AIS codes, which normally range from AIS-1 (minor injury) to AIS-6 (fatal injury), are primarily oriented toward the immediate risk to life resulting from injury and are estimated soon after an accident occurs. The use of AIS data could improve the accuracy of economic cost estimation and the relative number of injuries regarded as serious or slight.

3.4 Estimation of Accident Costs

The injury surveillance program was developed for public hospitals in Thailand, to maintain their trauma and injury records. The developed injury surveillance program can be further used as a road traffic accident database. For instance, the trauma registry management system of the Khon Kaen Regional Hospital, one of the well-documented medical centers in Thailand, has been using the injury surveillance program to further develop its own accident database system since 1989 (Ruengsorn et al 2002). In fact, its accident database system is widely known in Thailand because of its creative development and groundbreaking effort to employ advanced technological tools, such as the geographic information system, in developing the database system. Khon Kaen Regional Hospital is now considered a prototype for other hospitals in the country that are developing their own database systems.

In this study, the hospital and medical costs data of all road accident victims in 2002 were also obtained from the comprehensive and reliable injury surveillance database system of Khon Kaen Regional Hospital. Road accident victims are classified according to the AIS.

The hospital and medical costs, which exclude at-scene care and transport costs, are considered direct costs to road accident casualties. In this study, the costs are listed in accordance with the level of injury severity (fatal, seriously injured, or slightly injured).

For fatalities, the average cost that each patient spent while being hospitalized prior to death was estimated at B34,415 per case. Along with the funeral cost of B15,000, according to the Protection for Car Accident Victims Act 1992 (Ministry of Finance 1992), the total hospital and medical costs for each fatal casualty were accumulated to B49,415 per fatality.

The medical costs per seriously injured casualty amounted to B23,666 per case. This figure was derived from the average cost of B23,127 spent by each accident victim who stayed in a hospital for medical treatment and the average cost of B538 spent for outpatient treatment. Since only the outpatient treatment cost was considered for slightly injured casualties, the medical cost for any slight or minor casualty was estimated at B538 per case.

3.5 Lost Output

Lost output is the loss of productivity from those affected by road accidents. The main data required for lost output estimation are the average wages of the casualties and care givers and the amount of time lost due to road accidents. This amount of time lost is based either on the years that road accident fatalities could have spent working in the future, had they not died in road accidents, or the days lost that would have been spent working in the future by accident-injured victims, had they not been disabled or recovering in a hospital or at home, together with the days lost while visiting doctors (in the case of seriously or slightly injured accident victims). Accordingly, these costs can be varied from as little as 1 day lost, for a slightly injured casualty, to several years lost, for fatally injured or permanently disabled victims.

The costs of lives lost in future years of road accident fatalities must be discounted, as do the costs of days lost in treatment and rehabilitation of injured victims. These costs must be discounted to present values by applying the discount rate used and/or recommended by economists and planners in Thailand. The discount rate used in this study is 6.75% for 2002.

3.6 Estimation of Total Loss Due to Road Accidents

To estimate the total loss in future years of any road accident fatality, the average years lost and the average income earned by the road accident victim are taken into account. The number of years lost can be derived by subtracting the average age of the fatalities from their average retirement age.

As revealed in *Accident and Disaster Statistics in Thailand* (Ministry of Public Health, 2001), and as shown in Table 3, the average age of Thai road accident fatalities in 2001 was 31.7 years, whereas the average retirement age of Thai people is 60.0 years.

Since no national statistics on the average income of road fatalities are available, the most common alternative used to estimate the income of road accident fatalities is the national average net income per capita. According to the National Statistical Office (2003), and as shown in Table 4, the net income per capita in 2002 was B84,877, while the average fatal age of victims, as mentioned earlier, was 31.7 years. By using the discount rate of 6.75%, in accordance with the prime interest rates in Thailand, which ranged between 6.5% and 7.0% in 2002 (Bank of Thailand, 2003b), plus with the income growth rate of 6.0% obtained from the gross domestic product growth rate, which ranged between 5.5–6.5% per year in 2002 (Bank of Thailand 2003), the total loss of each road accident fatality is estimated to be B2,149,080 for 2002. Additionally, the estimated hospitalization costs prior to death of B6,530 per person were also considered. Thus, the total loss of each fatality is estimated at B2,155,610 per victim.

Table 3: Number of Fatalities in 2001
(classified by age group)

Group (years of age)	Number of Fatalities	Distribution of Fatalities (%)
< 1–4	208	1.63
5–9	226	1.78
10–14	339	2.66
15–19	1,607	12.63
20–24	1,801	14.16
25–29	1,562	12.28
30–34	1,417	11.14
35–39	1,295	10.18
40–44	1,054	8.28
45–49	898	7.06
50–54	637	5.01
55–59	460	3.62
60–64	444	3.49
65 – 69	335	2.63
70–74	199	1.56
> 75	231	1.82
Unknown	9	0.07
Total	**12,722**	**100.00**

< = less than, > = greater than.
Source: Ministry of Public Health.

Table 4: National Average Net Income per Capita

Year	Per Capita National Income (B)	Gross Domestic Product at Current Market Price (B million)
1999	74,946	4,637.1
2000	78,782	4,916.5
2001	81,435	5,123.4
2002	84,877	5,430.5

Source: National Statistical Office.

However, the lost output for a seriously injured victim can be derived from the average number of working days lost while being hospitalized and also the recovering period at home. Using the Khon Kaen Regional Hospital as an example, road accident statistics in 2002 revealed that the average working time lost by a seriously injured victim and a slightly injured victim was 30 days and 2 days, respectively. Assuming that the average wage rate in Thailand in 2002 was B326 per day, the average loss was B19,587 per seriously injured victim and B1,306 per slightly injured victim .

3.7 Property Damage Costs

Property damage cost estimated in this study is composed of two components: the cost of vehicle damage and the cost of public roadside property damages.

Due to the limited amount of information available from other sources, the cost of vehicle damage resulting from road accidents used in this study was obtained from Royal Thai Police (2003) records. Of the 91,623 road traffic accidents in 2002, the average cost of vehicle damage in Thailand was B16,316 per accident, which applies only to the cost of vehicle damage resulting from accidents in which the victims were slightly injured.

The cost of public roadside property or furniture damage was acquired from the Department of Highways. Among all 5,063 accidents that occurred along national highways, the Department of Highways reported that the total costs of public roadside property and furniture damage amounted to B84.73 million in 2002. This implies that the average public roadside property or furniture damage cost was B16,734 per slightly injured accident.

Given the information presented, the average property damage cost can be calculated by adding the two cost components, with the corresponding adjustment factors for fatal, seriously injured, slightly injured, and property damage only accidents. Eventually, the costs of property damage was calculated at B126,583 for a fatal accident, B55,194 for an accident resulting in serious injury, B33,051 for an accident resulting in slight injury, and B18,508 for a noncasualty or property damage only accident.

3.8 Administrative Costs

In any road traffic accident, administrative costs mostly include those associated with the administration of police services, court proceedings, insurance, rescue team and medical services, and others. However, in this study, only the insurance administrative costs and EMS costs are considered as administrative costs of road traffic accidents.

The insurance administrative costs are those associated with processing and handling insurance claims. According to an insurance industry survey, the average cost of insurance staff member time for claims is B1,200 per accident case (Ministry of Finance, Thailand 1992). This study assumes that all accidents claim their damages as a result of the compulsory car insurance policy under the Protection of Car Accident Victims Act, B.E. 2535 (1992).

EMS costs are those associated with emergency medical services and cover the labor cost (wage and overtime of rescue team and staff members); material cost (office materials, medicines and medical supplies, and fuel and maintenance costs); and capital cost (command control center, vehicle parking and garage, EMS room, and ambulances and tools and durable articles) as well as overhead cost. A recent study on the Khon Kaen EMS Center, conducted in 2002, concludes that an average at-scene accident unit

cost of EMS administration, which covers all elements mentioned, was B1,975 per accident (Danaitantrakool 2003). Summing up the two main cost components, the estimated administrative cost for road traffic accidents would be B3,175 per case.

3.9 Human Costs

All casualties in road accidents would suffer from the physical and emotional pain related to being accident victims, and often their families and friends also share such suffering. When accidents occur, not only are the victims and their families affected, but the society as a whole also experiences economic, functional, and behavioral impacts. To compensate for the social loss resulting from road accidents in estimating accident costs, the human costs that account for pain, grief, and suffering were usually added to the total accident unit costs for each severity type of accident. To determine the associated pain, grief, and suffering costs resulting from road accidents, this study adopts the proportion of the total accident costs method, which was recommended by TRL (Babtie Ross & Silcock 2003) and is calculated as follows: 20% of total costs for a fatal accident, 50% of total costs for an accident resulting in serious injury, and 1% of total costs for an accident resulting in slight injury.

Based on the percentages of total costs, the costs of pain, grief, and suffering (or the human costs) for each casualty type are estimated at B536,038 for a fatally injured victim, B53,656 for a seriously injured victim, and B379 for a slightly injured victim.

4 NATIONAL ACCIDENT COSTS

Once the road accident unit cost is calculated, the total number of accidents and casualties classified by types of accident severities would be taken into consideration to derive the national economic loss resulting from road traffic accidents.

4.1 National Casualties and Accident Estimation

Prior to determining the national economic loss, obtaining the number of casualties and accident cases is essential. The number of fatalities is obtained from police statistics, while the hospital statistics on the numbers of inpatients and outpatients are used to represent the number of serious and slight injuries, respectively, as the police records on accident injuries appear to be underreported when compared with hospital statistics. According to 2002 statistics, 13,116 road accident fatalities occurred, and the numbers of serious and slight injuries acquired from the Ministry of Public Health were 190,322 serious injuries and 1,338,712 slight injuries, respectively.

As obtaining the complete figures on accident cases directly from any available statistical sources in Thailand is impossible, this study first needs to estimate the average number of casualties per accident by type of severity, and then use these estimated averages to determine the number of accident cases by each type of severity.

To obtain the average number of casualties per accident, this study used nearly 2 years of records of accident cases reported by the Khon Kaen police station. Data were collected manually, by examining all police logbooks, case by case, from 1 January 2002 to 23 November 2003. A later conclusion was that for a fatality case, for example, the average number of casualties per accident was 1.16. The other average casualties are summarized in Table 5.

Table 5: Average Number of Casualties per Road Accident
(by severity)

Accident Severity	Number of Casualties per Accident			
	Fatalities	Serious Injuries	Slight Injuries	Total Casualties
Fatal	1.16	0.48	0.43	2.07
Serious		1.25	0.41	1.66
Slight			1.72	1.72

Source: Khon Kaen Police Station Survey.

Assuming that these average casualties per accident can represent the entire nation, the total numbers of fatal injuries, serious injuries, and slight injuries in accident cases for the country were 11,307 cases, 147,916 cases, and 740,235 cases, respectively.

To estimate the number of property damage only cases, this study adopted the proportion between property damage only accidents and injury accidents by assuming that 1.32 property damage only cases occurred for every injury accident case. Thus, the number of property damage only accidents totals 1,172,359 cases.

It should be noted that the proportion between property damage only cases and the number of injury cases seems to be arbitrary and varies considerably among different studies. Jacobs 1995) recommended approximately 6.0 property damage only cases for each injury in urban areas and 4.5 property damage only cases for each injury in rural areas in the United Kingdom. Meanwhile, Babtie Ross & Silcock (2003) recommended 5.3 property damage only cases for each injury in South Africa. The value of 1.32 property damage only cases for each injury used in this study is obtained from a previous study conducted in Thailand by Khomnamool (1979).

4.2 The Calculation of National Annual Accident Costs

After estimating the numbers of casualties and accidents by severity, the total national costs of crashes can be determined by including all six components of costs, as mentioned earlier. The summary of costs per casualty or per accident is illustrated in Table 6.

Using the previously mentioned associated costs, the average cost for all types of severities can be determined as follows: B2,852,924 per fatality, B142,273 per serious injury, B21,162 per slight injury, and B19,708 per property damage only accident.

Once the average cost per accident is estimated, then by multiplying the number of casualties, the total annual national economic loss due to road accidents can be determined, as illustrated in Table 7.

Table 6: Summary of Costs per Casualty or per Accident Type
(B)

Cost Component	Fatal Injury	Serious Injury	Slight Injury	Property Damage Only
Per Casualty				
Hospital and Medical Costs	49,415	23,666	538	—
Lost Output	2,155,611	19,587	1,306	—
Human Cost	536,038	53,656	379	—
Total	**2,741,064**	**96,909**	**2,223**	—
Per Accident				
Property Damage Cost	126,583	55,194	33,051	18,508
Insurance, Administrative Cost	1,200	1,200	1,200	1,200
Emergency Medical Service Cost	1,975	1,975	—	—
Total	**129,758**	**58,369**	**34,251**	**19,708**

— = no data available.
Source: Thailand data.

Table 7: National Cost of Road Accidents in Thailand
(2002)

Type of Casualty	Number of Casualties	Average Cost (B)	Total Cost (B million)
Fatal	13,116	2,852,924	37,419
Serious	190,322	142,273	27,078
Slight	1,338,712	21,162	28,330
All	1,542,150	—	92,827
Property damage only accident	1,172,359	19,708	23,105
Total	**—**	**—**	**115,932**

— = no data available.
Source: Thailand data.

5 CONCLUSION

This study contends that the national economic losses resulting from road accidents in Thailand are considerably high, even if the conservative human capital method is employed in estimating. As presented, in 2002, the total national economic loss resulting from road accidents is estimated at B115,932 million, or approximately 2.13% of the gross domestic product.

Based on this estimated annual road accident cost, it can be said that road accidents, one of the most severe health problems in Thailand, do not cause only losses in lives of productive members of the population and a substantial number of disabilities and injuries but also generate a gigantic loss to the country's economy. Is it timely to urge all agencies concerned to put forward more efforts, as well as sufficient manpower and other resources, to effectively address the road traffic accident problems? The question remains whether the presented estimated losses resulting from road accidents are convincing enough to persuade policy makers to seriously begin implementing road safety programs for the benefit of the society as a whole. This study firmly believes that economists as well as lay people realize how serious accident losses are for the Thai society. A duty of all parties concerned is therefore to use these estimates to persuade the Government to (i) play a more active, if not proactive, role in promoting road safety and (ii) allocate sufficient resources, particularly financial resources, to help alleviate this severe health problem in our country.

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