Road Safety Guidelines

for the Asian and Pacific Region

4.14

ROAD ACCIDENT COSTING

Asian Development Bank

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With the high growth of road accidents throughout the developing world, it is essential that adequate sums of money are spent in dealing with the problem. In the absence of an estimate of accident-related economic issues, it is difficult to identify the sums of money that should be invested each year on road safety counter-measures. The first need for accident cost valuations, therefore, is at the level of national resource planning to ensure that road safety is given adequate priority in terms of investment in its improvement.

A second need for road accident cost figures is to ensure that the best use is made of any investment and that the best (and most appropriate) safety improvements are introduced in terms of the benefits they might generate in relation to their cost.

Various methods exist for costing road accidents but the method currently recommended for use in the developing world is the gross output or human capital approach. The method takes into account the loss of current resources such as vehicle damage, medical treatment, police and administration costs, and damage to street furniture. It also attempts to cost the loss of future resources by considering the loss to society of a person's output when that person is killed or injured.

In using the gross output method, a sum is usually included to reflect pain, grief, and suffering of the accident victim and to those who care for the victim.

Accidents are usually costed by degree of severity so that separate values are determined for fatal, serious, slight, and damage-only accidents. The national cost of road accidents is then determined by multiplying the costs by accident severity by the number of those accidents taking place each year.

Once the total extent of the human casualty toll and economic costs of road accidents is known, the road safety situation will be better appreciated by politicians and decision makers and the case made for increased road safety investment. Road accident costs can then begin to be used to justify safety measures, and be considered along with construction and maintenance costs in the cost benefit analysis of road improvement projects.

PRIORITY ACTIONS NEEDED

1. Until local estimates are available, assume 1-2 percent of national gross domestic product (GDP) is lost annually through road accidents.

2. Prepare interim local estimates of the costs of road accidents by severity using the approach recommended by the Transport Research Laboratory (TRL) of the United Kingdom (UK).

3. Set in motion a research project at a university or economic research institute to prepare accurate valuations of road accident costs by severity using the gross output method.

An estimate of the total national cost of road accidents will help Governments realize the heavy economic losses (typically between 1 percent and 2 percent of gross domestic product [GDP]) being incurred annually). This will encourage them to invest in road safety improvements to reduce these losses and to see expenditure on road safety as an investment and not as a cost.

1 INTRODUCTION

These sector guidelines on "Road Accident Costing" are from a set of *Road Safety Guidelines for the Asian and Pacific Region* policymakers, developed as part of a regional technical assistance project (RETA 5620: Regional Initiatives in Road Safety) funded by the Asian Development Bank (ADB).

Road traffic accidents (RTA) are commonly viewed in terms of individual personal losses or as general statistics. Unlike aviation or rail accidents (where frequently, many persons may die in a single accident), the large-scale economic and social impact of road accidents is rarely appreciated, as road accident deaths and casualties normally only happen in ones and twos. Road accident costing attempts to estimate the annual cumulative losses incurred by a country as a result of road accidents.

Several different methods exist for costing road accidents, including court awards and life insurance contracts, but the two most common are the gross output method and the willingness to pay method. The gross output method (also referred to as the human capital approach) is based on assessing the economic consequences of road accidents, usually supplemented by a notional sum to reflect pain, grief, and suffering for those involved and also for family and friends of those killed and injured, as a proxy for accident costs. The willingness to pay method estimates the amount of money people affected by a particular measure would pay to avoid an accident and produces a much higher valuation of accident costs.

Since the late 1980s willingness to pay has increasingly been applied for accident costing in industrialized countries. However, the gross output method has been the most commonly used method in most countries over the past few decades. This method is recommended for developing countries as its primary objective, increasing a country's wealth, is thought more appropriate to their needs. Many assumptions are required in accident costing and, whenever alternative values or uncertainties present themselves, a conservative approach is recommended thus ensuring that a indisputable minimum value is obtained of road accident costs in a country. If investment can be justified on such a minimum value, it will certainly be justified on any other value.

2 WHY IS ROAD ACCIDENT COSTING NEEDED?

Accident costing highlights the socio-economic burden of road accidents. Developing countries face many challenges and have many resource needs. Road safety tends not to receive due consideration because not all road accidents and casualties are reported to the police and there is usually no other system of estimating road accidents and the corresponding casualties nationwide.

There is also a problem with the perception that road accidents are random, unintentional, or predestined; i.e., unavoidable. Road accidents are too often accepted as inevitable negative side effects of motorization. However tragic the personal losses, road accidents are rarely perceived as a serious drain on the economy and this leads to complacency towards road safety issues. This view is totally wrong. Road accidents have been shown to cost annually between 1 percent and 3 percent of GDP in developing countries. The gross national product (GNP) is often more readily available than the GDP figure and although usually slightly higher than the GDP, can be substituted for it for the purposes of rough estimation. These are large sums that few countries — especially de-

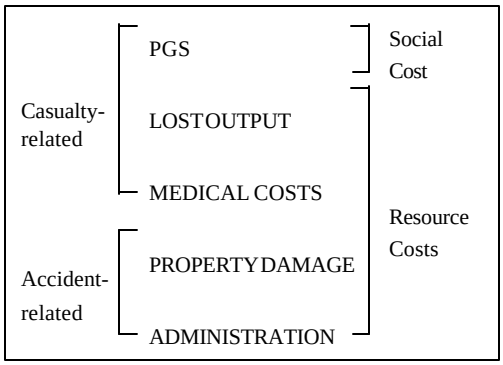

Figure 1: Road accident cost components

veloping countries — can afford to lose, year after year.

Knowledge of accident costs allows safety impacts to be economically justified. Road safety measures have been frequently ignored or downplayed in cost benefit analyses on the grounds that the associated costs and benefits are too intangible. Where road safety is included in cost benefit analyses of road improvements, it is often only factored on a subjective basis and so does not get applied in the consistent manner required for project comparisons. So road safety has generally been severely underfunded as it is not possible to prove its cost-effectiveness without the use of road accident cost values.

3 KEY COMPONENTS

The key components that need to be considered when examining this sector relate largely to the various cost components. These can be classified into **casualty-related costs** (lost output, medical costs, and the pain, grief, and suffering value), **accident-related costs** (property damage and administration), and **accident data**. As shown in Figure l, all are resource costs, except for the pain, grief, and suffering component.

The cost of an accident is the sum of the casualty-related costs, plus the accident-related costs, while the total cost of accidents in a country is the number of accidents by severity multiplied by their respective accident cost.

3.1 Accident Data

To calculate total accident costs, the number of accidents and casualties by severity must be known. While accident data is often taken for granted in industrialized countries, in developing countries with little road safety awareness, accident data may be incomplete and inconsistent.

To permit cost estimation, casualty figures need to be provided separately by the traffic police for each accident severity type, as shown in Table 1.

While the internationally accepted definition of a road accident death includes all related deaths within 30 days of the accident, many countries report only deaths occurring at the scene or within a few days. Adjustment factors* should, therefore, be applied when making international comparisons. Published ministry of health figures, when available, should be compared with police reported figures to ensure that an accurate assessment of total road accidents and casualties is achieved.

Serious injuries are defined as those that require hospitalization (at least one night) while slight injuries require medical treatment but no overnight stay in a hospital. In many countries, the number of police-reported road accident injuries is often unrealistically low and in such cases hospital surveys should be conducted to identify the actual number of serious and slight injuries, based on police or insurance company data.

Damage-only accidents are even less well documented than injury accidents, as few developing countries require damage-only accidents to be reported. Early accident costings in the UK assumed a damage-only accident ratio of six to every one injury accident. Subsequent insurance company surveys increased this ratio and a recent postal survey has concluded that the damage-only ratio should be more than 17 times that of injury accidents in urban areas of the UK. A nationwide average of 15 damage-only accidents to each injury accident is now used in the UK for cost estimation. The

Table 1: National Accident Data Requirements

Accident type	Accidents (No.)	Casualties (No.)		
		Fatality	Serious injury	Slight injury
Fatal	✓	✓	✓	✓
Serious	✓	0	✓	✓
Slight	✓	0	0	✓
Damage only	✓	0	0	0

* Corrections to convert different definitions of road deaths to 30 day deaths:
within four hours (+30 percent);
within three days (+15 percent);
within six days (+9 percent);
within seven days (+8 percent); and
within one year (-3 percent).

importance of estimating the number of damage-only accidents is shown by the fact that in the United States (US), the cost of damage-only accidents is estimated to be higher than the cost of all fatal accidents.

In order not to disregard the cost of damage-only accidents, their frequency will need to be estimated and a conservative ratio (five or six damage-only accidents for every injury accident) can be used in the interim until more accurate data is available. In Nepal, a ratio of 5:1 damage-only accidents to injury accidents was recently used for urban areas and a lower ratio of 2:1 was accepted for rural areas. The average cost of a personal injury accident is used in cost benefit analysis in the UK, but this cost also includes expected damage-only accident costs. In developing countries, the average injury accident cost may need to be factored to compensate for unreported injury accidents as well as unreported damage-only accidents.

3.2 Lost Output

Lost output refers to the contribution RTA victims were expected to make to the economy with future earnings weighted to present value (with an inflation rate currently in use in the country). The contribution is usually measured by the average earnings plus any nonwage payments (e.g., national insurance contribution or rent subsidy).

Average wage rates are frequently used with assumptions required to reflect the amount of agricultural labor and employment rates. Accident victim surveys have been conducted in some countries but are generally on a small scale and often have had conflicting results. Urban pedestrian deaths are commonly often assumed to be persons of low income yet a recent accident costing exercise in Kerala, India, estimated victims' income to be three times that of the local average per capita income[1].

The "lost output" of RTA deaths is calculated as the average earnings multiplied by the number of working years lost (i.e., average retirement age minus the average RTA fatality age) and then weighted at the accepted government rate to a present day value. Unlike other major causes of death in developing countries, road accidents strike down those in the prime of life (average RTA fatality age is usually between 28 and 31 years), when they are arguably of the most productive value to society.

Lost output for serious and slight injuries is the daily earning rate multiplied by the number of days off work. This is usually derived from hospital and victim surveys. Cost is not normally assigned to the amount of increased travel time caused by road accidents.

3.3 Vehicle Damage Costs

While all property-related damage costs should be valued (e.g., street furniture, guardrails, and walls), vehicle damage costs are often the only property item valued in developing countries. Vehicle damage costs include the repair or replacement cost (minus salvage value) insurance claim, surveyor fees, and any business lost due to the vehicle being out of commission (although this is rarely counted in developing countries). As the cost to society is being measured, vehicle damage costs should be calculated net of import duties and sales tax. In the gross output method, vehicle damage costs are often the largest cost component in analyses.

Insurance claims are the traditional source for vehicle damage costs, but the low rate of insurance coverage in many developing countries raises questions as to how representative accident claims are. Compensation is often less than damage costs, as policy coverage may be restricted, with the owner usually paying the first portion (say US$100) or more of any damage. Insurance claim surveyor reports, although still limited to insured vehicles, have the advantage of estimating vehicle damage costs regardless of coverage limitations and often they will report the present value of the car, any remaining salvage value, and will itemize the cost of labor and replacement parts separately. Where they are available they provide a good source for estimating damage costs.

Vehicle fleet operating companies can also be contacted for cost data but poor record keeping practices and low levels of safety awareness frequently limit cost data availability. Vehicle fleet companies should be contacted, however, to estimate the amount of business lost during postaccident repair time.

Vehicle damage costs can also be collected from accident victim surveys, but this is a slow process. Surveys were attempted in Nepal, with motorcyclists asked about accident damage costs, but the results were disappointing. Repair workshops in Nepal were also contacted for accident repair costs but little data was collected over three months.

Plate 1: Damaged vehicle.

Average vehicle damage costs should not be assumed to apply equally to all vehicles involved in accidents. While pedestrian accidents are a serious problem in many developing countries and contribute significantly to casualty figures and costs, pedestrian accidents often involve little or no vehicle damage. Accident reporting systems such as the Transport Research Laboratory's (TRL) Microcomputer Accident Analysis Package (MAAP) can be configured to include data on vehicle damage and can provide the number of reported accidents incurring no vehicle damage.

3.4 Medical Costs

Medical costs include emergency medical services, both inpatient and outpatient care, prescription costs, service fees (X-rays and operations), and rehabilitation costs (including artificial limbs). Medical costs are a difficult area in which to collect data. As they rarely account for more than 5 percent of accident costs, data collection can be kept to a minimum, as even gross errors have relatively little effect on the overall accident costs.

Often, neither health ministries nor individual hospitals are able to estimate the cost of an inpatient stay (per night) or an outpatient visit. Bed charges should not be used as they refer only to the patients' charge (and for partial service) and do not reflect the amount of subsidy received or the true cost incurred. As a last resort, a hospital's annual expenditure can be divided by the number of inpatient days and outpatient visits. Outpatient visit cost can be assumed to be a quarter that of an overnight stay, although this does not reflect capital costs. In developing countries, medical costs do not reflect the reality of the situation, as scarce resources limit the hospital beds and medical services available. The medical costs alone do not necessarily reflect the actual opportunity costs.

3.5 Administration Costs

Administration costs from road accidents are incurred by the police and the insurance companies. The situation is complicated, however, by the number of accidents not reported to the police and those accidents not involving insured vehicles. The responsibility for accident reporting may also be divided between several police forces or divisions, as in Bangladesh where traffic police report damage-only accidents and general duty police report injury accidents.

Many developing countries for convenience adopt the ratios determined by research in the UK and assume administration costs to represent 0.2 percent of the total resource costs in a fatal accident, 4 percent of serious accidents, 14 percent of slight accidents, and 10 percent of damage-only accidents. An alternative method is to assume a token amount for those accidents involving police and/or insurance involvement.

3.6 Pain, Grief, and Suffering Component

Early estimates of road accident costs focused exclusively on the direct economic costs and did not attempt to consider pain, grief, and suffering. With the onset of social cost benefit analysis in the 1970s, a notional value for pain, grief, and suffering was included in industrialized countries to reflect societies' and the individual's aversion to death. The original value for pain, grief, and suffering of a RTA death was determined by the amount required to ensure all lives (no matter what age and what remaining productivity) received a positive value under the net output method.

In the UK, pain, grief, and suffering values were increased several times throughout the 1970s and 1980s and ended at 38 percent of resource costs of a RTA death, 100 percent of a serious injury, and 10 percent of a slight injury. While many developing countries have

used these values, the accident costings in India and Nepal have used 20 percent of lost output costs.

With the increasing introduction of the willingness to pay method, the human costs are almost twice the resource costs in the UK[10]. This method is inappropriate to apply in developing countries, but does indicate that the calculation and use of a value based on gross output method perhaps still underestimates the real cost of road accidents in a country.

4 STAGES OF DEVELOPMENT

In order to produce accurate estimates of road accident costs and to incorporate these estimates into cost benefit analyses, a developing country usually needs to proceed through a number of stages. The major milestones of introducing and applying road accident costing are provided below, along with the activity involved:

1) **Accept 1 percent of annual national GDP as a minimum estimate of annual road accident costs.** This working estimate should be used to highlight the costs of road accidents incurred annually and to emphasize the overall national cost of road accidents that are usually considered as individual cases with separate financial and personal losses;

2) **conduct accident costing exercise based on gross output method**. Accident cost components can be estimated with economic indicators available for lost output calculations and vehicle damage costs derived from insurance company and surveyor data. Medical and administrative costs can be assumed (small percent of total costs) and a conservative estimate initially used for estimating pain, grief, and suffering (10 percent to 20 percent lost output). Pain, grief, and suffering estimate should be agreed by a national road safety council or those involved in road accident consequences; i.e., insurance company representatives, police, doctors, and legal experts. While some technical assistance may be required for initial accident costing calculations, a local research institute could be trained to conduct accident costing updates and revisions. TRL Road Note 10[5] provides guidance on how to carry out costing in developing countries;

3) **assess extent of underreporting of injury and damage only accidents.** If RTA injury is believed to be underreported, hospital surveys should be conducted to produce a more accurate estimate of accident injuries. Key hospitals along major highways should be surveyed using admission registers (assuming RTA is listed as cause of admission). Table 2 shows the minimal data required by such hospital surveys. Surveys of insurance and fleet companies should be undertaken to determine frequency and average cost of vehicle damage in damage-only accidents;

4) **estimate total annual road accident costs and average accident costs.** These estimates will be determined locally and reflect both reported and unreported accidents, i.e., an average reported injury accident cost would also include the costs of unreported injury and damage-only accidents. These costs would replace the GDP percentage estimate as the annual national cost of road accidents and should be used in road safety programs and campaigns;

5) **conduct accident victim surveys**. Accident victim surveys should be conducted to check the accuracy of cost estimates. Further research on accident costs can be conducted by following up a random sample (say 100 or so) road accidents by having researchers obtain from police records the names of those involved in the selected accidents. These individuals or their families can be followed up to identify how long the victim was in hospital, how many days' work were missed, average salary, and cost of vehicle repairs. Such surveys

Table 2: Hospital RTA Casualty Survey

	Inpatient	Emergency-room only	Brought in dead
Jan.			
Feb.			
March			

have been used in Sichuan, the People's Republic of China (PRC); and Karachi, Pakistan. Pain, grief, and suffering can be reconsidered and victim stories considered for publicity and educational campaigns;

6) **introduce accident costs in project cost benefit analyses**. Safety impacts should be evaluated based on accident costs and engineering judgment on the predicted accident change; i.e., effect of road widening on road accidents. Eventually, accident cost savings should be refined according to before and after-accident findings;

7) **target road safety funding to percentage of national road accident costs.** The target of road safety funding should be based on the national road accident cost estimate with anywhere between 10 percent and 50 percent requested for road safety (note that until recently, Japan allocated 0.6 percent of its annual GNP to road safety after calculating that accidents cost 1.3 percent of annual GNP; i.e., safety funding allocation was about 50 percent of annual losses); and

8) **regularly revise estimates and consider willingness to pay method.** Road accident costs should be recalculated every three to four years and updated annually during the interim period by the per capita GDP growth. Given the difficulty in adopting the willingness to pay method, countries should first carry out a pilot project if they are considering moving towards such an approach, as complex surveys are involved.

5 BENEFITS AND EFFECTS

5.1 Road Safety Awareness

In order to estimate the total cost of road accidents nationally, all accidents and related casualties (i.e., police reported and unreported injury, and damage-only accidents) need to be considered. Reported RTAs can be only an underestimate of the actual total that occurs each year. While underreporting exists in all countries, the severity indices found in developing countries indicate a much more serious problem exists in the developing world. Road accident costing offers an opportunity to overcome underreporting as hospital surveys often identify casualty totals much higher than police RTA figures (for example, in the PRC, Ministry of Health statistics show 111,000 road accident deaths whereas official police statistics for the same year [1994] show 66,362 road accident deaths). Similarly, with so few vehicles insured in developing countries, insurance company accident claims may represent only a fraction of the total vehicle damage costs incurred in the country.

By identifying the total impact of road accidents, road accident costing reveals the true extent of the problem in both the human casualty toll and also in economic terms. Road accidents pose a serious drain on scarce financial resources and medical services. RTA victims mainly belong to the most productive age range and have often just begun to pay back their debts to society.

5.2 Road Safety Funding

Once the total cost of road accident losses is known, an optimal safety budget can be determined and adequate resources can start to be justified for road safety. If the results are publicized, a road accident costing procedure should also be able to galvanize public and political support and generate private sector support for road safety. Road accidents will be shown to have many more victims and much wider and serious economic consequences than is commonly realized. The economic losses to the country are often viewed more seriously by governments than the thousands of persons killed or crippled each year. Being able to estimate the economic losses provides a means of attaining political interest in and support for road safety initiatives. It also tends to galvanize press and media support for safety initiatives to reduce such losses.

5.3 Promotion of Cost-effective Road Safety

With average accident costs estimated, road safety can now begin to be factored in a consistent manner on the same basis as construction and maintenance in cost benefit analyses of road projects and vehicle safety products;

e.g., seat belts, motorcycle helmets, and reflective stickers.

Safety engineering measures in developed countries have proven to have high rates of return and road safety expenditures can be promoted as an investment rather than purely as a cost. Safety measures can be shown to be cost-effective, a basic requirement in this era of scarce resources.

6 EXAMPLES OF GOOD PRACTICE

India has conducted several road accident costing studies with the first dating back to 1978. In recent years, the road accident costs have been regularly updated rather than revised, but individual localities have begun conducting their own accident costing exercises[1]. However, it would be better if a single value could be derived for each accident type and these values be applied throughout India. This should facilitate more consistency in decision making when considering alternative road safety initiatives.

Both the Indian Institute of Technology and the Central Road Research Institute[2] have conducted surveys of accident victims in an effort to learn more about road accident deaths.

Overseas Development Administration (ODA) of the UK has recently undertaken a study in several countries to determine the socioeconomic characteristics of accident victims. This study[3] has shown those injured in road accidents to have higher-than-average wage rates.

The Republic of Korea has carried out extensive research on accident costs and a valuation is now available for use in cost benefit analysis of proposed safety interventions.

Road accident costing was introduced recently in **Nepal** where the lack of national accident data required many assumptions to be made.

Detailed instructions were produced to guide the Nepal Department of Roads in updating the accident cost estimates in future years until a reliable national accident database is developed and accident cost estimates can be revised.

Nepal is fortunate to have a good source for medical costs, as the United Mission Nepal operates four hospitals and can provide average inpatient costs per night and outpatient visit costs, which are borne to a large extent (almost 80 percent) by the patients.

Both **Australia** and the **UK** have put much effort into researching road accident costs, with Australia producing estimated costs of various accident types while the latter has documented the transition from gross output method to the willingness to pay method. In the **US**, the National Highway Traffic Safety Administration has produced recommended average accident costs, but the individual states use their own calculations which are much lower than the Administration's.

Under the European Commission Cooperation in the field of Scientific and Technical Research (COST) program, 13 countries, including the UK, participated in a study[4] on the socioeconomic costs of road accidents. Over the past several years, road accident costing models and methods have been compared and assessed in terms of theoretical validity and general practicality.

7 REFERENCES AND KEY DOCUMENTS

In 1995, TRL published an *Overseas Note on Road Accident Costing*[5], which provided both background and a case study, while an earlier attempt at accident costing in India is well-documented in the *Road User Cost* study[2]. A summary of the recent accident costing exercise in Kerala is also available[1].

In Australia, one of the few motorized countries to still employ the gross output method, the Australian Road Research Board has produced many reports on accident costing[6], while the UK has documented much of its accident costing work in published TRL reports. The final report of the European Commission's research into the socioeconomic costs of road accidents was published in 1995[4].

A good reference for the application of road accident costs is *Safety and Highway Investment,* published by the University of Iowa (1994)[7]. This reviews the different costing methods used by the state highway departments in the US.

The UK method of valuation and current values are summarized periodically in UK Department of Transport Highways Economic Notes[8]. A review of current valuations used in different countries is given in a recent article by Elvik[9].

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Road Safety Guidelines for the Asian and Pacific Region

The guidelines cover 14 individual sectors affecting road safety, with four introductory chapters and four appendices. Information is presented in a series of freestanding documents that can be extracted for distribution and discussion.

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