# ADB-ASEAN Regional Road Safety Program

## Accident Costing Report: AC 5

## The Cost of Road Traffic Accidents in Malaysia

ADB

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

# Accident Costing Report AC 5: Malaysia

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## ABBREVIATIONS

GDP gross domestic product

## NOTE

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

## CONTENTS

# 1 INTRODUCTION

## 1.1 General

Road accidents generally receive less public attention than other types of transport-related accidents. This could be due to the importance placed on road safety by a country or society. In some societies, road accidents are accepted as fate. These societies fail to understand that road accidents are preventable and result in significant losses of resources. One way of bringing the importance of road safety to the attention of governments and societies is to show the real cost of accidents.

A recent study commissioned by Transport Research Laboratory estimated that the cost of road accidents in developing countries accumulates to about $65 billion annually. This sum is slightly higher than the total amount of official aid received by developing countries from all bilateral and multilateral agencies combined. Thus, on economic grounds alone, a vital need exists to reduce road accidents in these countries, as they consume massive financial resources that the countries concerned can ill afford to lose.

The benefits of estimating and publishing the real cost of accidents that are particularly important in developing countries include the following.

(i) Estimates of total annual costs of road traffic accidents can be used for resource allocation at the national level, to ensure road safety is given due recognition. Even relatively crude but realistic cost estimates will be useful in highlighting the economic benefits of investing in road safety.

(ii) Estimates of accident costs by injury severity can be used to ensure that best use is made of any road safety investment, through economic appraisal. Potential economic benefits can be estimated based upon predicted accident cost savings. Economic benefits can be estimated after a scheme has been implemented, based on before and after records of accidents, to which unit costs are applied.

As such, information regarding the costs of road accidents is important, if governments are to accord equitable priority in resource allocation for road accident prevention programs. In many European countries, detailed cost evaluations of road accidents are made periodically (Department of Environment, Transport and the Regions 1998; and Groeger 1998).

In Malaysia, an attempt to determine accident costs was undertaken in 2000. This was a research initiative to calculate road accident costs using the latest accepted method— the willingness-to-pay method. Road accident costs can be used for conducting strategic planning and performing cost-benefit analyses of major road safety projects.

Thus, it is proposed that there should be a permanent body in Malaysia to do road accident costing annually or periodically, to assess losses suffered by the nation and society. If costing is not done, resources may not be allocated for road safety improvement, and huge annual economic losses will continue to drain national resources.

## 1.2 Justification

The justification for reducing road traffic injuries or fatalities is often based on humanitarian reasons. Hence, it could be argued that it is not acceptable to wait for road accidents to occur or fatalities to be registered before taking preventive measures. However, authorities are commonly unwilling to be persuaded by such an argument and often adopt a reactive approach to solving road safety-related problems. The usual reason for

adopting this approach is that safety measures can be costly and, where there are competing needs for funding, devoting resources to safety-related expenditures can be less readily justifiable.

Another strong justification for improving road safety is economic, considering the massive financial resources consumed because of road accidents. As such, measures to prevent road accidents can be justified economically as investments. This has been the approach adopted in many developed and developing countries where the economic value of preventing road accidents can be considerable.

Following this approach, any safety improvement scheme to be adopted on roads can then be evaluated on the basis of cost-benefit analyses. Systematic procedures to select the best or most cost-effective schemes can then be put in place. While this may appear straightforward, certain obstacles can make this goal rather difficult to attain in practice.

It appears then that an important initial step in convincing national authorities to accord road safety a higher ranking at the national resource planning level is to demonstrate the huge losses being incurred annually by the Malaysia economy as a result of road accidents. In the longer term, resources need to be devoted to building a suitable database for cost estimation.

Thus, what is needed for a start is to estimate the scale of the cost of road accidents. Such less precise estimates can be used to get the magnitude of the losses, until more precise estimates are available. This is the focus of this report.

### 1.3 Objective and Scope of Study

The objective of this study is to prepare an initial approximation of the value of life of Malaysian motorists and use that to estimate the scale of annual economic losses being borne by the country as a result of road accidents.

### 1.4 Organization of the Report

This report is divided into five chapters. Chapter 2 tackles the commonly available methods of road accident costing, outlines the different approaches involved, and identifies the willingness-to-pay method as the most suitable. The willingness-to-pay method is elaborated in Chapter 3. Chapter 4 extends the cost computations to the national level. Chapter 5 is the conclusion. An appendix supplements and supports the findings presented in this report.

# 2 METHODOLOGY

## 2.1 Introduction

The valuation of road accidents is controversial because life is too important to be valued simply in monetary terms. While most people would not trade their lives for a sum of money, many are willing to spend a certain amount to avoid major threats to their lives. They will, for example, spend money to acquire safety devices or choose to accept some inconvenience to ensure an acceptable level of personal safety on roads.

The cost of road accidents may consist of two components, which can be regarded as the cold-blooded material cost and the warm-blooded willingness-to-pay component. Material costs may include property damage, administration charges, fees for medical treatment, hospital charges, and loss of productive work.

One problem in determining road accident costs is in obtaining accurate and relevant data for computation. The desire and hence willingness to pay for the economic cost of reducing the risk of road accidents is likely to be much higher than their material cost. This is why most developed countries adopt an ex ante method of estimation. However, considerable difficulties are involved in estimating the willingness-to-pay component.

Estimating the cost of road accidents involves two important steps: (i) identifying the cost components and (ii) placing a monetary value on each of these. Direct costs include hospital and treatment expenses incurred by the injured; replacement and repair costs resulting from property damage; and other expenses (e.g., transportation costs). However, in economic assessments as well as in insurance claims, costs arising from loss of earnings by those affected as well as compensation for pain and suffering are often included. Indirect costs are also associated with maintaining emergency and other essential services. Further, there may be other social costs, including those related to congestion and delays arising from road accidents and even perpetuating or increasing poverty among low-income families where the breadwinner is killed or permanently disabled.

## 2.2 Available methods

Placing a value on each of the cost components may not be straightforward, as this depends on not only the availability of data but also how the estimates are derived. The costs can be estimated in several ways. Hills and Jones-Lee (1983) and Jacobs (1995) discussed six methods for evaluating the cost of fatal road accidents. These methods are gross output, net output, life insurance, court award, implicit public sector valuation, and willingness to pay.

**Gross output or human capital method** is based on the assessment of economic consequences, usually supplemented by a notional sum to reflect the pain, grief, and suffering of victims and their family members.

**Net output method** deducts the future consumption of individuals killed in road accidents and reflects a more conservative economic cost to society.

**Life insurance method** measures the valuation of risk associated with road use and is determined by the premiums that the driver population is willing to pay.

**Court award method** is based on the actual compensation settlements awarded, which may be influenced by the degree of negligence found.

**Implicit public sector valuation method** is a set of implicit values that are used to value human lives.

**Willingness-to-pay method** estimates the amount of money people affected would pay to avoid a road accident.

Considerable overlaps exist in the different methods, but the derived values are substantially different. Based on the objective of reducing road accidents, articulated in the form of either a call to maximize national output or social welfare, two methods, the gross output (or human capital) method and willingness-to-pay method, are most appropriate. The approaches adopted in these two methods are different. The first adopts an ex post approach that estimates the true costs based on historical data of costs incurred after a road accident. The second adopts an ex ante approach that attempts to estimate the true costs by considering what a person would do to avoid being involved in a road accident (Babtie Ross & Silcock and Transport Research Laboratory 2003).

**Gross Output or Human Capital Method.** The main component in this ex post approach is the discounted present value of the victim's future income forgone due to premature death. To this are added market costs, such as cost of medical treatment, administration cost, and property damage and nonmarket output. This approach has clear disadvantages, as it focuses only on the output effects and does not account for the value and enjoyment of life forgone. This grossly underestimates the true costs of road accidents and will produce very significantly lower values than ex ante estimate. As a partial correction for this shortcoming, a life component is commonly added involving pain, grief, and suffering. Although this increases the value derived, it still results in a valuation that is generally much lower than values derived from the willingness-to-pay method.

Although a few of the more developed countries have moved toward willingness-to-pay approaches, the human capital method is very common in many countries where extensive surveys to obtain perceived risks of different groups of individuals are difficult or impossible to conduct. One appealing aspect in using the human capital method is that the cost estimates derived are necessarily conservative estimates. Further, where road accident databases may not be well integrated, which means that cost estimates cannot be made with a high degree of precision, the human capital method will suffice. This is the method recommended by the Asian Development Bank for use in the Asian Development Bank-Association of Southeast Asian Nations regional project and has been used in this report.

The various methods of costing are built on very different premises and thus result in vastly different cost figures. The choice of method depends on the purpose of the costing exercise. In developing a suitable methodology to estimate road accident costs for maximizing national output as well as social benefits, Jacobs (1995) evaluated these methods and proposed that only the gross output and the willingness-to-pay methods are most appropriate. Further, the willingness-to-pay method was considered the better approach for conventional cost-benefit analyses and the most efficient way of allocating scarce financial resources.

**Willingness-to-Pay Method.** This ex ante approach involves some assessment of risk and the willingness of individuals to commit resources in exchange for reducing this risk to an acceptable level. This trade-off between risk and economic resources, measured in the marginal rate of substitution of wealth for risk of death or injury, gives rise to the concept of willingness to pay in road accident costs analysis.
The willingness to pay to avoid a lost statistical life is influenced by context effects (the perceived seriousness of a road accident) and scale effects (the number of casualties the road accident will involve). Hence, it may be said that the willingness-to-pay approach is more

concerned with reducing the risk for the entire population than saving a specific life.

Under this approach, the cost components, or willingness-to-pay values, are assessed for three parties:

(i) the individual road user facing the risk of a road accident;
(ii) the family, relatives, and friends of the individual exposed to the risk; and
(iii) the rest of society affected by the risk.

The willingness-to-pay approach is conceptually appealing but has practical problems in being applied to developing countries (because of incomplete or inaccurate data). In determining the values, three types of information are needed:

(i) road accident or casualty risk,
(ii) risk elasticity, and
(iii) economic valuation.

**Road accident or casualty risk** is assessed by considering individual transport modes, vehicle types, and road user categories. Usually this is done by stratifying road accidents or casualties into several categories of injury severity.

**Risk elasticity** describes the changes in risk in relation to other road users and is often measured in terms of probability per million vehicle-kilometers of travel. Although extremely difficult to obtain, elasticity values are needed for different casualty and vehicle types.

**Economic valuation** is a combination of cost components, such as gross production losses, health costs, administration costs, and property damage, as well the as the subjective pure human value.

For this project, the willingness-to-pay method is used. Malaysia's costing report will therefore differ from counterpart reports using the human capital method.

# 3 WILLINGNESS-TO-PAY

## 3.1 Value of Statistical Life

The willingness-to-pay method is a variant of a popular value solicitation technique known as the contingent valuation method. The method has particularly gained popularity in valuation research since the late 1990s. It appeals to researchers because of the general ease of application in valuing a good (e.g., a small reduction in fatality risk) in the absence of existing market data. In addition, it also allows for valuation to be done for any population subgroup and provides for some flexibility in the specification of the good to be valued by the respondents. The willingness to pay for a given reduction in the risk of death is defined as the total amount of money that individuals would be willing to pay for a safety improvement that will result in a reduction of the risk of a premature death. The willingness to accept a given increase in the risk of death can be defined as the total amount of money that individuals would require as compensation to accept the given increase in the risk of a premature death. Both measures are determined using direct solicitation of individual preferences, usually by way of a questionnaire survey.

## 3.2 Methodology

The study was carried out for the whole of peninsular Malaysia. A survey questionnaire was prepared. This survey followed a similar format created by Jones-Lee et al. (1985 and 1993) during the national survey in the United Kingdom, with some adjustments to meet local needs. It was designed to accommodate an interview that would last 15–20 minutes.

**Instrument Development.** The survey questionnaire contained multipart questions that fell into three broad categories: contingent valuation questions (to provide estimates of the relevant marginal rates of substitution of wealth for fatal accidents); perception questions (to test the perception of individuals on risk and the understanding of probability concept); and demographic and vehicle ownership questions (to collect data on age, income, vehicle engine size and age, and other demographic and vehicle details).

Contingent valuation questions were posed to respondents to determine their willingness to pay for a small risk reduction and hence provide the basis for direct estimation of their marginal rates of substitution of wealth for a reduction or an increase in the risk of fatality. This survey focused only on own risk and did not consider possible willingness-to-pay valuation for other people's safety, as had been done in the United Kingdom (Jones-Lee et al. 1985). The exclusion is in line with recent theoretical works that raise doubt as to whether willingness-to-pay-based values of safety intended for use in public sector decision making should take any account at all of people's willingness to pay for others' safety (Jones-Lee et al. 1992 and Bergstrom 1982).

Once selected, respondents were briefed on the purpose and techniques of valuation, to ensure commitment on their part to completing the valuation exercise. The appropriate concept of risk was then explained by using two A4-size show cards. The first card showed 20 shaded grid boxes (out of 100,000), representing 20 deaths per annum for every 100,000 members of the population. The second card had 30 shaded grid boxes, representing 30 deaths involving all road users for every 100,000 population. This was intended to give respondents information about their present level of risk. Two questions were then posed to the respondents to test their comprehension of the risk concepts before valuation exercises were conducted.

The survey proceeded by asking the respondents to state their willingness to pay to reduce a prespecified risk of death. Before attempting the valuation questions, respondents were advised to state their valuation by considering only their own safety and to ignore financial effects as a direct consequence of the accident.

In one of the questions, respondents were asked to imagine that they were given RM300 for their traveling expenses on an excursion bus tour around all states in peninsular Malaysia. They were then given the name of a bus company that will take them to their destination for exactly RM300. They were also told that the company's safety record indicated that a passenger had a 10 in 100,000 chance of getting killed during a trip. Subsequently, they were asked to state whether they would be willing to pay RM50 extra to travel on a safer bus service, whose safety record indicated that a passenger had a 5 in 100,000 chance of getting killed during a trip (a 50% lower risk of death). If the answer was "yes," payment cards showing higher amounts (in RM5 increments) were shown to the respondents. They were then asked to state the actual amount they would be willing to pay for the safer bus service. Payment cards showing successively lower amounts were shown if the respondents initially answered "no."

Another question required respondents to state whether they would be willing to pay RM50 extra to travel on a safer bus service, whose safety record indicated that a passenger had an 8 in 100,000 chance of getting killed during a trip (a 20% lower risk of death). This second question was also intended to check if the respondents were sensitive to small variations in probability. Finally, two sets of questionnaires were prepared. The sets only differed in the sequence in risk reduction, to check whether the respondents were consistent in their answers.

**Pretest.** Prior to the full survey, a pilot test was conducted. Thirty respondents were interviewed during the pilot test, and it was discovered that the questionnaire form needed to be fine-tuned to overcome the following problems.

(i) Some elderly and uneducated respondents found it hard to communicate in Malay or English.

(ii) Actual average time taken to complete the questionnaire was 40–45 minutes, but respondents were found to be quite reluctant to devote more than 30 minutes to completing the questionnaire.

To overcome these problems the following actions were taken.

(i) Research assistants fluent in various chinese and Indian dialects were employed to interview elderly and uneducated Chinese and Indian respondents.

(ii) The number of multipart probability questions on risk was reduced without compromising the real purpose of the study. This was done to reduce the expected amount of time required to complete the questionnaire form.

**Sampling Method.** A total of 28 trained enumerators were fielded for over 1 month to solicit responses from the predetermined sample. The questionnaires were administered to 1,000 respondents obtained through a stratified random sampling method drawn from a nationwide population. Assistance from the Department of Statistics, Malaysia was obtained in coming up with the sampling frames. The sampling frames were essentially randomly selected blocks of residential units drawn from a national database. The selection process was designed so that the resulting sample properly represented the entire national population.

# 4 ROAD ACCIDENT COSTING

## 4.1 Introduction

Eight hundred and fifty-five respondents were eventually selected for analysis, 429 from the first set of questionnaires and 426 from the second set. Some responses were discarded because the respondents incorrectly answered two questions designed to show that they have a basic understanding of the probability concept. Contrary to prior belief, however, findings from the pilot test and, subsequently, the survey indicated that an overwhelming number of respondents had no problems comprehending and hence responding to the probability questions.

On the question asking which road is more dangerous given a probability of 2/100 and 8/100 fatal accidents, 97% of the respondents gave the correct answer. The next question was much tougher and required respondents to perform a simple calculation to arrive at the probabilities of fatal accidents. Ninety five percent of the respondents correctly answered the question. This being the case, the respondents generally had a good understanding of the probability concept of risk.

The marginal rate of substitution of wealth for self-only risk of death implied by the amounts respondents would pay for risk reduction can be calculated by dividing willingness to pay by the change of risk in the probability of death for which the respondents pay where marginal rate of substitution = willingness to pay/$\Delta p$.

The results in the marginal rate of substitution of wealth for risk of death (i.e., the value of a statistical life) are shown in Table A.1 and Table A.2. The figures are presented in mean, median, and trimmed mean values. The estimated mean figures from all valuation questions range from a minimum of RM1,283,776 to the maximum of RM3,125,875. From the tables it can be seen that the means for all marginal rate of substitution figures are generally higher than the medians, which attests to a positively skewed distribution. This could be due to the influence of outliers in the upper tails of the distribution. Notice also that some difference (although relatively small) exists between the mean, median, and trimmed mean values.

Given the difference between mean and median, it is natural to ask which of these two central tendencies can be used to value a life. Miller and Guria (1991) suggest that the median is the best estimate, if the survey does not weed out high values. But if these have been weeded out, the mean is more reliable. For Malaysia, the mean value is most appropriate and consistent with social cost-benefit analysis, as emphasized by Jones-Lee et al. (1992). If a single conservative value is required, RM1.2 million would perhaps be appropriate as an estimate for the value of a statistical life for a motorist in Malaysia.

The results also show that the respondents were not sensitive to different risk reductions, as can be deduced by comparing Table A.1 and Table A.2. After considering the probability difference in risk reduction, the majority of respondents seemed to be insensitive to the difference in the magnitude of the reduction in risk. The marginal rate of substitution is generally larger by a factor of 2.3 for the scenario that offers a 20% risk reduction, compared with the one with a 50% reduction. Persson et al. (1995) also experienced this phenomenon and suggested that willingness to pay is a diminishing function of the size of the risk reduction. As to whether respondents were sensitive or otherwise to the probability of risk reductions, a paired sample t-test was performed on the marginal rate of substitution values between the two risk reductions. Results