SWOV Fact sheet

The valuation of human losses of road deaths

Summary
Human losses constitute a considerable part of the total social road safety costs. This is damage in the form of suffering, pain, sorrow, and loss of the joy of living of the casualties as well as their family and friends. It is important for policy and its supporting research to be able to attach a value to this damage in terms of money. Detailed study has been made in the Netherlands of the valuation of human costs in fatal crashes. This study estimated the value of a 'statistical' life (VOSL) which mainly consists of human losses, at € 2.2 million ± € 0.3 million. This amounts to nearly € 1.8 million ± € 0.3 million in human losses. This value is higher than that used in the Netherlands until now, but roughly equals the estimates in other countries.

Background
Crashes lead to all sorts of social costs, such as material damage, loss of production, and medical costs, but also human costs. Human costs consist of loss in the quality of life for casualties and their family and friends. These are costs in the form of suffering, pain, sorrow, and loss of the joy of living. These costs are separate from material costs such as not being able to consume anymore, etc. Various studies indicate that the human losses resulting from crashes, for both fatalities and injured, are a substantial part of the total social costs of road safety. Therefore, knowledge about human costs is important for policy and its supporting research. This includes research into road safety costs and cost-benefit analyses. Following various other countries, a detailed study was made in the Netherlands of monetizing the human costs of (only) fatal car crashes. This fact sheet presents a summary of this knowledge.

Why should we monetize human losses?
There are at least three reasons to express human losses due to road crashes in monetary terms. The first reason is that the efficiency of traffic and road safety measures is increasingly determined by using cost-benefit analyses. In these analyses safety effects, including human losses, are expressed in monetary values as much as possible (see SWOV Fact sheet *Cost-benefit analysis of road safety measures*). This makes it possible to weigh the saving of road crash casualties against the costs of measures and their effect on, for example, mobility and pollution.
The second reason is that human losses are a large cost item in the total of road crash costs. Information about road safety costs is used in the preparation and assessment of national road safety policy. It offers possibilities of comparing the cost of road crashes with other social costs, such as those of traffic jams or pollution (see SWOV Fact sheet *Road crash costs*).
The third reason is that a fuller picture of the costs of a specific crash can be obtained if the human costs are also known. This can be important for insurance claims. The Netherlands does not (yet) have this possibility, but in other countries estimates of human costs are sometimes used for this purpose (Smith, 2000).

How does valuation work? – the term VOSL
In order to standardize the valuation of safety, including human losses, the concept Value of a Statistical Life (VOSL) was developed. This 'statistical human life' can be illustrated by the following example. A risk of a fatal crash of for instance 7:100,000 means that, statistically, 7 of every 100,000 people will die in a road crash each year. A decrease of the risk from 7 to 4 road deaths per 100,000 means that on a population of 100,000 inhabitants 3 'statistical lives' are saved.
The 'willingness-to-pay', which is the amount that people are prepared to pay for a certain decrease in crash rate, is used to determine the value of the decrease in crash rate. This concept originates from the economic theory of welfare, and makes it possible to put a price on risk reduction and thus on the saving of 'statistical' human lives. Suppose that people are willing to pay € 60 for a crash rate reduction from 4 per 100,000 to 7 per 100,000. In that case 100,000 people are collectively prepared to pay 100,000 x 60 = € 6 million for an expected decrease from 7 to 4 fatalities. The VOSL is then €6 million ÷ 3 saved statistical lives = € 2 million per statistical life.

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A technical complication is that the VOSL comprises the valuation of human losses (suffering, sorrow, etc.) as well as the material damage (not being able to consume anymore). To only determine the human losses, the material damage as a result of death must be deducted from the VOSL. As a measure, the loss of consumption during the years of life lost is used.
Please note that the VOSL does not concern the value of a specific individual's life, but the decrease in crash rate instead. Most people would 'give anything' not to die. In the concept 'willingness-to-pay', people make a trade-off between crash rate and money. Every day, people make decisions in which, unconsciously or not, they make such trade-offs. Take for example, choosing food, choosing driving speed, whether or not to take a smoke detector, or choosing whether or not to smoke.

Which methods are there for calculating the VOSL?
Various methods have been developed to measure 'willingness-to-pay'. The two most important groups of methods are (De Blaeij, 2003a):
- Revealed Preference (RP). These methods study how much money people actually spend on safety provisions.
- Stated Preference (SP). These methods use questionnaires in which people, directly or indirectly, are asked about how much they are willing to pay for safety provisions.

In principle, RP methods are preferable to SP methods because RP methods are based on the actual spending of real incomes. However, applicability of RP methods to road safety is limited. For example, the purchase of an airbag is often not a separate choice; it is usually part of a set of accessories. Furthermore, the purchase and use of many safety devices, such as seatbelts, is legally obligatory. Another limitation of RP methods is that they assume that people are capable of correctly estimating risks, and the risk reduction that is achieved by purchasing a particular device. However, the risks and the risk changes in relation with fatal crashes are very small. It is well known that people are hardly capable of judging them correctly. SP research can provide people with information about small risks and risk changes in such a way that they are more capable of processing them adequately. This is not possible with RP methods, which limits their applicability. SP methods also have a broader applicability because they are not dependant on the availability of data about peoples' actual choice behaviour. Therefore, SP methods are often used for the valuation of e.g. safety, travel time, or nature and pollution. On the other hand, this research is so complicated that it needs to be carried out carefully to obtain valid results.
In addition to RP and SP methods, use is sometimes made of the costs-per-life-saved method. This method uses policy documents about proposed or realised measures to derive how much money is invested per life saved. For each decision it is then possible to calculate how much one is prepared to spend to save a life. Strictly speaking, however, this is not a VOSL because this method does not look at the preferences of the population, but at the revealed preferences of the policy makers. The usefulness of this method is limited because it produces a minimal safety valuation. The maximum amount that policy makers would wish to invest in safety can be higher than the actual amount spent. In addition, it is often not known whether there were any other (side) effects involved that played a role in taking the decision about policy measures.

How much is the VOSL according to international research?
In various countries, research has been carried out into the 'value of a statistical human life', and a number of surveys have been published. A Canadian study analyzed the results of 85 VOSL studies (Dionne & Lanoie, 2004). 28 of these studies were related to road safety and the others to other types of safety, such as work safety. In the road safety studies, the average VOSL was more than $ 3.5 million (price level 2000). If the studies of other types of safety are included, the average VOSL amounts to $ 5.6 million. One of the possible explanations for this difference is that the road safety risk level is lower than that of other types of safety, especially work safety. In the last few years, there have also been a number of meta-analyses of the VOSL within various contexts. Meta-analyses give an overview of existing estimates and attempt to explain the differences between them, or to determine a 'best' VOSL estimate. An example is a meta-analysis by De Blaeij et al. (2003) which analyzed road safety VOSL estimates in a number of European countries and the United States. One of the things this study wanted to determine is which factors influence the VOSL estimate. The values found depend, among other things, on the method used and the initial crash rate. This study found an average VOSL of $ 4.4 million (price level 1997). The calculations also included studies that had used the costs-per-life-saved method; without them the average VOSL would have been higher.
A meta-analysis carried out by Miller (2000) intended to determine a so-called 'value transfer function', based on 69 VSOL studies in various countries. Using certain variables such as the net domestic

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product per capita, this function can be used to estimate the VSOL of any country. Miller used studies in work safety, fire safety, and road safety that used a variety of methods. For the Netherlands, Miller calculated a VOSL of $ 2.9 million (price level 1995).

Which VOSL values are used in policy?
Various countries have official, government-approved VOSL values that are recommended for use in policy support and assessment. Within the framework of the ROSEBUD project De Blaeij et al. (2004) made an inventory of the most up to date official VOSL values in 7 countries. These values vary between € 1.4 million and € 2.6 million (price level 2000).
Based on a literature study, a report of the European Conference of Ministers of Transport (ECMT, 1998) maintained that the best, scientifically based VOSL estimate was €2.4 ± € 1 million (price level 1990). However, for policy purposes, a more conservative approach was followed, and a lower limit of € 1.5 million (price level 1998) was recommended, as this would be more readily accepted as a minimum estimate. In addition, this amount agreed with the average of the official values used in 5 European countries which had carried out VOSL research.
In the European projects UNITE and HEATCO proposals were developed for standard European unit values, including a standard VOSL (Nellthorp et al., 2001; Bickel et al., 2006). Both projects propose a standard VOSL of € 1.5 million (price level 1998). This value is differentiated per country, taking differences in purchasing power into account. The estimate that is made for the Netherlands amounts to € 1.7 million. However, if a country has performed a thorough VOSL-study itself, it is recommended that this VOSL specific for this country is used.
Since a number of years a VOSL is also being used in the Netherlands. For calculating the social costs of road crashes the Ministry of Transport uses a VOSL of €2.2 million (AVV, 2006), based on the study of De Blaeij (2003b). This VOSL has previously been used in the *Mobility Policy Document* (VenW & VROM, 2004). The Ministry of Transport uses the OEI guideline for cost-benefit analysis, but this does not yet contain a recommendation about the VOSL (Eijgenraam et al., 2000); OEI stands for Overview Effects Infrastructure). There will shortly be an addition to the OEI guideline that will deal specifically with the safety effects and their valuation. Expectations are that this addition will make concrete recommendations about the VOSL that should be used in cost-benefit analyses.

How much is the VOSL in the Netherlands?
A thorough study of the VOSL which used SP methods was first carried out in the Netherlands in 2001 (De Blaeij, 2003b). The study used a questionnaire with two types of questions. The first type asked motorists to make comparative assessments between safety, travel time, and money. Every subject was asked ten times to make a choice between 2 routes from A to B, for which the toll (price), safety, and journey distance were different each time. *Table 1* presents an example of such a question. Analysis of the data resulted in a VOSL of € 2.2 million ± € 0.3 million (a 95% confidence interval).

You can choose for route A or route B. Each year 16 people die in a car crash on route A. If you choose A your journey lasts 1 hour, and the toll is Dfl. 5-. Each year 4 people fewer die in a car crash on route B. If you choose route B your journey is 10 minutes shorter, and the toll is Dfl. 5- more expensive, because it costs ƒ10. This information has been summarized for you in the table below.

If you have the choice between route A and route B, which would you choose?

	Route A	Route B
Toll Number of deaths each year Travel time	ƒ5 16 60 mins	ƒ10 12 50 mins
I choose for:	Route A	Route B

Table 1. *Example of a survey question from De Blaeij (2003b)*.

The second type of question requested respondents to make a choice between three different versions of the same car model, the only differences being the price and the safety. Then they were asked which maximum price they were willing to pay for one of the versions. From this answer, a safety valuation could be derived. This led to a higher VOSL (€ 5 million, with a 95% confidence interval of € 2 - € 9.5 million). There are different explanations for this difference. For example, people are generally prepared to pay more for safety if it concerns a personal purchase such as a car, than if they think that others will also profit from their purchase. The manner of payment (toll v. car price) can also be of influence. Another possible explanation is that people prefer paying for safety one time only, rather than having to make a trade-off regularly (every journey).

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Recommendations
The study by De Blaeij indicates that, among other things, the VOSL depends on the kind of measure (public or private) and the target group for which it is meant. However, it is less desirable (less credible), but also impossible (because of a lack of knowledge) to use a different VOSL in each case. It is better to use one standard value that can also be used in cases of a low VOSL. Therefore SWOV recommends using the lower of the two values found, i.e. a VOSL of € 2.2 ± € 0.3 million (price level 2001), for cost-benefit analyses and research into the costs of road safety (Wesemann et al, 2005). In the Netherlands, this value is already used in calculations of the social costs of road crashes. After deducting the material damage of fatal injury (loss of consumption during the years of life lost), an average of € 450,000 per fatality), there is nearly € 1.8 ± € 0.3 million left for the human costs of a road death. Based on analysis of foreign studies in which a VOSL for the Netherlands is determined, SWOV recommends, if desired, to use an even larger margin for the VOSL: € 1.6 - € 3.0 million in sensitivity analyses (price level 2001; Wesemann et al., 2005).
Because the VOSL can vary over the years, SWOV recommends carrying out research into the VOSL periodically, e.g. every 5 years, as is done for valuating travel time. At present, correction is only made for inflation, for example in determining the total human costs of road traffic crashes (see SWOV Fact sheet *Road crash costs*). For 2007 the calculations have been made using a € 2.5 million VOSL. In addition, the VOSL should be revised for 'real' growth in time. This means that the VOSL is adapted to for instance economic growth, as is also done for valuating travel time (VenW & CPB, 2004). This is necessary for using VOSL in cost-benefit analyses, because the effects of measures can stretch over a long period of time.

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