THE EXPENDITURE ON PREVENTING ROAD CASUALTIES

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ABSTRACT

Improving road safety means that money must be spent on the prevention of road crashes and injuries. This expenditure gives an indication of the efforts spent on improving road safety and how these efforts relate to road safety as a social problem. Information about expenditure on road safety (or: prevention costs) is also required for cost-effectiveness and cost-benefit analyses and for comparison with the expenditure in other policy areas. Until now, however, there has been very little information about this expenditure at the country level, not to mention at a regional or global level. Nor has an internationally accepted method for the estimation of road expenditures been available until now.

This paper presents a method to estimate expenditure on road safety, including government expenditure as well as expenditure of private individuals and companies. The definition of road safety expenditure as well as related concepts are discussed. A classification of prevention cost items and actors that spend money on road safety is presented, and methods and data sources that are required to estimate the expenditures are discussed.

The paper then presents the results of a study into the road safety expenditure in the Netherlands, in which the method was applied. The expenditure on road safety was found to amount to 2.3 to 3.1 billion Euro in 2007, or 0.4% to 0.5% of the gross domestic product. The largest cost items concern vehicle safety (1.2 to 1.6 billion Euro), enforcement (600 to 700 million Euro) and infrastructure (350 to 500 million Euro). Other prevention costs, among which education, research and policy making, are relatively limited. The major part of the expenditure was made by governments: approximately 1 billion Euro. Private individuals spent 900 million and companies 400 million Euro.

In comparison with the costs due to road traffic crashes in the Netherlands (12 billion Euro in 2007) the expenditure on the prevention of road traffic crashes is relatively low. Effective (extra) road safety measures can therefore save costs that exceed the costs of the measures themselves. This is confirmed by a cost-benefit analysis (CBA) of the implementation of the Sustainable Safety vision in the Netherlands during the period 1998-2007.

The paper finally recommends to develop an international standard method to estimate road safety expenditures, and to investigate the expenditures in other countries to allow making international comparisons.

1. INTRODUCTION

Improving road safety requires money being spent on the prevention of road crashes and injuries, preferably as cost-effective as possible. Information about road safety expenditure is required for several purposes. Firstly, this expenditure gives an indication of the efforts spent on improving road safety; changes in the expenditure may therefore indicate changes in the attention paid to road safety. Information about road safety expenditure not

only makes international comparison possible, it also enables comparison with the efforts (in terms of money spent) in other policy areas, e.g. reduction of traffic jams, safety improvement in other areas (e.g. industrial safety), crime reduction, or health care. Information about the road safety expenditure also reveals the importance that various stakeholders assign to road safety: higher expenditure (or a higher share in the total expenditure) indicates a higher priority for road safety. Furthermore, expenditure information is also needed to answer the question how these efforts relate to road safety as a social problem, for example expressed in terms of social costs, numbers of casualties or disability adjusted life years (DALYs). This relation can then be used for comparisons with other policy areas. Finally, information about expenditure on road safety is required for cost-effectiveness analyses (CEA) and cost-benefit analyses (CBA) of road safety measures or programs.

Until now, however, very little information about the expenditure on road safety has been available at the country level, not to mention at a regional or global level. Nor has an internationally accepted method for the estimation of road expenditure been available until now. OECD, for example, conducted a survey among OECD countries in order to collect data on government spending on road safety. Few countries could provide this data, and comparison between countries was not possible due to different approaches and assumptions used [1].

This paper presents a method to estimate expenditure on road safety, both government expenditure and expenditure by private individuals and companies. The results of application of this method in the Netherlands will be shown. The paper is structured as follows: first the definition of road safety expenditure will be discussed, as well as related concepts (Section 2). Then a classification of expenditure items and actors that spend money on road safety will be presented (Section 3), and methods and data sources needed to estimate the expenditures will be discussed (Section 4). Next, the results of application of this method in the Netherlands will be presented (Section 5). Road safety expenditure in the Netherlands in 2007 will be discussed, as well as the distribution among the various actors that spend money on road safety and among road safety areas (e.g. infrastructure, enforcement, etc.). Comparisons will be made with the expenditure on other policy areas. Application of these results in a CBA will also be shown. Finally, conclusions will be drawn and recommendations will be made (section 6).

2. HOW TO DEFINE ROAD SAFETY EXPENDITURE?

As stated above, little is known, as yet, about road safety expenditure, and (international) guidelines or methods to estimate this expenditure are not available. However, studies have been made into the expenditure in other policy areas like crime [2, 3] or health care [4]. Some of the methods and definitions used in these studies can be used to develop a method for estimating road safety expenditure. This section and Sections 3 and 4 discuss the main methodological issues for estimating road safety expenditure.

2.1. Road safety costs

Generally, two types of road safety costs can be distinguished. The first type are the costs resulting from road crashes. The main costs categories of this type are medical costs, property damage, administrative costs, production loss and human losses [5, 6]. Guidelines for estimating these costs have been developed, for example a European guideline developed within the 'COST 313' project, and many countries have estimated these costs [1, 7, 8]. The second type of road safety costs are the costs that are made to

prevent road crashes and injuries. These costs can be defined as the costs that are made for the implementation of road safety measures, for road safety policy making, and for research and consultancy in support of policy making.

2.2. Costs versus expenditure

The social costs of road safety measures and policy making (also referred to as prevention costs) can be defined as the labour, capital and other resources that are required to implement the measures and for policy making. This definition is mostly used in CEAs and CBAs that assess the social costs of measures as well as the effects (CEA) and/or benefits (CBA) of the measures. This definition is in accordance with the welfare economic theory which defines social costs by using the concept of 'opportunity costs'. The opportunity costs of an input are defined as 'its value in its best alternative use' [9]. It is the value that society must forgo if the input is used to produce a certain good or service. Assuming that market prices (if it concerns a resource that is traded on a market) reflect the opportunity costs is a practical approach that is often chosen to estimate these costs. Economic theory shows that this is indeed the case if there are no market failures. However, imperfections in the labour market, for example, may result in unemployment with the possible consequence that the wage rate does not fully reflect the opportunity costs of labour.

An expenditure can be defined as a flow of money that is related to an economic transaction. In many cases the expenditure on road safety measures and policy will be equal to their social costs. The actor that implements a measure pays a market price that reflects the price of the resources used. For example, a regional government that implements infrastructural measures pays a contractor to construct roundabouts. The price that is paid to the contractor reflects the labour costs, building material, administrative costs, etc. If no important market failures are anticipated, this price reflects the social costs of implementing the measure.

In an analysis of road safety expenditure, the expenditure preferably reflects the social costs so that the figures are appropriate for use in (social) CEAs and CBAs. This means that money transfers that do not reflect costs of resource use are not taken into account. Examples are taxes, subsidies and fines. These money transfers only reflect a redistribution of money between the payer and the recipient. All (other) expenditure on prevention of road crashes and injuries, made by actors within a certain society (e.g. a country), should be taken into account. In case there are obvious market failures that lead to discrepancies between expenditure and social costs, the expenditure figures should be adjusted in order to use them in CEAs and CBAs.

2.3. Road safety expenditure

Road safety expenditure can be defined as expenditure on the implementation of road safety measures, on road safety policy making, and on research and consultancy in support of decision making. A point of special interest is that some road safety measures may also be aimed at other policy areas, for example:

- driver training focuses on mobility (being able to operate a vehicle) as well as on road safety;
- road maintenance not only aims to improve road safety but also to improve driver comfort and to decrease travel times;
- vehicle registration numbers are necessary for efficient road traffic enforcement, but are also used for tackling crime against property.

This raises the question to what extent expenditure on these issues can be regarded as road safety expenditure. It is often impossible to attribute the expenditure on these types of measures to a specific policy area and no criteria have been found in the literature to do this. Only in certain cases can a measure be subdivided into various 'submeasures' that focus on just one policy area. For example, when constructing a new road, specific road safety 'submeasures' can be distinguished, e.g. safety barriers or obstacle free zones. In such cases the expenditure on these specific road safety submeasures can be assessed in order to estimate the road safety component of the expenditure on a measure (e.g. constructing a new road). However, the examples above illustrate that it will often not be possible to identify submeasures. Therefore, we propose to distinguish between two categories of road safety expenditure: (1) expenditure on measures, policy and research whose only target is improving road safety and (2) expenditure on measures, policy and research that have other main targets besides road safety. In addition, there is also a category of measures in other policy areas that have side effects on road safety. Although in theory the expenditure on this category of measures can partly be seen as road safety expenditure, we propose to exclude this expenditure from an analysis of road safety expenditure for practical reasons.

3. A CLASSIFICATION OF ROAD SAFETY EXPENDITURES AND ACTORS

As there is no (standard) methodology to estimate road safety expenditure, there is no standard classification of expenditure categories either. To develop such classification, we will use the following main groups of road safety measures that are in accordance with road safety literature, see e.g. [10], [11]:

- Infrastructural measures. These involve the construction of new roads, adaptations and maintenance of existing roads, and traffic control (e.g. traffic lights). Although improving road safety is not the main purpose of constructing new roads, submeasures may be identified that are aimed at road safety (as explained above).
- Public information and education, like information campaigns, driver training, education in schools, et cetera. Compulsory educational measures imposed on offenders like, for example, drunk drivers, belong to this category.
- Enforcement. Not only police enforcement activities (alcohol, red light, seat belts, etc.), but administrative and judicial affairs as well as vehicle registration should also be taken into account.
- Vehicle safety: this concerns safety devices like airbags, safety belts, electronic stability control, bicycle lights, etc. Helmets, child seats and periodic vehicle inspection are also placed in this category.

Besides expenditure on road safety measures, money is spent on:
- Road safety policy making. This is the expenditure on government bodies, for example personnel costs. Also expenditure on activities aimed at influencing policy making (e.g. lobbying) belongs to this category.
- Road safety research and consultancy. This is the expenditure on decision supporting research and consultancy, including road safety data collection and analysis.

Note that in the literature the costs of medical treatment of road casualties are included in the costs due to road crashes. On the other hand, medical treatment is also aimed at preventing road injuries from becoming more severe. However, from a practical point of view, it is impossible in cost studies, to separate these preventive medical costs from other medical costs. These costs should therefore not be incorporated in an analysis of the costs of preventing road crashes and injuries. This prevents double counting of these

costs. Also note that technology (e.g. road signalling), vehicle safety (safety devices) and research) is not a separate expenditure category in this classification; it is part of infrastructural measures.

Three main categories of actors that spend money on road safety can be distinguished: government, private individuals and companies. 'Government' can be divided into various subcategories, for example national, regional and local government, depending on the institutional structure in a country. The above expenditure categories can be linked to the actor categories. In many cases it is obvious which actor (category) is responsible for which expenditure (category). For example, governments normally finance infrastructural measures and vehicle safety is paid for by companies and private individuals in the form of a market price. However, differences across countries may occur depending on the (institutional) organization of road safety policy. Table 1 shows the expenditure and actor (sub)categories as identified in the Netherlands in 2007 [12].

Expenditure		Actor
Main category	Subcategory	
Infrastructure	Safety of main road network	Ministry of Transport
	Investments in safety of secundary road network	Provinces, municipalities, water boards
Information/education	Driver training and driving licence	Learner drivers
	Moped certificate	Learner riders
	Traffic education in schools	Ministry of Education
	Other traffic education (e.g. courses for elderly, bicycle course for immigrants, continuing education novice drivers)	Ministry of Transport, municipalities, road users
	Campaigns	Ministry of Transport, non-government organizations, provinces/ Regional Road Traffic Safety Authorities, municipalities
	Development teaching materials	provinces/ Regional Road Traffic Safety Authorities
	Compulsory course for offenders (alcohol)	Ministry of Justice, road users
	Driver diploma + refresher course	Drivers, companies
	Driving skills courses	Road users, companies
Enforcement	Enforcement	Ministry of the Interior (police), Ministry of Justice (Public Prosecution Service, judiciary, prison system)
	Licencing	Vehicle owners (private, companies)
Voertuigveiligheid	Safety facilities motorized vehicles and (light) mopeds	Vehicle owners (private, companies)
	periodic vehicle inspection	Vehicle owners (private, companies)
Research/consultancy	Research by knowledge institutes and consultancies	Ministry of Transport, lower governments, social organizations
Policy making	Organization costs, legislation	Ministry of Transport, lower governments, Ministry of Justice

Table 1 – Road expenditure categories and categories of actors in the Netherlands in 2007

A point of special attention is that there are always several actors that are in involved in an expenditure, thus forming a chain of spending and receiving actors. For example: a consumer who buys a car pays a price for the car's safety devices. The car dealer has paid a price for the same devices to the car manufacturer, and the car manufacturer buys them from, for instance, the airbag manufacturer. Another example: a local government invests in roundabouts and hires a contractor to implement this measure. The local government receives a subsidy for the roundabouts from the regional government, which, in its turn, is finally financed by the national government. These examples illustrate that the same expenditure on a road safety measure is made several times by different actors.

Totaling all these transactions would obviously lead to double counting the expenditure on a certain measure, resulting in a (huge) overestimation of the total expenditure. To get an idea of the total road safety expenditure, the expenditure of only one of these actors should be counted. We recommend to focus on the ´final link´ in the chain of actors: the actor that is responsible for implementing the measure and that pays the total price of the measure (the consumer in the first example and the local government in the second example).

4. METHODS AND DATA SOURCES

As opposed to studies that focus on a specific type of expenditure, it is necessary to use different data sources to obtain a full picture of road safety expenditure. For example, questionnaires are generally used to estimate the expenditure of companies on environmental protection (see e.g. [13]) or on prevention of crime (see e.g. [2], [3]). As explained above, road safety expenditure consists of a broad range of expenditures which implies that various types of data sources need to be used. The following methods and types of data sources are commonly used in expenditure studies, and may also be used to estimate road expenditure:

1. financial accounts, like annual accounts and annual reports;
2. budgets that are incorporated in for example medium or long term government policy plans;
3. questionnaires, for example asking consumers how much they spend on particular products or asking respondents how they spend their time (e.g. spending time of the police on enforcement);
4. statistics, for example regarding annual number of driving tests, number of traffic offences, etc.;
5. (official) documents in which (fixed) prices are stated, for example wages as documented in collective labour agreements;
6. prices given by suppliers of products, e.g. car prices;
7. expert judgements of expenditures, prices and or quantities.

Other studies into expenditures, prices and or quantities that make use of the above methods / data sources may of course also be used. Note that a distinction can be made between methods / data sources that are used to estimate the expenditure directly (data source 1, 2, 3 and 7), and methods / data sources that are used to estimate prices (5, 6 and 7) or quantities (3, 4 and 7).

A point of special interest here is that the reliability is different for each type of data source. Moreover, the reliability of data sources is different between countries, and it may be difficult to judge the reliability objectively. However, an indication of the order of reliability can be given. Generally, financial accounts are considered to be most reliable, followed by budgets. Next in the order of reliability are statistics and official price documents. Results of questionnaires are generally considered to be less reliable, because they are based on what people say instead of on actual spending. Of course it also depends on the (scientific) quality of the questionnaire. Prices as offered by suppliers are probably somewhat less reliable. Expert judgements are considered to be the least reliable source. It is recommended to only use expert judgement if no other data sources are available. When studying (road safety) expenditure, it is also recommended to specify the (type of) data source, to be able to judge the reliability of the estimate(s).

5. ROAD SAFETY EXPENDITURE IN THE NETHERLANDS

In the Netherlands, a study was carried out into the road expenditure in 2007, applying the method described above. The study investigated how much money was spent on road safety, by which actors, and which means or methods of prevention the money was spent on. This section discusses the main results of this study for as well as the methods and data sources used for each expenditure category. For more details we refer to the underlying study [12].

5.1. Infrastructure

Expenditure on infrastructure involves construction of new roads, adaptations and maintenance of existing roads, and traffic control measures. To estimate the road safety component of expenditure on new main roads, road safety (sub)measures (as explained above) were identified. For each measure an estimate was made of the percentage of road length on which the measure was implemented, based on statistics and expert judgements. The road safety expenditure on new roads was then calculated by multiplying the appropriate road length by unit implementation costs that were taken from other studies. A similar approach was used to estimate the maintenance costs of road safety measures on existing roads. The expenditure on improving road safety on existing main roads was based on budgets that the Ministry of Transport has available for road safety programs. This resulted in an estimate of a total road expenditure on main roads of 225 million Euro (60 million Euro on new roads, 70 million on road safety maintenance of existing roads, and 100 million on road safety improvement of existing roads), which is about 10% of the total expenditure of the Ministry of Transport on infrastructure. About half of this amount relates to specific road safety measures. The other half of the expenditure also involves other purposes, in particular improving accessibility.
An indication of the road safety expenditure on secondary roads was based on an earlier study into the expenditure of regional and local authorities in the period 1998-2002. It was estimated at 250 million Euro (price level 2007), which is about 5% of the infrastructure expenditure of these authorities.

5.2. Public information and education

The most relevant expenditures in the Netherlands in this category are:
- national campaigns;
- public information and education on the regional level;
- road safety lessons in primary schools;
- the Educational Measure Alcohol and Driving (EMA, a compulsory course for alcohol offenders);
- road safety courses, e.g. courses for the elderly;
- driver training.

Various data sources were used to estimate the expenditure on these items. The expenditure of the Dutch Ministry of Transport and regional authorities was based on financial reports and budgets. The other expenditures were mainly based on information about prices (prices of driver training for each type of driver licence, wages of school teachers, course prices, etc.) and corresponding 'quantities' (number of driving licences issued, hours of road safety lessons in schools, number of course participants). The data was taken from various sources, particularly national statistics and results of other studies. Driver training turned out to account for the largest expenditure by far: about 250 million Euro. However, as explained above, this expenditure cannot be fully attributed to road safety. The other items accounted for about 70 million Euro, 30 million of which was for primary school education. Regional authorities spent about 20 million Euro on public

information and education, and 7 million Euro was spent on national information campaigns.

5.3. Enforcement

Firstly, the enforcement expenditure concerns the expenditure on police enforcement activities. The expenditure on regular police enforcement was based on the total police budget and an estimate of the percentage of time spent on traffic enforcement. However, accurate and recent data about police time allocation is not available in the Netherlands. Therefore, older studies into police time allocation and expert judgments were used instead, resulting in a percentage of enforcement time of about 5 to 10%. This resulted in an estimated expenditure on regular police enforcement of about 350 million Euro. In addition, the budgets available for special traffic enforcement teams were used (66 million Euro).
Secondly, administrative and judicial costs due to enforcement were taken into account. For an estimate of these expenditures, we used financial accounts of the authorities in charge of the administration. In addition, the share of traffic offences in the judicial cost of all types of offences (that have been studied in the Netherlands [3]), was calculated on the basis of the share of traffic offences in all offences. Public Prosecution Service data was used for this purpose. The administrative and judicial costs were estimated at about 200 million Euro.
Thirdly, the costs of vehicle registration were estimated using statistics and financial accounts of the authority that issues vehicle registration numbers. This expenditure was estimated at about 90 million Euro. As explained above, however, this expenditure is not fully attributable to road safety.

5.4. Vehicle safety

Separate estimates have been made for the road safety expenditure on vehicle safety for cars, lorries, light goods vehicles, powered two-wheelers and bicycles. Firstly, the total expenditure on new vehicles was calculated by multiplying the number of new vehicles sold by the average vehicle price. Statistics on vehicle sales and vehicle prices were used for this purpose. Secondly, an estimate of the share of road safety devices in the price of a vehicle was used to calculate the road safety expenditure on vehicles. With the exception of bicycles, it proved to be difficult in the present study to collect reliable data on the proportion of road safety expenditure, for example from the automobile industry. However, earlier studies in the Netherlands used a percentage of 10%, based on expert judgements. We used this percentage in the present study, resulting in a road safety expenditure of about 1.2 billion Euro. The major part of this amount (about 800 million Euro) is related to cars. The road safety expenditures for light goods vehicles and lorries amount to approximately 150 million and 140 million Euro respectively.

5.5. Policy, research and consultancy

This information about this expenditure category has mainly been taken from financial accounts of the Ministry of Transport. The financial accounts were used for information about both the expenditure on policy making and for the expenditure on road safety research that the Ministry commissioned. In addition, financial accounts of research organisations were used to estimate the expenditure on research for other clients. The total expenditure in this category amounts to 13 million Euro, 4 million Euro of which is spent on policy making. Expenditure on regional and local policy making and research and consultancy for regional and local governments has not been included.

5.6. Overview total expenditure

An overview of the total road safety expenditure in the Netherlands in 2007 that is fully or partly attributable to road safety, is presented in Table 2.

Area	Amount attributable to road safety	
	Fully	Partly
Infrastructure		
– National government	110	120
– Regional and local governments	250	p.m.
Public information and education	70	250
Enforcement	600	90
Vehicle safety	1,200	350
Policy, research and advice		
– National government	13	p.m.
– Regional and local governments	p.m.	p.m.
Total	**2,300**	**800**

Table 2 – Road safety expenditure in the Netherlands in 2007 (million Euro; amounts have been rounded off)

In 2007, the expenditure on road safety amounted to 2.3 to 3.1 billion Euro, or 0.4% to 0.5% of the gross domestic product (GDP). The amount of 2.3 billion Euro only includes the expenditure on measures that are specifically targeted at road safety improvement; it is the lower limit of the total expenditure. In addition, as was discussed above, there are measures that have other purposes beside road safety. The expenditure on these measures amounts to a minimum of 0.8 billion Euro. Since it cannot accurately be determined which proportion of this amount can be attributed to road safety, the amount of 3.1 billion is the upper limit of the total expenditure.

A large part of the expenditure on road safety only, concerns vehicle safety (1.2 billion Euro). Furthermore, considerable amounts were spent on enforcement (approx 600 million Euro) and infrastructure (approx 350 million Euro). Expenditure on public information and education (other than the driver training) is relatively limited (approx 70 million Euro), as is the expenditure on research, advice and policy (13 million Euro). The most important expenditure items that cannot be fully attributed to road safety concern vehicle safety (350 million Euro) and the driver training (more than 250 million Euro).

Actor	Amount attributable to road safety	
	Fully	Partly
Government:		
- Ministry of Transport	150	120
- Ministry of Internal Affairs	350	-
- Ministry of Justice	250	-
- Ministry of Education	30	-
- Regional and local authorities	300	p.m.
Total	*1,000*	*120*
Private individuals	900	550
Companies	400	110
Total	**2,300**	**800**

Table 3 – Road safety expenditure in the Netherlands in 2007 by actor (million Euro; amounts have been rounded off)

Table 3 shows which parties are responsible for the expenditure. A distinction has been made between government, private individuals, and companies. The major part of the expenditure (excluding expenditure which is also done for other purposes) is made by governments: approximately 1 billion Euro. The expenditure on enforcement of the Ministries of Internal Affairs and Justice occupy a major place (approx 600 million). The remaining government expenditure is made by regional and local governments (300 million Euro) and the Ministry of Transport (150 million). By far the largest part of this expenditure goes to infrastructure. Private individuals spend 900 million and companies 400 million Euro; the major part of the expenditure is on vehicle safety. The major part of the expenditure for purposes other than road safety is made by private individuals and companies. Furthermore, the Ministry of Transport spends relatively large amounts on infrastructure not directly related to road safety (120 million Euro). Also in proportion to their total expenditure governments spend more on road safety than individual citizens and companies, namely 0.6% of the total government expenditure. The expenditure by private individuals amounts to 0.2% of the total consumer expenditure and the company expenditure amounts to 0.3% of the company investments.

5.7. Comparisons with expenditure on other policy areas

In the Netherlands, comparable expenditure studies only have been performed in the fields of health care and crime. In the health care studies, the expenditure on the prevention of illnesses and injuries (excluding road injuries) is estimated at about 11 billion Euro in 2003 (price level 2003) [4]. From a comparison with the consequences of illnesses and injuries, expressed in DALYs (disability adjusted life years), we can conclude that the expenditure on road safety is relatively high compared to the expenditure on health care (prevention). DALYs is a combined measure for the number of life years lost and quality of life loss. In the Netherlands, road injuries have a share of about 1.5% in the total amount of DALYs that result from all illnesses and injuries. In comparison the road expenditure is relatively high.

The expenditure on the prevention of crime in 2007 has been estimated at about 6 billion Euro [3]. Again we can make a comparison with the consequences of crime and road crashes. In the Netherlands, the social costs resulting from crime are about twice as high as the social costs resulting from road crashes (25 vs. 12 billion Euro in 2007) [3, 14]. Since the expenditure on preventing crime is a factor 2.5 higher than the road safety

expenditure, we can conclude that road safety expenditure is not very high compared with crime prevention expenditure.

The expenditures may indicate the priorities set by governments, private individuals and companies. On the other hand, we should be very careful making these types of comparisons, even though they give indications about priorities set by governments, private individuals and companies. The expenditure itself does not say anything about the effectiveness. To judge the expenditure levels, the benefits of the expenditure should also be taken into account. CEA and CBA are appropriate tools to assess both the costs (or expenditure) and benefits.

5.8. An illustration of the use of expenditure figures in CBA

In comparison with the costs resulting from road traffic crashes in the Netherlands (12 billion Euro in 2007) the expenditure on the prevention of road traffic crashes is relatively low. This may indicate that effective (extra) road safety measures can save costs that exceed the costs of the measures themselves. However, for a correct assessment of whether measures return more (in terms of savings on the costs of crashes) than they cost, performing cost-benefit analyses (CBA) is required. As an example, and as an illustration of the results of the study into road safety expenditure, we here present a CBA of Sustainable Safety measures that were implemented in the period 1998-2007 [15].

During the period 1998-2007, many measures were implemented that emanated from or were in line with the Sustainable Safety vision. In the CBA (only) the costs and benefits of the measures that contributed to a risk reduction in the period 1998-2007 were assessed. These measures included investments in a sustainably safe infrastructure (e.g. 30 and 60 km/h zones and roundabouts), intensified enforcement (speed, alcohol and red light among others), public information and public information campaigns, and an increase in the penetration of vehicle safety devices (e.g. airbags and seat belt reminders). Educational measures were left out of the analysis because very little information about their effectiveness (in terms of casualties saved) is available.

The costs of infrastructure, enforcement, and public information and public information campaigns are based on the study into the expenditure on road safety in Netherlands. The costs of vehicle safety measures were calculated separately, because it is not clear which part of the expenditure contributes to a risk reduction. Figures in relation with the vehicle fleet, the increase in the penetration rate of vehicle safety devices, and the costs of single devices were used to estimate this part of the expenditure. Table 4 shows the annual costs of road safety measures that contributed to a reduction of the crash rate.

Measure	Costs per year (million Euro)
Infrastructure	350
Enforcement	100
Public information and public information campaigns	10
Vehicle safety	70
Total	**530**

Table 4 – Annual costs of road safety measures that contributed to a reduction of the crash rate

Note that this picture of the costs differs considerably from the total expenditure in which also expenditure necessary to maintain the status quo is included. For example, the

enforcement costs are much lower here. Since in this CBA only the costs of an increase of enforcement that results in a reduction of the crash rate are taken into account, enforcement that is required to maintain a certain level of road safety is not included. Almost all road safety expenditure on infrastructure, on the other hand, is aimed at reducing the crash rate.

In the CBA these costs were weighed against the benefits (expressed in terms of money) of the investments in Sustainable Safety measures. The CBA showed that the benefits are higher than the costs with a factor of almost 4. This result is in accordance with other CBAs of road safety measures that often show that the benefit-cost ratio of investments in road safety is favourable [16, 17].

6. CONCLUSIONS AND RECOMMENDATIONS

Information about expenditure on road safety is useful for several reasons. This expenditure gives an indication of how much effort is spent on improving road safety and how this relates to the extent of road safety as a social problem. In addition, information about expenditure on road safety is needed for cost-effectiveness and cost-benefit analyses and for comparison with the expenditure in other policy areas.

This paper has presented a method to estimate road safety expenditure by defining road safety expenditure, by describing a classification of various road safety expenditures and actors that spend money on road safety, and by discussing methods and sources for data collection. The application of this method in the Netherlands shows that it is possible to estimate the full road safety expenditure, consisting of government expenditure on several means and methods of prevention of road crashes and casualties, as well as the expenditure made by private individuals and companies. The road safety expenditure is estimated at 2.3 to 3.1 billion Euro in 2007. A large part of the expenditure on road safety concerns vehicle safety (1.2 to 1.5 billion Euro). Furthermore, considerable amounts were spent on enforcement (approx 600-700 million Euro) and infrastructure (approx 350-450 million Euro). The major part of the expenditure (excluding expenditure which is also for other purposes) is made by governments: approximately 1 billion Euro. Private individuals spend 0.9-1.4 billion and companies 400-500 million Euro. For both parties the major part of the expenditure is on vehicle safety.

This study has also revealed some difficulties in estimating road safety expenditure, particularly concerning the availability of accurate data. Some of the higher expenditures, especially those for vehicle safety, infrastructure under authority of regional and local governments, and regular enforcement by the police, have (partly) been based on expert assessments or on older studies. Therefore, these expenditures have been determined less accurately and further investigation of these expenditures is recommended. Another difficulty concerns the fact that some expenditures are aimed at several different policy targets (for example road safety and mobility), so they can not be fully attributed to road safety. In many cases it is not possible to isolate the road safety component of such expenditure. However, these expenditures can be listed separately in an overview of road safety expenditure, resulting in a minimum and a maximum estimate of road safety expenditure. The study in the Netherlands shows that the expenditure that is fully attributable road safety is small (0.8 billion Euro in 2007) in proportion to the specific road safety expenditure (2.3 billion Euro).

We recommend to develop an internationally accepted 'standard' to estimate road safety expenditures, and to study the road safety expenditure in various countries according to

this method. This will enable making comparisons or road safety expenditure between countries. It may also help to explain differences in road safety performance between countries. In addition, we recommend to study the development of road expenditure in a country in the course of time. This indicates changes in road safety efforts and may also help to explain road safety developments in a country.

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