A road safety information system: from concept to implementation

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Contribution to the Road Safety Training Course of the World Bank,
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Summary

It is a proven fact that road safety problems are not unsolvable: what is man-made can also be unmade by man. This leads to questions such as which priorities to set, which measures to take, which effects to expect, what costs are involved, and how these can be financed. In order to be able to answer all these questions, data, knowledge, and information are needed to give a comprehensive and objective picture of the road safety problems and of the effectiveness and efficiency of potential road safety measures. A road safety information system comprises all the relevant data.

A road safety information system can be visualized by a pyramid construction with four layers. At the basic, bottom level the 'delivery' of policy (programmes, action plans, etc.) can be found. The delivery of policy should lead to certain changes in road traffic. These changes are described in terms of safety performance indicators, the next level. The purpose of this level is to be able to interpret better the road safety developments and to understand better the impact of policy interventions. The next level contains features of accident and victims, based on the police registration of accidents. The top level of the pyramid contains data that expresses (in which ever way) the costs of accidents to society. Between all four levels, causal linkages should be established.

An example of a road safety information system is the one developed in the Netherlands. This system aims to support rational decision-making by providing user-friendly access to current, relevant and qualified information which can be easily processed in e.g. documents and spreadsheets. The Dutch information system consists of two components: a PC application (to be transformed into an Internet-application) and an information / help-desk facility.

A road safety information system can play a crucial role in designing, implementing and monitoring an effective and efficient road safety policy and creating a sound basis for co-operation between all key actors in the field of road safety.

Contents

1. Introduction

Two indicators are regularly used as a yardstick to compare road safety in one country with another and to assess road safety developments over time: *traffic safety* and *personal safety* (Trinca et al., 1988).
Traffic safety, sometimes indicated in terms of fatality rate or casualty rate, is a measure of how safely the road transport function is performed. It is commonly measured in terms of deaths or casualties per 10,000 registered motor vehicles or per 100 million vehicle kilometres travelled.
The other indicator, personal safety, indicates the degree to which traffic accidents affect the safety of the population. It could be considered as a public health indicator: the number of traffic fatalities per 100,000 inhabitants (mortality).

On a long-term basis, the growth of motorization in many countries is accompanied by an exponentially decreasing curve for fatality rates (improving traffic safety): a reduction in annual road fatalities per kilometre driven with a constant percentage (log-linear trend), although this percentage differs from one year to the next. The percentage decline per year differs per country. However, in no sense can a correlation between growth of mobility and the reduction of fatality rates be the result of natural law or spontaneous development. We might consider this correlation as a collective influence to adapt society to growing traffic. Growing traffic requires, and most often leads to, an enlarged, renewed, improved, and well-maintained road traffic system. This traffic growth and its corresponding adaptation of the road transport system results in better and newer roads, increasing driver experience, newer and safer vehicles and appropriate traffic regulations and enforcement.

It is a misunderstanding to expect a fatality increase just as a result of mobility growth; many countries all over the world illustrate the opposite: a reduction in the number of fatalities when mobility increases. If the relative traffic/motorization growth is higher than the fatality rate reduction, the number of fatalities increases, and the mortality will increase as well. Or, if mobility growth accelerates, for example due to high economic growth, extra attention should be devoted to (road safety) measures in order to decrease the fatality rate, otherwise immediate increase in fatalities will be observed.

The correlation between traffic safety and personal safety can be seen in *Figure 1*. They are expressed as fatalities per number of vehicle kilometres travelled and fatalities per number of inhabitants, respectively. With growing motorization, countries move from the right-hand side of this graph to the left-hand side.

Experience teaches us that road safety problems are not unsolvable, as is for example illustrated in a PIARC-report *Road accidents: worldwide a problem, that can be tackled successfully* (PIARC, 1996). This leads to questions such as which measures to take, which priorities to set, which effects to expect, and more and more: what does that cost and where does the financing coming from? But before this kind of questions are asked, we have to raise awareness of politicians, policy makers, the press, and the general public. For all these questions we need data, information, and knowledge to give a comprehensive and objective picture of the road safety problem and of the related social costs. Furthermore, we require information about the effectiveness and efficiency of potential road safety measures.

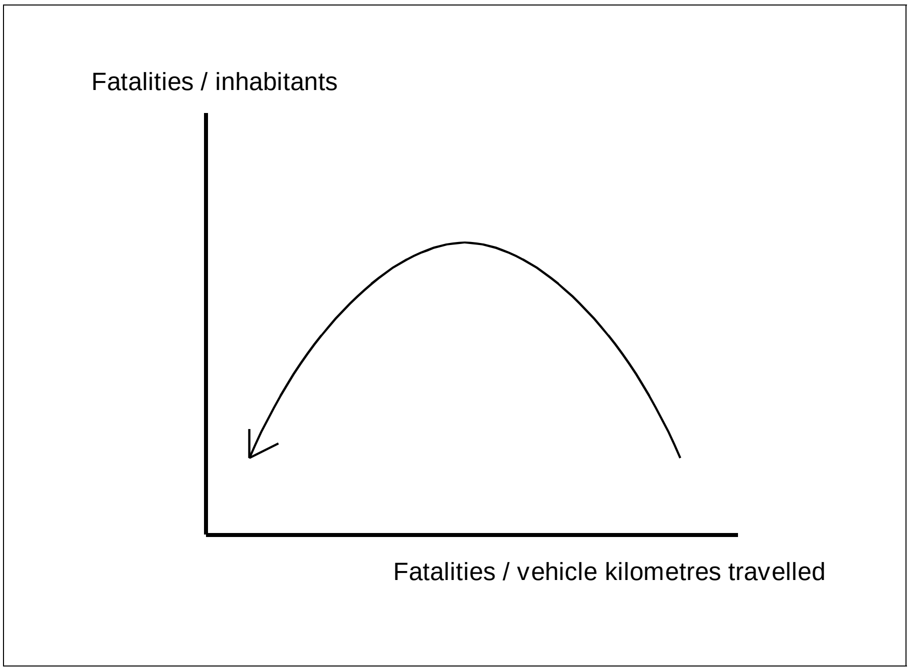

Figure 1. *Conceptual relationship between traffic safety and personal safety by growing motorization (from the right-hand side of this graph to the left-hand side)*.

2. A road safety information system

Various factors contribute to the occurrence of a road accident and its severity. Accidents rarely have one single cause. Human errors nearly always play a part (Rumar, 1985). It is, however, a mistake to think that these human errors can only (or mainly) be avoided if the road user can be better equipped for the traffic task, by giving better instruction or information, or punishing any highway code infringements. There are many other, and often many better possibilities of preventing such human errors. The main point is to analyse why accidents happen, which factors have played a role, and how to prevent accidents as effectively and efficiently possible.

Traffic and transport consist of many related parts that are more-or-less independent of each other (human-road-vehicle-laws). In general, accidents have a number of causes and, last but not least, there is not just one single actor that is responsible for the whole system. The responsibilities are spread over many different, often independent bodies: public (government) and commercial (e.g. car manufacturers, insurers); each with its own goals and interests. In the end, accident prevention is about the behaviour of millions of individual road users, who experience a large measure of personal freedom in traffic. For such an important management question it is important to have a broadly supported philosophy or vision at one's disposal as to what the best way is to reduce the social damage of road accidents; and to convert this into a concrete plan of action. Here, rational decisions should be based on a sound problem analysis, expert knowledge in general, and information concerning the effects of intervention. Which information is necessary to meet these requirements?

2.1. Why do accidents occur and how to prevent them?

In the course of the twentieth century the following road safety paradigms can be distinguished (OECD, 1997). These paradigms are briefly characterised in *Table 1*.

Period	Characteristic
1900-1920	Accidents are bad luck
1920-1950	Accidents are caused by accident prone drivers
1940-1960	Mono-causation of accidents
1950-1980	A combination of accident factors fitting in a ‘system approach’
1980-2000	‘Educating’ poor performing road user
2000	Better implementation of existing policy Sustainable safety/Vision Zero

Table 1. *Development of road safety paradigms*.

Some main developments can be distinguished. First of all, the focus has been widened during the century: attention only used to be paid originally to the driver and his or her vehicle, but later much more attention was paid to the (individual) traffic situation (of an accident). After this came the whole road traffic system. Nowadays attention is being paid to transport in its broadest sense, together with its implications for economic development and the environment. There is even a broader perspective of development possibilities for developing countries being considered (Koster & De Langen, 2000; TRL, 2000). The consequence of this is that even more types of specialists, working for more types of organizations, are involved, or have to be involved, in improving road safety. A second important development is that more and more knowledge and experience is becoming available about accident causes and the effectiveness and efficiency of interventions. This has also taught us that tailor-made interventions (i.e. that fit their own cultural and institutional circumstances) are necessary instead of simply exporting our own (western) successes.

A recent thought development about the origin of risks, and avoiding them, are directed at three sources: first of all are the errors/mistakes/failures by individual road users (just before or during an accident). Such errors are called 'active errors' (Reason, 1990). Secondly, the circumstances in which a road user carries out his or her traffic task ('definition of the workplace') partly determine the chances of errors and mistakes. Errors in the design and organization of the workplace are called 'latent errors or hidden errors': these have been made long before an accident and are triggered by active errors. Finally there are the political, cultural, historical, and economic environments that determine the demands made on the traffic environment (workplace).

The train of thought here is to prevent active and unintended errors by eliminating latent errors. However, in this model it should not be forgotten that it is not only a question of unintended errors and mistakes (active and latent) that are the causes of accidents, but also deliberate errors. These include, for whatever reasons, driving too fast, driving while intoxicated, being aggressive etc.

An accident registration system, and even broader a road safety information system, should reflect a model, as illustrated here, that provides a well-founded framework and insight into accident causes. This means, for example, that in a road safety information system the road and traffic circumstances at the time of the accident should be incorporated. It could also mean that a relatively low relevance should be given to the feature ‘legal guilt’ as is required by police and courts.

In the professional world that occupies itself with road safety improvement, it is important that there is agreement about which paradigms are supported. It is, moreover, important to realise that road safety is only one of the issues in a society needing a solution, and that it has to compete with many other issues. Attracting the necessary attention, and then making sure that road safety considerations become anchored in the relevant decision-making, is of great importance. In many countries this is, unfortunately, a rather neglected aspect in road safety policies (Mulder & Wegman, 1999).

2.2. Approach of a road safety information system

Traditionally, the main emphasis of a road information system has been laid on road accident registration. However, based on the range of thought in the previous paragraphs, a philosophy for a safety information system has been developed, which can be visualized as a pyramid construction with different levels (LTSA, 2000; ETSC, 2001). The idea behind this construction is that data at all levels of the pyramid is necessary to describe and understand the process leading to accidents. This knowledge can serve as a basis for a rational accident management. The road safety information system according to this philosophy is visualized in *Figure 2*.

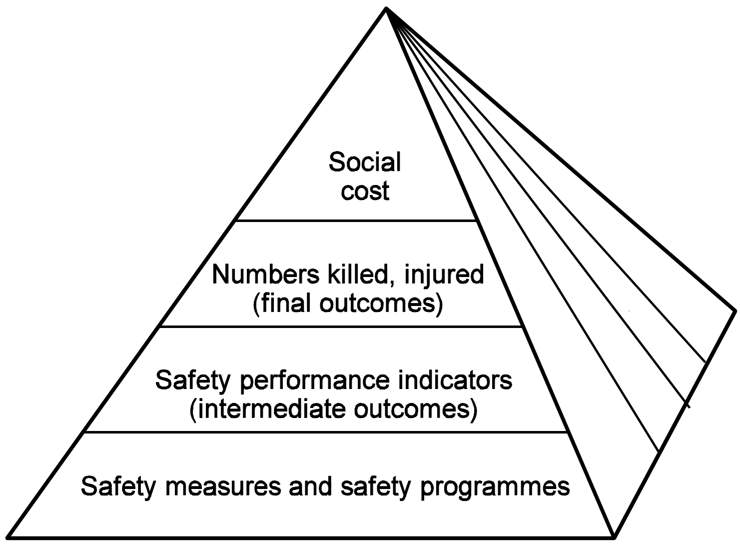

Figure 2. *Essential elements of a safety information system.*

The pyramid has four levels. In the bottom level, interventions can be found (policy, programmes, and measures). These are the production or delivery of policy. Possibilities are: the number of police hours spent on random breath testing (in a particular area, during a particular period), or the number of black spots that has been improved, etc.

The delivery of policy should lead to certain changes in road traffic (the next level). For example: a lower percentage of road users who drive while intoxicated, a shorter time interval that medically-qualified personnel need to reach an accident location, etc.. Such parameters are nowadays known as *Safety Performance Indicators*. These are parameters that have a causal relationship with accidents and casualties/victims. They are not used instead of data on accidents and victims, but in addition to them. The purpose is to be able to interpret better the road safety developments and to understand better the impact of policy interventions.

The next level contains the features of accidents and victims; possibly related to exposure quantities in order to calculate road safety risks. These contain the already well-known (national) accident registration data, that, nearly everywhere in the world, is based on the police registration of road accidents. This data is then processed into national accident statistics.

The top level of the pyramid contains data that express (in which ever way) the social cost of accidents. This concerns the damage that society judges to be negative, and therefore to be prevented.

When data at all four levels is available, the process leading to accidents can be described, analysed and understood. This knowledge can then serve as a basis for a rational accident management, in order to lower the social costs.

The third dimension of the pyramid is meant to distinguish the data of each level by various cross-sections. Thus one can compare the various modes of transport (road traffic, train, aeroplane, etc.) with each other, or the various transport modes in road traffic (cars, lorries, bicycles, etc.).

It can be seen that road accident registration, traditionally the main element of a road information system, is not the only level, although a 'crucial' one. Unfortunately, in the literature, there are many examples to be found of descriptive reports, exclusively based on accident data. In these, it is not possible to attach any significant importance, as far as policy or research are concerned. The pyramid presented here constitutes a good framework for determining the data required, and is to be considered as a guideline for collecting additional data.

3. The components of a road safety information system

3.1. Social costs

3.1.1. *Valuing road safety*

Worldwide, increasing attention is being paid in road safety decision-making to the consequences of accidents. On the one hand, this attention originates from the desire to bring into picture objectively all road accident consequences (economic, social, health, welfare, etc.). With these, political and public support for the problem can be gathered. On the other hand, there is an increasing interest in making rational decisions about possible measures to increase safety; this based on considerations of effectiveness and efficiency.

Two categories of consequences can be distinguished. On the one hand, there are the material consequences such as medical costs, economic costs (loss of production and income), material damage, and settlement costs. On the other hand, there is the quality of life; also referred to as immaterial costs. During the last few years, there have been a number of publications about this subject (Alfaro et al., 1994; ETSC, 1997). It would seem that there is agreement about the best way of calculating these costs. There are, however, also relatively large differences between countries. This can be a reflection of the differences in the methods used, in economic circumstances, or in quantifying bases. International studies show that on average 1-2% of the gross national income is attributed to road accidents, although there are countries with a higher estimate (e.g. Italy 3%, New Zealand 4%, and the United States nearly 6%).

3.1.2. *Socio-economic costs of road accidents*

The following valuation methods for the calculation of socio-economic costs are recommended (*Table 2*; Wesemann, 2000):

Costs group	Deceased victims	Surviving victims
Medical costs	Restitution costs	Restitution costs
Loss of production capacity	Human capital: net loss	Human capital: gross loss
Loss in ‘quality of life’	Willingness-to-pay	Willingness-to-pay
Property damage	Restitution costs	Restitution costs
Settlement costs	Restitution costs	Restitution costs

Table 2. *Recommended valuation methods for accident costs.*

To calculate the socio-economic costs of road accidents, two steps are needed. In the first step, the numbers of accidents and victims are estimated. In this step, attention should be paid to the phenomenon of

under-reporting of road accidents (see section 3.2.1). The cost estimates per accident and victim ae estimated in the second step.
The estimates from these two steps are then multiplied by each other. If a quantifying basis has been chosen, in general these cost estimates use national, available statistics. Examples are: economic statistics, and statistics of health, and transport & traffic statistics.
An example of such a calculation is given in *Table 3*, using the most recent data for the Netherlands.

Main cost groups	1993 costs	1997 costs
Medical costs	440	511
Production loss (gross)	4,346	5,397
Material damage costs	3,221	3,580
Settlement costs	1,280	1,410
Sub-total	9,277	10,898
Congestion costs	155	220
Immaterial damage	5,242	5,670
Total	14,674	16,788

Table 3. *Total material and immaterial road safety costs in the Netherlands in millions of Dutch guilders; 1 guilder = 0.454 Euro (Wesemann, 2000).*

Such cost estimates can also be used for comparisons between different types of transport. This has been done for the countries of the European Union in an ETSC-report entitled *Transport accident costs and the value of safety* (ETSC, 1997).

Mode	Total socio-economic costs per fatility (in million ECU]	Estimated number of fatalities in 1995	Total socio-economic costs (in billion ECU)
Road	3.6	45,000	162.00
Rail	2.1	1,300	2.74
Air	2.7	186	0.50
Water	9.8	180	1.78

Table 4. *Summary of the socio-economic costs in four transport modes*.

Table 4 shows that 97% of all socio-economic costs of transport accidents within the European Union occur in road accidents. The high costs per fatal accident in shipping accidents is due to the large material and environmental costs per accident and the relatively small number of injured victims.

3.2. Final outcomes

3.2.1. *Data collection and analysis*

In nearly every country in the world a system exists in which the police has the task of registering road accidents. This system, also in the whole world, has several shortcomings: 1) the police is not informed of every accident, 2) if so, they do not always go to the scene of the accident, 3) if so, they do not always complete an accident registration form, and 4) if they do, they do not always complete the whole form properly. Police does not always send the form to the national accident registration body. For a good quality of road accidents information it is of great importance that definitions on the registration form are sharply formulated (preferably the most commonly used international ones) and that it is clear to the police when they should complete such a form and when not.

A second important matter is the quality of the information flow between the accident forms completed by the police and the organization that processes them into a database and periodically publishes the most important statistics. This organization is sometimes the police themselves, sometimes not. In many countries, this data is stored in a computer and processed. If this is not so, a great deal of manpower is needed to provide a high quality.

The final step in this flow is the analysis of the data and the interpretation of these analyses. Analysing and interpreting such data in a valid way is an often underestimated expertise. In chapter 2 it was indicated that there should be a paradigm about accident causation. Moreover, background data should be available in order to describe the developments, and especially to explain them. It is also important to distinguish the mutual relationship between the various accident variables. As an example, a study showed that roads with street lighting had a greater risk than roads without. This in spite of the fact that it can be assumed that lighting during hours of darkness simplifies the driving task. Only then did it become apparent that lighting had been installed on relatively dangerous (and busy) roads. The study did not show the well-known risk reduction (c.30%) which is necessary to reduce the risk to the level of the unlit roads.

If the data has been computerised, the question still remains as to how it is published and who, under which conditions, may use the data. There is a certain tradition among organizations responsible for this to be somewhat reserved about this. Moreover, there is some interest to sell this data; which only, in general, slows down its use.

Fortunately, there are all sorts of tools for sale that, in a user-friendly way, can help the accident registration and analysis processes. For example, there is the MAAP-system for individual countries, developed by TRL (www.trlsoftware.co.uk/productMAAP.htm). The UNESCAP-financed system ARDAP (Niemann, 2000) and the system IRTAD (www.bast.de) should also be mentioned here.

3.2.2. *Road deaths and injured*

Road accidents involving deaths and injured are the severest accidents. It is therefore recommended that these serious accidents be registered as completely and as well as is possible. On the one hand, this can be achieved by giving strict instructions to the police. On the other hand, it is possible to link the accidents with other statistics: the cause of death statistics, and health statistics such as those of hospitals and their First Aid (Accident & Emergency department). The World Health Organisation has an enormous amount of data, and much of this is obtainable in their Annual World Health Report, as well as on-line (www.who.int).

In general, for national policy it is sufficient to have a high-quality registration of serious accidents. Such data is generally insufficient for individual road authorities (black spot analyses) or the police (specific surveillance) to base their policy on. This is because there are (statistically) too few serious accidents. This gives rise to a crucial balance of interests.

3.2.3. *Accident risks*

It is striking that in many countries which spend relatively large budgets on accident registration, relatively little attention is paid to exposure data. Exposure data measures how much one is exposed to those circumstances that can lead to an accident. One would like to know how often such exposure actually leads to an accident. In practice, exposure is usually estimated as the number of kilometres travelled in road traffic under various circumstances (i.e. with different transport modes, on various road types, etc.). If this is not known, then the number of kilometres travelled by motor vehicles is used as an estimation. Since 1978, the Netherlands has a continuous National Traffic Survey which includes pedestrians.

For policy reasons, there are three reasons for wanting exposure data (ETSC, 1999). Such data allows:
- to compare the risks of different means of transport, age-groups, and traffic situations;
- to detect the road traffic circumstances with high risks to develop policy;
- to monitor time-series and to determine the effects of measures (with the wish to assess whether or not the numbers of victims have declined because of less exposure or because of a smaller risk).

An example of this type of information is given in *Table 5* from the ETSC report mentioned.

Travel mode	Fatalities per 10^8 person km	Fatalities per 10^8 person hours
Bus, Coach	0.08	2
Car	0.8	30
Foot	7.5	30
Cycle	6.3	90
Motorcycle, Moped	16.0	500
Total on the road	1.1	33
Train	0.04	2
Ferry	0.33	10.5
Plane	0.08	36.5

Table 5. *Fatality risks over distance and time for travel modes in the EU.*

3.2.4. *Location information*

The coding of an accident location is always a special point of interest. This is of the utmost importance to regional and local road authorities.
On the one hand, they want to know where accidents have happened in order to be able to identify so-called black spots, analyse them and, if possible, remove them. A number of methods have been developed for the so-called black spot approach, and they have proved their value.
On the other hand, there are road authorities who are interested in the matter of which combinations of road and traffic circumstances have lead to large numbers of accidents and high risks. It is therefore clearly so that use of a Global Information System should be encouraged. We need to realise that such a system, only for 'curing' road safety problems is not justified. If, however, within the framework of road management activities, a Global Information System is operational, the linking of accidents to such a system should be considered. In all this, one should also realise that such an approach only makes sense if the system is continuously updated.

3.3. **Safety performance indicators**

Safety performance indicators can be defined as any measurement that is causally related to crashes or injuries, used in addition to a count of crashes or injuries in order to indicate safety performance or understand the process that leads to accidents. Safety performance indicators should be amenable to reliable measurement and be easily understandable (ETSC, 2001).

There are several reasons why we need safety performance indicators:
- The reporting of crashes and injuries in official road accident statistics is incomplete and biased towards those involving motor vehicles.
- The number of road accident crashes or injuries is subject to random fluctuations.
- A count of crashes tells us nothing about the process that produces crashes.

Based on an idea of the principal road safety problems (speed, alcohol, high risks of young/novice drivers, high risks of vulnerable road users) and based on the main contributing factors to these problems (poor safety standards of roads, vehicles and trauma management), several countries (e.g. Sweden) developed some comprehensive ideas in this field.

The following safety performance indicators can be considered as the most important ones:
- *Behaviour*: speed, alcohol, seat belts;
- *Vehicles*: active safety, passive safety;.
- *Road*: road network quality, road design quality;
- *Trauma management*: arrival time, quality of medical treatment.

These performance indicators can be used as bench-marks in international comparisons.

3.4. Safety strategies, policies, programmes, and measures

As has already been stated, it is not inevitable that mobility growth is accompanied by a growth in social costs caused by road accidents. In the course of time we have gained a lot of knowledge as to why accidents occur and how they can be prevented. But because not one single country in the world is satisfied with its present road safety level (and rightly so), we are all confronted with the questions of how road safety can be further improved, and how this can be achieved with the minimum effort. The answers to these questions require knowledge of a) the effectiveness of particular interventions, b) who wants to, and can, organize particular interventions, and c) how the available means can be optimally employed.

From the field of economics there are sufficient indications to be able to conclude that the 'free market mechanism' does not provide greater safety. The government, therefore, should see to it that a greater safety level is achieved and has to develop and conduct the safety programmes itself (Wesemann, 2000). Wesemann summarises the arguments as follows:

"[...] safety is a 'merit good', the external costs of accidents have not been completely internalized, the consequences of accidents are sometimes unfairly divided, a road system is a 'public good', has external benefits and has large indivisible production units, and safety is a qualitative aspect in terms of construction, maintenance and management of such a road system by the government" (Wesemann, 2000).

One should not be surprised that governments all over the world are developing plans to make road traffic safer and that the private sector contributes marginally to this approach. Manufacturers of components of the road traffic system comply or try to comply with government norms or rules (road design, vehicle design). This also applies to 'consumers' of the road (individual road users, road haulage companies).

For countries that develop, carry out, and evaluate road safety programmes (i.e. that ‘deliver’ safety policies in the lowest level of the pyramid of *Figure 2*) a lot of knowledge and information is available. A recent OECD overview (OECD, 2000) identifies and assesses ‘best practices’ among road safety programmes in OECD countries. Underlying criteria which influence the success or failure of these ‘best practices’ are identified to facilitate the development of effective road safety policies in OECD member countries and other countries as well. Of course, good examples should always be 'translated' to fit one's own conditions. The OECD-report concludes that an effective safety management system should include the following:

- political commitment, in order to place road safety high on the political agenda;
- co-ordination: communication and co-operation among the organizations involved with road safety;
- leadership: a focal point for development, establishment and implementation of safety goals (including data and information sharing between actors);
- safety planning: short- and long-term road safety goals and plans with funding;
- data sharing and data quality: collection, analysis, linkage, and use of safety data;
- evaluation: periodic and intentional assessment of safety management;

- accountability: evaluation of the effectiveness of the organizational structures;
- marketing, outreach and public education: public information and educational activities;
- equipped staff: identified skills, resources and training to implement road safety programmes and to advise executives who make road safety decisions.

4. An example of a road safety information system

If we start with the idea of a road safety policy being developed and carried out, and we can start with a concept such as that described in chapter 2, it is then to be recommended that all necessary information and knowledge be bundled and then made available in a user-friendly way to all those involved. It is obvious that not only the designers of the policy should be allowed to use the information; they often work in a road safety directorate in a national ministry, or for a road safety board. The information should also be available to those who manage matters at the national, regional, and sometimes even local level; they are responsible for the implementation at their level. Such a road safety information system is currently operational in the Netherlands, and is presented here as an example (Brouwer, 1997).

The Dutch road safety information system aims to support rational decision-making by providing user-friendly access to actual, relevant and qualified information which can be easily processed in e.g. documents and spreadsheets. This system was developed for three reasons:
1. National programme developers experienced that information was not available to them in an efficient way.
2. Regional en local actors were invited to play a more active role in policy implementation and they encountered the problem of being not a 'real' expert, of not knowing exactly where to get the relevant information.
3. The interest in rational decision-making based on proper information was increasing. This was triggered by the fact that since the mid-eighties quantitative (numerical) road safety targets are used in the Netherlands. The road safety developments are therefore being monitored and have lead to more interest in high-quality information.

The Dutch road safety information system is operational since 1993 and offers the following advantages: it integrates information from various sources; it contains recent information relevant to policy; the information is the best there is; the system is easy to use; the users can request every combination of data; and finally, all data is accompanied by 'explanatory' text. The Dutch information system consists of two components: a PC application and an information / help-desk facility.

Starting the PC application of the Dutch road safety information system, the user is only two screens away from the information he wants to see (*Figures 3 and 4*). The first screen offers all subjects, one of which is to be selected. The second screen enables menu driven specification of the requested information (table or text). The output screen contains buttons for further processing the information.

This concept has been accepted by the European Commission as a feasible basis meeting their wish to disseminate road safety data and knowledge for professionals and citizens. It was recommended to develop an Internet application to reach potentially every European citizen and to develop a concise paper version for a selected target group not having access to Internet yet (Brouwer et al., 1999). In a project commissioned by the Global Road Safety Partnership this concept was used for an application in Poland.

It is expected that a first version will become available in the second half of 2001. Special attention will be devoted to the possibilities of a broader application.

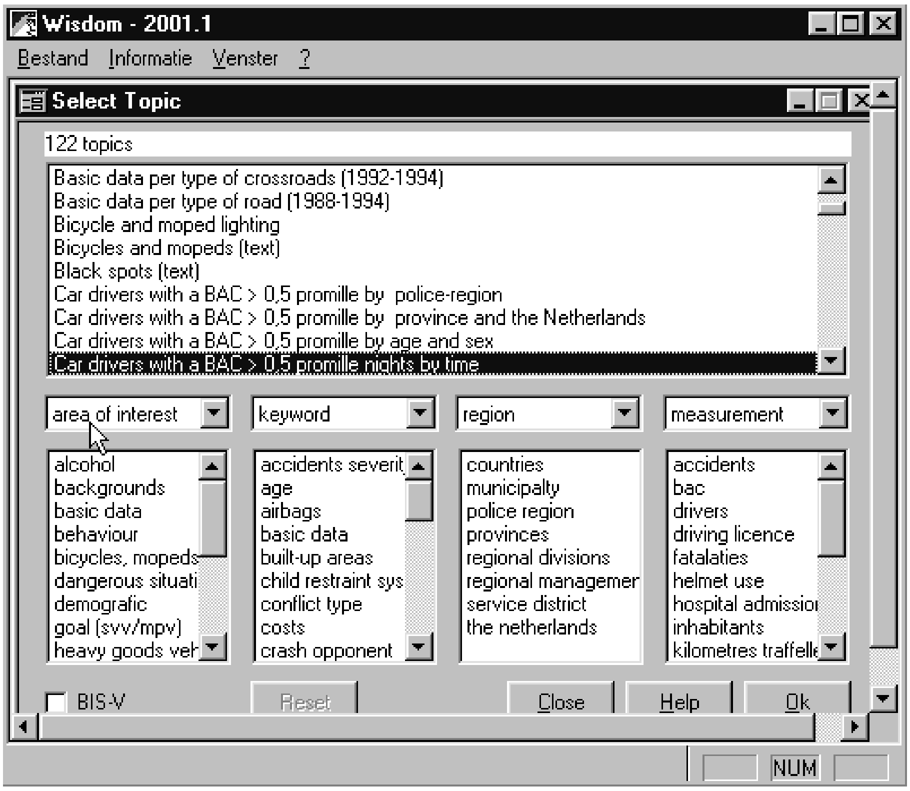

Figure 3. *Indicator selection screen*.

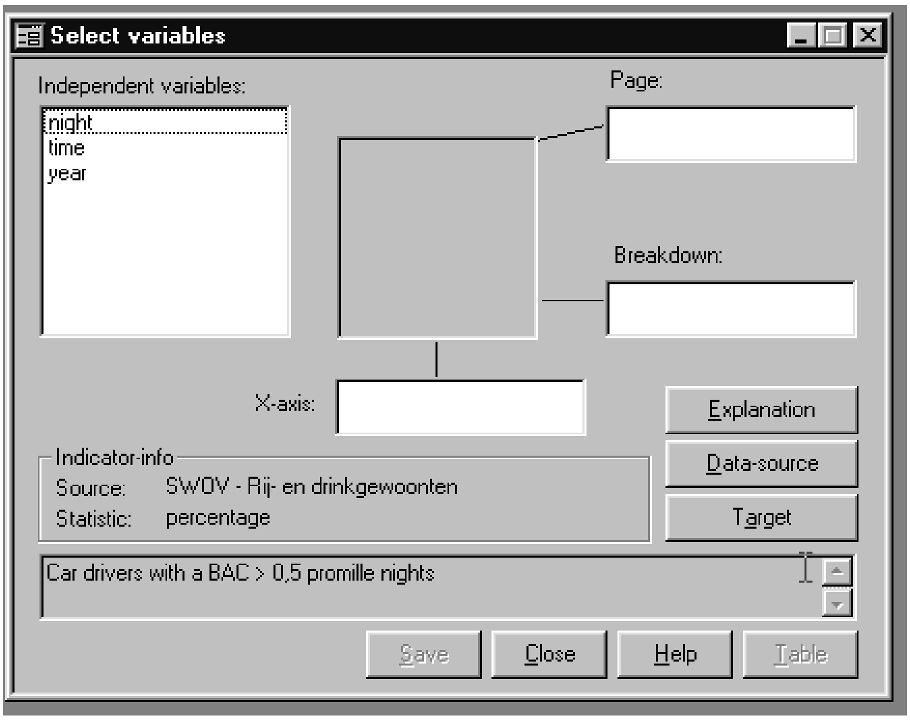

Figure 4. *Indicator manipulation screen*.

5. Conclusions and recommendations

Improving road safety is, intrinsically as well as organizationally, a complex matter. It requires many years of effort in which, hopefully, it is reasonable to expect that these efforts can considerably lower road traffic risks. There are enough proofs of this. Accident studies show which high-risk situations contribute to the occurrence of accidents and their severity. There are many examples to be found in the literature about which measures have proved themselves effective and efficient. It is much more difficult to provide road safety with a higher social and political priority. It is also a stubborn problem as to how well, foreign examples can be transferred to one's own circumstances. This applies between developed countries, and possibly even more so between developing and developed countries.

Obviously, a country should work in such a way that good examples from relatively safe countries are studied and judged as to how they can be implemented so as to be every bit as effective, even though the circumstances are different from those in the country of origin. This requires, on the one hand, an excellent knowledge of the political, cultural, economical, financial and social characteristics of the country which considers to follow certain examples (the demand side). On the other hand, it also requires that the road safety expert has a good insight in why a particular intervention works, in the validity of certain statements, and particularly in the conditions under which such statements apply (the supply side). The communication between supply(er) and demand(er) requires that both sides are completely committed, and are not just taking the easy and quick way out. Both sides could, in the future, employ more intellectual energy in bringing supply and demand together. There are three central issues involved:

1. How to ensure that road safety enjoys a higher political and social priority.
2. How to give road safety policy an organized form, and how to define the special role that the government (in all its manifestations) plays.
3. How to deal with information on:
   - the most important road safety problems and their trends.
   - which policy interventions are the most effective and efficient.

For a country that seriously wishes to improve its road safety, an adequate information system is essential. The organization of this information system is best placed in an intrinsic context. It is recommended that each country chooses a starting point for itself, and defines it. This applies even to countries that have already been very active in the field of road safety for many years.

A second recommendation is to adopt as many existing, international agreements, conventions, and definitions, etc. as possible. It is hard to realistically imagine that there are advantages in following one's own line. What is imaginable is that international organizations such as the United Nations, the World Bank, and the OECD (preferably together) formulate a standard for road safety information. This should then function as a reference for all countries world-wide, together with facilitating processes so that countries can gradually converge to this standard.

Traditionally, the police have played a central role in the registration of road accidents. It is rather obvious that the police will continue to play this central role if we assume that a) it is not easy to imagine another government organization that is so well-equipped to come into contact with all road accidents and b) the police, as part of their legal function are obliged to carry out the inalienable task of determining the guilty party. Within their tasks, the police must have sufficient manpower and budgets.
However, the data processing and making the data readily available to traffic and transport professionals in a user-friendly way, does not necessarily have to be a police task. No one will be surprised to hear that most countries use another organization to process, to a database, the accident forms that the police have completed. The police could, of course, fulfil this function. However, this means that they would have to introduce a customer-friendly organization that is not a difficult to approach 'monopolist'. It is, therefore, recommended that the responsibility for the data processing and making the data available be given to a government body or agency; i.e. nót to privatise it (only parts of the work can be privatised). Such a body or agency must be stable, and have a long-term guarantee. It is not recommended to introduce a financial barrier for using this data; neither should the registering body have to achieve a certain income target in the form of data sales.
It is further recommended to financially facilitate the formation of a national database and the delivery of information free-of-charge to all road safety actors.

If it is decided to follow a model such as the pyramid presented in this paper, then it will be so that other organizations than the police will also supply data. This requires co-operation. The central policy body (for example, the Road Safety Division of the Ministry of Transport) is the appropriate unit to bear responsibility for the co-ordination. This role should be formalised. The co-ordination should lead to the parties involved being reliable suppliers of data. This means that they are joint owners. Moreover, this offers the possibility of agreeing to the linking of the various databases to each other. Such linkages are also essential if we assume that the police accident registration is incomplete. Linkage to other databases (e.g. the hospitals) will show us how great (and select) their under-registration is.
A quality control of such a combined database is necessary. For this, it is recommended that this co-operation be formalised. This way, the various co-operating bodies will have committed themselves to their contribution in this registration process.

Finally, there should be sufficiently educated professionals who are able to carry out the task of producing such a database year-in, year-out. These professionals must also able to a) communicate with potential users about the valid use of the database, b) analyse the data themselves, and c) publish the data in an annual report. All these tasks require qualified (and motivated) people. To increase everybody's motivation, and thus increase the quality of the data and encourage its use, it is recommended that a system of feedback be organized between the suppliers, the processors, and the users (a 'users group').

If we assume that such a road safety information system is the responsibility of the government, and should therefore be in their hands, or in those of an agency (i.e. nót privatised), the problem of financing it is not very complicated. The government will finance it via the usual channels.

References

Alfaro, J.-L., Chapuis, M & Fabre, F. (1994). *Socio-economic cost of road accidents; Final report of action COST 313*. Commission of the European Communities, Directorate-General XIII, Brussels/Luxembourg.

Brouwer, M. (1997). *Road Safety Information System (RIS): key information supporting traffic safety policy in the Netherlands*. D-97-14. Contribution to the conference 'Traffic safety on two continents', Lisbon, Portugal, September 22-24, 1997.

Brouwer, M., Poppe, F., Blokpoel, T. & Kars, V. (1999). *CRASH - Community Road Accident System Homepage; Feasibility study on a European Road Safety Information System*. R-99-22. SWOV Institute for Road Safety Research, Leidschendam.

ETSC (1997). *Transport accident costs and the value of safety*. European Transport Safety Council, Brussels.

ETSC (1999). *Exposure data for travel risk assessment: current practice ab future needs in the EU.* European Transport Safety Council, Brussels.

ETSC (2001). *Transport safety performance indicators*. European Transport Safety Council, Brussels.

Koster, J.H. & de Langen, M. (editors) (2000). *Low-cost mobility in African cities*. Proceedings of the Expert Group Meeting, Delft, The Netherlands, 21-23 June 2000. IHE, Delft.

LTSA (2000). *Road safety strategy 2010*. National Road Safety Committee, Land Transport Safety Authority, Wellington.

Mulder, J. & Wegman, F.C.M. (1999). *A trail to a safer country. Conceptual approaches to road safety policy*. R-99-38E. SWOV Institute for Road Safety Research, Leidschendam.

Niemann, D. (2000). *APRAD Asia-Pacific Road Accident Database of UN ESCAP*. Contribution to the International Seminar on Road Traffic and Accident Data Needs for the New Century, Vienna, 25-26 September 2000. Kuratorium für Verkehrssicherheit, Vienna.

OECD (1997). *Road safety principles and models*. Organisation for Economic Co-operation and Development, Paris.

OECD (2000). *Safety management and implementation strategies*. Organisation for Economic Co-operation and Development, Paris

PIARC (1996). *Road accidents: worldwide a problem that can be tackled successfully!* Permanent International Association of Road Congresses PIARC, Paris.

Reason, J. (1990). *Human error*. Cambridge University Press, Cambridge.

Rumar, K. (1985) *The role of perceptual and cognitive filters in observed behaviour*. In: Evans, L. & Schwing, R.C. (1985). Human behavior and traffic safety; p. 151-165. Plenum Press, New York.

Trinca, G.W. et al. (1988). *Reducing traffic injury - a global challenge*. Royal Australasian College of Surgeons, Melbourne.

TRL (2000). *Review of road safety in urban areas. A contribution to the World Bank review of urban transport policy*. Projectreport PR/INT/200/00. TRL, Crowthorne.

Wesemann, P. (2000). *Economic evaluation of road safety measures*. D-2000-16E. SWOV Institute for Road Safety Research, Leidschendam.