STATISTICAL ASSESSMENT AND TARGETS

Contribution to PIARC XIXth World Road Congress, Ad hoc Group IV: Road Safety, Marrakesh, Marocco, 22-28 September 1991

R-91-58

F.C.M. Wegman

Leidschendam, 1991

SWOV Institute for Road Safety Research, The Netherlands

1. SETTING ACCEPTABLE, REALISTIC AND QUANTITATIVE TARGETS

1.1. Appealing targets: putting road safety on the political agenda

Accidents can happen on the road anywhere and at any time, leading to accident casualties. It is not feasible to reach an absolute level of safety: survival implies the necessity to take risks. Nevertheless, the road toll exacted by the traffic system in all countries of the world is so high that an increase in road safety has become one of the aims of government policies. The relevant question here is which aims should be formulated for such policy, if a zero record of accident casualties cannot be regarded as realistic.

The lack of road safety constitutes only one of the many social problems demanding a solution, so that road safety must compete for attention, must be recognised politically if it is to take a higher position on the political agenda. In addition, the improvement of road safety should not be carried out at all costs (both literally and figuratively). In general, mobility and economic interest must be weighed up against environmental, quality of life and safety considerations. In order to make up the balance, it is essential to formulate the aims as concretely as possible and indicate as factually as possible how, and at what cost, these aims should be realised.

A number of considerations may be put forward - which can also be observed in practice - stating that road safety arguments often do not play an important role in the decision making process. Firstly, there are problems with regard to how to measure road hazard: the commonly used yardstick (accident statistics) is not complete, is insufficiently reliable and varies in time. Furthermore, the anticipated effects of safety measures are often disputed and uncertain. In retrospect, the effects of measures prove to be difficult or impossible to ascertain.

As it was noted that, even when sufficient motivation is present or the necessity of improving road safety is acknowledged practice, road safety arguments are not, or are insufficiently included in the everyday decision making process, a number of countries decided to formulate quantitative tasks (e.g. in Denmark, Finland, France, Japan, the Netherlands and the

United Kingdom). The underlying intention was to ensure that road safety would be assigned a more prominent place in the decision making process over a period of years. By declaring its commitment to this task, Government imposed an obligation on itself.

This means, first of all, that plans must be developed in order to realise the tasks set (road safety in a limited sense). In addition, plans that in themselves are not oriented towards a safety goal but which are expected to affect the level of safety, must be assessed on the basis of the task set and adjusted if necessary.

This also means that for the duration of a formulated task interim assessment through monitoring should be conducted to determine whether actual developments give rise to sufficient confidence that the set task will be realised. If not, an adapted and/or new policy must be formulated and carried out on the basis of further analysis. This approach does assume, however, that disappointing developments do not lead to less stringent tasks being set.

A responsible Minister or Government is unable to reach the desired goal entirely unaided; a Government does not pull the strings of all road users, nor of the many social groups, road authorities, or industry. A task can be used as a catalyst, to convince all concerned that this is the way to tackle road safety. In other words, a task can be used to gain public support for policy or else to increase it. Setting a task can put road safety on the political agenda and keep it there.

1.2. Realistic and quantitative targets

It is impossible to measure road safety in the same way one can measure degrees Celsius or Fahrenheit with a thermometer. The phenomenon to be measured is so complex that various indicators are required to describe it, something which is also seen in other areas of policy and science, such as economy, psychology and sociology.

In this connection, indicator values can be considered as a means of making the concept of road safety operational. Comparisons between indicator values and analyses of indicator values in time make it

possible to form an impression of the scope, severity and direction of development of road safety. This picture can be sketched in general or relate to a particular area. The latter allows one to localise geographical areas, roads, road categories, locations, groups of traffic participants, traffic conditions etc. where danger on the road is relatively high.

Indicators must meet the following requirements:
- an indicator must agree with the notion people have of road safety or relate to the aims of the policy;
- an indicator should allow (politically determined) priorities to be taken into account;
- an indicator must be represented by measurable quantities;
- an indicator must allow meaningful comparisons; the parts of an indicator must be (made) compatible.

The selection of an indicator is based on accidents, in particular the consequence of accidents. As a rule, we are considering the direct consequence of accidents: injury, lasting effects, economic damage etc. Police registration of traffic accidents represents the basis for this form of registration in all countries.

At the most aggregated level (for example, a country or state within a country), two indicators should be considered: the mortality rate (number of road deaths per 100,000 inhabitants) and the morbidity rate (number of road injuries per 100,000 inhabitants) and the probability of road accident casualties (number of dead or injured per kilometre travelled).

Mortality or morbidity is a measure which indicates to what extent a society suffers from dangerous conditions on the road. Figures indicate that developing countries are relatively safe, while most industrialised countries are unsafe: a difference measurable by a factor of 2 - 10. By using this indicator, it is possible to compare road accidents as a cause of death (mortality) or the burden on public health (morbidity) within a country or specific area against other causes of death, or other burdens on the public health system, respectively.

The number of casualties per kilometre travelled on the road is used to measure the degree of safety of the road transport system. As many countries do not have data available on the number of kilometres travelled in a particular year, the number of cars registered on a nationwide basis is also used to estimate this value. When we compare these same countries again, we can see that per 10,000 vehicles, the chanceof becoming killed in a road accident will be 30 - 50 times less in industrialised countries than in developing countries. In other words: as the number of kilometres travelled increases, the chance of becoming a casualty drops by a factor of 40; however, the mortality rate will rise by factor of 5.

This does not imply, however, that all countries in a particular category are equally safe. When we look at highly industrialised countries, their mortality rates differ by a factor of 2, in a situation where the number of deaths per 10,000 vehicles is about the same.

What tasks do countries set themselves? Let us look at the reported examples. Australia's aim is "to match the best safety record in the world". A number of countries have associated themselves with the task set by the Word Health Organisation "Health for all by the year 2000", Switzerland has proposed the aim "accident-caused death should not be higher than the lowest risk of natural death" and Yugoslavia has joined the "campaign -10%". All of these approaches are not based on something that is in fact feasible, but rather on what should be realised: a task which represents an obligation to society!

In order to formulate realistic tasks, it is important to obtain further insight into the possible influences affecting the development of road safety on a macroscopic scale. The following serves to clarify this. The development in the number of road casualties is the result of the development in mobility (number of kilometres travelled) and the number of casualties per number of kilometres travelled in traffic ('casualty rate'). Mobility develops according to a so-called growth curve, a development which characterises many processes: commencing with a slow growth, followed by a rapid growth and concluding with a gradual growth towards a saturation level. The development of the mortality rate is a slowly descending one. As mass motorisation increases, society learns to increase safety on the roads. Of course, this is not an automatic development, but

the result of many efforts to improve road safety: improved roads, improved vehicles, better equipped road users.

The development described here is one which must be seen over a long period of time. When we consider the actual development in time, we can define a wave movement around the long term trend. In other words, if the mobility growth is greater than anticipated on the basis of the long term development, then the drop in the casualty rate will be greater than estimated on the basis of the long term prognosis.

There are two ways of (quantitative) goal-setting that are often applied. The first expresses the goal in terms of the number of casualties, mostly in terms of fatalities. This has been done in Japan, the Netherlands (-25% in 2000), France (under 10,000 in 5 years), Finland (in the beginning of the seventies, a reduction of 50%, recently a reduction of 15% in 5 years), Denmark (recently a reduction of 40-45% in 12 years) and the United Kingdom (-33% by 2000).

The second way is to set the goal in the number of casualties per 10,000 vehicles or thousand million vehicle-kilometers; a ratio goal. At the beginning of the seventies in Canada, the goal was set to diminish the probability of a fatality per 100.000 inhabitants by 15% in 5 years. This goal may mean, however, an increase in the number of casualties, if mobility rises very much (e.g. by more than 15% in a proportional relationship). A ratio goal-setting exerts less appeal than an absolute one, but the ratio-goal setting is more realistic on the basis of extrapolation.

In defining policy (at a political level), only one choice is really possible. If policy intends to reduce the toll resulting from a lack of road safety, then the absolute number of road accidents and casualties must drop, i.e. the mortality/morbidity rate. Only then can one be sure that successful developments are linked to a drop in accidents. This certainty is not offered by meeting relative tasks.

There is no reason to assume that for future developments of the fatality rate, the description of the past cannot be used. An estimation can then be made of the number of fatalities in the future (in the case of unchanged efforts in this field) on the basis of estimations of the develop-

ment in mobility. This would be a realistic basis on which to reach a (political) goal setting. Again, to prevent misunderstanding, these fatality rates are not going down automatically. The drop is the result of effective road safety measures.

The concrete formulation of a goal is important in the long run. If the goal is set too low, it will be achieved without real exertions and if it is set too high, it will annihilate the attractiveness of this way of decision-making. Knowledge is needed to formulate acceptable and realistic goals. It is recommended to set absolute targets based on knowledge about ratio goal-setting.

1.3. Specification of targets

Although it is important to formulate quantitative aims - acceptable and realistic - this alone is not sufficient. These aims must be further specified in order to develop specific road safety programmes. Essentially, two approaches can be selected: to select the major problems or to reduce road hazard maximally per monetary unit invested. For the first option, a preselection is made as it were, in which political priorities can be placed, e.g. offering high priority to vulnerable road users. In the second approach, every traffic casualty counts as one. In 2.3 the procedure followed in the Netherlands and Denmark has been further explained to serve as example.

Many other national reports do cite priorities, without explicitly indicating how these have been set. In addition, the results seem to agree to a large extent: vulnerable road user; young and old road users; driving under the influence of alcohol; reduction of speed, particularly inside built up areas; improving black spots and police enforcement to ensure the traffic code is upheld.

Road authorities also have many means at their disposal to select locations, stretches of road and types of road where a relatively large number of accidents occur. Many countries have a method available to select black spots and then take measures at that particular location in order to eliminate them. Austria has reported such an approach, where locations were selected on the basis of the absolute number of accidents, while Japan

also describes a procedure based on the number of accidents in relation to traffic density. Poland (Gdansk) has described such a procedure as well.

One disadvantage of this location-oriented approach is that causes for the large number of accidents or the high probability of accidents occurring are sought at the location itself, while measures taken are often limited to traffic engineering countermeasures at that location. The likelihood that problems are then displaced, rather that solved, is not imaginary, sometimes without people realising this fact. These problems will occur less if the approach is directed toward routes, networks or areas. These approaches have also been reasonably well documented, as is shown for example by contributions from the United Kingdom and Japan. The Dutch contribution presents indicators for road categories designated for different traffic intensities. This approach make it possible to establish whether a road - when compared with the average for a particular category and for a particular intensity - is relatively dangerous or not. These indicators can also be used to investigate the safety consequences for mobility policy aimed at altering the route choice. Area oriented approaches offer the only productive approach within the built-up area, in particular for residential areas.

The indicators presented to date all use accident statistics. However, it is not necessary to restrict oneself to this approach; in fact, one should not do so if the policy aims have been formulated in terms of so-called process aims. For example, one may formulate an aim to raise the wearing of seat belts to a level of 90%, or to restrict driving under the influence of alcohol amongst motorists on weekend nights to 3%. Of course, such process aims are only valid if their relationship to accidents has been satisfactorily established. However, the advantage of formulating these process aims is that the effect of policy can be determined much sooner than accident statistics would allow.

2. MONITORING OF TRENDS

2.1. Introduction

Road safety policy and related studies are based on, or make use of, accident statistics. These data are collected by the police. However, accident figures alone are not sufficient. As a rule, it is also necessary to have access to background information, e.g. demographic data, details about the road system, information about traffic, meteorological conditions etc. This has been indicated for example in the French report. Accident data can be 'corrected' for with the aid of such background information. The latter is also used to provide a realistic comparison between accident data.

If one uses a quantitative task setting, then it should be possible to make statements about developments in time. With the aid of methods such as the time-series analysis (uni-variate methods e.g Box Jenkins, multi-variate methods e.g. DYNAMALS), one can assess whether there is question of actual changes over time. These models assume that accidents have a stochastic component (Poisson distribution). If it can be established that there is question of a 'significant change', it then becomes possible to investigate whether this change can be explained on the basis of variations in background data: correction for seasonal effect, weather conditions, changes in the road system, the composition of the population etc. If unexplained effects still remain, one attempt to clarify these on the basis of changes in the traffic process. To this end, the first priority is to look for changes in the 'exposure to danger'. Often, intensity data for traffic is used, but it could also be the number of road-crossing movements in combination with the number of passing vehicles. The next phase is to examine specifically what changes in behaviour have been observed in traffic: speed, differences in speed, following distance between cars, reaction times, gap acceptance, use of seat belts, driving under the influence, etc. If one wishes to establish the effects of measures, it will be necessary to investigate and eliminate a series of possible influences which could explain these phenomena, in order to arrive at the correct conclusion. Only when this insight is present can fair explanatory statements be made about the future.

In summary, this means that road safety data must be of adequate quality and of constant quality in time in order to offer a basis for policy, particularly when one is working with a quantitative task.

2.2. Quality of road safety data

It is an accepted fact that not all accidents are reported to the police. As the consequences of accidents become less serious, the quality of police registration diminishes. Sometimes, a country will state explicitly that the police will only record accidents when injury is involved or in the event of more serious accidents involving material damage. We therefore speak of "dark numbers and hidden figures". Switzerland has compared the data from police statistics with data from insurance companies. This shows that an accident not recorded by the police exhibits a relationship with the mode of transport (particularly those accidents involving cyclists are underreported) and the severity (slight injuries are less frequently reported to the police). This leads one to conclude that police registration does not offer a complete picture; in addition, there is question of a distorted picture.

What does this mean when one wishes to conduct a policy in which a quantitative task has been formulated? First of all, that quantitative tasks are formulated only on the basis of data that offers sufficient guarantees that registration takes place at an adequate level. Furthermore, it must be periodically assessed whether, and to what extent, the registration of traffic accidents changes over time in practice. This can be realised by making comparisons with, for example, the registration of accidents by insurance companies, with data from hospitals or by asking road users about their accident history. Only when these criteria have been satisfied can one claim that the drop in accidents is actually a fact, and not simply the consequence of less thorough registration procedures.

The requirements formulated here are equally valid for the background data and the exposure data used.

An important problem in this context is the international harmonisation of road safety data. If one wishes to make relevant international comparisons, harmonisation is crucial. International comparisons are useful and

offer an efficient expenditure of funds, both from the point of view of policy and of research.

The contribution by what was the Federal Republic of Germany reports on one of the most recent attempts in this field. It concerns the IRTAD, the International Road Traffic and Accident Database. This German initiative has meantime been adapted by the OECD and a collaboration with the EC Commission is underway. The BASt is host to this system. The contribution from Germany includes further details about this system. In addition, attempts are in progress now through the OECD to start up a database (somewhat simplified) in developing countries as well.

2.3. Strategy for preventative measures

A number of countries developed methods to determine the most important problems. The approach in the Netherlands is as follows. Taking as starting points the mode of participation in traffic and the age of the casualties and taking into consideration developments in time, the most important problems have been determined on the basis of three criteria: share in the total amount, the risk, (casualties per kilometre driven) and the vulnerability of different kinds of road users (seriousness of the injuries in collisions between two different kinds of traffic partici- pants). The main problem categories are: aged cyclists and pedestrians, young moped riders, young cyclists and pedestrians and young car drivers. In parliament, these have been recognised and established as being the most important problems. The next step was to develop effective programmes. To this approach was added the selection of a number of effective measures in other areas, for example tackling black spots, reducing driving under the influence of alcohol, promoting the use of seat belts and the safety helmets.

The second approach (cost-effectiveness approach) has been used in Denmark, for example. Here the concept of 'profitability' is introduced, defined as:

$$\text{profitability} = \frac{\text{annual casualty avoidance}}{\text{annual societal cost of prevention}}$$

where casualty avoidance = 34 x fatalities avoided + non-fatal injuries avoided (34 is a weighing factor) and

annual societal costs = annual interest of investment + annual operating costs + annual depreciation costs.

The profitability figures give a simple rank ordering of 35 measures of the Danish national road safety programme, as can be seen in the Danish report. All Danish accidents have been evaluated against each of the 35 measures. Probability calculations have been applied to estimate the probability that the accidents will be prevented as a result of one or more of the relevant measures.

An important problem with these approaches is the uncertainty with the potential and actual effects of the intended policy. To give a simple example: the effectiveness of driving education and the driving exam has never been established satisfactorily, nor has the effect of traffic education at school. 'Satisfactory' in this case means the effects in terms of a reduction in accident probability. This does not mean that there is no such effect, but that it is difficult to verify. After all, the opportunity to participate in traffic on any scale without a driving course and then comparing the accident probability with those who have followed a course with those who have not (strictly experimental set up) has never been carried out anywhere in the world. This conclusion should and must not mean that driving education ought to be abolished, but does serve to illustrate what problems are encountered if one uses such an approach. For example, if one improves driving education, a pre-study and post-study comparison (with a control group) would then make statements possible in this regard.

Safety studies have shown that it is easier to establish the effects of a measure, the more such a measure is introduced at a later stage in the so-called accident process. For example, quite a number of measures in the field of injury prevention have been well documented, while quite a few measures in the field of accident prevention such as influencing behaviour through education or through influencing mobility via physical planning policy have been poorly documented.

Another problem in this sense is that technical measures to vehicles and to the infrastructure demand that road users adapt to these changes. For example, on a road where porous asphalt is introduced, vision will improve,

allowing better reaction times during wet weather conditions. But it is also realistic to expect that road users will drive faster and will undo at least part of the potential positive effect in this way.

One other problem is that the effects of measures over time are rarely constant. Change and adaptation take place constantly. This means that one cannot simply be satisfied with establishing "the effect". If this were done, one may run the risk of overestimating the true effect.

Both approaches could supplement each other. It is up to the policy makers to choose accents during the problem-defining phase. Nevertheless, an approach as indicated in Denmark and in the Netherlands would represent a rational and advisable approach, despite the significant problems associated with it. International collaboration will mean that the gathering of evidence about the effect of measures will be carried out more effectively and efficiently, thereby enhancing the opportunity of a rational approach.

2.4. Organisational aspects

A responsible Minister or Government is not able to achieve the set task entirely through their own policy. They are too dependent on others for that. There are various ways to commit those involved to the policy to be pursued.

Every year, when the accident figures become available and are published, it is possible to associate them with policy conclusions on the basis of a more detailed analysis. These conclusions can then assist the Government's account to Parliament. A free press can play an important role in this regard, as can active pressure groups. They can also help to reduce the apathy of the average citizen with regard to danger on the roads. France reports that one of the foundations of French policy aims to heighten or 'sensitise' public awareness. This can also be achieved by showing the public that the Government is serious about safety, by confronting the public emphatically with the problem to be tackled. Legislation, serious enforcement of the law and information campaigns are specific ways to realise this aim.

Another possibility is to keep institutions (at all government levels, social groups) committed to the task. One way is to make it attractive for these institutions to devote attention to the improvement of road safety: for example, by setting premium systems or awarding prizes, subsidies etc. Such opportunities were created in France, Austria and the Netherlands, where local government was stimulated to contribute to road safety and awarded if their efforts were successful.

Another possibility is offered through penalising governments. In the United States, the states run the risk of not receiving federal aid if particular efforts are not invested in the field of road safety. In Japan, the collaboration between governments has been formally laid down by law: the Traffic Safety Program Law. This law also includes financial agreements.

Depending on the governmental organisation and other parts of an administration and depending on the political culture in a country different methods and procedures can be used to implement public awareness and to commit the public and private sector in the struggle to improve road safety.