Methods for designing integrated road safety programmes: some reflections based on the work carried out in Estonia

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Introduction

A large number of countries in the world are now facing a sudden and serious growth in road accidents, related to rapid changes in motorisation volumes and patterns. This is particularly the case in Eastern European countries, where private car ownership has been soaring while it was, until the late 80's, reserved to a happy few. As road safety policies now address a population of drivers representative of a much larger share of society than before, they need to be designed in a radically different way and findings of past research into accident causation and road user behaviour are bound to be obsolete.

In such countries, researchers (and other road safety professionals) trained in parts of the world with a long history of road safety work are often called to help design proposals for integrated road safety programmes, usually at the national level, sometimes at the regional or local ones. In most cases, the proposals are seen as urgent by the decision-makers as the accident situation is worsening fast. Researchers thus act as « experts », which means that they are supposed to apply an accepted methodology to whatever data is readily available and have no time to perform field studies, even less research. To make matters worse, the decision-makers, whether members of the national administration or Parliament of the country or representatives of the sponsors, donors or money-lenders (as for example the World Bank or the European Union programmes), are usually unfamiliar with the nature of the accident phenomenon and with road safety methodologies, and their demands, drafted as « terms of reference », may be totally inadequate in view of the time and technical resources available.

Why should researchers try to respond to such demands ? Clearly, at a time when funding for research is dwindling in many Western European countries, undertaking work as experts may add a few cherries on the cake. But there are more positive reasons for it: it is interesting for validation purposes to reflect on technology transfer and to apply one's methods or findings to a traffic and social situation different of one's own; also, road safety researchers may have more adequate knowledge and more scientific scruples in

performing the requested task than other experts who will anyway submit proposals as soon as terms of reference are issued.

A project carried out in Estonia in 1996-97, within the PHARE programme of the EU, to design a national road safety programme for the short, the medium and the long-term is a good example to illustrate methodological problems and difficulties encountered by researchers and road safety professionals, as well as the experience that can be gained from this kind of work. The project was performed by a joint team from Viatek (Finland) and BCEOM (France), including experts from Inrets (France) and Stratum (Estonia) (Viatek-BCEOM, 1997).

The demand and how it was interpreted

The aim of the project was to produce alternate scenarios for national road safety policies in the short, medium and long terms, and to evaluate them *a priori* on a cost efficiency basis. The working team was requested to propose five different options (i.e. fifteen time-related scenarios) in relation to problems recognized as major « issues ». Unfortunately, different sets of issues were mentionned in the terms of reference, some of them being obvious accident problems, others bearing on different preoccupations such as developping the traffic infrastructure or reorganising the transport administration. It appeared, after discussion with our Estonian partners, that the scenarios were going to be presented to Parliament in order to select a course of action based on a minimum consensus of the society.

To the team of experts, it seemed illogical to base alternate scenarios on heterogenous issues: how could one possibly choose, for example, between a course of action primarily aimed at improving pedestrian safety, and another based on a maximum of engineering measures involving the Estonian Road Administration (ERA) ? If the main criteria of choice were to be the cost benefit performances of each action scenario and the main issues addressed, a lot of care was obviously needed in re-defining relevant issues. It was also assumed that if the choice of policies was ultimately to be made by members of Parliament, those were not road safety specialists and therefore would not have sufficient bases to assess the validity of the methods used to design the proposals and analyse their content in details; as elected representatives, they would also be inclined to judge mainly from a social viewpoint, which meant that issues must reflect clear options for the development of the Estonian society and way of life.

The working team finally agreed to base the options proposed for the final choice on objective problems emerging from accident analysis. All options would have a common core including the organisational and safety measures that were considered essential and inavoidable in view of the present accident situation and safety management system; each option would in addition treat more in-depth one prominent problem. After a first level of safety diagnosis aimed at identifiying the main target-problems, the choice was the following:

1. Emphasis on accident severity and on injuries to vehicle occupants: Accident severity was found very high in Estonia in comparison with other European countries 20 fatalities per 100 injury accidents in 1993-96), and this did not seem particularly related to a deficit of recording of non-fatal accidents; also, vehicle occupants were a most important safety target as they accounted for 40 % of urban road fatalities and over three quarters of the fatalities on rural roads.

2. Emphasis on pedestrian safety: In 1993-95, pedestrians were involved in a third of all road accidents in Estonia and nearly half the urban accidents and accounted for a fifth of the fatalities on rural roads and over 40 % in urban areas. These figures were already shown to have increased in 1996 and the rapid growth of urban traffic promised a worsening of the situation.

3. Emphasis on safety in urban areas: Nearly two-thirds of all accidents in Estonia occurred in urban areas, making 40 % of fatalities; as for pedestrian safety, the fast growth of urban traffic, mostly at the expense of public transport, promised further deterioration of the situation. Little had been done so far to improve safety in urban areas as most town or city authorities had other priorities, and a scenario thus oriented implied a new form of relationships between local authorities and the central administration responsible for road safety.

4. Emphasis on rural accidents on the national road network: Accidents on national roads made 30 % of all fatalities in the country and were mostly concentrated on the three main routes from Tallinn to Tartu, Pärnu and Narva. As there were plans to develop these major infrastructure links to cope with the expected traffic increase, there was an opportunity to seize for accident prevention, as a large reduction of fatalities should be obtained by concentrating resources on a relatively small part of the network.

5. Emphasis on traffic in difficult conditions: Accident risk was found particularly high at night as nearly 40 % of accidents occurred during the dark hours, making nearly half the fatalities. Also a significant proportion of accidents occurred on muddy, icy or snowy roads and there were indications that risk was higher for urban traffic in the winter months. Estonia being a Nordic country, difficult travel conditions are the rule for good part of the year.

The issues addressed in the five options were not independant: for example, the large proportion of pedestrian accidents contributed to the high accident severity; safety policies in urban areas and on the national road network both included some measures to protect pedestrians; reducing accidents in difficult traffic conditions involved action both in urban areas and on rural roads; etc. The global mix of measures to be considered in each of them was, however, widely different. It was also felt that the issues could have a clear meaning for decision-makers and showed the societal choices involved: scenarios with emphasis on vehicle occupants would illustrate a clear priority given to the development of private vehicle traffic, with only minimum attention to traffic participants using public transport, walking or cycling; scenarios with emphasis on pedestrian safety and on urban areas would, on the contrary, indicate a priority to the less favoured road users

(economically speaking) and the quality of everyday life, while initiating a completely new way of managing urban transport systems, on the basis of a joint involvement of national and local authorities; scenarios with emphasis on the primary rural road network would contribute to the general effort of modernizing the country while giving priority to the unheeded development of private vehicle traffic and concentrating the road safety effort in the hands of the national administration.

In order to further facilitate decision-making, it was found useful to describe each of the scenarios thus designed in terms of partnership (types of decision-makers and sponsors involved) and in terms of the main sectors of action that would intervene (management organisation, urban planning, road engineering, law and enforcement, information and education, vehicle technical checks, rescue services, professional training).

Problems with the safety diagnosis

According to the terms of reference, the team of experts was expected to design scenarios for safety action on the bases of whatever data was available in the country at the time of the study and of their own experience in other countries. No funding would be available for field investigations or for complementary data collection. In other words, as little time and effort as possible was to be spent on identifying problems. This proved quite unsatisfactory for experts who worked according to the principles that: (i) in order to be efficient in reducing accidents or injuries, the road safety measures considered as possible parts of an action programme need to address real accident problems, identified through objective methods; and (ii) accidents are the effect of some malfunctions in the road and traffic system, so that a thorough analysis of past accident processes and factors is needed to indicate what such malfunctions could be and the possible way(s) to correct them. Road safety work thus requires a rather complex diagnosis, based on both statistical data and detailed accident descriptions, and additional investigations, particularly of potentially dangerous items of road user behaviour, may be found necessary (Muhlrad, 1989, Ferrandez & Girard, 1995, Lassarre & Muhlrad, 1996).

The Estonian Road Administration managed a comprehensive and reliable enough national accident file, based on accident forms provided by the Police. However, the data collection procedure had not changed since the old times when the Police was responsible for road safety management at the national level and mostly included in their policies enforcement and, to a lesser degree, education. As a consequence, items of data recorded for each accident were defined with emphasis on behavioural « errors » and provided little information on how the collision actually happened. The « errors », often considered as traffic offenses even when they were not defined as violations of official rules, reflected a number of current prejudices, particularly with regards to pedestrians, and could not be used as objective data. As the police stored the detailed accidents reports, samples of them could have been analysed to provide better understanding of how accidents happened, but the funding necessary for this tedious part of the diagnosis could not be obtained from the PHARE programme before the time when scenarios had to be finalised.

On the basis of statistical data and their past knowledge of accident mechanisms, the working team could only make assumptions as to the probable processes and factors generating the main accident problems; it was impossible to check that these assumptions were right in the Estonian context, and, even more, to assess the relative importance of the various factors identified in order to put them in priority order. As a consequence, none of the assumed factors could be eliminated *a priori*, and a large number of road safety measures had to be considered: the diagnosis provided no rational basis to choose between them while still ensuring effectiveness of the action programme. The scenarios designed were thus extensive and (obviously) costly, and some waste of resources could be expected from the fact that: (i) it was impossible to assess the actual capacity of individual measures to reduce accidents or injuries, and (ii) some measures were bound to be redundant as addressing inter-related accident factors. Clearly, more time and resources devoted to a an in-depth diagnosis would have produced more selective scenarios, easier to fund and implement, and to monitor.

As it was, it could be expected that none of the scenarios proposed would be fully implemented because of the limited resources available; most probably, decision-makers would select particular measures in each scenario according to the opportunities for funding and facilities for implementation (including expected acceptability for the public), which would introduce a risk of inconsistencies in the programme. This was, to some extent, taken care of by putting forward a common core of measures deemed essential and included in all scenarios: it was hoped that these measures would be considered as a vital minimum.

Another problem arose in the diagnosis phase. Although the ERA data base could provide accidents statistics for quite a long period, it was decided to analyse data only for the years 1993-95, following the changes that occurred in the Estonian political and economic system: quite clearly the new traffic situation was not comparable to the old one, due to a sharp increase of car ownership and private vehicle travel, and probably as well to a significant change in road users' attitudes with regards to mobility, safety, regulations, etc. Over the period 1992-95, a slow increase of the numbers of accidents and injuries was observed (with seasonal variations) while fatalities remained stable. However, at the beginning of 1997, while the scenarios were being designed, the statistics for 1996 became available and showed such a sharp *decrease* of accidents (- 20 %) and, even more, of fatalities (- 36 %), that the question arose of the validity of data and of the diagnosis. Investigations showed that, although a new accident recording procedure was being planned, no changes had yet taken place and it seemed impossible to relate the unexpected variations of accident figures to any recent flaw in the data collection. Attempts were made at explaining at the sudden safety improvement, taking into consideration particularly: (i) bad winter conditions that probably produced a reduction in traffic, (ii) increased seat-belt wearing which was observed following a safety campaign launched by ERA, (iii) intensified enforcement of speed limits and of the drinking-and-driving law, and (iv) improved quality of vehicles related to a large number of newly bought ones as well as to mandatory technical checks. Together, these factors could barely explain half the reduction in fatalities.

As Estonia is a small country (about 1.5 million inhabitants), numbers of accidents and fatalities are statistically small (1644 injury accidents and 332 fatalities in 1995), so that variations can be partly explained by a random effect. However, this effect was not so potent in the previous years and it can be assumed that other changes may have played a part, most probably behavioural and attitudinal ones. Some pycho-sociological research would be necessary to check this, but none could be undertaken in the course of the study. It remains that researchers or experts are seldom faced with a situation like the Estonian one and the experience of the working team was really inadequate to assess the new trend properly. It could be said that applying knowledge and methodologies to countries where safety research has so far been limited is acceptable as long as the road safety situation varies according to a known model, but as soon as freak variations occur, some analysis of the economic, social and psychological context becomes sorely needed.

The difficulties of assessing road safety trends had serious consequences, particularly when performing an economic evaluation of the various scenarios proposed. One redeeming fact was that, when taking into account the statistics for 1996 in addition to the four-year period already considered, the hierarchy of the main accident problems did not change: the five issues emphasized in the five groups of scenarios did not have to be re-discussed.

In addition to the safety diagnosis, an investigation of the structures and means available for safety management was also performed, aimed at identifying the roles played by different partners (ERA, the Police, the Ministry of Transport, etc.), the working procedures related to particular areas of action (road user information, technical checks of vehicles, police enforcement, driver licensing, etc.), and the problems expected to arise when implementing parts of the future safety policies (for example, urban safety programmes). Again, this was not easy as some changes kept occurring during the study, particularly in the legal environment.

Problems with programme design

Following the diagnosis, alternate scenarios were built in a logical way, using two parallel approaches: identifying *corrective* measures, aimed at preventing further occurrence of types of accidents which had been observed in the past, and *structural* measures, aimed at getting the traffic and the road safety management systems to work more smoothly. In the first case, effectiveness of measures can be directly related to the number of expected accidents or injuries avoided. In the second, the measures do not address any specific accident target, but as they contribute to optimizing the traffic management system, it is expected that, over a period of time, they should both decrease the amount of malfunctions that could generate unsafety and reduce the amount of resources wasted.

The methods used to design the road safety scenarios for Estonia can be summarized as follows:

1. The corrective approach: For each main issue (or safety problem) identified, possible accident factors or processes were listed, and the safety measures that could be efficient to eliminate or neutralize them were examined on the basis of current knowledge. The measures retained were combined in scenarios according to: (i) the particular issue addressed, (ii) the necessary associations of different kinds of measures (for example, new regulations and corresponding information campaigns), (iii) the schedule of implementation of the measure and the time needed for any effects to be observed.

2. The structural approach: Measures were considered, first to adapt the existing decision-making structure in Estonia so that appropriate channels could be found to implement all the components of the proposed road safety programme, and second, to improve the existing procedures for different tasks that were already being carried out but needed optimization (data recording, treatment and dissemination, periodical vehicle checks, enforcement, road user information, etc.). In addition, training requirements were assessed and some road safety training seminars or networks were introduced in the package. As the structural measures did not depend on specific safety issues, most of them were included in the common core for all scenarios, in the short or in the medium term.

The cost of the various measures was estimated and the partners expected to get involved in their implementation identified. The total cost and complete pattern of partnership could then be shown for each scenario.This part of the study went on smoothly, in spite of the fact, as explained earlier, that too many measures had to be included in the scenarios, due to the limited scope of the diagnosis. Also, some structural measures, such as the mandatory periodical checks of vehicles, may not have been urgent or may have been replaced by simpler measures if the Estonian administration had not already organised an activity of this kind: it seemed to be less costly and more acceptable for the decision-makers to improve the existing organisation than to terminate it for the time being. Altogether, the scenarios proposed were far from optimal, but they were at least logically built and addressing real serious issues.

Unfortunately, by the time the work was nearly completed, the decision-makers requested that the scenarios be designed in order to obtain a specific reduction of road fatalities in the year 2000. In other words, the demand for alternate scenarios was replaced by a demand for a targeted safety programme. The working team got very embarrassed as the way the quantitative target was defined was unclear, but what was clear was that none of the scenarios could meet it. It was stated that an approach to designing a targeted safety programme was different from the one followed: first, the target would have to be set rationnally in view of the current accident trends and of the curb of future expected accidents if no preventive action was undertaken; then, measures would have to be chosen according both to the frequency of the accident factors they addressed and to their estimated potential of reducing fatalities, in order to optimize the overall effect (in the process, it is likely that some of the structural measures would have to be eliminated). Obviously, this could not be realistically done with the data available, as can be seen from the comments on the diagnosis. More generally, it seems difficult in the present state of our knowledge to quantify a target for action in countries such as Estonia where traffic patterns

have not yet stabilized and there are no valid models to forecast accident or fatality trends over a number of years.

Problems with the economic assessment of the scenarios

The terms of reference of the Estonian road safety study stated that a cost-benefit assessment of each of the scenarios proposed had to be performed. The cost of measures was roughly estimated, based on international experience (for safety campaigns, for example) as well as on local cost values (for infrastructure measures, organisational changes, training workshops or networks, etc.). Some costs were difficult to establish when mostly based on the use of manpower (as for police enforcement), as the number of man x hours spent on safety activities was not individualized in administrative budgets. However, it is the assessment of benefits that raised the most serious questions:

1. A cost of human life as well as of injuries and material damage from accidents had to be established and accepted by our Estonian partners. A previous estimate had already been performed in the country, based on the « gross output » approach; however, it took into account only economic calculations (loss of production) and objective costs and did not include the costs of grief, pain and suffering which are usually part of the estimate in European countries. In order to get a figure for the cost of human life in Estonia that could be compared to those used elsewhere, the figure available had to be augmented. The final figure put the cost of human life in Estonia in the bottom end of the range of values used in the European Union.

2. There are internationally accepted values of efficiency for the most usual safety measures (or packages of measures), such as speed limits, mandatory seat belt wearing, some infrastructure improvements, etc. In order to apply them to the Estonian situation, some assumptions had to be made as to the actual effects on average speeds of additional enforcement of speed limits, the increase of the rate of seat-belt wearing obtained through additional information campaigns etc. But the main problem was that a reference situation had to be defined (the « do-nothing » scenario) against which expected reductions of accidents or fatalities would be computed. In countries with a steady growth of traffic over a long period of time, some models (for example as developed at SWOV) have been used to try and forecast a trend of accidents; it is impossible to fit such kind of model to a country where only a four or five year time-series of accidents can be used. As no better approach could be found, the economist of the team proposed to compare the Estonian situation to that of Western European countries at a time when traffic was growing very fast and road safety action was only beginning (in the 70s). However, the reverse in trends of accidents and fatalities observed between 1995 and 1996 later showed that there might be elements influencing the traffic safety situation that had not been experienced earlier in Western European countries.

3. In order to estimate the global benefits to be expected from one given scenario, some procedure had to be found to aggregate the individual benefits expected from each measure (or package of associated measures) that was part of it. Some obvious points had

to be considered: (i) the measures aimed at reducing exposure have a basic effect on the targets concerned; (ii) the measures aimed at reducing risk adress targets already reduced by decreased exposure; and (iii) the measures aimed at reducing the severity of the injuries sustained in collisions adress targets reduced by both decreased exposure and decreased risk. A comprehensive model taking care of relationships between road safety measures applied simultaneously had, to our knowledge, not yet been designed. Such a model would, in any case, have relied on a large number of variables whose values would have been difficult to estimate without additional field investigations. It was therefore decided to simply reduce the individual expected efficiency of each measure by a standard percentage (25 %) before aggregating effects.

4. Benefits of safety measures are usually estimated on the basis of first-year-return. When designing road safety programmes in the short, the medium and the long terms, such limitation does not quite make sense. Some safety measures (information campaigns, etc.) do have decreasing effects in time, but others (infrastructure improvements, etc.) have continuing effects that may even increase with traffic growth and that will influence accident or fatality trends in the long term. Expected reductions in fatalities of each scenario therefore had to be computed over at least the period concerned by the safety programme (1997-2010).

Altogether, the economic assessment of each of the scenarios proposed was conducted methodically, but was based on so many assumptions and rough estimates that the cost-efficiency values obtained could only be considered as indicative and had to be used with the utmost care. One should wonder whether the decision-makers requesting such figures actually use them when making final choices and whether the result is worth all the work involved in obtaining them. More effort put into the diagnosis might have proved more fruitful....

Conclusions

Working on a study such as the Estonian Road Safety Programme was an interesting experience, as it showed work areas for which sound methodological tools are still lacking and it demonstrated the limitations of past road safety experience acquired in countries of the European Union when applied to fast changing social and traffic conditions. On these bases, new directions of research could be formulated; in particular, better methods for assessing *a priori* the overall effects of a safety programme should be found, and field surveys and investigations would be necessary to understand the processes influencing accidents in countries such as Estonia.

However, such type of work leaves the experts somehow unsatisfied. One problem is that the terms of reference of road safety studies are obviously not systematically performed by road safety specialists and the amount of investigations required is grossly underestimated. To use an obvious comparison, one could say that the same situation would occur if asking a physician to perform a diagnosis on a patient while refusing him all means to order blood tests, x-rays or other such examinations, even when he needs

them; the final treatment may not be the most efficient in the circumstances (even if the doctor is experienced !). Another problem is that the demand expressed is unstructured and mixes up elements belonging to different categories: safety issues (accident problems) are compared with administrative or organisational issues; targeted safety programmes are not differentiated from programmes aimed at treating specific « issues »; structural measures are considered on a level with corrective measures, although aim, time-schedule, implementation and evaluation methods are quite different. Finally, an economic assessment of the scenarios designed for safety action is requested while it is clear that so many assumptions and estimates have to be made that it is doubtful whether the amount of time spent on it is worth the results.

Such experience shows that the role and status of researchers or other road safety professionals participating in operational studies is unclear and needs to be better defined. A guide of good practice, providing guaranties of minimum methodological bases, should be elaborated and promoted in order to get it accepted by the various international donors or money-lenders.

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