ECONOMIC EVALUATION OF
ROAD TRAFFIC SAFETY MEASURES

Conclusions of Round Table 117, Paris, 26-27 October 2000

This Round Table was chaired by Mr. E. Quinet (F) and opened with papers by Messrs H. Baum and K.J. Hohnscheid (D), A. Evans (UK), U. Persson (S) and P. Wesemann (NL).

The following outline provides an initial summary of discussions at the Round Table.

1. Methodological overview or how to choose between accurate measurement of a non-relevant concept and inaccurate measurement of the parameter targeted

The economic appraisal of road safety measures poses the basic problem of determining which method to use for the valuation of road safety measures. Given that road safety or, to be more precise, lack of road safety is measured in terms of the total number of fatalities and injuries, either slight or severe, the economic calculation can be based on the value of human life and the estimated cost of injuries. There are two methods of valuation that can be applied at this stage: the so-called "human capital" approach and the approach based on the "willingness to pay" for the prevention of injury. Use of these two approaches is mutually exclusive, despite the fact that they are significantly complementary. They are briefly described below:

- The **human capital approach** consists in valuing damage (death, serious injury) in accordance with its economic impact, i.e. in terms of lost output (net of future consumption in the event of death), remedial costs (healthcare in the case of injury) and reconstruction costs (material damage). To these are added working hours lost and the impact on the "grey" economy, i.e. undeclared work, household work and DIY. In order to value output losses accurately, account is taken of age and activity rates within each age cohort. This makes it possible to take account of unemployment, although it is also possible to evaluate the loss of potential production compared with the full utilisation of resources in order to assess the virtual damage to the economy. A fair degree of experience has been acquired in the use of this method which is still commonly applied in some countries but which has the disadvantage of not providing an accurate measurement of the parameter targeted, namely, the intrinsic value of the damage in cases where there is loss of life or suffering caused by serious injury. It was the realisation of this shortcoming in particular which gave rise to the "willingness-to-pay" approach.
The **willingness-to-pay** approach consists in estimating the value that individuals attach to human life by means of surveys aimed at determining the amount of money that individuals would be prepared to pay to reduce the risk of loss of life. The same principle applies to injury, where an attempt is made to determine the monetary value which individuals would be prepared to pay to, in effect, reduce the risk of injury. Selected groups within the population are given a questionnaire describing situations in which the individual has the choice of spending a certain sum of money or exposing himself to a given risk. This approach is based on the preferences of those concerned. By adopting an approach based on the prevention of accidents and damage, it is possible to balance a risk against given sums of money and thereby obtain an inferred value of human life and serious injury. To ensure that economic damage is also taken into account, the following are added to the value thus obtained: net lost output, medical costs, administrative costs, etc., which are precisely the values of human capital. Logically, the willingness-to-pay approach yields values far higher than those based solely on the value of human capital. The willingness-to-pay approach, which is a concept that has been used for some years by a small number of countries, provides an imprecise valuation of the very parameter we are attempting to determine.

There are many reasons for the **lack of precision** of the willingness-to-pay approach, and these were briefly reviewed by the Round Table. First, by seeking to determine the value to assign to reduction of a given risk, the persons surveyed felt that they were themselves involved, that they were directly concerned by the valuation. However, **personal experience**, i.e. whether or not a person had actually had an accident, does have a role to play. In one of the first applications of this method, the results of the survey produced a multiplier of ten, depending upon whether the persons surveyed had or had not had an accident. In addition, in terms of the method used to present a notional risk to the persons surveyed, it would seem that survey respondents are relatively insensitive to small variations in risk; it is therefore difficult to derive a coherent value for human life from the results. However, to avoid this problem, researchers have constructed a questionnaire in which risk is broken down into highly precise stages, that is to say, a progressive analysis. In this way, scenarios are constructed on the basis of hypothetical safety schemes designed to measure the willingness to pay for variants of the same risk; respondents are thus able to answer questions where it can be shown that it is probable that the person injured will recover from the injury.

The Round Table also took note of the fact that **income and age** have an impact on willingness to pay. Willingness to pay does not vary linearly in accordance with age. It is at the age of forty that the highest value is placed on saving human life; it is also the age at which the sense of altruism and respect for the safeguard of other people's lives is the greatest. In terms of the impact of income, an elasticity in willingness to pay to income in the order of 0.3 has been observed. This problem can be circumvented by reducing the willingness to pay of the wealthiest and by increasing the willingness to pay of those with the least resources. In order to isolate this effect with regard to altruistic behaviour, efforts can be focused on variations in the risk for the individual surveyed, to the exclusion of all other individuals. Moreover, as a general rule, extreme values can be discarded in favour of the median in order to take account of the spread of willingness to pay within a sample.

These corrections illustrate the fact that willingness to pay is a method that is sensitive and therefore difficult to put into practice, but it is nonetheless a highly attractive procedure in that it **precisely targets the objective aimed at**. It must also be said that it is a method which still requires further refinement, although this does less than justice to the advances that have already been made and the relative consistency of the results obtained so far. Thus, for example, to illustrate the intrinsic problems with the use of this procedure in the valuation of loss of life or injury, the propensity of certain persons to engage in reckless driving reflects an implicit acceptance of risk and therefore modifies the willingness to pay. However, this approach is subject in particular to variations in the two factors of income and age mentioned above, two factors that we can in part correct. In addition,
this method, if all due precautions are taken in its application, produces **relatively stable results**. The contingent valuation approach uses hypothetical marketed measures whose impact on road safety can be described and compared with market values. Parasite factors can thereby be almost eliminated, although care must be exercised over the non-transitivity of choices. At another level, a choice must be made between wide-ranging samples and individual interviews that are more restricted in scope. In the case of a large sample, the response rate is obviously lower and it has been noted that not all questions were properly understood. The answers are always simple, but the questions are complex. In addition, again with large samples, respondents tend to be men with senior positions who are major car-users and who have already had an accident. The results therefore need to be adjusted. With in-depth interviews of a small sample of people, the response rate is always very high and questions are better understood, but the restricted size of the sample means that it may not be representative.

One point to emerge from the Round Table was that there is undoubtedly a need for **practical guides to methodology** which set out the conditions for constructing and using methods. Communication between researchers has certainly improved, but it would nonetheless be helpful to draw up a document which summarised good practices and the rules of the art, even if studies have shown that estimated values do not vary enormously from one method to another.

A more basic criticism that can be levelled at the willingness-to-pay approach is that it fails to provide a **market value**. The estimate of value solely reflects what people are prepared to pay in order to avoid damage and does not provide a comparison, as in a market, with a composite supply of safety-related instruments which would produce an equilibrium value. However, to counter this objection, it can be argued that the willingness-to-pay approach is simply a philosophical principle. As a method, it reveals the preferences of the public. These preferences must not dictate the content of legislation, but they can be taken into account in the decision-making process.

By comparison, the human capital approach, with which economists have greater experience, is not entirely free of inaccuracies either. For example, in order to determine net output losses, a coefficient must be used to escalate the value of future output, which does not in itself pose any insuperable problems were it not necessary at the same time to estimate future growth in per capita GDP. In new ECMT Member countries, projecting growth rates is particularly difficult as they are erratic and usually tend to be higher than the European average during periods of economic expansion. Underestimating values in new Member countries would suggest that road safety measures would not be economically justified, whereas they could have a major impact in terms of the number of lives saved. The conclusion to be drawn from this is that while it is possible to measure human capital, it is not possible to do so with any absolute degree of accuracy.

With regard to the willingness-to-pay approach, it would be wise to conduct surveys in which **respondents are contacted again** to see whether, for example, five years later the results are the same. Countries which have conducted such surveys have so far been able to show that results have remained stable. Generally speaking, we now have a better understanding of contingent analysis. Scientists have started to work together and countries which initially produced low values have seen them rise while countries whose values were above average have seen them fall closer to the average. This **convergence in values**, which values a life saved at 1.1 to 1.3 million euros, of which 80 per cent in terms of willingness to pay and the remainder in net losses, returns the theoretical debate to a proper footing. It should be noted that differences still remain over the ratio between the value placed on human life and that of the avoidance of serious injury, due to differences over the definition of what constitutes serious injury. It would seem that solely 1 per cent of injuries are actually very serious, and in this regard it would be helpful to draw up a breakdown of injuries in which the term "serious" is not applied to injuries that simply mean that the person involved has to receive hospital treatment.
The Round Table noted that if surveys and analyses are conducted with all due rigour, the willingness-to-pay approach provides results in terms of values for human life that are highly comparable from one mode of transport to another, in addition to which the values are also close between countries at comparable levels of economic development. This near-perfect match in terms of willingness to pay, regardless of the mode of transport, contrasts starkly with the policy differences noted ex post facto. Tolerance for low safety levels is far lower with regard to public air or rail transport than it is for the private car mode.

Unless a consensus is reached on which method to adopt -- some experts remain faithful to the human capital method -- hopes over forging a European method remain based on anticipated advances in the formulation of the willingness-to-pay approach, which is attracting increasing support from researchers. In addition, one result to emerge from the Round Table was that none of the experts objected to placing a value of 1.1 to 1.3 million euros on human life within countries whose standard of living is higher than the European average, which would put the European average at 1 million euros.

2. Incorporating evaluation methods into road safety policy

Are evaluation methodologies used in analytical studies of the effectiveness of road safety measures?

First, the methods described above are used to ensure a rational basis to the public decision-making process relating to road safety. If we return briefly now to the arguments made against the methods outlined above, the main one would seem to be that the human capital approach is easier to explain and to justify to decision-makers -- since it values losses to society -- than the willingness-to-pay approach, which uses an artificial means to determine the value that individuals themselves place on life or avoidance of injury. There is therefore a very real need for researchers to explain how these approaches work, not only to policy-makers but also to the general public, since both audiences are mutually interdependent.

These methods have been incorporated into analyses of the advisability of actions or investment for which they provide inputs in the form of a value assigned to a life saved or serious injury avoided. It is briefly worth recalling here that these broader procedures are both cost-benefit analysis, which consists in producing a report indicating the benefits in monetary terms compared with the economic costs of a measure, and cost-efficiency analysis which, for its part, consists in measuring the cost of the provisions adopted compared with the saving of human life. These analyses or procedures are available to politicians to guide them in the use of an array of measures.

It should be noted that, in general, as has certainly been the case for many years although to a lesser extent now, no attempt has been made to rationalise public decisions; decisions regarding road safety are routine decisions taken without the aid of appropriate instruments. The budget was determined by the higher echelons of government. While such practices are not ostensibly opposed to assigning high priority to road safety, it can simply be stated that economic analysis can at present help to guide policy-makers in their choices.

In an ideal world of economic theory, valuation methods can help to determine the budget for road safety in that adopting all measures whose cost-benefit ratio is greater than one will determine the budget envelope for road safety. In such a world, cost-benefit analysis should be the norm. However, because the data needed to quantify all impacts of road safety provisions may be missing, cost-efficiency analyses can be used to marshal an array of measures. Priority could therefore be given to all measures whose costs are low compared with the number of lives saved. In such cases,
such an analysis would be needed to calculate the cost of a life saved, which would then obviously make it possible to classify measures.

As a general rule, it would be wise to carry out more cost-benefit or cost-efficiency studies in all areas of public action so that measures can be ranked against each other and budget envelopes determined for different forms of action. In this context, road safety would probably be assigned higher priority and higher levels of funding than it usually receives at present. There would at least be a degree of reassignment of funds within the transport sector.

The answer that is given to the question "do we invest enough in road safety?" is that road safety measures can be highly effective. Greater resources could therefore be assigned to this issue, although this does not hold true for other modes of transport. For example, investments are sometimes made to improve the accessibility of regions located far from the major economic centres. Traffic levels in these regions are low and therefore accident rates are low too; besides which, the economic return of the investments aimed at opening up regions is not always as high as could be hoped. By analogy, therefore, it would be fair to say that road safety is not accorded the priority it deserves, since in this instance human lives are at stake.

However, even considering road safety alone, these remarks need to be qualified in certain respects in that significant sums of money are spent on measures that are not particularly effective. Priorities are poorly identified. For example, the three offences of drink-driving, speeding and failure to attach seat belts, on which most countries concentrate the bulk of public action, account for less than 50 per cent of road deaths.

All the discussions on road safety show that actions can indeed be classified according to their effectiveness, since analysis shows that the rate of return on road safety measures is higher than that in other sectors even though marginal rates of return are falling. However, under current road safety budgets, all the measures which cost-benefit ratios suggest would be profitable could be implemented. It was therefore clear to the experts at the Round Table that before considering increases to investment, priority should be given to ensuring that investment is better targeted.

With a view to "better" investment, not only forecasting studies but also retrospective analyses are required. It would therefore be highly advisable to have estimates of the results of road safety measures, estimates that could be drawn up by calling on the services of experts such as psychologists specialised in human behaviour and road traffic engineers. Ex post facto calculation of the number of lives saved through investment or road safety measures provides a precise evaluation of the effectiveness of the actions chosen and thus makes it easier to convince the public of the appropriateness of such actions. It is therefore important to carry out ex post facto evaluations and not simply halt programmes without giving consideration to performing valuations once the programme has been completed. There are ample grounds on which to justify the time and cost of in-depth research designed to avoid "extrapolation" without "verification", which is the case when an insufficient number of surveys are made of the results obtained.

In the same vein, it is essential to have follow-up on the ground. A map is therefore needed of the frequency and severity of accidents throughout the entire national territory. Such a map shows where investment is a priority. In this respect, the Round Table took note of the fact that local road investment to eliminate accident black spots, for example, by building roundabouts instead of intersections, have an extremely high cost-benefit ratio that is far superior to many actions in the public domain. The rate of return on these actions suggests that when insufficient data are available to carry out a proper cost-benefit study, which would thus make it possible to set a budget, there is no need for a set budget but rather a stated objective and to introduce all the measures that would help to achieve this objective on the basis of the findings of the cost-effectiveness and retrospective analyses.
However, to consider one example of the inherent ambiguity of evaluation techniques, a cost-benefit analysis of speed restrictions in rural areas with relatively low traffic densities fails to show significant gains due to the time lost by road users forced to travel at lower speeds. The goals of economic efficiency, the environment and road safety may therefore be mutually conflicting. This would seem to indicate, apart from methodological considerations, the need to make road safety a national priority, which would be feasible given the number of lives which could potentially be saved; some experts at the Round Table felt that a measure is justified even if it saved only one or two lives. This shows the importance of acknowledging that the fact that policy-making is an independent activity does not mean to say that aberrant policies will be pursued but rather that such policies will, in all likelihood, exhibit shortcomings unless evaluation methodologies are used to support them.

It should also be noted by researchers that it is important to carry out exploratory studies on the effectiveness of road safety measures even if such studies are not held to be of value by politicians. Experience has shown that sooner or later most measures become important issues. Policy-makers may also be looking for new actions to promote and it is highly desirable for researchers to be in a position to provide an evaluation of measures as soon as they appear on the political agenda. At such junctures, researchers can play a major role in ensuring the political and social acceptability of measures under review or consideration by demonstrating their relevance, as we mentioned earlier.

3. A number of points to bear in mind when implementing a road safety programme

The Round Table recalled a number of basic tenets which emerge from an economic evaluation of road safety measures and which are illustrated below:

- Road safety policy must not consist in disparate, disjointed measures but in a co-ordinated body of measures forming a coherent whole, that is to say, a judicious assembly of constituent parts. The aim should not be to prefer one measure to another but to implement a series of measures whose effectiveness is based on synergy. Thus if all measures exhibiting a cost-benefit ratio greater than one were to be implemented systematically, the number of road deaths in most countries would be cut by half.

  - The issue of social acceptability must not be neglected. A policy will not be successful if it is not properly understood by the population. It is commonplace for the policies which are the most effective to be those which are rejected, as in the case, for example, with on-board systems designed to automatically restrict the speed of vehicles according to the type of carriageway on which cars or HGVs are travelling. While perfectly feasible in technical terms, the introduction of these measures is opposed by manufacturers in particular but also by the public. For these various reasons, the advantage afforded by evaluation methodologies is that they can sway public opinion by providing direct evidence of the number of lives that could potentially be saved.

  - In connection with the comment made above, it is important when communicating with the public to always present matters in layman's terms, that is to say, by explaining issues clearly and simply. Stating clearly how many lives could potentially be saved is a compelling argument that will convince individual members of the public. By the same token, information campaigns that draw attention to the effectiveness of certain measures must be sustained and not simply repeated at intervals or limited over time, since the aim is to influence behaviour, which calls for continuous action over the
long term. Clearly stated rules must apply to the organisation of such information campaigns.

- Those who infringe regulations and drive without complying with the highway code are predisposed towards anti-social behaviour. **Awareness campaigns and driver re-education courses** generally have a positive impact on drivers who systematically infringe regulations and choose to behave recklessly. Such actions are, at all events, more acceptable to drivers and no less effective than punishment of offenders, which is slow to have an effect if it goes against ingrained behavioural patterns.

- In particular, when responsibility for the actions to be pursued lies with several Ministries, it is of the utmost importance to ensure that the actions of the various Ministries concerned are properly co-ordinated. In this respect, setting up a National Road Safety Council can provide the requisite linkage between the actors involved and ensure that together they can achieve results which alone would not be possible for them.

- The actors who are involved in road safety must also be considered in terms of their **personal strategies**. There is no point in involving the police if the latter consider road traffic policing to be a minor duty offering little in terms of returns. In such cases, it would be better to set up special police forces assigned to such tasks and thus restore their badge of honour. In this way, road safety would have to comply with the rules of actors whose strategy must be understood in all its complexity.

- **The private sector has a role to play.** It could, for example, be assigned the task of monitoring traffic flows. It could also play a role in the introduction of innovative technologies; what springs to mind here are the advances that have been made in vehicle technology aimed at both preventing and alleviating the consequences of accidents. As mentioned above, however, we need to remain vigilant. Car manufacturers have a strategy and most of them only started to show concern over vehicle safety once public opinion had shown itself to be sensitive to the shortcomings of vehicles. It might therefore be advisable to focus efforts on influencing public opinion through open dialogue.

- **It is easier to adapt infrastructure than it is to change patterns of behaviour.** However, most road safety measures continue to target driver behaviour. It would be wiser to integrate road safety into the evaluation of infrastructure projects and ensure that road safety is a factor that is taken into road investment. Even though much progress has been made in this respect, however, much still remains to be done.

- **Measures should not be rejected because they cannot be evaluated.** This comment recognises the primacy of politics and the importance of innovative measures. Obviously all Ministries seek funding and it is easier to argue that a policy is well-founded if it can be shown that funding will produce tangible results. Scope nonetheless remains for measures that cannot be evaluated; the fact that a measure cannot be evaluated often reflects its innovative nature. Experts also recognise the benefits of early action with inventive measures.

- Lastly, road safety policy must be rooted in compliance with the rules of **total strategic quality management**, rules that have been taken from management theory. No reticence should therefore be shown in treating road safety policy as an integral issue which is amenable to evaluation and which must meet criteria applied to strategic quality.
management. To further this objective, the benchmarking of road safety policies and measures could be undertaken at the European level.

4. Conclusions

There are several ways in which to estimate and take account of the value of human life or serious injury as part of an economic appraisal of road safety measures. This is not a new development and we are starting to accumulate a significant amount of experience in the application of these methods. Opting for the human capital approach is not conceptually sound. The willingness-to-pay approach, on the other hand, focuses on the correct parameter but its measurement of that parameter may be significantly flawed. Although there was no consensus, in this respect the experts at the Round Table felt that it was better to obtain an approximate measurement of the right parameter than to obtain an accurate measurement of the wrong parameter, particularly in view of the body of experience we are now starting to acquire in the use of the willingness-to-pay method. From this standpoint, it would be helpful to draft a manual on the correct use of the willingness-to-pay method in that a practical guide to the rules of the art in this area would bring it to the attention of a wider audience.

Even though the value obtained by means of the willingness-to-pay procedure is not a market value in the economic sense of the term, the values obtained are convergent from one country to another and, even more surprisingly, from one mode of transport to another. The average value assigned to human life within Europe would therefore be 1 million euros. The fact that there is virtually no change in this value from one mode of transport to another is in striking contrast to policy practices, since the investment in accident prevention in the public transport sector is much greater than that in the road sector, given that the authorities are liable for accidents in the public transport sector. This means that individuals would be willing to see government take charge of road safety with the same forcefulness in the road sector as in the rail and air sectors, an approach that is not reflected in the collective values commonly used.

Clearly, these values can serve as a basis for cost-benefit or cost-effectiveness analyses that would help to introduce greater rigour into policies that sometimes appear to have been framed on an ad hoc basis. The social acceptability of measures poses an acute problem, but although it is admittedly a determining issue, it is not one that arises systematically. In view of this, road safety policy should be a strategic process that takes account of the interplay of actors, their complementarity and the need to inform and consult with the public. The public must be given simple messages and efforts must be made to ensure a better balance between measures, in that although spending on road safety is already adequate, the money is not spent “wisely”. In addition, the implementation of measures must follow the principles of total quality management and, in order to avoid secondary effects such as possible impacts on social equity, ex post facto studies need to be carried out to determine the effectiveness of measures. Furthermore, actions whose effectiveness cannot be assessed should not be dismissed out of hand. We need to approach the issue of road safety with an open and receptive mind.

Lastly, apart from the guidelines outlined earlier in this report, the Round Table did not systematically discuss each measure individually to determine its relevance, but it did point out that investment in infrastructure produced results faster than attempting to bring about major changes in human behaviour. In contrast, the Round Table proposed that, once it had completed its work, it should carry out a survey, in the form of a questionnaire addressed to the Round Table experts, to determine which were, in the opinion of the latter, the most effective road safety policies. Readers of the present draft conclusions of the Round Table will find the results of this survey in the final proceedings of the Round Table.